

**NAME**

**Cg** – A multi-platform, multi-API C-based programming language for GPUs

**DESCRIPTION**

Cg is a high-level programming language designed to compile to the instruction sets of the programmable portions of GPUs. While Cg programs have great flexibility in the way that they express the computations they perform, the inputs, outputs, and basic resources available to those programs are dictated by where they execute in the graphics pipeline. Other documents describe how to write Cg programs. This document describes the library that application programs use to interact with Cg programs. This library and its associated API is referred to as the Cg runtime.

**DOCUMENTATION ORGANIZATION**

- Cg Topics
- Cg Language Specification
- Cg Commands
- Cg Core Runtime API
- Cg OpenGL Runtime API
- Cg Direct3D10 Runtime API
- Cg Direct3D9 Runtime API
- Cg Direct3D8 Runtime API
- Cg Profiles
- Cg Standard Library Routines
- CgFX States

**SEE ALSO**

Cg\_language, cgc, cgCreateContext, cgDestroyContext

## Cg 1.2 RUNTIME API ADDITIONS

Version 1.2 of the Cg runtime adds a number of new capabilities to the existing set of functionality from previous releases. These new features include functionality that make it possible to write programs that can run more efficiently on the GPU, techniques that help hide some of the inherent limitations of some Cg profiles on the GPU, and entrypoints that support new language functionality in the Cg 1.2 release.

### Parameter Literalization

The 1.2 Cg runtime makes it possible to denote some of the parameters to a program as having a fixed constant value. This feature can lead to substantially more efficient programs in a number of cases. For example, a program might have a block of code that implements functionality that is only used some of the time:

```
float4 main(uniform float enableDazzle, ...) : COLOR {
    if (enableDazzle) {
        // do lengthy computation
    }
    else {
        // do basic computation
    }
}
```

Some hardware profiles don't directly support branching (this includes all of the fragment program profiles supported in this release), and have to handle code like the program by effectively following both sides of the *if()* test. (They still compute the correct result in the end, just not very efficiently.)

However, if the “enableDazzle” parameter is marked as a literal parameter and a value is provided for it, the compiler can generate an optimized version of the program with the knowledge of “enableDazzle”'s value, just generating GPU code for one of the two cases. This can lead to substantial performance improvements. This feature also makes it easier to write general purpose shaders with a wide variety of supported functionality, while only paying the runtime cost for the functionality provided.

This feature is also useful for parameters with numeric values. For example, consider a shader that implements a diffuse reflection model:

```
float4 main(uniform float3 lightPos, uniform float3 lightColor,
            uniform float3 Kd, float3 pos : TEXCOORD0,
            float3 normal : TEXCOORD1) : COLOR
{
    return Kd*lightColor*max(0., dot(normalize(lightPos-pos), normal));
}
```

If the “lightColor” and “Kd” parameters are set to literals, it is possible for the compiler to compute the product “Kd \* lightColor” once, rather than once each time the program executes.

Given a parameter handle, the *cgSetParameterVariability()* entrypoint sets the variability of a parameter:

```
void cgSetParameterVariability(CGparameter param, CGenum vary);
```

To set it to a literal parameter, the *CG\_LITERAL* enumerator should be passed as the second parameter.

After a parameter has set to be a literal, the following routines should be used to set the parameter's value.

```

void cgSetParameter1f(CGparameter param, float x);
void cgSetParameter2f(CGparameter param, float x, float y);
void cgSetParameter3f(CGparameter param, float x, float y, float z);
void cgSetParameter4f(CGparameter param, float x, float y, float z,
                      float w);
void cgSetParameter1d(CGparameter param, double x);
void cgSetParameter2d(CGparameter param, double x, double y);
void cgSetParameter3d(CGparameter param, double x, double y, double z);
void cgSetParameter4d(CGparameter param, double x, double y, double z,
                      double w);

void cgSetParameter1fv(CGparameter param, const float *v);
void cgSetParameter2fv(CGparameter param, const float *v);
void cgSetParameter3fv(CGparameter param, const float *v);
void cgSetParameter4fv(CGparameter param, const float *v);
void cgSetParameter1dv(CGparameter param, const double *v);
void cgSetParameter2dv(CGparameter param, const double *v);
void cgSetParameter3dv(CGparameter param, const double *v);
void cgSetParameter4dv(CGparameter param, const double *v);

void cgSetMatrixParameterdr(CGparameter param, const double *matrix);
void cgSetMatrixParameterfr(CGparameter param, const float *matrix);
void cgSetMatrixParameterdc(CGparameter param, const double *matrix);
void cgSetMatrixParameterfc(CGparameter param, const float *matrix);

```

After a parameter has been set to be a literal, or after the value of a literal parameter has been changed, the program must be compiled and loaded into the GPU, regardless of whether it had already been compiled. This issue is discussed further in the section on program recompilation below.

### Array Size Specification

The Cg 1.2 language also adds support for “unsized array” variables; programs can be written to take parameters that are arrays with an indeterminate size. The actual size of these arrays is then set via the Cg runtime. This feature is useful for writing general-purpose shaders with a minimal performance penalty.

For example, consider a shader that computes shading given some number of light sources. If the information about each light source is stored in a struct `LightInfo`, the shader might be written as:

```

float4 main(LightInfo lights[], ...) : COLOR
{
    float4 color = float4(0,0,0,1);
    for (i = 0; i < lights.length; ++i) {
        // add lights[i]'s contribution to color
    }
    return color;
}

```

The runtime can then be used to set the length of the `lights[]` array (and then to initialize the values of the `LightInfo` structures.) As with literal parameters, the program must be recompiled and reloaded after a parameter’s array size is set or changes.

These two entrypoints set the size of an unsized array parameter referenced by the given parameter handle. To set the size of a multidimensional unsized array, all of the dimensions’ sizes must be set simultaneously, by providing them all via the pointer to an array of integer values.

```

void cgSetArraySize(CGparameter param, int size);
void cgSetMultiDimArraySize(CGparameter param, const int *sizes);

```

XXX what happens if these are called with an already-sized array?? XXX

To get the size of an array parameter, the *cgGetArraySize()* entrypoint can be used.

```
int cgGetArraySize(CGparameter param, int dimension);
```

### Program Recompilation at Runtime

The Cg 1.2 runtime environment will allow automatic and manual recompilation of programs. This functionality is useful for multiple reasons :

- **Changing variability of parameters**

Parameters may be changed from uniform variability to literal variability as described above.

- **Changing value of literal parameters**

Changing the value of a literal parameter will require recompilation since the value is used at compile time.

- **Resizing parameter arrays**

Changing the length of a parameter array may require recompilation depending on the capabilities of the profile of the program.

- **Binding sub-shader parameters**

Sub-shader parameters are structures that overload methods that need to be provided at compile time; they are described below. Binding such parameters to program parameters will require recompilation. See the Sub-Shaders entry elsewhere in this document for more information.

Recompilation can be executed manually by the application using the runtime or automatically by the runtime.

The entry point:

```
void cgCompileProgram(CGprogram program);
```

causes the given program to be recompiled, and the function:

```
CGbool cgIsProgramCompiled(CGprogram program);
```

returns a boolean value indicating whether the current program needs recompilation.

By default, programs are automatically compiled when *cgCreateProgram()* or *cgCreateProgramFromFile()* is called. This behavior can be controlled with the entry point :

```
void cgSetAutoCompile(CGcontext ctx, CGenum flag);
```

Where flag is one of the following three enumerants :

- **CG\_COMPILE\_MANUAL**

With this method the application is responsible for manually recompiling a program. It may check to see if a program requires recompilation with the entry point *cgIsProgramCompiled()*. *cgCompileProgram()* can then be used to force compilation.

- **CG\_COMPILE\_IMMEDIATE**

**CG\_COMPILE\_IMMEDIATE** will force recompilation automatically and immediately when a program enters an uncompiled state.

- **CG\_COMPILE\_LAZY**

This method is similar to **CG\_COMPILE\_IMMEDIATE** but will delay program recompilation until the program object code is needed. The advantage of this method is the reduction of extraneous recompilations. The disadvantage is that compile time errors will not be encountered when the program enters the uncompiled state but will instead be encountered at some later time.

For programs that use features like unsized arrays that can not be compiled until their array sizes are set, it is good practice to change the default behavior of compilation to **CG\_COMPILE\_MANUAL** so that

*cgCreateProgram()* or *cgCreateProgramFromFile()* do not unnecessarily encounter and report compilation errors.

### Shared Parameters (context global parameters)

Version 1.2 of the runtime introduces parameters that may be shared across programs in the same context via a new binding mechanism. Once shared parameters are constructed and bound to program parameters, setting the value of the shared parameter will automatically set the value of all of the program parameters they are bound to.

Shared parameters belong to a **CGcontext** instead of a **CGprogram**. They may be created with the following new entry points :

```
CGparameter cgCreateParameter(CGcontext ctx, CGtype type);
CGparameter cgCreateParameterArray(CGcontext ctx, CGtype type,
                                   int length);
CGparameter cgCreateParameterMultiDimArray(CGcontext ctx, CGtype type,
                                             int dim, const int *lengths);
```

They may be deleted with :

```
void cgDestroyParameter(CGparameter param);
```

After a parameter has been created, its value should be set with the *cgSetParameter\*()* routines described in the literalization section above.

Once a shared parameter is created it may be associated with any number of program parameters with the call:

```
void cgConnectParameter(CGparameter from, CGparameter to);
```

where “from” is a parameter created with one of the *cgCreateParameter()* calls, and “to” is a program parameter.

Given a program parameter, the handle to the shared parameter that is bound to it (if any) can be found with the call:

```
CGparameter cgGetConnectedParameter(CGparameter param);
```

It returns NULL if no shared parameter has been connected to “param”.

There are also calls that make it possible to find the set of program parameters to which a given shared parameter has been connected to. The entry point:

```
int cgGetNumConnectedToParameters(CGparameter param);
```

returns the total number of program parameters that “param” has been connected to, and the entry point:

```
CGparameter cgGetConnectedToParameter(CGparameter param, int index);
```

can be used to get CGparameter handles for each of the program parameters to which a shared parameter is connected.

A shared parameter can be unbound from a program parameter with :

```
void cgDisconnectParameter(CGparameter param);
```

The context in which a shared parameter was created can be returned with:

```
CGcontext cgGetParameterContext(CGparameter param);
```

And the entrypoint:

```
CGbool cgIsParameterGlobal(CGparameter param);
```

can be used to determine if a parameter is a shared (global) parameter.

### Shader Interface Support

From the runtime's perspective, shader interfaces are simply struct parameters that have a **CGtype** associated with them. For example, if the following Cg code is included in some program source compiled in the runtime :

```
interface FooInterface
{
    float SomeMethod(float x);
}

struct FooStruct : FooInterface
{
    float SomeMethod(float x);
    {
        return(Scale * x);
    }

    float Scale;
};
```

The named types **FooInterface** and **FooStruct** will be added to the context. Each one will have a unique **CGtype** associated with it. The **CGtype** can be retrieved with :

```
CGtype cgGetNamedUserType(CGprogram program, const char *name);
int cgGetNumUserTypes(CGprogram program);
CGtype cgGetUserType(CGprogram program, int index);

CGbool cgIsParentType(CGtype parent, CGtype child);
CGbool cgIsInterfaceType(CGtype type);
```

Once the **CGtype** has been retrieved, it may be used to construct an instance of the struct using `cgCreateParameter()`. It may then be bound to a program parameter of the parent type (in the above example this would be `FooInterface`) using `cgBindParameter()`.

Calling `cgGetParameterType()` on such a parameter will return the **CG\_STRUCT** to keep backwards compatibility with code that recurses parameter trees. In order to obtain the enumerator of the named type the following entry point should be used :

```
CGtype cgGetParameterNamedType(CGparameter param);
```

The parent types of a given named type may be obtained with the following entry points :

```
int cgGetNumParentTypes(CGtype type);
CGtype cgGetParentType(CGtype type, int index);
```

If Cg source modules with differing definitions of named types are added to the same context, an error will be thrown.

XXX update for new scoping/context/program local definitions stuff XXX

**Updated Parameter Management Routines**

XXX where should these go?

Some entrypoints from before have been updated in backwards compatible ways

```
CGparameter cgGetFirstParameter(CGprogram program, CGenum name_space);  
CGparameter cgGetFirstLeafParameter(CGprogram program, CGenum name_space);
```

like `cgGetNamedParameter`, but limits search to the given `name_space` (`CG_PROGRAM` or `CG_GLOBAL`)...

```
CGparameter cgGetNamedProgramParameter(CGprogram program, CGenum name_space,  
                                       const char *name);
```

**TOPIC**

**glut** – using Cg with the OpenGL Utility Toolkit (GLUT)

**ABSTRACT**

GLUT provides a cross-platform window system API for writing OpenGL examples and demos. For this reason, the Cg examples packaged with the Cg Toolkit rely on GLUT.

**WINDOWS INSTALLATION**

The Cg Toolkit installer for Windows provides a pre-compiled 32-bit (and 64-bit if selected) versions of GLUT. GLUT is provided both as a Dynamic Link Library (DLL) and a static library.

The GLUT DLL is called glut32.dll and requires linking against glut32.lib. These 32-bit versions are typically installed at:

```
c:\Program Files\NVIDIA Corporation\Cg\bin\glut32.dll
c:\Program Files\NVIDIA Corporation\Cg\lib\glut32.lib
```

The 64-bit (x64) versions are installed at:

```
c:\Program Files\NVIDIA Corporation\Cg\bin.x64\glut32.dll
c:\Program Files\NVIDIA Corporation\Cg\lib.x64\glut32.lib
```

As with any DLL in Windows, if you link your application with the GLUT DLL, running your application requires that glut32.dll can be found when executing GLUT.

Alternatively you can link statically with GLUT. This can easily be done by defining the GLUT\_STATIC\_LIB preprocessor macro before including GLUT's <GL/glut.h> header file. This is typically done by adding the -DGLUT\_STATIC\_LIB option to your compiler command line. When defined, a #pragma in <GL/glut.h> requests the linker link against glutstatic.lib instead of glut32.lib.

The 32-bit and 64-bit versions of the GLUT static library are installed at:

```
c:\Program Files\NVIDIA Corporation\Cg\lib\glutstatic.lib
c:\Program Files\NVIDIA Corporation\Cg\lib.x64\glutstatic.lib
```

**SEE ALSO**

TBD



## TOPIC

**win64** – using Cg with 64-bit Windows

## ABSTRACT

The Cg Toolkit for Windows installs versions of the Cg compiler and runtime libraries for both 32-bit (x86) and 64-bit (x64) compilation. This topic documents how to use Cg for 64-bit Windows.

## 64-BIT INSTALLATION

The Cg Toolkit installer (CgSetup.exe) installs the 32-bit version of the Cg compiler and the Cg runtime libraries by default. To install the 64-bit support, you must check the component labeled “Files to run and link 64-bit (x64) Cg-based applications” during your installation.

If you’ve forgotten to install the 64-bit component, you can re-run the Cg Toolkit installer and check the 64-bit component.

## EXAMPLES

The Cg Toolkit includes Visual Studio .NET 2003 projects intended to compile 64-bit versions of the Cg Toolkit examples.

These project files match the pattern \*\_x64.vcproj

The solution files that collect these projects matches the pattern \*\_x64.sln

To use these project files with Visual Studio .NET 2003, you *must* also install the latest Windows Platform SDK to obtain 64-bit compiler tools and libraries.

Once the Platform SDK is installed, from the Start menu navigate to start a Windows shell for the 64-bit Windows Build Environment. This shell is started with the correct environment variables (Path, Include, and Lib) for the 64-bit compiler tools and libraries.

Now run devenv.exe with the /useenv command line option that forces Visual Studio to pick up Path, Include, and Lib settings from the shell’s environment. When the Visual Studio IDE appears, select File->Open->Project... and locate one of the \*\_x64.sln files for the Cg examples. These are usually under:

```
c:\Program Files\NVIDIA Corporation\Cg\examples
```

When you open a \*\_x64.vcproj solution, it references a number of \*\_x64.vcproj projects. These have a “Debug x64” and “Release x64” configuration to build.

## HINTS

Remember to link with BufferOverflowU.lib because of the /GS option to help detect string overflow runtime errors because Microsoft has enabled this option by default in its 64-bit compilers. See:

<http://support.microsoft.com/?id=894573>

## IA64 SUPPORT

The Cg Toolkit does not provide 64-bit support for Intel’s Itanium architecture.

## SEE ALSO

TBD

## Cg Language Specification

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This is version 2.0 of the Cg Language specification. This language specification describes version 2.0 of the Cg language

### Language Overview

The Cg language is primarily modeled on ANSI C, but adopts some ideas from modern languages such as C++ and Java, and from earlier shading languages such as RenderMan and the Stanford shading language. The language also introduces a few new ideas. In particular, it includes features designed to represent data flow in stream-processing architectures such as GPUs. Profiles, which are specified at compile time, may subset certain features of the language, including the ability to implement loops and the precision at which certain computations are performed.

Like C, Cg is designed primarily as a low-level programming language. Features are provided that map as directly as possible to hardware capabilities. Higher level abstractions are designed primarily to not get in the way of writing code that maps directly to the hardware in the most efficient way possible. The changes in the language from C primarily reflect differences in the way GPU hardware works compared to conventional CPUs. GPUs are designed to run large numbers of small threads of processing in parallel, each running a copy of the same program on a different data set.

### Differences from ANSI C

Cg was developed based on the ANSI-C language with the following major additions, deletions, and changes. (This is a summary-more detail is provided later in this document):

#### Silent Incompatibilities

Most of the changes from ANSI C are either omissions or additions, but there are a few potentially silent incompatibilities. These are changes within Cg that could cause a program that compiles without errors to behave in a manner different from C:

- The type promotion rules for constants are different when the constant is not explicitly typed using a type cast or type suffix. In general, a binary operation between a constant that is not explicitly typed and a variable is performed at the variable's precision, rather than at the constant's default precision.
- Declarations of `struct` perform an automatic `typedef` (as in C++) and thus could override a previously declared type.
- Arrays are first-class types that are distinct from pointers. As a result, array assignments semantically perform a copy operation for the entire array.

#### Similar Operations That Must be Expressed Differently

There are several changes that force the same operation to be expressed differently in Cg than in C:

- A Boolean type, `bool`, is introduced, with corresponding implications for operators and control constructs.
- Arrays are first-class types because Cg does not support pointers.
- Functions pass values by value/result, and thus use an `out` or `inout` modifier in the formal parameter list to return a parameter. By default, formal parameters are `in`, but it is acceptable to specify this explicitly. Parameters can also be specified as `in out`, which is semantically the same as `inout`.

#### C features not present in Cg

- Language profiles (described in the Profiles section) may subset language capabilities in a variety of ways. In particular, language profiles may restrict the use of `for` and `while` loops. For example, some profiles may only support loops that can be fully unrolled at compile time.

- Reserved keywords `goto`, `switch`, `case`, and `default` are not supported, nor are labels.
- Pointers and pointer-related capabilities, such as the `&` and `->` operators, are not supported.
- Arrays are supported, but with some limitations on size and dimensionality. Restrictions on the use of computed subscripts are also permitted. Arrays may be designated as `packed`. The operations allowed on packed arrays may be different from those allowed on unpacked arrays. Predefined packed types are provided for vectors and matrices. It is strongly recommended that these predefined types be used.
- There is no `enum` or `union`.
- There are no bit-field declarations in structures.
- All integral types are implicitly signed, there is no *signed* keyword.

### Cg features not present in C

- A *binding semantic* may be associated with a structure tag, a variable, or a structure element to denote that object's mapping to a specific hardware or API resource. Binding semantics are described in the *Binding Semantics* section.
- There is a built-in swizzle operator: `.xyzw` or `.rgba` for vectors. This operator allows the components of a vector to be rearranged and also replicated. It also allows the creation of a vector from a scalar.
- For an lvalue, the swizzle operator allows components of a vector or matrix to be selectively written.
- There is a similar built-in swizzle operator for matrices: `._m<row><col>[_m<row><col>][...]`. This operator allows access to individual matrix components and allows the creation of a vector from elements of a matrix. For compatibility with DirectX 8 notation, there is a second form of matrix swizzle, which is described later.
- Numeric data types are different. Cg's primary numeric data types are `float`, `half`, and `fixed`. Fragment profiles are required to support all three data types, but may choose to implement `half` and/or `fixed` at `float` precision. Vertex profiles are required to support `half` and `float`, but may choose to implement `half` at `float` precision. Vertex profiles may omit support for `fixed` operations, but must still support definition of `fixed` variables. Cg allows profiles to omit run-time support for `int` and other integer types. Cg allows profiles to treat `double` as `float`.
- Many operators support per-element vector operations.
- The `?:`, `||`, `&&`, `!`, and comparison operators can be used with `bool` vectors to perform multiple conditional operations simultaneously.

The side effects of all operands to vector `?:`, `||`, and `&&` operators are always executed.

- Non-static global variables, and parameters to top-level functions (such as `main()`) may be designated as `uniform`. A `uniform` variable may be read and written within a program, just like any other variable. However, the `uniform` modifier indicates that the initial value of the variable/parameter is expected to be constant across a large number of invocations of the program.
- A new set of `sampler*` types represents handles to texture sampler units.
- Functions may have default values for their parameters, as in C++. These defaults are expressed using assignment syntax.
- Function and operator overloading is supported.
- Variables may be defined anywhere before they are used, rather than just at the beginning of a scope as in C. (That is, we adopt the C++ rules that govern where variable declarations are allowed.) Variables may not be redeclared within the same scope.

- Vector constructors, such as the form `float4(1,2,3,4)`, and matrix constructors may be used anywhere in an expression.
- A `struct` definition automatically performs a corresponding `typedef`, as in C++.
- C++-style `//` comments are allowed in addition to C-style `/* ... */` comments.
- A limited form of inheritance is supported; `interface` types may be defined which contain only member functions (no data members) and `struct` types may inherit from a single interface and provide specific implementations for all the member functions. Interface objects may not be created; a variable of interface type may have any implementing struct type assigned to it.

## Detailed Language Specification

### Definitions

The following definitions are based on the ANSI C standard:

**Object:**

An object is a region of data storage in the execution environment, the contents of which can represent values. When referenced, an object may be interpreted as having a particular type.

**Declaration:**

A declaration specifies the interpretation and attributes of a set of identifiers.

**Definition:**

A declaration that also causes storage to be reserved for an object or code that will be generated for a function named by an identifier is a definition.

### Profiles

Compilation of a Cg program, a top-level function, always occurs in the context of a compilation profile. The profile specifies whether certain optional language features are supported. These optional language features include certain control constructs and standard library functions. The compilation profile also defines the precision of the `float`, `half`, and `fixed` data types, and specifies whether the `fixed` and `sampler*` data types are fully or only partially supported. The profile also specifies the environment in which the program will be run. The choice of a compilation profile is made externally to the language, by using a compiler command-line switch, for example.

The profile restrictions are only applied to the top-level function that is being compiled and to any variables or functions that it references, either directly or indirectly. If a function is present in the source code, but not called directly or indirectly by the top-level function, it is free to use capabilities that are not supported by the current profile.

The intent of these rules is to allow a single Cg source file to contain many different top-level functions that are targeted at different profiles. The core Cg language specification is sufficiently complete to allow all of these functions to be parsed. The restrictions provided by a compilation profile are only needed for code generation, and are therefore only applied to those functions for which code is being generated. This specification uses the word “program” to refer to the top-level function, any functions the top-level function calls, and any global variables or `typedef` definitions it references.

Each profile must have a separate specification that describes its characteristics and limitations.

This core Cg specification requires certain minimum capabilities for all profiles. In some cases, the core specification distinguishes between vertex-program and fragment-program profiles, with different minimum capabilities for each.

### Declarations and declaration specifiers.

A Cg program consists of a series of declarations, each of which declares one or more variables or functions, or declares and defines a single function. Each declaration consists of zero or more declaration specifiers, a type, and one or more declarators. Some of the declaration specifiers are the same as those in ANSI C; others are new to Cg

**const**

Marks a variable as a constant that cannot be assigned to within the program. Unless this is combined with `uniform` or `varying`, the declarator must include an initializer to give the variable a value.

**extern**

Marks this declaration as solely a declaration and not a definition. There must be a non-extern declaration elsewhere in the program.

**in** Only usable on parameter and `varying` declarations. Marks the parameter or `varying` as an input to the function or program. Function parameters with no `in`, `out`, or `inout` specifier are implicitly `in`

**inline**

Only usable on a function definition. Tells the compiler that it should always inline calls to the function if at all possible.

**inout**

Only usable on parameter and `varying` declarations. Marks the parameter or `varying` as both an input to and an output from the function or program

**static**

Only usable on global variables. Marks the variable as 'private' to the program, and not visible externally. Cannot be combined with `uniform` or `varying`

**out** Only usable on parameter and `varying` declarations. Marks the parameter or `varying` as an output from the function or program

**uniform**

Only usable on global variables and parameters to the top-level main function of a program. If specified on a non-top-level function parameter it is ignored. The intent of this rule is to allow a function to serve as either a top-level function or as one that is not.

Note that `uniform` variables may be read and written just like non-`uniform` variables. The `uniform` qualifier simply provides information about how the initial value of the variable is to be specified and stored, through a mechanism external to the language.

**varying**

Only usable on global variables and parameters to the top-level main function of a program. If specified on a non-top-level function parameter it is ignored.

**profile name**

The name of any profile (or profile wildcard — see Profiles) may be used as a specifier on any function declaration. It defines a function that is only visible in the corresponding profiles.

The specifiers `uniform` and `varying` specify how data is transferred between the rest of the world and a Cg program. Typically, the initial value of a `uniform` variable or parameter is stored in a different class of hardware register for a `varying`. Furthermore, the external mechanism for specifying the initial value of `uniform` variables or parameters may be different than that used for specifying the initial value of `varying` variables or parameters. Parameters qualified as `uniform` are normally treated as persistent state, while `varying` parameters are treated as streaming data, with a new value specified for each stream record (such as within a vertex array).

Non-static global variables are treated as `uniform` by default, while parameters to the top-level function are treated as `varying` by default.

Each declaration is visible (“in scope”) from the point of its declarator until the end of the enclosing block or the end of the compilation unit if outside any block. Declarations in named scopes (such as structs and interfaces) may be visible outside of their scope using explicit scope qualifiers, as in C++.

## Semantics

Each declarator in a declaration may optionally have a semantic specified with it. A semantic specifies how the variable is connected to the environment in which the program runs. All semantics are profile specific (so they have different meanings in different profiles), though there is some attempt to be consistent across profiles. Each profile specification must specify the set of semantics which the profile understands, as well as what behavior occurs for any other unspecified semantics.

## Function Declarations

Functions are declared essentially as in C. A function that does not return a value must be declared with a `void` return type. A function that takes no parameters may be declared in one of two ways:

As in C, using the `void` keyword:

```
functionName(void)
```

With no parameters at all:

```
functionName()
```

Functions may be declared as `static`. If so, they may not be compiled as a program and are not visible externally

## Function overloading and optional arguments

Cg supports function overloading; that is you may define multiple functions with the same name. The function actually called at any given call site is based on the types of the arguments at that call site; the definition that best matches is called. See the the Overload resolution entry elsewhere in this document section for the precise rules. Trailing arguments with initializers are optional arguments; defining a function with optional arguments is equivalent to defining multiple overloaded functions that differ by having and not having the optional argument. The value of the initializer is used only for the version that does not have the argument and is ignored if the argument is present.

## Overloading of Functions by Profile

Cg supports overloading of functions by compilation profile. This capability allows a function to be implemented differently for different profiles. It is also useful because different profiles may support different subsets of the language capabilities, and because the most efficient implementation of a function may be different for different profiles.

The profile name must precede the return type name in the function declaration. For example, to define two different versions of the function `myfunc` for the `profileA` and `profileB` profiles:

```
profileA float myfunc(float x) {...};
profileB float myfunc(float x) {...};
```

If a type is defined (using a `typedef`) that has the same name as a profile, the identifier is treated as a type name, and is not available for profile overloading at any subsequent point in the file.

If a function definition does not include a profile, the function is referred to as an “open-profile” function. Open-profile functions apply to all profiles.

Several wildcard profile names are defined. The name `vs` matches any vertex profile, while the name `ps` matches any fragment or pixel profile. The names `ps_1` and `ps_2` match any DX8 pixel shader 1.x profile, or DX9 pixel shader 2.x profile, respectively. Similarly, the names `vs_1` and `vs_2` match any DX vertex shader 1.x or 2.x, respectively. Additional valid wildcard profile names may be defined by individual profiles.

In general, the most specific version of a function is used. More details are provided in the section on function overloading, but roughly speaking, the search order is the following:

1. version of the function with the exact profile overload
2. version of the function with the most specific wildcard profile overload (e.g. `vs`, “`ps_1`”)
3. version of function with no profile overload

This search process allows generic versions of a function to be defined that can be overridden as needed for particular hardware.

### Syntax for Parameters in Function Definitions

Functions are declared in a manner similar to C, but the parameters in function definitions may include a binding semantic (discussed later) and a default value.

Each parameter in a function definition takes the following form:

```
<declspecs> <type> identifier [: <binding_semantic>] [= <default>]
```

<default> is an expression that resolves to a constant at compile time.

Default values are only permitted for uniform parameters, and for `in` parameters to non top-level functions.

### Function Calls

A function call returns an rvalue. Therefore, if a function returns an array, the array may be read but not written. For example, the following is allowed:

```
y = myfunc(x)[2];
```

But, this is not:

```
myfunc(x)[2] = y;
```

For multiple function calls within an expression, the calls can occur in any order — it is undefined.

### Types

Cg’s types are as follows:

- The `int` type is preferably 32-bit two’s complement. Profiles may optionally treat `int` as `float`.
- The `unsigned` type is preferably a 32-bit ordinal value. `unsigned` may also be used with other integer types to make different sized unsigned values
- The `char`, `short`, and `long` types are two’s complement integers of various sizes. The only requirement is that `char` is no larger than `short`, `short` is no larger than `int` and `long` is at least as large as `int`
- The `float` type is as close as possible to the IEEE single precision (32-bit) floating point format. Profiles must support the `float` data type.
- The `half` type is lower-precision IEEE-like floating point. Profiles must support the `half` type, but may choose to implement it with the same precision as the `float` type.
- The `fixed` type is a signed type with a range of at least  $[-2, 2)$  and with at least 10 bits of fractional precision. Overflow operations on the data type clamp rather than wrap. Fragment profiles must support the `fixed` type, but may implement it with the same precision as the `half` or `float` types. Vertex profiles are required to provide partial support (as defined below) for the `fixed` type. Vertex profiles have the option to provide full support for the `fixed` type or to implement the `fixed` type with the same precision as the `half` or `float` types.
- The `bool` type represents Boolean values. Objects of `bool` type are either true or false.

- The `cint` type is 32-bit two's complement. This type is meaningful only at compile time; it is not possible to declare objects of type `cint`.
- The `cfloat` type is IEEE single-precision (32-bit) floating point. This type is meaningful only at compile time; it is not possible to declare objects of type `cfloat`.
- The `void` type may not be used in any expression. It may only be used as the return type of functions that do not return a value.
- The `sampler*` types are handles to texture objects. Formal parameters of a program or function may be of type `sampler*`. No other definition of `sampler*` variables is permitted. A `sampler*` variable may only be used by passing it to another function as an `in` parameter. Assignment to `sampler*` variables is not permitted, and `sampler*` expressions are not permitted.

The following sampler types are always defined: `sampler`, `sampler1D`, `sampler2D`, `sampler3D`, `samplerCUBE`, `samplerRECT`.

The base `sampler` type may be used in any context in which a more specific sampler type is valid. However, a `sampler` variable must be used in a consistent way throughout the program. For example, it cannot be used in place of both a `sampler1D` and a `sampler2D` in the same program. The `sampler` type is deprecated and only provided for backwards compatibility with Cg 1.0

Fragment profiles are required to fully support the `sampler`, `sampler1D`, `sampler2D`, `sampler3D`, and `samplerCUBE` data types. Fragment profiles are required to provide partial support (as defined below) for the `samplerRECT` data type and may optionally provide full support for this data type.

Vertex profiles are required to provide partial support for the six sampler data types and may optionally provide full support for these data types.

- An *array* type is a collection of one or more elements of the same type. An *array* variable has a single index.
- Some array types may be optionally designated as *packed*, using the `packed` type modifier. The storage format of a *packed* type may be different from the storage format of the corresponding unpacked type. The storage format of *packed* types is implementation dependent, but must be consistent for any particular combination of compiler and profile. The operations supported on a *packed* type in a particular profile may be different than the operations supported on the corresponding unpacked type in that same profile. Profiles may define a maximum allowable size for *packed* arrays, but must support at least size 4 for *packed* vector (1D array) types, and 4x4 for *packed* matrix (2D array) types.
- When declaring an array of arrays in a single declaration, the `packed` modifier refers to all of the arrays. However, it is possible to declare an unpacked array of *packed* arrays by declaring the first level of array in a `typedef` using the `packed` keyword and then declaring an array of this type in a second statement. It is not possible to declare a *packed* array of unpacked arrays.
- For any supported numeric data type *TYPE*, implementations must support the following *packed* array types, which are called *vector types*. Type identifiers must be predefined for these types in the global scope:

```
typedef packed TYPE TYPE1[1];
typedef packed TYPE TYPE2[2];
typedef packed TYPE TYPE3[3];
typedef packed TYPE TYPE4[4];
```

For example, implementations must predefine the type identifiers `float1`, `float2`, `float3`, `float4`, and so on for any other supported numeric type.



- For any supported numeric data type *TYPE*, implementations must support the following packed array types, which are called *matrix types*. Implementations must also predefine type identifiers (in the global scope) to represent these types:

```
packed TYPE1 TYPE1x1[1];
packed TYPE2 TYPE1x2[1];
packed TYPE3 TYPE1x3[1];
packed TYPE4 TYPE1x4[1];
packed TYPE1 TYPE2x1[2];
packed TYPE2 TYPE2x2[2];
packed TYPE3 TYPE2x3[2];
packed TYPE4 TYPE2x4[2];
packed TYPE1 TYPE3x1[3];
packed TYPE2 TYPE3x2[3];
packed TYPE3 TYPE3x3[3];
packed TYPE4 TYPE3x4[3];
packed TYPE1 TYPE4x1[4];
packed TYPE2 TYPE4x2[4];
packed TYPE3 TYPE4x3[4];
packed TYPE4 TYPE4x4[4];
```

For example, implementations must predefine the type identifiers `float2x1`, `float3x3`, `float4x4`, and so on. A typedef follows the usual matrix-naming convention of `TYPErows_X_columns`. If we declare `float4x4 a`, then

`a[3]` is equivalent to `a._m30_m31_m32_m33`

Both expressions extract the third row of the matrix.

- Implementations are required to support indexing of vectors and matrices with constant indices.
- A `struct` type is a collection of one or more members of possibly different types. It may include both function members (methods) and data members (fields).

### Struct and Interface types

Interface types are defined with a *interface* keyword in place of the normal *struct* keyword. Interface types may only declare member functions, not data members. Interface member functions may only be declared, not defined (no default implementations in C++ parlance).

Struct types may inherit from a single interface type, and must define an implementation member function for every member function declared in the interface type.

### Partial Support of Types

This specification mandates “partial support” for some types. Partial support for a type requires the following:

- Definitions and declarations using the type are supported.
- Assignment and copy of objects of that type are supported (including implicit copies when passing function parameters).
- Top-level function parameters may be defined using that type.

If a type is partially supported, variables may be defined using that type but no useful operations can be performed on them. Partial support for types makes it easier to share data structures in code that is targeted at different profiles.

## Type Categories

- The *signed integral* type category includes types `cint`, `char`, `short`, `int`, and `long`.
- The *unsigned integral* type category includes types `unsigned char`, `unsigned short`, `unsigned int`, and `unsigned long`. `unsigned` is the same as `unsigned int`.
- The *integral* category includes both *signed integral* and *unsigned integral* types.
- The *floating* type category includes types `cfloat`, `float`, `half`, and `fixed` (Note that floating really means floating or fixed/fractional.)
- The *numeric* type category includes *integral* and *floating* types.
- The *compile-time* type category includes types `cfloat` and `cint`. These types are used by the compiler for constant type conversions.
- The *dynamic* type category includes all interface and the unsized array entry elsewhere in this document types.
- The *concrete* type category includes all types that are not included in the *compile-time* and *dynamic* type category.
- The *scalar* type category includes all types in the numeric category, the `bool` type, and all types in the compile-time category. In this specification, a reference to a <category> type (such as a reference to a numeric type) means one of the types included in the category (such as `float`, `half`, or `fixed`).

## Constants

Constant literals are defined as in C, including an optional 0 or 0x prefix for octal or hexadecimal constants, and e exponent suffix for floating point constants. A constant may be explicitly typed or implicitly typed. Explicit typing of a constant is performed, as in C, by suffixing the constant with a one or two characters indicating the type of the constant:

- **d** for double
- **f** for float
- **h** for half
- **i** for int
- **l** for long
- **s** for short
- **t** for char
- **u** for unsigned, which may also be followed by **s**, **t**, **i**, or **l**
- **x** for fixed

Any constant that is not explicitly typed is implicitly typed. If the constant includes a decimal point or an 'e' exponent suffix, it is implicitly typed as `cfloat`. If it does not include a decimal point, it is implicitly typed as `cint`.

By default, constants are base 10. For compatibility with C, integer hexadecimal constants may be specified by prefixing the constant with 0x, and integer octal constants may be specified by prefixing the constant with 0.

Compile-time constant folding is preferably performed at the same precision that would be used if the operation were performed at run time. Some compilation profiles may allow some precision flexibility for the hardware; in such cases the compiler should ideally perform the constant folding at the highest hardware precision allowed for that data type in that profile.

If constant folding cannot be performed at run-time precision, it may optionally be performed using the precision indicated below for each of the numeric datatypes:

float  
     s23e8 (“fp32”) IEEE single precision floating point

half  
     s10e5 (“fp16”) floating point w/ IEEE semantics

fixed  
     S1.10 fixed point, clamping to [−2, 2)

double  
     s52e11 (“fp64”) IEEE double precision floating point

int   signed 32 bit twos-complement integer

char  
     signed 8 bit twos-complement integer

short  
     signed 16 bit twos-complement integer

long  
     signed 64 bit twos-complement integer

### Type Conversions

Some type conversions are allowed implicitly, while others require an cast. Some implicit conversions may cause a warning, which can be suppressed by using an explicit cast. Explicit casts are indicated using C-style syntax (e.g., casting `variable` to the `float4` type may be achieved via `“(float4)variablename”`).

#### Scalar conversions:

Implicit conversion of any scalar numeric type to any other scalar numeric type is allowed. A warning may be issued if the conversion is implicit and it is possible that precision is lost. implicit conversion of any scalar object type to any compatible scalar object type is also allowed. Conversions between incompatible scalar object types or object and numeric types are not allowed, even with an explicit cast. “sampler” is compatible with “sampler1D”, “sampler2D”, “sampler3D”, “samplerCube”, and “samplerRECT”. No other object types are compatible (“sampler1D” is not compatible with “sampler2D”, even though both are compatible with “sampler”).

Scalar types may be implicitly converted to vectors and matrixes of compatible type. The scalar will be replicated to all elements of the vector or matrix. Scalar types may also be explicitly cast to structure types if the scalar type can be legally cast to every member of the structure.

#### Vector conversions

Vectors may be converted to scalar types (selects the first element of the vector). A warning is issued if this is done implicitly. A vector may also be implicitly converted to another vector of the same size and compatible element type.

A vector may be converted to a smaller compatible vector, or a matrix of the same total size, but a warning if issued if an explicit cast is not used.

#### Matrix conversions

Matrixes may be converted to a scalar type (selects to 0,0 element). As with vectors, this causes a warning if its done implicitly. A matrix may also be converted implicitly to a matrix of the same size and shape and compatible element type

A Matrix may be converted to a smaller matrix type (selects the upper- left submatrix), or to a vector of the same total size, but a warning is issued if an explicit cast is not used.

#### Structure conversions

a structure may be explicitly cast to the type of its first member, or to another structure type with the same number of members, if each member of the struct can be converted to the corresponding member of the new struct. No implicit conversions of struct types are allowed.

### Array conversions

An array may be explicitly converted to another array type with the same number of elements and a compatible element type. A compatible element type is any type to which the element type of the initial array may be implicitly converted to. No implicit conversions of array types are allowed.

		Source type				
		Scalar	Vector	Matrix	Struct	Array
Target	Scalar	A	W	W	E(3)	-
	Vector	A	A/W(1)	W(2)	E(3)	E(6)
	Matrix	A	W(2)	A/W(1)	E(3)	E(7)
	Struct	E	E(4)	E(4)	E(4/5)	E(4)
	Array	-	E(6)	E(7)	E(3)	E(6)

A = allowed implicitly or explicitly

W = allowed, but warning issued if implicit

E = only allowed with explicit cast

- = not allowed

#### notes

- (1) not allowed if target is larger than source. Warning if target is smaller than source
- (2) only allowed if source and target are the same total size
- (3) only if the first member of the source can be converted to the target
- (4) only if the target struct contains a single field of the source type
- (5) only if both source and target have the same number of members and each member of the source can be converted to the corresponding member of the target.
- (6) Source and target sizes must be the same and element types must be compatible
- (7) Array type must be an array of vectors that matches the matrix type.

Explicit casts are:

- compile-time type when applied to expressions of compile-time type.
- numeric type when applied to expressions of numeric or compile-time types.
- numeric vector type when applied to another vector type of the same number of elements.
- numeric matrix type when applied to another matrix type of the same number of rows and columns.

### Type Equivalency

Type T1 is equivalent to type T2 if any of the following are true:

- T2 is equivalent to T1.

- T1 and T2 are the same scalar, vector, or structure type.  
A packed array type is *not* equivalent to the same size unpacked array.
- T1 is a typedef name of T2.
- T1 and T2 are arrays of equivalent types with the same number of elements.
- The unqualified types of T1 and T2 are equivalent, and both types have the same qualifications.
- T1 and T2 are functions with equivalent return types, the same number of parameters, and all corresponding parameters are pair-wise equivalent.

### Type-Promotion Rules

The `cfloat` and `cint` types behave like `float` and `int` types, except for the usual arithmetic conversion behavior (defined below) and function-overloading rules (defined later).

The *usual arithmetic conversions* for binary operators are defined as follows:

1. If one operand is `cint` it is converted to the other type
2. If one operand is `cfloat` and the other is *floating*, the `cfloat` is converted to the other type
3. If both operands are *floating* then the smaller type is converted to the larger type
4. If one operand is *floating* and the other is *integral*, the integral argument is converted to the floating type.
5. If both operands are *integral* the smaller type is converted to the larger type
6. If one operand is *signed integral* while the other is *unsigned integral* and they are the same size, the signed type is converted to unsigned.

Note that conversions happen prior to performing the operation.

### Assignment

Assignment of an expression to a concrete typed object converts the expression to the type of the object. The resulting value is then assigned to the object or value.

The value of the assignment expressions (`=`, `*=`, and so on) is defined as in C:

An assignment expression has the value of the left operand after the assignment but is not an lvalue. The type of an assignment expression is the type of the left operand unless the left operand has a qualified type, in which case it is the unqualified version of the type of the left operand. The side effect of updating the stored value of the left operand occurs between the previous and the next sequence point.

An assignment of an expression to a dynamic typed object is only possible if the type of the expression is compatible with the dynamic object type. The object will then take on the type of the expression assigned to it until the next assignment to it.

### “Smearing” of Scalars to Vectors

If a binary operator is applied to a vector and a scalar, the scalar is automatically type-promoted to a same-sized vector by replicating the scalar into each component. The ternary `?:` operator also supports smearing. The binary rule is applied to the second and third operands first, and then the binary rule is applied to this result and the first operand.

### Namespaces

Just as in C, there are two namespaces. Each has multiple scopes, as in C.

- Tag namespace, which consists of `struct` tags

- Regular namespace:
  - typedef names (including an automatic typedef from a `struct` declaration)
  - variables
  - function names

### Arrays and Subscripting

Arrays are declared as in C, except that they may optionally be declared to be packed, as described earlier. Arrays in Cg are first-class types, so array parameters to functions and programs must be declared using array syntax, rather than pointer syntax. Likewise, assignment of an *array*-typed object implies an array copy rather than a pointer copy.

Arrays with size `[ 1 ]` may be declared but are considered a different type from the corresponding non-array type.

Because the language does not currently support pointers, the storage order of arrays is only visible when an application passes parameters to a vertex or fragment program. Therefore, the compiler is currently free to allocate temporary variables as it sees fit.

The declaration and use of arrays of arrays is in the same style as in C. That is, if the 2D array `A` is declared as

```
float A[4][4];
```

then, the following statements are true:

- The array is indexed as `A[row][column]`;
- The array can be built with a constructor using

```
float4x4 A = { { A[0][0], A[0][1], A[0][2], A[0][3] },
               { A[1][0], A[1][1], A[1][2], A[1][3] },
               { A[2][0], A[2][1], A[2][2], A[2][3] },
               { A[3][0], A[3][1], A[3][2], A[3][3] } };
```

- `A[0]` is equivalent to `float4(A[0][0], A[0][1], A[0][2], A[0][3])`

Support must be provided for structs containing arrays.

### Unsize Arrays

Objects may be declared as *unsize* arrays by using a declaration with an empty size `[ ]` and no initializer. If a declarator uses unsize array syntax with an initializer, it is declared with a concrete (size) array type based on the declarator. Unsize arrays are dynamic typed objects that take on the size of any array assigned to them.

### Minimum Array Requirements

Profiles are required to provide partial support for certain kinds of arrays. This partial support is designed to support vectors and matrices in all profiles. For vertex profiles, it is additionally designed to support arrays of light state (indexed by light number) passed as uniform parameters, and arrays of skinning matrices passed as uniform parameters.

Profiles must support subscripting, copying, size querying and swizzling of vectors and matrices. However, subscripting with run-time computed indices is not required to be supported.

Vertex profiles must support the following operations for any non-packed array that is a uniform parameter to the program, or is an element of a structure that is a uniform parameter to the program. This requirement also applies when the array is indirectly a uniform program parameter (that is, it and or the structure containing it has been passed via a chain of `in` function parameters). The three operations that must be supported are

- rvalue subscripting by a run-time computed value or a compile-time value.
- passing the entire array as a parameter to a function, where the corresponding formal function parameter is declared as `in`.
- querying the size of the array with a `.length` suffix.

The following operations are explicitly not required to be supported:

- lvalue-subscripting
- copying
- other operators, including multiply, add, compare, and so on

Note that when a uniform array is rvalue subscripted, the result is an expression, and this expression is no longer considered to be a `uniform` program parameter. Therefore, if this expression is an array, its subsequent use must conform to the standard rules for array usage.

These rules are not limited to arrays of numeric types, and thus imply support for arrays of struct, arrays of matrices, and arrays of vectors when the array is a `uniform` program parameter. Maximum array sizes may be limited by the number of available registers or other resource limits, and compilers are permitted to issue error messages in these cases. However, profiles must support sizes of at least `float arr[8]`, `float4 arr[8]`, and `float4x4 arr[4][4]`.

Fragment profiles are not required to support any operations on arbitrarily sized arrays; only support for vectors and matrices is required.

### Function Overloading

Multiple functions may be defined with the same name, as long as the definitions can be distinguished by unqualified parameter types and do not have an open-profile conflict (as described in the section on open functions).

Function-matching rules:

1. Add all visible functions with a matching name in the calling scope to the set of function candidates.
2. Eliminate functions whose profile conflicts with the current compilation profile.
3. Eliminate functions with the wrong number of formal parameters. If a candidate function has excess formal parameters, and each of the excess parameters has a default value, do not eliminate the function.
4. If the set is empty, fail.
5. For each actual parameter expression in sequence (left to right), perform the following:
  - a. If the type of the actual parameter matches the unqualified type of the corresponding formal parameter in any function in the set, remove all functions whose corresponding parameter does not match exactly.
  - b. If there is a function with a dynamically typed formal argument which is compatible with the actual parameter type, remove all functions whose corresponding parameter is not similarly compatible.
  - B. If there is a defined promotion for the type of the actual parameter to the unqualified type of the formal parameter of any function, remove all functions for which this is not true from the set.
  - d. If there is a valid implicit cast that converts the type of the actual parameter to the unqualified type of the formal parameter of any function, remove all functions for which this is not true from the set.
  - e. Fail.

6. Choose a function based on profile:
  - a. If there is at least one function with a profile that exactly matches the compilation profile, discard all functions that don't exactly match.
  - b. Otherwise, if there is at least one function with a wildcard profile that matches the compilation profile, determine the 'most specific' matching wildcard profile in the candidate set. Discard all functions except those with this 'most specific' wildcard profile. How 'specific' a given wildcard profile name is relative to a particular profile is determined by the profile specification.
7. If the number of functions remaining in the set is not one, then fail.

### Global Variables

Global variables are declared and used as in C. Non-static variables may have a semantic associated with them. Uniform non-static variables may have their value set through the run-time API.

### Use of Uninitialized Variables

It is incorrect for a program to use an uninitialized static or local variable. However, the compiler is not obligated to detect such errors, even if it would be possible to do so by compile-time data-flow analysis. The value obtained from reading an uninitialized variable is undefined. This same rule applies to the implicit use of a variable that occurs when it is returned by a top-level function. In particular, if a top-level function returns a `struct`, and some element of that `struct` is never written, then the value of that element is undefined.

Note: The language designers did not choose to define variables as being initialized to zero because that would result in a performance penalty in cases where the compiler is unable to determine if a variable is properly initialized by the programmer.

### Preprocessor

Cg profiles must support the full ANSI C standard preprocessor capabilities: `#if`, `#define`, and so on. However, while `#include` must be supported the mechanism by which the file to be included is located is implementation defined.

## Overview of Binding Semantics

In stream-processing architectures, data packets flow between different programmable units. On a GPU, for example, packets of vertex data flow from the application to the vertex program.

Because packets are produced by one program (the application, in this case), and consumed by another (the vertex program), there must be some mechanism for defining the interface between the two. Cg allows the user to choose between two different approaches to defining these interfaces.

The first approach is to associate a binding semantic with each element of the packet. This approach is a *bind-by-name* approach. For example, an output with the binding semantic `FOO` is fed to an input with the binding semantic `FOO`. Profiles may allow the user to define arbitrary identifiers in this “semantic namespace”, or they may restrict the allowed identifiers to a predefined set. Often, these predefined names correspond to the names of hardware registers or API resources.

In some cases, predefined names may control non-programmable parts of the hardware. For example, vertex programs normally compute a position that is fed to the rasterizer, and this position is stored in an output with the binding semantic `POSITION`.

For any profile, there are two namespaces for predefined binding semantics—the namespace used for `in` variables and the namespace used for `out` variables. The primary implication of having two namespaces is that the binding semantic cannot be used to implicitly specify whether a variable is `in` or `out`.

The second approach to defining data packets is to describe the data that is present in a packet and allow the compiler to decide how to store it. In Cg, the user can describe the contents of a data packet by placing all of its contents into a `struct`. When a `struct` is used in this manner, we refer to it as a *connector*. The two approaches are not mutually exclusive, as is discussed later. The connector approach allows the user to rely on a combination of user-specified semantic bindings and compiler-determined bindings.



## Binding Semantics

A binding semantic may be associated with an input to a top-level function or a global variable in one of three ways:

- The binding semantic is specified in the formal parameter declaration for the function. The syntax for formal parameters to a function is:

```
[const] [in | out | inout] <type> <identifier> [: <binding-semantic>] [=
```

- If the formal parameter is a struct, the binding semantic may be specified with an element of the struct when the struct is defined:

```
struct <struct-tag> {
    <type> <identifier>[ : <binding-semantic>];
    ...
};
```

- If the input to the function is implicit (a non-static global variable that is read by the function), the binding semantic may be specified when the non-static global variable is declared:

```
[varying [in | out]] <type> <identifier> [ : <binding-semantic>];
```

If the non-static global variable is a struct, the binding semantic may be specified when the struct is defined, as described in the second bullet above.

- A binding semantic may be associated with the output of a top-level function in a similar manner:

```
<type> <identifier> ( <parameter-list> ) [: <binding-semantic>]
{
    :
}
```

Another method available for specifying a semantic for an output value is to return a struct, and to specify the binding *semantic*(s) with elements of the struct when the struct is defined. In addition, if the output is a formal parameter, then the binding semantic may be specified using the same approach used to specify binding semantics for inputs.

## Aliasing of Semantics

Semantics must honor a copy-on-input and copy-on-output model. Thus, if the same input binding semantic is used for two different variables, those variables are initialized with the same value, but the variables are not aliased thereafter. Output aliasing is illegal, but implementations are not required to detect it. If the compiler does not issue an error on a program that aliases output binding semantics, the results are undefined.

## Additional Details for Binding Semantics

The following are somewhat redundant, but provide extra clarity:

- Semantic names are case-insensitive.
- Semantics attached to parameters to non-main functions are ignored.
- Input semantics may be aliased by multiple variables.
- Output semantics may not be aliased.

### Using a Structure to Define Binding Semantics (Connectors)

Cg profiles may optionally allow the user to avoid the requirement that a binding semantic be specified for every non-uniform input (or output) variable to a top-level program. To avoid this requirement, all the non-uniform variables should be included within a single `struct`. The compiler automatically allocates the elements of this structure to hardware resources in a manner that allows any program that returns this `struct` to interoperate with any program that uses this `struct` as an input.

It is not *required* that all non-uniform inputs be included within a single `struct` in order to omit binding semantics. Binding semantics may be omitted from any input or output, and the compiler performs automatic allocation of that input or output to a hardware resource. However, to guarantee interoperability of one program's output with another program's input when automatic binding is performed, it is necessary to put all of the variables in a single `struct`.

It is permissible to explicitly specify a binding semantic for some elements of the `struct`, but not others. The compiler's automatic allocation must honor these explicit bindings. The allowed set of explicitly specified binding semantics is defined by the allocation-rule identifier. The most common use of this capability is to bind variables to hardware registers that write to, or read from, non-programmable parts of the hardware. For example, in a typical vertex-program profile, the output `struct` would contain an element with an explicitly specified `POSITION` semantic. This element is used to control the hardware rasterizer.

### Defining Binding Semantics via an external API

It may be possible to define binding semantics on inputs and outputs by using an external API that manipulates the programs environment. The Cg Runtime API is such an API that allows this, and others may exist.

### How Programs Receive and Return Data

A program is a non-static function that has been designated as the main entry point at compilation time. The varying inputs to the program come from this top-level function's varying `in` parameters, and any global varying variables that do not have an `out` modifier. The uniform inputs to the program come from the top-level function's uniform `in` parameters and from any non-static global variables that are referenced by the top-level function or by any functions that it calls. The output of the program comes from the return value of the function (which is always implicitly varying), from any `out` parameters, which must also be varying, and from any varying `out` global variables that are written by the program.

Parameters to a program of type `sampler*` are implicitly `const`.

### Statements and Expressions

Statements are expressed just as in C, unless an exception is stated elsewhere in this document. Additionally,

- `if`, `while`, and `for` require `bool` expressions in the appropriate places.
- Assignment is performed using `=`. The assignment operator returns a value, just as in C, so assignments may be chained.
- The new `discard` statement terminates execution of the program for the current data element (such as the current vertex or current fragment) and suppresses its output. Vertex profiles may choose to omit support for `discard`.

### Minimum Requirements for `if`, `while`, `for`

The minimum requirements are as follows:

- All profiles should support `if`, but such support is not strictly required for older hardware.
- All profiles should support `for` and `while` loops if the number of loop iterations can be determined at compile time. "Can be determined at compile time" is defined as follows: The loop-iteration expressions can be evaluated at compile time by use of intra-procedural constant propagation and folding, where the variables through which constant values are propagated do not appear as lvalues

within any kind of control statement (`if`, `for`, or `while`) or `?:` construct. Profiles may choose to support more general constant propagation techniques, but such support is not required.

- Profiles may optionally support fully general `for` and `while` loops.

### New Vector Operators

These new operators are defined for vector types:

- Vector construction operator: *typeID*(...):

This operator builds a vector from multiple scalars or shorter vectors:

- `float4(scalar, scalar, scalar, scalar)`
- `float4(float3, scalar)`

- Matrix construction operator: *typeID*(...):

This operator builds a matrix from multiple rows.

Each row may be specified either as multiple scalars or as any combination of scalars and vectors with the appropriate size, e.g.

```
float3x3(1, 2, 3, 4, 5, 6, 7, 8, 9)
float3x3(float3, float3, float3)
float3x3(1, float2, float3, 1, 1, 1)
```

- Vector swizzle operator: `(.)`

```
a = b.xyz; // A swizzle operator example
```

- At least one swizzle character must follow the operator.
- There are three sets of swizzle characters and they may not be mixed: Set one is `xyzw` = 0123, set two is `rgba` = 0123, and set three is `stpq` = 0123.
- The vector swizzle operator may only be applied to vectors or to scalars.
- Applying the vector swizzle operator to a scalar gives the same result as applying the operator to a vector of length one. Thus, `myscalar.xxx` and `float3(myscalar, myscalar, myscalar)` yield the same value.
- If only one swizzle character is specified, the result is a scalar not a vector of length one. Therefore, the expression `b.y` returns a scalar.
- Care is required when swizzling a constant scalar because of ambiguity in the use of the decimal point character. For example, to create a three-vector from a scalar, use one of the following: `(1).xxx` or `1.xxx` or `1.0.xxx` or `1.0f.xxx`
- The size of the returned vector is determined by the number of swizzle characters. Therefore, the size of the result may be larger or smaller than the size of the original vector. For example, `float2(0,1).xxyy` and `float4(0,0,1,1)` yields the same result.

- Matrix swizzle operator:

For any matrix type of the form '`<type><rows>x<columns>`', the notation: '`<matrixObject>._m<row><col>[_m<row><col>][...]`' can be used to access individual matrix elements (in the case of only one `<row>`, `<col>` pair) or to construct vectors from elements of a matrix (in the case of more than one `<row>`, `<col>` pair). The row and column numbers are zero-based.

For example:

```

float4x4 myMatrix;
float    myFloatScalar;
float4    myFloatVec4;

// Set myFloatScalar to myMatrix[3][2]
myFloatScalar = myMatrix._m32;

// Assign the main diagonal of myMatrix to myFloatVec4
myFloatVec4 = myMatrix._m00_m11_m22_m33;

```

For compatibility with the D3DMatrix data type, Cg also allows one-based swizzles, using a form with the `m` omitted after the `_`: '`<matrixObject>._<row><col>[_<row><col>][...]`' In this form, the indexes for `<row>` and `<col>` are one-based, rather than the C standard zero-based. So, the two forms are functionally equivalent:

```

float4x4 myMatrix;
float4    myVec;

// These two statements are functionally equivalent:
myVec = myMatrix._m00_m23_m11_m31;
myVec = myMatrix._11_34_22_42;

```

Because of the confusion that can be caused by the one-based indexing, its use is strongly discouraged. Also one-based indexing and zero-based indexing cannot be mixed in a single swizzle

The matrix swizzles may only be applied to matrices. When multiple components are extracted from a matrix using a swizzle, the result is an appropriately sized vector. When a swizzle is used to extract a single component from a matrix, the result is a scalar.

- The write-mask operator: `(.)` It can only be applied to an lvalue that is a vector or matrix. It allows assignment to particular elements of a vector or matrix, leaving other elements unchanged. It looks exactly like a swizzle, with the additional restriction that a component cannot be repeated.

### Arithmetic Precision and Range

Some hardware may not conform exactly to IEEE arithmetic rules. Fixed-point data types do not have IEEE-defined rules.

Optimizations are permitted to produce slightly different results than unoptimized code. Constant folding must be done with approximately the correct precision and range, but is not required to produce bit-exact results. It is recommended that compilers provide an option either to forbid these optimizations or to guarantee that they are made in bit-exact fashion.

### Operator Precedence

Cg uses the same operator precedence as C for operators that are common between the two languages.

The swizzle and write-mask operators `(.)` have the same precedence as the structure member operator `(.)` and the array index operator `[ ]`.

### Operator Enhancements

The standard C arithmetic operators `(+, -, *, /, %, unary -)` are extended to support vectors and matrices. Sizes of vectors and matrices must be appropriately matched, according to standard mathematical rules. Scalar-to-vector promotion, as described earlier, allows relaxation of these rules.

#### **M[n][m]**

Matrix with `n` rows and `m` columns

**V[n]**

Vector with n elements

**-V[n] -> V[n]**

Unary vector negate

**-M[n] -> M[n]**

Unary matrix negate

**V[n] \* V[n] -> V[n]**

Componentwise \*

**V[n] / V[n] -> V[n]**

Componentwise /

**V[n] % V[n] -> V[n]**

Componentwise %

**V[n] + V[n] -> V[n]**

Componentwise +

**V[n] - V[n] -> V[n]**

Componentwise -

**M[n][m] \* M[n][m] -> M[n][m]**

Componentwise \*

**M[n][m] / M[n][m] -> M[n][m]**

Componentwise /

**M[n][m] % M[n][m] -> M[n][m]**

Componentwise %

**M[n][m] + M[n][m] -> M[n][m]**

Componentwise +

**M[n][m] - M[n][m] -> M[n][m]**

Componentwise -

**Operators***Boolean*

&amp;&amp;   ||   !

Boolean operators may be applied to `bool` packed bool vectors, in which case they are applied in elementwise fashion to produce a result vector of the same size. Each operand must be a `bool` vector of the same size.

Both sides of `&&` and `||` are always evaluated; there is no short-circuiting as there is in C.

*Comparisons*

&lt;   &gt;   &lt;=   &gt;=   !=   ==

Comparison operators may be applied to numeric vectors. Both operands must be vectors of the same size. The comparison operation is performed in elementwise fashion to produce a `bool` vector of the same size.

Comparison operators may also be applied to `bool` vectors. For the purpose of relational comparisons, `true` is treated as one and `false` is treated as zero. The comparison operation is performed in elementwise fashion to produce a `bool` vector of the same size.

Comparison operators may also be applied to numeric or bool scalars.

*Arithmetic*

+ - \* / % ++ -- unary- unary+

The arithmetic operator % is the remainder operator, as in C. It may only be applied to two operands of `cint` or `int` types.

When / or % is used with `cint` or `int` operands, C rules for integer / and % apply.

The C operators that combine assignment with arithmetic operations (such as +=) are also supported when the corresponding arithmetic operator is supported by Cg.

#### *Conditional Operator*

?:

If the first operand is of type `bool`, one of the following must hold for the second and third operands:

- Both operands have compatible structure types.
- Both operands are scalars with numeric or `bool` type.
- Both operands are vectors with numeric or `bool` type, where the two vectors are of the same size, which is less than or equal to four.

If the first operand is a packed vector of `bool`, then the conditional selection is performed on an elementwise basis. Both the second and third operands must be numeric vectors of the same size as the first operand.

Unlike C, side effects in the expressions in the second and third operands are always executed, regardless of the condition.

#### *Miscellaneous Operators*

(typecast) ,

Cg supports C's typecast and comma operators.

### **Reserved Words**

The following are currently used reserved words in Cg. A '\*' indicates that the reserved word is case-insensitive.

\_\_[anything] (i.e. any identifier with two underscores as a prefix)

asm\*

asm\_fragment

auto

bool

break

case

catch

char

class

column\_major

compile

const

const\_cast

continue

decl\*

default

delete

discard

do  
double  
dword\*  
dynamic\_cast  
else  
emit  
enum  
explicit  
extern  
false  
fixed  
float\*  
for  
friend  
get  
goto  
half  
if  
in  
inline  
inout  
int  
interface  
long  
matrix\*  
mutable  
namespace  
new  
operator  
out  
packed  
pass\*  
pixelfragment\*  
pixelshader\*  
private  
protected  
public  
register  
reinterpret\_cast  
return  
row\_major  
sampler  
sampler\_state  
sampler1D  
sampler2D  
sampler3D  
samplerCUBE  
shared  
short  
signed  
sizeof  
static

static\_cast  
string\*  
struct  
switch  
technique\*  
template  
texture\*  
texture1D  
texture2D  
texture3D  
textureCUBE  
textureRECT  
this  
throw  
true  
try  
typedef  
typeid  
typename  
uniform  
union  
unsigned  
using  
vector\*  
vertexfragment\*  
vertexshader\*  
virtual  
void  
volatile  
while

### **Cg Standard Library Functions**

Cg provides a set of built-in functions and structures to simplify GPU programming. These functions are similar in spirit to the C standard library functions, providing a convenient set of common functions.

The Cg Standard Library is documented in “spec\_stdlib.txt”.

### **VERTEX PROGRAM PROFILES**

A few features of the Cg language that are specific to vertex program profiles are required to be implemented in the same manner for all vertex program profiles.

#### **Mandatory Computation of Position Output**

Vertex program profiles may (and typically do) require that the program compute a position output. This homogeneous clip-space position is used by the hardware rasterizer and must be stored in a program output with an output binding semantic of POSITION (or HPOS for backward compatibility).

#### **Position Invariance**

In many graphics APIs, the user can choose between two different approaches to specifying per-vertex computations: use a built-in configurable “fixed-function” pipeline or specify a user-written vertex program. If the user wishes to mix these two approaches, it is sometimes desirable to guarantee that the position computed by the first approach is bit-identical to the position computed by the second approach. This “position invariance” is particularly important for multipass rendering.

Support for position invariance is optional in Cg vertex profiles, but for those vertex profiles that support it, the following rules apply:



- Position invariance with respect to the fixed function pipeline is guaranteed if two conditions are met:
  - A `#pragma position_invariant <top-level-function-name>` appears before the body of the top-level function for the vertex program.
  - The vertex program computes position as follows:

```
OUT_POSITION = mul(MVP, IN_POSITION)
```

where:

**OUT\_POSITION**

is a variable (or structure element) of type `float4` with an output binding semantic of `POSITION` or `HPOS`.

**IN\_POSITION**

is a variable (or structure element) of type `float4` with an input binding semantic of `POSITION`.

**MVP**

is a uniform variable (or structure element) of type `float4x4` with an input binding semantic that causes it to track the fixed-function modelview-projection matrix. (The name of this binding semantic is currently profile-specific — for OpenGL profiles, the semantic `state.matrix.mvp` is recommended).

- If the first condition is met but not the second, the compiler is encouraged to issue a warning.
- Implementations may choose to recognize more general versions of the second condition (such as the variables being copy propagated from the original inputs and outputs), but this additional generality is not required.

### Binding Semantics for Outputs

As shown in Table 10, there are two output binding semantics for vertex program profiles:

Table 10 Vertex Output Binding Semantics

Name	Meaning	Type	Default Value
-----	-----	-----	-----
POSITION	Homogeneous clip-space position; fed to rasterizer.	float4	Undefined
PSIZE	Point size	float	Undefined

Profiles may define additional output binding semantics with specific behaviors, and these definitions are expected to be consistent across commonly used profiles.

## FRAGMENT PROGRAM PROFILES

A few features of the Cg language that are specific to fragment program profiles are required to be implemented in the same manner for all fragment program profiles.

### Binding semantics for outputs

As shown in Table 11, there are three output binding semantics for fragment program profiles:

Table 11 Fragment Output Binding Semantics

Name	Meaning	Type	Default Value
----	-----	-----	-----
COLOR	RGBA output color	float4	Undefined
COLOR0	Same as COLOR		
DEPTH	Fragment depth value (in range [0,1])	float	Interpolated depth from rasterizer (in range [0,1])

Profiles may define additional output binding semantics with specific behaviors, and these definitions are

expected to be consistent across commonly used profiles.

If a program desires an output color alpha of 1.0, it should explicitly write a value of 1.0 to the W component of the COLOR output. The language does *\*not\** define a default value for this output.

Note: If the target hardware uses a default value for this output, the compiler may choose to optimize away an explicit write specified by the user if it matches the default hardware value. Such defaults are not exposed in the language.)

In contrast, the language does define a default value for the DEPTH output. This default value is the interpolated depth obtained from the rasterizer. Semantically, this default value is copied to the output at the beginning of the execution of the fragment program.

As discussed earlier, when a binding semantic is applied to an output, the type of the output variable is not required to match the type of the binding semantic. For example, the following is legal, although not recommended:

```
struct myfragoutput {  
    float2 mycolor : COLOR;  
}
```

In such cases, the variable is implicitly copied (with a typecast) to the semantic upon program completion. If the variable's vector size is shorter than the semantic's vector size, the larger-numbered components of the semantic receive their default values if applicable, and otherwise are undefined. In the case above, the R and G components of the output color are obtained from mycolor, while the B and A components of the color are undefined.

**NAME**

**cgc** – cg compiler driver

**SYNOPSIS**

cgc [options] file ...

**DESCRIPTION**

**cgc** is the standalone Cg compiler which translates Cg or GLSL programs into OpenGL or DirectX shader assembly code, or OpenGL or DirectX shading language code.

**OPTIONS****Basic options**

**-entry** *name*

Sets the entry function for the shader to compile. Defaults to `main`

**-o** *file*

Sets the output file to be written. Default outputs to `stdout`

**-l** *file*

Sets the listing file, where error and warning messages are written. Defaults to `stderr`

**-profile** *name*

Selects the target profile, specifying the shader language to be generated

**-profileopts** *opt1,opt2,...*

**-po** *opt1,opt2,...*

Sets one or more profile specific options

**-noentry**

Sets check only mode, where no shader is compiled, but all the code in the input file is checked for syntactic correctness

**Language options**

**-oglsl**

Sets the source language to GLSL.

**-ogles**

Sets the source language to OpenGL/ES GLSL.

**-strict**

**-nostrict**

Enable or disable strict typechecking, where most questionable constructs will be flagged as warnings.

**-glslWerror**

Like **-strict** but in addition, unportable GLSL constructs will be flagged as errors

**-nowarn**

Disable all warnings

**-nowarn**=*N,N,...*

Disable one or more specific numbered warnings

**-fx**

**-nofx**

Enables or disables FX parsing mode, where FX keywords are recognized. Defaults to on in Cg mode and off in GLSL mode

**-nostdlib**

Disable the standard library.

## Code Generation Options

`-fastmath`

`-nofastmath`

Enable or disable optimizations that may change/lose precision in low order bits, such as associative transforms like  $(a + b) + c$  instead of  $a + (b + c)$ . Default is `-fastmath`

`-fastprecision`

`-nofastprecision`

Enable or disable optimizations doing operations at lower precision than is specified when the result is later converted to a lower precision or the operands were originally in lower precision. Default is `-nofastprecision`

`-bestprecision`

Always do things in the best possible precision; only use lower precision operations if there is no possibility of difference. Implies `-nofastmath` and `-nofastprecision`

`-unroll all|none|count=N`

Control loop unrolling. `-unroll all` will force unrolling of all loops that can be unrolled, while `-unroll none` will prevent unrolling except if code cannot otherwise be generated in the current profiles (so it will have no effect in profiles that don't support looping). `unroll count=N` will unroll loops if the estimate of the resulting code is less than  $N$  instructions. The estimate does not take into account further optimizations that may be done after unrolling, so it might be quite inaccurate.

`-inline all|none|count=N`

Control function inlining. Setting `-inline none` will additionally disable inlining of functions with an explicit `inline` keyword, which are otherwise always inlined. Setting `-inline count=0` will effectively disable inlining of all functions that do not have an explicit `inline` keyword.

`-ifcvt all|none|count=N`

control if conversion (replacement of small if/else blocks with conditional assignments)

`-ON`

Sets the optimization level of the compiler, from 0 (lowest) to 3 (highest). Higher values may produce better code and will cause compile time to increase. Default is `-O1`.

`-looplimit N`

Assume loops that the compiler cannot determine an upper bound on the number of iterations may loop as many as  $N$  iterations. This may require generating extra code for such loops in some profiles.

`-d3d`

Generate code compatible with the Direct3D specification.

`-MaxInstInBasicBlock N`

break basic blocks after  $N$  instructions. This has an effect on local optimizations that don't cross basic block boundaries and may avoid bad compile time blowups in the presence of huge basic blocks due to algorithms that are non-linear in the basic block size.

`-maxunrollcount N`

Deprecated. Don't unroll loops with more than  $N$  iterations. Use the `-unroll` option instead, which provides better fine-grained control.

## Preprocessor Options

`-DMACRO[=VALUE]`

Sets a preprocessor macro. If *VALUE* is not specified it defaults to 1.

`-Idirectory`

Adds a directory to the end of the search path for `#include` files. The default search path is empty.

- E Don't compile, just preprocess the input.
- P With -E, suppresses the generation of `#line` directives in the output.
- C With -E, preserves comments in the output.
- MG  
Ignore `#include` files that can't be found, rather than issuing an error
- M
- MM
- MD
- MMD
- MP
- MF *file*
- MT *target*
- MQ *target*  
Generate dependency information about `#included` files. These options are intended to be compatible with the options to `gcc`

### Miscellaneous Options

- quiet
- q Suppress all 'noise' output (copyright notices, indications of which files are being compiled, etc). With -o and -l, should result in no output being produced.
- nocode  
Suppress final code generation. Will actually run all the way through the compiler (so any errors present should be diagnosed), but don't produce any actual output code.
- v
- version  
Print compiler version information to listing.
- h Print short option help summary to stdout and exit
- help  
Print longer option help summary to stdout, including all supported profiles and profile options, and exit
- type *type\_definition*  
Set an override type binding for a variable
- typefile *file*  
Read override type bindings for variables from a file.
- dumpinputbind <file>  
Dump type bindings for all variables to a file. This file may be passed back to the compiler with -typefile.

### Debugging options

- debug  
Enable the debug builtin function to abort operation of a shader and immediately output a value.
- debuglast  
Like -debug, except the shader does not abort; instead it continues and outputs the value of the last debug function called.
- debugdefault=*value*  
Like -debug, except if no debug call is reached, the output will be set to the specified value instead of what the shader normally computes.

## PROFILES

A *profile* specifies the output language of the cg compiler (either a shader assembly dialect, or a shading language). Each profile has its own set of *profile options* that can be set for it, though many related profiles have similar or identical options. Profiles can be grouped by program type, API, or GPU generation.

### DirectX profiles

dx8ps, dx8vs, dx9ps2, dxvs2, hlslf, hlslv, ps\_1\_1, ps\_1\_2, ps\_1\_3, ps\_2\_0, ps\_2\_x, ps\_3\_0, vs\_1\_1, vs\_2\_0, vs\_2\_x, vs\_3\_0

### OpenGL profiles

arbfp1, arbvpl, fp20, fp30, fp30unlimited, fp40, fp40unlimited, glslf, glslv, gp4fp, gp4gp, gp4vp, gpu\_fp, gpu\_gp, gpu\_vp, vp20, vp30, vp40

### Fragment profiles

arbfp1, dx8ps, dx9ps2, hlslf, fp20, fp30, fp30unlimited, fp40, fp40unlimited, glslf, gp4fp, gpu\_fp, ps\_1\_1, ps\_1\_2, ps\_1\_3, ps\_2\_0, ps\_2\_x, ps\_3\_0

### Geometry profiles

gp4gp, gpu\_gp

### Vertex profiles

arbvpl, dx8vs, dxvs2, glslv, gp4vp, gpu\_vp, hlslv, vp20, vp30, vp40, vs\_1\_1, vs\_2\_0, vs\_2\_x, vs\_3\_0

### Geforce 3/4 profiles

fp20, vp20

### Geforce 5 profiles

fp30, vp30

### Geforce 6/7 profiles

fp40, vp40

### Geforce 8 profiles

gp4fp, gp4gp, gp4vp, gpu\_fp, gpu\_gp, gpu\_vp

## Profile options

Here is a complete list of all profiles and their corresponding profile options

### arbfp1

Targets the ARB\_fragment\_program OpenGL extension

-po ARB\_draw\_buffers

Use the ARB\_draw\_buffers option for multiple renderbuffer targets (MRT). This is the default

-po ATI\_draw\_buffers

Use the ATI\_draw\_buffers option for multiple renderbuffer targets (MRT).

-po MaxDrawBuffers=*N*

Set the maximum number of renderbuffer targets. Default is 1

-po MaxLocalParams=*N*

Set the maximum number of uniform parameter slots available. Default is 32

-po MaxTexIndirections=*N*

Sets the maximum number of texture indirections allowed in the output program. Default is 1024

-po NumInstructionSlots=*N*

Sets the maximum number of instructions in the output program. Default is 1024

-po NumMathInstructionSlots=*N*

Sets the maximum number of non-texture instructions in the output program. Default is 1024

- po NumTemps=*N*  
Sets the maximum number of TEMP registers in the output program. Default is 32
- po NumTexInstructionSlots=*N*  
Sets the maximum number of texture instructions in the output program. Default is 1024

#### arbvp1

Targets the ARB\_vertex\_program OpenGL extension

- po MaxAddressRegs=*N*  
Sets the maximum number of ADDRESS registers in the output program. Default is 1
- po MaxInstructions=*N*  
Sets the maximum number of instructions in the output program. Default is 1024
- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 96
- po NumTemps=*N*  
Sets the maximum number of TEMP registers in the output program. Default is 32
- po PosInv  
Generate position invariant code (same as fixed-function) for POSITION output

#### dx8ps

Targets DirectX8 pixel programs (ps 1.1)

- po MaxPixelShaderValue=*N*  
Maximum absolute value representable in a pixel shader. Default is 1.

#### dx8vs

Targets DirectX8 vertex programs (vs 1.1)

- po dcls  
Output dx9-style dcls statements
- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 96
- po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 128
- po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 12

#### dx9ps2

Targets DirectX9 pixel programs (ps 2.0)

- po MaxDrawBuffers=*N*  
Set the maximum number of renderbuffer targets. Default is 1
- po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 96
- po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 12

#### dxvs2

Targets DirectX9 vertex programs (ps 2.0)

- po dcls  
Output dx9-style dcls statements
- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 32

-po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 256

-po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 12

fp20  
Targets the NV\_register\_combiners2 and NV\_texture\_shader OpenGL extensions

fp30  
Targets the NV\_fragment\_program OpenGL extension

-po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 256

-po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 32

fp30unlimited  
Same as fp30 with various hardware limits on registers and instructions lifted

-po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 4194304

-po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 512

fp40  
Targets the NV\_fragment\_program2 OpenGL extension

-po appleKilWAR  
Work around various bugs with KIL instructions in the OSX-tiger implementation of NV\_fragment\_program2

-po ARB\_draw\_buffers  
Use the ARB\_draw\_buffers option for multiple renderbuffer targets (MRT). This is the default

-po ATI\_draw\_buffers  
Use the ATI\_draw\_buffers option for multiple renderbuffer targets (MRT).

-po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is infinite

-po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is infinite

-po NumTemps=*N*  
Sets the maximum number of TEMP registers in the output program. Default is infinite

-po OutColorPrec=*N*  
If *N* is 3 or 4, force output to fp16 precision. If *N* is 2, force output to fp32 precision.

fp40unlimited  
Same as fp40 with various hardware limits on registers and instructions lifted

-po appleKilWAR  
Work around various bugs with KIL instructions in the OSX-tiger implementation of NV\_fragment\_program2

-po ARB\_draw\_buffers  
Use the ARB\_draw\_buffers option for multiple renderbuffer targets (MRT). This is the default

-po ATI\_draw\_buffers  
Use the ATI\_draw\_buffers option for multiple renderbuffer targets (MRT).



`-po MaxLocalParams=N`  
 Set the maximum number of uniform parameter slots available. Default is 1024

`-po NumInstructionSlots=N`  
 Sets the maximum number of instructions in the output program. Default is 4194304

`-po NumTemps=N`  
 Sets the maximum number of TEMP registers in the output program. Default is 512

`-po OutColorPrec=N`  
 If *N* is 3 or 4, force output to fp16 precision. If *N* is 2, force output to fp32 precision.

`generic`  
 Produces a dump of the program in a non-executable format

`glslf glslv`  
 Targets the OpenGL Shading language (GLSL) v1.10. `glslf` targets fragment programs while `glslv` targets vertex programs

`gp4fp gpu_fp`  
 Targets the NV\_gpu\_program4 and NV\_fragment\_program4 OpenGL extensions.

`-po ARB_draw_buffers`  
 Use the ARB\_draw\_buffers option for multiple renderbuffer targets (MRT). This is the default

`-po ATI_draw_buffers`  
 Use the ATI\_draw\_buffers option for multiple renderbuffer targets (MRT).

`gp4gp gpu_gp`  
 Targets the NV\_gpu\_program4 and NV\_geometry\_program4 OpenGL extensions.

`-po POINT`  
`-po LINE`  
`-po LINE_ADJ`  
`-po TRIANGLE`  
`-po TRIANGLE_ADJ`  
 Set the input primitive type for the geometry program

`-po POINT_OUT`  
`-po LINE_OUT`  
`-po TRIANGLE_OUT`  
 Set the output primitive type for the geometry program

`-po Vertices=N`  
 Set the number of vertices output by the geometry program

`gp4vp gpu_vp`  
 Targets the NV\_gpu\_program4 and NV\_vertex\_program4 OpenGL extensions.

`-po PosInv`  
 Generate position invariant code (same as fixed-function) for POSITION output

`hlslf hlslv`  
 Targets Microsoft High-Level Shading Language (HLSL). `hlslf` targets pixel programs while `hlslv` targets vertex programs

`ps_1_1 ps_1_2 ps_1_3`  
 Targets DirectX pixel programs

`-po MaxPixelShaderValue=N`  
 Maximum absolute value representable in a pixel shader. Default is 1.

`ps_2_0 ps_2_x`  
 Targets DirectX pixel programs

- po MaxDrawBuffers=*N*  
Set the maximum number of renderbuffer targets. Default is 1
- po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 96 or 512
- po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 12 or 32

**ps\_3\_0**

Targets DirectX pixel programs

- po MaxDrawBuffers=*N*  
Set the maximum number of renderbuffer targets. Default is 1
- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 224
- po NumInstructionSlots=*N*  
Sets the maximum number of instructions in the output program. Default is 32768
- po NumTemps=*N*  
Sets the maximum number of temporaries in the output program. Default is 32
- po OutColorPrec=*N*  
If *N* is 3 or 4, force output to fp16 precision. If *N* is 2, force output to fp32 precision.

**vp20**

Targets the NV\_vertex\_program OpenGL extension

- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 96
- po PosInv  
Generate position invariant code (same as fixed-function) for POSITION output

**vp30**

Targets the NV\_vertex\_program2 OpenGL extension

- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 256
- po PosInv  
Generate position invariant code (same as fixed-function) for POSITION output

**vp40**

Targets the NV\_vertex\_program3 OpenGL extension

- po MaxAddressRegs=*N*  
Sets the maximum number of ADDRESS registers in the output program. Default is 2
- po MaxInstructions=*N*  
Sets the maximum number of instructions in the output program. Default is 2048
- po MaxLocalParams=*N*  
Set the maximum number of uniform parameter slots available. Default is 544
- po NumTemps=*N*  
Sets the maximum number of TEMP registers in the output program. Default is 32
- po PosInv  
Generate position invariant code (same as fixed-function) for POSITION output

**vs\_1\_1**

Targets DirectX vertex programs

```

-po dcls
    Output dx9-style dcls statements

-po MaxLocalParams=N
    Set the maximum number of uniform parameter slots available. Default is 96

-po NumInstructionSlots=N
    Sets the maximum number of instructions in the output program. Default is 128

-po NumTemps=N
    Sets the maximum number of temporaries in the output program. Default is 12

vs_2_0 vs_2_x
    Targets DirectX vertex programs

-po dcls
    Output dx9-style dcls statements

-po MaxLocalParams=N
    Set the maximum number of uniform parameter slots available. Default is 256

-po NumInstructionSlots=N
    Sets the maximum number of instructions in the output program. Default is 256

-po NumTemps=N
    Sets the maximum number of temporaries in the output program. Default is 12

vs_3_0
    Targets DirectX vertex programs

-po dcls
    Output dx9-style dcls statements

-po MaxLocalParams=N
    Set the maximum number of uniform parameter slots available. Default is 256

-po NumInstructionSlots=N
    Sets the maximum number of instructions in the output program. Default is 32768

-po NumTemps=N
    Sets the maximum number of temporaries in the output program. Default is 32

```

**ENVIRONMENT****SEE ALSO**

Cg\_language, arbfp1, arbvpl, fp20, fp30, fp40, glslf, glslv, gp4fp, gp4gp, gp4vp, hlslf, hlslv, vp20, vp30, vp40

**NAME**

**cgfxcat** – dump a Cg FX file

**SYNOPSIS**

cgfxcat [-gl] f1 [f2...]

**DESCRIPTION**

**cgfxcat** attempts to exercise every query operation possible on a Cg effect file using the core Cg runtime. It prints its results to the standard output.

The source code for **cgfxcat** is found under examples/Tools/cgfxcat.

**OPTIONS**

**-gl** Register states using cgGLRegisterStates instead of the generic register state code built in to **cgfxcat**.

**fn** The Cg FX *file* (s) to be dumped.

**SEE ALSO**

Cg\_language, cgGLRegisterStates, cgCreateEffectFromFile

**NAME**

**cginfo** – print Cg library information

**SYNOPSIS**

**cginfo** [-help] [-profiles] [/path/to/library]

**DESCRIPTION**

**cginfo** will print a Cg library's version string to the standard output along with the path to the library from which the version was retrieved. The list of supported profiles can also be displayed.

The source code for **cginfo** is found under examples/Tools/cginfo. This example demonstrates how to load the Cg library and get the address of a symbol from the library for all of the platforms on which Cg is supported.

**OPTIONS**

-help

Print a description of the command line options understood by **cginfo** on the standard output.

-profiles

Also print a list of profiles supported by this library on the standard output. Note that the APIs to enumerate supported profiles were introduced in Cg 2.2. If the library being queried is 2.1 or earlier then this option will have no effect.

/path/to/library

Platform specific path the library to be queried. If no explicit library path is given the platform specific rules for finding shared libraries will be used to locate a copy of the Cg library to query.

**SEE ALSO**

Cg\_language

**NAME**

**cgAddStateEnumerant** – associates an integer enumerant value as a possible value for a state

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgAddStateEnumerant( CGstate state,
                          const char * name,
                          int value );
```

**PARAMETERS**

state     The state to which to associate the name and value.  
name     The name of the enumerant.  
value     The value of the enumerant.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgAddStateEnumerant** associates a given named integer enumerant value with a state definition. When that state is later used in a pass in an effect file, the value of the state assignment can optionally be given by providing a named enumerant defined with **cgAddStateEnumerant**. The state assignment will then take on the value provided when the enumerant was defined.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgAddStateEnumerant** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateState, cgCreateArrayState, cgCreateSamplerState, cgCreateArraySamplerState, cgGetStateName

**NAME**

**cgCallStateResetCallback** – calls the state resetting callback function for a state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgCallStateResetCallback( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment handle.

**RETURN VALUES**

Returns the boolean value returned by the callback function. It should be **CG\_TRUE** upon success.

Returns **CG\_TRUE** if no callback function was defined.

**DESCRIPTION**

**cgCallStateResetCallback** calls the graphics state resetting callback function for the given state assignment.

The semantics of “resetting state” will depend on the particular graphics state manager that defined the valid state assignments; it will generally either mean that graphics state is reset to what it was before the pass, or that it is reset to the default value. The OpenGL state manager in the OpenGL Cg runtime implements the latter approach.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgCallStateResetCallback** was introduced in Cg 1.4.

**SEE ALSO**

cgResetPassState, cgSetStateCallbacks, cgCallStateSetCallback, cgCallStateValidateCallback

**NAME**

**cgCallStateSetCallback** – calls the state setting callback function for a state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgCallStateSetCallback( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment handle.

**RETURN VALUES**

Returns the boolean value returned by the callback function. It should be **CG\_TRUE** upon success.

Returns **CG\_TRUE** if no callback function was defined.

**DESCRIPTION**

**cgCallStateSetCallback** calls the graphics state setting callback function for the given state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgCallStateSetCallback** was introduced in Cg 1.4.

**SEE ALSO**

cgSetPassState, cgSetStateCallbacks, cgCallStateResetCallback, cgCallStateValidateCallback



**NAME**

**cgCallStateValidateCallback** – calls the state validation callback function for a state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgCallStateValidateCallback( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment handle.

**RETURN VALUES**

Returns the boolean value returned by the validation function. It should be **CG\_TRUE** upon success.

Returns **CG\_TRUE** if no callback function was defined.

**DESCRIPTION**

**cgCallStateValidateCallback** calls the state validation callback function for the given state assignment. The validation callback will return **CG\_TRUE** or **CG\_FALSE** depending on whether the current hardware and driver support the graphics state set by the state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgCallStateValidateCallback** was introduced in Cg 1.4.

**SEE ALSO**

cgSetStateCallbacks, cgCallStateSetCallback, cgCallStateResetCallback

**NAME**

**cgCombinePrograms** – combine programs from different domains

**SYNOPSIS**

```
#include <Cg/cg.h>

CGprogram cgCombinePrograms( int n,
                             const CGprogram * exeList );
```

**PARAMETERS**

**n**           The number of program objects in **exeList**.

**exeList**    An array of two or more executable programs, each from a different domain.

**RETURN VALUES**

Returns a handle to the newly created program on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCombinePrograms** will take a set of **n** programs and combine them into a single **CGprogram**. This allows a single call to **BindProgram** (instead of a **BindProgram** for each individual program) and provides optimizations between the combined set of program inputs and outputs.

**EXAMPLES**

```
CGprogram p1 = cgCreateProgram(context, CG_SOURCE, vSrc, vProfile,
                               vEntryName, NULL);
CGprogram p2 = cgCreateProgram(context, CG_SOURCE, fSrc, fProfile,
                               fEntryName, NULL);

CGprogram programs[] = {p1, p2};
CGprogram combined = cgCombinePrograms(2, programs);

cgDestroyProgram(p1);
cgDestroyProgram(p2);

cgGLBindProgram(combined); /* Assuming cgGL runtime */

/* Render... */
```

**ERRORS**

**CG\_INVALID\_DIMENSION\_ERROR** is generated if **n** less than or equal to 1 or **n** is greater than 3.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **exeList** is **NULL**.

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if one of the programs in **exeList** is invalid.

The errors listed in **cgCreateProgram** might also be generated.

**HISTORY**

**cgCombinePrograms** was introduced in Cg 1.5.

**SEE ALSO**

**cgCombinePrograms2**,       **cgCombinePrograms3**,       **cgCreateProgram**,       **cgGLBindProgram**,  
**cgD3D9BindProgram**, **cgD3D8BindProgram**

**NAME**

**cgCombinePrograms2** – combine programs from two different domains

**SYNOPSIS**

```
#include <Cg/cg.h>

CGprogram cgCombinePrograms2( const CGprogram program1,
                             const CGprogram program2 );
```

**PARAMETERS**

**program1**  
An executable program from one domain.

**program2**  
An executable program from a different domain.

**RETURN VALUES**

Returns a handle to the newly created program on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCombinePrograms2** takes two programs from different domains and combines them into a single **CGprogram**. This is a convenience function for **cgCombinePrograms**.

**EXAMPLES**

```
CGprogram p1 = cgCreateProgram(context, CG_SOURCE, vSrc, vProfile,
                               vEntryName, NULL);
CGprogram p2 = cgCreateProgram(context, CG_SOURCE, fSrc, fProfile,
                               fEntryName, NULL);

CGprogram combined = cgCombinePrograms2(p1, p2);

cgDestroyProgram(p1);
cgDestroyProgram(p2);

cgGLBindProgram(combined); /* Assuming cgGL runtime */

/* Render... */
```

**ERRORS**

The errors listed in **cgCombinePrograms** might be generated.

**HISTORY**

**cgCombinePrograms2** was introduced in Cg 1.5.

**SEE ALSO**

**cgCombinePrograms**, **cgCombinePrograms3**

**NAME**

**cgCombinePrograms3** – combine programs from three different domains

**SYNOPSIS**

```
#include <Cg/cg.h>

CGprogram cgCombinePrograms3( const CGprogram program1,
                             const CGprogram program2,
                             const CGprogram program3 );
```

**PARAMETERS**

program1  
An executable program from one domain.

program2  
An executable program from a second domain.

program3  
An executable program from a third domain.

**RETURN VALUES**

Returns a handle to the newly created program on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCombinePrograms3** takes three programs from different domains and combines them into a single **CGprogram**. This is a convenience function for **cgCombinePrograms**.

**EXAMPLES**

```
CGprogram p1 = cgCreateProgram(context, CG_SOURCE, vSrc, vProfile,
                               vEntryName, NULL);
CGprogram p2 = cgCreateProgram(context, CG_SOURCE, fSrc, fProfile,
                               fEntryName, NULL);
CGprogram p3 = cgCreateProgram(context, CG_SOURCE, gSrc, gProfile,
                               gEntryName, NULL);

CGprogram combined = cgCombinePrograms3(p1, p2, p3);

cgDestroyProgram(p1);
cgDestroyProgram(p2);
cgDestroyProgram(p3);

cgGLBindProgram(combined); /* Assuming cgGL runtime */

/* Render... */
```

**ERRORS**

The errors listed in **cgCombinePrograms** might be generated.

**HISTORY**

**cgCombinePrograms3** was introduced in Cg 1.5.

**SEE ALSO**

**cgCombinePrograms**, **cgCombinePrograms2**

**NAME**

**cgCompileProgram** – compile a program object

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgCompileProgram( CGprogram program );
```

**PARAMETERS**

**program** The program object to compile.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgCompileProgram** compiles the specified Cg program for its target profile. A program must be compiled before it can be loaded (by the API-specific part of the runtime). It must also be compiled before its parameters can be inspected.

The compiled program can be retrieved as a text string by passing **CG\_COMPILED\_PROGRAM** to **cgGetProgramString**.

Certain actions invalidate a compiled program and the current value of all of its parameters. If one of these actions is performed, the program must be recompiled before it can be used. A program is invalidated if the program source is modified, if the compile arguments are modified, or if the entry point is changed.

If one of the parameter bindings for a program is changed, that action invalidates the compiled program, but does not invalidate the current value of the program's parameters.

**EXAMPLES**

```
if( !cgIsProgramCompiled(program) )  
    cgCompileProgram(program);
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

**HISTORY**

**cgCompileProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgIsProgramCompiled**, **cgCreateProgram**, **cgGetNextParameter**, **cgIsParameter**, **cgGetProgramString**

**NAME****cgConnectParameter** – connect two parameters**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgConnectParameter( CGparameter from,
                        CGparameter to );
```

**PARAMETERS**

from     The source parameter.

to       The destination parameter.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgConnectParameter** connects a source (from) parameter to a destination (to) parameter. The resulting connection forces the value and variability of the destination parameter to be identical to the source parameter. A source parameter may be connected to multiple destination parameters but there may only be one source parameter per destination parameter.

**cgConnectParameter** may be used to create an arbitrarily deep tree. A runtime error will be thrown if a cycle is inadvertently created. For example, the following code snippet would generate a **CG\_BIND\_CREATES\_CYCLE\_ERROR**:

```
CGcontext context = cgCreateContext();
CGparameter Param1 = cgCreateParameter(context, CG_FLOAT);
CGparameter Param2 = cgCreateParameter(context, CG_FLOAT);
CGparameter Param3 = cgCreateParameter(context, CG_FLOAT);

cgConnectParameter(Param1, Param2);
cgConnectParameter(Param2, Param3);
cgConnectParameter(Param3, Param1); /* This will generate the error */
```

If the source type is a complex type (e.g., struct, or array) the topology and member types of both parameters must be identical. Each correlating member parameter will be connected.

Both parameters must be of the same type unless the source parameter is a struct type, the destination parameter is an interface type, and the struct type implements the interface type. In such a case, a copy of the parameter tree under the source parameter will be duplicated, linked to the original tree, and placed under the destination parameter.

If an array parameter is connected to a resizable array parameter the destination parameter array will automatically be resized to match the source array.

The source parameter may not be a program parameter. Also the variability of the parameters may not be **CG\_VARYING**.

**EXAMPLES**

```
CGparameter TimeParam1 = cgGetNamedParameter(program1, "time");
CGparameter TimeParam2 = cgGetNamedParameter(program2, "time");
CGparameter SharedTime = cgCreateParameter(context,
                                           cgGetParameterType(TimeParam1));

cgConnectParameter(SharedTime, TimeParam1);
cgConnectParameter(SharedTime, TimeParam2);
```

```
cgSetParameter1f(SharedTime, 2.0);
```

## ERRORS

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if either of the **from** or **to** parameters are invalid handles.

**CG\_PARAMETER\_IS\_NOT\_SHARED\_ERROR** is generated if the source parameter is a program parameter.

**CG\_BIND\_CREATES\_CYCLE\_ERROR** is generated if the connection will result in a cycle.

**CG\_PARAMETERS\_DO\_NOT\_MATCH\_ERROR** is generated if the parameters do not have the same type or the topologies do not match.

**CG\_ARRAY\_TYPES\_DO\_NOT\_MATCH\_ERROR** is generated if the type of two arrays being connected do not match.

**CG\_ARRAY\_DIMENSIONS\_DO\_NOT\_MATCH\_ERROR** is generated if the dimensions of two arrays being connected do not match.

## HISTORY

**cgConnectParameter** was introduced in Cg 1.2.

## SEE ALSO

cgGetConnectedParameter, cgGetConnectedToParameter, cgDisconnectParameter

**NAME**

**cgCopyEffect** – make a copy of an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgCopyEffect( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect object to be copied.

**RETURN VALUES**

Returns a copy of **effect** on success.

Returns **NULL** if **effect** is invalid or the copy fails.

**DESCRIPTION**

**cgCopyEffect** creates a new effect object that is a copy of **effect** and adds it to the same context as **effect**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgCopyEffect** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile, cgDestroyEffect



**NAME**

**cgCopyProgram** – make a copy of a program object

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgCopyProgram( CGprogram program );
```

**PARAMETERS**

**program** The program object to copy.

**RETURN VALUES**

Returns a copy of **program** on success.

Returns **NULL** if **program** is invalid or the copy fails.

**DESCRIPTION**

**cgCopyProgram** creates a new program object that is a copy of **program** and adds it to the same context as **program**. **cgCopyProgram** is useful for creating a new instance of a program whose parameter properties have been modified by the run-time API.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgCopyProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgDestroyProgram

**NAME**

**cgCreateArraySamplerState** – create an array-typed sampler state definition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgCreateArraySamplerState( CGcontext context,  
                                   const char * name,  
                                   CGtype type,  
                                   int nelements );
```

**PARAMETERS**

context     The context in which to define the sampler state.  
name        The name of the new sampler state.  
type        The type of the new sampler state.  
nelements   The number of elements in the array.

**RETURN VALUES**

Returns a handle to the newly created **CGstate**.

Returns **NULL** if there is an error.

**DESCRIPTION**

**cgCreateArraySamplerState** adds a new array-typed sampler state definition to **context**. All state in **sampler\_state** blocks must have been defined ahead of time via a call to **cgCreateSamplerState** or **cgCreateArraySamplerState** before adding an effect file to the context.

Applications will typically call **cgSetStateCallbacks** shortly after creating a new state with **cgCreateArraySamplerState**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL** or not a valid identifier, if **type** is not a simple scalar, vector, or matrix-type, or if **nelements** is not a positive number.

**HISTORY**

**cgCreateArraySamplerState** was introduced in Cg 1.4.

**SEE ALSO**

**cgCreateSamplerState**,    **cgGetStateName**,    **cgGetStateType**,    **cgIsState**,    **cgSetStateCallbacks**,  
**cgGLRegisterStates**

**NAME**

**cgCreateArrayState** – create an array-typed state definition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgCreateArrayState( CGcontext context,  
                           const char * name,  
                           CGtype type,  
                           int nelements );
```

**PARAMETERS**

context     The context in which to define the state.  
name        The name of the new state.  
type        The type of the new state.  
nelements   The number of elements in the array.

**RETURN VALUES**

Returns a handle to the newly created **CGstate**.

Returns **NULL** if there is an error.

**DESCRIPTION**

**cgCreateArrayState** adds a new array-typed state definition to **context**. Before a CgFX file is added to a context, all state assignments in the file must have previously been defined via a call to **cgCreateState** or **cgCreateArrayState**.

Applications will typically call **cgSetStateCallbacks** shortly after creating a new state with **cgCreateArrayState**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL** or not a valid identifier, if **type** is not a simple scalar, vector, or matrix-type, or if **nelements** is not a positive number.

**HISTORY**

**cgCreateArrayState** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetStateContext**, **cgGetStateName**, **cgGetStateType**, **cgIsState**, **cgSetStateCallbacks**, **cgGLRegisterStates**

**NAME**

**cgCreateBuffer** – create a buffer object managed by the runtime

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbuffer cgCreateBuffer( CGcontext context,
                        int size,
                        const void *data,
                        CGbufferusage bufferUsage );
```

**PARAMETERS**

context    The context to which the new buffer will be added.

size       The length in bytes of the buffer to create.

data       Pointer to initial buffer data. NULL will fill the buffer with zero.

bufferUsage  
Indicates the intended usage method of the buffer.

Can be one of the following types:

- **CG\_BUFFER\_USAGE\_STREAM\_DRAW**
- **CG\_BUFFER\_USAGE\_STREAM\_READ**
- **CG\_BUFFER\_USAGE\_STREAM\_COPY**
- **CG\_BUFFER\_USAGE\_STATIC\_DRAW**
- **CG\_BUFFER\_USAGE\_STATIC\_READ**
- **CG\_BUFFER\_USAGE\_STATIC\_COPY**
- **CG\_BUFFER\_USAGE\_DYNAMIC\_DRAW**
- **CG\_BUFFER\_USAGE\_DYNAMIC\_READ**
- **CG\_BUFFER\_USAGE\_DYNAMIC\_COPY**

**RETURN VALUES**

Returns a **CGbuffer** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateBuffer** creates a runtime managed Cg buffer object.

There is no way to query the 3D API-specific resource for a managed buffer. **cgGLCreateBuffer** should be used if the application wishes to later query the 3D API-specific resource for the buffer.

**EXAMPLES**

```
CGbuffer myBuffer = cgCreateBuffer( myCgContext, sizeof( float ) * 16,
                                   initialData, CG_BUFFER_USAGE_STATIC_DRAW );
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgCreateBuffer** was introduced in Cg 2.0.

**SEE ALSO**

**cgGLCreateBuffer**, **cgDestroyBuffer**

**NAME**

**cgCreateContext** – create a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGcontext cgCreateContext( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns a valid **CGcontext** on success.

Returns **NULL** if context creation fails.

**DESCRIPTION**

**cgCreateContext** creates a Cg context object and returns its handle. A Cg context is a container for Cg programs. All Cg programs must be added to a Cg context.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_MEMORY\_ALLOC\_ERROR** is generated if a context couldn't be created.

**HISTORY**

**cgCreateContext** was introduced in Cg 1.1.

**SEE ALSO**

cgDestroyContext, cgCreateProgram, cgCreateEffect, cgCreateState

## NAME

**cgCreateEffect** – create an effect object from a source string

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGeffect cgCreateEffect( CGcontext context,  
                        const char * source,  
                        const char ** args );
```

## PARAMETERS

context The context to which the new effect will be added.

source A string containing the effect's source code.

args If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

## RETURN VALUES

Returns a **CGeffect** handle on success.

Returns **NULL** if an error occurs.

## DESCRIPTION

**cgCreateEffect** generates a new **CGeffect** object and adds it to the specified Cg context.

If an error occurs **cgGetLastListing** can be called to retrieve any warning or error messages from the compilation process.

## EXAMPLES

Creating an effect:

```
char *effectSource = ...;  
CGcontext context = cgCreateContext();  
CGeffect effect = cgCreateEffect(context,  
                                effectSource,  
                                NULL);
```

Iterating through the techniques in an effect:

```
CGtechnique technique = cgGetFirstTechnique(effect);  
while (technique) {  
    // Do something with each technique  
    technique = cgGetNextTechnique(technique);  
}
```

## ERRORS

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

## HISTORY

**cgCreateEffect** was introduced in Cg 1.4.

## SEE ALSO

**cgCreateContext**, **cgCreateEffectFromFile**, **cgGetLastListing**, **cgGetFirstTechnique**, **cgGetTechniqueEffect**, **cgGetFirstEffect**

**NAME**

**cgCreateEffectAnnotation** – create an effect annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgCreateEffectAnnotation( CGeffect effect,
                                       const char * name,
                                       CGtype type );
```

**PARAMETERS**

**effect**     The effect to which the new annotation will be added.

**name**       The name of the new annotation.

**type**       The type of the new annotation.

**RETURN VALUES**

Returns the new **CGannotation** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateEffectAnnotation** adds a new annotation to the effect.

**EXAMPLES**

```
/* create a float annotation named "Apple" for CGeffect effect */
CGannotation ann = cgCreateEffectAnnotation( effect, "Apple", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_DUPLICATE\_NAME\_ERROR** is generated if **name** is already used by an annotation for this effect.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **type** is not **CG\_INT**, **CG\_FLOAT**, **CG\_BOOL**, or **CG\_STRING**.

**HISTORY**

**cgCreateEffectAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedEffectAnnotation, cgGetFirstEffectAnnotation, cgGetNextAnnotation

**NAME**

**cgCreateEffectFromFile** – create an effect object from a file

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgCreateEffectFromFile( CGcontext context,  
                                const char * filename,  
                                const char ** args );
```

**PARAMETERS**

context The context to which the new effect will be added.

filename Name of a file that contains the effect's source code.

args If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGeffect** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateEffectFromFile** generates a new **CGeffect** object and adds it to the specified Cg context.

If an error occurs **cgGetLastListing** can be called to retrieve any warning or error messages from the compilation process.

**EXAMPLES**

```
CGcontext context = cgCreateContext();  
CGeffect effect = cgCreateEffectFromFile(context, "filename.cgfx", NULL);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_FILE\_READ\_ERROR** is generated if the given filename cannot be read.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

**HISTORY**

**cgCreateEffectFromFile** was introduced in Cg 1.4.

**SEE ALSO**

**cgCreateContext**, **cgCreateEffect**, **cgGetLastListing**, **cgGetTechniqueEffect**, **cgGetEffectName**, **cgSetEffectName**, **cgCreateEffectAnnotation**, **cgDestroyEffect**, **cgGetFirstEffect**



**NAME**

**cgCreateEffectParameter** – create a parameter in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateEffectParameter( CGeffect effect,  
                                     const char * name,  
                                     CGtype type );
```

**PARAMETERS**

**effect**     The effect to which the new parameter will be added.

**name**     The name of the new parameter.

**type**     The type of the new parameter.

**RETURN VALUES**

Returns the handle to the new parameter.

**DESCRIPTION**

**cgCreateEffectParameter** adds a new parameter to the specified effect.

**EXAMPLES**

```
CGeffect effect = cgCreateEffect( ... );  
CGparameter param = cgCreateEffectParameter( effect, "myFloatParam", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**HISTORY**

**cgCreateEffectParameter** was introduced in Cg 1.5.

**SEE ALSO**

cgIsParameter, cgCreateEffectParameterArray, cgCreateEffectParameterMultiDimArray,  
cgCreateTechnique, cgCreatePass, cgConnectParameter

**NAME**

**cgCreateEffectParameterArray** – create an array parameter in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateEffectParameterArray( CGeffect effect,
                                           const char * name,
                                           CGtype type,
                                           int length );
```

**PARAMETERS**

**effect**     The effect to which the new parameter will be added.  
**name**     The name of the new parameter.  
**type**     The type of the new parameter.  
**length**    The size of the array.

**RETURN VALUES**

Returns the handle to the new array parameter on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateEffectParameterArray** adds a new array parameter to the specified effect.

**EXAMPLES**

```
CGeffect effect = cgCreateEffect( ... );
CGparameter array = cgCreateEffectParameterArray( effect, "myFloatArray",
                                                  CG_FLOAT, 2 );
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**HISTORY**

**cgCreateEffectParameterArray** was introduced in Cg 1.5.

**SEE ALSO**

cgCreateEffectParameter, cgCreateEffectParameterMultiDimArray

**NAME**

**cgCreateEffectParameterMultiDimArray** – create a multi-dimensional array in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateEffectParameterMultiDimArray( CGeffect effect,
                                                    const char * name,
                                                    CGtype type,
                                                    int dim,
                                                    const int * lengths );
```

**PARAMETERS**

**effect** The effect to which the new parameter will be added.

**name** The name of the new parameter.

**type** The type of the new parameter.

**dim** The dimension of the array.

**lengths** The sizes for each dimension of the array.

**RETURN VALUES**

Returns the handle of the new parameter on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateEffectParameterMultiDimArray** adds a new multidimensional array parameter to the specified effect.

**EXAMPLES**

```
CGeffect effect = cgCreateEffect( ... );
int lengths[] = {2,2};
CGparameter array = cgCreateEffectParameterMultiDimArray(effect,
                                                           "myFloatMultiArray", CG_FLOAT, 2, lengths);
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**HISTORY**

**cgCreateEffectParameterMultiDimArray** was introduced in Cg 1.5.

**SEE ALSO**

cgCreateEffectParameter, cgCreateEffectParameterArray

**NAME**

**cgCreateObj** – create a cg object type from a shader string

**SYNOPSIS**

```
#include <Cg/cg.h>

CGobj cgCreateObj( CGcontext context,
                  CGenum program_type,
                  const char * source,
                  CGprofile profile,
                  const char ** args );
```

**PARAMETERS**

**context** The context to which the new object will be added.

**program\_type**

An enumerator describing the contents of the **source** string. The following enumerants are allowed:

**CG\_SOURCE**

**source** contains Cg source code.

**CG\_OBJECT**

**source** contains object code that resulted from the precompilation of some Cg source code.

**source** A string containing either the programs source or object code. See **program\_type** for more information.

**profile** The profile enumerator for the program.

**args** If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGobj** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateObj** creates a new **CGobj** which is a source code object similar to a .obj or .o in C/C++ programming where various forms of data can be extracted. This can be used, for example, to create user defined data types from a Cg source string.

**EXAMPLES**

```
// Imagine a Cg source string that contains:

const char src[] =
    "typedef struct { \n"
    " float3 param1; \n"
    " half4 param2; \n"
    "} MyType;";

// To create a Cg obj:

CGcontext ctx = cgCreateContext();
CGobj structObj = cgCreateObj(ctx, CG_SOURCE, src, CG_PROFILE_ARBVP1, NULL);

// Now we can get the CGtype:

CGtype userDefinedMyType = cgGetNamedUserType(structObj, "MyType");
```

```
// We could also iterate through all the types in the CGobj printing their
// names like this:

int numTypes = cgGetNumUserTypes(structObj);
for (int i=0; i<numTypes; i++) {
    cout << cgGetTypeString(cgGetUserType(structObj, i)) << endl;
}
```

## ERRORS

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **program\_type** is not **CG\_SOURCE** or **CG\_OBJECT**.

**CG\_UNKNOWN\_PROFILE\_ERROR** is generated if **profile** is not a supported profile.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

## HISTORY

**cgCreateObj** was introduced in Cg 2.0.

## SEE ALSO

cgCreateObjFromFile, cgDestroyObj

**NAME**

**cgCreateObjFromFile** – create a cg object type from a shader file

**SYNOPSIS**

```
#include <Cg/cg.h>

CGobj cgCreateObjFromFile( CGcontext context,
                           CGenum program_type,
                           const char * source_file,
                           CGprofile profile,
                           const char ** args );
```

**PARAMETERS**

**context** The context to which the new object will be added.

**program\_type**

An enumerator describing the contents of the **source** string. The following enumerants are allowed:

**CG\_SOURCE**

**source** contains Cg source code.

**CG\_OBJECT**

**source** contains object code that resulted from the precompilation of some Cg source code.

**source\_file**

Name of a file containing source or object code. See **program\_type** for more information.

**profile** The profile enumerator for the program.

**args** If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGobj** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateObjFromFile** creates a new **CGobj** which is a source code object similar to a .obj or .o in C/C++ programming where various forms of data can be extracted. This can be used, for example, to create user defined data types from a Cg source string.

**EXAMPLES**

```
// To create a Cg obj:

CGcontext ctx = cgCreateContext();
CGobj structObj = cgCreateObjFromFile(ctx, CG_SOURCE, source_file,
                                     CG_PROFILE_ARBVP1, NULL);

// Now we can get the CGtype:

CGtype userDefinedMyType = cgGetNamedUserType(structObj, "MyType");

// We could also iterate through all the types in the CGobj printing
// their names like this:
```

```
int numTypes = cgGetNumUserTypes(structObj);  
for (int i=0; i<numTypes; i++) {  
    cout << cgGetTypeString(cgGetUserType(structObj, i)) << endl;  
}
```

## ERRORS

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **program\_type** is not **CG\_SOURCE** or **CG\_OBJECT**.

**CG\_UNKNOWN\_PROFILE\_ERROR** is generated if **profile** is not a supported profile.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

## HISTORY

**cgCreateObjFromFile** was introduced in Cg 2.0.

## SEE ALSO

cgCreateObj, cgDestroyObj

**NAME**

**cgCreateParameter** – create a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateParameter( CGcontext context,  
                               CGtype type );
```

**PARAMETERS**

context    The context to which the new parameter will be added.

type       The type of the new parameter.

**RETURN VALUES**

Returns the handle to the new parameter.

**DESCRIPTION**

**cgCreateParameter** creates context level shared parameters. These parameters are primarily used by connecting them to one or more program parameters with **cgConnectParameter**.

**EXAMPLES**

```
CGcontext context = cgCreateContext();  
CGparameter param = cgCreateParameter(context, CG_FLOAT);
```

**ERRORS**

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgCreateParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgCreateParameterArray**, **cgCreateParameterMultiDimArray**, **cgCreateEffectParameter**,  
**cgDestroyParameter**, **cgConnectParameter**



**NAME**

**cgCreateParameterAnnotation** – create an annotation in a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgCreateParameterAnnotation( CGparameter param,  
                                          const char * name,  
                                          CGtype type );
```

**PARAMETERS**

**parm**     The parameter to which the new annotation will be added.  
**name**     The name of the new annotation.  
**type**     The type of the new annotation.

**RETURN VALUES**

Returns the new **CGannotation** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateParameterAnnotation** adds a new annotation to the specified parameter.

**EXAMPLES**

```
CGannotation ann = cgCreateParameterAnnotation( param, "Apple", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_DUPLICATE\_NAME\_ERROR** is generated if **name** is already used by an annotation for this parameter.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **type** is not **CG\_INT**, **CG\_FLOAT**, **CG\_BOOL**, or **CG\_STRING**.

**HISTORY**

**cgCreateParameterAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedParameterAnnotation, cgGetFirstParameterAnnotation, cgGetNextAnnotation

**NAME**

**cgCreateParameterArray** – creates a parameter array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateParameterArray( CGcontext context,  
                                     CGtype type,  
                                     int length );
```

**PARAMETERS**

context    The context to which the new parameter will be added.

type       The type of the new parameter.

length    The length of the array being created.

**RETURN VALUES**

Returns the handle to the new parameter array.

**DESCRIPTION**

**cgCreateParameterArray** creates context level shared parameter arrays. These parameters are primarily used by connecting them to one or more program parameter arrays with **cgConnectParameter**.

**cgCreateParameterArray** works similarly to **cgCreateParameter**, but creates an array of parameters rather than a single parameter.

**EXAMPLES**

```
CGcontext context = cgCreateContext();  
CGparameter param = cgCreateParameterArray(context, CG_FLOAT, 5);
```

**ERRORS**

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgCreateParameterArray** was introduced in Cg 1.2.

**SEE ALSO**

**cgCreateParameter**, **cgCreateParameterMultiDimArray**, **cgDestroyParameter**

**NAME**

**cgCreateParameterMultiDimArray** – creates a multi-dimensional parameter array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgCreateParameterMultiDimArray( CGcontext context,
                                             CGtype type,
                                             int dim,
                                             const int * lengths );
```

**PARAMETERS**

**context** The context to which the new parameter will be added.

**type** The type of the new parameter.

**dim** The dimension of the multi-dimensional array.

**lengths** An array of length values, one for each dimension of the array to be created.

**RETURN VALUES**

Returns the handle to the new parameter array.

**DESCRIPTION**

**cgCreateParameterMultiDimArray** creates context level shared multi-dimensional parameter arrays. These parameters are primarily used by connecting them to one or more program parameter arrays with **cgConnectParameter**.

**cgCreateParameterMultiDimArray** works similarly to **cgCreateParameterArray**. Instead of taking a single length parameter it takes an array of lengths, one per dimension. The dimension of the array is defined by the **dim** parameter.

**EXAMPLES**

```
/* Creates a three dimensional float array similar to */
/* the C declaration : float param[5][3][4]; */

int lengths[] = { 5, 3, 4 };
CGcontext context = cgCreateContext();
CGparameter param = cgCreateParameterMultiDimArray(context, CG_FLOAT,
                                                    3, lengths);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_VALUE\_TYPE\_ERROR** is generated if **type** is invalid.

**HISTORY**

**cgCreateParameterMultiDimArray** was introduced in Cg 1.2.

**SEE ALSO**

**cgCreateParameter**, **cgCreateParameterArray**, **cgDestroyParameter**, **cgConnectParameter**

**NAME**

**cgCreatePass** – create a pass in a technique

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGpass cgCreatePass( CGtechnique tech,  
                    const char * name );
```

**PARAMETERS**

tech      The technique to which the new pass will be added.

name      The name of the new pass.

**RETURN VALUES**

Returns the handle to the new pass on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreatePass** adds a new pass to the specified technique.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgCreatePass** was introduced in Cg 1.5.

**SEE ALSO**

cgCreateTechnique

**NAME**

**cgCreatePassAnnotation** – create an annotation in a pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgCreatePassAnnotation( CGpass pass,
                                     const char * name,
                                     CGtype type );
```

**PARAMETERS**

**pass**      The pass to which the new annotation will be added.  
**name**      The name of the new annotation.  
**type**      The type of the new annotation.

**RETURN VALUES**

Returns the new **CGannotation** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreatePassAnnotation** adds a new annotation to a pass.

**EXAMPLES**

```
/* create a float annotation named "Apple" for CGpass pass */
CGannotation ann = cgCreatePassAnnotation( pass, "Apple", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_DUPLICATE\_NAME\_ERROR** is generated if **name** is already used by an annotation for this pass.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **type** is not **CG\_INT**, **CG\_FLOAT**, **CG\_BOOL**, or **CG\_STRING**.

**HISTORY**

**cgCreatePassAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedPassAnnotation, cgGetFirstPassAnnotation, cgGetNextAnnotation

**NAME**

**cgCreateProgram** – create a program object from a string

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgCreateProgram( CGcontext context,
                           CGenum program_type,
                           const char * program,
                           CGprofile profile,
                           const char * entry,
                           const char ** args );
```

**PARAMETERS**

**context** The context to which the new program will be added.

**program\_type**

An enumerant describing the contents of the **program** string. The following enumerants are allowed:

**CG\_SOURCE**

**program** contains Cg source code.

**CG\_OBJECT**

**program** contains object code that resulted from the precompilation of some Cg source code.

**program** A string containing either the programs source or object code. See **program\_type** for more information.

**profile** The profile enumerant for the program.

**entry** The entry point to the program in the Cg source. If **NULL**, the entry point defaults to "**main**".

**args** If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGprogram** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

cgCreateProgram generates a new **CGprogram** object and adds it to the specified Cg context.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGprogram program = cgCreateProgram(context,
                                     CG_SOURCE,
                                     mysourcestring,
                                     CG_PROFILE_ARBVP1,
                                     "myshader",
                                     NULL);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **program\_type** is not **CG\_SOURCE** or **CG\_OBJECT**.

**CG\_UNKNOWN\_PROFILE\_ERROR** is generated if **profile** is not a supported profile.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

**HISTORY**

**cgCreateProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateContext, cgCreateProgramFromFile, cgDestroyProgram, cgGetProgramString

**NAME**

**cgCreateProgramAnnotation** – create an annotation in a program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgCreateProgramAnnotation( CGprogram program,  
                                         const char * name,  
                                         CGtype type );
```

**PARAMETERS**

**program** The program to which the new annotation will be added.

**name** The name of the new annotation.

**type** The type of the new annotation.

**RETURN VALUES**

Returns the new **CGannotation** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateProgramAnnotation** adds a new annotation to a program.

**EXAMPLES**

```
/* create a float annotation named "Apple" for CGprogram prog */  
CGannotation ann = cgCreateProgramAnnotation( prog, "Apple", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_DUPLICATE\_NAME\_ERROR** is generated if **name** is already used by an annotation for this program.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **type** is not **CG\_INT**, **CG\_FLOAT**, **CG\_BOOL**, or **CG\_STRING**.

**HISTORY**

**cgCreateProgramAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedProgramAnnotation, cgGetFirstProgramAnnotation, cgGetNextAnnotation



**NAME**

**cgCreateProgramFromEffect** – create a program object from an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgCreateProgramFromEffect( CGeffect effect,
                                     CGprofile profile,
                                     const char * entry,
                                     const char ** args );
```

**PARAMETERS**

**effect**     The effect containing the program source code from which to create the program.

**profile**    The profile enumerator for the program.

**entry**     The entry point to the program in the Cg source. If **NULL**, the entry point defaults to "**main**".

**args**      If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGprogram** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateProgramFromEffect** generates a new **CGprogram** object and adds it to the effect's Cg context.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_UNKNOWN\_PROFILE\_ERROR** is generated if **profile** is not a supported profile.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

**HISTORY**

**cgCreateProgramFromEffect** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateProgram, cgCreateProgramFromFile

**NAME**

**cgCreateProgramFromFile** – create a program object from a file

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgCreateProgramFromFile( CGcontext context,
                                   CGenum program_type,
                                   const char * program_file,
                                   CGprofile profile,
                                   const char * entry,
                                   const char ** args );
```

**PARAMETERS**

**context** The context to which the new program will be added.

**program\_type**

An enumerant describing the contents of the **program\_file**. The following enumerants are allowed:

**CG\_SOURCE**

**program\_file** contains Cg source code.

**CG\_OBJECT**

**program\_file** contains object code that resulted from the precompilation of some Cg source code.

**program\_file**

Name of a file containing source or object code. See **program\_type** for more information.

**profile** The profile enumerant for the program.

**entry** The entry point to the program in the Cg source. If **NULL**, the entry point defaults to **"main"**.

**args** If **args** is not **NULL** it is assumed to be an array of NULL-terminated strings that will be passed directly to the compiler as arguments. The last value of the array must be a **NULL**.

**RETURN VALUES**

Returns a **CGprogram** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateProgramFromFile** generates a new **CGprogram** object and adds it to the specified Cg context.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGprogram program = cgCreateProgramFromFile(context,
                                             CG_SOURCE,
                                             mysourcefilename,
                                             CG_PROFILE_ARBVP1,
                                             "myshader",
                                             NULL);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **program\_type** is not **CG\_SOURCE** or **CG\_OBJECT**.

**CG\_UNKNOWN\_PROFILE\_ERROR** is generated if **profile** is not a supported profile.

**CG\_COMPILER\_ERROR** is generated if compilation fails.

**HISTORY**

**cgCreateProgramFromFile** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateContext, cgCreateProgram, cgCreateProgramFromEffect, cgGetProgramString

**NAME**

**cgCreateSamplerState** – create a sampler state definition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgCreateSamplerState( CGcontext context,  
                             const char * name,  
                             CGtype type );
```

**PARAMETERS**

context    The context in which to define the new sampler state.

name       The name of the new sampler state.

type       The type of the new sampler state.

**RETURN VALUES**

Returns a handle to the newly created **CGstate**.

Returns **NULL** if there is an error.

**DESCRIPTION**

**cgCreateSamplerState** adds a new sampler state definition to the context. When an effect file is added to the context, all state in **sampler\_state** blocks must have already been defined via a call to **cgCreateSamplerState** or **cgCreateArraySamplerState**.

Applications will typically call **cgSetStateCallbacks** shortly after creating a new state with **cgCreateSamplerState**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL** or not a valid identifier, or if **type** is not a simple scalar, vector, or matrix-type. Array-typed state should be created with **cgCreateArrayState**.

**HISTORY**

**cgCreateSamplerState** was introduced in Cg 1.4.

**SEE ALSO**

**cgCreateArraySamplerState**, **cgGetStateName**, **cgGetStateType**, **cgIsState**,  
**cgCreateSamplerStateAssignment**, **cgGLRegisterStates**

**NAME**

**cgCreateSamplerStateAssignment** – create a sampler state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgCreateSamplerStateAssignment( CGparameter param,  
                                                  CGstate state );
```

**PARAMETERS**

param     The sampler parameter to which the new state assignment will be associated.

state     The state for which to create the new state assignment.

**RETURN VALUES**

Returns the handle to the created sampler state assignment.

**DESCRIPTION**

**cgCreateSamplerStateAssignment** creates a new state assignment for the given state and sampler parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgCreateSamplerStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgCreateTechnique, cgCreateStateAssignment, cgCreateSamplerState

**NAME****cgCreateState** – create a state definition**SYNOPSIS**

```
#include <Cg/cg.h>

CGstate cgCreateState( CGcontext context,
                      const char * name,
                      CGtype type );
```

**PARAMETERS**

context    The context in which to define the new state.

name       The name of the new state.

type       The type of the new state.

**RETURN VALUES**

Returns a handle to the newly created **CGstate**.

Returns **NULL** if there is an error.

**DESCRIPTION**

**cgCreateState** adds a new state definition to the context. When a CgFX file is added to the context, all state assignments in the file must have already been defined via a call to **cgCreateState** or **cgCreateArrayState**.

Applications will typically call **cgSetStateCallbacks** shortly after creating a new state with **cgCreateState**.

**EXAMPLES**

Example callback functions for a state to register:

```
CGbool foo_set( CGstateassignment sa )
{
    int nVals = 0;
    const CGbool *val = cgGetBoolStateAssignmentValues( sa, &nVals );
    printf( "\nFooState set called with value %d.\n", *val );
    return CG_TRUE;
}

CGbool foo_reset( CGstateassignment sa )
{
    printf( "\nFooState reset called.\n" );
    return CG_TRUE;
}

CGbool foo_validate( CGstateassignment sa )
{
    printf( "FooState validate called.\n" );
    return CG_TRUE;
}
```

Registering the state:

```
// Create and register new state FooState
CGstate fooState = cgCreateState( myCgContext, "FooState", CG_BOOL );
cgSetStateCallbacks( fooState, foo_set, foo_reset, foo_validate );
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL** or not a valid identifier, or if **type** is not a simple scalar, vector, or matrix-type. Array-typed state should be created with `cgCreateArrayState`.

**HISTORY**

**cgCreateState** was introduced in Cg 1.4.

**SEE ALSO**

`cgCreateArrayState`, `cgGetStateContext`, `cgGetStateName`, `cgGetStateType`, `cgIsState`, `cgSetStateCallbacks`, `cgGLRegisterStates`, `cgD3D9RegisterStates`, `cgCreateContext`

**NAME****cgCreateStateAssignment** – create a state assignment**SYNOPSIS**

```
#include <Cg/cg.h>

CGstateassignment cgCreateStateAssignment( CGpass pass,
                                           CGstate state );
```

**PARAMETERS**

**pass**      The pass in which to create the state assignment.

**state**      The state used to create the state assignment.

**RETURN VALUES**

Returns the handle to the created state assignment.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateStateAssignment** creates a state assignment for the specified pass. The new state assignment is appended to the pass' existing list of state assignments. If the state is actually a state array, the created state assignment is created for array index zero. Use **cgCreateStateAssignmentIndex** to create state assignments for other indices of an array state.

**EXAMPLES**

```
/* Procedurally create state assignment equivalent to */
/* "BlendFunc = { SrcAlpha, OneMinusSrcAlpha };" */
CGstate blendFuncState = cgGetNamedState(context, "BlendFunc");
CGstateassignment blendFuncSA =
    cgCreateStateAssignment(pass, blendFuncState);
static const int blendFuncConfig[2] =
    { GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA };
cgSetIntArrayStateAssignment(blendFuncSA, blendFuncConfig);

/* Procedurally create state assignment equivalent to */
/* "BlendEnable = true;" */
CGstate blendEnableState =
    cgGetNamedState(context, "BlendEnable");
CGstateassignment blendEnableSA =
    cgCreateStateAssignment(pass, blendEnableState);
cgSetBoolStateAssignment(blendEnableSA, CG_TRUE);
```

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgCreateStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

**cgCreateTechnique**, **cgCreateSamplerStateAssignment**, **cgCreateState**, **cgCreateStateAssignmentIndex**



## NAME

**cgCreateStateAssignmentIndex** – create a state assignment for a state array

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGstateassignment cgCreateStateAssignmentIndex( CGpass pass,
                                                CGstate state,
                                                int index );
```

## PARAMETERS

**pass**      The pass in which to create the state assignment.

**state**      The state array used to create the state assignment.

**index**      The index for the state array.

## RETURN VALUES

Returns the new state assignment handle.

Returns **NULL** if an error occurs.

## DESCRIPTION

**cgCreateStateAssignmentIndex** creates a state assignment for the specified pass. The new state assignment is appended to the pass's existing list of state assignments. The state assignment is for the given index of for the specified array state.

## EXAMPLES

This example shows how to create a state assignment for enabling light 5:

```
/* Procedurally create state assignment equivalent to */
/* "LightEnable[5] = 1;" */
CGstate lightEnableState = cgGetNamedState(context, "LightEnable");
CGstateassignment light5sa =
    cgCreateStateAssignmentIndex(pass, lightEnableState , 5);
cgSetBoolStateAssignment(light5sa, CG_TRUE);
```

## ERRORS

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

If the **index** is negative or **index** is greater than or equal the number of elements for the state array, no error is generated but **NULL** is returned.

## HISTORY

**cgCreateStateAssignmentIndex** was introduced in Cg 1.5.

## SEE ALSO

cgGetStateAssignmentIndex, cgCreateTechnique, cgCreateSamplerStateAssignment, cgCreateState, cgCreateStateAssignment

**NAME**

**cgCreateTechnique** – create a technique in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtechnique cgCreateTechnique( CGeffect effect,  
                                const char * name );
```

**PARAMETERS**

effect     The effect to which the new technique will be added.

name     The name for the new technique.

**RETURN VALUES**

Returns the handle to the new technique on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateTechnique** adds a new technique to the specified effect.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgCreateTechnique** was introduced in Cg 1.5.

**SEE ALSO**

cgIsTechnique,     cgCreatePass,     cgCreateEffectParameter,     cgCreateEffectParameterArray,  
cgCreateEffectParameterMultiDimArray

**NAME**

**cgCreateTechniqueAnnotation** – create a technique annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgCreateTechniqueAnnotation( CGtechnique tech,
                                           const char * name,
                                           CGtype type );
```

**PARAMETERS**

**tech**      The technique to which the new annotation will be added.

**name**      The name of the new annotation.

**type**      The type of the new annotation.

**RETURN VALUES**

Returns the new **CGannotation** handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgCreateTechniqueAnnotation** adds a new annotation to the technique.

**EXAMPLES**

```
/* create a float annotation named "Apple" for CGtechnique technique */
CGannotation ann = cgCreateTechniqueAnnotation( tech, "Apple", CG_FLOAT );
```

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**CG\_DUPLICATE\_NAME\_ERROR** is generated if **name** is already used by an annotation for this technique.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **type** is not **CG\_INT**, **CG\_FLOAT**, **CG\_BOOL**, or **CG\_STRING**.

**HISTORY**

**cgCreateTechniqueAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedTechniqueAnnotation, cgGetFirstTechniqueAnnotation, cgGetNextAnnotation

**NAME**

**cgDestroyBuffer** – delete a buffer

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgDestroyBuffer( CGbuffer buffer );
```

**PARAMETERS**

**buffer**     The buffer to delete.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyBuffer** deletes a buffer. The buffer object is not actually destroyed until no more programs are bound to the buffer object and any pending use of the buffer has completed. However, the handle **buffer** no longer refers to the buffer object (although it may be subsequently allocated to a different created resource).

**EXAMPLES**

```
cgDestroyBuffer( myBuffer );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**HISTORY**

**cgDestroyBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateBuffer, cgGLCreateBuffer

**NAME**

**cgDestroyContext** – destroy a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgDestroyContext( CGcontext context );
```

**PARAMETERS**

context

The context to be deleted.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyContext** deletes a Cg context object and all the programs it contains.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgDestroyContext** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateContext

**NAME**

**cgDestroyEffect** – destroy an effect

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgDestroyEffect( CGeffect effect );
```

**PARAMETERS**

effect     The effect object to delete.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyEffect** removes the specified effect object and all its associated data. Any **CGeffect** handles that reference this effect will become invalid after the effect is deleted. Likewise, all techniques, passes, and parameters contained in the effect also become invalid after the effect is destroyed.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgDestroyEffect** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile

**NAME**

**cgDestroyObj** – destroy an obj

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgDestroyObj( CGobj obj );
```

**PARAMETERS**

obj        The object to delete.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyObj** removed the specified object and all its associated data.

**EXAMPLES**

```
CGcontext ctx = cgCreateContext();
CGobj structObj = cgCreateObj(ctx, CG_SOURCE, src, CG_PROFILE_ARBVP1, NULL);

// Use obj, then ...

cgDestroyObj( structObj );
```

**ERRORS**

**CG\_INVALID\_OBJ\_HANDLE\_ERROR** is generated if **obj** is not a valid object handle.

**HISTORY**

**cgDestroyObj** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateObj, cgCreateObjFromFile

**NAME**

**cgDestroyParameter** – destroy a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgDestroyParameter( CGparameter param );
```

**PARAMETERS**

**param**     The parameter to destroy.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyParameter** destroys parameters created with **cgCreateParameter**, **cgCreateParameterArray**, or **cgCreateParameterMultiDimArray**.

Upon destruction, **param** will become invalid. Any connections (see **cgConnectParameter**) in which **param** is the destination parameter will be disconnected. An error will be thrown if **param** is a source parameter in any connections.

The parameter being destroyed may not be one of the children parameters of a struct or array parameter. In other words it must be a **CGparameter** returned by one of the **cgCreateParameter** family of entry points.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGparameter floatParam = cgCreateParameter(context, CG_FLOAT);
CGparameter floatParamArray = cgCreateParameterArray(context, CG_FLOAT, 5);

/* ... */

cgDestroyParameter(floatParam);
cgDestroyParameter(floatParamArray);
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_NOT\_ROOT\_PARAMETER\_ERROR** is generated if the **param** isn't the top-level parameter of a struct or array that was created.

**CG\_PARAMETER\_IS\_NOT\_SHARED\_ERROR** is generated if **param** does not refer to a parameter created by one of the **cgCreateParameter** family of entry points.

**CG\_CANNOT\_DESTROY\_PARAMETER\_ERROR** is generated if **param** is a source parameter in a connection made by **cgConnectParameter**. **cgDisconnectParameter** should be used before calling **cgDestroyParameter** in such a case.

**HISTORY**

**cgDestroyParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgCreateParameter**, **cgCreateParameterArray**, **cgCreateParameterMultiDimArray**



**NAME**

**cgDestroyProgram** – destroy a program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgDestroyProgram( CGprogram program );
```

**PARAMETERS**

**program** The program object to delete.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDestroyProgram** removes the specified program object and all its associated data. Any **CGprogram** variables that reference this program will become invalid after the program is deleted. Likewise, any objects contained by this program (e.g. **CGparameter** objects) will also become invalid after the program is deleted.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgDestroyProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgCreateProgramFromFile

**NAME**

**cgDisconnectParameter** – disconnects two parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgDisconnectParameter( CGparameter param );
```

**PARAMETERS**

**param**    The destination parameter in the connection that will be disconnected.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgDisconnectParameter** disconnects an existing connection made with **cgConnectParameter** between two parameters. Since a given parameter can only be connected to one source parameter, only the destination parameter is required as an argument to **cgDisconnectParameter**.

If the type of **param** is an interface and the struct connected to it implements the interface, any sub-parameters created by the connection will also be destroyed. See **cgConnectParameter** for more information.

**EXAMPLES**

```
CGparameter timeParam = cgGetNamedParameter(program, "time");
CGparameter sharedTime = cgCreateParameter(context,
                                           cgGetParameterType(timeParam));

cgConnectParameter(sharedTime, timeParam);

/* ... */

cgDisconnectParameter(timeParam);
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgDisconnectParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetConnectedParameter**, **cgGetConnectedToParameter**, **cgConnectParameter**

**NAME**

**cgEvaluateProgram** – evaluates a Cg program on the CPU

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgEvaluateProgram( CGprogram program,
                        float * buf,
                        int ncomps,
                        int nx,
                        int ny,
                        int nz );
```

**PARAMETERS**

**program** The program to be evaluated.

**buf** Buffer in which to store the results of program evaluation.

**ncomps** Number of components to store for each returned program value.

**nx** Number of points at which to evaluate the program in the x direction.

**ny** Number of points at which to evaluate the program in the y direction.

**nz** Number of points at which to evaluate the program in the z direction.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgEvaluateProgram** evaluates a Cg program at a set of regularly spaced points in one, two, or three dimensions. The program must have been compiled with the **CG\_PROFILE\_GENERIC** profile. The value returned from the program via the **COLOR** semantic is stored in the given buffer for each evaluation point, and any varying parameters to the program with **POSITION** semantic take on the (x,y,z) position over the range zero to one at which the program is evaluated at each point. The **PSIZE** semantic can be used to find the spacing between evaluating points.

The total size of **buf** should be equal to **ncomps\*nx\*ny\*nz**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PROFILE\_ERROR** is generated if **program**'s profile is not **CG\_PROFILE\_GENERIC**.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **buf** is **NULL**, any of **nx**, **ny**, or **nz** is less than zero, or **ncomps** is not 0, 1, 2, or 3.

**HISTORY**

**cgEvaluateProgram** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateProgram, cgCreateProgramFromFile, cgCreateProgramFromEffect, cgGetProgramProfile

**NAME**

**cgGetAnnotationName** – get an annotation's name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetAnnotationName( CGannotation ann );
```

**PARAMETERS**

ann        The annotation from which to get the name.

**RETURN VALUES**

Returns the NULL-terminated name string for the annotation.

Returns **NULL** if **ann** is invalid.

**DESCRIPTION**

**cgGetAnnotationName** allows the application to retrieve the name of a annotation. This name can be used later to retrieve the annotation using **cgGetNamedPassAnnotation**, **cgGetNamedParameterAnnotation**, **cgGetNamedTechniqueAnnotation**, or **cgGetNamedProgramAnnotation**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**HISTORY**

**cgGetAnnotationName** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedPassAnnotation**,    **cgGetNamedParameterAnnotation**,    **cgGetNamedTechniqueAnnotation**,  
**cgGetNamedProgramAnnotation**

**NAME**

**cgGetAnnotationType** – get an annotation’s type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetAnnotationType( CGannotation ann );
```

**PARAMETERS**

ann        The annotation from which to get the type.

**RETURN VALUES**

Returns the type enumerator of **ann**.

Returns **CG\_UNKNOWN\_TYPE** if an error occurs.

**DESCRIPTION**

**cgGetAnnotationType** allows the application to retrieve the type of an annotation in a Cg effect.

**cgGetAnnotationType** will return **CG\_STRUCT** if the annotation is a struct and **CG\_ARRAY** if the annotation is an array. Otherwise it will return the data type associated with the annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**HISTORY**

**cgGetAnnotationType** was introduced in Cg 1.4.

**SEE ALSO**

cgGetType, cgGetTypeString

**NAME**

**cgGetArrayDimension** – get the dimension of an array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetArrayDimension( CGparameter param );
```

**PARAMETERS**

param    The array parameter handle.

**RETURN VALUES**

Returns the dimension of **param** if **param** references an array.

Returns **0** otherwise.

**DESCRIPTION**

**cgGetArrayDimension** returns the dimension of the array specified by **param**. **cgGetArrayDimension** is used when inspecting an array parameter in a program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**HISTORY**

**cgGetArrayDimension** was introduced in Cg 1.1.

**SEE ALSO**

cgGetArraySize, cgCreateParameterArray, cgCreateParameterMultiDimArray

**NAME**

**cgGetArrayParameter** – get a parameter from an array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetArrayParameter( CGparameter param,  
                                int index );
```

**PARAMETERS**

param     The array parameter handle.

index     The index into the array.

**RETURN VALUES**

Returns the parameter at the specified index of **param** if **param** references an array, and the index is valid.

Returns **NULL** otherwise.

**DESCRIPTION**

**cgGetArrayParameter** returns the parameter of array **param** specified by **index**. **cgGetArrayParameter** is used when inspecting elements of an array parameter in a program.

**EXAMPLES**

```
CGparameter array = ...; /* some array parameter */  
int array_size = cgGetArraySize( array );  
for(i=0; i < array_size; ++i)  
{  
    CGparameter element = cgGetArrayParameter(array, i);  
    /* Do stuff with element */  
}
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is outside the bounds of **param**.

**HISTORY**

**cgGetArrayParameter** was introduced in Cg 1.1.

**SEE ALSO**

cgGetArrayDimension, cgGetArraySize, cgGetParameterType

**NAME**

**cgGetArraySize** – get the size of one dimension of an array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetArraySize( CGparameter param,
                    int dimension );
```

**PARAMETERS**

**param**     The array parameter handle.

**dimension**

            The array dimension whose size will be returned.

**RETURN VALUES**

Returns the size of **param** if **param** is an array.

Returns **0** if **param** is not an array, or an error occurs.

**DESCRIPTION**

**cgGetArraySize** returns the size of the given dimension of the array specified by **param**. **cgGetArraySize** is used when inspecting an array parameter in a program.

**EXAMPLES**

```
/* Compute the number of elements in an array, in the */
/* style of cgGetArrayTotalSize(param) */
int elements = cgGetArraySize(param, 0);
if (elements>0) {
    int dim = cgGetArrayDimension(param);
    for (int i = 1; i < dim; i++) {
        elements *= cgGetArraySize(param, i);
    }
}
```

**ERRORS**

**CG\_INVALID\_DIMENSION\_ERROR** is generated if **dimension** is less than 0.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetArraySize** was introduced in Cg 1.1.

**SEE ALSO**

cgGetArrayTotalSize, cgGetArrayDimension, cgGetArrayParameter, cgGetMatrixSize, cgGetTypeSizes



**NAME**

**cgGetArrayTotalSize** – get the total size of an array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetArrayTotalSize( CGparameter param );
```

**PARAMETERS**

param     The array parameter handle.

**RETURN VALUES**

Returns the total size of **param** if **param** is an array.

Returns **0** if **param** is not an array, or if an error occurs.

**DESCRIPTION**

**cgGetArrayTotalSize** returns the total number of elements of the array specified by **param**. The total number of elements is equal to the product of the size of each dimension of the array.

**EXAMPLES**

Given a handle to a parameter declared as:

```
float2x3 array[6][1][4];
```

**cgGetArrayTotalSize** will return 24.

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetArrayTotalSize** was introduced in Cg 1.4.

**SEE ALSO**

cgGetArraySize, cgGetArrayDimension, cgGetArrayParameter

**NAME**

**cgGetArrayType** – get the type of an array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetArrayType( CGparameter param );
```

**PARAMETERS**

param     The array parameter handle.

**RETURN VALUES**

Returns the the type of the inner most array.

Returns **CG\_UNKNOWN\_TYPE** if an error occurs.

**DESCRIPTION**

**cgGetArrayType** returns the type of the members of an array. If the given array is multi-dimensional, it will return the type of the members of the inner most array.

**EXAMPLES**

```
CGcontext context = cgCreateContext();  
CGparameter array = cgCreateParameterArray(context, CG_FLOAT, 5);  
  
CGtype arrayType = cgGetArrayType(array); /* This will return CG_FLOAT */
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**HISTORY**

**cgGetArrayType** was introduced in Cg 1.2.

**SEE ALSO**

cgGetArraySize, cgGetArrayDimension

**NAME**

**cgGetAutoCompile** – get the auto-compile enumerator for a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGenum cgGetAutoCompile( CGcontext context );
```

**PARAMETERS**

context    The context.

**RETURN VALUES**

Returns the auto-compile enumerator for **context**.

Returns **CG\_UNKNOWN** if **context** is not a valid context.

**DESCRIPTION**

**cgGetAutoCompile** returns the auto-compile enumerator for **context**. See **cgSetAutoCompile** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetAutoCompile** was introduced in Cg 1.4.

**SEE ALSO**

**cgSetAutoCompile**

**NAME**

**cgGetBoolAnnotationValues** – get the values from a boolean-valued annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const CGbool * cgGetBoolAnnotationValues( CGannotation ann,  
                                           int * nvalues );
```

**PARAMETERS**

ann        The annotation.

nvalues   Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **CGbool** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if no values are available. **nvalues** will be **0**.

**DESCRIPTION**

**cgGetBoolAnnotationValues** allows the application to retrieve the *value* (s) of a boolean typed annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**HISTORY**

**cgGetBoolAnnotationValues** was introduced in Cg 1.5.

**SEE ALSO**

cgGetAnnotationType,  
cgGetStringAnnotationValue

cgGetFloatAnnotationValues,

cgGetIntAnnotationValues,

**NAME**

**cgGetBoolStateAssignmentValues** – get the values from a bool-valued state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const CGbool * cgGetBoolStateAssignmentValues( CGstateassignment sa,  
                                                int * nvalues );
```

**PARAMETERS**

sa           The state assignment.

nvalues    Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **CGbool** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if an error occurs or if no values are available. **nvalues** will be **0** in the latter case.

**DESCRIPTION**

**cgGetBoolStateAssignmentValues** allows the application to retrieve the *value* (s) of a boolean typed state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a bool type.

**HISTORY**

**cgGetBoolStateAssignmentValues** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState,                   cgGetStateType,                   cgGetFloatStateAssignmentValues,  
cgGetIntStateAssignmentValues, cgGetStringStateAssignmentValue, cgGetProgramStateAssignmentValue,  
cgGetSamplerStateAssignmentValue, cgGetTextureStateAssignmentValue

**NAME**

**cgGetBooleanAnnotationValues** – deprecated

**DESCRIPTION**

**cgGetBooleanAnnotationValues** is deprecated. Use **cgGetBoolAnnotationValues** instead.

**SEE ALSO**

**cgGetBoolAnnotationValues**

**NAME**

**cgGetBufferSize** – get the size of a buffer

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetBufferSize( CGbuffer buffer );
```

**PARAMETERS**

**buffer**     The buffer for which the size will be retrieved.

**RETURN VALUES**

Returns the size in bytes of **buffer**.

Returns **-1** if an error occurs.

**DESCRIPTION**

**cgGetBufferSize** returns the size in bytes of **buffer**.

**EXAMPLES**

```
int size = cgGetBufferSize( myBuffer );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**HISTORY**

**cgGetBufferSize** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateBuffer, cgGLCreateBuffer, cgSetBufferData, cgSetBufferSubData

**NAME**

**cgGetCompilerIncludeCallback** – get the include callback function

**SYNOPSIS**

```
#include <Cg/cg.h>

typedef void (*CGIncludeCallbackFunc)( CGcontext context, const char *filename );

CGIncludeCallbackFunc cgGetCompilerIncludeCallback( CGcontext context );
```

**PARAMETERS**

**context** The context of the desired include callback function.

**RETURN VALUES**

Returns the current include callback function.

Returns **NULL** if no callback function is set.

**DESCRIPTION**

**cgGetCompilerIncludeCallback** returns the current callback function used for handling include statements.

**EXAMPLES**

```
CGIncludeCallbackFunc includeCB = cgGetCompilerIncludeCallback(context);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetCompilerIncludeCallback** was introduced in Cg 2.1.

**SEE ALSO**

cgSetCompilerIncludeCallback, cgSetCompilerIncludeString, cgSetCompilerIncludeFile



**NAME**

**cgGetConnectedParameter** – gets the connected source parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetConnectedParameter( CGparameter param );
```

**PARAMETERS**

param    The destination parameter.

**RETURN VALUES**

Returns the connected source parameter if **param** is connected to one.

Returns **NULL** otherwise.

**DESCRIPTION**

Returns the source parameter to which **param** is connected.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetConnectedParameter** was introduced in Cg 1.2.

**SEE ALSO**

cgConnectParameter, cgDisconnectParameter, cgGetConnectedToParameter

## NAME

**cgGetConnectedStateAssignmentParameter** – get effect parameter which determines a state assignment's value

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGparameter cgGetConnectedStateAssignmentParameter( CGstateassignment sa );
```

## PARAMETERS

**sa** A state assignment whose value is determined using an effect parameter.

## RETURN VALUES

Returns the effect parameter used by **sa**.

Returns **0** if **sa** is not using a parameter for its value, if the state assignment is set to an expression, or if an error occurs.

## DESCRIPTION

**cgGetConnectedStateAssignmentParameter** returns the effect parameter from which a given state assignment's value is determined.

## EXAMPLES

```
/* in Effect.cgfx file */
```

```
int MyMinFilter;  
sampler2D Samp = sampler_state {  
    MinFilter = MyMinFilter;  
};
```

```
/* in .c/.cpp file */
```

```
CGparameter sampParam = cgGetNamedEffectParameter( myEffect, "Samp" );  
CGstateassignment sa = cgGetNamedSamplerStateAssignment( sampParam,  
                                                         "MinFilter" );  
CGparameter connected = cgGetConnectedStateAssignmentParameter( sa );
```

## ERRORS

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

## HISTORY

**cgGetConnectedStateAssignmentParameter** was introduced in Cg 2.0.

## SEE ALSO

cgGetNamedEffectParameter, cgGetNamedSamplerStateAssignment

**NAME**

**cgGetConnectedToParameter** – gets a connected destination parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetConnectedToParameter( CGparameter param,  
                                       int index );
```

**PARAMETERS**

**param**     The source parameter.

**index**     Since there may be multiple destination (to) parameters connected to **param**, **index** is need to specify which one is returned. **index** must be within the range of **0** to **N – 1** where **N** is the number of connected destination parameters.

**RETURN VALUES**

Returns one of the destination parameters connected to **param**.

Returns **NULL** if an error occurs.

**DESCRIPTION**

Returns one of the destination parameters connected to **param**. **cgGetNumConnectedToParameters** should be used to determine the number of destination parameters connected to **param**.

**EXAMPLES**

```
int nParams = cgGetNumConnectedToParameters( sourceParam );  
  
for ( int i=0; i < nParams; ++i )  
{  
    CGparameter toParam = cgGetConnectedToParameter( sourceParam, i );  
    /* Do stuff with toParam ... */  
}
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is less than 0 or greater than or equal to the number of parameters connected to **param**.

**HISTORY**

**cgGetConnectedToParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgConnectParameter**, **cgGetNumConnectedToParameters**

**NAME**

**cgGetDependentAnnotationParameter** – get one of the parameters that an annotation’s value depends on

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetDependentAnnotationParameter( CGannotation ann,  
                                                int index );
```

**PARAMETERS**

ann        The annotation handle.

index     The index of the parameter to return.

**RETURN VALUES**

Returns a handle to the selected dependent annotation on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

Annotations in CgFX files may include references to one or more effect parameters on the right hand side of the annotation that are used for computing the annotation’s value. **cgGetDependentAnnotationParameter** returns one of these parameters, as indicated by the given index. **cgGetNumDependentAnnotationParameters** can be used to determine the total number of such parameters.

This information can be useful for applications that wish to cache the values of annotations so that they can determine which annotations may change as the result of changing a particular parameter’s value.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is less than zero or greater than or equal to the number of dependent parameters, as returned by **cgGetNumDependentAnnotationParameters**.

**HISTORY**

**cgGetDependentAnnotationParameter** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetDependentStateAssignmentParameter**, **cgGetNumDependentAnnotationParameters**

## NAME

**cgGetDependentStateAssignmentParameter** – get one of the parameters that a state assignment’s value depends on

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGparameter cgGetDependentStateAssignmentParameter( CGstateassignment sa,  
                                                    int index );
```

## PARAMETERS

sa           The state assignment handle.

index        The index of the parameter to return.

## RETURN VALUES

Returns a handle to the selected dependent parameter on success.

Returns **NULL** if an error occurs.

## DESCRIPTION

State assignments in CgFX files may include references to one or more effect parameters on the right hand side of the state assignment that are used for computing the state assignment’s value. **cgGetDependentStateAssignmentParameter** returns one of these parameters, as indicated by the given index. **cgGetNumDependentStateAssignmentParameters** can be used to determine the total number of such parameters.

This information can be useful for applications that wish to cache the values of annotations so that they can determine which annotations may change as the result of changing a particular parameter’s value.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is less than zero or greater than or equal to the number of dependent parameters, as returned by **cgGetNumDependentStateAssignmentParameters**.

## HISTORY

**cgGetDependentStateAssignmentParameter** was introduced in Cg 1.4.

## SEE ALSO

**cgGetDependentAnnotationParameter**, **cgGetNumDependentStateAssignmentParameters**

**NAME**

**cgGetDomain** – get the domain enumerator from a domain name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGdomain cgGetDomain( const char * domain_string );
```

**PARAMETERS**

domain\_string

A string containing the case-sensitive domain name.

**RETURN VALUES**

Returns the domain enumerator of **domain\_string**.

Returns **CG\_UNKNOWN** if the given domain does not exist.

**DESCRIPTION**

**cgGetDomain** returns the enumerator assigned to a domain name.

**EXAMPLES**

```
CGdomain ARBVPlDomain = cgGetDomain("arbvpl");

if(cgGetProgramDomain(myprog) == ARBVPlDomain)
{
    /* Do stuff */
}
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **domain\_string** is **NULL**.

**HISTORY**

**cgGetDomain** was introduced in Cg 2.2.

**SEE ALSO**

cgGetDomainString, cgGetProgramDomain

**NAME**

**cgGetDomainString** – get the domain name associated with a domain enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetDomainString( CGdomain domain );
```

**PARAMETERS**

domain    The domain enumerator.

**RETURN VALUES**

Returns the domain string of the enumerator **domain**.

Returns **NULL** if **domain** is not a valid domain.

**DESCRIPTION**

**cgGetDomainString** returns the domain named associated with a domain enumerator.

**EXAMPLES**

```
static void dumpCgProgramInfo(CGprogram program)
{
    const char* p = cgGetDomainString(cgGetProgramDomain(program));
    if ( p ) {
        printf(" Domain: %s\n", cgGetDomainString(cgGetProgramDomain(program)));
    }
    /* ... */
}
```

**ERRORS**

None.

**HISTORY**

**cgGetDomainString** was introduced in Cg 2.2.

**SEE ALSO**

cgGetDomain, cgGetProgramDomain

**NAME**

**cgGetEffectContext** – get a effect's context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGcontext cgGetEffectContext( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect.

**RETURN VALUES**

Returns the context to which **effect** belongs.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetEffectContext** allows the application to retrieve a handle to the context to which a given effect belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetEffectContext** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile, cgCreateContext



**NAME**

**cgGetEffectName** – get an effect’s name

**SYNOPSIS**

```
#include <Cg/cg.h>

const char * cgGetEffectName( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect from which the name will be retrieved.

**RETURN VALUES**

Returns the name from the specified effect.

Returns **NULL** if the effect doesn’t have a valid name or an error occurs.

**DESCRIPTION**

**cgGetEffectName** returns the name from the specified effect.

**EXAMPLES**

```
char *effectSource = ...;
CGcontext context = cgCreateContext();
CGeffect effect = cgCreateEffect(context, effectSource, NULL);

const char* myEffectName = "myEffectName";
CGbool okay = cgSetEffectName(effect, myEffectName);
if (!okay) {
    /* handle error */
}

const char* testName = cgGetEffectName(effect);

if (strcmp(testName, myEffectName)) {
    /* shouldn't be here */
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetEffectName** was introduced in Cg 1.5.

**SEE ALSO**

cgSetEffectName

**NAME**

**cgGetEffectParameterBySemantic** – get the a parameter in an effect via its semantic

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetEffectParameterBySemantic( CGeffect effect,  
                                             const char * semantic );
```

**PARAMETERS**

**effect**     The effect from which to retrieve the parameter.

**semantic**  
            The name of the semantic.

**RETURN VALUES**

Returns the **CGparameter** object in **effect** that has the given semantic.

Returns **NULL** if **effect** is invalid or does not have any parameters with the given semantic.

**DESCRIPTION**

**cgGetEffectParameterBySemantic** returns the parameter in an effect which is associated with the given semantic. If multiple parameters in the effect have this semantic, an arbitrary one of them will be returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **semantic** is **NULL** or the empty string.

**HISTORY**

**cgGetEffectParameterBySemantic** was introduced in Cg 1.4.

**SEE ALSO**

cgGetNamedEffectParameter

**NAME**

**cgGetEnum** – get the enumerant assigned with the given string name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CEnum cgGetEnum( const char * enum_string );
```

**PARAMETERS**

enum\_string

A string containing the case-sensitive enum name.

**RETURN VALUES**

Returns the enumerant for **enum\_string**.

Returns **CG\_UNKNOWN** if no such enumerant exists

**DESCRIPTION**

**cgGetEnum** returns the enumerant assigned to an enum name.

**EXAMPLES**

```
CEnum VaryingEnum = cgGetEnum( "CG_VARYING" );
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **enum\_string** is **NULL**.

**HISTORY**

**cgGetEnum** was introduced in Cg 1.2.

**SEE ALSO**

cgGetEnumString

**NAME**

**cgGetEnumString** – get the name string associated with an enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetEnumString( CGenum enum );
```

**PARAMETERS**

enum     The enumerator.

**RETURN VALUES**

Returns the string representation of the enumerator **enum**.

Returns **NULL** if **enum** is not a valid Cg enumerator.

**DESCRIPTION**

**cgGetEnumString** returns the name string associated with an enumerator. It's primary use to print debugging information.

**EXAMPLES**

```
/* This prints "CG_UNIFORM" to stdout */
const char *EnumString = cgGetEnumString(CG_UNIFORM);
printf("%s\n", EnumString);
```

**ERRORS**

None.

**HISTORY**

**cgGetEnumString** was introduced in Cg 1.2.

**SEE ALSO**

cgGetEnum

**NAME**

**cgGetError** – get error condition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGerror cgGetError( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the last error condition that has occurred.

Returns **CG\_NO\_ERROR** if no error has occurred.

**DESCRIPTION**

**cgGetError** returns the last error condition that has occurred. The error condition is reset after **cgGetError** is called.

**EXAMPLES**

```
CGerror err = cgGetError();
```

**ERRORS**

None.

**HISTORY**

**cgGetError** was introduced in Cg 1.1.

**SEE ALSO**

cgSetErrorCallback, cgSetErrorHandler

**NAME**

**cgGetErrorCallback** – get the error callback function

**SYNOPSIS**

```
#include <Cg/cg.h>

typedef void (*CGerrorCallbackFunc)( void );

CGerrorCallbackFunc cgGetErrorCallback( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the currently set error callback function.

Returns **NULL** if no callback function has been set.

**DESCRIPTION**

**cgGetErrorCallback** returns the current error callback function.

**EXAMPLES**

```
CGerrorCallbackFunc errorCB = cgGetErrorCallback();
```

**ERRORS**

None.

**HISTORY**

**cgGetErrorCallback** was introduced in Cg 1.1.

**SEE ALSO**

cgSetErrorCallback

**NAME**

**cgGetErrorHandler** – get the error handler callback function

**SYNOPSIS**

```
#include <Cg/cg.h>

typedef void (*CGErrorHandlerFunc)( CGcontext context,
                                     CGerror error,
                                     void * appdata );

CGErrorHandlerFunc cgGetErrorHandler( void ** appdataptr );
```

**PARAMETERS**

appdataptr  
A pointer for an application provided data pointer.

**RETURN VALUES**

Returns the current error handler callback function.

Returns **NULL** if no callback function is set.

If **appdataptr** is not **NULL** then the current **appdata** pointer will be copied into the location pointed to by **appdataptr**.

**DESCRIPTION**

**cgGetErrorHandler** returns the current error handler callback function and application provided data pointer.

**EXAMPLES**

```
void * appdata = NULL;
CGErrorHandlerFunc errorHandler = cgGetErrorHandler( &appdata );
```

**ERRORS**

None.

**HISTORY**

**cgGetErrorHandler** was introduced in Cg 1.4.

**SEE ALSO**

cgSetErrorHandler

**NAME**

**cgGetErrorString** – get a human readable error string

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetErrorString( CGerror error );
```

**PARAMETERS**

error     The error condition.

**RETURN VALUES**

Returns a human readable error string for the given error condition.

**DESCRIPTION**

**cgGetErrorString** returns a human readable error string for the given error condition.

**EXAMPLES**

```
const char * pCompilerError = cgGetErrorString( CG_COMPILER_ERROR );
```

**ERRORS**

None.

**HISTORY**

**cgGetErrorString** was introduced in Cg 1.1.

**SEE ALSO**

cgGetError



**NAME**

**cgGetFirstDependentParameter** – get the first dependent parameter from a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstDependentParameter( CGparameter param );
```

**PARAMETERS**

param    The parameter.

**RETURN VALUES**

Returns a handle to the first member parameter.

Returns **NULL** if **param** is not a struct or if some other error occurs.

**DESCRIPTION**

**cgGetFirstDependentParameter** returns the first member dependent parameter associated with a given parameter. The rest of the members may be retrieved from the first member by iterating with **cgGetNextParameter**.

Dependent parameters are parameters that have the same name as a given parameter but different resources. They only exist in profiles that have multiple resources associated with one parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetFirstDependentParameter** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNextParameter**, **cgGetFirstParameter**

**NAME**

**cgGetFirstEffect** – get the first effect in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgGetFirstEffect( CGcontext context );
```

**PARAMETERS**

**context** The context from which to retrieve the first effect.

**RETURN VALUES**

Returns the first **CGeffect** object in **context**.

Returns **NULL** if **context** contains no effects.

**DESCRIPTION**

**cgGetFirstEffect** is used to begin iteration over all of the effects contained by a context. See **cgGetNextEffect** for more information.

**EXAMPLES**

```
/* one or more effects have previously been loaded into context */  
CGeffect effect = cgGetFirstEffect( context );
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetFirstEffect** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextEffect**, **cgCreateEffect**, **cgCreateEffectFromFile**, **cgDestroyEffect**, **cgIsEffect**, **cgGetFirstProgram**

**NAME**

**cgGetFirstEffectAnnotation** – get the first annotation in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetFirstEffectAnnotation( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect from which to retrieve the first annotation.

**RETURN VALUES**

Returns the first annotation in an effect.

Returns **NULL** if the effect has no annotations.

**DESCRIPTION**

The first annotation associated with an effect can be retrieved using **cgGetFirstEffectAnnotation**. The rest of the effect's annotations can be discovered by iterating through them using **cgGetNextAnnotation**.

**EXAMPLES**

```
CGannotation ann = cgGetFirstEffectAnnotation( effect );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetFirstEffectAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

**cgGetNamedEffectAnnotation**, **cgGetNextAnnotation**

**NAME**

**cgGetFirstEffectParameter** – get the first parameter in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstEffectParameter( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect from which to retrieve the first parameter.

**RETURN VALUES**

Returns the first **CGparameter** object in **effect**.

Returns **NULL** if **effect** is invalid or if **effect** does not have any parameters.

**DESCRIPTION**

The first top-level parameter in an effect can be retrieved using **cgGetFirstEffectParameter**. The rest of the effect's parameters can be discovered by iterating through them using **cgGetNextParameter**.

**EXAMPLES**

```
CGparameter param = cgGetFirstEffectParameter( effect );
while( param )
{
    /* do something with param */
    param = cgGetNextParameter( param );
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetFirstEffectParameter** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextParameter**, **cgGetNamedEffectParameter**

**NAME**

**cgGetFirstError** – get the first error condition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGError cgGetFirstError( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the first error condition that has occurred since **cgGetFirstError** was last called.

Returns **CG\_NO\_ERROR** if no error has occurred.

**DESCRIPTION**

**cgGetFirstError** returns the first error condition that has occurred since **cgGetFirstError** was previously called.

**EXAMPLES**

```
CGError firstError = cgGetFirstError();
```

**ERRORS**

None.

**HISTORY**

**cgGetFirstError** was introduced in Cg 1.4.

**SEE ALSO**

cgSetErrorHandler, cgGetError

**NAME**

**cgGetFirstLeafEffectParameter** – get the first leaf parameter in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstLeafEffectParameter( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect from which to retrieve the first leaf parameter.

**RETURN VALUES**

Returns the first leaf **CGparameter** object in **effect**.

Returns **NULL** if **effect** is invalid or if **effect** does not have any parameters.

**DESCRIPTION**

**cgGetFirstLeafEffectParameter** returns the first leaf parameter in an effect. The combination of **cgGetFirstLeafEffectParameter** and **cgGetNextLeafParameter** allows the iteration through all of the parameters of basic data types (not structs or arrays) without recursion. See **cgGetNextLeafParameter** for more information.

**EXAMPLES**

```
CGparameter leaf = cgGetFirstLeafEffectParameter( effect );
while(leaf)
{
    /* Do stuff with leaf */
    leaf = cgGetNextLeafParameter( leaf );
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetFirstLeafEffectParameter** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextLeafParameter**, **cgGetFirstLeafParameter**

## NAME

**cgGetFirstLeafParameter** – get the first leaf parameter in a program

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstLeafParameter( CGprogram program,
                                      CGenum name_space );
```

## PARAMETERS

**program**        The program from which to retrieve the first leaf parameter.

**name\_space**    Specifies the parameter namespace through which to iterate. Currently **CG\_PROGRAM** and **CG\_GLOBAL** are supported.

## RETURN VALUES

Returns the first leaf **CGparameter** object in **program**.

Returns **NULL** if **program** is invalid or if **program** does not have any parameters.

## DESCRIPTION

**cgGetFirstLeafParameter** returns the first leaf parameter in a program. The combination of **cgGetFirstLeafParameter** and **cgGetNextLeafParameter** allow the iteration through all of the parameters of basic data types (not structs or arrays) without recursion. See **cgGetNextLeafParameter** for more information.

## EXAMPLES

```
CGparameter leaf = cgGetFirstLeafParameter( program );
while ( leaf )
{
    /* Do stuff with leaf */
    leaf = cgGetNextLeafParameter( leaf );
}
```

## ERRORS

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **name\_space** is not **CG\_PROGRAM** or **CG\_GLOBAL**.

## HISTORY

**cgGetFirstLeafParameter** was introduced in Cg 1.1.

## SEE ALSO

**cgGetNextLeafParameter**

**NAME**

**cgGetFirstParameter** – get the first parameter in a program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstParameter( CGprogram program,
                                CGenum name_space );
```

**PARAMETERS**

**program**        The program from which to retrieve the first parameter.

**name\_space**    Specifies the parameter namespace through which to iterate. Currently **CG\_PROGRAM** and **CG\_GLOBAL** are supported.

**RETURN VALUES**

Returns the first **CGparameter** object in **program**.

Returns zero if **program** is invalid or if **program** does not have any parameters.

Also returns zero if **program** is a combined program. To access the parameters of a combined program, use **cgGetProgramDomainProgram** to get each domain program and then call **cgGetFirstParameter** on each domain program.

**DESCRIPTION**

**cgGetFirstParameter** returns the first top-level parameter in a program. **cgGetFirstParameter** is used for recursing through all parameters in a program. See **cgGetNextParameter** for more information on parameter traversal.

**EXAMPLES**

```
CGparameter param = cgGetFirstParameter( program, CG_GLOBAL );
while ( param )
{
    /* Do stuff with leaf */
    param = cgGetNextParameter( param );
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **name\_space** is not **CG\_PROGRAM** or **CG\_GLOBAL**.

**HISTORY**

**cgGetFirstParameter** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNextParameter**, **cgGetProgramDomainProgram**, **cgGetFirstDependentParameter**,  
**cgGetFirstEffectParameter**, **cgGetFirstParameterAnnotation**



**NAME**

**cgGetFirstParameterAnnotation** – get the first annotation of a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetFirstParameterAnnotation( CGparameter param );
```

**PARAMETERS**

param    The parameter from which to retrieve the annotation.

**RETURN VALUES**

Returns the first annotation for the given parameter.

Returns **NULL** if the parameter has no annotations or an error occurs.

**DESCRIPTION**

The annotations associated with a parameter can be retrieved with **cgGetFirstParameterAnnotation**. Use **cgGetNextAnnotation** to iterate through the remainder of the parameter's annotations.

**EXAMPLES**

```
CGannotation ann = cgGetFirstParameterAnnotation( param );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetFirstParameterAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

cgGetNamedParameterAnnotation, cgGetNextAnnotation

**NAME**

**cgGetFirstPass** – get the first pass in a technique

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGpass cgGetFirstPass( CGtechnique tech );
```

**PARAMETERS**

**tech**      The technique from which to retrieve the first pass.

**RETURN VALUES**

Returns the first **CGpass** object in **tech**.

Returns **NULL** if **tech** contains no passes.

**DESCRIPTION**

**cgGetFirstPass** is used to begin iteration over all of the passes contained within a technique. See **cgGetNextPass** for more information.

**EXAMPLES**

```
CGpass pass = cgGetFirstPass( tech );
while ( pass )
{
    /* Do stuff with pass */
    leaf = cgGetNextPass( pass );
}
```

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetFirstPass** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextPass**, **cgGetNamedPass**, **cgIsPass**, **cgGetFirstPassAnnotation**

**NAME**

**cgGetFirstPassAnnotation** – get the first annotation of a pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetFirstPassAnnotation( CGpass pass );
```

**PARAMETERS**

pass      The pass from which to retrieve the annotation.

**RETURN VALUES**

Returns the first annotation from the given pass.

Returns **NULL** if the pass has no annotations or an error occurs.

**DESCRIPTION**

The annotations associated with a pass can be retrieved using **cgGetFirstPassAnnotation**. The remainder of the pass's annotations can be discovered by iterating through the parameters, calling **cgGetNextAnnotation** to get to the next one.

**EXAMPLES**

```
CGannotation ann = cgGetFirstPassAnnotation( pass );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetFirstPassAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedPassAnnotation**, **cgGetNextAnnotation**

**NAME**

**cgGetFirstProgram** – get the first program in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetFirstProgram( CGcontext context );
```

**PARAMETERS**

context The context from which to retrieve the first program.

**RETURN VALUES**

Returns the first **CGprogram** object in **context**.

Returns **NULL** if **context** contains no programs or an error occurs.

**DESCRIPTION**

**cgGetFirstProgram** is used to begin iteration over all of the programs contained within a context. See **cgGetNextProgram** for more information.

**EXAMPLES**

```
CGprogram program = cgGetFirstProgram( context );
while ( program )
{
    /* do something with program */
    program = cgGetNextProgram( program );
}
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetFirstProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNextProgram**, **cgCreateProgram**, **cgDestroyProgram**, **cgIsProgram**, **cgGetFirstEffect**

**NAME**

**cgGetFirstProgramAnnotation** – get the first annotation of a program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetFirstProgramAnnotation( CGprogram program );
```

**PARAMETERS**

**program** The program from which to retrieve the annotation.

**RETURN VALUES**

Returns the first annotation from the given program.

Returns **NULL** if the program has no annotations.

**DESCRIPTION**

The annotations associated with a program can be retrieved using **cgGetFirstProgramAnnotation**. The remainder of the program's annotations can be discovered by iterating through the parameters, calling **cgGetNextAnnotation** to get to the next one.

**EXAMPLES**

```
CGannotation ann = cgGetFirstProgramAnnotation( program );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetFirstProgramAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedProgramAnnotation**, **cgGetNextAnnotation**

**NAME**

**cgGetFirstSamplerState** – get the first sampler state definition in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetFirstSamplerState( CGcontext context );
```

**PARAMETERS**

**context** The context from which to retrieve the first sampler state definition.

**RETURN VALUES**

Returns the first **CGstate** object in **context**.

Returns **NULL** if **context** contains no programs or an error occurs.

**DESCRIPTION**

**cgGetFirstSamplerState** is used to begin iteration over all of the sampler state definitions contained within a context. See **cgGetNextState** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetFirstSamplerState** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextState**, **cgGetNamedSamplerState**

**NAME**

**cgGetFirstSamplerStateAssignment** – get the first state assignment in a `sampler_state` block

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgGetFirstSamplerStateAssignment( CGparameter param );
```

**PARAMETERS**

`param` The sampler parameter from which to retrieve the first state assignment.

**RETURN VALUES**

Returns the first **CGstateassignment** object assigned to **param**.

Returns **NULL** if **param** has no **sampler\_state** block or an error occurs.

**DESCRIPTION**

**cgGetFirstSamplerStateAssignment** is used to begin iteration over all of the state assignments contained within a **sampler\_state** block assigned to a parameter in an effect file. See **cgGetNextStateAssignment** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetFirstSamplerStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextStateAssignment**, **cgIsStateAssignment**

**NAME**

**cgGetFirstState** – get the first state definition in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetFirstState( CGcontext context );
```

**PARAMETERS**

**context** The context from which to retrieve the first state definition.

**RETURN VALUES**

Returns the first **CGstate** object in **context**.

Returns **NULL** if **context** contains no state definitions or an error occurs.

**DESCRIPTION**

**cgGetFirstState** is used to begin iteration over all of the state definitions contained within a context. See **cgGetNextState** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetFirstState** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextState**, **cgGetNamedState**, **cgIsState**



**NAME**

**cgGetFirstStateAssignment** – get the first state assignment in a pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgGetFirstStateAssignment( CGpass pass );
```

**PARAMETERS**

**pass**        The pass from which to retrieve the first state assignment.

**RETURN VALUES**

Returns the first **CGstateassignment** object in **pass**.

Returns **NULL** if **pass** contains no state assignments or an error occurs.

**DESCRIPTION**

**cgGetFirstStateAssignment** is used to begin iteration over all of the state assignment contained within a pass. See **cgGetNextStateAssignment** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetFirstStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNextStateAssignment**, **cgIsStateAssignment**

**NAME**

**cgGetFirstStructParameter** – get the first child parameter from a struct parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetFirstStructParameter( CGparameter param );
```

**PARAMETERS**

**param** Specifies the struct parameter. This parameter must be of type **CG\_STRUCT** (returned by `cgGetParameterType`).

**RETURN VALUES**

Returns a handle to the first member parameter.

Returns **NULL** if **param** is not a struct or if some other error occurs.

**DESCRIPTION**

**cgGetFirstStructParameter** returns the first member parameter of a struct parameter. The rest of the members may be retrieved from the first member by iterating with `cgGetNextParameter`.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **param** is not a struct parameter.

**HISTORY**

**cgGetFirstStructParameter** was introduced in Cg 1.1.

**SEE ALSO**

`cgGetNextParameter`, `cgGetFirstParameter`

**NAME**

**cgGetFirstTechnique** – get the first technique in an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtechnique cgGetFirstTechnique( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect from which to retrieve the first technique.

**RETURN VALUES**

Returns the first **CGtechnique** object in **effect**.

Returns **NULL** if **effect** contains no techniques or an error occurs.

**DESCRIPTION**

**cgGetFirstTechnique** is used to begin iteration over all of the techniques contained within a effect. See **cgGetNextTechnique** for more information.

**EXAMPLES**

Iterating through the techniques in an effect:

```
CGeffect effect = cgCreateEffectFromFile(context, cgfx_filename, NULL);
CGtechnique technique = cgGetFirstTechnique(effect);
while (technique) {
    // Do something with each technique
    technique = cgGetNextTechnique(technique);
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetFirstTechnique** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstTechniqueAnnotation,            cgGetNamedTechniqueAnnotation,            cgGetNextTechnique,  
cgGetNamedTechnique,    cgValidateTechnique,    cgGetPassTechnique,    cgGetTechniqueEffect,  
cgGetTechniqueName, cgIsTechnique

**NAME**

**cgGetFirstTechniqueAnnotation** – get the first annotation of a technique

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetFirstTechniqueAnnotation( CGtechnique tech );
```

**PARAMETERS**

tech      The technique from which to retrieve the annotation.

**RETURN VALUES**

Returns the first annotation in the given technique.

Returns **NULL** if the technique has no annotations or an error occurs.

**DESCRIPTION**

The annotations associated with a technique can be retrieved using **cgGetFirstTechniqueAnnotation**. The remainder of the technique's annotations can be discovered by iterating through the parameters, calling **cgGetNextAnnotation** to get to the next one.

**EXAMPLES**

```
CGannotation ann = cgGetFirstTechniqueAnnotation( technique );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetFirstTechniqueAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

cgGetNamedTechniqueAnnotation, cgGetNextAnnotation

**NAME**

**cgGetFloatAnnotationValues** – get a float-valued annotation’s values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const float * cgGetFloatAnnotationValues( CGannotation ann,  
                                           int * nvalues );
```

**PARAMETERS**

**ann**        The annotation from which the values will be retrieved.

**nvalues**   Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **float** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if no values are available. **nvalues** will be **0**.

**DESCRIPTION**

**cgGetFloatAnnotationValues** allows the application to retrieve the *value*(s) of a floating-point typed annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**HISTORY**

**cgGetFloatAnnotationValues** was introduced in Cg 1.4.

**SEE ALSO**

cgGetAnnotationType,  
cgGetBoolAnnotationValues

cgGetIntAnnotationValues,

cgGetStringAnnotationValue,

**NAME**

**cgGetFloatStateAssignmentValues** – get a float-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const float * cgGetFloatStateAssignmentValues( CGstateassignment sa,  
                                                int * nvalues );
```

**PARAMETERS**

sa           The state assignment from which the values will be retrieved.

nvalues    Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **float** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if an error occurs or if no values are available. **nvalues** will be **0** in the latter case.

**DESCRIPTION**

**cgGetFloatStateAssignmentValues** allows the application to retrieve the *value* (s) of a floating-point typed state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a float type.

**HISTORY**

**cgGetFloatStateAssignmentValues** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState,  
cgGetBoolStateAssignmentValues,  
cgGetProgramStateAssignmentValue,  
cgGetTextureStateAssignmentValue

cgGetStateType,

cgGetIntStateAssignmentValues,  
cgGetStringStateAssignmentValue,  
cgGetSamplerStateAssignmentValue,

**NAME**

**cgGetIntAnnotationValues** – get an integer-valued annotation's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const int * cgGetIntAnnotationValues( CGannotation ann,  
                                     int * nvalues );
```

**PARAMETERS**

**ann**        The annotation from which the values will be retrieved.

**nvalues**   Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **int** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if no values are available. **nvalues** will be **0**.

**DESCRIPTION**

**cgGetIntAnnotationValues** allows the application to retrieve the *value* (s) of an int typed annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**HISTORY**

**cgGetIntAnnotationValues** was introduced in Cg 1.4.

**SEE ALSO**

cgGetAnnotationType,

cgGetFloatAnnotationValues,

cgGetStringAnnotationValue,

cgGetBoolAnnotationValues

**NAME**

**cgGetIntStateAssignmentValues** – get an int-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const int * cgGetIntStateAssignmentValues( CGstateassignment sa,  
                                           int * nvalues );
```

**PARAMETERS**

sa           The state assignment from which the values will be retrieved.

nvalues   Pointer to integer where the number of values returned will be stored.

**RETURN VALUES**

Returns a pointer to an array of **int** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if an error occurs or if no values are available. **nvalues** will be **0** in the latter case.

**DESCRIPTION**

**cgGetIntStateAssignmentValues** allows the application to retrieve the *value*(s) of an integer typed state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of an integer type.

**HISTORY**

**cgGetIntStateAssignmentValues** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState,  
cgGetBoolStateAssignmentValues,  
cgGetProgramStateAssignmentValue,  
cgGetTextureStateAssignmentValue

cgGetStateType,

cgGetFloatStateAssignmentValues,  
cgGetStringStateAssignmentValue,  
cgGetSamplerStateAssignmentValue,



**NAME**

**cgGetLastErrorString** – get the current error condition

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetLastErrorString( CGerror * error );
```

**PARAMETERS**

**error**     A pointer to a **CGerror** variable for returning the last error code.

**RETURN VALUES**

Returns the last error string.

Returns **NULL** if there was no error.

If **error** is not **NULL**, the last error code will be returned in the location specified by **error**. This is the same value that would be returned by `cgGetError`.

**DESCRIPTION**

**cgGetLastErrorString** returns the current error condition and error condition string. It's similar to calling `cgGetErrorString` with the result of `cgGetError`. However in certain cases the error string may contain more information about the specific error that last occurred than what `cgGetErrorString` would return.

**EXAMPLES**

```
CGerror error;  
const char* errorString = cgGetLastErrorString( &error );
```

**ERRORS**

None.

**HISTORY**

**cgGetLastErrorString** was introduced in Cg 1.2.

**SEE ALSO**

`cgGetError`, `cgGetErrorString`

**NAME**

**cgGetLastListing** – get the current listing text

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetLastListing( CGcontext context );
```

**PARAMETERS**

context    The context handle.

**RETURN VALUES**

Returns a NULL-terminated string containing the current listing text.

Returns **NULL** if no listing text is available, or the listing text string is empty.

In all cases, the pointer returned by **cgGetLastListing** is only guaranteed to be valid until the next Cg entry point not related to error reporting is called. For example, calls to `cgCreateProgram`, `cgCompileProgram`, `cgCreateEffect`, or `cgValidateTechnique` will invalidate any previously-returned listing pointer.

**DESCRIPTION**

Each Cg context maintains a NULL-terminated string containing warning and error messages generated by the Cg compiler, state managers and the like. **cgGetLastListing** allows applications and custom state managers to query the listing text.

**cgGetLastListing** returns the current listing string for the given **CGcontext**. When a Cg runtime error occurs, applications can use the listing text from the appropriate context to provide the user with detailed information about the error.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetLastListing** was introduced in Cg 1.1.

**SEE ALSO**

`cgSetLastListing`, `cgCreateContext`, `cgSetErrorHandler`

**NAME**

**cgGetLockingPolicy** – get locking policy

**SYNOPSIS**

```
#include <Cg/cg.h>

CGLenum cgGetLockingPolicy( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns an enumerant indicating the current locking policy.

**DESCRIPTION**

**cgGetLockingPolicy** returns an enumerant indicating the current locking policy for the library. See **cgSetLockingPolicy** for more information.

**EXAMPLES**

```
CGLenum currentLockingPolicy = cgGetLockingPolicy();
```

**ERRORS**

None.

**HISTORY**

**cgGetLockingPolicy** was introduced in Cg 2.0.

**SEE ALSO**

**cgSetLockingPolicy**

**NAME**

**cgGetMatrixParameter** – gets the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float, or double */

void cgGetMatrixParameter{ifd}{rc}( CGparameter param,
                                     TYPE * matrix );
```

**PARAMETERS**

**param**    The parameter from which the values will be returned.

**matrix**   An array of values into which the parameter's value will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGetMatrixParameter** functions retrieve the value of a given matrix parameter. The functions are available in various combinations.

There are versions of each function that take **int**, **float** or **double** values signified by the **i**, **f** or **d** in the function name.

There are versions of each function that specify the order in which matrix values should be written to the array. Row-major copying is indicated by **r**, while column-major is indicated by **c**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

The **cgGetMatrixParameter** functions were introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameterOrder, cgGetParameterValues

**NAME**

**cgGetMatrixParameterdc** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameterdc( CGparameter param,  
                             double * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of doubles into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameterdc** retrieves the values of the given matrix parameter using column-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameterdc** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgGetMatrixParameterdr** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameterdr( CGparameter param,  
                             double * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of doubles into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameterdr** retrieves the values of the given matrix parameter using row-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameterdr** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgGetMatrixParameterfc** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameterfc( CGparameter param,  
                             float * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of floats into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameterfc** retrieves the values of the given matrix parameter using column-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameterfc** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgGetMatrixParameterfr** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameterfr( CGparameter param,  
                             float * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of floats into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameterfr** retrieves the values of the given matrix parameter using row-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameterfr** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues



**NAME**

**cgGetMatrixParameteric** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameteric( CGparameter param,  
                             int * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of ints into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameteric** retrieves the values of the given matrix parameter using column-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameteric** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgGetMatrixParameterir** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgGetMatrixParameterir( CGparameter param,  
                             int * matrix );
```

**PARAMETERS**

**param**     The parameter from which the values will be returned.

**matrix**    An array of ints into which the matrix values will be written. The array must have size equal to the number of rows in the matrix times the number of columns in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixParameterir** retrieves the values of the given matrix parameter using row-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetMatrixParameterir** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgGetMatrixParameterOrder** – get the row or column order of a matrix parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetMatrixParameterOrder( Cgparameter param );
```

**PARAMETERS**

param    The parameter.

**RETURN VALUES**

Returns **CG\_ROW\_MAJOR** for a row-major matrix parameter.

Returns **CG\_COLUMN\_MAJOR** for a column-major matrix parameter.

Returns **CG\_UNKNOWN** for a parameter that is not a matrix.

**DESCRIPTION**

**cgGetMatrixParameterOrder** returns the row or column order of a matrix parameter.

The Cg compiler supports **#pragma pack\_matrix(row\_major)** or **#pragma pack\_matrix(column\_major)** for specifying the order of matrix parameters. Row-major order is the Cg default.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter or **param** is not a matrix parameter.

**HISTORY**

**cgGetMatrixParameterOrder** was introduced in Cg 2.2.

**SEE ALSO**

cgGetMatrixParameter, cgGetMatrixSize

**NAME**

**cgGetMatrixSize** – get the size of one dimension of an array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgGetMatrixSize( CGtype type,
                     int * nrows,
                     int * ncols );
```

**PARAMETERS**

**type**      The type enumerator.

**nrows**     A pointer to the location where the number of rows that **type** has will be written.

**ncols**     A pointer to the location where the number of columns that **type** has will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGetMatrixSize** writes the number of rows and columns contained by the specified matrix type into **nrows** and **ncols** locations respectively. If **type** is not a matrix enumerator type, **0** is written as both the rows and columns size.

Contrast this routine with **cgGetTypeSizes** where the number of rows and columns will be set to **1** row and **1** column for both scalar and non-numeric types but for vector types, the number of rows and columns will be set to **1** row and **N** columns where **N** is the number of components in the vector.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGetMatrixSize** was introduced in Cg 1.5.

**SEE ALSO**

**cgGetMatrixParameterOrder**,   **cgGetArrayTotalSize**,   **cgGetArrayDimension**,   **cgGetArrayParameter**,  
**cgGetTypeSizes**

**NAME**

**cgGetNamedEffect** – get an effect from a context by name

**SYNOPSIS**

```
#include <Cg/cg.h>

CGeffect cgGetNamedEffect( CGcontext context,
                           const char * name );
```

**PARAMETERS**

context    The context from which to retrieve the effect.

name       The name of the effect to retrieve.

**RETURN VALUES**

Returns the named effect if found.

Returns **NULL** if **context** has no effect corresponding to **name** or if an error occurs.

**DESCRIPTION**

The effects in a context can be retrieved directly by name using **cgGetNamedEffect**. The effect names can be discovered by iterating through the context's effects (see **cgGetFirstEffect** and **cgGetNextEffect**) and calling **cgGetEffectName** for each.

**EXAMPLES**

```
/* get "simpleEffect" from context */
CGeffect effect = cgGetNamedEffect( context, "simpleEffect" );
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetNamedEffect** was introduced in Cg 1.5.

**SEE ALSO**

**cgGetEffectName**, **cgSetEffectName**, **cgGetFirstEffect**, **cgGetNextEffect**

**NAME**

**cgGetNamedEffectAnnotation** – get an effect annotation by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNamedEffectAnnotation( CGeffect effect,  
                                         const char * name );
```

**PARAMETERS**

effect     The effect from which to retrieve the annotation.

name      The name of the annotation to retrieve.

**RETURN VALUES**

Returns the named annotation.

Returns **NULL** if the effect has no annotation corresponding to **name**.

**DESCRIPTION**

The annotations associated with an effect can be retrieved directly by name using **cgGetNamedEffectAnnotation**. The names of a effect's annotations can be discovered by iterating through the annotations (see `cgGetFirstEffectAnnotation` and `cgGetNextAnnotation`), calling `cgGetAnnotationName` for each one in turn.

**EXAMPLES**

```
/* fetch annotation "Apple" from CGeffect effect */  
CGannotation ann = cgGetNamedEffectAnnotation( effect, "Apple" );
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**CG\_INVALID\_POINTER\_ERROR** is generated if **name** is **NULL**.

**HISTORY**

**cgGetNamedEffectAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

`cgGetFirstEffectAnnotation`, `cgGetNextAnnotation`, `cgGetAnnotationName`

**NAME**

**cgGetNamedEffectParameter** – get an effect parameter by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetNamedEffectParameter( CGeffect effect,  
                                         const char * name );
```

**PARAMETERS**

effect     The effect from which to retrieve the parameter.

name     The name of the parameter to retrieve.

**RETURN VALUES**

Returns the named parameter from the effect.

Returns **NULL** if the effect has no parameter corresponding to **name**.

**DESCRIPTION**

The parameters of a effect can be retrieved directly by name using **cgGetNamedEffectParameter**. The names of the parameters in a effect can be discovered by iterating through the effect's parameters (see **cgGetFirstEffectParameter** and **cgGetNextParameter**), calling **cgGetParameterName** for each one in turn.

The given name may be of the form “foo.bar[2]”, which retrieves the second element of the array “bar” in a structure named “foo”.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetNamedEffectParameter** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetFirstEffectParameter**, **cgGetNextParameter**, **cgGetParameterName**, **cgGetNamedParameter**

**NAME**

**cgGetNamedParameter** – get a program parameter by name

**SYNOPSIS**

```
#include <Cg/cg.h>

CGparameter cgGetNamedParameter( CGprogram program,
                                  const char * name );
```

**PARAMETERS**

program The program from which to retrieve the parameter.

name The name of the parameter to retrieve.

**RETURN VALUES**

Returns the named parameter from the program.

Returns **NULL** if the program has no parameter corresponding to **name**.

**DESCRIPTION**

The parameters of a program can be retrieved directly by name using **cgGetNamedParameter**. The names of the parameters in a program can be discovered by iterating through the program's parameters (see **cgGetNextParameter**), calling **cgGetParameterName** for each one in turn.

The parameter name does not have to be complete name for a leaf node parameter. For example, if you have Cg program with the following parameters :

```
struct FooStruct
{
    float4 A;
    float4 B;
};

struct BarStruct
{
    FooStruct Foo[2];
};

void main(BarStruct Bar[3])
{
    /* ... */
}
```

The following leaf-node parameters will be generated :

```
Bar[0].Foo[0].A
Bar[0].Foo[0].B
Bar[0].Foo[1].A
Bar[0].Foo[1].B
Bar[1].Foo[0].A
Bar[1].Foo[0].B
Bar[1].Foo[1].A
Bar[1].Foo[1].B
Bar[2].Foo[0].A
Bar[2].Foo[0].B
Bar[2].Foo[1].A
Bar[2].Foo[1].B
```

A handle to any of the non-leaf arrays or structs can be directly obtained by using the appropriate name.



The following are a few examples of names valid names that may be used with **cgGetNamedParameter** given the above Cg program :

```
"Bar"  
"Bar[1]"  
"Bar[1].Foo"  
"Bar[1].Foo[0]"  
"Bar[1].Foo[0].B"  
...
```

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

## HISTORY

**cgGetNamedParameter** was introduced in Cg 1.1.

## SEE ALSO

cgIsParameter, cgGetFirstParameter, cgGetNextParameter, cgGetArrayParameter, cgGetParameterName

## NAME

**cgGetNamedParameterAnnotation** – get a parameter annotation by name

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNamedParameterAnnotation( CGparameter param,  
                                             const char * name );
```

## PARAMETERS

**param**     The parameter from which to retrieve the annotation.

**name**     The name of the annotation to retrieve.

## RETURN VALUES

Returns the named annotation.

Returns **NULL** if the parameter has no annotation corresponding to **name**.

## DESCRIPTION

The annotations associated with a parameter can be retrieved directly by name using **cgGetNamedParameterAnnotation**. The names of a parameter's annotations can be discovered by iterating through the annotations (see **cgGetFirstParameterAnnotation** and **cgGetNextAnnotation**), calling **cgGetAnnotationName** for each one in turn.

## EXAMPLES

```
/* fetch annotation "Apple" from CGparameter param */  
CGannotation ann = cgGetNamedParameterAnnotation( param, "Apple" );
```

## ERRORS

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

## HISTORY

**cgGetNamedParameterAnnotation** was introduced in Cg 1.4.

## SEE ALSO

**cgGetFirstParameterAnnotation**, **cgGetNextAnnotation**, **cgGetAnnotationName**

**NAME**

**cgGetNamedPass** – get a technique pass by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGpass cgGetNamedPass( CGtechnique tech,  
                      const char * name );
```

**PARAMETERS**

**tech**      The technique from which to retrieve the pass.

**name**      The name of the pass to retrieve.

**RETURN VALUES**

Returns the named pass from the technique.

Returns **NULL** if the technique has no pass corresponding to **name**.

**DESCRIPTION**

The passes of a technique can be retrieved directly by name using **cgGetNamedPass**. The names of the passes in a technique can be discovered by iterating through the technique's passes (see **cgGetFirstPass** and **cgGetNextPass**), calling **cgGetPassName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetNamedPass** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetFirstPass**, **cgGetNextPass**, **cgGetPassName**

## NAME

**cgGetNamedPassAnnotation** – get a pass annotation by name

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNamedPassAnnotation( CGpass pass,
                                       const char * name );
```

## PARAMETERS

pass      The pass from which to retrieve the annotation.

name      The name of the annotation to retrieve.

## RETURN VALUES

Returns the named annotation.

Returns **NULL** if the pass has no annotation corresponding to **name**.

## DESCRIPTION

The annotations associated with a pass can be retrieved directly by name using **cgGetNamedPassAnnotation**. The names of a pass's annotations can be discovered by iterating through the annotations (see `cgGetFirstPassAnnotation` and `cgGetNextAnnotation`), calling `cgGetAnnotationName` for each one in turn.

## EXAMPLES

```
/* fetch annotation "Apple" from CGpass pass */
CGannotation ann = cgGetNamedPassAnnotation( pass, "Apple" );
```

## ERRORS

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

## HISTORY

**cgGetNamedPassAnnotation** was introduced in Cg 1.4.

## SEE ALSO

`cgGetFirstPassAnnotation`, `cgGetNextAnnotation`, `cgGetAnnotationName`

**NAME**

**cgGetNamedProgramAnnotation** – get a program annotation by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNamedProgramAnnotation( CGprogram program,  
                                           const char * name );
```

**PARAMETERS**

program The program from which to retrieve the annotation.

name The name of the annotation to retrieve.

**RETURN VALUES**

Returns the named annotation.

Returns **NULL** if the program has no annotation corresponding to **name**.

**DESCRIPTION**

The annotations associated with a program can be retrieved directly by name using **cgGetNamedProgramAnnotation**. The names of a program's annotations can be discovered by iterating through the annotations (see `cgGetFirstProgramAnnotation` and `cgGetNextAnnotation`), calling `cgGetAnnotationName` for each one in turn.

**EXAMPLES**

```
/* fetch annotation "Apple" from CGprogram program */  
CGannotation ann = cgGetNamedProgramAnnotation( program, "Apple" );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetNamedProgramAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

`cgGetFirstProgramAnnotation`, `cgGetNextAnnotation`, `cgGetAnnotationName`

**NAME**

**cgGetNamedProgramParameter** – get a program parameter by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetNamedProgramParameter( CGprogram program,
                                          CGenum name_space,
                                          const char * name );
```

**PARAMETERS**

program	The program from which to retrieve the parameter.
name_space	Specifies the namespace of the parameter to iterate through. Currently <b>CG_PROGRAM</b> and <b>CG_GLOBAL</b> are supported.
name	Specifies the name of the parameter to retrieve.

**RETURN VALUES**

Returns the named parameter from the program.

Returns **NULL** if the program has no parameter corresponding to **name**.

**DESCRIPTION**

**cgGetNamedProgramParameter** is essentially identical to **cgGetNamedParameter** except it limits the search of the parameter to the name space specified by **name\_space**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetNamedProgramParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetNamedParameter**

**NAME**

**cgGetNamedSamplerState** – get a sampler state by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetNamedSamplerState( CGcontext context,  
                                const char * name );
```

**PARAMETERS**

context    The context from which to retrieve the named sampler state.

name       The name of the state to retrieve.

**RETURN VALUES**

Returns the named sampler state.

Returns **NULL** if **context** is invalid or if **context** has no sampler states corresponding to **name**.

**DESCRIPTION**

The sampler states associated with a context, as specified with a **sampler\_state** block in an effect file, can be retrieved directly by name using **cgGetNamedSamplerState**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL**.

**HISTORY**

**cgGetNamedSamplerState** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateArraySamplerState, cgCreateSamplerState, cgGetFirstSamplerState, cgSetSamplerState

**NAME**

**cgGetNamedSamplerStateAssignment** – get a sampler state assignment by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgGetNamedSamplerStateAssignment( CGparameter param,
                                                    const char * name );
```

**PARAMETERS**

**param**     The sampler parameter from which to retrieve the sampler state assignment.

**name**     The name of the state assignment to retrieve.

**RETURN VALUES**

Returns the named sampler state assignment.

Returns **NULL** if the pass has no sampler state assignment corresponding to **name**.

**DESCRIPTION**

The sampler state assignments associated with a **sampler** parameter, as specified with a **sampler\_state** block in an effect file, can be retrieved directly by name using **cgGetNamedSamplerStateAssignment**. The names of the sampler state assignments can be discovered by iterating through the sampler's state assignments (see **cgGetFirstSamplerStateAssignment** and **cgGetNextStateAssignment**), calling **cgGetSamplerStateAssignmentState** then **cgGetStateName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetNamedSamplerStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

**cgIsStateAssignment**, **cgGetFirstSamplerStateAssignment**, **cgGetNextStateAssignment**, **cgGetStateName**



**NAME**

**cgGetNamedState** – get a context state by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetNamedState( CGcontext context,  
                        const char * name );
```

**PARAMETERS**

context    The context from which to retrieve the state.

name       The name of the state to retrieve.

**RETURN VALUES**

Returns the named state from the context.

Returns **NULL** if the context has no state corresponding to **name**.

**DESCRIPTION**

The states of a context can be retrieved directly by name using **cgGetNamedState**. The names of the states in a context can be discovered by iterating through the context's states (see **cgGetFirstState** and **cgGetNextState**), calling **cgGetStateName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **name** is **NULL**.

**HISTORY**

**cgGetNamedState** was introduced in Cg 1.4.

**SEE ALSO**

**cgCreateState**, **cgGetFirstState**, **cgGetNextState**, **cgGetStateEnumerantName**, **cgGetStateEnumerantValue**, **cgGetStateName**, **cgGetStateType**, **cgIsState**

**NAME**

**cgGetNamedStateAssignment** – get a pass state assignment by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgGetNamedStateAssignment( CGpass pass,
                                              const char * name );
```

**PARAMETERS**

pass      The pass from which to retrieve the state assignment.

name      The name of the state assignment to retrieve.

**RETURN VALUES**

Returns the named state assignment from the pass.

Returns **NULL** if the pass has no state assignment corresponding to **name**.

**DESCRIPTION**

The state assignments of a pass can be retrieved directly by name using **cgGetNamedStateAssignment**. The names of the state assignments in a pass can be discovered by iterating through the pass's state assignments (see **cgGetFirstStateAssignment** and **cgGetNextStateAssignment**), calling **cgGetStateAssignmentState** then **cgGetStateName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetNamedStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

**cgIsStateAssignment**, **cgGetFirstStateAssignment**, **cgGetNextStateAssignment**,  
**cgGetStateAssignmentState**, **cgGetStateName**

**NAME**

**cgGetNamedStructParameter** – get a struct parameter by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetNamedStructParameter( CGparameter param,  
                                         const char * name );
```

**PARAMETERS**

**param**     The struct parameter from which to retrieve the member parameter.

**name**      The name of the member parameter to retrieve.

**RETURN VALUES**

Returns the member parameter from the given struct.

Returns **NULL** if the struct has no member parameter corresponding to **name**.

**DESCRIPTION**

The member parameters of a struct parameter may be retrieved directly by name using **cgGetNamedStructParameter**.

The names of the parameters in a struct may be discovered by iterating through the struct's member parameters (see **cgGetFirstStructParameter** and **cgGetNextParameter**), and calling **cgGetParameterName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **param** is not a struct parameter.

**HISTORY**

**cgGetNamedStructParameter** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetFirstStructParameter**, **cgGetNextParameter**, **cgGetParameterName**

**NAME**

**cgGetNamedSubParameter** – gets a “shallow” or “deep” parameter from an aggregate parameter (ie struct, array, etc.)

**SYNOPSIS**

```
#include <Cg/cg.h>

CGparameter cgGetNamedSubParameter( CGparameter param,
                                     const char * name );
```

**PARAMETERS**

param    Aggregate parameter.  
name    Name of the parameter inside the aggregate parameter (param) being requested.

**RETURN VALUES**

Returns the named parameter.  
Returns **NULL** if **param** has no parameter corresponding to **name**.

**DESCRIPTION**

**cgGetNamedSubParameter** is a generalized parameter getter function that will retrieve parameters, including deep parameters, of an aggregate parameter type such as a structure or an array.

**EXAMPLES**

```
CGparameter parent = cgGetNamedParameter( program, "someParameter" );
CGparameter deepChild = cgGetNamedSubParameter( parent, "foo.list[3].item" );

/* Note: 'deepChild' is the same parameter returned by:
   cgGetNamedParameter( program, "someParameter.foo.list[3].item" ); */
```

**ERRORS**

None.

**HISTORY**

**cgGetNamedSubParameter** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNamedParameter, cgGetNamedStructParameter, cgGetArrayParameter

**NAME**

**cgGetNamedTechnique** – get an effect’s technique by name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtechnique cgGetNamedTechnique( CGeffect effect,  
                                const char * name );
```

**PARAMETERS**

effect     The effect from which to retrieve the technique.

name      The name of the technique to retrieve.

**RETURN VALUES**

Returns the named technique from the effect.

Returns **NULL** if the effect has no technique corresponding to **name**.

**DESCRIPTION**

The techniques of an effect can be retrieved directly by name using **cgGetNamedTechnique**. The names of the techniques in a effect can be discovered by iterating through the effect’s techniques (see **cgGetFirstTechnique** and **cgGetNextTechnique**), calling **cgGetTechniqueName** for each one in turn.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetNamedTechnique** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetFirstTechnique**, **cgGetNextTechnique**, **cgGetTechniqueName**

## NAME

**cgGetNamedTechniqueAnnotation** – get a technique annotation by name

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNamedTechniqueAnnotation( CGtechnique tech,  
                                             const char * name );
```

## PARAMETERS

**tech**      The technique from which to retrieve the annotation.

**name**      The name of the annotation to retrieve.

## RETURN VALUES

Returns the named annotation.

Returns **NULL** if the technique has no annotation corresponding to **name**.

## DESCRIPTION

The annotations associated with a technique can be retrieved directly by name using **cgGetNamedTechniqueAnnotation**. The names of a technique's annotations can be discovered by iterating through the annotations (see **cgGetFirstTechniqueAnnotation** and **cgGetNextAnnotation**), calling **cgGetAnnotationName** for each one in turn.

## EXAMPLES

```
/* fetch annotation "Apple" from CGtechnique technique */  
CGannotation ann = cgGetNamedTechniqueAnnotation( technique, "Apple" );
```

## ERRORS

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

## HISTORY

**cgGetNamedTechniqueAnnotation** was introduced in Cg 1.4.

## SEE ALSO

**cgGetFirstTechniqueAnnotation**, **cgGetNextAnnotation**, **cgGetAnnotationName**

**NAME**

**cgGetNamedUserType** – get enumerant associated with type name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetNamedUserType( CGhandle handle,  
                           const char * name );
```

**PARAMETERS**

handle    The **CGprogram** or **CGeffect** in which the type is defined.

name      A string containing the case-sensitive type name.

**RETURN VALUES**

Returns the type enumerant associated with **name**.

Returns **CG\_UNKNOWN\_TYPE** if no such type exists.

**DESCRIPTION**

**cgGetNamedUserType** returns the enumerant associated with the named type defined in the construct associated with **handle**, which may be a **CGprogram** or **CGeffect**.

For a given type name, the enumerant returned by this entry point is guaranteed to be identical if called with either an **CGeffect** handle, or a **CGprogram** that is defined within that effect.

If two programs in the same context define a type using identical names and definitions, the associated enumerants are also guaranteed to be identical.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **handle** is not a valid program or effect.

**HISTORY**

**cgGetNamedUserType** was introduced in Cg 1.2.

**SEE ALSO**

cgGetUserType, cgGetType

**NAME**

**cgGetNextAnnotation** – iterate through annotations

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGannotation cgGetNextAnnotation( CGannotation ann );
```

**PARAMETERS**

ann        The current annotation.

**RETURN VALUES**

Returns the next annotation in the sequence of annotations associated with the annotated object.

Returns **NULL** when **ann** is the last annotation.

**DESCRIPTION**

The annotations associated with a parameter, pass, technique, or program can be iterated over by using **cgGetNextAnnotation**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each annotation will be visited exactly once.

**EXAMPLES**

```
CGannotation ann = cgGetFirstParameterAnnotation( param );
while( ann )
{
    /* do something with ann */
    ann = cgGetNextAnnotation( ann );
}
```

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**HISTORY**

**cgGetNextAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstParameterAnnotation,        cgGetFirstPassAnnotation,        cgGetFirstTechniqueAnnotation,  
cgGetFirstProgramAnnotation,        cgGetNamedParameterAnnotation,        cgGetNamedPassAnnotation,  
cgGetNamedTechniqueAnnotation, cgGetNamedProgramAnnotation, cgIsAnnotation



**NAME**

**cgGetNextEffect** – iterate through effects in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgGetNextEffect( CGeffect effect );
```

**PARAMETERS**

**effect**     The current effect.

**RETURN VALUES**

Returns the next effect in the context's internal sequence of effects.

Returns **NULL** when **effect** is the last effect in the context.

**DESCRIPTION**

The effects within a context can be iterated over with **cgGetNextEffect**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each effect will be visited exactly once. No guarantees can be made if effects are created or deleted during iteration.

**EXAMPLES**

```
CGeffect effect = cgGetFirstEffect( context );
while( effect )
{
    /* do something with effect */
    effect = cgGetNextEffect( effect );
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgGetNextEffect** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstEffect

**NAME**

**cgGetNextLeafParameter** – get the next leaf parameter in a program or effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetNextLeafParameter( CGparameter param );
```

**PARAMETERS**

param    The current leaf parameter.

**RETURN VALUES**

Returns the next leaf **CGparameter** object.

Returns **NULL** if **param** is invalid or if the program or effect from which the iteration started does not have any more leaf parameters.

**DESCRIPTION**

**cgGetNextLeafParameter** returns the next leaf parameter (not struct or array parameters) following a given leaf parameter.

In a similar manner, the leaf parameters in an effect can be iterated over starting with a call to **cgGetFirstLeafEffectParameter**.

**EXAMPLES**

```
CGparameter leaf = cgGetFirstLeafParameter( program );
while(leaf)
{
    /* Do stuff with leaf */
    leaf = cgGetNextLeafParameter( leaf );
}
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetNextLeafParameter** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetFirstLeafParameter**, **cgGetFirstLeafEffectParameter**

**NAME**

**cgGetNextParameter** – iterate through a program’s or effect’s parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

CGparameter cgGetNextParameter( CGparameter current );
```

**PARAMETERS**

current The current parameter.

**RETURN VALUES**

Returns the next parameter in the program or effect’s internal sequence of parameters.

Returns **NULL** when **current** is the last parameter in the program or effect.

**DESCRIPTION**

The parameters of a program or effect can be iterated over using **cgGetNextParameter** with **cgGetFirstParameter**, or **cgGetArrayParameter**.

Similarly, the parameters in an effect can be iterated over starting with a call to **cgGetFirstEffectParameter**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each parameter will be visited exactly once.

**EXAMPLES**

```
void RecurseParams( CGparameter param )
{
    if(!param)
        return;

    do
    {
        switch(cgGetParameterType(param))
        {
            case CG_STRUCT :
                RecurseParams(cgGetFirstStructParameter(param));
                break;

            case CG_ARRAY :
                {
                    int ArraySize = cgGetArraySize(param, 0);
                    int i;

                    for(i=0; i < ArraySize; ++i)
                        RecurseParams(cgGetArrayParameter(param, i));
                }
                break;

            default :
                /* Do stuff to param */
        }
    } while((param = cgGetNextParameter(param)) != 0);
}
```

```
void RecurseParamsInProgram( CGprogram program )
{
    RecurseParams( cgGetFirstParameter( program ) );
}
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetNextParameter** was introduced in Cg 1.1.

**SEE ALSO**

cgGetFirstParameter, cgGetFirstEffectParameter, cgGetFirstStructParameter, cgGetArrayParameter,  
cgGetParameterType

**NAME**

**cgGetNextPass** – iterate through the passes in a technique

**SYNOPSIS**

```
#include <Cg/cg.h>

CGpass cgGetNextPass( CGpass pass );
```

**PARAMETERS**

pass      The current pass.

**RETURN VALUES**

Returns the next pass in the technique's internal sequence of passes.

Returns **NULL** when **pass** is the last pass in the technique.

**DESCRIPTION**

The passes within a technique can be iterated over using **cgGetNextPass**.

Passes are returned in the order defined in the technique.

**EXAMPLES**

```
CGpass pass = cgGetFirstPass( technique );
while( pass )
{
    /* do something with pass */
    pass = cgGetNextPass( pass )
}
```

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetNextPass** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstPass, cgGetNamedPass, cgIsPass

**NAME**

**cgGetNextProgram** – iterate through programs in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetNextProgram( CGprogram program );
```

**PARAMETERS**

program The current program.

**RETURN VALUES**

Returns the next program in the context's internal sequence of programs.

Returns **NULL** when **program** is the last program in the context.

**DESCRIPTION**

The programs within a context can be iterated over by using **cgGetNextProgram**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each program will be visited exactly once. No guarantees can be made if programs are generated or deleted during iteration.

**EXAMPLES**

```
CGprogram program = cgGetFirstProgram( context );
while( program )
{
    /* do something with program */
    program = cgGetNextProgram( program )
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetNextProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgGetFirstProgram, cgCreateProgram, cgDestroyProgram, cgIsProgram

**NAME**

**cgGetNextState** – iterate through states in a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetNextState( CGstate state );
```

**PARAMETERS**

state      The current state.

**RETURN VALUES**

Returns the next state in the context's internal sequence of states.

Returns **NULL** when **state** is the last state in the context.

**DESCRIPTION**

The states within a context can be iterated over using **cgGetNextState**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each state will be visited exactly once. No guarantees can be made if states are created or deleted during iteration.

**EXAMPLES**

```
CGstate state = cgGetFirstState( context );
while( state )
{
    /* do something with state */
    state = cgGetNextState( state )
}
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetNextState** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstState, cgGetNamedState, cgCreateState, cgIsState

**NAME**

**cgGetNextStateAssignment** – iterate through state assignments in a pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstateassignment cgGetNextStateAssignment( CGstateassignment sa );
```

**PARAMETERS**

sa           The current state assignment.

**RETURN VALUES**

Returns the next state assignment in the pass' internal sequence of state assignments.

Returns **NULL** when **prog** is the last state assignment in the pass.

**DESCRIPTION**

The state assignments within a pass can be iterated over by using **cgGetNextStateAssignment**.

State assignments are returned in the same order specified in the pass in the effect.

**EXAMPLES**

```
CGstateassignment sa = cgGetFirstStateAssignment( pass );
while( sa )
{
    /* do something with sa */
    sa = cgGetNextStateAssignment( sa )
}
```

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgGetNextStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstStateAssignment, cgGetNamedStateAssignment, cgIsStateAssignment



**NAME**

**cgGetNextTechnique** – iterate through techniques in a effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtechnique cgGetNextTechnique( CGtechnique tech );
```

**PARAMETERS**

tech      The current technique.

**RETURN VALUES**

Returns the next technique in the effect's internal sequence of techniques.

Returns **NULL** when **tech** is the last technique in the effect.

**DESCRIPTION**

The techniques within a effect can be iterated over using **cgGetNextTechnique**.

Note that no specific order of traversal is defined by this mechanism. The only guarantee is that each technique will be visited exactly once.

**EXAMPLES**

```
CGtechnique tech = cgGetFirstTechnique( effect );
while( tech )
{
    /* do something with tech */
    tech = cgGetNextTechnique( tech )
}
```

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetNextTechnique** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstTechnique, cgGetNamedTechnique

**NAME**

**cgGetNumConnectedToParameters** – gets the number of connected destination parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetNumConnectedToParameters( CGparameter param );
```

**PARAMETERS**

param    The source parameter.

**RETURN VALUES**

Returns the number of destination parameters connected to **param**.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetNumConnectedToParameters** returns the number of destination parameters connected to the source parameter **param**. It's primarily used with **cgGetConnectedToParameter**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetNumConnectedToParameters** was introduced in Cg 1.2.

**SEE ALSO**

**cgConnectParameter**, **cgGetConnectedParameter**, **cgGetConnectedToParameter**

## NAME

**cgGetNumDependentAnnotationParameters** – get the number of effect parameters on which an annotation depends

## SYNOPSIS

```
#include <Cg/cg.h>
```

```
int cgGetNumDependentAnnotationParameters( CGannotation ann );
```

## PARAMETERS

ann        The annotation handle.

## RETURN VALUES

Returns the number of parameters on which **ann** depends.

## DESCRIPTION

Annotations in CgFX files may include references to one or more effect parameters on the right hand side of the annotation that are used for computing the annotation's value. **cgGetNumDependentAnnotationParameters** returns the total number of such parameters. **cgGetDependentAnnotationParameter** can then be used to iterate over these parameters.

This information can be useful for applications that wish to cache the values of annotations so that they can determine which annotations may change as the result of changing a particular parameter's value.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

## HISTORY

**cgGetNumDependentAnnotationParameters** was introduced in Cg 1.4.

## SEE ALSO

**cgGetDependentAnnotationParameter**, **cgGetNumDependentStateAssignmentParameters**

cgGetNumDependentStateAssignmentParameters( CGCoreRuntimeAPI cgGetNumDependentStateAssignmentParameters(3)

## NAME

**cgGetNumDependentStateAssignmentParameters** – get the number of effect parameters on which a state assignment depends

## SYNOPSIS

```
#include <Cg/cg.h>

int cgGetNumDependentStateAssignmentParameters( CGstateassignment sa );
```

## PARAMETERS

sa           The state assignment handle.

## RETURN VALUES

Returns the number of parameters on which **sa** depends.

## DESCRIPTION

State assignments in CgFX passes may include references to one or more effect parameters on the right hand side of the state assignment that are used for computing the state assignment's value. **cgGetNumDependentStateAssignmentParameters** returns the total number of such parameters. **cgGetDependentStateAssignmentParameter** can then be used to iterate over these parameters.

This information can be useful for applications that wish to cache the values of state assignments for customized state mangement so that they can determine which state assignments may change as the result of changing a parameter's value.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

## HISTORY

**cgGetNumDependentStateAssignmentParameters** was introduced in Cg 1.4.

## SEE ALSO

**cgGetDependentStateAssignmentParameter**, **cgGetFirstStateAssignment**, **cgGetNamedStateAssignment**, **cgGetNumDependentAnnotationParameters**

**NAME**

**cgGetNumParentTypes** – gets the number of parent types of a given type

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetNumParentTypes( CGtype type );
```

**PARAMETERS**

type      The child type.

**RETURN VALUES**

Returns the number of parent types.

Returns **0** if there are no parents.

**DESCRIPTION**

**cgGetNumParentTypes** returns the number of parents from which **type** inherits.

A parent type is one from which the given type inherits, or an interface type that the given type implements.

Note that the current Cg language specification implies that a type may only have a single parent type — an interface implemented by the given type.

**EXAMPLES**

Given the type definitions:

```
interface myiface {
    float4 eval(void);
};

struct mystruct : myiface {
    float4 value;
    float4 eval(void ) { return value; }
};
```

**mystruct** has a single parent type, **myiface**.

**ERRORS**

None.

**HISTORY**

**cgGetNumParentTypes** was introduced in Cg 1.2.

**SEE ALSO**

cgGetParentType

**NAME**

**cgGetNumProgramDomains** – get the number of domains in a combined program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetNumProgramDomains( CGprogram program );
```

**PARAMETERS**

**program** The combined program object to be queried.

**RETURN VALUES**

Returns the number of domains in the combined program *program*.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGetNumProgramDomains** returns the number of domains in a combined program. For example, if the combined program contained a vertex program and a fragment program, **cgGetNumProgramDomains** will return 2.

**cgGetNumProgramDomains** will always return **1** for a non-combined program.

**EXAMPLES**

```
CGprogram combined = cgCombinePrograms2( prog1, prog2 );
int numDomains = cgGetNumProgramDomains( combined );
/* numDomains == 2 */
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetNumProgramDomains** was introduced in Cg 1.5.

**SEE ALSO**

cgGetProfileDomain, cgGetProgramDomainProfile, cgGetProgramDomainProgram

**NAME**

**cgGetNumStateEnumerants** – gets the number of enumerants associated with a state

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetNumStateEnumerants( CGstate state );
```

**PARAMETERS**

state      The state from which to retrieve the number of associated enumerants.

**RETURN VALUES**

Returns the number of enumerants associated with **state**.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGetNumStateEnumerants** returns the number of enumerants associated with a given **CGstate**. Enumerants can be added to a **CGstate** using **cgAddStateEnumerant**.

**EXAMPLES**

```
int value;
char* pName;

int nEnums = cgGetNumStateEnumerants(state);

for (ii=0; ii<nEnums; ++ii) {
    pName = cgGetStateEnumerant(state, ii, &value );
    printf("%i: %s %i\n", ii+1, pName, value);
}
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetNumStateEnumerants** was introduced in Cg 2.2.

**SEE ALSO**

**cgAddStateEnumerant**, **cgGetStateEnumerant**, **cgGetStateEnumerantName**, **cgGetStateEnumerantValue**

**NAME**

**cgGetNumSupportedProfiles** – get the number of supported profiles

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetNumSupportedProfiles( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the number of profiles supported by this version of Cg.

**DESCRIPTION**

**cgGetNumSupportedProfiles** provides the number of profiles which are supported by this version of the Cg library.

Note that a profile may be recognized by Cg but not supported by the platform on which the application is currently running. A graphics API specific routine such as `cgGLIsProfileSupported` must still be used to determine if the current GPU and driver combination supports a given profile.

**EXAMPLES**

```
CGprofile profile;
int nProfiles;
int ii;

nProfiles = cgGetNumSupportedProfiles();
printf("NumSupportedProfiles: %i\n", nProfiles);

for (ii=0; ii<nProfiles; ++ii) {
    profile = cgGetSupportedProfile(ii);
    printf("SupportedProfile %i: %s %i\n", ii, cgGetProfileString(profile),
          cgGetProfile(cgGetProfileString(profile)));
}
```

**ERRORS**

None.

**HISTORY**

**cgGetNumSupportedProfiles** was introduced in Cg 2.2.

**SEE ALSO**

`cgGetSupportedProfile`, `cgIsProfileSupported`, `cgGetProfileProperty`, `cgGLIsProfileSupported`, `cgD3D9IsProfileSupported`, `cgD3D10IsProfileSupported`, `cgGetProfileString`, `cgGetProfile`



**NAME**

**cgGetNumUserTypes** – get number of user-defined types in a program or effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetNumUserTypes( CGhandle handle );
```

**PARAMETERS**

handle    The **CGprogram** or **CGeffect** in which the types are defined.

**RETURN VALUES**

Returns the number of user defined types.

**DESCRIPTION**

**cgGetNumUserTypes** returns the number of user-defined types in a given **CGprogram** or **CGeffect**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **handle** is not a valid program or effect handle.

**HISTORY**

**cgGetNumUserTypes** was introduced in Cg 1.2.

**SEE ALSO**

cgGetUserType, cgGetNamedUserType

**NAME**

**cgGetParameterBaseResource** – get a parameter's base resource

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGresource cgGetParameterBaseResource( CGparameter param );
```

**PARAMETERS**

**param**    The parameter.

**RETURN VALUES**

Returns the base resource of **param**.

Returns **CG\_UNDEFINED** if no base resource exists for the given parameter.

**DESCRIPTION**

**cgGetParameterBaseResource** allows the application to retrieve the base resource for a parameter in a Cg program. The base resource is the first resource in a set of sequential resources. For example, if a given parameter has a resource of **CG\_ATTR7**, its base resource would be **CG\_ATTR0**. Only parameters with resources whose name ends with a number will have a base resource. For all other parameters the undefined resource **CG\_UNDEFINED** will be returned.

The numerical portion of the resource may be retrieved with **cgGetParameterResourceIndex**. For example, if the resource for a given parameter is **CG\_ATTR7**, **cgGetParameterResourceIndex** will return **7**.

**EXAMPLES**

```
/* log info about parameter param for debugging */

printf("Resource: %s:%d (base %s)\n",
       cgGetResourceString(cgGetParameterResource(param)),
       cgGetParameterResourceIndex(param),
       cgGetResourceString(cgGetParameterBaseResource(param)));
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a leaf node.

**HISTORY**

**cgGetParameterBaseResource** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetParameterResource**, **cgGetParameterResourceIndex**, **cgGetResourceString**

**NAME**

**cgGetParameterBaseType** – get a program parameter's base type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetParameterBaseType( CGparameter param );
```

**PARAMETERS**

**param**     The parameter.

**RETURN VALUES**

Returns the base type enumerator of **param**.

Returns **CG\_UNKNOWN\_TYPE** if an error occurs.

**DESCRIPTION**

**cgGetParameterBaseType** allows the application to retrieve the base type of a parameter.

If **param** is of a numeric type (scalar, vector, or matrix), the scalar enumerator corresponding to **param**'s type will be returned. For example, if **param** is of type **CG\_FLOAT4x3**, **cgGetParameterBaseType** will return **CG\_FLOAT**.

If **param** is an array, the base type of the array elements will be returned.

If **param** is a structure, its type-specific enumerator will be returned, as per **cgGetParameterNamedType**.

Otherwise, **param**'s type enumerator will be returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterBaseType** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterType**, **cgGetParameterNamedType**, **cgGetType**, **cgGetTypeString**, **cgGetParameterClass**

**NAME**

**cgGetParameterBufferIndex** – get buffer index by parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterBufferIndex( CGparameter param );
```

**PARAMETERS**

param     The parameter for which the associated buffer index will be retrieved.

**RETURN VALUES**

Returns the index for the buffer to which **param** belongs.

Returns **-1** if **param** does not belong to a buffer or an error occurs.

**DESCRIPTION**

**cgGetParameterBufferIndex** returns the index for the buffer to which a parameter belongs. If **param** does not belong to a buffer, then **-1** is returned.

**EXAMPLES**

```
int index = cgGetParameterBufferIndex( myParam );
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterBufferIndex** was introduced in Cg 2.0.

**SEE ALSO**

cgSetProgramBuffer, cgGetParameterBufferOffset, cgGetParameterResourceSize

**NAME**

**cgGetParameterBufferOffset** – get a parameter’s buffer offset

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterBufferOffset( CGparameter param );
```

**PARAMETERS**

**param**     The parameter for which the buffer offset will be retrieved.

**RETURN VALUES**

Returns the buffer offset for **param**.

Returns **-1** if **param** does not belong to a buffer or an error occurs.

**DESCRIPTION**

**cgGetParameterBufferOffset** returns the buffer offset associated with a parameter. If **param** does not belong to a buffer, then **-1** is returned.

**EXAMPLES**

```
int offset = cgGetParameterBufferOffset( myParam );
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterBufferOffset** was introduced in Cg 2.0.

**SEE ALSO**

cgGetParameterBufferIndex, cgGetParameterResourceSize

**NAME**

**cgGetParameterClass** – get a parameter’s class

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameterclass cgGetParameterClass( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the parameter class enumerant of **param**.

Returns **CG\_PARAMETERCLASS\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgGetParameterClass** allows the application to retrieve the class of a parameter.

The returned **CGparameterclass** value enumerates the high-level parameter classes:

**CG\_PARAMETERCLASS\_SCALAR**

The parameter is of a scalar type, such as **CG\_INT**, or **CG\_FLOAT**.

**CG\_PARAMETERCLASS\_VECTOR**

The parameter is of a vector type, such as **CG\_INT1**, or **CG\_FLOAT4**.

**CG\_PARAMETERCLASS\_MATRIX**

The parameter is of a matrix type, such as **CG\_INT1x1**, or **CG\_FLOAT4x4**.

**CG\_PARAMETERCLASS\_STRUCT**

The parameter is a struct or interface.

**CG\_PARAMETERCLASS\_ARRAY**

The parameter is an array.

**CG\_PARAMETERCLASS\_SAMPLER**

The parameter is a sampler.

**CG\_PARAMETERCLASS\_OBJECT**

The parameter is a texture, string, or program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterClass** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterClassString,     cgGetParameterClassEnum,     cgGetParameterType,     cgGetType,  
cgGetTypeString

**NAME**

**cgGetParameterClassEnum** – get the enumerant associated with a parameter class name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameterclass cgGetParameterClassEnum( const char * pString );
```

**PARAMETERS**

pString A string containing the case-sensitive parameter class name.

**RETURN VALUES**

Returns the parameter class enumerant associated with **pString**.

Returns **CG\_PARAMETERCLASS\_UNKNOWN** if the given parameter class does not exist.

**DESCRIPTION**

**cgGetParameterClassEnum** returns the enumerant associated with a parameter class name.

**EXAMPLES**

```
CGparameterclass structParameterClass = cgGetParameterClassEnum("struct");

if(cgGetParameterClassEnum(myparam) == structParameterClass)
{
    /* Do struct stuff */
}
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **pString** is **NULL**.

**HISTORY**

**cgGetParameterClassEnum** was introduced in Cg 2.2.

**SEE ALSO**

cgGetParameterClassString, cgGetParameterClass, cgGetTypeClass

**NAME**

**cgGetParameterClassString** – get the name associated with a parameter class enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetParameterClassString( CGparameterclass parameterclass );
```

**PARAMETERS**

parameterclass

The parameter class enumerator.

**RETURN VALUES**

Returns the name associated with **parameterclass**.

Returns “unknown” if **parameterclass** is not a valid parameter class.

**DESCRIPTION**

**cgGetParameterClassString** returns the name associated with a parameter class enumerator.

**EXAMPLES**

```
static void dumpCgParameterInfo(CGparameter parameter)
{
    /* ... */
    const char* p = cgGetParameterClassString(cgGetParameterType(parameter));
    if ( p ) {
        printf(" ParameterClass: %s\n", p);
    }
    /* ... */
}
```

**ERRORS**

None.

**HISTORY**

**cgGetParameterClassString** was introduced in Cg 2.2.

**SEE ALSO**

cgGetParameterClassEnum, cgGetParameterClass, cgGetTypeClass



**NAME**

**cgGetParameterColumns** – get number of parameter columns

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterColumns( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the number of columns associated with the type if **param** is a numeric type or an array of numeric types.

Returns **0** otherwise.

**DESCRIPTION**

**cgGetParameterColumns** return the number of columns associated with the given parameter's type.

If **param** is an array, the number of columns associated with each element of the array is returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterColumns** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterType, cgGetParameterRows

**NAME**

**cgGetParameterContext** – get a parameter's parent context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGcontext cgGetParameterContext( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns a **CGcontext** handle to the parent context.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetParameterContext** allows the application to retrieve a handle to the context to which a given parameter belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterContext** was introduced in Cg 1.2.

**SEE ALSO**

cgCreateParameter, cgGetParameterProgram

**NAME**

**cgGetParameterDefaultValue** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float, or double */

int cgGetParameterDefaultValue{ifd}{rc}( CGparameter param,
                                         int nelements,
                                         TYPE * v );
```

**PARAMETERS**

param	The program parameter whose default values will be retrieved.
nelements	The number of elements in array <b>v</b> .
v	Destination buffer to which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

The **cgGetParameterDefaultValue** functions allow the application to get the default values from any numeric parameter or parameter array. The default values are returned in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

There are versions of each function that return **int**, **float** or **double** values signified by **i**, **f** or **d** in the function name.

There are versions of each function that will cause any matrices referenced by **param** to be copied in either row-major or column-major order, as signified by the **r** or **c** in the function name.

For example, **cgGetParameterDefaultValueic** retrieves the default values of the given parameter using the supplied array of integer data, and copies matrix data in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

The **cgGetParameterDefaultValue** functions were introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize, cgGetParameterValue,  
cgSetParameterValue, cgGetParameterDefaultValuedc, cgGetParameterDefaultValuedr,  
cgGetParameterDefaultValuefc, cgGetParameterDefaultValuefr, cgGetParameterDefaultValueic,  
cgGetParameterDefaultValueir

**NAME**

**cgGetParameterDefaultValuedc** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValuedc( CGparameter param,
                                   int nelements,
                                   double * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValuedc** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as doubles in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValuedc** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize

**NAME**

**cgGetParameterDefaultValuedr** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValuedr( CGparameter param,
                                   int nelements,
                                   double * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValuedr** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as doubles in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows( param );
int ncols = cgGetParameterColumns( param );
int asize = cgGetArrayTotalSize( param );
int ntotal = nrows*ncols;
if ( asize > 0 ) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValuedr** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize

**NAME**

**cgGetParameterDefaultValuefc** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValuefc( CGparameter param,
                                int nelelements,
                                float * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValuefc** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as floats in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValuefc** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize

**NAME**

**cgGetParameterDefaultValuefr** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValuefr( CGparameter param,
                                int nelements,
                                float * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

           The number of elements in array **v**.

**v**

           Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValuefr** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as floats in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows( param );
int ncols = cgGetParameterColumns( param );
int asize = cgGetArrayTotalSize( param );
int ntotal = nrows*ncols;
if ( asize > 0 ) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValuefr** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize



**NAME**

**cgGetParameterDefaultValueic** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValueic( CGparameter param,
                                int nelements,
                                int * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValueic** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as ints in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows( param );
int ncols = cgGetParameterColumns( param );
int asize = cgGetArrayTotalSize( param );
int ntotal = nrows*ncols;
if ( asize > 0 ) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValueic** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize

**NAME**

**cgGetParameterDefaultValueir** – get the default values of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterDefaultValueir( CGparameter param,
                                int nelements,
                                int * v );
```

**PARAMETERS**

**param**     The parameter whose default values will be retrieved.

**nelements**

           The number of elements in array **v**.

**v**

           Destination buffer into which the parameter default values will be written.

**RETURN VALUES**

Returns the total number of default values written to **v**.

**DESCRIPTION**

**cgGetParameterDefaultValueir** allows the application to get the default values from any numeric parameter or parameter array. The default values are returned as ints in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of default values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of default values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows( param );
int ncols = cgGetParameterColumns( param );
int asize = cgGetArrayTotalSize( param );
int ntotal = nrows*ncols;
if ( asize > 0 ) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterDefaultValueir** was introduced in Cg 2.1.

**SEE ALSO**

cgGetParameterValue,     cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,  
cgGetArrayTotalSize

**NAME**

**cgGetParameterDirection** – get a program parameter's direction

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetParameterDirection( CGparameter param );
```

**PARAMETERS**

**param**     The program parameter.

**RETURN VALUES**

Returns the direction of **param**.

Returns **CG\_ERROR** if an error occurs.

**DESCRIPTION**

**cgGetParameterDirection** allows the application to distinguish program input parameters from program output parameters. This information is necessary for the application to properly supply the program inputs and use the program outputs.

**cgGetParameterDirection** will return one of the following enumerants :

**CG\_IN**         Specifies an input parameter.

**CG\_OUT**        Specifies an output parameter.

**CG\_INOUT**      Specifies a parameter that is both input and output.

**CG\_ERROR**      If an error occurs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterDirection** was introduced in Cg 1.1.

**SEE ALSO**

cgGetNamedParameter,     cgGetNextParameter,     cgGetParameterName,     cgGetParameterType,  
cgGetParameterVariability, cgSetParameterVariability

**NAME**

**cgGetParameterEffect** – get a parameter's parent program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgGetParameterEffect( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns a **CGeffect** handle to the parent effect.

Returns **NULL** if the parameter is not a child of an effect or if an error occurs.

**DESCRIPTION**

**cgGetParameterEffect** allows the application to retrieve a handle to the effect to which a given parameter belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterEffect** was introduced in Cg 1.5.

**SEE ALSO**

cgCreateEffect, cgGetParameterProgram, cgCreateParameter

**NAME**

**cgGetParameterIndex** – get an array member parameter's index

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterIndex( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the index associated with an array member parameter.

Returns **-1** if the parameter is not in an array.

**DESCRIPTION**

**cgGetParameterIndex** returns the integer index of an array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**HISTORY**

**cgGetParameterIndex** was introduced in Cg 1.2.

**SEE ALSO**

cgGetArrayParameter

**NAME**

**cgGetParameterName** – get a program parameter's name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetParameterName( CGparameter param );
```

**PARAMETERS**

param     The program parameter.

**RETURN VALUES**

Returns the NULL-terminated name string for the parameter.

Returns **NULL** if **param** is invalid.

**DESCRIPTION**

**cgGetParameterName** allows the application to retrieve the name of a parameter in a Cg program. This name can be used later to retrieve the parameter from the program using **cgGetNamedParameter**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterName** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNamedParameter**, **cgGetNextParameter**, **cgGetParameterType**, **cgGetParameterVariability**,  
**cgGetParameterDirection**, **cgSetParameterVariability**

**NAME**

**cgGetParameterNamedType** – get a program parameter's type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetParameterNamedType( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the type of **param**.

**DESCRIPTION**

**cgGetParameterNamedType** returns the type of **param** similarly to **cgGetParameterType**. However, if the type is a user defined struct it will return the unique enumerant associated with the user defined type instead of **CG\_STRUCT**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterNamedType** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterType**, **cgGetParameterBaseType**

**NAME**

**cgGetParameterOrdinalNumber** – get a program parameter’s ordinal number

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetParameterOrdinalNumber( CGparameter param );
```

**PARAMETERS**

param    The program parameter.

**RETURN VALUES**

Returns the ordinal number associated with a parameter. If the parameter is a constant (cgGetParameterVariability returns **CG\_CONSTANT**) then **0** is returned and no error is generated.

When **cgGetParameterOrdinalNumber** is passed an array, the ordinal number of the first array element is returned. When passed a struct, the ordinal number of first struct data member is returned.

**DESCRIPTION**

**cgGetParameterOrdinalNumber** returns an integer that represents the order in which the parameter was declared within the Cg program.

Ordinal numbering begins at zero, starting with a program’s first local leaf parameter. The subsequent local leaf parameters are enumerated in turn, followed by the program’s global leaf parameters.

**EXAMPLES**

The following Cg program:

```
struct MyStruct { float a; sampler2D b; };
float globalvar1;
float globalvar2
float4 main(float2 position : POSITION,
            float4 color      : COLOR,
            uniform MyStruct mystruct,
            float2 texCoord : TEXCOORD0) : COLOR
{
    /* etc ... */
}
```

Would result in the following parameter ordinal numbering:

```
position    -> 0
color       -> 1
mystruct.a  -> 2
mystruct.b  -> 3
texCoord    -> 4
globalvar1  -> 5
globalvar2  -> 6
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterOrdinalNumber** was introduced in Cg 1.1.

**SEE ALSO**

cgGetParameterVariability



**NAME**

**cgGetParameterProgram** – get a parameter's parent program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetParameterProgram( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns a **CGprogram** handle to the parent program.

Returns **NULL** if the parameter is not a child of a program or an error occurs.

**DESCRIPTION**

**cgGetParameterProgram** allows the application to retrieve a handle to the program to which a given parameter belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgGetParameterEffect

**NAME**

**cgGetParameterResource** – get a program parameter’s resource

**SYNOPSIS**

```
#include <Cg/cg.h>

CGresource cgGetParameterResource( CGparameter param );
```

**PARAMETERS**

param     The program parameter.

**RETURN VALUES**

Returns the resource of **param**.

**DESCRIPTION**

**cgGetParameterResource** allows the application to retrieve the resource for a parameter in a Cg program. This resource is necessary for the application to be able to supply the program’s inputs and use the program’s outputs.

The resource enumerator is a profile-specific hardware resource.

**EXAMPLES**

```
/* log info about parameter param for debugging */

printf("Resource: %s:%d (base %s)\n",
       cgGetResourceString(cgGetParameterResource(param)),
       cgGetParameterResourceIndex(param),
       cgGetResourceString(cgGetParameterBaseResource(param)));
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a leaf node.

**HISTORY**

**cgGetParameterResource** was introduced in Cg 1.1.

**SEE ALSO**

cgGetParameterResourceIndex, cgGetParameterBaseResource, cgGetResourceString

**NAME**

**cgGetParameterResourceIndex** – get a program parameter's resource index

**SYNOPSIS**

```
#include <Cg/cg.h>

unsigned long cgGetParameterResourceIndex( CGparameter param );
```

**PARAMETERS**

param     The program parameter.

**RETURN VALUES**

Returns the resource index of **param**.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGetParameterResourceIndex** allows the application to retrieve the resource index for a parameter in a Cg program. This index value is only used with resources that are linearly addressable.

**EXAMPLES**

```
/* log info about parameter param for debugging */

printf("Resource: %s:%d (base %s)\n",
       cgGetResourceString(cgGetParameterResource(param)),
       cgGetParameterResourceIndex(param),
       cgGetResourceString(cgGetParameterBaseResource(param)));
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a leaf node.

**HISTORY**

**cgGetParameterResourceIndex** was introduced in Cg 1.1.

**SEE ALSO**

cgGetParameterResource, cgGetResource, cgGetResourceString

**NAME**

**cgGetParameterResourceName** – get a program parameter's resource name

**SYNOPSIS**

```
#include <Cg/cg.h>

const char * cgGetParameterResourceName( CGparameter param );
```

**PARAMETERS**

param     The program parameter.

**RETURN VALUES**

Returns the resource name of **param**.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetParameterResourceName** allows the application to retrieve the resource name for a parameter in a Cg program. For translated profiles this name will most likely be different from the string returned by **cgGetResourceString**.

**EXAMPLES**

```
/* log info about parameter param for debugging */

printf("Resource: %s:%d (base %s) [name:%s]\n",
       cgGetResourceString(cgGetParameterResource(param)),
       cgGetParameterResourceIndex(param),
       cgGetResourceString(cgGetParameterBaseResource(param)),
       cgGetParameterResourceName(param));
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a leaf node.

**HISTORY**

**cgGetParameterResourceName** was introduced in Cg 2.1.

**SEE ALSO**

**cgGetParameterBaseResource**, **cgGetParameterResource**, **cgGetParameterResourceIndex**, **cgGetResource**, **cgGetResourceString**

**NAME**

**cgGetParameterResourceSize** – get size of resource associated with a parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
long cgGetParameterResourceSize( CGparameter param );
```

**PARAMETERS**

**param**     The parameter for which the associated resource size will be retrieved.

**RETURN VALUES**

Returns the size on the GPU of the resource associated with **param**.

Returns **-1** if an error occurs.

**DESCRIPTION**

**cgGetParameterResourceSize** returns the size in bytes of the resource corresponding to a parameter if the parameter belongs to a Cg buffer resource.

The size of sampler parameters is zero because they have no actual data storage.

The size of an array parameter is the size of an array element parameter times the length of the array.

The size of a structure parameter is the sum of the size of all the members of the structure plus zero or more bytes of profile-dependent padding.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterResourceSize** was introduced in Cg 2.0.

**SEE ALSO**

cgGetParameterBufferOffset, cgGetParameterBufferIndex

**NAME**

**cgGetParameterResourceType** – get a parameter's resource type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetParameterResourceType( CGparameter param );
```

**PARAMETERS**

**param**     The parameter for which the resource type will be returned.

**RETURN VALUES**

Returns the resource type of **param**.

Returns **CG\_UNKNOWN\_TYPE** if the parameter does not belong to a program, if the program is not compiled, or if an error occurs.

**DESCRIPTION**

**cgGetParameterResourceType** allows the application to retrieve the resource type for a parameter in a Cg program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterResourceType** was introduced in Cg 2.0.

**SEE ALSO**

cgGetParameterResource, cgGetParameterResourceIndex, cgGetParameterResourceSize, cgGetResource, cgGetResourceString

**NAME**

**cgGetParameterRows** – get number of parameter rows

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterRows( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the number of rows associated with the type if **param** is a numeric type or an array of numeric types.

Returns **0** otherwise.

**DESCRIPTION**

**cgGetParameterRows** return the number of rows associated with the given parameter's type.

If **param** is an array, the number of rows associated with each element of the array is returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterRows** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterType, cgGetParameterColumns

**NAME**

**cgGetParameterSemantic** – get a parameter’s semantic

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetParameterSemantic( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the NULL-terminated semantic string for the parameter.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetParameterSemantic** allows the application to retrieve the semantic of a parameter in a Cg program. If a uniform parameter does not have a user-assigned semantic, an empty string will be returned. If a varying parameter does not have a user-assigned semantic, the semantic string corresponding to the compiler-assigned resource for that varying will be returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterSemantic** was introduced in Cg 1.1.

**SEE ALSO**

cgGetParameterResource, cgGetParameterResourceIndex, cgGetParameterName, cgGetParameterType



**NAME**

**cgGetParameterSettingMode** – get the parameter setting mode for a context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetParameterSettingMode( CGcontext context );
```

**PARAMETERS**

**context** The context from which the parameter setting mode will be retrieved.

**RETURN VALUES**

Returns the parameter setting mode enumerant for **context**.

Returns **CG\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgGetParameterSettingMode** returns the current parameter setting mode enumerant for **context**. See **cgSetParameterSettingMode** for more information.

**EXAMPLES**

```
/* assumes cgGetProgramContext(program) == context */

if (cgGetParameterSettingMode(context) == CG_DEFERRED_PARAMETER_SETTING) {
    cgUpdateProgramParameters(program);
}
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGetParameterSettingMode** was introduced in Cg 2.0.

**SEE ALSO**

**cgSetParameterSettingMode**, **cgUpdatePassParameters**, **cgUpdateProgramParameters**

**NAME**

**cgGetParameterType** – get a program parameter's type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetParameterType( CGparameter param );
```

**PARAMETERS**

param     The parameter.

**RETURN VALUES**

Returns the type enumerator of **param**.

Returns **CG\_UNKNOWN\_TYPE** if an error occurs.

**DESCRIPTION**

**cgGetParameterType** allows the application to retrieve the type of a parameter in a Cg program. This type is necessary for the application to be able to supply the program's inputs and use the program's outputs.

**cgGetParameterType** will return **CG\_STRUCT** if the parameter is a struct and **CG\_ARRAY** if the parameter is an array. Otherwise it will return the data type associated with the parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterType** was introduced in Cg 1.1.

**SEE ALSO**

cgGetType, cgGetParameterBaseType, cgGetTypeString, cgGetParameterClass

**NAME**

**cgGetParameterValue** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float, or double */

int cgGetParameterValue{ifd}{rc}( CGparameter param,
                                int nelelements,
                                TYPE * v );
```

**PARAMETERS**

**param**            The program parameter whose value will be retrieved.

**nelements**       The number of elements in array **v**.

**v**                Destination buffer to which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

The **cgGetParameterValue** functions allow the application to get the *value* (s) from any numeric parameter or parameter array. The *value* (s) are returned in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

There are versions of each function that return **int**, **float** or **double** values signified by **i**, **f** or **d** in the function name.

There are versions of each function that will cause any matrices referenced by **param** to be copied in either row-major or column-major order, as signified by the **r** or **c** in the function name.

For example, **cgGetParameterValueic** retrieves the values of the given parameter using the supplied array of integer data, and copies matrix data in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**Note:** Previous releases of Cg allowed you to store more values in a parameter than indicated by the parameter's type. For example, one could use **cgGLSetParameter4f** to store four values into a parameter of type **CG\_FLOAT** (not **CG\_FLOAT4**). All four values could later be retrieved using a get call which requested more than one value. However, this feature conflicts with the GLSL approach and also leads to issues with parameters mapped into BUFFERS. Therefore, beginning with Cg 2.0 any components beyond the number indicated by the parameter type are ignored.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

## HISTORY

The **cgGetParameterValue** functions were introduced in Cg 1.4.

## SEE ALSO

cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize, cgGetParameterDefaultValue,  
cgSetParameterValue, cgGetParameterValuedc, cgGetParameterValuedr, cgGetParameterValuefc,  
cgGetParameterValuefr, cgGetParameterValueic, cgGetParameterValueir

**NAME**

**cgGetParameterValuedc** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValuedc( CGparameter param,
                           int nelements,
                           double * v );
```

**PARAMETERS**

**param**    The parameter whose value will be retrieved.

**nelements**

The number of elements in array **v**.

**v**

Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValuedc** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as doubles in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValuedc** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterDefaultValuedc**, **cgGetParameterValue**, **cgSetParameterValue**, **cgGetParameterRows**, **cgGetParameterColumns**, **cgGetArrayTotalSize**

**NAME**

**cgGetParameterValuedr** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValuedr( CGparameter param,
                           int nelements,
                           double * v );
```

**PARAMETERS**

**param** The parameter whose value will be retrieved.

**nelements**

The number of elements in array **v**.

**v**

Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValuedr** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as doubles in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValuedr** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterDefaultValuedr**, **cgGetParameterValue**, **cgSetParameterValue**, **cgGetParameterRows**, **cgGetParameterColumns**, **cgGetArrayTotalSize**

**NAME**

**cgGetParameterValuefc** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValuefc( CGparameter param,
                           int nelements,
                           float * v );
```

**PARAMETERS**

**param**     The parameter whose value will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValuefc** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as floats in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValuefc** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterDefaultValuefc**, **cgGetParameterValue**, **cgSetParameterValue**, **cgGetParameterRows**, **cgGetParameterColumns**, **cgGetArrayTotalSize**

**NAME**

**cgGetParameterValuefr** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValuefr( CGparameter param,
                           int nelements,
                           float * v );
```

**PARAMETERS**

**param**     The parameter whose value will be retrieved.

**nelements**

           The number of elements in array **v**.

**v**

           Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValuefr** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as floats in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValuefr** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterDefaultValuefr**, **cgGetParameterValue**, **cgSetParameterValue**, **cgGetParameterRows**, **cgGetParameterColumns**, **cgGetArrayTotalSize**



**NAME**

**cgGetParameterValueic** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValueic( CGparameter param,
                           int nelements,
                           int * v );
```

**PARAMETERS**

**param**     The parameter whose value will be retrieved.

**nelements**

            The number of elements in array **v**.

**v**

            Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValueic** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as ints in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in column-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValueic** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterDefaultValueic**, **cgGetParameterValue**, **cgSetParameterValue**, **cgGetParameterRows**, **cgGetParameterColumns**, **cgGetArrayTotalSize**

**NAME**

**cgGetParameterValueir** – get the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetParameterValueir( CGparameter param,
                           int nelements,
                           int * v );
```

**PARAMETERS**

**param** The parameter whose value will be retrieved.

**nelements**

The number of elements in array **v**.

**v**

Destination buffer into which the parameter values will be written.

**RETURN VALUES**

Returns the total number of values written to **v**.

**DESCRIPTION**

**cgGetParameterValueir** allows the application to get the *value*(s) from any numeric parameter or parameter array. The *value*(s) are returned as ints in **v**.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** will be copied in row-major order.

The size of **v** is passed as **nelements**. If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgGetParameterValueir** was introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterDefaultValueir, cgGetParameterValue, cgSetParameterValue, cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize

**NAME**

**cgGetParameterValues** – deprecated

**DESCRIPTION**

**cgGetParameterValues** is deprecated. Use a variation of `cgGetParameterValue` or `cgGetParameterDefaultValue` instead.

**SEE ALSO**

`cgGetParameterValue`, `cgGetParameterDefaultValue`

**NAME**

**cgGetParameterVariability** – get a parameter’s variability

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetParameterVariability( Cgparameter param );
```

**PARAMETERS**

**param**     The program parameter.

**RETURN VALUES**

Returns the variability of **param**.

Returns **CG\_ERROR** if an error occurs.

**DESCRIPTION**

**cgGetParameterVariability** allows the application to retrieve the variability of a parameter in a Cg program. This variability is necessary for the application to be able to supply the program’s inputs and use the program’s outputs.

**cgGetParameterVariability** will return one of the following variabilities:

**CG\_VARYING**

A varying parameter is one whose value changes with each invocation of the program.

**CG\_UNIFORM**

A uniform parameter is one whose value does not change with each invocation of a program, but whose value can change between groups of program invocations.

**CG\_LITERAL**

A literal parameter is folded out at compile time. Making a uniform parameter literal with **cgSetParameterVariability** will often make a program more efficient at the expense of requiring a compile every time the value is set.

**CG\_CONSTANT**

A constant parameter is never changed by the user. It’s generated by the compiler by certain profiles that require immediate values to be placed in certain resource locations.

**CG\_MIXED**

A structure parameter that contains parameters that differ in variability.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGetParameterVariability** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNamedParameter**,     **cgGetNextParameter**,     **cgGetParameterName**,     **cgGetParameterType**,  
**cgGetParameterDirection**, **cgSetParameterVariability**

**NAME**

**cgGetParentType** – gets a parent type of a child type

**SYNOPSIS**

```
#include <Cg/cg.h>

CGtype cgGetParentType( CGtype type,
                        int index );
```

**PARAMETERS**

**type**      The child type.

**index**     The index of the parent type. **index** must be greater than or equal to **0** and less than the value returned by `cgGetNumParentTypes`.

**RETURN VALUES**

Returns the number of parent types.

Returns **NULL** if there are no parents.

Returns **CG\_UNKNOWN\_TYPE** if **type** is a built-in type or an error is thrown.

**DESCRIPTION**

**cgGetParentType** returns a parent type of **type**.

A parent type is one from which the given type inherits, or an interface type that the given type implements. For example, given the type definitions:

```
interface myiface {
    float4 eval(void);
};

struct mystruct : myiface {
    float4 value;
    float4 eval(void ) { return value; }
};
```

**mystruct** has a single parent type, **myiface**.

Note that the current Cg language specification implies that a type may only have a single parent type — an interface implemented by the given type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is outside the proper range.

**HISTORY**

**cgGetParentType** was introduced in Cg 1.2.

**SEE ALSO**

`cgGetNumParentTypes`

**NAME**

**cgGetPassName** – get a technique pass's name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetPassName( CGpass pass );
```

**PARAMETERS**

pass      The pass.

**RETURN VALUES**

Returns the NULL-terminated name string for the pass.

Returns **NULL** if **pass** is invalid.

**DESCRIPTION**

**cgGetPassName** allows the application to retrieve the name of a pass in a Cg program. This name can be used later to retrieve the pass from the program using **cgGetNamedPass**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetPassName** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedPass**, **cgGetFirstPass**, **cgGetNextPass**

**NAME**

**cgGetPassProgram** – get domain program from a pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetPassProgram( CGpass pass,  
                             CGdomain domain );
```

**PARAMETERS**

**pass**      The pass from which to get a program.

**domain**    The domain for which a program will be retrieved.

**RETURN VALUES**

Returns the program associated with a specified domain from the given pass.

Returns **NULL** if **pass** or **domain** is invalid.

**DESCRIPTION**

**cgGetPassProgram** allows the application to retrieve the program associated with a specific domain from a pass.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **domain** is not **CG\_VERTEX\_DOMAIN**, **CG\_FRAGMENT\_DOMAIN**, or **CG\_GEOMETRY\_DOMAIN**.

**HISTORY**

**cgGetPassProgram** was introduced in Cg 2.1.

**SEE ALSO**

cgGetFirstPass, cgGetNextPass

**NAME**

**cgGetPassTechnique** – get a pass’s technique

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtechnique cgGetPassTechnique( CGpass pass );
```

**PARAMETERS**

pass      The pass.

**RETURN VALUES**

Returns a **CGtechnique** handle to the technique.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetPassTechnique** allows the application to retrieve a handle to the technique to which a given pass belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**HISTORY**

**cgGetPassTechnique** was introduced in Cg 1.4.

**SEE ALSO**

cgIsTechnique, cgGetNextTechnique, cgIsPass



**NAME**

**cgGetProfile** – get the profile enumerator from a profile name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprofile cgGetProfile( const char * profile_string );
```

**PARAMETERS**

profile\_string

A string containing the case-sensitive profile name.

**RETURN VALUES**

Returns the profile enumerator of **profile\_string**.

Returns **CG\_PROFILE\_UNKNOWN** if the given profile does not exist.

**DESCRIPTION**

**cgGetProfile** returns the enumerator assigned to a profile name.

**EXAMPLES**

```
CGprofile ARBVP1Profile = cgGetProfile("arbvp1");

if(cgGetProgramProfile(myprog) == ARBVP1Profile)
{
    /* Do stuff */
}
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **profile\_string** is NULL.

**HISTORY**

**cgGetProfile** was introduced in Cg 1.1.

**SEE ALSO**

cgGetProfileString, cgGetProgramProfile

**NAME**

**cgGetProfileDomain** – get the domain of a profile enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGdomain cgGetProfileDomain( CGprofile profile );
```

**PARAMETERS**

profile    The profile enumerator.

**RETURN VALUES**

Returns:

```
CG_UNKNOWN_DOMAIN  
CG_VERTEX_DOMAIN  
CG_FRAGMENT_DOMAIN  
CG_GEOMETRY_DOMAIN
```

**DESCRIPTION**

**cgGetProfileDomain** returns which type of domain the given profile belongs to.

**EXAMPLES**

```
CGdomain domain = cgGetProfileDomain(CG_PROFILE_PS_3_0);  
/* domain == CG_FRAGMENT_DOMAIN */
```

**ERRORS**

None.

**HISTORY**

**cgGetProfileDomain** was introduced in Cg 1.5.

**CG\_GEOMETRY\_DOMAIN** was introduced in Cg 2.0.

**SEE ALSO**

cgGetNumProgramDomains, cgGetProgramDomainProfile

**NAME**

**cgGetProfileProperty** – query property of a profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgGetProfileProperty( CGprofile profile, CGenum query );
```

**PARAMETERS**

**profile**    The profile to query.

**query**     An enumerator describing the property to be queried. The following enumerants are allowed:

- **CG\_IS\_OPENGL\_PROFILE**
- **CG\_IS\_DIRECT3D\_PROFILE**
- **CG\_IS\_DIRECT3D\_8\_PROFILE**
- **CG\_IS\_DIRECT3D\_9\_PROFILE**
- **CG\_IS\_DIRECT3D\_10\_PROFILE**
- **CG\_IS\_VERTEX\_PROFILE**
- **CG\_IS\_FRAGMENT\_PROFILE**
- **CG\_IS\_GEOMETRY\_PROFILE**
- **CG\_IS\_TRANSLATION\_PROFILE**
- **CG\_IS\_HLSL\_PROFILE**
- **CG\_IS\_GLSL\_PROFILE**

**RETURN VALUES**

Returns **CG\_TRUE** if **profile** holds the property expressed by **query**.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgGetProfileProperty** returns property information about the given profile.

**query** must be one of the following enumerants :

- **CG\_IS\_OPENGL\_PROFILE**  
**profile** is an OpenGL profile.
- **CG\_IS\_DIRECT3D\_PROFILE**  
**profile** is Direct3D profile.
- **CG\_IS\_DIRECT3D\_8\_PROFILE**  
**profile** is Direct3D8 profile.
- **CG\_IS\_DIRECT3D\_9\_PROFILE**  
**profile** is Direct3D9 profile.
- **CG\_IS\_DIRECT3D\_10\_PROFILE**  
**profile** is Direct3D10 profile.
- **CG\_IS\_VERTEX\_PROFILE**  
**profile** is vertex profile.
- **CG\_IS\_FRAGMENT\_PROFILE**  
**profile** is fragment profile.
- **CG\_IS\_GEOMETRY\_PROFILE**  
**profile** is geometry profile.
- **CG\_IS\_TRANSLATION\_PROFILE**  
**profile** is a translation profile.

- **CG\_IS\_HLSL\_PROFILE**

**profile** is an HLSL translation profile.

- **CG\_IS\_GLSL\_PROFILE**

**profile** is a GLSL translation profile.

## EXAMPLES

```
CGprofile profile;
int nProfiles;
int ii;

nProfiles = cgGetNumSupportedProfiles();
printf("NumSupportedProfiles: %i\n", nProfiles);

for (ii=0; ii<nProfiles; ++ii) {
    profile = cgGetSupportedProfile(ii);
    if (cgGetProfileProperty(profile, CG_IS_OPENGL_PROFILE)) {
        printf("%s is an OpenGL profile\n", cgGetProfileString(profile));
    } else {
        printf("%s is not an OpenGL profile\n", cgGetProfileString(profile));
    }
}
```

## ERRORS

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **profile** is not supported by this version of the Cg library.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **query** is not **CG\_IS\_OPENGL\_PROFILE**, **CG\_IS\_DIRECT3D\_PROFILE**, **CG\_IS\_DIRECT3D\_8\_PROFILE**, **CG\_IS\_DIRECT3D\_9\_PROFILE**, **CG\_IS\_DIRECT3D\_10\_PROFILE**, **CG\_IS\_VERTEX\_PROFILE**, **CG\_IS\_FRAGMENT\_PROFILE**, **CG\_IS\_GEOMETRY\_PROFILE**, **CG\_IS\_TRANSLATION\_PROFILE**, **CG\_IS\_HLSL\_PROFILE**, or **CG\_IS\_GLSL\_PROFILE**

## HISTORY

**cgGetProfileProperty** was introduced in Cg 2.2.

## SEE ALSO

cgGetNumSupportedProfiles, cgGetSupportedProfile, cgIsProfileSupported, cgGetProfileString, cgGetProfile

**NAME**

**cgGetProfileString** – get the profile name associated with a profile enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>

const char * cgGetProfileString( CGprofile profile );
```

**PARAMETERS**

profile    The profile enumerator.

**RETURN VALUES**

Returns the profile string of the enumerator **profile**.

Returns **NULL** if **profile** is not a valid profile.

**DESCRIPTION**

**cgGetProfileString** returns the profile named associated with a profile enumerator.

**EXAMPLES**

```
static void dumpCgProgramInfo(CGprogram program)
{
    const char* p = cgGetProfileString(cgGetProgramProfile(program));
    if ( p ) {
        printf(" Profile: %s\n", cgGetProfileString(cgGetProgramProfile(program)));
    }
    /* ... */
}
```

**ERRORS**

None.

**HISTORY**

**cgGetProfileString** was introduced in Cg 1.1.

**SEE ALSO**

cgGetProfile, cgGetProgramProfile

**NAME**

**cgGetProgramBuffer** – get buffer associated with a buffer index

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbuffer cgGetProgramBuffer( CGprogram program,  
                             int bufferIndex );
```

**PARAMETERS**

**program** The program from which the associated buffer will be retrieved.

**bufferIndex**

The buffer index for which the associated buffer will be retrieved.

**RETURN VALUES**

Returns a buffer handle on success.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetProgramBuffer** returns the buffer handle associated with a given buffer index from **program**. The returned value can be **NULL** if no buffer is associated with this index or if an error occurs.

**EXAMPLES**

```
CGbuffer myBuffer = cgGetProgramBuffer( myProgram, 0 );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_BUFFER\_INDEX\_OUT\_OF\_RANGE\_ERROR** is generated if **bufferIndex** is not within the valid range of buffer indices for **program**.

**HISTORY**

**cgGetProgramBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgSetProgramBuffer, cgGetParameterBufferIndex, cgCreateBuffer

**NAME**

**cgGetProgramBufferMaxIndex** – get the maximum index of a buffer for a given profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetProgramBufferMaxIndex( CGprofile profile );
```

**PARAMETERS**

profile    The target for determining the maximum buffer index.

**RETURN VALUES**

Returns the maximum buffer index for a given profile.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGetProgramBufferMaxIndex** returns the maximum buffer index for a **profile**.

**cgGetProgramBufferMaxIndex** will return **0** if an invalid profile is passed.

**EXAMPLES**

```
int size = cgGetProgramBufferMaxIndex( CG_PROFILE_GPU_VP );
```

**ERRORS**

none.

**HISTORY**

**cgGetProgramBufferMaxIndex** was introduced in Cg 2.0.

**SEE ALSO**

cgSetProgramBuffer, cgGetParameterBufferIndex, cgCreateBuffer

**NAME**

**cgGetProgramBufferMaxSize** – get the maximum size of a buffer in bytes for a given profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetProgramBufferMaxSize( CGprofile profile );
```

**PARAMETERS**

profile    The target for determining the maximum buffer size.

**RETURN VALUES**

Returns the size of a buffer for the given profile in bytes.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGetProgramBufferMaxSize** returns the maximum size of a buffer for a **profile** in bytes.

**cgGetProgramBufferMaxSize** will return **0** if an invalid profile is passed.

**EXAMPLES**

```
int size = cgGetProgramBufferMaxSize( CG_PROFILE_GPU_VP );
```

**ERRORS**

none.

**HISTORY**

**cgGetProgramBufferMaxSize** was introduced in Cg 2.0.

**SEE ALSO**

cgSetProgramBuffer, cgGetParameterBufferIndex, cgCreateBuffer



**NAME**

**cgGetProgramContext** – get a programs parent context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGcontext cgGetProgramContext( CGprogram program );
```

**PARAMETERS**

program The program.

**RETURN VALUES**

Returns a **CGcontext** handle to the parent context.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetProgramContext** allows the application to retrieve a handle to the context to which a given program belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetProgramContext** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgCreateContext

**NAME**

**cgGetProgramDomain** – get a program's domain

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGdomain cgGetProgramDomain( CGprogram program );
```

**PARAMETERS**

program The program.

**RETURN VALUES**

Returns the domain enumerant associated with **program**.

**DESCRIPTION**

**cgGetProgramDomain** retrieves the domain enumerant currently associated with a program. This is a convenience routine which essentially calls <cgGetProgramProfile|cgGetProgramProfile> followed by <cgGetProfileDomain|cgGetProfileDomain>.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetProgramDomain** was introduced in Cg 2.2.

**SEE ALSO**

cgGetDomain, cgGetDomainString

**NAME**

**cgGetProgramDomainProfile** – get the profile associated with a domain

**SYNOPSIS**

```
#include <Cg/cg.h>

CGprofile cgGetProgramDomainProfile( CGprogram program,
                                     int index );
```

**PARAMETERS**

**program** The handle of the combined program object.

**index** The index of the program's domain to be queried.

**RETURN VALUES**

Returns the profile enumerator for the program with the given domain index, specifically one of:

```
CG_UNKNOWN_DOMAIN
CG_VERTEX_DOMAIN
CG_FRAGMENT_DOMAIN
CG_GEOMETRY_DOMAIN
```

Returns **CG\_PROFILE\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgGetProgramDomainProfile** gets the profile of the passed combined program using the index to select which domain to choose.

**EXAMPLES**

```
/* This will enable all profiles for each domain in glslComboProgram */
int domains = cgGetProgramDomains(glslComboProgram);
for (int i=0; i<domains; i++) {
    cgGLEnableProfile( cgGetProgramDomainProfile(glslComboProgram, i) );
}

/* This will enable the profile for the first program domain */
/* in glslComboProgram */
cgGLEnableProfile( cgGetProgramDomainProfile(glslComboProgram, 0) );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **index** is less than **0** or greater than or equal to the number of domains in **program**.

**HISTORY**

**cgGetProgramDomainProfile** was introduced in Cg 1.5.

**SEE ALSO**

cgGetNumProgramDomains, cgGetProfileDomain

**NAME**

**cgGetProgramDomainProgram** – get an indexed domain program of a combined program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetProgramDomainProgram( CGprogram program,
                                     int index );
```

**PARAMETERS**

**program** The handle of the combined program object.

**index** The index of the program's domain program to be queried.

**RETURN VALUES**

Returns the program handle for the program with the given domain index.

Returns 0 if an error occurs.

**DESCRIPTION**

A combined program consists of multiple domain programs. For example, a combined program may contain a vertex domain program and a fragment domain program. **cgGetProgramDomainProgram** gets the indexed domain program of the specified combined program.

If the program parameter is not a combined program and the index is zero, program handle is simply returned as-is without error.

**EXAMPLES**

```
/* This will enable all profiles for each domain in glslComboProgram */
int domains = cgGetNumProgramDomains(glslComboProgram);
for (int i=0; i<domains; i++) {
    CGprogram subprog = cgGetProgramDomainProgram(glslComboProgram, i);
    CGparameter param = cgGetFirstParameter(subprog);
    while (param) {
        // Do something to each parameter of each domain program
        param = cgGetNextParameter(param);
    }
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **index** is less than **0** or greater than or equal to the number of domains in **program**.

**HISTORY**

**cgGetProgramDomainProgram** was introduced in Cg 2.1.

**SEE ALSO**

cgGetNumProgramDomains, cgGetProfileDomain, cgGetProgramDomainProfile

**NAME**

**cgGetProgramInput** – get the program's input

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetProgramInput( CGprogram program );
```

**PARAMETERS**

program A program handle.

**RETURN VALUES**

Returns a program input enumerator. If the program is a vertex or fragment program, it returns **CG\_VERTEX** or **CG\_FRAGMENT**, respectively. For geometry programs the input is one of: **CG\_POINT**, **CG\_LINE**, **CG\_LINE\_ADJ**, **CG\_TRIANGLE**, or **CG\_TRIANGLE\_ADJ**.

Returns **CG\_UNKNOWN** if the input is unknown.

**DESCRIPTION**

**cgGetProgramInput** returns the program input enumerator.

**EXAMPLES**

```
void printProgramInput(CGprogram program)
{
    char * input = NULL;
    switch(cgGetProgramInput(program))
    {
        case CG_FRAGMENT:
            input = "fragment";
            break;
        case CG_VERTEX:
            input = "vertex";
            break;
        case CG_POINT:
            input = "point";
            break;
        case CG_LINE:
            input = "line";
            break;
        case CG_LINE_ADJ:
            input = "line adjacency";
            break;
        case CG_TRIANGLE:
            input = "triangle";
            break;
        case CG_TRIANGLE_ADJ:
            input = "triangle adjacency";
            break;
        default:
            input = "unknown";
            break;
    }
    printf("Program inputs %s.\n", input);
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not valid program handle.

**HISTORY**

**cgGetProgramInput** was introduced in Cg 2.0.

**SEE ALSO**

cgGetProgramOutput

**NAME**

**cgGetProgramOptions** – get strings from a program object

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
char const * const * cgGetProgramOptions( CGprogram program );
```

**PARAMETERS**

**program** The Cg program to query.

**RETURN VALUES**

Returns the options used to compile the program as an array of NULL-terminated strings.

Returns **NULL** if no options exist, or if an error occurs.

**DESCRIPTION**

**cgGetProgramOptions** allows the application to retrieve the set of options used to compile the program.

The options are returned in an array of ASCII-encoded NULL-terminated character strings. Each string contains a single option. The last element of the string array is guaranteed to be **NULL**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetProgramOptions** was introduced in Cg 1.4.

**SEE ALSO**

cgGetProgramString

**NAME**

**cgGetProgramOutput** – get the program’s output

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgGetProgramOutput( CGprogram program );
```

**PARAMETERS**

program A program handle.

**RETURN VALUES**

Returns a program output enumerator. If the program is a vertex or fragment program, it returns **CG\_VERTEX** or **CG\_FRAGMENT**, respectively. For geometry programs the output is one of: **CG\_POINT\_OUT**, **CG\_LINE\_OUT**, or **CG\_TRIANGLE\_OUT**.

Returns **CG\_UNKNOWN** if the output is unknown.

**DESCRIPTION**

**cgGetProgramOutput** returns the program output enumerator.

For geometry programs, an input must be specified but not an output because of implicit output defaults. For example, if either “TRIANGLE” or “TRIANGLE\_ADJ” is specified as an input without an explicit output in the shader source, then **cgGetProgramOutput** will return **CG\_TRIANGLE\_OUT**.

**EXAMPLES**

```
void printProgramOutput(CGprogram program)
{
    char * output = NULL;
    switch(cgGetProgramOutput(program))
    {
        case CG_POINT_OUT:
            output = "point";
            break;
        case CG_LINE_OUT:
            output = "line";
            break;
        case CG_TRIANGLE_OUT:
            output = "triangle";
            break;
        default:
            output = "unknown";
            break;
    }
    printf("Program outputs %s.\n", output);
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetProgramOutput** was introduced in Cg 2.0.

**SEE ALSO**

cgGetProgramInput



**NAME**

**cgGetProgramProfile** – get a program's profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprofile cgGetProgramProfile( CGprogram program );
```

**PARAMETERS**

program The program.

**RETURN VALUES**

Returns the profile enumerant associated with **program**.

**DESCRIPTION**

**cgGetProgramProfile** retrieves the profile enumerant currently associated with a program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGetProgramProfile** was introduced in Cg 1.1.

**SEE ALSO**

cgSetProgramProfile, cgGetProfile, cgGetProfileString, cgCreateProgram

**NAME**

**cgGetProgramStateAssignmentValue** – get a program-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprogram cgGetProgramStateAssignmentValue( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment.

**RETURN VALUES**

Returns a **CGprogram** handle.

Returns **NULL** if an error occurs or no program is available.

**DESCRIPTION**

**cgGetProgramStateAssignmentValue** allows the application to retrieve the *value* (s) of a state assignment that stores a **CGprogram**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a program type.

**HISTORY**

**cgGetProgramStateAssignmentValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState,                   cgGetStateType,                   cgGetFloatStateAssignmentValues,  
cgGetIntStateAssignmentValues, cgGetBoolStateAssignmentValues, cgGetStringStateAssignmentValue,  
cgGetSamplerStateAssignmentValue, cgGetTextureStateAssignmentValue

**NAME**

**cgGetProgramString** – get strings from a program object

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetProgramString( CGprogram program,
                                CGenum enum );
```

**PARAMETERS**

**program** The program to query.

**enum** Specifies the string to retrieve. **enum** can be one of **CG\_PROGRAM\_SOURCE**, **CG\_PROGRAM\_ENTRY**, **CG\_PROGRAM\_PROFILE**, or **CG\_COMPILED\_PROGRAM**.

**RETURN VALUES**

Returns a NULL-terminated string based on the value of **enum**.

Returns an empty string if an error occurs.

**DESCRIPTION**

**cgGetProgramString** allows the application to retrieve program strings that have been set via functions that modify program state.

When **enum** is **CG\_PROGRAM\_SOURCE** the original Cg source program is returned.

When **enum** is **CG\_PROGRAM\_ENTRY** the main entry point for the program is returned.

When **enum** is **CG\_PROGRAM\_PROFILE** the profile for the program is returned.

When **enum** is **CG\_COMPILED\_PROGRAM** the string for the compiled program is returned.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGprogram program = cgCreateProgramFromFile(context,
                                           CG_SOURCE,
                                           mysourcefilename,
                                           CG_PROFILE_ARBVP1,
                                           "myshader",
                                           NULL);

if(cgIsProgramCompiled(program))
    printf("%s\n", cgGetProgramString(program, CG_COMPILED_PROGRAM));
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **enum** is not **CG\_PROGRAM\_SOURCE**, **CG\_PROGRAM\_ENTRY**, **CG\_PROGRAM\_PROFILE**, or **CG\_COMPILED\_PROGRAM**.

**HISTORY**

**cgGetProgramString** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgGetProgramOptions

**NAME**

**cgGetResource** – get the resource enumerant assigned to a resource name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGresource cgGetResource( const char * resource_string );
```

**PARAMETERS**

resource\_string      A string containing the resource name.

**RETURN VALUES**

Returns the resource enumerant of **resource\_string**.

Returns **CG\_UNKNOWN** if no such resource exists.

**DESCRIPTION**

**cgGetResource** returns the enumerant assigned to a resource name.

**EXAMPLES**

```
CGresource PositionResource = cgGetResource("POSITION");

if(cgGetParameterResource(myparam) == PositionResource)
{
    /* Do stuff to the "POSITION" parameter */
}
```

**ERRORS**

None.

**HISTORY**

**cgGetResource** was introduced in Cg 1.1.

**SEE ALSO**

cgGetResourceString, cgGetParameterResource

**NAME**

**cgGetString** – get the resource name associated with a resource enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>

const char * cgGetString( CGresource resource );
```

**PARAMETERS**

resource The resource enumerator.

**RETURN VALUES**

Returns the NULL-terminated resource string of the enumerator **resource**.

**DESCRIPTION**

**cgGetString** returns the resource named associated with a resource enumerator.

**EXAMPLES**

```
/* log info about parameter param for debugging */

printf("Resource: %s:%d (base %s)\n",
       cgGetString(cgGetParameterResource(param)),
       cgGetParameterResourceIndex(param),
       cgGetString(cgGetParameterBaseResource(param)));
```

**ERRORS**

None.

**HISTORY**

**cgGetString** was introduced in Cg 1.1.

**SEE ALSO**

cgGetResource, cgGetParameterResource

**NAME**

**cgGetSamplerStateAssignmentParameter** – get the sampler parameter being set up given a state assignment in its `sampler_state` block

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetSamplerStateAssignmentParameter( CGstateassignment sa );
```

**PARAMETERS**

`sa` The state assignment in a **sampler\_state** block

**RETURN VALUES**

Returns a handle to a parameter.

Returns **NULL** if `sa` is not a state assignment in a **sampler\_state** block.

**DESCRIPTION**

Given the handle to a state assignment in a **sampler\_state** block in an effect file, **cgGetSamplerStateAssignmentParameter** returns a handle to the sampler parameter being initialized.

**EXAMPLES**

Given an effect file with:

```
sampler2D foo = sampler_state { GenerateMipmap = true; }
```

**cgGetSamplerStateAssignmentParameter** returns a handle to **foo** if passed a handle to the **GenerateMipmap** state assignment.

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if `sa` is not a valid state assignment.

**HISTORY**

**cgGetSamplerStateAssignmentParameter** was introduced in Cg 1.4.

**SEE ALSO**

`cgIsStateAssignment`, `cgIsParameter`

**NAME**

**cgGetSamplerStateAssignmentState** – get a sampler-valued state assignment’s state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetSamplerStateAssignmentState( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment.

**RETURN VALUES**

Returns a **CGstate** handle for the state.

Returns **NULL** if the handle **sa** is invalid.

**DESCRIPTION**

**cgGetSamplerStateAssignmentState** allows the application to retrieve the state of a state assignment that stores a sampler.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgGetSamplerStateAssignmentState** was introduced in Cg 1.4.

**SEE ALSO**

cgGetFirstSamplerStateAssignment, cgGetNamedSamplerStateAssignment,  
cgGetSamplerStateAssignmentParameter, cgGetSamplerStateAssignmentValue

**NAME**

**cgGetSamplerStateAssignmentValue** – get a sampler-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetSamplerStateAssignmentValue( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment.

**RETURN VALUES**

Returns a **CGparameter** handle for the sampler.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetSamplerStateAssignmentValue** allows the application to retrieve the *value* (s) of a state assignment that stores a sampler.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a sampler type.

**HISTORY**

**cgGetSamplerStateAssignmentValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState,                   cgGetStateType,                   cgGetFloatStateAssignmentValues,  
cgGetIntStateAssignmentValues, cgGetBoolStateAssignmentValues, cgGetStringStateAssignmentValue,  
cgGetProgramStateAssignmentValue, cgGetTextureStateAssignmentValue



**NAME**

**cgGetSemanticCasePolicy** – get semantic case policy

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CEnum cgGetSemanticCasePolicy( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns an enumerant indicating the current semantic case policy.

**DESCRIPTION**

**cgGetSemanticCasePolicy** returns an enumerant indicating the current semantic case policy for the library. See **cgSetSemanticCasePolicy** for more information.

**EXAMPLES**

```
CEnum currentSemanticCasePolicy = cgGetSemanticCasePolicy();
```

**ERRORS**

None.

**HISTORY**

**cgGetSemanticCasePolicy** was introduced in Cg 2.0.

**SEE ALSO**

**cgSetSemanticCasePolicy**, **cgGetParameterSemantic**

**NAME**

**cgGetStateAssignmentIndex** – get the array index of a state assignment for array-valued state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
int cgGetStateAssignmentIndex( CGstateassignment sa );
```

**PARAMETERS**

sa        The state assignment.

**RETURN VALUES**

Returns an integer index value.

Returns **0** if the **CGstate** for this state assignment is not an array type.

**DESCRIPTION**

**cgGetStateAssignmentIndex** returns the array index of a state assignment if the state it is based on is an array type.

**EXAMPLES**

Given a “LightPosition” state defined as an array of eight **float3** values and an effect file with the following state assignment:

```
pass { LightPosition[3] = float3(10,0,0); }
```

**cgGetStateAssignmentIndex** will return **3** when passed a handle to this state assignment.

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgGetStateAssignmentIndex** was introduced in Cg 1.4.

**SEE ALSO**

cgIsStateAssignment, cgCreateStateAssignmentIndex

**NAME**

**cgGetStateAssignmentPass** – get a state assignment's pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGpass cgGetStateAssignmentPass( CGstateassignment sa );
```

**PARAMETERS**

**sa**           The state assignment.

**RETURN VALUES**

Returns a **CGpass** handle to the pass.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetStateAssignmentPass** allows the application to retrieve a handle to the pass to which a given stateassignment belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**HISTORY**

**cgGetStateAssignmentPass** was introduced in Cg 1.4.

**SEE ALSO**

cgIsStateAssignment, cgIsPass

**NAME**

**cgGetStateAssignmentState** – returns the state type of a particular state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstate cgGetStateAssignmentState( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment handle.

**RETURN VALUES**

Returns the state corresponding to the given state assignment.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetStateAssignmentState** returns the **CGstate** object that corresponds to a particular state assignment in a pass. This object can then be queried to find out its type, giving the type of the state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if the effect doesn't contain a state matching the given state assignment.

**HISTORY**

**cgGetStateAssignmentState** was introduced in Cg 1.4.

**SEE ALSO**

cgGetType, cgCreateState, cgCreateArrayState

**NAME**

**cgGetStateContext** – get a state's context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStateContext( CGstate state );
```

**PARAMETERS**

state      The state.

**RETURN VALUES**

Returns the context for the state.

Returns **NULL** if **state** is invalid.

**DESCRIPTION**

**cgGetStateContext** allows the application to retrieve the context of a state. This is the context used to create the state with **cgCreateState**.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGstate state = cgCreateState(context, "GreatStateOfTexas", CG_FLOAT);
assert(context == cgGetStateContext(state));
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateContext** was introduced in Cg 1.5.

**SEE ALSO**

**cgCreateState**, **cgCreateArrayState**, **cgGetEffectContext**, **cgGetParameterContext**, **cgGetProgramContext**

**NAME**

**cgGetStateEnumerant** – get a state enumerant name and value by index

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStateEnumerant( CGstate state, int index, int * value );
```

**PARAMETERS**

**state**      The state from which to retrieve an enumerant name and value.

**index**      The index for the enumerant in **state**.

**value**      Pointer to integer where the enumerant value will be stored.

**RETURN VALUES**

Returns the NULL-terminated enumerant name string associated with **state** at position **index**. The enumerant value is returned via the **value** parameter.

Returns **NULL** if an error occurs. **value** will be **0**.

**DESCRIPTION**

**cgGetStateEnumerant** allows the application to retrieve the enumerant name and value associated with a **CGstate** at a specified index location. The number of enumerants associated with a state can be discovered using **cgGetNumStateEnumerants**.

**EXAMPLES**

```
int value;
char* pName;

int nEnums = cgGetNumStateEnumerants(state);

for (ii=0; ii<nEnums; ++ii) {
    pName = cgGetStateEnumerant(state, ii, &value );
    printf("%i: %s %i\n", ii+1, pName, value);
}
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**CG\_INVALID\_POINTER\_ERROR** is generated if **value** is **NULL**.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **index** is less than **0** or **index** is greater than or equal to the number of enumerants associated with **state**.

**HISTORY**

**cgGetStateEnumerant** was introduced in Cg 2.2.

**SEE ALSO**

**cgAddStateEnumerant**,                      **cgGetNumStateEnumerants**,                      **cgGetStateEnumerantName**,  
**cgGetStateEnumerantValue**

**NAME**

**cgGetStateEnumerantName** – get a state enumerant name by value

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStateEnumerantName( CGstate state,  
                                       int value );
```

**PARAMETERS**

state      The state from which to retrieve an enumerant name.

value      The enumerant value for which to retrieve the associated name.

**RETURN VALUES**

Returns the NULL-terminated enumerant name string associated with the given enumerant **value** in **state**.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetStateEnumerantName** returns the enumerant name associated with a given enumerant value from a specified state.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **state** does not contain an enumerant defined for **value**.

**HISTORY**

**cgGetStateEnumerantName** was introduced in Cg 1.5.

**SEE ALSO**

cgGetStateEnumerantValue, cgAddStateEnumerant, cgIsState

**NAME**

**cgGetStateEnumerantValue** – get state enumerant value by name

**SYNOPSIS**

```
#include <Cg/cg.h>

int cgGetStateEnumerantValue( CGstate state,
                             const char * name );
```

**PARAMETERS**

**state**      The state from which to retrieve the value associated with **name**.  
**name**      The enumerant name for which to retrieve the associated value from **state**.

**RETURN VALUES**

Returns the enumerant value associated with **name**.  
Returns **-1** if an error occurs.

**DESCRIPTION**

**cgGetStateEnumerantValue** retrieves the enumerant value associated with a given enumerant name from the specified state.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.  
**CG\_INVALID\_PARAMETER\_ERROR** is generated if **state** does not contain **name**, if **name** is **NULL**, or if **name** points to an empty string.

**HISTORY**

**cgGetStateEnumerantValue** was introduced in Cg 1.5.

**SEE ALSO**

cgGetStateEnumerantName, cgAddStateEnumerant, cgIsState



**NAME**

**cgGetStateLatestProfile** – gets a state's designated latest profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprofile cgGetStateLatestProfile( CGstate state );
```

**PARAMETERS**

state      The state handle.

**RETURN VALUES**

Returns the designated latest profile if **state** is of type **CG\_PROGRAM\_TYPE**.

Returns **CG\_PROFILE\_UNKNOWN** otherwise.

**DESCRIPTION**

**cgGetStateLatestProfile** gets the specified state's designated latest profile for states of type **CG\_PROGRAM\_TYPE**.

This profile is used to compile the program for a state assignment for the state where the profile in the **compile** statement is the identifier **latest**.

**EXAMPLES**

Get the latest profile for fragment programs:

```
CGstate state = cgGetNamedState(context, "FragmentProgram");  
CGprofile profile = cgGetStateLatestProfile(state);
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateLatestProfile** was introduced in Cg 2.2.

**SEE ALSO**

cgGetNamedState, cgSetStateLatestProfile

**NAME**

**cgGetStateName** – get a state’s name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStateName( CGstate state );
```

**PARAMETERS**

state      The state.

**RETURN VALUES**

Returns the NULL-terminated name string for the state.

Returns **NULL** if **state** is invalid.

**DESCRIPTION**

**cgGetStateName** allows the application to retrieve the name of a state defined in a Cg context. This name can be used later to retrieve the state from the context using **cgGetNamedState**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateName** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedState**, **cgGetFirstState**, **cgGetNextState**

**NAME**

**cgGetStateResetCallback** – get the state resetting callback function for a state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstatecallback cgGetStateResetCallback( CGstate state );
```

**PARAMETERS**

state      The state from which to retrieve the callback.

**RETURN VALUES**

Returns a pointer to the state resetting callback function.

Returns **NULL** if **state** is not a valid state or if it has no callback.

**DESCRIPTION**

**cgGetStateResetCallback** returns the callback function used for resetting the state when the given state is encountered in a pass in a technique. See **cgSetStateCallbacks** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateResetCallback** was introduced in Cg 1.4.

**SEE ALSO**

**cgSetStateCallbacks**, **cgCallStateResetCallback**, **cgResetPassState**

**NAME**

**cgGetStateSetCallback** – get the state setting callback function for a state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstatecallback cgGetStateSetCallback( CGstate state );
```

**PARAMETERS**

state      The state from which to retrieve the callback.

**RETURN VALUES**

Returns a pointer to the state setting callback function.

Returns **NULL** if **state** is not a valid state or if it has no callback.

**DESCRIPTION**

**cgGetStateSetCallback** returns the callback function used for setting the state when the given state is encountered in a pass in a technique. See **cgSetStateCallbacks** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateSetCallback** was introduced in Cg 1.4.

**SEE ALSO**

**cgSetStateCallbacks**, **cgCallStateSetCallback**, **cgSetPassState**

**NAME**

**cgGetStateType** – returns the type of a given state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetStateType( CGstate state );
```

**PARAMETERS**

state      The state from which to retrieve the type.

**RETURN VALUES**

Returns the **CGtype** of the given state.

**DESCRIPTION**

**cgGetStateType** returns the type of a state that was previously defined via `cgCreateState`, `cgCreateArrayState`, `cgCreateSamplerState`, or `cgCreateArraySamplerState`.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateType** was introduced in Cg 1.4.

**SEE ALSO**

`cgCreateState`, `cgCreateArrayState`, `cgCreateSamplerState`, `cgCreateArraySamplerState`, `cgGetStateName`

**NAME**

**cgGetStateValidateCallback** – get the state validation callback function for a state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGstatecallback cgGetStateValidateCallback( CGstate state );
```

**PARAMETERS**

state      The state from which to retrieve the callback.

**RETURN VALUES**

Returns a pointer to the state validating callback function.

Returns **NULL** if **state** is not a valid state or if it has no callback.

**DESCRIPTION**

**cgGetStateValidateCallback** returns the callback function used for validating the state when the given state is encountered in a pass in a technique. See **cgSetStateCallbacks** and **cgCallStateValidateCallback** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgGetStateValidateCallback** was introduced in Cg 1.4.

**SEE ALSO**

**cgSetStateCallbacks**, **cgCallStateValidateCallback**, **cgValidateTechnique**

**NAME**

**cgGetString** – gets a special string

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetString( CGenum enum );
```

**PARAMETERS**

enum     An enumerator describing the string to be returned.

**RETURN VALUES**

Returns the string associated with **enum**.

Returns **NULL** in the event of an error.

**DESCRIPTION**

**cgGetString** returns an informative string depending on the **enum**. Currently there is only one valid enumerator that may be passed in.

**CG\_VERSION**

Returns the version string of the Cg runtime and compiler.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **enum** is not **CG\_VERSION**.

**HISTORY**

**cgGetString** was introduced in Cg 1.2.

**SEE ALSO**

Cg

**NAME**

**cgGetStringAnnotationValue** – get a string-valued annotation’s value

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStringAnnotationValue( CGannotation ann );
```

**PARAMETERS**

ann        The annotation.

**RETURN VALUES**

Returns a pointer to a string contained by **ann**.

Returns **NULL** if no value is available.

**DESCRIPTION**

**cgGetStringAnnotationValue** allows the application to retrieve the value of a string typed annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**HISTORY**

**cgGetStringAnnotationValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetAnnotationType,                      cgGetStringAnnotationValues,                      cgGetFloatAnnotationValues,  
cgGetIntAnnotationValues, cgGetBoolAnnotationValues



**NAME**

**cgGetStringAnnotationValues** – get the values from a string-valued annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * const * cgGetStringAnnotationValues( CGannotation ann,  
int * nvalues );
```

**PARAMETERS**

**ann**        The annotation from which the values will be retrieved.

**nvalues**   Pointer to integer where the number of returned values will be stored.

**RETURN VALUES**

Returns a pointer to an array of **string** values. The number of values in the array is returned via the **nvalues** parameter.

Returns **NULL** if no values are available, **ann** is not string-typed, or an error occurs. **nvalues** will be 0.

**DESCRIPTION**

**cgGetStringAnnotationValues** allows the application to retrieve the *value* (s) of a string typed annotation.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **nvalues** is **NULL**.

**HISTORY**

**cgGetStringAnnotationValues** was introduced in Cg 2.0.

**SEE ALSO**

cgGetAnnotationType,                      cgGetStringAnnotationValue,                      cgGetBoolAnnotationValues,  
cgGetFloatAnnotationValues, cgGetIntAnnotationValues

**NAME**

**cgGetStringParameterValue** – get the value of a string parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStringParameterValue( CGparameter param );
```

**PARAMETERS**

**param**     The parameter whose value will be retrieved.

**RETURN VALUES**

Returns a pointer to the string contained by a string parameter.

Returns **NULL** if the parameter does not contain a valid string value.

**DESCRIPTION**

**cgGetStringParameterValue** allows the application to get the value of a string parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **param** is not string-typed.

**HISTORY**

**cgGetStringParameterValue** was introduced in Cg 1.4.

**SEE ALSO**

cgSetStringParameterValue

**NAME**

**cgGetStringStateAssignmentValue** – get a string-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetStringStateAssignmentValue( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment.

**RETURN VALUES**

Returns a pointer to a string.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetStringStateAssignmentValue** allows the application to retrieve the *value* (s) of a string typed state assignment.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a string type.

**HISTORY**

**cgGetStringStateAssignmentValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState, cgGetStateType, cgGetFloatStateAssignmentValues,  
cgGetIntStateAssignmentValues, cgGetBoolStateAssignmentValues, cgGetProgramStateAssignmentValue,  
cgGetSamplerStateAssignmentValue, cgGetTextureStateAssignmentValue

**NAME**

**cgGetSupportedProfile** – get a supported profile by index

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprofile cgGetSupportedProfile( int index );
```

**PARAMETERS**

index     The index for the supported profile.

**RETURN VALUES**

Returns the supported **CGprofile** at position **index**.

Returns the **CG\_PROFILE\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgGetSupportedProfile** retrieves by **index** a profile supported by this version of the Cg library. The number of supported profiles can be found using **cgGetNumSupportedProfiles**.

Note that a profile may be recognized by Cg but not supported by the platform on which the application is currently running. A graphics API specific routine such as **cgGLIsProfileSupported** must still be used to determine if the current GPU and driver combination supports a given profile.

**EXAMPLES**

```
CGprofile profile;
int nProfiles;
int ii;

nProfiles = cgGetNumSupportedProfiles();
printf("NumSupportedProfiles: %i\n", nProfiles);

for (ii=0; ii<nProfiles; ++ii) {
    profile = cgGetSupportedProfile(ii);
    printf("SupportedProfile %i: %s %i\n", ii, cgGetProfileString(profile), prof
}
}
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **index** is less than **0** or greater than or equal to the number of supported profiles returned by **cgGetNumSupportedProfiles**.

**HISTORY**

**cgGetSupportedProfile** was introduced in Cg 2.2.

**SEE ALSO**

**cgGetNumSupportedProfiles**, **cgIsProfileSupported**, **cgGetProfileProperty**, **cgGLIsProfileSupported**, **cgD3D9IsProfileSupported**, **cgD3D10IsProfileSupported**, **cgGetProfileString**, **cgGetProfile**

**NAME**

**cgGetTechniqueEffect** – get a technique’s effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGeffect cgGetTechniqueEffect( CGtechnique tech );
```

**PARAMETERS**

tech      The technique.

**RETURN VALUES**

Returns a **CGeffect** handle to the effect.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetTechniqueEffect** allows the application to retrieve a handle to the effect to which a given technique belongs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetTechniqueEffect** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile

**NAME**

**cgGetTechniqueName** – get a technique’s name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetTechniqueName( CGtechnique tech );
```

**PARAMETERS**

tech      The technique.

**RETURN VALUES**

Returns the NULL-terminated name string for the technique.

Returns **NULL** if **tech** is invalid.

**DESCRIPTION**

**cgGetTechniqueName** allows the application to retrieve the name of a technique in a Cg effect. This name can be used later to retrieve the technique from the effect using **cgGetNamedTechnique**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgGetTechniqueName** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetNamedTechnique**, **cgGetFirstTechnique**, **cgGetNextTechnique**

**NAME**

**cgGetTextureStateAssignmentValue** – get a texture-valued state assignment's values

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameter cgGetTextureStateAssignmentValue( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment.

**RETURN VALUES**

Returns a handle to the texture parameter associated with this state assignment.

Returns **NULL** if an error occurs.

**DESCRIPTION**

**cgGetTextureStateAssignmentValue** allows the application to retrieve the *value* (s) of a state assignment that stores a texture parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a texture type.

**HISTORY**

**cgGetTextureStateAssignmentValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStateAssignmentState, cgGetStateType, cgGetFloatStateAssignmentValues,  
cgGetIntStateAssignmentValues, cgGetStringStateAssignmentValue, cgGetSamplerStateAssignmentValue

**NAME**

**cgGetType** – get the type enumerator assigned to a type name

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetType( const char * type_string );
```

**PARAMETERS**

type\_string

A string containing the case-sensitive type name.

**RETURN VALUES**

Returns the type enumerator of **type\_string**.

Returns **CG\_UNKNOWN\_TYPE** if no such type exists.

**DESCRIPTION**

**cgGetType** returns the enumerator assigned to a type name.

**EXAMPLES**

```
CGtype Float4Type = cgGetType("float4");

if(cgGetParameterType(myparam) == Float4Type)
{
    /* Do stuff */
}
```

**ERRORS**

None.

**HISTORY**

**cgGetType** was introduced in Cg 1.1.

**SEE ALSO**

cgGetTypeString, cgGetParameterType



**NAME**

**cgGetTypeBase** – get the base type associated with a type enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGtype cgGetTypeBase( CGtype type );
```

**PARAMETERS**

type      The type enumerator.

**RETURN VALUES**

Returns the scalar base type of the enumerator **type**.

**DESCRIPTION**

**cgGetTypeBase** returns the base (scalar) type associated with a type enumerator. For example, `cgGetTypeBase(CG_FLOAT3x4)` returns **CG\_FLOAT**. The base type for a non-numeric type such as **CG\_STRING**, **CG\_STRUCT**, **CG\_SAMPLER2D**, or user-defined types is simply the type itself.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGetTypeBase** was introduced in Cg 1.5.

**SEE ALSO**

`cgGetType`, `cgGetTypeClass`, `cgGetParameterType`

**NAME**

**cgGetTypeClass** – get the parameter class associated with a type enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGparameterclass cgGetTypeClass( CGtype type );
```

**PARAMETERS**

type      The type enumerator.

**RETURN VALUES**

Returns the parameter class of the enumerator **type**. Possible return values are:

- **CG\_PARAMETERCLASS\_UNKNOWN**
- **CG\_PARAMETERCLASS\_SCALAR**
- **CG\_PARAMETERCLASS\_VECTOR**
- **CG\_PARAMETERCLASS\_MATRIX**
- **CG\_PARAMETERCLASS\_STRUCT**
- **CG\_PARAMETERCLASS\_ARRAY**
- **CG\_PARAMETERCLASS\_SAMPLER**
- **CG\_PARAMETERCLASS\_OBJECT**

**DESCRIPTION**

**cgGetTypeClass** returns the parameter class associated with a type enumerator. For example, `cgGetTypeClass(CG_FLOAT3x4)` returns **CG\_PARAMETERCLASS\_MATRIX** while `cgGetTypeClass(CG_HALF)` returns **CG\_PARAMETERCLASS\_SCALAR** and `cgGetTypeClass(CG_BOOL3)` returns **CG\_PARAMETERCLASS\_VECTOR**.

**CG\_PARAMETERCLASS\_UNKNOWN** is returned if the type is unknown.

**EXAMPLES**

*to-be-written*

**ERRORS**

None

**HISTORY**

**cgGetTypeClass** was introduced in Cg 1.5.

**SEE ALSO**

`cgGetType`, `cgGetTypeBase`, `cgGetParameterType`

**NAME**

**cgGetTypeSizes** – get the row and/or column size of a type enumerator

**SYNOPSIS**

```
#include <Cg/cg.h>

CGbool cgGetTypeSizes( CGtype type,
                       int * nrows,
                       int * ncols );
```

**PARAMETERS**

**type**      The type enumerator.

**nrows**     The location where the number of rows will be written.

**ncols**     The location where the number of columns will be written.

**RETURN VALUES**

Returns **CG\_TRUE** if the type enumerator is for a matrix.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgGetTypeSizes** returns the number of rows and columns for enumerator **type** in the locations specified by **nrows** and **ncols** respectively.

When the type enumerator is not a matrix type then **1** is returned in **nrows**, in contrast to **cgGetMatrixSize** where the number of rows and columns will be **0** if the type enumerator is not a matrix.

For a numeric types, **ncols** will be the vector length for vectors and **1** for scalars. For non-numeric types, **ncols** will be **0**.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGetTypeSizes** was introduced in Cg 1.5.

**SEE ALSO**

**cgGetArrayTotalSize**, **cgGetArrayDimension**, **cgGetArrayParameter**, **cgGetMatrixSize**

**NAME**

**cgGetTypeString** – get the type name associated with a type enumerant

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
const char * cgGetTypeString( CGtype type );
```

**PARAMETERS**

type      The type enumerant.

**RETURN VALUES**

Returns the type string of the enumerant **type**.

**DESCRIPTION**

**cgGetTypeString** returns the type named associated with a type enumerant.

**EXAMPLES**

```
const char *MatrixTypeStr = cgGetTypeString(CG_FLOAT4x4);

/* MatrixTypeStr will be "float4x4" */
```

**ERRORS**

None.

**HISTORY**

**cgGetTypeString** was introduced in Cg 1.1.

**SEE ALSO**

cgGetType, cgGetParameterType

**NAME**

**cgGetUserType** – get enumerant of user-defined type from a program or effect

**SYNOPSIS**

```
#include <Cg/cg.h>

CGtype cgGetUserType( CGhandle handle,
                      int index );
```

**PARAMETERS**

**handle**    The **CGprogram** or **CGeffect** in which the type is defined.

**index**    The index of the user-defined type. **index** must be greater than or equal to **0** and less than the value returned by `cgGetNumUserTypes`.

**RETURN VALUES**

Returns the type enumerant associated with the type with the given **index**.

**DESCRIPTION**

**cgGetUserType** returns the enumerant associated with the user-defined type with the given **index** in the given **CGprogram** or **CGeffect**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **handle** is not a valid program or effect handle.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **index** is outside the proper range.

**HISTORY**

**cgGetUserType** was introduced in Cg 1.2.

**SEE ALSO**

`cgGetNumUserTypes`, `cgGetNamedUserType`

**NAME**

**cgIsAnnotation** – determine if an annotation handle references a valid annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsAnnotation( CGannotation ann );
```

**PARAMETERS**

ann        The annotation handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **ann** references a valid annotation.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsAnnotation** returns **CG\_TRUE** if **ann** references a valid annotation, **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsAnnotation** was introduced in Cg 1.4.

**SEE ALSO**

cgGetNextAnnotation,    cgGetAnnotationName,    cgGetAnnotationType,    cgCreateEffectAnnotation,  
cgCreateParameterAnnotation,    cgCreatePassAnnotation,    cgCreateProgramAnnotation,  
cgCreateTechniqueAnnotation

**NAME**

**cgIsContext** – determine if a context handle references a valid context

**SYNOPSIS**

```
#include <Cg/cg.h>

CGbool cgIsContext( CGcontext context );
```

**PARAMETERS**

context The context handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **context** references a valid context.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsContext** returns **CG\_TRUE** if **context** references a valid context, **CG\_FALSE** otherwise.

**EXAMPLES**

```
CGcontext context = NULL;
cgIsContext(context);           /* returns CG_FALSE */

context = cgCreateContext();
cgIsContext(context);           /* returns CG_TRUE if create succeeded */

cgDestroyContext(context);
cgIsContext(context);           /* returns CG_FALSE */
```

**ERRORS**

None.

**HISTORY**

**cgIsContext** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateContext, cgDestroyContext

**NAME**

**cgIsEffect** – determine if an effect handle references a valid effect

**SYNOPSIS**

```
#include <Cg/cg.h>

Cgbool cgIsEffect( CGeffect effect );
```

**PARAMETERS**

**effect**     The effect handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **effect** references a valid effect.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsEffect** returns **CG\_TRUE** if **effect** references a valid effect, **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsEffect** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile



**NAME**

**cgIsInterfaceType** – determine if a type is an interface

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsInterfaceType( CGtype type );
```

**PARAMETERS**

type      The type being evaluated.

**RETURN VALUES**

Returns **CG\_TRUE** if **type** is an interface (not just a struct).

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsInterfaceType** returns **CG\_TRUE** if **type** is an interface (not just a struct), **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsInterfaceType** was introduced in Cg 1.2.

**SEE ALSO**

cgGetType

**NAME**

**cgIsParameter** – determine if a parameter handle references a valid parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

Cgbool cgIsParameter( Cgparameter param );
```

**PARAMETERS**

param     The parameter handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **param** references a valid parameter object.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsParameter** returns **CG\_TRUE** if **param** references a valid parameter object. **cgIsParameter** is typically used for iterating through the parameters of an object. It can also be used as a consistency check when the application caches **CGparameter** handles. Certain program operations like deleting the program or context object that the parameter is contained in will cause a parameter object to become invalid.

**EXAMPLES**

```
if (cgIsParameter(param)) {
    /* do something with param */
} else {
    /* handle situation where param is not a valid parameter */
}
```

**ERRORS**

None.

**HISTORY**

**cgIsParameter** was introduced in Cg 1.1.

**SEE ALSO**

cgGetNextParameter

**NAME**

**cgIsParameterGlobal** – determine if a parameter is global

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsParameterGlobal( CGparameter param );
```

**PARAMETERS**

param     The parameter handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **param** is global.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsParameterGlobal** returns **CG\_TRUE** if **param** is a global parameter and **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgIsParameterGlobal** was introduced in Cg 1.2.

**SEE ALSO**

cgCreateParameter, cgIsParameter, cgIsParameterReferenced, cgIsParameterUsed

**NAME**

**cgIsParameterReferenced** – determine if a program parameter is potentially referenced

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsParameterReferenced( CGparameter param );
```

**PARAMETERS**

**param**     The handle of the parameter to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **param** is a program parameter and is potentially referenced by the program.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsParameterReferenced** returns **CG\_TRUE** if **param** is a program parameter, and is potentially referenced (used) within the program. It otherwise returns **CG\_FALSE**.

Program parameters are those parameters associated directly with a **CGprogram**, whose handles are retrieved by calling, for example, **cgGetNamedProgramParameter**.

The value returned by **cgIsParameterReferenced** is conservative, but not always exact. A return value of **CG\_TRUE** indicates that the parameter may be used by its associated program. A return value of **CG\_FALSE** indicates that the parameter is definitely not referenced by the program.

If **param** is an aggregate program parameter (a struct or array), **CG\_TRUE** is returned if any of **param**'s children are potentially referenced by the program.

If **param** is a leaf parameter and the return value is **CG\_FALSE**, **cgGetParameterResource** may return **CG\_INVALID\_VALUE** for this parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgIsParameterReferenced** was introduced in Cg 1.1.

**SEE ALSO**

**cgGetNamedProgramParameter**, **cgIsParameterUsed**, **cgGetParameterResource**

**NAME**

**cgIsParameterUsed** – determine if a parameter is potentially used

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsParameterUsed( CGparameter param,
                          CGhandle container );
```

**PARAMETERS**

**param**     The parameter to check.

**container**

Specifies the **CGeffect**, **CGtechnique**, **CGpass**, **CGstateassignment**, or **CGprogram** that may potentially use **param**.

**RETURN VALUES**

Returns **CG\_TRUE** if **param** is potentially used by **container**.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsParameterUsed** returns **CG\_TRUE** if **param** is potentially used by the given **container**. If **param** is a struct or array, **CG\_TRUE** is returned if any of its children are potentially used by **container**. It otherwise returns **CG\_FALSE**.

The value returned by **cgIsParameterUsed** is conservative, but not always exact. A return value of **CG\_TRUE** indicates that the parameter may be used by **container**. A return value of **CG\_FALSE** indicates that the parameter is definitely not used by **container**.

The given **param** handle may reference a program parameter, an effect parameter, or a shared parameter.

The **container** handle may reference a **CGeffect**, **CGtechnique**, **CGpass**, **CGstateassignment**, or **CGprogram**.

If **container** is a **CGprogram**, **CG\_TRUE** is returned if any of the program's referenced parameters inherit their values directly or indirectly (due to parameter connections) from **param**.

If **container** is a **CGstateassignment**, **CG\_TRUE** is returned if the right-hand side of the state assignment may directly or indirectly depend on the value of **param**. If the state assignment involves a **CGprogram**, the program's parameters are also considered, as above.

If **container** is a **CGpass**, **CG\_TRUE** is returned if any of the pass' state assignments potentially use **param**.

If **container** is a **CGtechnique**, **CG\_TRUE** is returned if any of the technique's passes potentially use **param**.

If **container** is a **CGeffect**, **CG\_TRUE** is returned if any of the effect's techniques potentially use **param**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter, or if **container** is not the handle of a valid container.

**HISTORY**

**cgIsParameterUsed** was introduced in Cg 1.4.

**SEE ALSO**

**cgIsParameterReferenced**, **cgConnectParameter**

**NAME**

**cgIsParentType** – determine if a type is a parent of another type

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsParentType( CGtype parent,  
                       CGtype child );
```

**PARAMETERS**

parent     The parent type.

child     The child type.

**RETURN VALUES**

Returns **CG\_TRUE** if **parent** is a parent type of **child**.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsParentType** returns **CG\_TRUE** if **parent** is a parent type of **child**. Otherwise **CG\_FALSE** is returned.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsParentType** was introduced in Cg 1.2.

**SEE ALSO**

cgGetParentType

**NAME**

**cgIsPass** – determine if a pass handle references a valid pass

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsPass( CGpass pass );
```

**PARAMETERS**

pass      The pass handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **pass** references a valid pass.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsPass** returns **CG\_TRUE** if **pass** references a valid pass, **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsPass** was introduced in Cg 1.4.

**SEE ALSO**

cgCreatePass, cgGetFirstPass, cgGetNamedPass, cgGetNextPass, cgGetPassName, cgGetPassTechnique

**NAME**

**cgIsProfileSupported** – determine if a profile is supported

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsProfileSupported( CGprofile profile );
```

**PARAMETERS**

profile    The profile enumerator to test.

**RETURN VALUES**

Returns **CG\_TRUE** if **profile** is supported.

**DESCRIPTION**

**cgIsProfileSupported** checks whether **profile** is supported by this version of the Cg library.

Note that a profile may be recognized by Cg but not supported by the platform on which the application is currently running. A graphics API specific routine such as **cgGLIsProfileSupported** must still be used to determine if the current GPU and driver combination supports a given profile.

**EXAMPLES**

```
CGprofile profile;
int nProfiles;
int ii;

nProfiles = cgGetNumSupportedProfiles();
printf("NumSupportedProfiles: %i\n", nProfiles);

for (ii=0; ii<nProfiles; ++ii) {
    profile = cgGetSupportedProfile(ii);
    printf("IsProfileSupported %i: %s %i\n", ii, cgGetProfileString(profile),
        cgIsProfileSupported(profile));
}
```

**ERRORS**

None.

**HISTORY**

**cgIsProfileSupported** was introduced in Cg 2.2.

**SEE ALSO**

**cgGetNumSupportedProfiles**, **cgGetSupportedProfile**, **cgGetProfileProperty**, **cgGLIsProfileSupported**, **cgD3D9IsProfileSupported**, **cgD3D10IsProfileSupported**, **cgGetProfileString**, **cgGetProfile**



**NAME**

**cgIsProgram** – determine if a program handle references a program object

**SYNOPSIS**

```
#include <Cg/cg.h>

CGbool cgIsProgram( CGprogram program );
```

**PARAMETERS**

**program** The program handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **program** references a valid program object.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsProgram** return **CG\_TRUE** if **program** references a valid program object. Note that this does not imply that the program has been successfully compiled.

**EXAMPLES**

```
char *programSource = ...;
CGcontext context = cgCreateContext();
CGprogram program = cgCreateProgram( context,
                                     CG_SOURCE,
                                     programSource,
                                     CG_PROFILE_ARBVP1,
                                     "myshader",
                                     NULL );

CGbool isProgram = cgIsProgram( program );
```

**ERRORS**

None.

**HISTORY**

**cgIsProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgCreateProgram, cgDestroyProgram, cgGetNextProgram

**NAME**

**cgIsProgramCompiled** – determine if a program has been compiled

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsProgramCompiled( CGprogram program );
```

**PARAMETERS**

program The program.

**RETURN VALUES**

Returns **CG\_TRUE** if **program** has been compiled.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsProgramCompiled** returns **CG\_TRUE** if **program** has been compiled and **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgIsProgramCompiled** was introduced in Cg 1.1.

**SEE ALSO**

cgCompileProgram, cgSetAutoCompile

**NAME**

**cgIsState** – determine if a state handle references a valid state

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsState( CGstate state );
```

**PARAMETERS**

state      The state handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **state** references a valid state.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsState** returns **CG\_TRUE** if **state** references a valid state, **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgIsState** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateState

**NAME**

**cgIsStateAssignment** – determine if a state assignment handle references a valid Cg state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsStateAssignment( CGstateassignment sa );
```

**PARAMETERS**

sa           The state assignment handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **sa** references a valid state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsStateAssignment** returns **CG\_TRUE** if **sa** references a valid state assignment, **CG\_FALSE** otherwise.

**EXAMPLES**

```
if (cgIsStateAssignment(sa)) {  
    /* do something with sa */  
} else {  
    /* handle situation where sa is not a valid state assignment */  
}
```

**ERRORS**

None.

**HISTORY**

**cgIsStateAssignment** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateStateAssignment,	cgCreateStateAssignmentIndex,	cgGetFirstStateAssignment,
cgGetFirstSamplerStateAssignment,	cgGetNamedStateAssignment,	cgGetNamedSamplerStateAssignment,
cgGetNextStateAssignment,	cgGetStateAssignmentIndex,	cgGetStateAssignmentPass,
cgGetStateAssignmentState		

**NAME**

**cgIsTechnique** – determine if a technique handle references a valid technique

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsTechnique( CGtechnique tech );
```

**PARAMETERS**

tech      The technique handle to check.

**RETURN VALUES**

Returns **CG\_TRUE** if **tech** references a valid technique.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgIsTechnique** returns **CG\_TRUE** if **tech** references a valid technique, **CG\_FALSE** otherwise.

**EXAMPLES**

```
if (cgIsTechnique(tech)) {  
    /* do something with tech */  
} else {  
    /* handle situation where tech is not a valid technique */  
}
```

**ERRORS**

None.

**HISTORY**

**cgIsTechnique** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateTechnique, cgGetFirstTechnique, cgGetNamedTechnique, cgGetNextTechnique,  
cgGetTechniqueEffect, cgGetTechniqueName, cgIsTechniqueValidated, cgValidateTechnique

**NAME**

**cgIsTechniqueValidated** – indicates whether the technique has passed validation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgIsTechniqueValidated( CGtechnique tech );
```

**PARAMETERS**

**tech**      The technique handle.

**RETURN VALUES**

Returns **CG\_TRUE** if the technique has previously passes validation via a call to `cgValidateTechnique`.

Returns **CG\_FALSE** if validation hasn't been attempted or the technique has failed a validation attempt.

**DESCRIPTION**

**cgIsTechniqueValidated** returns **CG\_TRUE** if the technique has previously passes validation via a call to `cgValidateTechnique`. **CG\_FALSE** is returned both if validation hasn't been attempted as well as if the technique has failed a validation attempt.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgIsTechniqueValidated** was introduced in Cg 1.4.

**SEE ALSO**

`cgValidateTechnique`, `cgCallStateValidateCallback`

**NAME**

**cgMapBuffer** – map buffer into application’s address space

**SYNOPSIS**

```
#include <Cg/cg.h>

void * cgMapBuffer( CGbuffer buffer,
                   CGbufferaccess access );
```

**PARAMETERS**

**buffer** The buffer which will be mapped into the application’s address space.

**access** An enumerant indicating the operations the client may perform on the data store through the pointer while the buffer data is mapped.

The following enumerants are allowed:

**CG\_MAP\_READ**

The application can read but not write through the data pointer.

**CG\_MAP\_WRITE**

The application can write but not read through the data pointer.

**CG\_MAP\_READ\_WRITE**

The application can read and write through the data pointer.

**CG\_MAP\_WRITE\_DISCARD**

Same as CG\_MAP\_READ\_WRITE if using a GL buffer.

**CG\_MAP\_WRITE\_NO\_OVERWRITE**

Same as CG\_MAP\_READ\_WRITE if using a GL buffer.

**RETURN VALUES**

Returns a pointer through which the application can read or write the buffer’s data store.

Returns NULL if an error occurs.

**DESCRIPTION**

**cgMapBuffer** maps a buffer into the application’s address space for memory-mapped updating of the buffer’s data. The application should call **cgUnmapBuffer** when it’s done updating or querying the buffer.

**EXAMPLES**

```
unsigned char *bufferPtr = cgMapBuffer( myBuffer, CG_MAP_READ_WRITE );
memcpy( ptr, bufferPtr, size );
cgUnmapBuffer( myBuffer );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **access** is not **CG\_READ\_ONLY**, **CG\_WRITE\_ONLY**, or **CG\_READ\_WRITE**.

**CG\_BUFFER\_ALREADY\_MAPPED\_ERROR** is generated if **buffer** is already mapped.

**HISTORY**

**cgMapBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgUnmapBuffer, cgSetBufferData, cgSetBufferSubData, cgSetParameter

**NAME**

**cgResetPassState** – calls the state resetting callback functions for all of the state assignments in a pass.

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgResetPassState( CGpass pass );
```

**PARAMETERS**

pass      The pass handle.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgResetPassState** resets all of the graphics state defined in a pass by calling the state resetting callbacks for all of the state assignments in the pass.

The semantics of “resetting state” will depend on the particular graphics state manager that defined the valid state assignments; it will generally either mean that graphics state is reset to what it was before the pass, or that it is reset to the default value. The OpenGL state manager in the OpenGL Cg runtime implements the latter approach.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_INVALID\_TECHNIQUE\_ERROR** is generated if the technique of which **pass** is a part has failed validation.

**HISTORY**

**cgResetPassState** was introduced in Cg 1.4.

**SEE ALSO**

cgSetPassState, cgCallStateResetCallback



**NAME**

**cgSetArraySize** – sets the size of a resizable array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetArraySize( CGparameter param,
                    int size );
```

**PARAMETERS**

**param**    The array parameter handle.  
**size**     The new size of the array.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetArraySize** sets the size of a resiable array parameter **param** to **size**.

**EXAMPLES**

If you have Cg program with a parameter like this :

```
/* ... */

float4 main(float4 myarray[])
{
    /* ... */
}
```

You can set the size of the **myarray** array parameter to **5** like so :

```
CGparameter arrayParam =
    cgGetNamedProgramParameter(program, CG_PROGRAM, "myarray");

cgSetArraySize(arrayParam, 5);
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_ARRAY\_HAS\_WRONG\_DIMENSION\_ERROR** is generated if the dimension of the array parameter **param** is not 1.

**CG\_PARAMETER\_IS\_NOT\_RESIZABLE\_ARRAY\_ERROR** is generated if **param** is not a resizable array.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **size** is less than **0**.

**HISTORY**

**cgSetArraySize** was introduced in Cg 1.2.

**SEE ALSO**

cgGetArraySize, cgGetArrayDimension, cgSetMultiDimArraySize

**NAME**

**cgSetAutoCompile** – sets the auto-compile mode for a context

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetAutoCompile( CGcontext context,
                      CGenum autoCompileMode );
```

**PARAMETERS**

context    The context.

autoCompileMode

The auto-compile mode to which to set **context**. Must be one of the following :

- **CG\_COMPILE\_MANUAL**
- **CG\_COMPILE\_IMMEDIATE**
- **CG\_COMPILE\_LAZY**

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetAutoCompile** sets the auto compile mode for a given context. By default, programs are immediately recompiled when they enter an uncompiled state. This may happen for a variety of reasons including :

- Setting the value of a literal parameter.
- Resizing arrays.
- Binding structs to interface parameters.

**autoCompileMode** may be one of the following three enumerants :

- **CG\_COMPILE\_IMMEDIATE**

**CG\_COMPILE\_IMMEDIATE** will force recompilation automatically and immediately when a program enters an uncompiled state. This is the default mode.

- **CG\_COMPILE\_MANUAL**

With this method the application is responsible for manually recompiling a program. It may check to see if a program requires recompilation with the entry point `cgIsProgramCompiled`. `cgCompileProgram` can then be used to force compilation.

- **CG\_COMPILE\_LAZY**

This method is similar to **CG\_COMPILE\_IMMEDIATE** but will delay program recompilation until the program object code is needed. The advantage of this method is the reduction of extraneous recompilations. The disadvantage is that compile time errors will not be encountered when the program enters the uncompiled state but will instead be encountered at some later time.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **autoCompileMode** is not **CG\_COMPILE\_MANUAL**, **CG\_COMPILE\_IMMEDIATE**, or **CG\_COMPILE\_LAZY**.

**HISTORY**

**cgSetAutoCompile** was introduced in Cg 1.2.

**SEE ALSO**

`cgCompileProgram`, `cgIsProgramCompiled`

**NAME**

**cgSetBoolAnnotation** – set the value of a bool annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetBoolAnnotation( CGannotation ann,  
                             CGbool value );
```

**PARAMETERS**

ann        The annotation that will be set.

value     The value to which **ann** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the annotation.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetBoolAnnotation** sets the value of an annotation of bool type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **ann** is not an annotation of bool type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **ann** is not a scalar.

**HISTORY**

**cgSetBoolAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetBoolAnnotationValues, cgSetIntAnnotation, cgSetFloatAnnotation, cgSetStringAnnotation

**NAME**

**cgSetBoolArrayStateAssignment** – set a bool-valued state assignment array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetBoolArrayStateAssignment( CGstateassignment sa,  
                                       const CGbool * vals );
```

**PARAMETERS**

sa            A handle to a state assignment array of type **CG\_BOOL**.

vals         The values which will be used to set **sa**.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetBoolArrayStateAssignment** sets the value of a state assignment of bool array type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a bool type.

**HISTORY**

**cgSetBoolArrayStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetBoolStateAssignmentValues,	cgSetBoolStateAssignment,	cgSetFloatArrayStateAssignment,
cgSetFloatStateAssignment,	cgSetIntArrayStateAssignment,	cgSetIntStateAssignment,
cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,	cgSetStringStateAssignment,
cgSetTextureStateAssignment		

**NAME**

**cgSetBoolStateAssignment** – set the value of a bool state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetBoolStateAssignment( CGstateassignment sa,  
                                CGbool value );
```

**PARAMETERS**

sa           A handle to a state assignment of type **CG\_BOOL**.

value        The value to which **sa** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetBoolStateAssignment** sets the value of a state assignment of bool type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a bool type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**HISTORY**

**cgSetBoolStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetBoolStateAssignmentValues,	cgSetBoolArrayStateAssignment,	cgSetFloatArrayStateAssignment,
cgSetFloatStateAssignment,	cgSetIntArrayStateAssignment,	cgSetIntStateAssignment,
cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,	cgSetStringStateAssignment,
cgSetTextureStateAssignment		

**NAME**

**cgSetBufferData** – resize and completely update a buffer object

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetBufferData( CGbuffer buffer,
                     int size,
                     const void * data );
```

**PARAMETERS**

**buffer**     The buffer which will be updated.

**size**       Specifies a new size for the buffer object. Zero for size means use the existing size of the buffer as the effective size.

**data**       Pointer to the data to copy into the buffer. The number of bytes to copy is determined by the size parameter.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetBufferData** resizes and completely updates an existing buffer object.

A buffer which has been mapped into an applications address space with **cgMapBuffer** must be unmapped using **cgUnmapBuffer** before it can be updated with **cgSetBufferData**.

**EXAMPLES**

```
cgSetBufferData( myBuffer, sizeof( myData ), myData );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**CG\_BUFFER\_UPDATE\_NOT\_ALLOWED\_ERROR** is generated if **buffer** is currently mapped.

**HISTORY**

**cgSetBufferData** was introduced in Cg 2.0.

**SEE ALSO**

**cgCreateBuffer**, **cgGLCreateBuffer**, **cgSetBufferSubData**, **cgMapBuffer**, **cgUnmapBuffer**

**NAME**

**cgSetBufferSubData** – partially update a Cg buffer object

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetBufferSubData( CGbuffer buffer,
                        int offset,
                        int size,
                        const void * data );
```

**PARAMETERS**

**buffer**     Buffer being updated.

**offset**     Buffer offset in bytes of the beginning of the partial update.

**size**       Number of buffer bytes to be updated. Zero means no update.

**data**       Pointer to the start of the data being copied into the buffer.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetBufferSubData** resizes and partially updates an existing buffer object.

A buffer which has been mapped into an applications address space with **cgMapBuffer** must be unmapped using **cgUnmapBuffer** before it can be updated with **cgSetBufferSubData**.

**EXAMPLES**

```
cgSetBufferSubData( myBuffer, 16, sizeof( myData ), myData );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**CG\_BUFFER\_UPDATE\_NOT\_ALLOWED\_ERROR** is generated if **buffer** is currently mapped.

**CG\_BUFFER\_INDEX\_OUT\_OF\_RANGE\_ERROR** is generated if **offset** or **size** is out of range.

**HISTORY**

**cgSetBufferSubData** was introduced in Cg 2.0.

**SEE ALSO**

**cgCreateBuffer**, **cgGLCreateBuffer**, **cgSetBufferData**, **cgMapBuffer**, **cgUnmapBuffer**

**NAME**

**cgSetCompilerIncludeCallback** – set the include callback function

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
typedef void (*CGIncludeCallbackFunc)( CGcontext context, const char *filename );
```

```
void cgSetCompilerIncludeCallback( CGcontext context, CGIncludeCallbackFunc func )
```

**PARAMETERS**

context    The context for which the include callback will be used.

func       A pointer to the include callback function.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetCompilerIncludeCallback** sets a callback function used for handling include statements. Each Cg runtime context maintains a virtual file system of shader source code for inclusion by the compiler. Source code is populated into the virtual filesystem using **cgSetCompilerIncludeString** and **cgSetCompilerIncludeFile**. When the compiler encounters an include, firstly the virtual file system is searched for a match. Secondly the include callback function is called, providing an opportunity for populating shader source via **cgSetCompilerIncludeString** and **cgSetCompilerIncludeFile**. The callback function is passed the context and the requested name. Thirdly, the filesystem is searched in the usual manner. Fourthly, an error is raised by the compiler that the include can not be satisfied. **NULL** is passed to **cgSetCompilerIncludeCallback** to disable the callback.

**EXAMPLES****ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgSetCompilerIncludeCallback** was introduced in Cg 2.1.

**SEE ALSO**

**cgGetCompilerIncludeCallback**, **cgSetCompilerIncludeString**, **cgSetCompilerIncludeFile**



**NAME**

**cgSetCompilerIncludeFile** – add shader source file to context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetCompilerIncludeFile( CGcontext context, const char *name, const char *fi
```

**PARAMETERS**

context The context in which to add the source code for inclusion by the compiler.

name The virtual file system name of the shader source.

filename System file system name of shader source file.

**RETURN VALUES**

None.

**DESCRIPTION**

Each Cg runtime context maintains a virtual filesystem of shader source code for inclusion by the compiler. **cgSetCompilerIncludeFile** populates source code into the virtual filesystem from a file. A name is removed from the virtual filesystem by using **NULL** for the **filename**. The virtual filesystem is completely cleared by using **NULL** for the **name**.

**EXAMPLES****ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_FILE\_READ\_ERROR** is generated if the file **filename** can not be opened for input.

**HISTORY**

**cgSetCompilerIncludeFile** was introduced in Cg 2.1.

**SEE ALSO**

cgSetCompilerIncludeString, cgGetCompilerIncludeCallback, cgSetCompilerIncludeCallback

**NAME**

**cgSetCompilerIncludeString** – add shader source string to context

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetCompilerIncludeString( CGcontext context, const char *name, const char *
```

**PARAMETERS**

context    The context in which to add the source code for inclusion by the compiler.

name       The virtual file system name of the shader source.

source     Shader source code string.

**RETURN VALUES**

None.

**DESCRIPTION**

Each Cg runtime context maintains a virtual file system of shader source code for inclusion by the compiler. **cgSetCompilerIncludeString** populates source code into the virtual filesystem. A name is removed from the virtual filesystem by using **NULL** for the **source**. The virtual filesystem is completely cleared by using **NULL** for the **name**.

**EXAMPLES****ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgSetCompilerIncludeString** was introduced in Cg 2.1.

**SEE ALSO**

cgSetCompilerIncludeFile, cgGetCompilerIncludeCallback, cgSetCompilerIncludeCallback

**NAME**

**cgSetEffectName** – set the name of an effect

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetEffectName( CGeffect effect,  
                        const char * name );
```

**PARAMETERS**

effect     The effect in which the name will be set.

name     The new name for **effect**.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetEffectName** allows the application to set the name of an effect.

**EXAMPLES**

```
char *effectSource = ...;  
CGcontext context = cgCreateContext();  
CGeffect effect = cgCreateEffect(context, effectSource, NULL);  
  
const char* myEffectName = "myEffectName";  
CGbool okay = cgSetEffectName(effect, myEffectName);  
if (!okay) {  
    /* handle error */  
}
```

**ERRORS**

**CG\_INVALID\_EFFECT\_HANDLE\_ERROR** is generated if **effect** is not a valid effect.

**HISTORY**

**cgSetEffectName** was introduced in Cg 1.5.

**SEE ALSO**

cgGetEffectName, cgCreateEffect

**NAME**

**cgSetErrorCallback** – set the error callback function

**SYNOPSIS**

```
#include <Cg/cg.h>

typedef void (*CGerrorCallbackFunc)( void );

void cgSetErrorCallback( CGerrorCallbackFunc func );
```

**PARAMETERS**

func      A function pointer to the error callback function.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetErrorCallback** sets a callback function that will be called every time an error occurs. The callback function is not passed any parameters. It is assumed that the callback function will call **cgGetError** to obtain the current error. To disable the callback function, **cgSetErrorCallback** may be called with **NULL**.

**EXAMPLES**

The following is an example of how to set and use an error callback :

```
void MyErrorCallback( void ) {
    int myError = cgGetError();
    fprintf(stderr, "CG ERROR : %s\n", cgGetErrorString(myError));
}

void main(int argc, char *argv[])
{
    cgSetErrorCallback(MyErrorCallback);

    /* Do stuff */
}
```

**ERRORS**

None.

**HISTORY**

**cgSetErrorCallback** was introduced in Cg 1.1.

**SEE ALSO**

cgGetErrorCallback, cgGetError, cgGetErrorString

**NAME**

**cgSetErrorHandler** – set the error handler callback function

**SYNOPSIS**

```
#include <Cg/cg.h>

typedef void (*CGErrorHandlerFunc)( CGcontext context,
                                     CGerror error,
                                     void * appdata );

void cgSetErrorHandler( CGErrorHandlerFunc func,
                        void * appdata );
```

**PARAMETERS**

**func** A pointer to the error handler callback function.

**appdata** A pointer to arbitrary application-provided data.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetErrorHandler** specifies an error handler function that will be called every time a Cg runtime error occurs. The callback function is passed:

**context**

The context in which the error occurred. If the context cannot be determined, **NULL** is used.

**error**

The enumerator of the error triggering the callback.

**appdata**

The value of the pointer passed to **cgSetErrorHandler**. This pointer can be used to make arbitrary application-side information available to the error handler.

To disable the callback function, specify a **NULL** callback function pointer via **cgSetErrorHandler**.

**EXAMPLES**

```
void MyErrorHandler(CGcontext context, CGerror error, void *data) {
    char *progrname = (char *)data;
    fprintf(stderr, "%s: Error: %s\n", progrname, cgGetErrorString(error));
}

void main(int argc, char *argv[])
{
    ...
    cgSetErrorHandler(MyErrorHandler, (void *)argv[0]);
    ...
}
```

**ERRORS**

*to-be-written*

**HISTORY**

**cgSetErrorHandler** was introduced in Cg 1.4.

**SEE ALSO**

cgGetErrorHandler, cgGetError, cgGetErrorString, cgGetFirstError

**NAME**

**cgSetFloatAnnotation** – set the value of a float annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetFloatAnnotation( CGannotation ann,  
                             float value );
```

**PARAMETERS**

ann        The annotation that will be set.

value     The value to which **ann** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the annotation.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetFloatAnnotation** sets the value of an annotation of float type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **ann** is not an annotation of float type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **ann** is not a scalar.

**HISTORY**

**cgSetFloatAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetFloatAnnotationValues, cgSetBoolAnnotation, cgSetIntAnnotation, cgSetStringAnnotation

**NAME**

**cgSetFloatArrayStateAssignment** – set a float-valued state assignment array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetFloatArrayStateAssignment( CGstateassignment sa,  
                                       const float * vals );
```

**PARAMETERS**

**sa**           A handle to a state assignment array of type **CG\_FLOAT**, **CG\_FIXED**, **CG\_HALF**.  
**vals**        The values which will be used to set **sa**.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetFloatArrayStateAssignment** sets the value of a state assignment of float array type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a float type.

**HISTORY**

**cgSetFloatArrayStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetFloatStateAssignmentValues,	cgSetFloatStateAssignment,	cgSetBoolArrayStateAssignment,
cgSetBoolStateAssignment,	cgSetIntArrayStateAssignment,	cgSetIntStateAssignment,
cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,	cgSetStringStateAssignment,
cgSetTextureStateAssignment		

**NAME**

**cgSetFloatStateAssignment** – set the value of a state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetFloatStateAssignment( CGstateassignment sa,  
                                  float value );
```

**PARAMETERS**

**sa**           A handle to a state assignment of type **CG\_FLOAT**, **CG\_FIXED**, or **CG\_HALF**.  
**value**       The value to which **sa** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetFloatStateAssignment** sets the value of a state assignment of float type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a float type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**HISTORY**

**cgSetFloatStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetFloatStateAssignmentValues, cgSetFloatArrayStateAssignment, cgSetBoolArrayStateAssignment,  
cgSetBoolStateAssignment, cgSetIntArrayStateAssignment, cgSetIntStateAssignment,  
cgSetProgramStateAssignment, cgSetSamplerStateAssignment, cgSetStringStateAssignment,  
cgSetTextureStateAssignment



**NAME**

**cgSetIntAnnotation** – set the value of an int annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetIntAnnotation( CGannotation ann,  
                           int value );
```

**PARAMETERS**

ann        The annotation that will be set.

value     The value to which **ann** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the annotation.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetIntAnnotation** sets the value of an annotation of int type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **ann** is not an annotation of int type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **ann** is not a scalar.

**HISTORY**

**cgSetIntAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetIntAnnotationValues, cgSetBoolAnnotation, cgSetFloatAnnotation, cgSetStringAnnotation

**NAME**

**cgSetIntArrayStateAssignment** – set an int-valued state assignment array

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetIntArrayStateAssignment( CGstateassignment sa,  
                                     const int * vals );
```

**PARAMETERS**

sa           A handle to a state assignment array of type **CG\_INT**.

vals         The values which will be used to set **sa**.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetIntArrayStateAssignment** sets the value of a state assignment of int array type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of an int type.

**HISTORY**

**cgSetIntArrayStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetIntStateAssignmentValues,	cgSetIntStateAssignment,	cgSetBoolArrayStateAssignment,
cgSetBoolStateAssignment,	cgSetFloatArrayStateAssignment,	cgSetFloatStateAssignment,
cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,	cgSetStringStateAssignment,
cgSetTextureStateAssignment		

**NAME**

**cgSetIntStateAssignment** – set the value of an int state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetIntStateAssignment( CGstateassignment sa,
                                int value );
```

**PARAMETERS**

**sa**        A handle to a state assignment of type **CG\_INT**.

**value**     The value to which **sa** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetIntStateAssignment** sets the value of a state assignment of int type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of an int type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**HISTORY**

**cgSetIntStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetIntStateAssignmentValues,	cgSetIntArrayStateAssignment,	cgSetBoolArrayStateAssignment,
cgSetBoolStateAssignment,	cgSetFloatArrayStateAssignment,	cgSetFloatStateAssignment,
cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,	cgSetStringStateAssignment,
cgSetTextureStateAssignment		

**NAME**

**cgSetLastListing** – set the current listing text

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetLastListing( CGhandle handle,
                      const char * listing );
```

**PARAMETERS**

handle    A **CGcontext**, **CGstateassignment**, **CGeffect**, **CGpass**, or **CGtechnique** belonging to the context whose listing text is to be set.

listing    The new listing text.

**RETURN VALUES**

None.

**DESCRIPTION**

Each Cg context maintains a NULL-terminated string containing warning and error messages generated by the Cg compiler, state managers and the like. **cgSetLastListing** allows applications and custom state managers to set the listing text.

**cgSetLastListing** is not normally used directly by applications. Instead, custom state managers can use **cgSetLastListing** to provide detailed technique validation error messages to the application.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **handle** is invalid.

**HISTORY**

**cgSetLastListing** was introduced in Cg 1.4.

**SEE ALSO**

cgGetLastListing, cgCreateContext, cgSetErrorHandler

**NAME**

**cgSetLockingPolicy** – set locking policy

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgSetLockingPolicy( CGLenum lockingPolicy );
```

**PARAMETERS**

lockingPolicy

An enumerant describing the desired locking policy for the library. The following enumerants are allowed:

**CG\_THREAD\_SAFE\_POLICY**

Locks will be used to serialize thread access to the library.

**CG\_NO\_LOCKS\_POLICY**

Locks will not be used.

**RETURN VALUES**

Returns the previous locking policy, or **CG\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgSetLockingPolicy** allows an application to change the locking policy used by the Cg library. The default policy is **CG\_THREAD\_SAFE\_POLICY**, meaning a lock is used to serialize access to the library by multiple threads. Single threaded applications can change this policy to **CG\_NO\_LOCKS\_POLICY** to avoid the overhead associated with this lock. Multithreaded applications should **never** change this policy.

**EXAMPLES**

```
/* multithreaded apps should *never* do this */  
cgSetLockingPolicy(CG_NO_LOCKS_POLICY);
```

**ERRORS**

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **lockingPolicy** is not **CG\_NO\_LOCKS\_POLICY** or **CG\_THREAD\_SAFE\_POLICY**.

**HISTORY**

**cgSetLockingPolicy** was introduced in Cg 2.0.

**SEE ALSO**

cgGetLockingPolicy

**NAME**

**cgSetMatrixParameter** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float or double */

void cgSetMatrixParameter{ifd}{rc}( CGparameter param,
                                     const TYPE * matrix );
```

**PARAMETERS**

**param**     The parameter that will be set.

**matrix**     An array of values to which to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgSetMatrixParameter** functions set the value of a given matrix parameter. The functions are available in various combinations.

There are versions of each function that take **int**, **float** or **double** values signified by the **i**, **f** or **d** in the function name.

There are versions of each function that assume the array of values are laid out in either row or column order signified by the **r** or **c** in the function name respectively.

The **cgSetMatrixParameter** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

The **d** and **f** versions of **cgSetMatrixParameter** were introduced in Cg 1.2.

The **i** versions of **cgSetMatrixParameter** were introduced in Cg 1.4.

**SEE ALSO**

cgGetParameterRows, cgGetParameterColumns, cgGetMatrixParameter, cgGetParameterValues

**NAME**

**cgSetMatrixParameterdc** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetMatrixParameterdc( CGparameter param,  
                             const double * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameterdc** sets the value of a given matrix parameter from an array of doubles laid out in column-major order.

**cgSetMatrixParameterdc** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameterdc** was introduced in Cg 1.2.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues

**NAME**

**cgSetMatrixParameterdr** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetMatrixParameterdr( CGparameter param,
                             const double * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameterdr** sets the value of a given matrix parameter from an array of doubles laid out in row-major order.

**cgSetMatrixParameterdr** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameterdr** was introduced in Cg 1.2.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues



**NAME**

**cgSetMatrixParameterfc** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetMatrixParameterfc( CGparameter param,  
                             const float * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameterfc** sets the value of a given matrix parameter from an array of floats laid out in column-major order.

**cgSetMatrixParameterfc** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameterfc** was introduced in Cg 1.2.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues

**NAME**

**cgSetMatrixParameterfr** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetMatrixParameterfr( CGparameter param,  
                             const float * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameterfr** sets the value of a given matrix parameter from an array of floats laid out in row-major order.

**cgSetMatrixParameterfr** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameterfr** was introduced in Cg 1.2.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues

**NAME**

**cgSetMatrixParameteric** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetMatrixParameteric( CGparameter param,  
                             const int * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameteric** sets the value of a given matrix parameter from an array of ints laid out in column-major order.

**cgSetMatrixParameteric** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameteric** was introduced in Cg 1.4.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues

**NAME**

**cgSetMatrixParameterir** – sets the value of matrix parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetMatrixParameterir( CGparameter param,  
                             const int * matrix );
```

**PARAMETERS**

param     The parameter that will be set.

matrix    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMatrixParameterir** sets the value of a given matrix parameter from an array of ints laid out in row-major order.

**cgSetMatrixParameterir** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgSetMatrixParameterir** was introduced in Cg 1.4.

**SEE ALSO**

cgSetMatrixParameter,    cgGetParameterRows,    cgGetParameterColumns,    cgGetMatrixParameter,  
cgGetParameterValues

**NAME**

**cgSetMultiDimArraySize** – sets the size of a resizable multi-dimensional array parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetMultiDimArraySize( CGparameter param,
                             const int * sizes );
```

**PARAMETERS**

**param**     The array parameter handle.

**sizes**     An array of sizes for each dimension of the array.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetMultiDimArraySize** sets the size of each dimension of resizable multi-dimensional array parameter **param**. **sizes** must be an array that has **N** number of elements where **N** is equal to the result of **cgGetArrayDimension**.

**EXAMPLES**

If you have Cg program with a parameter like this :

```
/* ... */

float4 main(float4 myarray[][][]){
{
/* ... */
}
```

You can set the sizes of each dimension of the **myarray** array parameter like so :

```
const int sizes[] = { 3, 2, 4 };
CGparameter myArrayParam =
    cgGetNamedProgramParameter(program, CG_PROGRAM, "myarray");

cgSetMultiDimArraySize(myArrayParam, sizes);
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **sizes** is **NULL**.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if any value in **sizes** is less than or equal to **0**.

**CG\_PARAMETER\_IS\_NOT\_RESIZABLE\_ARRAY\_ERROR** is generated if **param** is not a resizable array.

**HISTORY**

**cgSetMultiDimArraySize** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetArraySize**, **cgGetArrayDimension**, **cgSetArraySize**

**NAME**

**cgSetParameter** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float or double */

void cgSetParameter1{ifd}( CGparameter param,
                           TYPE x );

void cgSetParameter2{ifd}( CGparameter param,
                           TYPE x,
                           TYPE y );

void cgSetParameter3{ifd}( CGparameter param,
                           TYPE x,
                           TYPE y,
                           TYPE z );

void cgSetParameter4{ifd}( CGparameter param,
                           TYPE x,
                           TYPE y,
                           TYPE z,
                           TYPE w );

void cgSetParameter{1234}{ifd}v( CGparameter param,
                                const TYPE * v );
```

**PARAMETERS**

param    The parameter that will be set.

x, y, z, and w

          The values to which to set the parameter.

v

          The values to set the parameter to for the array versions of the set functions.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgSetParameter** functions set the value of a given scalar or vector parameter. The functions are available in various combinations.

Each function takes either 1, 2, 3, or 4 values depending on the function that is used. If more values are passed in than the parameter requires, the extra values will be ignored.

There are versions of each function that take **int**, **float** or **double** values signified by the **i**, **f** or **d** in the function name.

The functions with the **v** at the end of their names take an array of values instead of explicit parameters.

Once **cgSetParameter** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**Note:** Previous releases of Cg allowed you to store more values in a parameter than indicated by the parameter's type. For example, one could use **cgGLSetParameter4f** to store four values into a parameter of type **CG\_FLOAT** (not **CG\_FLOAT4**). All four values could later be retrieved using a get call which

requested more than one value. However, this feature conflicts with the GLSL approach and also leads to issues with parameters mapped into BUFFERS. Therefore, beginning with Cg 2.0 any components beyond the number indicated by the parameter type are ignored.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

## HISTORY

The **d** and **f** versions of **cgSetParameter** were introduced in Cg 1.2.

The **i** versions of **cgSetParameter** were introduced in Cg 1.4.

## SEE ALSO

cgGetParameterValue

**NAME**

**cgSetParameter1d** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1d( CGparameter param,  
                      double x );
```

**PARAMETERS**

param     The parameter that will be set.

x         The value to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1d** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1d** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1d** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**



**NAME**

**cgSetParameter1dv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1dv( CGparameter param,  
                        const double * v );
```

**PARAMETERS**

param     The parameter that will be set.

v          Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1dv** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1dv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1dv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter1f** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1f( CGparameter param,  
                      float x );
```

**PARAMETERS**

param     The parameter that will be set.

x         The value to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1f** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1f** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1f** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter1fv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1fv( CGparameter param,  
                        const float * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1fv** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1fv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1fv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter1i** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1i( CGparameter param,  
                       int x );
```

**PARAMETERS**

param     The parameter that will be set.

x         The value to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1i** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1i** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1i** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter1iv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter1iv( CGparameter param,  
                        const int * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter1iv** sets the value of a given scalar or vector parameter.

Once **cgSetParameter1iv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter1iv** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter2d** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter2d( CGparameter param,  
                      double x,  
                      double y );
```

**PARAMETERS**

param     The parameter that will be set.

x, y       The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2d** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2d** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2d** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter2dv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter2dv( CGparameter param,  
                        const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2dv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2dv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2dv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter2f** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameter2f( CGparameter param,
                      float x,
                      float y );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y**       The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2f** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2f** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2f** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**



**NAME**

**cgSetParameter2fv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter2fv( CGparameter param,  
                        const float * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2fv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2fv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2fv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter2i** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter2i( CGparameter param,  
                       int x,  
                       int y );
```

**PARAMETERS**

param     The parameter that will be set.

x, y       The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2i** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2i** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with `cgGetParameterValues`.

If an API-dependant layer of the Cg runtime (e.g. `cgGL`) is used, these entry points may end up making API (e.g. `OpenGL`) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2i** was introduced in Cg 1.4.

**SEE ALSO**

`cgGetParameterValue`, `cgGetParameterValues`

**NAME**

**cgSetParameter2iv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter2iv( CGparameter param,  
                        const int * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter2iv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter2iv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter2iv** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter3d** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter3d( CGparameter param,  
                      double x,  
                      double y,  
                      double z );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z**     The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3d** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3d** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3d** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter3dv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter3dv( CGparameter param,  
                        const double * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3dv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3dv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3dv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter3f** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameter3f( CGparameter param,
                       float x,
                       float y,
                       float z );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z**     The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3f** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3f** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3f** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter3fv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter3fv( CGparameter param,  
                        const float * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3fv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3fv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3fv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter3i** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameter3i( CGparameter param,
                      int x,
                      int y,
                      int z );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z**     The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3i** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3i** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3i** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**



**NAME**

**cgSetParameter3iv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter3iv( CGparameter param,  
                        const int * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter3iv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter3iv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter3iv** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter4d** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameter4d( CGparameter param,
                       double x,
                       double y,
                       double z,
                       double w );
```

**PARAMETERS**

param     The parameter that will be set.

x, y, z, w

The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4d** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4d** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4d** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter4dv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter4dv( CGparameter param,  
                        const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4dv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4dv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4dv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter4f** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter4f( CGparameter param,  
                       float x,  
                       float y,  
                       float z,  
                       float w );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z, w**

The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4f** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4f** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4f** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter4fv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter4fv( CGparameter param,  
                        const float * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4fv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4fv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4fv** was introduced in Cg 1.2.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameter4i** – set the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter4i( CGparameter param,  
                       int x,  
                       int y,  
                       int z,  
                       int w );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z, w**

The values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4i** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4i** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. **cgGL**) is used, these entry points may end up making API (e.g. **OpenGL**) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4i** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**, **cgGetParameterValues**

**NAME**

**cgSetParameter4iv** – sets the value of scalar and vector parameters

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameter4iv( CGparameter param,  
                        const int * v );
```

**PARAMETERS**

param     The parameter that will be set.

v         Array of values to use to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameter4iv** sets the value of a given scalar or vector parameter.

If more values are passed in than **param** requires, the extra values will be ignored.

Once **cgSetParameter4iv** has been used to set a parameter, the values may be retrieved from the parameter using the **CG\_CURRENT** enumerant with **cgGetParameterValues**.

If an API-dependant layer of the Cg runtime (e.g. cgGL) is used, these entry points may end up making API (e.g. OpenGL) calls.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**HISTORY**

**cgSetParameter4iv** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetParameterValue**

**NAME**

**cgSetParameterSemantic** – set a program parameter’s semantic

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameterSemantic( CGparameter param,
                             const char * semantic );
```

**PARAMETERS**

param     The program parameter.  
semantic     The semantic.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterSemantic** allows the application to set the semantic of a parameter in a Cg program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a leaf node, or if the semantic string is **NULL**.

**HISTORY**

**cgSetParameterSemantic** was introduced in Cg 1.2.

**SEE ALSO**

cgGetParameterResource, cgGetParameterResourceIndex, cgGetParameterName, cgGetParameterType



**NAME**

**cgSetParameterSettingMode** – set the parameter setting mode for a context

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameterSettingMode( CGcontext context,
                                CGenum parameterSettingMode );
```

**PARAMETERS**

context The context in which to set the parameter setting mode.

parameterSettingMode

The mode to which **context** will be set. Must be one of the following :

- **CG\_IMMEDIATE\_PARAMETER\_SETTING**
- **CG\_DEFERRED\_PARAMETER\_SETTING**

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterSettingMode** controls the behavior of the context when setting parameters. With deferred parameter setting, the corresponding 3D API parameter is not immediately updated by **cgSetParameter** commands. If the application does not need to access these 3D API parameter values, then this mode allows improved performance by avoiding unnecessary 3D API calls.

Parameters of variability **CG\_VARYING** are never deferred.

When the parameter setting mode is **CG\_DEFERRED\_PARAMETER\_SETTING**, non-erroneous **cgSetParameter** commands record the updated parameter value but do not immediately update the corresponding 3D API parameter. Instead the parameter is marked internally as *update deferred*. The 3D API commands required to update any program parameters marked *update deferred* are performed as part of the next program bind (see **cgGLBindProgram**, **cgD3D9BindProgram**, or **cgD3D8BindProgram**).

If a context's parameter setting mode was **CG\_DEFERRED\_PARAMETER\_SETTING** and one or more parameters are marked *update deferred*, changing the parameter setting mode to **CG\_IMMEDIATE\_PARAMETER\_SETTING** does not cause parameters marked *update deferred* to be updated. The application can use **cgUpdateProgramParameters** or **cgUpdatePassParameters** to force the updating of parameters marked *update deferred*.

**parameterSettingMode** must be one of the following enumerants :

- **CG\_IMMEDIATE\_PARAMETER\_SETTING**

Non-erroneous **cgSetParameter** commands immediately update the corresponding 3D API parameter. This is the default mode.

- **CG\_DEFERRED\_PARAMETER\_SETTING**

Non-erroneous **cgSetParameter** commands record the updated parameter value but do not immediately update the corresponding 3D API parameter. These updates will happen during the next program bind. The updates can be explicitly forced to occur by using **cgUpdateProgramParameters** or **cgUpdatePassParameters**.

**EXAMPLES**

Change context to use deferred parameter updates:

```
cgSetParameterSettingMode(myCgContext, CG_DEFERRED_PARAMETER_SETTING);
```

Change context to its initial behavior of performing parameter updates immediately:

```
cgSetParameterSettingMode(myCgContext, CG_IMMEDIATE_PARAMETER_SETTING);
```

## ERRORS

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **parameterSettingMode** is not **CG\_IMMEDIATE\_PARAMETER\_SETTING** or **CG\_DEFERRED\_PARAMETER\_SETTING**.

## HISTORY

**cgSetParameterSettingMode** was introduced in Cg 2.0.

## SEE ALSO

cgGetParameterSettingMode, cgUpdateProgramParameters, cgUpdatePassParameters, cgSetParameter, cgSetParameterVariability, cgGetParameterVariability, cgGLBindProgram, cgD3D9BindProgram, cgD3D8BindProgram

**NAME**

**cgSetParameterValue** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

/* TYPE is int, float or double */

void cgSetParameterValue{ifd}{rc}( CGparameter param,
                                   int nelements,
                                   const TYPE * v );
```

**PARAMETERS**

**param**     The program parameter whose value will be set.

**nelements**  
            The number of elements in array **v**.

**v**           Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValue** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

There are versions of each function that take **int**, **float** or **double** values signified by the **i**, **f** or **d** in the function name.

There are versions of each function that will cause any matrices referenced by **param** to be initialized in either row-major or column-major order, as signified by the **r** or **c** in the function name.

For example, **cgSetParameterValueic** sets the given parameter using the supplied array of integer data, and initializes matrices in column-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**Note:** Previous releases of Cg allowed you to store more values in a parameter than indicated by the parameter's type. For example, one could use **cgGLSetParameter4f** to store four values into a parameter of type **CG\_FLOAT** (not **CG\_FLOAT4**). All four values could later be retrieved using a get call which requested more than one value. However, this feature conflicts with the GLSL approach and also leads to issues with parameters mapped into BUFFERS. Therefore, beginning with Cg 2.0 any components beyond the number indicated by the parameter type are ignored.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

## HISTORY

The **cgSetParameterValue** functions were introduced in Cg 1.4.

## SEE ALSO

cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize, cgGetParameterValue

**NAME**

**cgSetParameterValuedc** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetParameterValuedc( CGparameter param,
                             int nelements,
                             const double * v );
```

**PARAMETERS**

**param**     The program parameter whose value will be set.

**nelements**     The number of elements in array **v**.

**v**     Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValuedc** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in column-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValuedc** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,     cgGetArrayTotalSize,  
cgGetParameterValue

**NAME**

**cgSetParameterValuedr** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterValuedr( CGparameter param,
                             int nelements,
                             const double * v );
```

**PARAMETERS**

**param** The program parameter whose value will be set.

**nelements**

The number of elements in array **v**.

**v**

Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValuedr** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in row-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValuedr** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue, cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize,  
cgGetParameterValue

**NAME**

**cgSetParameterValuefc** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterValuefc( CGparameter param,
                           int nelements,
                           const float * v );
```

**PARAMETERS**

**param**     The program parameter whose value will be set.

**nelements**

          The number of elements in array **v**.

**v**

          Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValuefc** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in column-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValuefc** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,     cgGetArrayTotalSize,  
cgGetParameterValue

**NAME**

**cgSetParameterValuefr** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterValuefr( CGparameter param,
                           int nelements,
                           const float * v );
```

**PARAMETERS**

**param** The program parameter whose value will be set.

**nelements**

The number of elements in array **v**.

**v**

Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValuefr** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in row-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValuefr** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue, cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize,  
cgGetParameterValue



**NAME**

**cgSetParameterValueic** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterValueic( CGparameter param,
                           int nelements,
                           const int * v );
```

**PARAMETERS**

**param** The program parameter whose value will be set.

**nelements**

The number of elements in array **v**.

**v**

Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValueic** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in column-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValueic** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue, cgGetParameterRows, cgGetParameterColumns, cgGetArrayTotalSize,  
cgGetParameterValue

**NAME**

**cgSetParameterValueir** – set the value of any numeric parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterValueir( CGparameter param,
                           int nelements,
                           const int * v );
```

**PARAMETERS**

**param**     The program parameter whose value will be set.

**nelements**

            The number of elements in array **v**.

**v**

            Source buffer from which the parameter values will be read.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterValueir** allows the application to set the value of any numeric parameter or parameter array.

The given parameter must be a scalar, vector, matrix, or a (possibly multidimensional) array of scalars, vectors, or matrices.

Any matrices referenced by **param** to be initialized in row-major order.

If **v** is smaller than the total number of values in the given source parameter, **CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated.

The total number of values in a parameter, **ntotal**, may be computed as follow:

```
int nrows = cgGetParameterRows(param);
int ncols = cgGetParameterColumns(param);
int asize = cgGetArrayTotalSize(param);
int ntotal = nrows*ncols;
if (asize > 0) ntotal *= asize;
```

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is a varying input to a fragment program.

**CG\_INVALID\_POINTER\_ERROR** is generated if **v** is **NULL**.

**CG\_NOT\_ENOUGH\_DATA\_ERROR** is generated if **nelements** is less than the total size of **param**.

**CG\_NON\_NUMERIC\_PARAMETER\_ERROR** is generated if **param** is of a non-numeric type.

**HISTORY**

**cgSetParameterValueir** was introduced in Cg 1.4.

**SEE ALSO**

cgSetParameterValue,     cgGetParameterRows,     cgGetParameterColumns,     cgGetArrayTotalSize,  
cgGetParameterValue

**NAME**

**cgSetParameterVariability** – set a parameter’s variability

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetParameterVariability( CGparameter param,  
                                CGenum vary );
```

**PARAMETERS**

param     The parameter.

vary       The variability to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetParameterVariability** allows the application to change the variability of a parameter.

Currently parameters may not be changed to or from **CG\_VARYING** variability. However parameters of **CG\_UNIFORM** and **CG\_LITERAL** variability may be changed.

Valid values for **vary** include :

**CG\_UNIFORM**

A uniform parameter is one whose value does not change with each invocation of a program, but whose value can change between groups of program invocations.

**CG\_LITERAL**

A literal parameter is folded out at compile time. Making a uniform parameter literal will often make a program more efficient at the expense of requiring a compile every time the value is set.

**CG\_DEFAULT**

By default, the variability of a parameter will be overridden by the a source parameter connected to it unless it is changed with **cgSetParameterVariability**. If it is set to **CG\_DEFAULT** it will restore the default state of assuming the source parameters variability.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **vary** is not **CG\_UNIFORM**, **CG\_LITERAL**, or **CG\_DEFAULT**.

**CG\_INVALID\_PARAMETER\_VARIABILITY\_ERROR** is generated if the parameter could not be changed to the variability indicated by **vary**.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **vary** is **CG\_LITERAL** and **param** is a not a numeric parameter.

**HISTORY**

**cgSetParameterVariability** was introduced in Cg 1.2.

**SEE ALSO**

cgGetParameterVariability

**NAME**

**cgSetPassProgramParameters** – set uniform parameters specified via a compile statement

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetPassProgramParameters( CGprogram program );
```

**PARAMETERS**

program The program

**RETURN VALUES**

None.

**DESCRIPTION**

Given the handle to a program specified in a pass in a CgFX file, **cgSetPassProgramParameters** sets the values of the program's uniform parameters given the expressions in the **compile** statement in the CgFX file.

(This entrypoint is normally only needed by state managers and doesn't need to be called by users.)

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgSetPassProgramParameters** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateEffect, cgCreateEffectFromFile

**NAME**

**cgSetPassState** – calls the state setting callback functions for all state assignments in a pass

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetPassState( CGpass pass );
```

**PARAMETERS**

pass      The pass handle.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetPassState** sets all of the graphics state defined in a pass by calling the state setting callbacks for all of the state assignments in the pass.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if **pass** is not a valid pass.

**CG\_INVALID\_TECHNIQUE\_ERROR** is generated if the technique of which **pass** is a part has failed validation.

**HISTORY**

**cgSetPassState** was introduced in Cg 1.4.

**SEE ALSO**

cgResetPassState, cgCallStateSetCallback

**NAME**

**cgSetProgramBuffer** – set a buffer for a program

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetProgramBuffer( CGprogram program,  
                        int bufferIndex,  
                        CGbuffer buffer );
```

**PARAMETERS**

**program** The program for which the buffer will be set.

**bufferIndex**

The buffer index of **program** to which **buffer** will be bound.

**buffer** The buffer to be bound.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetProgramBuffer** sets the buffer for a given buffer index of a program. A **NULL** buffer handle means the given buffer index should not be bound to a buffer.

**bufferIndex** must be non-negative and within the program's range of buffer indices. For OpenGL programs, **bufferIndex** can be 0 to 11. For Direct3D10 programs, **bufferIndex** can be 0 to 15.

When the next program bind operation occurs, each buffer index which is set to a valid buffer handle is bound (along with the program) for use by the 3D API. No buffer bind operation occurs for buffer indices bound to a **NULL** buffer handle.

**EXAMPLES**

```
cgSetProgramBuffer( myProgram, 2, myBuffer );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**CG\_BUFFER\_INDEX\_OUT\_OF\_RANGE\_ERROR** is generated if **bufferIndex** is not within the valid range of buffer indices for **program**.

**HISTORY**

**cgSetProgramBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateBuffer, cgGetProgramBuffer, cgGLBindProgram, cgD3D9BindProgram, cgD3D8BindProgram

**NAME**

**cgSetProgramProfile** – set a program’s profile

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetProgramProfile( CGprogram program,
                          CGprofile profile );
```

**PARAMETERS**

program The program.

profile The profile to be used when compiling the program.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetProgramProfile** allows the application to specify the profile to be used when compiling the given program. When called, the program will be unloaded if it is currently loaded, and marked as uncompiled. When the program is next compiled (see **cgSetAutoCompile**), the given **profile** will be used. **cgSetProgramProfile** can be used to override the profile specified in a CgFX **compile** statement, or to change the profile associated with a program created by a call to **cgCreateProgram**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PROFILE\_ERROR** is generated if **profile** is not a valid profile enumerator.

**HISTORY**

**cgSetProgramProfile** was introduced in Cg 1.4.

**SEE ALSO**

**cgGetProgramProfile**, **cgGetProfile**, **cgGetProfileString**, **cgCreateProgram**, **cgSetAutoCompile**

**NAME**

**cgSetProgramStateAssignment** – set the value of a program state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetProgramStateAssignment( CGstateassignment sa,  
                                     CGprogram program );
```

**PARAMETERS**

**sa** A handle to a state assignment of type **CG\_PROGRAM\_TYPE**.

**program** The program object to which **sa** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetProgramStateAssignment** sets the value of a state assignment of program type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a program type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgSetProgramStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetProgramStateAssignmentValue, cgSetBoolArrayStateAssignment, cgSetBoolStateAssignment,  
cgSetFloatArrayStateAssignment, cgSetFloatStateAssignment, cgSetIntArrayStateAssignment,  
cgSetIntStateAssignment, cgSetSamplerStateAssignment, cgSetStringStateAssignment,  
cgSetTextureStateAssignment



**NAME**

**cgSetSamplerState** – initializes the state specified for a sampler parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetSamplerState( CGparameter param );
```

**PARAMETERS**

param     The parameter handle.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetSamplerState** sets the sampler state for a sampler parameter that was specified via a **sampler\_state** block in a CgFX file. The corresponding sampler should be bound via the graphics API before this call is made.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgSetSamplerState** was introduced in Cg 1.4.

**SEE ALSO**

cgCreateSamplerState, cgGetFirstSamplerState, cgGetNamedSamplerState, cgGetNextState

**NAME**

**cgSetSamplerStateAssignment** – sets a state assignment to a sampler effect parameter.

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetSamplerStateAssignment( CGstateassignment sa,
                                     CGparameter param );
```

**PARAMETERS**

**sa** A state assignment of a sampler type (one of **CG\_SAMPLER1D**, **CG\_SAMPLER2D**, **CG\_SAMPLER3D**, **CG\_SAMPLERCUBE**, or **CG\_SAMPLERRECT**).

**param** An effect parameter of a sampler type.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetSamplerStateAssignment** sets a state assignment of a sampler type to an effect parameter of the same sampler type.

**EXAMPLES**

```
CGparameter effectParam = cgCreateEffectParameter(effect,
                                                    "normalizeCube",
                                                    CG_SAMPLERCUBE);

CGstate state = cgGetNamedSamplerState(context, "TextureCubeMap");
CGstateassignment sa = cgCreateStateAssignment(technique, state);
CGbool ok = cgSetSamplerStateAssignment(sa, effectParam);
```

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a sampler type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgSetSamplerStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetSamplerStateAssignmentValue,	cgSetTextureStateAssignment,	cgSetBoolArrayStateAssignment,
cgSetBoolStateAssignment,	cgSetFloatArrayStateAssignment,	cgSetFloatStateAssignment,
cgSetIntArrayStateAssignment,	cgSetIntStateAssignment,	cgSetProgramStateAssignment,
cgSetStringStateAssignment		

**NAME**

**cgSetSemanticCasePolicy** – set semantic case policy

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGLenum cgSetSemanticCasePolicy( CGLenum casePolicy );
```

**PARAMETERS**

casePolicy

An enumerant describing the desired semantic case policy for the library. The following enumerants are allowed:

**CG\_FORCE\_UPPER\_CASE\_POLICY**

Semantics strings will be converted to all upper-case letters. This is the default policy.

**CG\_UNCHANGED\_CASE\_POLICY**

Semantic strings will be left unchanged.

**RETURN VALUES**

Returns the previous semantic case policy, or **CG\_UNKNOWN** if an error occurs.

**DESCRIPTION**

**cgSetSemanticCasePolicy** allows an application to change the semantic case policy used by the Cg library. A policy of **CG\_FORCE\_UPPER\_CASE\_POLICY** means that semantic strings returned by **cgGetParameterSemantic** will have been converted to all upper-case letters. This is the default policy for the library. If the policy is changed to **CG\_UNCHANGED\_CASE\_POLICY** no case conversion will be done to the semantic strings.

**EXAMPLES**

```
/* set to return original semantic strings */  
cgSetSemanticCasePolicy(CG_UNCHANGED_CASE_POLICY);
```

**ERRORS**

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **casePolicy** is not **CG\_FORCE\_UPPER\_CASE\_POLICY** or **CG\_UNCHANGED\_CASE\_POLICY**.

**HISTORY**

**cgSetSemanticCasePolicy** was introduced in Cg 2.0.

**SEE ALSO**

**cgGetSemanticCasePolicy**, **cgGetParameterSemantic**

**NAME**

**cgSetStateCallbacks** – registers the callback functions for a state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgSetStateCallbacks( CGstate state,
                          CGstatecallback set,
                          CGstatecallback reset,
                          CGstatecallback validate );
```

**PARAMETERS**

**state**      The state handle.

**set**        The pointer to the callback function to call for setting the state of state assignments based on **state**. This may be a **NULL** pointer.

**reset**      The pointer to the callback function to call for resetting the state of state assignments based on **state**. This may be a **NULL** pointer.

**validate**   The pointer to the callback function to call for validating the state of state assignments based on **state**. This may be a **NULL** pointer.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetStateCallbacks** sets the three callback functions for a state definition. These functions are later called when the state a particular state assignment based on this state must be set, reset, or validated. Any of the callback functions may be specified as **NULL**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**HISTORY**

**cgSetStateCallbacks** was introduced in Cg 1.4.

**SEE ALSO**

cgSetPassState,    cgCallStateSetCallback,    cgCallStateResetCallback,    cgCallStateValidateCallback,  
cgValidateTechnique

**NAME**

**cgSetStateLatestProfile** – sets a state's designated latest profile

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGprofile cgSetStateLatestProfile( CGstate state, CGprofile profile );
```

**PARAMETERS**

state      The state handle.

profile    The profile to designate as the state's latest profile.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetStateLatestProfile** sets the specified state's designated latest profile for states of type **CG\_PROGRAM\_TYPE**.

This profile is used to compile the program for a state assignment for the state where the profile in the **compile** statement is the identifier **latest**.

**EXAMPLES**

This shows how to force the designated latest state profile for the **FragmentProgram** state assignment to be the arbfp1 profile (even if cgGLRegisterStates was to register a different profile).

```
cgGLRegisterStates(context);  
CGstate state = cgGetNamedState(context, "FragmentProgram");  
cgSetStateLatestProfile(state, CG_PROFILE_ARBFP1);
```

**ERRORS**

**CG\_INVALID\_STATE\_HANDLE\_ERROR** is generated if **state** is not a valid state.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if the type of **state** is not **CG\_PROGRAM\_TYPE**.

**HISTORY**

**cgSetStateLatestProfile** was introduced in Cg 2.2.

**SEE ALSO**

cgGetNamedState, cgGetStateLatestProfile, cgGLRegisterStates

**NAME**

**cgSetStringAnnotation** – set the value of a string annotation

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetStringAnnotation( CGannotation ann,  
                             const char * value );
```

**PARAMETERS**

ann        The annotation that will be set.

value     The value to which **ann** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the annotation.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetStringAnnotation** sets the value of an annotation of string type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_ANNOTATION\_HANDLE\_ERROR** is generated if **ann** is not a valid annotation.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **ann** is not an annotation of string type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **ann** is not a scalar.

**HISTORY**

**cgSetStringAnnotation** was introduced in Cg 1.5.

**SEE ALSO**

cgGetStringAnnotationValue, cgSetBoolAnnotation, cgSetIntAnnotation, cgSetFloatAnnotation

**NAME**

**cgSetStringParameterValue** – set the value of a string parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
void cgSetStringParameterValue( CGparameter param,  
                               const char * value );
```

**PARAMETERS**

param     The parameter whose value will be set.  
value     The string to set the parameter's value as.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgSetStringParameterValue** allows the application to set the value of a string parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_TYPE\_ERROR** is generated if **param** is not string-typed.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **value** is **NULL**.

**HISTORY**

**cgSetStringParameterValue** was introduced in Cg 1.4.

**SEE ALSO**

cgGetStringParameterValue

**NAME**

**cgSetStringStateAssignment** – set the value of a string state assignment

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetStringStateAssignment( CGstateassignment sa,  
                                   const char * value );
```

**PARAMETERS**

**sa**           A handle to a state assignment of type **CG\_STRING**.

**value**       The value to which **sa** will be set.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetStringStateAssignment** sets the value of a state assignment of string type.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of a string type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**HISTORY**

**cgSetStringStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetStringStateAssignmentValue,	cgSetBoolArrayStateAssignment,	cgSetBoolStateAssignment,
cgSetFloatArrayStateAssignment,	cgSetFloatStateAssignment,	cgSetIntArrayStateAssignment,
cgSetIntStateAssignment,	cgSetProgramStateAssignment,	cgSetSamplerStateAssignment,
cgSetTextureStateAssignment		



**NAME**

**cgSetTextureStateAssignment** – sets a state assignment to a texture effect parameter

**SYNOPSIS**

```
#include <Cg/cg.h>
```

```
CGbool cgSetTextureStateAssignment( CGstateassignment sa,
                                     CGparameter param );
```

**PARAMETERS**

**sa** A state assignment of type **CG\_TEXTURE**.

**param** An effect parameter of type **CG\_TEXTURE**.

**RETURN VALUES**

Returns **CG\_TRUE** if it succeeds in setting the state assignment.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgSetTextureStateAssignment** sets the value of a state assignment of texture type to an effect parameter of type **CG\_TEXTURE**.

**EXAMPLES**

```
CGparameter effectParam = cgCreateEffectParameter(effect,
                                                    "normalizeCube",
                                                    CG_SAMPLERCUBE);

CGstate state = cgGetNamedSamplerState(context, "Texture");
CGstateassignment sa = cgCreateSamplerStateAssignment(effectParam, state);
CGbool ok = cgSetTextureStateAssignment(sa, value);
```

**ERRORS**

**CG\_INVALID\_STATE\_ASSIGNMENT\_HANDLE\_ERROR** is generated if **sa** is not a valid state assignment.

**CG\_STATE\_ASSIGNMENT\_TYPE\_MISMATCH\_ERROR** is generated if **sa** is not a state assignment of texture type.

**CG\_ARRAY\_SIZE\_MISMATCH\_ERROR** is generated if **sa** is an array and not a scalar.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgSetTextureStateAssignment** was introduced in Cg 1.5.

**SEE ALSO**

cgGetTextureStateAssignmentValue,	cgSetSamplerStateAssignment,	cgSetBoolArrayStateAssignment,
cgSetBoolStateAssignment,	cgSetFloatArrayStateAssignment,	cgSetFloatStateAssignment,
cgSetIntArrayStateAssignment,	cgSetIntStateAssignment,	cgSetProgramStateAssignment,
cgSetStringStateAssignment		

**NAME**

**cgUnmapBuffer** – unmap buffer from application's address space

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgUnmapBuffer( CGbuffer buffer );
```

**PARAMETERS**

**buffer**     The buffer which will be unmapped from the application's address space.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgUnmapBuffer** unmaps a buffer from the application's address space.

**EXAMPLES**

```
unsigned char *bufferPtr = cgMapBuffer( myBuffer, CG_MAP_READ_WRITE );
memcpy( data, bufferPtr, size );
cgUnmapBuffer( myBuffer );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**HISTORY**

**cgUnmapBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgMapBuffer, cgSetBufferData, cgSetBufferSubData, cgSetParameter

**NAME**

**cgUpdatePassParameters** – update the deferred parameters for a pass

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgUpdatePassParameters( CGpass pass );
```

**PARAMETERS**

pass      The pass for which deferred parameters will be updated.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgUpdatePassParameters** is a convenience routine which calls **cgUpdateProgramParameters** for all programs of a pass.

**EXAMPLES**

```
cgSetParameterSettingMode(context, CG_DEFERRED_PARAMETER_SETTING);

CGeffect effect = cgCreateEffectFromFile( context, "tst.cgfx", NULL );

CGtechnique tech1 = cgGetNamedTechnique( effect, "tech1" );

CGpass pass1 = cgGetNamedPass( tech1, "pass1" );

cgSetPassState(pass1);

for (some number of times)
{
    cgSetParameter(uniform1,...);
    cgSetParameter(uniform2,...);
    cgUpdatePassParameters(pass1);
    DrawSomeGeometry();
}

cgResetPassState(pass1);
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **pass** is not a valid pass handle.

**HISTORY**

**cgUpdatePassParameters** was introduced in Cg 2.1.

**SEE ALSO**

**cgSetParameterSettingMode**, **cgGetParameterSettingMode**, **cgUpdateProgramParameters**, **cgSetParameter**, **cgGLBindProgram**, **cgD3D9BindProgram**, **cgD3D8BindProgram**

**NAME**

**cgUpdateProgramParameters** – update the 3D API state for deferred parameters

**SYNOPSIS**

```
#include <Cg/cg.h>

void cgUpdateProgramParameters( CGprogram program );
```

**PARAMETERS**

**program** The program for which deferred parameters will be sent to the corresponding 3D API parameters.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgUpdateProgramParameters** performs the appropriate 3D API commands to set the 3D API resources for all of **program**'s parameters that are marked *update deferred* and clears the *update deferred* state of these parameters. **cgUpdateProgramParameters** does nothing when none of **program**'s parameters are marked *update deferred*.

**cgUpdateProgramParameters** assumes the specified program has already been bound using the appropriate 3D API commands. Results are undefined if the program is not actually bound by the 3D API when **cgUpdateProgramParameters** is called, with the likely result being that the 3D API state for **program**'s parameters will be mis-loaded.

**EXAMPLES**

```
/* assumes cgGetProgramContext(program) == context */

if (cgGetParameterSettingMode(context) == CG_DEFERRED_PARAMETER_SETTING) {
    cgUpdateProgramParameters(program);
}
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgUpdateProgramParameters** was introduced in Cg 2.0.

**SEE ALSO**

cgSetParameterSettingMode, cgGetParameterSettingMode, cgUpdatePassParameters, cgSetParameter, cgGLBindProgram, cgD3D9BindProgram, cgD3D8BindProgram

**NAME**

**cgValidateTechnique** – validate a technique from an effect

**SYNOPSIS**

```
#include <Cg/cg.h>

CGbool cgValidateTechnique( CGtechnique tech );
```

**PARAMETERS**

**tech**      The technique handle to validate.

**RETURN VALUES**

Returns **CG\_TRUE** if all of the state assignments in all of the passes in **tech** are valid and can be used on the current hardware.

Returns **CG\_FALSE** if any state assignment fails validation, or if an error occurs.

**DESCRIPTION**

**cgValidateTechnique** iterates over all of the passes of a technique and tests to see if every state assignment in the pass passes validation.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
CGeffect effect = cgCreateEffectFromFile(context, filename, NULL);

CGtechnique tech = cgGetFirstTechnique(effect);
while (tech && cgValidateTechnique(tech) == CG_FALSE) {
    fprintf(stderr, "Technique %s did not validate.  Skipping.\n",
        cgGetTechniqueName(tech));
    tech = cgGetNextTechnique(tech);
}

if (tech) {
    fprintf(stderr, "Using technique %s.\n", cgGetTechniqueName(tech));
} else {
    fprintf(stderr, "No valid technique found\n");
    exit(1);
}
```

**ERRORS**

**CG\_INVALID\_TECHNIQUE\_HANDLE\_ERROR** is generated if **tech** is not a valid technique.

**HISTORY**

**cgValidateTechnique** was introduced in Cg 1.4.

**SEE ALSO**

cgCallStateValidateCallback, cgSetStateCallbacks

**NAME**

**cgGLBindProgram** – bind a program to the current state

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLBindProgram( CGprogram program );
```

**PARAMETERS**

**program** The program to bind to the current state.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLBindProgram** binds a program to the current state. The program must have been loaded with **cgGLLoadProgram** before it can be bound. Also, the profile of the program must be enabled for the binding to work. This may be done with the **cgGLEnableProfile** function.

For profiles that do not support program local parameters (e.g. the vp20 profile), **cgGLBindProgram** will reset all uniform parameters that were set with any of the Cg parameter setting functions

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PROFILE\_ERROR** is generated if **program**'s profile is not a supported OpenGL profile.

**CG\_PROGRAM\_BIND\_ERROR** is generated if the program fails to bind for any reason.

**HISTORY**

**cgGLBindProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLLoadProgram**, **cgGLSetParameter**, **cgGLSetMatrixParameter**, **cgGLSetTextureParameter**,  
**cgGLEnableProfile**

**NAME**

**cgGLCreateBuffer** – create an OpenGL buffer object

**SYNOPSIS**

```
#include <Cg/cgGL.h>

CGbuffer cgGLCreateBuffer( CGcontext context,
                           int size,
                           const void *data,
                           GLenum bufferUsage );
```

**PARAMETERS**

**context**    The context to which the new buffer will be added.

**size**       The length in bytes of the buffer to create.

**data**       The initial data to be copied into the buffer. NULL will fill the buffer with zero.

**bufferUsage**  
             One of the usage flags specified as valid for **glBufferData**.

**RETURN VALUES**

Returns a **CGbuffer** handle on success.

Returns **NULL** if any error occurs.

**DESCRIPTION**

**cgGLCreateBuffer** creates an OpenGL buffer object.

**EXAMPLES**

```
CGbuffer myBuffer = cgGLCreateBuffer( myCgContext, sizeof( float ) * 16,
                                       myData, GL_STATIC_DRAW );
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGLCreateBuffer** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateBuffer, cgGLGetBufferObject

**NAME**

**cgGLDisableClientState** – disables a vertex attribute in the OpenGL state

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLDisableClientState( CGparameter param );
```

**PARAMETERS**

param    The varying parameter for which the client state will be disabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLDisableClientState** disables the vertex attribute associated with the given varying parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a varying parameter.

**HISTORY**

**cgGLDisableClientState** was introduced in Cg 1.1.

**SEE ALSO**

cgGLEnableClientState



**NAME**

**cgGLDisableProfile** – disable a profile within OpenGL

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLDisableProfile( CGprofile profile );
```

**PARAMETERS**

profile    The enumerant for the profile to disable.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLDisableProfile** disables a profile by making the necessary OpenGL calls. For most profiles, this will simply make a call to **glDisable** with the appropriate enumerant.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **profile** is not a supported OpenGL profile.

**HISTORY**

**cgGLDisableProfile** was introduced in Cg 1.1.

**SEE ALSO**

cgGLEnableProfile

**NAME**

**cgGLDisableProgramProfiles** – disable all profiles associated with a combined program

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLDisableProgramProfiles( CGprogram program );
```

**PARAMETERS**

**program** The combined program for which the profiles will be disabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLDisableProgramProfiles** disables the profiles for all of the programs in a combined program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PROFILE\_ERROR** is generated if the profile for any of the programs in **program** is not a supported OpenGL profile.

**HISTORY**

**cgGLDisableProgramProfiles** was introduced in Cg 1.5.

**SEE ALSO**

cgGLEnableProgramProfiles, cgCombinePrograms

**NAME**

**cgGLDisableTextureParameter** – disables the texture unit associated with a texture parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLDisableTextureParameter( CGparameter param );
```

**PARAMETERS**

param    The texture parameter which will be disabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLDisableTextureParameter** unbinds and disables the texture object associated **param**.

See cgGLEnableTextureParameter for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a texture parameter or if the parameter fails to set for any other reason.

**HISTORY**

**cgGLDisableTextureParameter** was introduced in Cg 1.1.

**SEE ALSO**

cgGLEnableTextureParameter, cgGLSetTextureParameter

**NAME**

**cgGLEnableClientState** – enables a vertex attribute in the OpenGL state

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLEnableClientState( CGparameter param );
```

**PARAMETERS**

param     The varying parameter for which the client state will be enabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLEnableClientState** enables the vertex attribute associated with the given varying parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a varying parameter.

**HISTORY**

**cgGLEnableClientState** was introduced in Cg 1.1.

**SEE ALSO**

cgGLDisableClientState

**NAME**

**cgGLEnableProfile** – enable a profile within OpenGL

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLEnableProfile( CGprofile profile );
```

**PARAMETERS**

profile    The enumerant for the profile to enable.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLEnableProfile** enables a profile by making the necessary OpenGL calls. For most profiles, this will simply make a call to **glEnable** with the appropriate enumerant.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **profile** is not a supported OpenGL profile.

**HISTORY**

**cgGLEnableProfile** was introduced in Cg 1.1.

**SEE ALSO**

cgGLDisableProfile

**NAME**

**cgGLEnableProgramProfiles** – enable all profiles associated with a combined program

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLEnableProgramProfiles( CGprogram program );
```

**PARAMETERS**

**program** The combined program for which the profiles will be enabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLEnableProgramProfiles** enables the profiles for all of the programs in a combined program.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_INVALID\_PROFILE\_ERROR** is generated if the profile for any of the programs in **program** is not a supported OpenGL profile.

**HISTORY**

**cgGLEnableProgramProfiles** was introduced in Cg 1.5.

**SEE ALSO**

cgGLDisableProgramProfiles, cgCombinePrograms

**NAME**

**cgGLEnableTextureParameter** – enables the texture unit associated with a texture parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLEnableTextureParameter( CGparameter param );
```

**PARAMETERS**

**param**     The texture parameter which will be enabled.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLEnableTextureParameter** binds and enables the texture object associated with **param**. It must be called after **cgGLSetTextureParameter** is called but before the geometry is drawn.

**cgGLDisableTextureParameter** should be called once all of the geometry is drawn to avoid applying the texture to the wrong geometry and shaders.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile. In particular, if **param** is not a parameter handle retrieved from a **CGprogram** but was instead retrieved from a **CGeffect** or is a shared parameter created at runtime, this error will be generated since those parameters do not have a profile associated with them.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a texture parameter or if the enable operation fails for any other reason.

**HISTORY**

**cgGLEnableTextureParameter** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLDisableTextureParameter**, **cgGLSetTextureParameter**

**NAME**

**cgGLGetBufferObject** – get OpenGL buffer object for a buffer

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
GLuint CGGLENTY cgGLGetBufferObject( Cgbuffer buffer );
```

**PARAMETERS**

**buffer**     The buffer for which the associated OpenGL buffer object will be retrieved.

**RETURN VALUES**

Returns the OpenGL buffer object associated with **buffer**.

Returns **0** if an error occurs.

**DESCRIPTION**

**cgGLGetBufferObject** returns the OpenGL buffer object associated with a buffer.

**EXAMPLES**

```
GLuint id = cgGLGetBufferObject( myBuffer );
```

**ERRORS**

**CG\_INVALID\_BUFFER\_HANDLE\_ERROR** is generated if **buffer** is not a valid buffer.

**HISTORY**

**cgGLGetBufferObject** was introduced in Cg 2.0.

**SEE ALSO**

cgCreateBuffer, cgGLCreateBuffer



**NAME**

**cgGLGetLatestProfile** – get the latest profile for a profile class

**SYNOPSIS**

```
#include <Cg/cgGL.h>

CGprofile cgGLGetLatestProfile( CGGLenum profileClass );
```

**PARAMETERS**

profileClass

The class of profile that will be returned. Must be one of the following :

- **CG\_GL\_VERTEX**
- **CG\_GL\_GEOMETRY**
- **CG\_GL\_FRAGMENT**

**RETURN VALUES**

Returns a profile enumerator for the latest profile of the given class.

Returns **CG\_PROFILE\_UNKNOWN** if no appropriate profile is available or an error occurs.

**DESCRIPTION**

**cgGLGetLatestProfile** returns the best available profile of a given class. The OpenGL extensions are checked to determine the best profile which is supported by the current GPU, driver, and cgGL library combination.

**profileClass** may be one of the following enumerants :

- **CG\_GL\_VERTEX**  
The latest available vertex profile will be returned.
- **CG\_GL\_GEOMETRY**  
The latest available geometry profile will be returned.
- **CG\_GL\_FRAGMENT**  
The latest available fragment profile will be returned.

**cgGLGetLatestProfile** can be used in conjunction with **cgCreateProgram** to ensure that more optimal profiles are used as they are made available, even though they might not have been available at compile time or with a different version of the runtime.

Starting in Cg 2.2, certain environment variables can *override* the value returned by **cgGLGetLatestProfile**:

If **cgGLGetLatestProfile** is called with **profileClass** being **CG\_GL\_VERTEX** and an environment variable named **CGGL\_LATEST\_VERTEX\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), the **CGprofile** value returned by **cgGetProfile** is returned by **cgGLGetLatestProfile**.

If **cgGLGetLatestProfile** is called with **profileClass** being **CG\_GL\_GEOMETRY** and an environment variable named **CGGL\_LATEST\_GEOMETRY\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), the **CGprofile** value returned by **cgGetProfile** is returned by **cgGLGetLatestProfile**.

If **cgGLGetLatestProfile** is called with **profileClass** being **CG\_GL\_FRAGMENT** and an environment variable named **CGGL\_LATEST\_FRAGMENT\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), the **CGprofile** value returned by **cgGetProfile** is returned by **cgGLGetLatestProfile**.

**EXAMPLES**

```
/* Output information about available profiles */
printf("vertex profile:  %s\n",
       cgGetProfileString(cgGLGetLatestProfile(CG_GL_VERTEX)));
printf("geometry profile: %s\n",
       cgGetProfileString(cgGLGetLatestProfile(CG_GL_GEOMETRY)));
printf("fragment profile: %s\n",
       cgGetProfileString(cgGLGetLatestProfile(CG_GL_FRAGMENT)));
```

## ERRORS

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if **profileClass** is not **CG\_GL\_VERTEX**, **CG\_GL\_GEOMETRY** or **CG\_GL\_FRAGMENT**.

## HISTORY

**cgGLGetLatestProfile** was introduced in Cg 1.1.

**CG\_GL\_GEOMETRY** support was introduced in Cg 2.0.

## SEE ALSO

cgGLSetOptimalOptions, cgCreateProgram

**NAME**

**cgGLGetManageTextureParameters** – gets the manage texture parameters flag from a context

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
CGbool cgGLGetManageTextureParameters( CGcontext context );
```

**PARAMETERS**

**context** The context from which the automatic texture management setting will be retrieved.

**RETURN VALUES**

Returns the manage textures setting for **context**.

**DESCRIPTION**

**cgGLGetManageTextureParameters** gets the current manage textures setting from **context**. See **cgGLSetManageTextureParameters** for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGLGetManageTextureParameters** was introduced in Cg 1.2.

**SEE ALSO**

**cgGLSetManageTextureParameters**, **cgGLBindProgram**, **cgGLUnbindProgram**

**NAME**

**cgGLGetMatrixParameter** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLGetMatrixParameter{fd}{rc}( CGparameter param,
                                     TYPE * matrix );
```

**PARAMETERS**

**param**    The matrix parameter from which the values will be retrieved.

**matrix**    An array into which the values will be retrieved. The size must be the number of rows times the number of columns of **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLGetMatrixParameter** functions retrieve the values from a matrix parameter.

There are versions of the function that return either **float** or **double** values signified by **f** or **d** in the function name.

There are versions of the function that assume the array of values is laid out in either row or column order signified by **r** or **c** respectively in the function name.

The **cgGLGetMatrixParameter** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

The **cgGLGetMatrixParameter** functions were introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameterArray, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLGetMatrixParameterArray** – get the values from an matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLGetMatrixParameterArray{fd}{rc}( CGparameter param,
                                           long offset,
                                           long nelements,
                                           TYPE * v );
```

**PARAMETERS**

- param**     The matrix array parameter from which the values will be retrieved.
- offset**     An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array into which to retrieve the values. The size of the array must be **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLGetMatrixParameterArray** functions retrieve an array of values from a matrix array parameter. There are versions of the function that return either **float** or **double** values signified by **f** or **d** in the function name.

There are versions of the function that assume the array of values is laid out in either row or column order signified by **r** or **c** respectively in the function name.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if the **offset** or the **nelements** parameter is out of the array bounds.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

The **cgGLGetMatrixParameterArray** functions were introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetMatrixParameterArraydc** – get the values from a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetMatrixParameterArraydc( CGparameter param,
                                     long offset,
                                     long nelements,
                                     double * v );
```

**PARAMETERS**

- param**     The matrix array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         The array into which to retrieve the values. The size of **v** must be **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterArraydc** retrieves an array of values from a matrix array parameter using column-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterArraydc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetMatrixParameterArraydr** – get the values from a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetMatrixParameterArraydr( CGparameter param,
                                     long offset,
                                     long nelements,
                                     double * v );
```

**PARAMETERS**

- param**     The matrix array parameter from which the values will be retrieved.
- offset**     An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array into which to retrieve the values. The size of **v** must be **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterArraydr** retrieves an array of values from a matrix array parameter using row-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterArraydr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetMatrixParameterArrayfc** – get the values from a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetMatrixParameterArrayfc( CGparameter param,
                                     long offset,
                                     long nelements,
                                     float * v );
```

**PARAMETERS**

- param**     The matrix array parameter from which the values will be retrieved.
- offset**     An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array into which to retrieve the values. The size of **v** must be **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterArrayfc** retrieves an array of values from a matrix array parameter using column-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterArrayfc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray



**NAME**

**cgGLGetMatrixParameterArrayfr** – get the values from a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetMatrixParameterArrayfr( CGparameter param,
                                     long offset,
                                     long nelements,
                                     float * v );
```

**PARAMETERS**

**param**     The matrix array parameter from which the values will be retrieved.

**offset**     An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.

**nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**     The array into which to retrieve the values. The size of **v** must be **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterArrayfr** retrieves an array of values from a matrix array parameter using row-major ordering.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterArrayfr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetMatrixParameterdc** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetMatrixParameterdc( CGparameter param,  
                               double * matrix );
```

**PARAMETERS**

**param**     The matrix parameter from which the values will be retrieved.

**matrix**     An array of **doubles** into which the matrix values will be retrieved. The size must be the number of rows times the number of columns of **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterdc** retrieves the values from a matrix parameter using column-major ordering.

**cgGLGetMatrixParameterdc** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterdc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameterArray, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLGetMatrixParameterdr** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetMatrixParameterdr( CGparameter param,  
                               double * matrix );
```

**PARAMETERS**

**param**     The matrix parameter from which the values will be retrieved.

**matrix**     An array of **doubles** into which the matrix values will be retrieved. The size must be the number of rows times the number of columns of **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterdr** retrieves the values from a matrix parameter using row-major ordering.

**cgGLGetMatrixParameterdr** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterdr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameterArray, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLGetMatrixParameterfc** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetMatrixParameterfc( CGparameter param,  
                               float * matrix );
```

**PARAMETERS**

**param**    The matrix parameter from which the values will be retrieved.

**matrix**    An array of **floats** into which the matrix values will be retrieved. The size must be the number of rows times the number of columns of **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterfc** retrieves the values from a matrix parameter using column-major ordering.

**cgGLGetMatrixParameterfc** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterfc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameterArray, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLGetMatrixParameterfr** – get the values from a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetMatrixParameterfr( CGparameter param,  
                               float * matrix );
```

**PARAMETERS**

**param**    The matrix parameter from which the values will be retrieved.

**matrix**    An array of **floats** into which the matrix values will be retrieved. The size must be the number of rows times the number of columns of **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetMatrixParameterfr** retrieves the values from a matrix parameter using row-major ordering.

**cgGLGetMatrixParameterfr** may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetMatrixParameterfr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameterArray, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLGetOptimalOptions** – get the best set of compiler options for a profile

**SYNOPSIS**

```
#include <Cg/cgGL.h>

char const ** cgGLGetOptimalOptions( CGprofile profile );
```

**PARAMETERS**

profile    The profile whose optimal arguments are requested.

**RETURN VALUES**

Returns a null-terminated array of strings representing the optimal set of compiler options for **profile**.

Returns **NULL** if **profile** isn't supported by the current driver or GPU.

**DESCRIPTION**

**cgGLGetOptimalOptions** returns the best set of compiler options for a given profile on the current driver and GPU. Note that different driver/GPU combinations might return different sets of options for the same **profile** value.

The elements of the returned array are meant to be used as part of the **args** parameter to **cgCreateProgram** or **cgCreateProgramFromFile**.

The strings returned for each value of **profile** remain valid until the next time **cgGLGetOptimalOptions** is called with this **profile** value.

The application does **not** need to destroy the returned strings.

**EXAMPLES**

```
char const ** ppOptions = cgGLGetOptimalOptions(vertProfile);

if (ppOptions && *ppOptions) {
    while (*ppOptions) {
        printf("%s\n", *ppOptions);
        ppOptions++;
    }
}

const char* vertOptions[] = { myCustomArgs,
                              ppOptions,
                              NULL };

CGprogram myVS = cgCreateProgramFromFile( context,
                                          CG_SOURCE,
                                          "vshader.cg",
                                          vertProfile,
                                          "VertexShader",
                                          vertOptions);
```

**ERRORS**

None.

**HISTORY**

**cgGLGetOptimalOptions** was introduced in Cg 2.2.

**SEE ALSO**

**cgGLSetOptimalOptions**, **cgGLGetLatestProfile**, **cgCreateProgram**, **cgCreateProgramFromFile**

**NAME**

**cgGLGetParameter** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLGetParameter{1234}{fd}( CGparameter param,
                                TYPE * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.

**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLGetParameter** functions extract the values set by **cgGLSetParameter** functions.

There are versions of the function that take either **float** or **double** values signified by **f** or **d** in the function name.

Each function returns either 1, 2, 3, or 4 values.

These functions may only be called with uniform numeric parameters.

**Note:** Previous releases of Cg allowed you to store more values in a parameter than indicated by the parameter's type. For example, one could use **cgGLSetParameter4f** to store four values into a parameter of type **CG\_FLOAT** (not **CG\_FLOAT4**). All four values could later be retrieved using a get call which requested more than one value. However, this feature conflicts with the GLSL approach and also leads to issues with parameters mapped into BUFFERS. Therefore, beginning with Cg 2.0 any components beyond the number indicated by the parameter type are ignored.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

The **cgGLGetParameter** functions were introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter1d** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameter1d( CGparameter param,
                        double * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.  
**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter1d** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter1d** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter1d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**



**NAME**

**cgGLGetParameter1f** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetParameter1f( CGparameter param,  
                        float * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.

**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter1f** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter1f** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter1f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter2d** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameter2d( CGparameter param,
                        double * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.  
**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter2d** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter2d** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter2d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter2f** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameter2f( CGparameter param,
                        float * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.  
**v**           Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter2f** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter2f** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter2f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter3d** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameter3d( CGparameter param,
                        double * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.  
**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter3d** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter3d** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter3d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter3f** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetParameter3f( CGparameter param,  
                        float * v );
```

**PARAMETERS**

param     The parameter from which the values will be retrieved.

v         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter3f** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter3f** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter3f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter4d** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetParameter4d( CGparameter param,  
                        double * v );
```

**PARAMETERS**

param     The parameter from which the values will be retrieved.

v         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter4d** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter4d** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter4d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

**NAME**

**cgGLGetParameter4f** – get the values from a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLGetParameter4f( CGparameter param,  
                        float * v );
```

**PARAMETERS**

**param**     The parameter from which the values will be retrieved.

**v**         Destination buffer into which the values will be written.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameter4f** extracts parameter values set by the **cgGLSetParameter** functions.

**cgGLGetParameter4f** may only be called with uniform numeric parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameter4f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetParameter**, **cgGLGetParameterArray**

## NAME

**cgGLGetParameterArray** – get the values from an array parameter

## SYNOPSIS

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLGetParameterArray{1234}{fd}( CGparameter param,
                                       long offset,
                                       long nelements,
                                       const TYPE * v );
```

## PARAMETERS

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **nelements** times the vector size indicated by the number in the function name.

## RETURN VALUES

None.

## DESCRIPTION

The **cgGLGetParameterArray** functions retrieve the values from a scalar or vector array parameter.

There are versions of each function that return either **float** or **double** values signified by **f** or **d** in the function name.

Either 1, 2, 3, or 4 values per array element is returned depending on which function is used.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

## HISTORY

The **cgGLGetParameterArray** functions were introduced in Cg 1.1.

## SEE ALSO

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray



**NAME**

**cgGLGetParameterArray1d** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray1d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray1d** retrieves the values from a scalar or vector array parameter.

The function retrieves 1 value per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray1d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray1f** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray1f( CGparameter param,
                               long offset,
                               long nelements,
                               const float * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray1f** retrieves the values from a scalar or vector array parameter.

The function retrieves 1 value per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray1f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray2d** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray2d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **2 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray2d** retrieves the values from a scalar or vector array parameter.

The function retrieves 2 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray2d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray2f** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray2f( CGparameter param,
                              long offset,
                              long nelements,
                              const float * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **2 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray2f** retrieves the values from a scalar or vector array parameter.

The function retrieves 2 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray2f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray3d** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray3d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **3 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray3d** retrieves the values from a scalar or vector array parameter.

The function retrieves 3 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray3d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray3f** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray3f( CGparameter param,
                              long offset,
                              long nelements,
                              const float * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **3 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray3f** retrieves the values from a scalar or vector array parameter.

The function retrieves 3 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray3f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray4d** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray4d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **4 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray4d** retrieves the values from a scalar or vector array parameter.

The function retrieves 4 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray4d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray

**NAME**

**cgGLGetParameterArray4f** – get the values from an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLGetParameterArray4f( CGparameter param,
                              long offset,
                              long nelements,
                              const float * v );
```

**PARAMETERS**

- param**     The array parameter from which the values will be retrieved.
- offset**    An offset into the array parameter at which to start getting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to get. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         Destination buffer into which the values will be written. The size of **v** must be **4 \* nelements**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLGetParameterArray4f** retrieves the values from a scalar or vector array parameter.

The function retrieves 4 values per array element.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**HISTORY**

**cgGLGetParameterArray4f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetParameter, cgGLSetParameter, cgGLSetParameterArray



**NAME**

**cgGLGetProgramID** – get the OpenGL program ID associated with a program

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
GLuint cgGLGetProgramID( CGprogram program );
```

**PARAMETERS**

**program** The program for which the OpenGL program ID will be retrieved.

**RETURN VALUES**

Returns a **GLuint** associated with the GL program object for profiles that use program object.

Returns **0** for profiles that do not have OpenGL programs (e.g. fp20).

**DESCRIPTION**

**cgGLGetProgramID** returns the identifier to the OpenGL program object associated with **program**.

**cgGLGetProgramID** should not be called before **cgGLLoadProgram** is called.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **program**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGLGetProgramID** was introduced in Cg 1.2.

**SEE ALSO**

**cgGLLoadProgram**, **cgGLBindProgram**

**NAME**

**cgGLGetTextureEnum** – get the OpenGL enumerant for the texture unit associated with a parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
GLenum cgGLGetTextureEnum( CGparameter param );
```

**PARAMETERS**

**param**     The texture parameter for which the OpenGL texture unit enumerant will be retrieved.

**RETURN VALUES**

Returns a **GLenum** of the form **GL\_TEXTURE#\_ARB**.

Returns **GL\_INVALID\_OPERATION** if an error occurs.

**DESCRIPTION**

**cgGLGetTextureEnum** returns the OpenGL enumerant for the texture unit assigned to **param**. The enumerant has the form **GL\_TEXTURE#\_ARB** where **#** is the texture unit number.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a texture parameter or if the operation fails for any other reason.

**HISTORY**

**cgGLGetTextureEnum** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLSetTextureParameter**

**NAME**

**cgGLGetTextureParameter** – get the OpenGL object from a texture parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
GLuint cgGLGetTextureParameter( CGparameter param );
```

**PARAMETERS**

param     The texture parameter for which the OpenGL texture object will be retrieved.

**RETURN VALUES**

Returns the OpenGL object to which the texture was set.

Returns **0** if the parameter has not been set.

**DESCRIPTION**

**cgGLGetTextureParameter** gets the OpenGL object from a texture parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGLGetTextureParameter** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetTextureParameter, cgGLGetParameter

**NAME**

**cgGLIsProfileSupported** – determine if a profile is supported by cgGL

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
Cgbool cgGLIsProfileSupported( CGprofile profile );
```

**PARAMETERS**

**profile**    The profile which will be checked for support.

**RETURN VALUES**

Returns **CG\_TRUE** if **profile** is supported by the cgGL library.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgGLIsProfileSupported** returns **CG\_TRUE** if the profile indicated by **profile** is supported by the cgGL library. A profile may not be supported if required OpenGL extensions are not available.

**EXAMPLES**

*to-be-written*

**ERRORS**

None.

**HISTORY**

**cgGLIsProfileSupported** was introduced in Cg 1.1.

**SEE ALSO**

cgGLEnableProfile, cgGLDisableProfile

**NAME**

**cgGLIsProgramLoaded** – determine if a program is loaded

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
CGbool cgGLIsProgramLoaded( CGprogram program );
```

**PARAMETERS**

**program** The program which will be checked.

**RETURN VALUES**

Returns **CG\_TRUE** if **program** has been loaded.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgGLIsProgramLoaded** returns **CG\_TRUE** if **program** has been loaded with **cgGLLoadProgram** and **CG\_FALSE** otherwise.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGLIsProgramLoaded** was introduced in Cg 1.2.

**SEE ALSO**

**cgGLLoadProgram** **cgGLBindProgram**

**NAME**

**cgGLLoadProgram** – prepares a program for binding

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLLoadProgram( CGprogram program );
```

**PARAMETERS**

**program** The program which will be loaded.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLLoadProgram** prepares a program for binding. All programs must be loaded before they can be bound to the current state. See **cgGLBindProgram** for more information about binding programs.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **program**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**CG\_PROGRAM\_LOAD\_ERROR** is generated if the program fails to load for any reason.

**HISTORY**

**cgGLLoadProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLIsProgramLoaded**, **cgGLBindProgram**

**NAME**

**cgGLRegisterStates** – registers graphics pass states for CgFX files

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLRegisterStates( CGcontext context );
```

**PARAMETERS**

context    The context in which to register the states.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLRegisterStates** registers a set of states for the passes in a CgFX effect file. These states correspond to the set of OpenGL state that is relevant and/or useful to be setting in passes in effect files. See the Cg User's Guide for complete documentation of the states that are made available after calling **cgGLRegisterStates**.

**EXAMPLES**

```
CGcontext context = cgCreateContext();
HGLRC glcontext = wglCreateContext(hdc);
wglMakeCurrent(hdc, glcontext);
cgGLRegisterStates(context);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgGLRegisterStates** was introduced in Cg 1.4.

Starting with Cg 2.2, **cgGLRegisterStates** calls **cgSetStateLatestProfile** for program states it creates and registers the latest profile returned by **cgGLGetLatestProfile** for the appropriate program domain.

**SEE ALSO**

**cgCreateState**, **cgSetStateLatestProfile**, **cgSetPassState**, **cgResetPassState**, **cgCallStateValidateCallback**, **cgD3D9RegisterStates**

**NAME**

**cgGLSetDebugMode** – control whether the cgGL runtime calls **glGetError**

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetDebugMode( CGbool debug );
```

**PARAMETERS**

**debug**     Flag indicating whether the library should use OpenGL error checking.

**RETURN VALUES**

None.

**DESCRIPTION**

The OpenGL Cg runtime calls **glGetError** at various points to verify that no errors have occurred. While this is helpful during development, the resulting performance penalty may be deemed too severe. **cgGLSetDebugMode** allows the application to turn off the OpenGL error checking if so desired.

**EXAMPLES**

```
cgGLSetDebugMode( CG_TRUE );    // Enables debug mode
cgGLSetDebugMode( CG_FALSE );   // Disables debug mode
```

**ERRORS**

None.

**HISTORY**

**cgGLSetDebugMode** was introduced in Cg 1.5.

**SEE ALSO**

cgSetErrorHandler, cgGetError



## NAME

**cgGLSetManageTextureParameters** – set the manage texture parameters flag for a context

## SYNOPSIS

```
#include <Cg/cgGL.h>
```

```
void cgGLSetManageTextureParameters( CGcontext context,  
                                     CGbool flag );
```

## PARAMETERS

**context** The context in which the automatic texture management behavior will be changed.

**flag** A boolean switch which controls automatic texture management by the runtime.

## RETURN VALUES

None.

## DESCRIPTION

By default, cgGL does not manage any texture state in OpenGL. It is up to the user to enable and disable textures using **cgGLEnableTextureParameter** and **cgGLDisableTextureParameter** respectively. This behavior is the default in order to avoid conflicts with texture state on geometry that's rendered with the fixed function pipeline or without cgGL.

If automatic texture management is desired, **cgGLSetManageTextureParameters** may be called with **flag** set to **CG\_TRUE** before **cgGLBindProgram** is called. Whenever **cgGLBindProgram** is called, the cgGL runtime will make all the appropriate texture parameter calls on the application's behalf.

**cgGLUnbindProgram** may be used to reset the texture state

Calling **cgGLSetManageTextureParameters** with **flag** set to **CG\_FALSE** will disable automatic texture management.

**NOTE:** When **cgGLSetManageTextureParameters** is set to **CG\_TRUE**, applications should not make texture state change calls to OpenGL (such as **glBindTexture**, **glActiveTexture**, etc.) after calling **cgGLBindProgram**, unless the application is trying to override some parts of cgGL's texture management.

## EXAMPLES

*to-be-written*

## ERRORS

None.

## HISTORY

**cgGLSetManageTextureParameters** was introduced in Cg 1.2.

## SEE ALSO

**cgGLGetManageTextureParameters**, **cgGLBindProgram**, **cgGLUnbindProgram**

**NAME**

**cgGLSetMatrixParameter** – set the value of a matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLSetMatrixParameter{fd}{rc}( CGparameter param,
                                       const TYPE * matrix );
```

**PARAMETERS**

**param**    The matrix parameter that will be set.

**matrix**    An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLSetMatrixParameter** functions set the value of a matrix parameter.

There are versions of the function that take either **float** or **double** values signified by **f** or **d** in the function name.

There are versions of the function that assume the array of values are laid out in either row or column order signified by **r** or **c** in the function name respectively.

The **cgGLSetMatrixParameter** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_POINTER\_ERROR** is generated if **matrix** is **NULL**.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the operation fails for any other reason.

**HISTORY**

The **cgGLSetMatrixParameter** functions were introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLSetMatrixParameterArray** – set the value of an array matrix parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLSetMatrixParameterArray{fd}{rc}( CGparameter param,
                                           long offset,
                                           long nelements,
                                           const TYPE * v );
```

**PARAMETERS**

- param**     The matrix array parameter that will be set.
- offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array of values to which to set the parameter. This must be a contiguous set of values with size **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLSetMatrixParameterArray** functions set the value of a scalar or vector array parameter.

There are versions of the function that take either **float** or **double** values signified by **f** or **d** in the function name.

There are versions of the function that assume the array of values are laid out in either row or column order signified by **r** or **c** in the function name respectively.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

The **cgGLSetMatrixParameterArray** functions were introduced in Cg 1.1.

**SEE ALSO**

cgGLSetMatrixParameter, cgGLGetMatrixParameterArray

**NAME**

**cgGLSetMatrixParameterArraydc** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterArraydc( CGparameter param,
                                     long offset,
                                     long nelements,
                                     const double * v );
```

**PARAMETERS**

- param**     The matrix array parameter that will be set.
- offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array of values to which to set the parameter. This must be a contiguous set of values with size **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterArraydc** sets the value of a matrix array parameter from an array of **doubles** laid out in column-major order.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.
- CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterArraydc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetMatrixParameter, cgGLGetMatrixParameterArray

**NAME**

**cgGLSetMatrixParameterArraydr** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterArraydr( CGparameter param,
                                     long offset,
                                     long nelements,
                                     const double * v );
```

**PARAMETERS**

- param**     The matrix array parameter that will be set.
- offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array of values to which to set the parameter. This must be a contiguous set of values with size **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterArraydr** sets the value of a matrix array parameter from an array of **doubles** laid out in row-major order.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.
- CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterArraydr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetMatrixParameter, cgGLGetMatrixParameterArray

## NAME

**cgGLSetMatrixParameterArrayfc** – set the values of a matrix array parameter

## SYNOPSIS

```
#include <Cg/cgGL.h>
```

```
void cgGLSetMatrixParameterArrayfc( CGparameter param,
                                     long offset,
                                     long nelements,
                                     const float * v );
```

## PARAMETERS

- param**     The matrix array parameter that will be set.
- offset**    An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         The array of values to which to set the parameter. This must be a contiguous set of values with size **nelements** times the number of elements in the matrix.

## RETURN VALUES

None.

## DESCRIPTION

**cgGLSetMatrixParameterArrayfc** sets the value of a matrix array parameter from an array of **floats** laid out in column-major order.

## EXAMPLES

*to-be-written*

## ERRORS

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.
- CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

## HISTORY

**cgGLSetMatrixParameterArrayfc** was introduced in Cg 1.1.

## SEE ALSO

cgGLSetMatrixParameter, cgGLGetMatrixParameterArray

**NAME**

**cgGLSetMatrixParameterArrayfr** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterArrayfr( CGparameter param,
                                     long offset,
                                     long nelements,
                                     const float * v );
```

**PARAMETERS**

- param**     The matrix array parameter that will be set.
- offset**    An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         The array of values to which to set the parameter. This must be a contiguous set of values with size **nelements** times the number of elements in the matrix.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterArrayfr** sets the value of a matrix array parameter from an array of **floats** laid out in row-major order.

**EXAMPLES**

*to-be-written*

**ERRORS**

- CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.
- CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.
- CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if the elements of **param** are not matrix parameters.
- CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.
- CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.
- CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterArrayfr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetMatrixParameter, cgGLGetMatrixParameterArray

**NAME**

**cgGLSetMatrixParameterdc** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterdc( CGparameter param,
                               const double * matrix );
```

**PARAMETERS**

**param**     The matrix parameter that will be set.

**matrix**     An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterdc** sets the value of a matrix parameter from an array of **doubles** laid out in column-major order.

**cgGLSetMatrixParameterdc** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterdc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetParameter



**NAME**

**cgGLSetMatrixParameterdr** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterdr( CGparameter param,
                               const double * matrix );
```

**PARAMETERS**

**param**     The matrix parameter that will be set.

**matrix**     An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterdr** sets the value of a matrix parameter from an array of **doubles** laid out in row-major order.

**cgGLSetMatrixParameterdr** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterdr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLSetMatrixParameterfc** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterfc( CGparameter param,
                               const float * matrix );
```

**PARAMETERS**

**param**     The matrix parameter that will be set.

**matrix**     An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterfc** sets the value of a matrix parameter from an array of **floats** laid out in column-major order.

**cgGLSetMatrixParameterfc** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterfc** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLSetMatrixParameterfr** – set the values of a matrix array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetMatrixParameterfr( CGparameter param,
                               const float * matrix );
```

**PARAMETERS**

**param**     The matrix parameter that will be set.

**matrix**     An array of values used to set the matrix parameter. The array must be the number of rows times the number of columns in size.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetMatrixParameterfr** sets the value of a matrix parameter from an array of **floats** laid out in row-major order.

**cgGLSetMatrixParameterfr** functions may only be called with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetMatrixParameterfr** was introduced in Cg 1.1.

**SEE ALSO**

cgGLGetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetParameter

**NAME**

**cgGLSetOptimalOptions** – set the implicit compiler optimization options for a profile

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetOptimalOptions( CGprofile profile );
```

**PARAMETERS**

profile    The profile for which the optimal options will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetOptimalOptions** sets implicit compiler arguments that are appended to the argument list passed to **cgCreateProgram**. The arguments are chosen based on the the available compiler arguments, GPU, and driver.

The arguments will be appended to the argument list every time **cgCreateProgram** is called until the last **CGcontext** is destroyed, after which this function should be called again.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **profile** is not a supported OpenGL profile.

**HISTORY**

**cgGLSetOptimalOptions** was introduced in Cg 1.1.

**SEE ALSO**

**cgCreateProgram**

**NAME**

**cgGLSetParameter** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLSetParameter1{fd}( CGparameter param,
                             TYPE x );

void cgGLSetParameter2{fd}( CGparameter param,
                             TYPE x,
                             TYPE y );

void cgGLSetParameter3{fd}( CGparameter param,
                             TYPE x,
                             TYPE y,
                             TYPE z );

void cgGLSetParameter4{fd}( CGparameter param,
                             TYPE x,
                             TYPE y,
                             TYPE z,
                             TYPE w );

void cgGLSetParameter{1234}{fd}v( CGparameter param,
                                   const TYPE * v );
```

**PARAMETERS**

param     The parameter that will be set.

x, y, z, and w

          The values used to set the parameter.

v             An array of values used to set the parameter for the array versions of the set functions.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLSetParameter** functions set the value of a scalar or vector parameter.

The function takes either 1, 2, 3, or 4 values depending on which version is used. If more values are passed in than the parameter requires, the extra values will be ignored.

There are versions of each function that take either **float** or **double** values signified by **f** or **d** in the function name.

The functions with **v** at the end of their names take an array of values instead of explicit parameters.

The **cgGLSetParameter** functions may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the cgGLGetParameter functions will only work with uniform parameters.

**Note:** Previous releases of Cg allowed you to store more values in a parameter than indicated by the parameter's type. For example, one could use cgGLSetParameter4f to store four values into a parameter of type **CG\_FLOAT** (not **CG\_FLOAT4**). All four values could later be retrieved using a get call which requested more than one value. However, this feature conflicts with the GLSL approach and also leads to issues with parameters mapped into BUFFERS. Therefore, beginning with Cg 2.0 any components beyond

the number indicated by the parameter type are ignored.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

## HISTORY

The **cgGLSetParameter** functions were introduced in Cg 1.1.

## SEE ALSO

cgGLGetParameter, cgGLSetParameterArray, cgGLSetMatrixParameter, cgGLSetMatrixParameterArray, cgGLSetTextureParameter, cgGLBindProgram

**NAME**

**cgGLSetParameter1d** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter1d( CGparameter param,
                          double x );
```

**PARAMETERS**

**param**     The parameter that will be set.  
**x**         The value to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter1d** sets the value of a scalar or vector parameter.

**cgGLSetParameter1d** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter1d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter1dv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter1dv( CGparameter param,
                          const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter1dv** sets the values of a scalar or vector parameter from the given array of values.

**cgGLSetParameter1dv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter1dv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**



**NAME**

**cgGLSetParameter1f** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter1f( CGparameter param,
                          float x );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x**         The value to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter1f** sets the value of a scalar or vector parameter.

**cgGLSetParameter1f** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter1f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter1fv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter1fv( CGparameter param,
                          const float * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter1fv** sets the values of a scalar or vector parameter from the given array of values.

**cgGLSetParameter1fv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter1fv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter2d** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter2d( CGparameter param,
                        double x,
                        double y );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y**       The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter2d** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter2d** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter2d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter2dv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter2dv( CGparameter param,
                          const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter2dv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter2dv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter2dv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter2f** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter2f( CGparameter param,
                        float x,
                        float y );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y**       The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter2f** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter2f** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter2f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter2fv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter2fv( CGparameter param,
                          const float * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter2fv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter2fv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter2fv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter3d** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter3d( CGparameter param,
                        double x,
                        double y,
                        double z );
```

**PARAMETERS**

**param**     The parameter that will be set.  
**x, y, z**     The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter3d** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter3d** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter3d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter3dv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter3dv( CGparameter param,
                          const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter3dv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter3dv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter3dv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**



**NAME**

**cgGLSetParameter3f** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter3f( CGparameter param,
                        float x,
                        float y,
                        float z );
```

**PARAMETERS**

**param**     The parameter that will be set.  
**x, y, z**     The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter3f** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter3f** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter3f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter3fv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter3fv( CGparameter param,
                          const float * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter3fv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter3fv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter3fv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter4d** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter4d( CGparameter param,
                          double x,
                          double y,
                          double z,
                          double w );
```

**PARAMETERS**

**param**     The parameter that will be set.

**x, y, z, w**

The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter4d** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter4d** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter4d** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter4dv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter4dv( CGparameter param,
                          const double * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter4dv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter4dv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter4dv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter4f** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter4f( CGparameter param,
                        float x,
                        float y,
                        float z,
                        float w );
```

**PARAMETERS**

param     The parameter that will be set.

x, y, z, w

The values to which **param** will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter4f** sets the value of a scalar or vector parameter.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter4f** may be called with uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter4f** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameter4fv** – set the values of a scalar or vector parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameter4fv( CGparameter param,
                          const float * v );
```

**PARAMETERS**

**param**     The parameter that will be set.

**v**         Array of values used to set **param**.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameter4fv** sets the values of a scalar or vector parameter from the given array of values.

If more values are passed in than the parameter requires, the extra values will be ignored.

**cgGLSetParameter4fv** may be called with either uniform or varying parameters. When called with a varying parameter, the appropriate immediate mode OpenGL entry point will be called. However, the **cgGLGetParameter** functions only work with uniform parameters.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameter4fv** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetParameter**, **cgGLSetParameterArray**, **cgGLSetMatrixParameter**, **cgGLSetMatrixParameterArray**, **cgGLSetTextureParameter**, **cgGLBindProgram**

**NAME**

**cgGLSetParameterArray** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

/* TYPE is float or double */

void cgGLSetParameterArray{1234}{fd}( CGparameter param,
                                       long offset,
                                       long nelements,
                                       const TYPE * v );
```

**PARAMETERS**

- param**     The array parameter that will be set.
- offset**    An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         The array of values used to set the parameter. This must be a contiguous set of values that total **nelements** times the vector size indicated by the number in the function name.

**RETURN VALUES**

None.

**DESCRIPTION**

The **cgGLSetParameterArray** functions set the value of a scalar or vector array parameter.

Either 1, 2, 3, or 4 values per array element will be set, depending on which function is used.

There are versions of the function that take either **float** or **double** values signified by **f** or **d** in the function name.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

The **cgGLSetParameterArray** functions were introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray1d** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLSetParameterArray1d( CGparameter param,  
                               long offset,  
                               long nelements,  
                               const double * v );
```

**PARAMETERS**

**param**     The array parameter that will be set.

**offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.

**nelements**

The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**           The array of values used to set the parameter. This must be a contiguous set of **nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray1d** sets 1 value per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray1d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray



**NAME**

**cgGLSetParameterArray1f** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLSetParameterArray1f( CGparameter param,  
                               long offset,  
                               long nelements,  
                               const float * v );
```

**PARAMETERS**

**param**     The array parameter that will be set.

**offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.

**nelements**

The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**           The array of values used to set the parameter. This must be a contiguous set of **nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray1f** sets 1 value per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray1f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray2d** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameterArray2d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

**param**     The array parameter that will be set.

**offset**    An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.

**nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**         The array of values used to set the parameter. This must be a contiguous set of **2 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray2d** sets 2 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray2d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray2f** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameterArray2f( CGparameter param,
                              long offset,
                              long nelements,
                              const float * v );
```

**PARAMETERS**

- param**     The array parameter that will be set.
- offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array of values used to set the parameter. This must be a contiguous set of **2 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray2f** sets 2 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray2f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray3d** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameterArray3d( CGparameter param,
                              long offset,
                              long nelements,
                              const double * v );
```

**PARAMETERS**

- param**     The array parameter that will be set.
- offset**    An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**         The array of values used to set the parameter. This must be a contiguous set of **3 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray3d** sets 3 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray3d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray3f** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLSetParameterArray3f( CGparameter param,  
                               long offset,  
                               long nelements,  
                               const float * v );
```

**PARAMETERS**

**param**     The array parameter that will be set.

**offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.

**nelements**

The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**           The array of values used to set the parameter. This must be a contiguous set of **3 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray3f** sets 3 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray3f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray4d** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameterArray4d( CGparameter param,
                               long offset,
                               long nelements,
                               const double * v );
```

**PARAMETERS**

- param**     The array parameter that will be set.
- offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.
- nelements**     The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.
- v**     The array of values used to set the parameter. This must be a contiguous set of **4 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray4d** sets 4 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray4d** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterArray4f** – set the values of an array parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>
```

```
void cgGLSetParameterArray4f( CGparameter param,  
                              long offset,  
                              long nelements,  
                              const float * v );
```

**PARAMETERS**

**param**     The array parameter that will be set.

**offset**     An offset into the array parameter at which to start setting elements. A value of **0** will begin at the first element of the array.

**nelements**

The number of elements to set. A value of **0** will default to the total number of elements in the array minus the value of **offset**.

**v**         The array of values used to set the parameter. This must be a contiguous set of **4 \* nelements** values.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterArray4f** sets 4 values per element of a scalar or vector array parameter.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_ARRAY\_PARAM\_ERROR** is generated if **param** is not an array parameter.

**CG\_OUT\_OF\_ARRAY\_BOUNDS\_ERROR** is generated if **offset** or **nelements** is outside the bounds of **param**.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterArray4f** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter, cgGLGetParameterArray

**NAME**

**cgGLSetParameterPointer** – sets a varying parameter with an attribute array

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetParameterPointer( CGparameter param,
                              GLint fsize,
                              GLenum type,
                              GLsizei stride,
                              const GLvoid * pointer );
```

**PARAMETERS**

**param**     The parameter that will be set.

**fsize**     The number of coordinates per vertex.

**type**     The data type of each coordinate. Possible values are **GL\_UNSIGNED\_BYTE**, **GL\_SHORT**, **GL\_INT**, **GL\_FLOAT**, and **GL\_DOUBLE**.

**stride**    The byte offset between consecutive vertices. When **stride** is **0** the array is assumed to be tightly packed.

**pointer**   The pointer to the first coordinate in the vertex array.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetParameterPointer** sets a varying parameter to a given vertex array in the typical OpenGL style. See the OpenGL documentation on the various vertex array functions (e.g. **glVertexPointer**, **glNormalPointer**, etc...) for more information.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_UNSUPPORTED\_GL\_EXTENSION\_ERROR** is generated if **param** required an OpenGL extension that is not available.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetParameterPointer** was introduced in Cg 1.1.

**SEE ALSO**

cgGLSetParameter



**NAME**

**cgGLSetStateMatrixParameter** – set the values of a matrix parameter to a matrix in the OpenGL state

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetStateMatrixParameter( CGparameter param,
                                   CGGLenum matrix,
                                   CGGLenum transform );
```

**PARAMETERS**

**param** The matrix parameter that will be set.

**matrix** An enumerator indicating which matrix should be retrieved from the OpenGL state. Must be one of the following :

- **CG\_GL\_MODELVIEW\_MATRIX**
- **CG\_GL\_PROJECTION\_MATRIX**
- **CG\_GL\_TEXTURE\_MATRIX**
- **CG\_GL\_MODELVIEW\_PROJECTION\_MATRIX**

**transform**

An enumerator indicating an optional transformation that may be applied to the matrix before it is set. Must be one of the following :

- **CG\_GL\_MATRIX\_IDENTITY**
- **CG\_GL\_MATRIX\_TRANSPOSE**
- **CG\_GL\_MATRIX\_INVERSE**
- **CG\_GL\_MATRIX\_INVERSE\_TRANSPOSE**

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetStateMatrixParameter** sets a matrix parameter to the values retrieved from an OpenGL state matrix. The state matrix to retrieve is indicated by **matrix**, which may be one of the following :

- **CG\_GL\_MODELVIEW\_MATRIX**  
Get the current modelview matrix.
- **CG\_GL\_PROJECTION\_MATRIX**  
Get the current projection matrix.
- **CG\_GL\_TEXTURE\_MATRIX**  
Get the current texture matrix.
- **CG\_GL\_MODELVIEW\_PROJECTION\_MATRIX**  
Get the concatenated modelview and projection matrices.

The **transform** parameter specifies an optional transformation which will be applied to the retrieved matrix before setting the values in the parameter. **transform** must be one of the following :

- **CG\_GL\_MATRIX\_IDENTITY**  
Don't apply any transform, leaving the matrix as is.
- **CG\_GL\_MATRIX\_TRANSPOSE**  
Transpose the matrix.
- **CG\_GL\_MATRIX\_INVERSE**  
Invert the matrix.
- **CG\_GL\_MATRIX\_INVERSE\_TRANSPOSE**  
Transpose and invert the matrix.

**cgGLSetStateMatrixParameter** may only be called with a uniform matrix parameter. If the size of the

matrix is less than 4x4, the upper left corner of the matrix that fits into the given matrix parameter will be returned.

## EXAMPLES

*to-be-written*

## ERRORS

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_NOT\_MATRIX\_PARAM\_ERROR** is generated if **param** is not a matrix parameter.

**CG\_INVALID\_ENUMERANT\_ERROR** is generated if either **matrix** or **transform** is not one of the allowed enumerant values.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if the parameter fails to set for any other reason.

## HISTORY

**cgGLSetStateMatrixParameter** was introduced in Cg 1.1.

## SEE ALSO

cgGLSetMatrixParameter, cgGLGetMatrixParameter

**NAME**

**cgGLSetTextureParameter** – sets the value of a texture parameter

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetTextureParameter( CGparameter param,
                               GLuint texobj );
```

**PARAMETERS**

**param**     The texture parameter that will be set.

**texobj**    An OpenGL texture object name to which the parameter will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetTextureParameter** sets the value of a texture parameter to an OpenGL texture object.

Note that in order to use the texture, either **cgGLEnableTextureParameter** must be called after **cgGLSetTextureParameter** and before the geometry is drawn, or **cgGLSetManageTextureParameters** must be called with a value of **CG\_TRUE**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a texture parameter or if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetTextureParameter** was introduced in Cg 1.1.

**SEE ALSO**

**cgGLGetTextureParameter**, **cgGLSetParameter**

**NAME**

**cgGLSetupSampler** – initializes a sampler's state and texture object handle

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLSetupSampler( CGparameter param,
                      GLuint texobj );
```

**PARAMETERS**

**param**    The sampler parameter that will be set.  
**texobj**    An OpenGL texture object name to which the parameter will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLSetupSampler** initializes a sampler; like **cgGLSetTextureParameter**, it informs the OpenGL Cg runtime which OpenGL texture object to associate with the sampler. Furthermore, if the sampler was defined in the source file with a **sampler\_state** block that specifies sampler state, this sampler state is initialized for the given texture object.

Note that in order to use the texture, either **cgGLEnableTextureParameter** must be called after **cgGLSetTextureParameter** and before the geometry is drawn, or **cgGLSetManageTextureParameters** must be called with a value of **CG\_TRUE**.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **param**'s profile is not a supported OpenGL profile.

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if **param** is not a valid parameter.

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is not a texture parameter or if the parameter fails to set for any other reason.

**HISTORY**

**cgGLSetupSampler** was introduced in Cg 1.4.

**SEE ALSO**

**cgGLSetTextureParameter**, **cgGLGetTextureParameter**, **cgGLSetManageTextureParameters**

**NAME**

**cgGLUnbindProgram** – unbinds the program bound in a profile

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLUnbindProgram( CGprofile profile );
```

**PARAMETERS**

profile    The profile from which to unbind any bound program.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLUnbindProgram** unbinds the program which is bound in the profile specified by **profile**. It also resets the texture state back to the state it was in at the point **cgGLBindProgram** was first called with a program in the given profile.

**EXAMPLES**

*to-be-written*

**ERRORS**

**CG\_INVALID\_PROFILE\_ERROR** is generated if **profile** is not a supported OpenGL profile.

**HISTORY**

**cgGLUnbindProgram** was introduced in Cg 1.2.

**SEE ALSO**

**cgGLSetManageTextureParameters**, **cgGLBindProgram**

**NAME**

**cgGLUnloadProgram** – destroy the OpenGL shader object associated with a program

**SYNOPSIS**

```
#include <Cg/cgGL.h>

void cgGLUnloadProgram( CGprogram program );
```

**PARAMETERS**

**program** The program for which to destroy the shader object. The **CGprogram** handle is still valid after this call.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgGLUnloadProgram** destroys the OpenGL shader object for a program.

This call does not destroy the **CGprogram** itself, only the associated GL shader object. Use **cgDestroyProgram** to free the **CGprogram** itself. Also note that freeing a **CGprogram** using the core runtime implicitly calls this routine to avoid resource leaks.

**EXAMPLES**

```
// prog is a CGprogram initialized elsewhere
...
cgGLUnloadProgram(prog);

Cgbool loaded = cgGLIsProgramLoaded(prog); // loaded == CG_FALSE
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if **program** is not a valid program handle.

**HISTORY**

**cgGLUnloadProgram** was introduced in Cg 2.1.

**SEE ALSO**

**cgGLLoadProgram**, **cgGLIsProgramLoaded**, **cgDestroyProgram**

**NAME**

**cgD3D10BindProgram** – activate a program with D3D

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

HRESULT cgD3D10BindProgram( CGprogram program );
```

**PARAMETERS**

**program** The program to activate with D3D.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D10BindProgram** activates a program with D3D. The program is activated using **ID3D10Device::SetVertexShader** or **ID3D10Device::SetPixelShader** depending on the program's profile type.

D3D allows only one vertex shader and one pixel shader to be active at any given time, so activating a program of a given type implicitly deactivates any other program of a that type.

**EXAMPLES**

```
// vertexProg and pixelProg are CGprograms initialized elsewhere
// pDev is an ID3D10Device interface initialized elsewhere
...
HRESULT hr = cgD3D10BindProgram(vertexProg);
HRESULT hr2 = cgD3D10BindProgram(pixelProg);
// Draw a quad using the vertex and pixel shader
// A vertex and index buffer are set up elsewhere.
HRESULT hr3 = pDev->DrawIndexedPrimitive(D3DPT_TRIANGLELIST, 0, 4, 0, 2);
```

**ERRORS**

**cgD3D10Failed** is generated if a D3D function returns an error.

**CGD3D10ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D10LoadProgram**.

**CGD3D10ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D10SetDevice**.

**HISTORY**

**cgD3D10BindProgram** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10LoadProgram**, **cgD3D10SetTextureParameter**

**NAME**

**cgD3D10GetBufferByIndex** – Returns a pointer to an ID3D10Buffer interface by the constant buffer index.

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

ID3D10Buffer * cgD3D10GetBufferByIndex( CGprogram Program,
                                         UINT Index );
```

**PARAMETERS**

Program The Cg program containing the buffer.

Index A zero-based index.

**RETURN VALUES**

Returns a pointer to an ID3D10Buffer interface containing the constant buffer.

**DESCRIPTION**

**cgD3D10GetBufferByIndex** returns a pointer to an ID3D10Buffer interface containing the constant buffer for manual manipulation. If the user manually changes the constant values in this way, the constant values contained in the corresponding CGBuffer (if exists) will be stale.

**EXAMPLES**

```
ID3D10Buffer * myConstantBuffer = cgD3D10GetBufferByIndex( myCgProgram, 0 );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** if Program is not a valid Cg program.

**HISTORY**

**cgD3D10GetBufferByIndex** was introduced in Cg 2.1.

**SEE ALSO**

cgCreateBuffer



**NAME**

**cgD3D10GetCompiledProgram** – Gets the compiled shader as a ID3D10Blob returned from Direct3D after cgD3D10LoadProgram is called.

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>
```

```
ID3D10Blob * cgD3D10GetCompiledProgram( CGprogram program );
```

**PARAMETERS**

**program** The program handle after a call to cgD3D10LoadProgram has been made.

**RETURN VALUES**

Returns a pointer to a ID3D10Blob object containing the compiled shader code.

Returns NULL if the program was not loaded.

**DESCRIPTION**

**cgD3D10GetCompiledProgram** allows the user to get back the compiled shader from Direct3D once cgD3D10LoadProgram has been called.

**EXAMPLES**

```
CGprogram myCgProgram = cgCreateProgram( ... ); cgD3D10LoadProgram( myCgProgram, 0 );
```

```
ID3D10Blob * obj = cgD3D10GetCompiledProgram( myCgProgram );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if the **program** is invalid.

**HISTORY**

**cgD3D10GetCompiledProgram** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10LoadProgram

**NAME**

**cgD3D10GetDevice** – retrieves the current D3D10 device associated with a context

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>
```

```
ID3D10Device * cgD3D10GetDevice( CGcontext context );
```

**PARAMETERS**

context    The context from which to get the current device.

**RETURN VALUES**

Returns the current D3D10 device associated with **context**.

**DESCRIPTION**

**cgD3D10GetDevice** retrieves the current D3D10 device associated with **context**. Note that the returned device pointer may be **NULL**.

**EXAMPLES**

```
ID3D10Device* curDevice = cgD3D10GetDevice(ctx);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgD3D10GetDevice** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10SetDevice

**NAME**

**cgD3D10GetIASignatureByPass** – Gets the compiled vertex shader signature as a ID3D10Blob from a pass of a validated technique.

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

ID3D10Blob * cgD3D10GetIASignatureByPass( CGpass pass );
```

**PARAMETERS**

pass      The pass handle after validation of a CgFX technique.

**RETURN VALUES**

Returns a pointer to a ID3D10Blob object containing the vertex shader signature.

Returns NULL if the program was not loaded.

**DESCRIPTION**

**cgD3D10GetIASignatureByPass** allows the user to get back the vertex shader signature of a pass of a validated CgFX technique.

**EXAMPLES**

```
myCgEffect = cgCreateEffectFromFile( myCgContext, "effect.cgfx", NULL ); myCgTechnique =
cgGetFirstTechnique( myCgEffect );

if( cgValidateTechnique( myCgTechnique ) != CG_FALSE ) {
    const D3D10_INPUT_ELEMENT_DESC layout[] =
    {
        { "POSITION", 0, DXGI_FORMAT_R32G32B32_FLOAT, 0, 0,
D3D10_INPUT_PER_VERTEX_DATA, 0 },
    };

    CGpass myPass = cgGetFirstPass( myCgTechnique );

    ID3D10Blob * pVSBuf = cgD3D10GetIASignatureByPass( myPass );

    hr = pDevice->CreateInputLayout( layout, 1, pVSBuf->GetBufferPointer(),
        pVSBuf->GetBufferSize(), &g_pVertexLayout );
}
```

**ERRORS**

**CG\_INVALID\_PASS\_HANDLE\_ERROR** is generated if the **pass** is invalid.

**HISTORY**

**cgD3D10GetIASignatureByPass** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10GetCompiledProgram

**NAME**

**cgD3D10GetLastError** – get the last D3D error that occurred

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>
```

```
HRESULT cgD3D10GetLastError( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the last D3D error that occurred during an expanded interface function call.

Returns **D3D\_OK** if no D3D error has occurred since the last call to **cgD3D10GetLastError**.

**DESCRIPTION**

**cgD3D10GetLastError** retrieves the last D3D error that occurred during an expanded interface function call. The last error is always cleared immediately after the call.

**EXAMPLES**

```
HRESULT lastError = cgD3D10GetLastError();
```

**ERRORS**

None.

**HISTORY**

**cgD3D10GetLastError** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10TranslateHRESULT

**NAME**

**cgD3D10GetLatestGeometryProfile** – get the latest supported geometry shader version

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

CGprofile cgD3D10GetLatestGeometryProfile( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the latest geometry shader version supported by the current D3D device.

Returns **CG\_PROFILE\_UNKNOWN** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D10GetLatestGeometryProfile** retrieves the latest geometry shader version that the current D3D device supports. This is an expanded interface function because it needs to know about the D3D device to determine the most current version supported.

Starting in Cg 2.2, if the environment variable **CGD3D10\_LATEST\_GEOMETRY\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), then it is this **CGprofile** value that will be returned by **cgD3D10GetLatestGeometryProfile**.

**EXAMPLES**

```
CGprofile bestGeometryProfile = cgD3D10GetLatestGeometryProfile();
```

**ERRORS**

None.

**HISTORY**

**cgD3D10GetLatestGeometryProfile** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10GetLatestPixelProfile**, **cgD3D10GetLatestVertexProfile**

**NAME**

**cgD3D10GetLatestPixelProfile** – get the latest supported pixel shader version

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

CGprofile cgD3D10GetLatestPixelProfile( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the latest pixel shader version supported by the current D3D device.

Returns **CG\_PROFILE\_UNKNOWN** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D10GetLatestPixelProfile** retrieves the latest pixel shader version that the current D3D device supports. This is an expanded interface function because it needs to know about the D3D device to determine the most current version supported.

Starting in Cg 2.2, if the environment variable **CGD3D10\_LATEST\_PIXEL\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), then it is this **CGprofile** value that will be returned by **cgD3D10GetLatestPixelProfile**.

**EXAMPLES**

```
CGprofile bestPixelProfile = cgD3D10GetLatestPixelProfile();
```

**ERRORS**

None.

**HISTORY**

**cgD3D10GetLatestPixelProfile** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10GetLatestGeometryProfile**, **cgD3D10GetLatestVertexProfile**

**NAME**

**cgD3D10GetLatestVertexProfile** – get the latest supported vertex shader version

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

CGprofile cgD3D10GetLatestVertexProfile( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the latest vertex shader version supported by the current D3D device.

Returns **CG\_PROFILE\_UNKNOWN** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D10GetLatestVertexProfile** retrieves the latest vertex shader version that the current D3D device supports. This is an expanded interface function because it needs to know about the D3D device to determine the most current version supported.

Starting in Cg 2.2, if the environment variable **CGD3D10\_LATEST\_VERTEX\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), then it is this **CGprofile** value that will be returned by **cgD3D10GetLatestVertexProfile**.

**EXAMPLES**

```
CGprofile bestVertexProfile = cgD3D10GetLatestVertexProfile();
```

**ERRORS**

None.

**HISTORY**

**cgD3D10GetLatestVertexProfile** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10GetLatestGeometryProfile**, **cgD3D10GetLatestPixelProfile**

## NAME

**cgD3D10GetManageTextureParameters** – get the manage texture parameters flag from a context

## SYNOPSIS

```
#include <Cg/cgD3D10.h>
```

```
CGbool cgD3D10GetManageTextureParameters( CGcontext context );
```

## PARAMETERS

context The context from which the automatic texture management setting will be retrieved.

## RETURN VALUES

Returns the manage texture management flag from **context**.

## DESCRIPTION

**cgD3D10GetManageTextureParameters** returns the manage texture management flag from context. See **cgD3D10SetManageTextureParameters** for more information.

## EXAMPLES

```
CGbool manage = cgD3D10GetManageTextureParameters( pCtx );
if( manage )
    doSomething();
```

## ERRORS

None.

## HISTORY

**cgD3D10GetManageTextureParameters** was introduced in Cg 2.1.

## SEE ALSO

**cgD3D10SetManageTextureParameters**



**NAME**

**cgD3D10GetOptimalOptions** – get the best set of compiler options for a profile

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

char const ** cgD3D10GetOptimalOptions( CGprofile profile );
```

**PARAMETERS**

profile    The profile whose optimal arguments are requested.

**RETURN VALUES**

Returns a null-terminated array of strings representing the optimal set of compiler options for **profile**.

Returns **NULL** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D10GetOptimalOptions** returns the best set of compiler options for a given profile. This is an expanded interface function because it needs to know about the D3D device to determine the most optimal options.

The elements of the returned array are meant to be used as part of the **args** parameter to **cgCreateProgram** or **cgCreateProgramFromFile**.

The returned string does not need to be destroyed by the application. However, the contents could change if the function is called again for the same profile but a different D3D device.

**EXAMPLES**

```
const char* vertOptions[] = { myCustomArgs,
                              cgD3D10GetOptimalOptions(vertProfile),
                              NULL };

// create the vertex shader
CGprogram myVS = cgCreateProgramFromFile( context,
                                          CG_SOURCE,
                                          "vshader.cg",
                                          vertProfile,
                                          "VertexShader",
                                          vertOptions );
```

**ERRORS**

None.

**HISTORY**

**cgD3D10GetOptimalOptions** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10GetLatestVertexProfile,                      cgD3D10GetLatestPixelProfile,                      cgCreateProgram,  
cgCreateProgramFromFile

**NAME**

**cgD3D10GetProgramErrors** – Gets a list of errors returned from Direct3D if the program did not load.

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>
```

```
ID3D10Blob * cgD3D10GetProgramErrors( CGprogram program );
```

**PARAMETERS**

**program** The program handle after a call to `cgD3D10LoadProgram` has been made.

**RETURN VALUES**

Returns a pointer to a `ID3D10Blob` object containing a list of errors if the program did not load.

Returns `NULL` if the program was loaded.

**DESCRIPTION**

**cgD3D10GetProgramErrors** allows the user to get back the compiled shader from Direct3D once `cgD3D10LoadProgram` has been called.

**EXAMPLES**

```
CGprogram myCgProgram = cgCreateProgram( ... ); cgD3D10LoadProgram( myCgProgram, 0 );  
ID3D10Blob * err = cgD3D10GetProgramErrors( myCgProgram );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if the **program** is invalid;

**HISTORY**

**cgD3D10GetProgramErrors** was introduced in Cg 2.1.

**SEE ALSO**

`cgD3D10LoadProgram`

**NAME**

**cgD3D10IsProfileSupported** – determine if a profile is supported by cgD3D10

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

CGbool cgD3D10IsProfileSupported( CGprofile profile );
```

**PARAMETERS**

profile    The profile which will be checked for support.

**RETURN VALUES**

Returns **CG\_TRUE** if **profile** is supported by the cgD3D10 library.

Returns **CG\_FALSE** otherwise.

However if cgD3D10SetDevice has not been called to register a **ID3D10Device** device yet, this routine returns **CG\_TRUE** for all valid D3D10 profiles.

**DESCRIPTION**

**cgD3D10IsProfileSupported** returns **CG\_TRUE** if the profile indicated by **profile** is supported by the cgD3D10 library.

**EXAMPLES**

```
// assuming the program requires Shader Model 3.0 ...

if ((!cgD3D10IsProfileSupported(CG_PROFILE_VS_3_0)) ||
    (!cgD3D10IsProfileSupported(CG_PROFILE_PS_3_0))) {
    fprintf(stderr, "Sorry, required profiles not supported on this system.\n");
    exit(1);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D10IsProfileSupported** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10GetLatestPixelProfile, cgD3D10GetLatestVertexProfile

**NAME**

**cgD3D10IsProgramLoaded** – determine if a program has been loaded

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>
```

```
CGbool cgD3D10IsProgramLoaded( CGprogram program );
```

**PARAMETERS**

program The program which will be checked.

**RETURN VALUES**

Returns **CG\_TRUE** if **program** has been loaded using cgD3D10LoadProgram.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgD3D10IsProgramLoaded** determines if a program has been loaded using cgD3D10LoadProgram.

**EXAMPLES**

```
// program is a CGprogram initialized elsewhere
...
CGbool isLoaded = cgD3D10IsProgramLoaded(program);
```

**ERRORS**

None.

**HISTORY**

**cgD3D10IsProgramLoaded** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10LoadProgram

**NAME**

**cgD3D10LoadProgram** – create a D3D shader and enable the expanded interface routines

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

HRESULT cgD3D10LoadProgram( CGprogram program,
                           UINT flags );
```

**PARAMETERS**

**program** A program whose compiled output is used to create the D3D shader.

**flags** The flags to pass to **D3DXAssembleShader**. See the D3D documentation for a list of valid flags.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds or **program** has already been loaded.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D10LoadProgram** creates a D3D shader for a program and enables use of expanded interface routines for that program.

**cgD3D10LoadProgram** assembles the compiled Cg output for **program** using **D3DXAssembleShader** and then creates a D3D shader using **ID3D10Device::CreateVertexShader** or **ID3D10Device::CreatePixelShader** depending on the program's profile.

The D3D shader handle is not returned. If the shader handle is desired by the application, the expanded interface should not be used for that program.

**EXAMPLES**

```
// vertexProg is a CGprogram using a vertex profile
// pixelProg is a CGprogram using a pixel profile
...
HRESULT hr1 = cgD3D10LoadProgram(vertexProg, TRUE, D3DXASM_DEBUG);
HRESULT hr2 = cgD3D10LoadProgram(pixelProg, TRUE, 0);
```

**ERRORS**

**cgD3D10Failed** is generated if a D3D function returns an error.

**CGD3D10ERR\_INVALIDPROFILE** is returned if **program**'s profile is not a supported D3D profile.

**CGD3D10ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D10SetDevice**.

**HISTORY**

**cgD3D10LoadProgram** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10SetDevice**

**NAME**

**cgD3D10RegisterStates** – registers graphics pass states for CgFX files

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

void cgD3D10RegisterStates( CGcontext context );
```

**PARAMETERS**

context    The context in which to register the states.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D10RegisterStates** registers a set of states for passes in techniques in CgFX effect files. These states correspond to the set of D3D states that is relevant and/or useful to be set in passes in effect files. See the Cg User's Guide for complete documentation of the states that are made available after calling **cgD3D10RegisterStates**.

**EXAMPLES**

```
// register D3D10 states for this context

CGcontext context = cgCreateContext();
cgD3D10RegisterStates(context);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgD3D10RegisterStates** was introduced in Cg 2.1.

Starting with Cg 2.2, **cgD3D10RegisterStates** calls **cgSetStateLatestProfile** for program states it creates and registers the latest profile returned by **cgD3D10GetLatestVertexProfile**, **cgD3D10GetLatestGeometryProfile** or **cgD3D10GetLatestPixelProfile** for the appropriate program domain.

**SEE ALSO**

**cgCreateState**, **cgSetStateLatestProfile**, **cgSetPassState**, **cgResetPassState**, **cgCallStateValidateCallback**, **cgGLRegisterStates**, **cgD3D9RegisterStates**

**NAME****cgD3D10SetDevice** – set the D3D device**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

HRESULT cgD3D10SetDevice( CGcontext context,
                          ID3D10Device * device );
```

**PARAMETERS**

**context** The context in which to set the current device.

**device** Pointer to an **ID3D10Device** interface that the expanded interface will use for any D3D-specific routine it may call. This parameter can be **NULL** to free all D3D resources used by the expanded interface and remove its reference to the D3D device.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D10SetDevice** informs the expanded interface of the new D3D device. This will destroy any D3D resources for programs previously loaded with **cgD3D10LoadProgram** and use the new D3D device to recreate them. The expanded interface will increment the reference count to the D3D device, so this function must eventually be called with **NULL** to release that reference so D3D can be properly shut down.

If **device** is **NULL**, all D3D resources for programs previously loaded with **cgD3D10LoadProgram** are destroyed. However, these programs are still considered managed by the expanded interface, so if a new D3D device is set later these programs will be recreated using the new D3D device.

If a new device is being set, all D3D resources for programs previously loaded with **cgD3D10LoadProgram** are rebuilt using the new device. All shadowed parameters for these programs are maintained across D3D device changes except texture parameters. Since textures in D3D are bound to a particular D3D device, these resources cannot be saved across device changes. When these textures are recreated for the new D3D device, they must be re-bound to the sampler parameter.

Note that calling **cgD3D10SetDevice(NULL)** does not destroy any core runtime resources (**CGprograms**, **CGparameters**, etc.) used by the expanded interface. These must be destroyed separately using **cgDestroyProgram** and **cgDestroyContext**.

**EXAMPLES**

```
// pDev is an ID3D10Device interface initialized elsewhere
...
cgD3D10SetDevice(pDev);
```

**ERRORS**

**cgD3D10Failed** is generated if a D3D function returns an error.

**HISTORY**

**cgD3D10SetDevice** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10GetDevice**, **cgDestroyProgram**, **cgDestroyContext**, **cgD3D10LoadProgram**

## NAME

**cgD3D10SetManageTextureParameters** – set the manage texture parameters flag for a context

## SYNOPSIS

```
#include <Cg/cgD3D10.h>

void cgD3D10SetManageTextureParameters( CGcontext context,
                                         CGbool flag );
```

## PARAMETERS

context The context in which the automatic texture management behavior will be changed.

flag A boolean switch which controls automatic texture management by the runtime.

## RETURN VALUES

None.

## DESCRIPTION

By default, cgD3D10 does not manage any texture state in D3D. It is up to the user to enable and disable textures using D3D. This behavior is the default to avoid conflicts with texture state on geometry that's rendered with the fixed function pipeline or without cgD3D10.

If automatic texture management is desired, **cgD3D10SetManageTextureParameters** may be called with flag set to **CG\_TRUE** before cgD3D10BindProgram is called. Whenever cgD3D10BindProgram is called, the cgD3D10 runtime will make all the appropriate texture parameter calls on the application's behalf.

Calling **cgD3D10SetManageTextureParameters** with flag set to **CG\_FALSE** will disable automatic texture management.

NOTE: When **cgD3D10SetManageTextureParameters** is set to **CG\_TRUE**, applications should not make texture state change calls to D3D after calling cgD3D10BindProgram, unless the application is trying to override some parts of cgD3D10's texture management.

## EXAMPLES

```
// Enable automatic texture management
cgD3D10SetManageTextureParameters( pCtx, CG_TRUE );
```

## ERRORS

None.

## HISTORY

**cgD3D10SetManageTextureParameters** was introduced in Cg 2.1.

## SEE ALSO

cgD3D10GetManageTextureParameters, cgD3D10BindProgram



**NAME**

**cgD3D10SetSamplerStateParameter** – Sets a sampler state object to a Cg sampler parameter.

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

void cgD3D10SetSamplerStateParameter( CGparameter param,
                                       ID3D10SamplerState * samplerState );
```

**PARAMETERS**

param     The sampler parameter whose state is to be set.

samplerState  
          The D3D sampler state to set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D10SetSamplerStateParameter** sets the sampler state associated with a sampler parameter.

NULL means default sampler state.

**EXAMPLES**

```
ID3D10SamplerState * sstate = NULL; Device->CreateSamplerState( &samplerDesc, &sstate );
cgD3D10SetSamplerStateParameter( myCgSamplerParam, sstate );
```

**ERRORS**

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is invalid.

**HISTORY**

**cgD3D10SetSamplerStateParameter** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10SetTextureSamplerStateParameter

**NAME**

**cgD3D10SetTextureParameter** – sets the value of a texture parameter

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

void cgD3D10SetTextureParameter( CGparameter param,
                                   ID3D10Resource * texture );
```

**PARAMETERS**

param    The texture parameter that will be set.  
texture   An D3D texture to which the parameter will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D10SetTextureParameter** sets the value of a texture parameter to a given D3D10 texture object.

**EXAMPLES**

```
ID3D10Resource *myTexture;  
// Assume myTexture is loaded here...  
  
// .. and param is an effect sampler parameter  
cgD3D10SetTextureParameter( param, myTexture );
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if param is not a valid parameter handle.

**HISTORY**

**cgD3D10SetTextureParameter** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10SetManageTextureParameters

cgD3D10SetTextureSamplerStateParameter(Cg Direct3D10 Runtime API) ID3D10SetTextureSamplerStateParameter(3)

## NAME

**cgD3D10SetTextureSamplerStateParameter** – Sets a texture resource and sampler state object to a Cg sampler parameter.

## SYNOPSIS

```
#include <Cg/cg.h>

void cgD3D10SetTextureSamplerStateParameter( CGparameter param,
                                              ID3D10Resource * texture,
                                              ID3D10SamplerState * samplerState );
```

## PARAMETERS

param     The sampler parameter whose texture and state is to be set.  
texture    The texture resource object being set.  
samplerState  
           The sampler state object being set.

## RETURN VALUES

None.

## DESCRIPTION

**cgD3D10SetTextureSamplerStateParameter** accomplishes the same thing as calling both **cgD3D10SetTextureParameter** and **cgD3D10SetSamplerStateParameter** together.

## EXAMPLES

```
ID3D10Resource * myTexture; ID3D10SamplerState * mySamplerState;

Device->CreateTexture2D( &desc, &initialData, &myTexture ); Device->CreateSamplerState( &desc,
&mySamplerState );

cgD3D10SetTextureSamplerStateParameter( myCgSamplerParam, myTexture, mySamplerState );
```

## ERRORS

**CG\_INVALID\_PARAMETER\_ERROR** is generated if **param** is invalid.

## HISTORY

**cgD3D10SetTextureSamplerStateParameter** was introduced in Cg 2.1.

## SEE ALSO

**cgD3D10SetTextureParameter**, **cgD3D10SetSamplerStateParameter**

**NAME**

**cgD3D10TranslateCError** – convert a Cg runtime error into a string

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

const char * cgD3D10TranslateCError( CError error );
```

**PARAMETERS**

**error**     The error code to translate. Can be a core runtime error or a D3D runtime error.

**RETURN VALUES**

Returns a pointer to a string describing **error**.

**DESCRIPTION**

**cgD3D10TranslateCError** converts a Cg runtime error into a string. This routine should be called instead of the core runtime routine `cgGetErrorString` because it will also translate errors that the Cg D3D runtime generates.

This routine will typically be called in debugging situations such as inside an error callback set using `cgSetErrorCallback`.

**EXAMPLES**

```
char buf[512];
CError error = cgGetLastError();
if (error != CG_NO_ERROR)
{
    sprintf(buf, "An error occurred. Error description: '%s'\n",
            cgD3D10TranslateCError(error));
    OutputDebugString(buf);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D10TranslateCError** was introduced in Cg 2.1.

**SEE ALSO**

`cgGetErrorString`, `cgSetErrorCallback`

**NAME**

**cgD3D10TranslateHRESULT** – convert an HRESULT into a string

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

const char * cgD3D10TranslateHRESULT( HRESULT hr );
```

**PARAMETERS**

hr        The **HRESULT** to translate. Can be a generic **HRESULT** or a D3D runtime error.

**RETURN VALUES**

Returns a pointer to a string describing the error.

**DESCRIPTION**

**cgD3D10TranslateHRESULT** converts an **HRESULT** into a string. This routine should be called instead of **DXGetErrorDescription10** because it will also translate errors that the Cg D3D runtime generates.

This routine will typically be called in debugging situations such as inside an error callback set using **cgSetErrorCallback**.

**EXAMPLES**

```
char buf[512];
HRESULT hres = cgD3D10GetLastError();
if (FAILED(hres))
{
    sprintf(buf, "A D3D error occurred. Error description: '%s'\n",
            cgD3D10TranslateHRESULT(hres));
    OutputDebugString(buf);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D10TranslateHRESULT** was introduced in Cg 2.1.

**SEE ALSO**

**cgD3D10TranslateCError**, **cgGetErrorString**, **cgSetErrorCallback**

**NAME**

**cgD3D10TypeToSize** – get the size of a CGtype enumerated type

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

DWORD cgD3D10TypeToSize( CGtype type );
```

**PARAMETERS**

type      Member of the **CGtype** enumerated type whose size is to be returned.

**RETURN VALUES**

Returns the size of **type** in terms of consecutive floating point values.

Returns **0** if the type does not have an inherent size. Sampler types fall into this category.

**DESCRIPTION**

**cgD3D10TypeToSize** retrieves the size of a **CGtype** enumerated type in terms of consecutive floating point values.

If the type does not have an inherent size, the return value is 0. Sampler types fall into this category.

**EXAMPLES**

```
// param is a CGparameter initialized earlier
...
DWORD size = cgD3D10TypeToSize(cgGetParameterType(param));

// (sanity check that parameters have the expected size)
...
assert(cgD3D10TypeToSize(cgGetParameterType(vsModelView)) == 16);
assert(cgD3D10TypeToSize(cgGetParameterType(psColor)) == 4);
```

**ERRORS**

None.

**HISTORY**

**cgD3D10TypeToSize** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10SetDevice

**NAME**

**cgD3D10UnloadProgram** – Unloads a D3D shader from the runtime data structures

**SYNOPSIS**

```
#include <Cg/cgD3D10.h>

void cgD3D10UnloadProgram( CGprogram Program );
```

**PARAMETERS**

Program A program whose compiled output is used to create the D3D shader.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D10UnloadProgram** Unloads a D3D shader from the runtime data structures.

**EXAMPLES**

```
// vertexProg is a CGprogram using a vertex profile
...
cgD3D10UnloadProgram( vertexProg );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if Program is not a valid program.

**HISTORY**

**cgD3D10UnloadProgram** was introduced in Cg 2.1.

**SEE ALSO**

cgD3D10LoadProgram

**NAME**

**cgD3D9BindProgram** – activate a program with D3D

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

HRESULT cgD3D9BindProgram( CGprogram program );
```

**PARAMETERS**

**program** The program to activate with D3D.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9BindProgram** activates a program with D3D. The program is activated using **IDirect3DDevice9::SetVertexShader** or **IDirect3DDevice9::SetPixelShader** depending on the program's profile type.

D3D allows only one vertex shader and one pixel shader to be active at any given time, so activating a program of a given type implicitly deactivates any other program of a that type.

If parameter shadowing is enabled for **program**, this call will set the D3D state for all shadowed parameters associated with **program**. If a parameter associated with **program** has not been shadowed when this function is called, the D3D state associated with that parameter is not modified.

If parameter shadowing is disabled, only the D3D shader is activated, and no other D3D state is modified.

**EXAMPLES**

```
// vertexProg and pixelProg are CGprograms initialized elsewhere
// pDev is an IDirect3DDevice9 interface intialized elsewhere
...
HRESULT hr = cgD3D9BindProgram(vertexProg);
HRESULT hr2 = cgD3D9BindProgram(pixelProg);
// Draw a quad using the vertex and pixel shader
// A vertex and index buffer are set up elsewhere.
HRESULT hr3 = pDev->DrawIndexedPrimitive(D3DPT_TRIANGLELIST, 0, 4, 0, 2);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**HISTORY**

**cgD3D9BindProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9LoadProgram**, **cgD3D9EnableParameterShadowing**, **cgD3D9IsParameterShadowingEnabled**, **cgD3D9SetUniform**, **cgD3D9SetUniformMatrix**, **cgD3D9SetTextureParameter**



**NAME**

**cgD3D9EnableDebugTracing** – enable or disable debug output

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

void cgD3D9EnableDebugTracing( CGbool enable );
```

**PARAMETERS**

enable    A boolean switch which controls debugging output by the library.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D9EnableDebugTracing** enables or disables debug output for an application when using the debug DLL.

If an error callback is registered, breakpoints can be set for Debug DLL debug traces by testing the result of **cgGetError** for **cgD3D9DebugTrace**. Breakpoints can be set for D3D errors by testing for **cgD3D9Failed** and using **cgD3D9GetLastError** to determine the particular D3D error that occurred.

**EXAMPLES**

```
cgD3D9EnableDebugTracing(CG_TRUE);
// use code to be debugged
...
cgD3D9EnableDebugTracing(CG_FALSE);
```

**ERRORS**

None.

**HISTORY**

**cgD3D9EnableDebugTracing** was introduced in Cg 1.1.

**SEE ALSO**

**cgSetErrorCallback**, **cgGetError**, **cgD3D9GetLastError**

**NAME**

**cgD3D9EnableParameterShadowing** – enable or disable parameter shadowing for a program

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9EnableParameterShadowing( CGprogram program,
                                          CGbool enable );
```

**PARAMETERS**

**program** The program in which to set the parameter shadowing state.

**enable** A boolean switch which controls parameter shadowing for **program**.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9EnableParameterShadowing** enables or disables parameter shadowing for a program.

If parameter shadowing is enabled for a program, any call to set the value of a parameter for that program does not set any D3D state. Instead it merely shadows the value so it can be set during a subsequent call to **cgD3D9BindProgram**.

If parameter shadowing is disabled, these calls immediately sets the D3D state and do not shadow the value.

When using this call to disable parameter shadowing, all shadowed parameters for that program are immediately invalidated. No D3D calls are made, so any active program retains its current D3D state. However, subsequent calls to **cgD3D9BindProgram** for that program will not apply any shadowed state. Parameter shadowing for the program will continue to be disabled until explicitly enabled with another call to **cgD3D9EnableParameterShadowing**.

Parameter shadowing can also be specified during a call to **cgD3D9LoadProgram**.

**EXAMPLES**

```
// prog is a CGprogram initialized elsewhere
...
HRESULT hres = cgD3D9EnableParameterShadowing(prog, CG_FALSE);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**HISTORY**

**cgD3D9EnableParameterShadowing** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9IsParameterShadowingEnabled**, **cgD3D9LoadProgram**

**NAME**

**cgD3D9GetDevice** – retrieves the current D3D9 device associated with the runtime

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
IDirect3DDevice9 * cgD3D9GetDevice( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the current D3D9 device associated with the runtime.

**DESCRIPTION**

**cgD3D9GetDevice** retrieves the current D3D9 device associated with the runtime. Note that the returned device pointer may be **NULL**.

**EXAMPLES**

```
IDirect3DDevice9* curDevice = cgD3D9GetDevice();
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetDevice** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9SetDevice

**NAME**

**cgD3D9GetLastError** – get the last D3D error that occurred

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9GetLastError( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the last D3D error that occurred during an expanded interface function call.

Returns **D3D\_OK** if no D3D error has occurred since the last call to **cgD3D9GetLastError**.

**DESCRIPTION**

**cgD3D9GetLastError** retrieves the last D3D error that occurred during an expanded interface function call. The last error is always cleared immediately after the call.

**EXAMPLES**

```
HRESULT lastError = cgD3D9GetLastError();
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetLastError** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9TranslateHRESULT

**NAME**

**cgD3D9GetLatestPixelProfile** – get the latest supported pixel shader version

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
CGprofile cgD3D9GetLatestPixelProfile( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the latest pixel shader version supported by the current D3D device.

Returns **CG\_PROFILE\_UNKNOWN** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D9GetLatestPixelProfile** retrieves the latest pixel shader version that the current D3D device supports. This is an expanded interface function because it needs to know about the D3D device to determine the most current version supported.

Starting in Cg 2.2, if the environment variable **CGD3D9\_LATEST\_PIXEL\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), then it is this **CGprofile** value that will be returned by **cgD3D9GetLatestPixelProfile**.

**EXAMPLES**

```
CGprofile bestPixelProfile = cgD3D9GetLatestPixelProfile();
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetLatestPixelProfile** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9GetLatestVertexProfile**

**NAME**

**cgD3D9GetLatestVertexProfile** – get the latest supported vertex shader version

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

CGprofile cgD3D9GetLatestVertexProfile( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

Returns the latest vertex shader version supported by the current D3D device.

Returns **CG\_PROFILE\_UNKNOWN** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D9GetLatestVertexProfile** retrieves the latest vertex shader version that the current D3D device supports. This is an expanded interface function because it needs to know about the D3D device to determine the most current version supported.

Starting in Cg 2.2, if the environment variable **CGD3D9\_LATEST\_VERTEX\_PROFILE** is set in the application's environment to a string that **cgGetProfile** translates to a valid profile (meaning not **CG\_PROFILE\_UNKNOWN**), then it is this **CGprofile** value that will be returned by **cgD3D9GetLatestVertexProfile**.

**EXAMPLES**

```
CGprofile bestVertexProfile = cgD3D9GetLatestVertexProfile();
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetLatestVertexProfile** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9GetLatestPixelProfile**

## NAME

**cgD3D9GetManageTextureParameters** – get the manage texture parameters flag from a context

## SYNOPSIS

```
#include <Cg/cgD3D9.h>
```

```
CGbool cgD3D9GetManageTextureParameters( CGcontext context );
```

## PARAMETERS

context The context from which the automatic texture management setting will be retrieved.

## RETURN VALUES

Returns the manage texture management flag from **context**.

## DESCRIPTION

**cgD3D9GetManageTextureParameters** returns the manage texture management flag from context. See **cgD3D9SetManageTextureParameters** for more information.

## EXAMPLES

```
CGbool manage = cgD3D9GetManageTextureParameters( pCtx );
if( manage )
    doSomething();
```

## ERRORS

None.

## HISTORY

**cgD3D9GetManageTextureParameters** was introduced in Cg 1.5.

## SEE ALSO

**cgD3D9SetManageTextureParameters**

**NAME**

**cgD3D9GetOptimalOptions** – get the best set of compiler options for a profile

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
char const ** cgD3D9GetOptimalOptions( CGprofile profile );
```

**PARAMETERS**

profile    The profile whose optimal arguments are requested.

**RETURN VALUES**

Returns a null-terminated array of strings representing the optimal set of compiler options for **profile**.

Returns **NULL** if no D3D device is currently set.

**DESCRIPTION**

**cgD3D9GetOptimalOptions** returns the best set of compiler options for a given profile. This is an expanded interface function because it needs to know about the D3D device to determine the most optimal options.

The elements of the returned array are meant to be used as part of the **args** parameter to **cgCreateProgram** or **cgCreateProgramFromFile**.

The returned string does not need to be destroyed by the application. However, the contents could change if the function is called again for the same profile but a different D3D device.

**EXAMPLES**

```
const char* vertOptions[] = { myCustomArgs,
                              cgD3D9GetOptimalOptions(vertProfile),
                              NULL };

// create the vertex shader
CGprogram myVS = cgCreateProgramFromFile( context,
                                          CG_SOURCE,
                                          "vshader.cg",
                                          vertProfile,
                                          "VertexShader",
                                          vertOptions );
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetOptimalOptions** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9GetLatestVertexProfile,                      cgD3D9GetLatestPixelProfile,                      cgCreateProgram,  
cgCreateProgramFromFile



**NAME**

**cgD3D9GetTextureParameter** – get the value of a texture parameter

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
IDirect3DBaseTexture9 * cgD3D9GetTextureParameter( CGparameter param );
```

**PARAMETERS**

**param**    The texture parameter for which the D3D texture object will be retrieved.

**RETURN VALUES**

Returns a pointer to the D3D texture to which **param** was set.

Return **NULL** if **param** has not been set.

**DESCRIPTION**

**cgD3D9GetTextureParameter** returns the D3D texture pointer to which a texture parameter was set using **cgD3D9SetTextureParameter**. If the parameter has not been set, the **NULL** will be returned.

**EXAMPLES**

```
// param is a texture parameter defined elsewhere...
```

```
HRESULT hr = cgD3D9SetTexture( param, cgD3D9GetTextureParameter( param ) );
```

**ERRORS**

None.

**HISTORY**

**cgD3D9GetTextureParameter** was introduced in Cg 1.5.

**SEE ALSO**

**cgD3D9SetTextureParameter**

**NAME**

**cgD3D9GetVertexDeclaration** – get the default vertex declaration stream

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
CGbool cgD3D9GetVertexDeclaration( CGprogram program,
                                   D3DVERTEXELEMENT9 decl[MAXD3DDECLLENGTH] );
```

**PARAMETERS**

program The program from which to retrieve the vertex declaration.

decl A **D3DVERTEXELEMENT9** array that will be filled with the D3D9 vertex declaration.

**RETURN VALUES**

Returns **CG\_TRUE** on success.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgD3D9GetVertexDeclaration** retrieves the default vertex declaration stream for a program. The declaration always uses a tightly packed single stream. The stream is always terminated with **D3DDECL\_END()**, so this can be used to determine the actual length of the returned declaration.

The default vertex declaration is always a single stream. There will be one **D3DVERTEXELEMENT9** element for each varying input parameter.

If you want to use a custom vertex declaration, you can test that declaration for compatibility by calling **cgD3D9ValidateVertexDeclaration**.

**EXAMPLES**

For example:

```
void main( in float4 pos : POSITION,
           in float4 dif : COLOR0,
           in float4 tex : TEXCOORD0,
           out float4 hpos : POSITION );
```

would have this default vertex declaration:

```
const D3DVERTEXELEMENT9 decl[] = {
    { 0, 0, D3DDECLTYPE_FLOAT4, D3DDECLMETHOD_DEFAULT, D3DDECLUSAGE_POSITION, 0 },
    { 0, 16, D3DDECLTYPE_FLOAT4, D3DDECLMETHOD_DEFAULT, D3DDECLUSAGE_COLOR, 0 },
    { 0, 32, D3DDECLTYPE_FLOAT4, D3DDECLMETHOD_DEFAULT, D3DDECLUSAGE_TEXCOORD, 0 },
    D3DDECL_END()
};
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if program is not a valid program handle.

**HISTORY**

**cgD3D9GetVertexDeclaration** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9ValidateVertexDeclaration**

## NAME

**cgD3D9IsParameterShadowingEnabled** – determine if parameter shadowing is enabled

## SYNOPSIS

```
#include <Cg/cgD3D9.h>
```

```
CGbool cgD3D9IsParameterShadowingEnabled( CGprogram program );
```

## PARAMETERS

**program** The program to check for parameter shadowing.

## RETURN VALUES

Returns **CG\_TRUE** if parameter shadowing is enabled for **program**.

Returns **CG\_FALSE** otherwise.

## DESCRIPTION

**cgD3D9IsParameterShadowingEnabled** determines if parameter shadowing is enabled for **program**.

## EXAMPLES

```
// program is a CGprogram initialized elsewhere
...
CGbool isShadowing = cgD3D9IsParameterShadowingEnabled(program);
```

## ERRORS

None.

## HISTORY

**cgD3D9IsParameterShadowingEnabled** was introduced in Cg 1.1.

## SEE ALSO

cgD3D9EnableParameterShadowing, cgD3D9LoadProgram

**NAME**

**cgD3D9IsProfileSupported** – determine if a profile is supported by cgD3D9

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

CGbool cgD3D9IsProfileSupported( CGprofile profile );
```

**PARAMETERS**

profile    The profile which will be checked for support.

**RETURN VALUES**

Returns **CG\_TRUE** if **profile** is supported by the cgD3D9 library.

Returns **CG\_FALSE** otherwise.

However if cgD3D9SetDevice has not been called to register a IDirect3DDevice9 device yet, this routine returns **CG\_TRUE** for all valid D3D9 profiles.

**DESCRIPTION**

**cgD3D9IsProfileSupported** returns **CG\_TRUE** if the profile indicated by **profile** is supported by the cgD3D9 library.

**EXAMPLES**

```
// assuming the program requires Shader Model 3.0 ...

if ((!cgD3D9IsProfileSupported(CG_PROFILE_VS_3_0)) ||
    (!cgD3D9IsProfileSupported(CG_PROFILE_PS_3_0))) {
    fprintf(stderr, "Sorry, required profiles not supported on this system.\n");
    exit(1);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D9IsProfileSupported** was introduced in Cg 1.5.

**SEE ALSO**

cgD3D9GetLatestPixelProfile, cgD3D9GetLatestVertexProfile

**NAME**

**cgD3D9IsProgramLoaded** – determine if a program has been loaded

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
CGbool cgD3D9IsProgramLoaded( CGprogram program );
```

**PARAMETERS**

program The program which will be checked.

**RETURN VALUES**

Returns **CG\_TRUE** if **program** has been loaded using **cgD3D9LoadProgram**.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgD3D9IsProgramLoaded** determines if a program has been loaded using **cgD3D9LoadProgram**.

**EXAMPLES**

```
// program is a CGprogram initialized elsewhere
...
CGbool isLoaded = cgD3D9IsProgramLoaded(program);
```

**ERRORS**

None.

**HISTORY**

**cgD3D9IsProgramLoaded** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9LoadProgram**

**NAME**

**cgD3D9LoadProgram** – create a D3D shader and enable the expanded interface routines

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

HRESULT cgD3D9LoadProgram( CGprogram program,
                           CGbool paramShadowing,
                           DWORD assemFlags );
```

**PARAMETERS**

**program** A program whose compiled output is used to create the D3D shader.

**paramShadowing**

Indicates if parameter shadowing is desired for **program**.

**assemFlags**

The flags to pass to **D3DXAssembleShader**. See the D3D documentation for a list of valid flags.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds or **program** has already been loaded.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9LoadProgram** creates a D3D shader for a program and enables use of expanded interface routines for that program.

**cgD3D9LoadProgram** assembles the compiled Cg output for **program** using **D3DXAssembleShader** and then creates a D3D shader using **IDirect3DDevice9::CreateVertexShader** or **IDirect3DDevice9::CreatePixelShader** depending on the program's profile.

Parameter shadowing is enabled or disabled for the program with **paramShadowing**. This behavior can be changed after creating the program by calling **cgD3D9EnableParameterShadowing**.

The D3D shader handle is not returned. If the shader handle is desired by the application, the expanded interface should not be used for that program.

**EXAMPLES**

```
// vertexProg is a CGprogram using a vertex profile
// pixelProg is a CGprogram using a pixel profile
...
HRESULT hr1 = cgD3D9LoadProgram(vertexProg, TRUE, D3DXASM_DEBUG);
HRESULT hr2 = cgD3D9LoadProgram(pixelProg, TRUE, 0);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_INVALIDPROFILE** is returned if **program**'s profile is not a supported D3D profile.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**HISTORY**

**cgD3D9LoadProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9EnableParameterShadowing**, **cgD3D9ValidateVertexDeclaration**, **cgD3D9SetDevice**

**NAME**

**cgD3D9RegisterStates** – registers graphics pass states for CgFX files

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

void cgD3D9RegisterStates( CGcontext context );
```

**PARAMETERS**

context    The context in which to register the states.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D9RegisterStates** registers a set of states for passes in techniques in CgFX effect files. These states correspond to the set of D3D states that is relevant and/or useful to be set in passes in effect files. See the Cg User's Guide for complete documentation of the states that are made available after calling **cgD3D9RegisterStates**.

**EXAMPLES**

```
// register D3D9 states for this context

CGcontext = cgCreateContext();
cgD3D9RegisterStates(context);
```

**ERRORS**

**CG\_INVALID\_CONTEXT\_HANDLE\_ERROR** is generated if **context** is not a valid context.

**HISTORY**

**cgD3D9RegisterStates** was introduced in Cg 1.5.

Starting with Cg 2.2, when **cgD3D9RegisterStates** creates program states it calls **cgSetStateLatestProfile** to register the latest profile for the appropriate program domain. The latest profile value is determined via **cgD3D9GetLatestVertexProfile** or **cgD3D9GetLatestPixelProfile**

**SEE ALSO**

**cgCreateState**, **cgSetStateLatestProfile**, **cgSetPassState**, **cgResetPassState**, **cgCallStateValidateCallback**, **cgGLRegisterStates**, **cgD3D10RegisterStates**

**NAME**

**cgD3D9ResourceToDeclUsage** – get the D3DDECLUSAGE member associated with a resource

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
BYTE cgD3D9ResourceToDeclUsage( CGresource resource );
```

**PARAMETERS**

resource Enumerated type indicating the resource to convert to a **D3DDECLUSAGE**.

**RETURN VALUES**

Returns the **D3DDECLUSAGE** member associated with **resource**. This is generally the **CGresource** name with the index stripped off.

Returns CGD3D9\_INVALID\_USAGE if the resource is not a vertex shader input resource.

**DESCRIPTION**

**cgD3D9ResourceToDeclUsage** converts a **CGresource** enumerated type to a member of the **D3DDECLUSAGE** enum. The returned type is not an explicit member of the enum to match the associated member of the **D3DVERTEXELEMENT9** struct, and also to allow for an error return condition.

The returned value can be used as the **Usage** member of the **D3DVERTEXELEMENT9** struct to create a vertex declaration for a shader. See the D3D9 documentation for the full details on declaring vertex declarations in D3D9.

**EXAMPLES**

```
D3DVERTEXELEMENT9 elt =
{
    0, 0,
    D3DDECLTYPE_FLOAT3,
    D3DDECLMETHOD_DEFAULT,
    cgD3D9ResourceToDeclUsage( CG_TEXCOORD3 ),
    cgD3D9GetParameterResourceIndex( CG_TEXCOORD3 )
};
```

**ERRORS**

None.

**HISTORY**

**cgD3D9ResourceToDeclUsage** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9GetVertexDeclaration, cgD3D9ValidateVertexDeclaration



**NAME**

**cgD3D9SetDevice** – set the D3D device

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetDevice( IDirect3DDevice9 * device );
```

**PARAMETERS**

**device** Pointer to an **IDirect3DDevice9** interface that the expanded interface will use for any D3D-specific routine it may call. This parameter can be **NULL** to free all D3D resources used by the expanded interface and remove its reference to the D3D device.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetDevice** informs the expanded interface of the new D3D device. This will destroy any D3D resources for programs previously loaded with **cgD3D9LoadProgram** and use the new D3D device to recreate them. The expanded interface will increment the reference count to the D3D device, so this function must eventually be called with **NULL** to release that reference so D3D can be properly shut down.

If **device** is **NULL**, all D3D resources for programs previously loaded with **cgD3D9LoadProgram** are destroyed. However, these programs are still considered managed by the expanded interface, so if a new D3D device is set later these programs will be recreated using the new D3D device.

If a new device is being set, all D3D resources for programs previously loaded with **cgD3D9LoadProgram** are rebuilt using the new device. All shadowed parameters for these programs are maintained across D3D device changes except texture parameters. Since textures in D3D are bound to a particular D3D device, these resources cannot be saved across device changes. When these textures are recreated for the new D3D device, they must be re-bound to the sampler parameter.

Note that calling **cgD3D9SetDevice(NULL)** does not destroy any core runtime resources (**CGprograms**, **CGparameters**, etc.) used by the expanded interface. These must be destroyed separately using **cgDestroyProgram** and **cgDestroyContext**.

**EXAMPLES**

```
// pDev is an IDirect3DDevice9 interface initialized elsewhere
...
cgD3D9SetDevice(pDev);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**HISTORY**

**cgD3D9SetDevice** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9GetDevice**, **cgDestroyProgram**, **cgDestroyContext**, **cgD3D9LoadProgram**

**NAME**

**cgD3D9SetManageTextureParameters** – set the manage texture parameters flag for a context

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

void cgD3D9SetManageTextureParameters( CGcontext context,
                                         CGbool flag );
```

**PARAMETERS**

context The context in which the automatic texture management behavior will be changed.

flag A boolean switch which controls automatic texture management by the runtime.

**RETURN VALUES**

None.

**DESCRIPTION**

By default, cgD3D9 does not manage any texture state in D3D. It is up to the user to enable and disable textures using D3D. This behavior is the default to avoid conflicts with texture state on geometry that's rendered with the fixed function pipeline or without cgD3D9.

If automatic texture management is desired, **cgD3D9SetManageTextureParameters** may be called with flag set to **CG\_TRUE** before cgD3D9BindProgram is called. Whenever cgD3D9BindProgram is called, the cgD3D9 runtime will make all the appropriate texture parameter calls on the application's behalf.

Calling **cgD3D9SetManageTextureParameters** with flag set to **CG\_FALSE** will disable automatic texture management.

NOTE: When **cgD3D9SetManageTextureParameters** is set to **CG\_TRUE**, applications should not make texture state change calls to D3D after calling cgD3D9BindProgram, unless the application is trying to override some parts of cgD3D9's texture management.

**EXAMPLES**

```
// Enable automatic texture management
cgD3D9SetManageTextureParameters( pCtx, CG_TRUE );
```

**ERRORS**

None.

**HISTORY**

**cgD3D9SetManageTextureParameters** was introduced in Cg 1.5.

**SEE ALSO**

cgD3D9GetManageTextureParameters, cgD3D9BindProgram

**NAME**

**cgD3D9SetSamplerState** – set the state associated with a sampler parameter

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetSamplerState( CGparameter param,
                                D3DSAMPLERSTATETYPE type,
                                DWORD value );
```

**PARAMETERS**

param    The sampler parameter whose state is to be set.

type     The D3D sampler state to set.

value    A value appropriate for **type**. See the D3D documentation for appropriate values for each valid type.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetSamplerState** sets the state associated with a sampler parameter.

**EXAMPLES**

```
// param is a CGparameter handle of type sampler
...
// Set this sampler for tri-linear filtering
cgD3D9SetSamplerState(param, D3DSAMP_MAGFILTER, D3DTEXF_LINEAR);
cgD3D9SetSamplerState(param, D3DSAMP_MINFILTER, D3DTEXF_LINEAR);
cgD3D9SetSamplerState(param, D3DSAMP_MIPFILTER, D3DTEXF_LINEAR);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_INVALIDPROFILE** is returned if **params**'s profile is not a supported D3D profile.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTSAMPLER** is returned if **param** is not a sampler.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

**HISTORY**

**cgD3D9SetSamplerState** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9SetTexture**, **cgD3D9SetTextureWrapMode**

## NAME

**cgD3D9SetTexture** – set the texture for a sampler parameter

## SYNOPSIS

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetTexture( CGparameter param,
                          IDirect3DBaseTexture9 * texture );
```

## PARAMETERS

**param** The sampler parameter whose values are to be set.

**texture** Pointer to an **IDirect3DBaseTexture9**, the texture to set for **param**.

## RETURN VALUES

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

## DESCRIPTION

**cgD3D9SetTexture** sets the texture for a sampler parameter.

When parameter shadowing is enabled, the D3D runtime will maintain a reference (via **AddRef**) to **texture**, so care must be taken to set the parameter back to **NULL** when the texture is no longer needed. Otherwise the reference count will not reach zero and the texture's resources will not get destroyed. When destroying the program that the parameter is associated with, all references to these textures are automatically removed.

## EXAMPLES

```
// param is a CGparameter handle of type sampler
// tex is an IDirect3DTexture9* initialized elsewhere
...
cgD3D9SetTexture(param, tex);
```

## ERRORS

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_INVALIDPROFILE** is returned if **params**'s profile is not a supported D3D profile.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTSAMPLER** is returned if **param** is not a sampler.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

## HISTORY

**cgD3D9SetTexture** was introduced in Cg 1.1.

## SEE ALSO

**cgD3D9SetSamplerState**, **cgD3D9SetTextureWrapMode**

**NAME**

**cgD3D9SetTextureParameter** – sets the value of a texture parameter

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
void cgD3D9SetTextureParameter( CGparameter param,  
                                IDirect3DBaseTexture9 * texture );
```

**PARAMETERS**

param     The texture parameter that will be set.

texture   An D3D texture to which the parameter will be set.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D9SetTextureParameter** sets the value of a texture parameter to a given D3D9 texture object.

**cgD3D9SetTextureParameter** is to be used for setting texture parameters in a CgFX effect instead of `cgD3D9SetTexture`.

**EXAMPLES**

```
IDirect3DTexture9 *myTexture;  
// Assume myTexture is loaded here...  
  
// param is an effect sampler parameter  
cgD3D9SetTextureParameter( param, myTexture );
```

**ERRORS**

**CG\_INVALID\_PARAM\_HANDLE\_ERROR** is generated if param is not a valid parameter handle.

**HISTORY**

**cgD3D9SetTextureParameter** was introduced in Cg 1.5.

**SEE ALSO**

`cgD3D9GetTextureParameter`, `cgD3D9SetManageTextureParameters`

## NAME

**cgD3D9SetTextureWrapMode** – set the texture wrap mode for a sampler parameter

## SYNOPSIS

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetTextureWrapMode( CGparameter param,  
                                   DWORD value );
```

## PARAMETERS

**param** The sampler parameter whose wrap mode is to be set.

**value** The texture wrap mode. **value** can be zero (0) or a combination of **D3DWRAP\_U**, **D3DWRAP\_V**, and **D3DWRAP\_W**. See the D3D documentation for an explanation of texture wrap modes (**D3DRS\_WRAP0–7**).

## RETURN VALUES

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

## DESCRIPTION

**cgD3D9SetTextureWrapMode** sets the texture wrap mode associated with a sampler parameter.

## EXAMPLES

```
// param is a CGparameter handle of type sampler  
...  
// Set this sampler for wrapping in 2D  
cgD3D9SetTextureWrapMode(param, D3DWRAP_U | D3DWRAP_V);
```

## ERRORS

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_INVALIDPROFILE** is returned if **params**'s profile is not a supported D3D profile.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTSAMPLER** is returned if **param** is not a sampler.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

## HISTORY

**cgD3D9SetTextureWrapMode** was introduced in Cg 1.1.

## SEE ALSO

**cgD3D9SetTexture**, **cgD3D9SetSamplerState**

**NAME**

**cgD3D9SetUniform** – set the value of a uniform parameter

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

HRESULT cgD3D9SetUniform( CGparameter param,
                          const void * values );
```

**PARAMETERS**

- param** The parameter whose values are to be set. **param** must be a uniform parameter that is not a sampler.
- values** The values to which to set **param**. The amount of data required depends on the type of parameter, but is always specified as an array of one or more floating point values. The type is **void\*** so a compatible user-defined structure can be passed in without type-casting. Use `cgD3D9TypeToSize` to determine how many values are required for a particular type.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetUniform** sets the value for a uniform parameter. All values should be of type float. There is assumed to be enough values to set all elements of the parameter.

**EXAMPLES**

```
// param is a CGparameter handle of type float3
// matrixParam is a CGparameter handle of type float2x3
// arrayParam is a CGparameter handle of type float2x2[3]
...
// initialize the data for each parameter
D3DXVECTOR3 paramData(1,2,3);
float matrixData[2][3] =
{
    0,1,2,
    3,4,5
};
float arrayData[3][2][2] =
{
    0,1,
    2,3,
    4,5,
    6,7,
    8,9,
    0,1
};
...
// set the parameters
cgD3D9SetUniform(param, paramData);
cgD3D9SetUniform(matrixParam, matrixData);
// you can use arrays, but you must set the entire array
cgD3D9SetUniform(arrayParam, arrayData);
```

## ERRORS

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

## HISTORY

**cgD3D9SetUniform** was introduced in Cg 1.1.

## SEE ALSO

**cgD3D9SetUniformArray**, **cgD3D9SetUniformMatrix**, **cgD3D9SetUniformMatrixArray**,  
**cgD3D9TypeToSize**



**NAME**

**cgD3D9SetUniformArray** – set the elements of an array of uniform parameters

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetUniformArray( CGparameter param,
                                DWORD offset,
                                DWORD numItems,
                                const void * values );
```

**PARAMETERS**

- param**     The parameter whose array elements are to be set. It must be a uniform parameter that is not a sampler.
- offset**     The offset at which to start setting array elements.
- numItems**     The number of array elements to set.
- values**     An array of floats, the elements in the array to set for param. The amount of data required depends on the type of parameter, but is always specified as an array of one or more floating point values. The type is **void\*** so a compatible user-defined structure can be passed in without type-casting. Use `cgD3D9TypeToSize` to determine how many values are required for a particular type. This size multiplied by **numItems** is the number of values this function expects.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetUniformArray** sets the elements for an array of uniform parameters. All values should be of type float. There is assumed to be enough values to set all specified elements of the array.

**EXAMPLES**

```
// param is a CGparameter handle of type float3
// arrayParam is a CGparameter handle of type float2x2[3]
...
// initialize the data for each parameter
D3DXVECTOR3 paramData(1,2,3);
float arrayData[2][2][2] =
{
    0,1,
    2,3,
    4,5,
    6,7
};
...
// non-arrays can be set, but only when offset=0 and numItems=1.
cgD3D9SetUniformArray(param, paramData, 0, 1);
// set the 2nd and 3rd elements of the array
cgD3D9SetUniform(arrayParam, arrayData, 1, 2);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with `cgD3D9SetDevice`.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the `cgD3D9LoadProgram`.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_NULLVALUE** is returned if **values** is **NULL**.

**CGD3D9ERR\_OUTOFRANGE** is returned if **offset** plus **numItems** is out of the range of **param**.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

## HISTORY

`cgD3D9SetUniformArray` was introduced in Cg 1.1.

## SEE ALSO

`cgD3D9SetUniform`, `cgD3D9SetUniformMatrix`, `cgD3D9SetUniformMatrixArray`, `cgD3D9TypeToSize`

**NAME**

**cgD3D9SetUniformMatrix** – set the values of a uniform matrix parameter

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

HRESULT cgD3D9SetUniformMatrix( CGparameter param,
                                const D3DMATRIX * matrix );
```

**PARAMETERS**

**param**     The parameter whose values are to be set. It must be a uniform matrix parameter.

**matrix**     The matrix to set for the parameter. The upper-left portion of the matrix is extracted to fit the size of **param**.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetUniformMatrix** sets the values of a uniform matrix parameter.

**EXAMPLES**

```
// matrixParam is a CGparameter handle of type float3x2
// arrayParam is a CGparameter handle of type float4x4[2]
...
// initialize the data for each parameter
D3DXMATRIX matTexTransform(
    0.5f,    0, 0, 0,
    0, 0.5f, 0, 0,
    0.5f, 0.5f, 0, 0,
    0,    0, 0, 0
);
D3DXMATRIX matRot[2];
D3DXMatrixRotationAxis(&matRot[0], &D3DXVECTOR3(0,0,1), D3DX_PI*0.5f);
D3DXMatrixRotationAxis(&matRot[1], &D3DXVECTOR3(0,1,0), D3DX_PI*0.5f);
...
// only use the upper-left portion
cgD3D9SetUniform(matrixParam, &matTexTransform);
// you can use arrays, but you must set the entire array
cgD3D9SetUniform(arrayParam, matRot);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTMATRIX** is returned if **param** is not a matrix.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

**HISTORY**

**cgD3D9SetUniformMatrix** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9SetUniform, cgD3D9SetUniformMatrixArray, cgD3D9TypeToSize

**NAME**

**cgD3D9SetUniformMatrixArray** – set the elements for an array of uniform matrix parameters

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
HRESULT cgD3D9SetUniformMatrixArray( CGparameter param,
                                       DWORD offset,
                                       DWORD numItems,
                                       const D3DMATRIX * matrices );
```

**PARAMETERS**

**param** The parameter whose array elements are to be set. It must be a uniform matrix parameter.

**offset** The offset at which to start setting array elements.

**numItems**

The number of array elements to set.

**matrices** An array of matrices to set for **param**. The upper-left portion of each matrix is extracted to fit the size of the input parameter. **numItems** matrices are expected to be passed to the function.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9SetUniformMatrixArray** sets the elements for an array of uniform matrix parameters.

**EXAMPLES**

```
// matrixParam is a CGparameter handle of type float3x2
// arrayParam is a CGparameter handle of type float4x4[4]
...
// initialize the data for each parameter
D3DXMATRIX matTexTransform(
    0.5f,0,      0,0,
    0    ,0.5f,  0,0,
    0.5f,0.5f,   0,0,
    0    ,0,     0,0
);
D3DXMATRIX matRot[2];
D3DXMatrixRotationAxis(&matRot[0], &D3DXVECTOR3(0,0,1), D3DX_PI*0.5f);
D3DXMatrixRotationAxis(&matRot[1], &D3DXVECTOR3(0,1,0), D3DX_PI*0.5f);
...
// only use the upper-left portion.
// non-arrays can be set, but only when offset=0 and numItems=1.
cgD3D9SetUniformArray(matrixParam, &matTexTransform, 0, 1);
// set the 3rd and 4th elements of the array
cgD3D9SetUniformArray(arrayParam, matRot, 2, 2);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NOTMATRIX** is returned if **param** is not a matrix.

**CGD3D9ERR\_NOTUNIFORM** is returned if **param** is not a uniform parameter.

**CGD3D9ERR\_NULLVALUE** is returned if **matrices** is **NULL**.

**CGD3D9ERR\_OUTOFRANGE** is returned if **offset** plus **numItems** is out of the range of **param**.

**CGD3D9ERR\_INVALIDPARAM** is returned if the parameter fails to set for any other reason.

## HISTORY

**cgD3D9SetUniformMatrixArray** was introduced in Cg 1.1.

## SEE ALSO

cgD3D9SetUniform, cgD3D9SetUniformArray, cgD3D9SetUniformMatrix, cgD3D9TypeToSize

**NAME**

**cgD3D9TranslateCError** – convert a Cg runtime error into a string

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

const char * cgD3D9TranslateCError( CError error );
```

**PARAMETERS**

**error**     The error code to translate. Can be a core runtime error or a D3D runtime error.

**RETURN VALUES**

Returns a pointer to a string describing **error**.

**DESCRIPTION**

**cgD3D9TranslateCError** converts a Cg runtime error into a string. This routine should be called instead of the core runtime routine `cgGetErrorString` because it will also translate errors that the Cg D3D runtime generates.

This routine will typically be called in debugging situations such as inside an error callback set using `cgSetErrorCallback`.

**EXAMPLES**

```
char buf[512];
CError error = cgGetLastError();
if (error != CG_NO_ERROR)
{
    sprintf(buf, "An error occurred. Error description: '%s'\n",
            cgD3D9TranslateCError(error));
    OutputDebugString(buf);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D9TranslateCError** was introduced in Cg 1.1.

**SEE ALSO**

`cgGetErrorString`, `cgSetErrorCallback`

**NAME**

**cgD3D9TranslateHRESULT** – convert an HRESULT into a string

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

const char * cgD3D9TranslateHRESULT( HRESULT hr );
```

**PARAMETERS**

hr        The **HRESULT** to translate. Can be a generic **HRESULT** or a D3D runtime error.

**RETURN VALUES**

Returns a pointer to a string describing the error.

**DESCRIPTION**

**cgD3D9TranslateHRESULT** converts an **HRESULT** into a string. This routine should be called instead of **DXGetErrorDescription9** because it will also translate errors that the Cg D3D runtime generates.

This routine will typically be called in debugging situations such as inside an error callback set using **cgSetErrorCallback**.

**EXAMPLES**

```
char buf[512];
HRESULT hres = cgD3D9GetLastError();
if (FAILED(hres))
{
    sprintf(buf, "A D3D error occurred. Error description: '%s'\n",
            cgD3D9TranslateHRESULT(hres));
    OutputDebugString(buf);
}
```

**ERRORS**

None.

**HISTORY**

**cgD3D9TranslateHRESULT** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9TranslateCgError**, **cgGetErrorString**, **cgSetErrorCallback**



**NAME**

**cgD3D9TypeToSize** – get the size of a CGtype enumerated type

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

DWORD cgD3D9TypeToSize( CGtype type );
```

**PARAMETERS**

type      Member of the **CGtype** enumerated type whose size is to be returned.

**RETURN VALUES**

Returns the size of **type** in terms of consecutive floating point values.

Returns **0** if the type does not have an inherent size. Sampler types fall into this category.

**DESCRIPTION**

**cgD3D9TypeToSize** retrieves the size of a **CGtype** enumerated type in terms of consecutive floating point values.

If the type does not have an inherent size, the return value is 0. Sampler types fall into this category.

**EXAMPLES**

```
// param is a CGparameter initialized earlier
...
DWORD size = cgD3D9TypeToSize(cgGetParameterType(param));

// (sanity check that parameters have the expected size)
...
assert(cgD3D9TypeToSize(cgGetParameterType(vsModelView)) == 16);
assert(cgD3D9TypeToSize(cgGetParameterType(psColor)) == 4);
```

**ERRORS**

None.

**HISTORY**

**cgD3D9TypeToSize** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9ResourceToDeclUsage, cgD3D9GetVertexDeclaration, cgD3D9ValidateVertexDeclaration

**NAME**

**cgD3D9UnloadAllPrograms** – unload all D3D programs

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

void cgD3D9UnloadAllPrograms( void );
```

**PARAMETERS**

None.

**RETURN VALUES**

None.

**DESCRIPTION**

**cgD3D9UnloadAllPrograms** unloads all of the currently loaded D3D programs.

See `cgD3D9UnloadProgram` for details on what the runtime does when unloading a program.

**EXAMPLES**

```
// unload all D3D programs

cgD3D9UnloadAllPrograms( );
```

**ERRORS**

None.

**HISTORY**

**cgD3D9UnloadAllPrograms** was introduced in Cg 1.5.

**SEE ALSO**

`cgD3D9UnloadProgram`

**NAME**

**cgD3D9UnloadProgram** – destroy D3D shader and disable use of expanded interface routines

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>

HRESULT cgD3D9UnloadProgram( CGprogram program );
```

**PARAMETERS**

**program** The program for which to disable expanded interface management. The **CGprogram** handle is still valid after this call.

**RETURN VALUES**

Returns **D3D\_OK** if the function succeeds.

Returns the D3D failure code if the function fails due to a D3D call.

**DESCRIPTION**

**cgD3D9UnloadProgram** destroys the D3D shader for a program and disables use of expanded interface routines for that program.

This call does not destroy the **CGprogram** itself. It only destroys the resources used by the expanded interface, such as the D3D shader object and any shadowed parameters. Use the core runtime function **cgDestroyProgram** to free the **CGprogram** itself. Also note that freeing a **CGprogram** using the core runtime implicitly calls this routine to avoid resource leaks.

This call is only necessary if specific lifetime control of expanded interface resources outside the lifetime of their associated **CGprogram** is desired. For instance, if the expanded interface is no longer used, but the **CGprogram** handle will still be used.

**EXAMPLES**

```
// prog is a CGprogram initialized elsewhere
...
HRESULT hres = cgD3D9UnloadProgram(prog);
```

**ERRORS**

**cgD3D9Failed** is generated if a D3D function returns an error.

**CGD3D9ERR\_NOTLOADED** is returned if **program** was not loaded with the **cgD3D9LoadProgram**.

**CGD3D9ERR\_NODEVICE** is returned if a required D3D device is **NULL**. This usually occurs when an expanded interface routine is called but a D3D device has not been set with **cgD3D9SetDevice**.

**HISTORY**

**cgD3D9UnloadProgram** was introduced in Cg 1.1.

**SEE ALSO**

**cgD3D9UnloadAllPrograms**, **cgDestroyProgram**

**NAME**

**cgD3D9ValidateVertexDeclaration** – validate a custom D3D9 vertex declaration stream

**SYNOPSIS**

```
#include <Cg/cgD3D9.h>
```

```
CGbool cgD3D9ValidateVertexDeclaration( CGprogram program,  
                                         const D3DVERTEXELEMENT9 * decl );
```

**PARAMETERS**

program The program to test for compatibility.

decl The D3D9 custom vertex declaration stream to test for compatibility. It must be terminated by *D3DDECL\_END()*.

**RETURN VALUES**

Returns **CG\_TRUE** if the vertex stream is compatible.

Returns **CG\_FALSE** otherwise.

**DESCRIPTION**

**cgD3D9ValidateVertexDeclaration** tests a custom D3D9 vertex declaration stream for compatibility with the inputs expected by a program.

For a vertex stream to be compatible with a program's expected inputs it must have a **D3DVERTEXELEMENT9** element for each varying input parameter that the program uses.

**EXAMPLES**

```
// Decl is a custom vertex declaraton already setup  
  
CGbool ret = cgD3D9ValidateVertexDeclaration( program, Decl );  
if( ret == CG_FALSE )  
    printf( "Vertex declaration not compatable with "  
           "the program's varying parameters.\n" );
```

**ERRORS**

**CG\_INVALID\_PROGRAM\_HANDLE\_ERROR** is generated if program is not a valid program handle.

**HISTORY**

**cgD3D9ValidateVertexDeclaration** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9ResourceToDeclUsage

**NAME**

**cgD3D8BindProgram** – activate a program with D3D

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8BindProgram( CGprogram prog );
```

**PARAMETERS**

program A **CGprogram** handle, the program to activate with D3D.

**RETURN VALUES**

**cgD3D8BindProgram** returns **D3D\_OK** if the function succeeds.

If the function fails due to a D3D call, that D3D failure code is returned.

**DESCRIPTION**

**cgD3D8BindProgram** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8BindProgram** was introduced in Cg 1.1.

**SEE ALSO**

cgD3D9BindProgram

**NAME**

**cgD3D8EnableDebugTracing** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>

void cgD3D8EnableDebugTracing( CGbool enable );
```

**PARAMETERS**

*to-be-written*

*to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8EnableDebugTracing** returns *to-be-written*

**DESCRIPTION**

**cgD3D8EnableDebugTracing** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8EnableDebugTracing** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME****cgD3D8EnableParameterShadowing** – *to-be-written***SYNOPSIS**

```
#include <Cg/cgD3D8.h>

HRESULT cgD3D8SetTextureWrapMode( CGparameter param,
                                   DWORD          value );
```

**PARAMETERS***to-be-written**to-be-written***RETURN VALUES**

None.

or

**cgD3D8EnableParameterShadowing** returns *to-be-written***DESCRIPTION****cgD3D8EnableParameterShadowing** does *to-be-written***EXAMPLES**// example code *to-be-written***ERRORS**

None.

or

*to-be-written***HISTORY****cgD3D8EnableParameterShadowing** was introduced in Cg 1.1.**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8GetDevice** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
IDirect3DDevice8* cgD3D8GetDevice();
```

**PARAMETERS**

*to-be-written*

*to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8GetDevice** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetDevice** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetDevice** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text



**NAME**

**cgD3D8GetLastError** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8GetLastError();
```

**PARAMETERS**

None

**RETURN VALUES**

None.

or

**cgD3D8GetLastError** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetLastError** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetLastError** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8GetLatestPixelProfile** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
CGprofile cgD3D8GetLatestPixelProfile();
```

**PARAMETERS**

*to-be-written*

*to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8GetLatestPixelProfile** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetLatestPixelProfile** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetLatestPixelProfile** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8GetLatestVertexProfile** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
CGprofile cgD3D8GetLatestVertexProfile();
```

**PARAMETERS**

None

**RETURN VALUES**

None.

or

**cgD3D8GetLatestVertexProfile** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetLatestVertexProfile** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetLatestVertexProfile** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8GetOptimalOptions** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
char const* cgD3D8GetOptimalOptions( CGprofile profile );
```

**PARAMETERS**

*profile* Cg profile for which to get optimal options.

**RETURN VALUES**

None.

or

**cgD3D8GetOptimalOptions** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetOptimalOptions** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetOptimalOptions** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8GetVertexDeclaration** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

cgD3D8GetVertexDeclaration prototype goes here.

```
CGbool cgD3D8GetVertexDeclaration( CGprogram prog,  
                                   DWORD      decl[MAX_FVF_DECL_SIZE] );
```

**PARAMETERS**

*to-be-written*

*to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8GetVertexDeclaration** returns *to-be-written*

**DESCRIPTION**

**cgD3D8GetVertexDeclaration** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8GetVertexDeclaration** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

cgD3D8IsParameterShadowingEnabled(3) Cg Direct3D8 Runtime API cgD3D8IsParameterShadowingEnabled(3)

## NAME

**cgD3D8IsParameterShadowingEnabled** – *to-be-written*

## SYNOPSIS

```
#include <Cg/cgD3D8.h>
```

```
CGbool cgD3D8IsParameterShadowingEnabled( CGprogram prog );
```

## PARAMETERS

*prog* Cg program for which to query if parameter shadowing is enabled.

## RETURN VALUES

None.

or

**cgD3D8IsParameterShadowingEnabled** returns *to-be-written*

## DESCRIPTION

**cgD3D8IsParameterShadowingEnabled** does *to-be-written*

## EXAMPLES

```
// example code to-be-written
```

## ERRORS

None.

or

*to-be-written*

## HISTORY

**cgD3D8IsParameterShadowingEnabled** was introduced in Cg 1.1.

## SEE ALSO

function1text, function2text

**NAME**

**cgD3D8IsProgramLoaded** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
CGbool cgD3D8IsProgramLoaded( CGprogram prog );
```

**PARAMETERS**

*prog* Cg program handle.

**RETURN VALUES**

None.

or

**cgD3D8IsProgramLoaded** returns *to-be-written*

**DESCRIPTION**

**cgD3D8IsProgramLoaded** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8IsProgramLoaded** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8LoadProgram** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8LoadProgram( CGprogram    prog,
                             CGbool       paramShadowing,
                             DWORD        assemFlags,
                             DWORD        vshaderUsage,
                             const DWORD* vertexDecl );
```

**PARAMETERS**

*prog*        Cg program handle.

*paramShadowing*  
            Boolean for whether parameter shadowing should occur.

*assemFlags*  
            Flags passed to the assembler.

*vsharedUsage*  
            *to-be-written*

*vertexDecl*  
            *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8LoadProgram** returns *to-be-written*

**DESCRIPTION**

**cgD3D8LoadProgram** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8LoadProgram** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text



**NAME**

**cgD3D8ResourceToInputRegister** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
DWORD cgD3D8ResourceToInputRegister( CGresource resource );
```

**PARAMETERS**

*resource to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8ResourceToInputRegister** returns *to-be-written*

**DESCRIPTION**

**cgD3D8ResourceToInputRegister** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8ResourceToInputRegister** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetDevice** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetDevice( IDirect3DDevice8* pDevice );
```

**PARAMETERS**

*pDevice* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetDevice** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetDevice** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetDevice** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetTexture** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetTexture( CGparameter param,  
                           IDirect3DTexture8* tex );
```

**PARAMETERS**

*param* Cg parameter handle.

*tex* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetTexture** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetTexture** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetTexture** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetTextureStageState** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetTextureStageState( CGparameter          param,  
                                     D3DTEXTURESTAGESTATETYPE type,  
                                     DWORD                  value );
```

**PARAMETERS**

*param* Cg parameter handle.

*type* *to-be-written*

*value* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetTextureStageState** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetTextureStageState** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetTextureStageState** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetTextureWrapMode** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetTextureWrapMode( CGparameter param,  
                                   DWORD          value );
```

**PARAMETERS**

*param* Cg parameter handle.

*value* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetTextureWrapMode** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetTextureWrapMode** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetTextureWrapMode** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetUniform** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>

HRESULT cgD3D8SetUniform( CGparameter param,
                          const void* floats );
```

**PARAMETERS**

*param*     Cg parameter handle.

*floats*    *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetUniform** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetUniform** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetUniform** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetUniformArray** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetUniformArray( CGparameter param,  
                                DWORD          offset,  
                                DWORD          numItems,  
                                const void*    values );
```

**PARAMETERS**

*param* Cg parameter handle.

*offset* *to-be-written*

*numItems*  
*to-be-written*

*values* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetUniformArray** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetUniformArray** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetUniformArray** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8SetUniformMatrix** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetUniformMatrix( CGparameter    param,  
                                const D3DMATRIX* matrix );
```

**PARAMETERS**

*param* Cg parameter handle.

*matrix* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetUniformMatrix** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetUniformMatrix** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetUniformMatrix** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text



**NAME**

**cgD3D8SetUniformMatrixArray** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8SetUniformMatrixArray( CGparameter    param,  
                                       DWORD           offset,  
                                       DWORD           numItems,  
                                       const D3DMATRIX* matrices );
```

**PARAMETERS**

*param* Cg parameter handle.

*offset* *to-be-written*

*numItems*  
*to-be-written*

*matrices* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8SetUniformMatrixArray** returns *to-be-written*

**DESCRIPTION**

**cgD3D8SetUniformMatrixArray** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8SetUniformMatrixArray** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8TranslateCError** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
const char* cgD3D8TranslateCError( CError error );
```

**PARAMETERS**

*error* Cg error code.

**RETURN VALUES**

None.

or

**cgD3D8TranslateCError** returns *to-be-written*

**DESCRIPTION**

**cgD3D8TranslateCError** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8TranslateCError** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8TranslateHRESULT** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
const char* cgD3D8TranslateHRESULT( HRESULT hr );
```

**PARAMETERS**

*hr*            *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8TranslateHRESULT** returns *to-be-written*

**DESCRIPTION**

**cgD3D8TranslateHRESULT** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8TranslateHRESULT** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8TypeToSize** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
DWORD cgD3D8TypeToSize( CGtype type );
```

**PARAMETERS**

*type*      Cg type enumerant.

**RETURN VALUES**

None.

or

**cgD3D8TypeToSize** returns *to-be-written*

**DESCRIPTION**

**cgD3D8TypeToSize** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8TypeToSize** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8UnloadProgram** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
HRESULT cgD3D8UnloadProgram( CGprogram prog );
```

**PARAMETERS**

*prog* Cg program handle.

**RETURN VALUES**

None.

or

**cgD3D8UnloadProgram** returns *to-be-written*

**DESCRIPTION**

**cgD3D8UnloadProgram** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8UnloadProgram** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**cgD3D8ValidateVertexDeclaration** – *to-be-written*

**SYNOPSIS**

```
#include <Cg/cgD3D8.h>
```

```
CGbool cgD3D8ValidateVertexDeclaration( CGprogram    prog,  
                                         const DWORD* decl );
```

**PARAMETERS**

*prog* Cg program handle.

*decl* *to-be-written*

**RETURN VALUES**

None.

or

**cgD3D8ValidateVertexDeclaration** returns *to-be-written*

**DESCRIPTION**

**cgD3D8ValidateVertexDeclaration** does *to-be-written*

**EXAMPLES**

```
// example code to-be-written
```

**ERRORS**

None.

or

*to-be-written*

**HISTORY**

**cgD3D8ValidateVertexDeclaration** was introduced in Cg 1.1.

**SEE ALSO**

function1text, function2text

**NAME**

**arbfpl** – OpenGL fragment profile for multi-vendor ARB\_fragment\_program extension

**SYNOPSIS**

arbfpl

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by GeForce FX and other DirectX 9 GPUs. This profile is supported by any OpenGL implementation that conformantly implements ARB\_fragment\_program.

The compiler output for this profile conforms to the assembly format defined by **ARB\_fragment\_program**.

Data-dependent loops are not allowed; all loops must be unrollable.

Conditional expressions are supported without branching so both conditions must be evaluated.

Relative indexing of uniform arrays is not supported; use texture accesses instead.

**3D API DEPENDENCIES**

Requires OpenGL support for the multi-vendor **ARB\_fragment\_program** extension. This extension is supported by GeForce FX and later GPUS. ATI GPUs also support this extension.

**PROFILE OPTIONS**

NumTemps=*n*

Number of temporaries to use (from 12 to 32).

MaxInstructionSlots=*n*

Maximum allowable (static) instructions. Not an issue for NVIDIA GPUs.

NoDependentReadLimit=*b*

Boolean for whether a read limit exists.

NumTexInstructions=*n*

Maximum number of texture instructions to generate. Not an issue for NVIDIA GPUs, but important for ATI GPUs (set it to 32).

NumMathInstructions=*n*

Maximum number of math instructions to generate. Not an issue for NVIDIA GPUs, but important for ATI GPUs (set it to 64).

MaxTexIndirections=*n*

Maximum number of texture indirections. Not an issue for NVIDIA GPUs, but important for ATI GPUs (set it to 4).

ATI\_draw\_buffers

When multiple draw buffers are used, use the **ATI\_draw\_buffers** syntax so the generated code says `OPTION ATI_draw_buffers`. The default, if this option is not specified, is to use **ARB\_draw\_buffers**.

ARB\_draw\_buffers

When multiple draw buffers are used, use the **ARB\_draw\_buffers** syntax so the generated code says `OPTION ARB_draw_buffers`. This option is the default.

MaxDrawBuffers=*n*

Maximum draw buffers for use with **ARB\_draw\_buffers**. Set to 1 for NV3x GPUs. Use up to 4 for NV4x or ATI GPUs.

MaxLocalParams=*n*

Maximum allowable local parameters.

**DATA TYPES***to-be-written***SEMANTICS****VARYING INPUT SEMANTICS***to-be-written***UNIFORM INPUT SEMANTICS***to-be-written***OUTPUT SEMANTICS***to-be-written***STANDARD LIBRARY ISSUES***to-be-written***SEE ALSO**

arbv1, fp40, gp4fp, cgGLSetOptimalOptions



**NAME**

**arbvpl** – OpenGL vertex profile for multi-vendor ARB\_vertex\_program extension

**SYNOPSIS**

arbvpl

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by GeForce3. This profile is supported by any OpenGL implementation that conformantly implements ARB\_vertex\_program.

The compiler output for this profile conforms to the assembly format defined by **ARB\_vertex\_program**.

Data-dependent loops are not allowed; all loops must be unrollable.

Conditional expressions are supported without branching so both conditions must be evaluated.

Relative indexing of uniform arrays *is* supported; but texture accesses are not supported.

**3D API DEPENDENCIES**

Requires OpenGL support for the multi-vendor **ARB\_vertex\_program** extension. These extensions were introduced by GeForce3 and Quadro DCC GPUs. ATI GPUs also support this extension.

**PROFILE OPTIONS**

NumTemps=*n*

Number of temporaries to use (from 12 to 32).

MaxInstructions=*n*

Maximum allowable (static) instructions.

MaxLocalParams=*n*

Maximum allowable local parameters.

**DATA TYPES**

*to-be-written*

**SEMANTICS****VARYING INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**OUTPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

*to-be-written*

**SEE ALSO**

arbfpl, vp30, vp40, gp4vp

**NAME**

**fp20** – OpenGL fragment profile for NV2x (GeForce3, GeForce4 Ti, Quadro DCC, etc.)

**SYNOPSIS**

fp20

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by GeForce3.

The capabilities of this profile are quite limited.

The compiler output for this profile conforms to the **nvparse** file format for describing **NV\_register\_combiners** and **NV\_texture\_shader** state configurations.

**3D API DEPENDENCIES**

Requires OpenGL support for **NV\_texture\_shader**, **NV\_texture\_shader2**, and **NV\_register\_combiners2** extensions. These extensions were introduced by GeForce3 and Quadro DCC GPUs.

Some standard library functions may require **NV\_texture\_shader3**. This extension was introduced by GeForce4 Ti and Quadro4 XGL GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/register\\_combiners.txt](http://www.opengl.org/registry/specs/NV/register_combiners.txt)  
[http://www.opengl.org/registry/specs/NV/register\\_combiners2.txt](http://www.opengl.org/registry/specs/NV/register_combiners2.txt)  
[http://www.opengl.org/registry/specs/NV/texture\\_shader.txt](http://www.opengl.org/registry/specs/NV/texture_shader.txt)  
[http://www.opengl.org/registry/specs/NV/texture\\_shader2.txt](http://www.opengl.org/registry/specs/NV/texture_shader2.txt)

**PROFILE OPTIONS**

None.

**DATA TYPES**

**fixed** The **fixed** data type corresponds to a native signed 9-bit integers normalized to the  $[-1.0, +1.0]$  range.

**float**

**half** In most cases, the **float** and **half** data types are mapped to **fixed** for math operations.

Certain built-in standard library functions corresponding to **NV\_texture\_shader** operations operate at 32-bit floating-point precision.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **fp20** profile correspond to the respectively named varying output semantics of the **vp20** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COL0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	

TEX1 TEXCOORD1	Input texture coordinate sets 1
TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
FOGP FOG	Input fog color (XYZ) and factor (W)

## OUTPUT SEMANTICS

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

## STANDARD LIBRARY ISSUES

There are a lot of standard library issues with this profile.

Because the 'fp20' profile has limited capabilities, not all of the Cg standard library functions are supported. The list below presents the Cg standard library functions that are supported by this profile. See the standard library documentation for descriptions of these functions.

```
dot(floatN, floatN)
lerp(floatN, floatN, floatN)
lerp(floatN, floatN, float)
tex1D(sampler1D, float)
tex1D(sampler1D, float2)
tex1Dproj(sampler1D, float2)
tex1Dproj(sampler1D, float3)
tex2D(sampler2D, float2)
tex2D(sampler2D, float3)
tex2Dproj(sampler2D, float3)
tex2Dproj(sampler2D, float4)
texRECT(samplerRECT, float2)
texRECT(samplerRECT, float3)
texRECTproj(samplerRECT, float3)
texRECTproj(samplerRECT, float4)
tex3D(sampler3D, float3)
tex3Dproj(sampler3D, float4)
texCUBE(samplerCUBE, float3)
texCUBEproj(samplerCUBE, float4)
```

Note: The non-projective texture lookup functions are actually done as projective lookups on the underlying hardware. Because of this, the 'w' component of the texture coordinates passed to these functions from the application or vertex program must contain the value 1.

Texture coordinate parameters for projective texture lookup functions must have swizzles that match the swizzle done by the generated texture shader instruction. While this may seem burdensome, it is intended to allow 'fp20' profile programs to behave correctly under other pixel shader profiles. The list below shows

the swizzles required on the texture coordinate parameter to the projective texture lookup functions.

Texture lookup function	Texture coordinate swizzle
tex1Dproj	.xw/.ra
tex2Dproj	.xyw/.rga
texRECTproj	.xyw/.rga
tex3Dproj	.xyzw/.rgba
texCUBEproj	.xyzw/.rgba

## TEXTURE SHADER OPERATIONS

In order to take advantage of the more complex hard-wired shader operations provided by **NV\_texture\_shader**, a collection of built-in functions implement the various shader operations.

offsettex2D

offsettexRECT

```
offsettex2D(uniform sampler2D tex,
            float2 st,
            float4 prevlookup,
            uniform float4 m)

offsettexRECT(uniform samplerRECT tex,
              float2 st,
              float4 prevlookup,
              uniform float4 m)
```

Performs the following

```
float2 newst = st + m.xy * prevlookup.xx + m.zw * prevlookup.yy;
return tex2D/RECT(tex, newst);
```

where 'st' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a previous texture operation, and 'm' is the offset texture matrix. This function can be used to generate the 'offset\_2d' or 'offset\_rectangle' NV\_texture\_shader instructions.

offsettex2DScaleBias

offsettexRECTScaleBias

```
offsettex2DScaleBias(uniform sampler2D tex,
                    float2 st,
                    float4 prevlookup,
                    uniform float4 m,
                    uniform float scale,
                    uniform float bias)

offsettexRECTScaleBias(uniform samplerRECT tex,
                      float2 st,
                      float4 prevlookup,
                      uniform float4 m,
                      uniform float scale,
                      uniform float bias)
```

Performs the following

```
float2 newst = st + m.xy * prevlookup.xx + m.zw * prevlookup.yy;
float4 result = tex2D/RECT(tex, newst);
return result * saturate(prevlookup.z * scale + bias);
```

where 'st' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a previous texture operation, 'm' is the offset texture matrix, 'scale' is the offset texture scale and 'bias' is the offset texture bias. This function can be used to generate the 'offset\_2d\_scale' or 'offset\_rectangle\_scale' NV\_texture\_shader instructions.

```
tex1D_dp3(sampler1D tex, float3 str, float4 prevlookup)
    tex1D_dp3(sampler1D tex,
              float3 str,
              float4 prevlookup)
```

Performs the following

```
return tex1D(tex, dot(str, prevlookup.xyz));
```

where 'str' are texture coordinates associated with sampler 'tex' and 'prevlookup' is the result of a previous texture operation. This function can be used to generate the 'dot\_product\_1d' NV\_texture\_shader instruction.

```
tex2D_dp3x2
texRECT_dp3x2
    tex2D_dp3x2(uniform sampler2D tex,
                float3 str,
                float4 intermediate_coord,
                float4 prevlookup)

    texRECT_dp3x2(uniform samplerRECT tex,
                  float3 str,
                  float4 intermediate_coord,
                  float4 prevlookup)
```

Performs the following

```
float2 newst = float2(dot(intermediate_coord.xyz, prevlookup.xyz),
                      dot(str, prevlookup.xyz));
return tex2D/RECT(tex, newst);
```

where 'str' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a previous texture operation and 'intermediate\_coord' are texture coordinates associated with the previous texture unit. This function can be used to generate the 'dot\_product\_2d' or 'dot\_product\_rectangle' NV\_texture\_shader instruction combinations.

```
tex3D_dp3x3
texCUBE_dp3x3
    tex3D_dp3x3(sampler3D tex,
                float3 str,
                float4 intermediate_coord1,
                float4 intermediate_coord2,
                float4 prevlookup)
```

```
texCUBE_dp3x3(samplerCUBE tex,
              float3 str,
              float4 intermediate_coord1,
              float4 intermediate_coord2,
              float4 prevlookup)
```

Performs the following

```
float3 newst = float3(dot(intermediate_coord1.xyz, prevlookup.xyz),
                      dot(intermediate_coord2.xyz, prevlookup.xyz),
                      dot(str, prevlookup.xyz));
return tex3D/CUBE(tex, newst);
```

where 'str' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a previous texture operation, 'intermediate\_coord1' are texture coordinates associated with the 'n-2' texture unit and 'intermediate\_coord2' are texture coordinates associated with the 'n-1' texture unit. This function can be used to generate the 'dot\_product\_3d' or 'dot\_product\_cube\_map' NV\_texture\_shader instruction combinations.

texCUBE\_reflect\_dp3x3

```
texCUBE_reflect_dp3x3(uniform samplerCUBE tex,
                      float4 strq,
                      float4 intermediate_coord1,
                      float4 intermediate_coord2,
                      float4 prevlookup)
```

Performs the following

```
float3 E = float3(intermediate_coord2.w, intermediate_coord1.w,
                  strq.w);
float3 N = float3(dot(intermediate_coord1.xyz, prevlookup.xyz),
                  dot(intermediate_coord2.xyz, prevlookup.xyz),
                  dot(strq.xyz, prevlookup.xyz));
return texCUBE(tex, 2 * dot(N, E) / dot(N, N) * N - E);
```

where 'strq' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a previous texture operation, 'intermediate\_coord1' are texture coordinates associated with the 'n-2' texture unit and 'intermediate\_coord2' are texture coordinates associated with the 'n-1' texture unit. This function can be used to generate the 'dot\_product\_reflect\_cube\_map\_eye\_from\_qs' NV\_texture\_shader instruction combination.

texCUBE\_reflect\_eye\_dp3x3

```
texCUBE_reflect_eye_dp3x3(uniform samplerCUBE tex,
                           float3 str,
                           float4 intermediate_coord1,
                           float4 intermediate_coord2,
                           float4 prevlookup,
                           uniform float3 eye)
```

Performs the following

```
float3 N = float3(dot(intermediate_coord1.xyz, prevlookup.xyz),
                  dot(intermediate_coord2.xyz, prevlookup.xyz),
                  dot(coords.xyz, prevlookup.xyz));
return texCUBE(tex, 2 * dot(N, E) / dot(N, N) * N - E);
```

where 'strq' are texture coordinates associated with sampler 'tex', 'prevlookup' is the result of a

previous texture operation, 'intermediate\_coord1' are texture coordinates associated with the 'n-2' texture unit, 'intermediate\_coord2' are texture coordinates associated with the 'n-1' texture unit and 'eye' is the eye-ray vector. This function can be used generate the 'dot\_product\_reflect\_cube\_map\_const\_eye' NV\_texture\_shader instruction combination.

```
tex_dp3x2_depth
    tex_dp3x2_depth(float3 str,
                    float4 intermediate_coord,
                    float4 prevlookup)
```

Performs the following

```
float z = dot(intermediate_coord.xyz, prevlookup.xyz);
float w = dot(str, prevlookup.xyz);
return z / w;
```

where 'str' are texture coordinates associated with the 'n'th texture unit, 'intermediate\_coord' are texture coordinates associated with the 'n-1' texture unit and 'prevlookup' is the result of a previous texture operation. This function can be used in conjunction with the 'DEPTH' varying out semantic to generate the 'dot\_product\_depth\_replace' NV\_texture\_shader instruction combination.

## EXAMPLES

The following examples illustrate how a developer can use Cg to achieve NV\_texture\_shader/NV\_register\_combiners functionality.

### Example 1

```
struct VertexOut {
    float4 color      : COLOR0;
    float4 texCoord0  : TEXCOORD0;
    float4 texCoord1  : TEXCOORD1;
};

float4 main(VertexOut IN,
            uniform sampler2D diffuseMap,
            uniform sampler2D normalMap) : COLOR
{
    float4 diffuseTexColor = tex2D(diffuseMap, IN.texCoord0.xy);
    float4 normal = 2 * (tex2D(normalMap, IN.texCoord1.xy) - 0.5);
    float3 light_vector = 2 * (IN.color.rgb - 0.5);
    float4 dot_result = saturate(dot(light_vector, normal.xyz).xxxx);
    return dot_result * diffuseTexColor;
}
```

### Example 2

```
struct VertexOut {
    float4 texCoord0 : TEXCOORD0;
    float4 texCoord1 : TEXCOORD1;
    float4 texCoord2 : TEXCOORD2;
    float4 texCoord3 : TEXCOORD3;
};
```

```
float4 main(VertexOut IN,
             uniform sampler2D normalMap,
             uniform sampler2D intensityMap,
             uniform sampler2D colorMap) : COLOR
{
    float4 normal = 2 * (tex2D(normalMap, IN.texCoord0.xy) - 0.5);
    float2 intensCoord = float2(dot(IN.texCoord1.xyz, normal.xyz),
                                dot(IN.texCoord2.xyz, normal.xyz));
    float4 intensity = tex2D(intensityMap, intensCoord);
    float4 color = tex2D(colorMap, IN.texCoord3.xy);
    return color * intensity;
}
```

**SEE ALSO**

vp20, fp30



**NAME**

**fp30** – OpenGL fragment profile for NV3x (GeForce FX, Quadro FX, etc.)

**SYNOPSIS**

fp30

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by the GeForce FX and Quadro FX line of NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_fragment\_program**.

Data-dependent loops are not allowed; all loops must be unrollable.

Conditional expressions are supported without branching so both conditions must be evaluated.

Relative indexing of uniform arrays is not supported; use texture accesses instead.

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_fragment\_program** extension. These extensions were introduced by the GeForce FX and Quadro FX GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/fragment\\_program.txt](http://www.opengl.org/registry/specs/NV/fragment_program.txt)

**PROFILE OPTIONS**

NumInstructionSlots=*val*

How many instructions the compiler should assume it can use.

NumTemps=*val*

How many temporaries the compiler should assume it can use.

**DATA TYPES**

**fixed** The **fixed** data type corresponds to a native signed fixed-point integers with the range  $[-2.0, +2.0]$ , sometimes called *fx12*. This type provides 10 fractional bits of precision.

**half** The **half** data type corresponds to a floating-point encoding with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** The **float** data type corresponds to a standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

**SEMANTICS****VARYING INPUT SEMANTICS**

The varying input semantics in the **fp30** profile correspond to the respectively named varying output semantics of the **vp30** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COL0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	

TEX1 TEXCOORD1	Input texture coordinate sets 1
TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)

**UNIFORM INPUT SEMANTICS**

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

**OUTPUT SEMANTICS**

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

**STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives *are* supported.

**SEE ALSO**

fp20, fp40, vp30

**NAME**

**fp40** – OpenGL fragment profile for NV4x (GeForce 6xxx and 7xxx Series, NV4x-based Quadro FX, etc.)

**SYNOPSIS**

fp40

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by the GeForce 6800 and other NV4x-based NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_fragment\_program2**.

Data-dependent loops *are* allowed with a limit of 256 iterations maximum. Four levels of nesting are allowed.

Conditional expressions *can be* supported with data-dependent branching.

Relative indexing of uniform arrays is not supported; use texture accesses instead.

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_fragment\_program2** extension. These extensions were introduced by the GeForce 6800 and other NV4x-based GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/fragment\\_program2.txt](http://www.opengl.org/registry/specs/NV/fragment_program2.txt)

**PROFILE OPTIONS**

None.

**DATA TYPES**

- fixed     The **fixed** data type corresponds to a native signed fixed-point integers with the range  $[-2.0, +2.0)$ , sometimes called *fx12*. This type provides 10 fractional bits of precision.
- half      The **half** data type corresponds to a floating-point encoding with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.
- float     The **half** data type corresponds to a standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

**SEMANTICS****VARYING INPUT SEMANTICS**

The varying input semantics in the **fp30** profile correspond to the respectively named varying output semantics of the **vp30** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COL0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	
TEX1	Input texture coordinate sets 1
TEXCOORD1	

TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)
FACE	Polygon facing. +1 for front-facing polygon or line or point -1 for back-facing polygon

**UNIFORM INPUT SEMANTICS**

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

**OUTPUT SEMANTICS**

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

**STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives *are* supported.

**SEE ALSO**

arbf1, fp30, gp4fp, vp40, cgGLSetOptimalOptions

**NAME**

**glslf** – OpenGL fragment profile for the OpenGL Shading Language (GLSL)

**SYNOPSIS**

glslf

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by the OpenGL Shading Language.

The compiler output for this profile conforms to the language grammar defined by the OpenGL Shading Language specification.

**3D API DEPENDENCIES**

Requires OpenGL support for **OpenGL 2.0**.

**PROFILE OPTIONS**

None.

**DATA TYPES**

The Cg half and fixed data types are both mapped to float because GLSL lacks first-class half and fixed data types.

**SEMANTICS****VARYING INPUT SEMANTICS**

Binding Semantics Name	Corresponding Data	GLSL Equivalent
COLOR COLOR0 COL0 COL	Primary color (float4)	gl_Color
COLOR1 COL1	Secondary color (float4)	gl_SecondaryColor
TEXCOORD TEXCOORD# TEX#	Texture coordinate set 0 Texture coordinate set #	gl_TexCoord[0] gl_TexCoord[#]

**UNIFORM INPUT SEMANTICS**

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

The Cg profiles for GLSL provide access to all the uniform constants and variables documented in Section 7.4 (Built-in Constants) and 7.5 (Built-in Uniform State) respectively of the OpenGL Shading Language specification found at:

<http://www.opengl.org/documentation/glsl/>  
<http://www.opengl.org/registry/doc/GLSLangSpec.Full.1.10.8.pdf>

Example:

```

glslf void main(float4 color : COLOR,
               out float4 ocol : COLOR)
{
    ocol.xyz = mul(gl_NormalMatrix, color.xyz);
    ocol.w = 1;
}

```

### OUTPUT SEMANTICS

The following standard fragment output semantics are supported:

Binding Semantics Name	Corresponding Data	GLSL Equivalent
COLOR COLOR0 COL0 COL	Output color (float4)	gl_FragColor
COLOR0-COLOR7 COL0-COL7	Output color (float4) for draw buffers 0 to 7	gl_FragData[n]
DEPTH DEPR	Output depth (float)	gl_FragDepth

### STANDARD LIBRARY ISSUES

Fragment program Cg standard library routines are available.

### SEE ALSO

The glslv and glslg profiles are translation profiles for GLSL vertex and geometry shaders.

The **glslf** profile is similar to the DirectX 9 hlslf profile that translates Cg into Microsoft's High Level Shader Language (HLSL) for pixel shaders.

**NAME**

**glslg** – OpenGL geometry profile for the OpenGL Shading Language (GLSL)

**SYNOPSIS**

*glslg*

**DESCRIPTION**

This OpenGL profile corresponds to the geometry shader functionality introduced by the EXT\_geometry\_shader4 multi-vendor OpenGL extension.

The compiler output for this profile conforms to the language grammar defined by the OpenGL Shading Language specification.

**3D API DEPENDENCIES**

Requires OpenGL support for **GL\_EXT\_geometry\_shader4**.

**PROFILE OPTIONS**

None.

**DATA TYPES****SEMANTICS**

*to-be-written*

**VARYING INPUT SEMANTICS****UNIFORM INPUT SEMANTICS****OUTPUT SEMANTICS****STANDARD LIBRARY ISSUES**

Geometry program Cg standard library routines are available.

**SEE ALSO**

The glslf and glslv profiles are translation profiles for GLSL fragment and vertex shaders.

**NAME**

**glslv** – OpenGL vertex profile for the OpenGL Shading Language (GLSL)

**SYNOPSIS**

glslv

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by the OpenGL Shading Language.

The compiler output for this profile conforms to the language grammar defined by the OpenGL Shading Language specification.

**3D API DEPENDENCIES**

Requires OpenGL support for **OpenGL 2.0**.

**PROFILE OPTIONS**

None.

**DATA TYPES**

The Cg half and fixed data types are both mapped to float because GLSL lacks first-class half and fixed data types.

**SEMANTICS****VARYING INPUT SEMANTICS**

Binding Semantics Name	Corresponding Data	GLSL Equivalent
POSITION ATTR0	Object-space position	gl_Vertex
NORMAL ATTR2	Object-space normal	gl_Normal
COLOR COLOR0 ATTR3 DIFFUSE	Primary color (float4)	gl_Color
COLOR1 SPECULAR ATTR4	Secondary color (float4)	gl_SecondaryColor
FOGCOORD ATTR5	Fog coordinate	gl_FogCoord
TEXCOORD# ATTR8 ATTR9 ATTR10 ATTR11 ATTR12 ATTR13 ATTR14 ATTR15	Texture coordinate set # Texture coordinate set 0 Texture coordinate set 1 Texture coordinate set 2 Texture coordinate set 3 Texture coordinate set 4 Texture coordinate set 5 Texture coordinate set 6 Texture coordinate set 7	gl_MultiTexCoord#



## UNIFORM INPUT SEMANTICS

The Cg profiles for GLSL provide access to all the uniform constants and variables documented in Section 7.4 (Built-in Constants) and 7.5 (Built-in Uniform State) respectively of the OpenGL Shading Language specification found at:

<http://www.opengl.org/documentation/glsl/>  
<http://www.opengl.org/registry/doc/GLSLangSpec.Full.1.1.20.8.pdf>

Example:

```
gslsv void main(float4 position : POSITION,
               out float4 opos : POSITION)
{
    opos = mul(gl_ModelViewMatrix, position);
}
```

## OUTPUT SEMANTICS

Binding Semantics Name	Corresponding Data	GLSL Equivalent
POSITION HPOS	Clip-space position	gl_Position
COLOR COLOR0 COL0 COL	Front primary color	gl_FrontColor
COLOR1 COL1	Front secondary color	gl_FrontSecondaryColor
BCOL0	Back primary color	gl_BackColor
BCOL1	Back secondary color	gl_BackSecondaryColor
CLPV	Clip vertex	gl_ClipVertex
TEXCOORD# TEX#	Texture coordinate set #	gl_TexCoord[#]
FOGC FOG	Fog coordinate	gl_FogFragCoord
PSIZE PSIZ	Point size	gl_PointSize

## STANDARD LIBRARY ISSUES

Vertex program Cg standard library routines are available.

Vertex texture fetches are supported only if the OpenGL implementation advertises a positive value for the implementation-dependent `GL_MAX_VERTEX_TEXTURE_IMAGE_UNITS` limit.

## SEE ALSO

The `gslg` and `gslf` profiles are translation profiles for GLSL geometry and fragment shaders.

The **gslsv** profile is similar to the Direct3D `hlsv` profile that translates Cg into Microsoft's High Level

Shading Language (HLSL) for vertex shaders.

**NAME**

**gp4** – OpenGL profiles for G8x (GeForce 8xxx Series, G8x-based Quadro FX, etc.)

**SYNOPSIS**

gp4

**DESCRIPTION**

**gp4** corresponds not to a single profile but to a family of profiles that include gp4vp, gp4gp and gp4fp. Since most of the functionality exposed in these profiles is almost identical and defined by **NV\_gpu\_program4** these profiles are named the **gp4** profiles. For more details refer to each profile documentation.

**SEE ALSO**

gp4vp, gp4gp, gp4fp

**NAME**

**gp4fp** – OpenGL fragment profile for G8x (GeForce 8xxx Series, G8x-based Quadro FX, etc.)

**SYNOPSIS**

gp4fp

**DESCRIPTION**

This OpenGL profile corresponds to the per-fragment functionality introduced by the GeForce 8800 and other G8x-based NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_gpu\_program4** and **ARB\_fragment\_program**.

Note that the **NV\_gpu\_program4** extension has its fragment domain-specific aspects documented in the **NV\_fragment\_program4** specification.

Data-dependent loops and branching *are* allowed.

Relative indexing of uniform arrays *is* supported.

Parameter buffer objects (also known as “constant buffers” in DirectX 10 or “bindable uniform” in GLSL’s EXT\_bindable\_uniform extension) provide a way to source uniform values from OpenGL buffer objects.

Texture accesses include support for texture arrays (see the EXT\_texture\_array OpenGL extension for more details) and texture buffer objects (see the EXT\_texture\_buffer\_object extension for details). Texture results can be either conventional floating-point vectors or integer vectors (see the EXT\_texture\_integer extension for details).

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_gpu\_program4** extension. This extension was introduced by the GeForce 6800 and other G8x-based GPUs.

**OpenGL Extension Specifications**

Programmability:

[http://www.opengl.org/registry/specs/NV/gpu\\_program4.txt](http://www.opengl.org/registry/specs/NV/gpu_program4.txt)  
[http://www.opengl.org/registry/specs/NV/fragment\\_program4.txt](http://www.opengl.org/registry/specs/NV/fragment_program4.txt)

New texture samplers:

[http://www.opengl.org/registry/specs/EXT/texture\\_array.txt](http://www.opengl.org/registry/specs/EXT/texture_array.txt)  
[http://www.opengl.org/registry/specs/EXT/texture\\_buffer\\_object.txt](http://www.opengl.org/registry/specs/EXT/texture_buffer_object.txt)

New integer texture formats:

[http://www.opengl.org/registry/specs/EXT/texture\\_integer.txt](http://www.opengl.org/registry/specs/EXT/texture_integer.txt)

Draw buffers:

[http://www.opengl.org/registry/specs/ARB/draw\\_buffers.txt](http://www.opengl.org/registry/specs/ARB/draw_buffers.txt)  
[http://www.opengl.org/registry/specs/ATI/draw\\_buffers.txt](http://www.opengl.org/registry/specs/ATI/draw_buffers.txt)

**PROFILE OPTIONS****Common GP4 Options**

fastimul

Assume integer multiply inputs have at most 24 significant bits. Example: “-po fastimul”

### Fragment Domain-specific GP4 Options

*ARB\_draw\_buffers=val*

*ATI\_draw\_buffers=val*

Indicates that the *ARB\_draw\_buffers* or *ATI\_draw\_buffers* OpenGL extension is supported and what the extension's implementation dependent value of *GL\_MAX\_DRAW\_BUFFERS\_ARB* or *GL\_MAX\_DRAW\_BUFFERS\_ATI* is.

When specified, the compiler generates the “*OPTION ARB\_draw\_buffers;*” or “*OPTION ATI\_draw\_buffers;*” in the compiled code to enable output to multiple draw buffers. Output to multiple draw buffers is done by specifying output parameters with the *COLOR1*, *COLOR2*, etc. semantics.

GPUs that support these extensions typically support up to 4 buffers.

These options are useful in the rare situation you want to control the specific *OPTION* name used. For example, Apple drivers support the *ARB\_draw\_buffers* extension but not the *ATI\_draw\_buffers* extension.

The CgGL runtime routine *cgGLSetOptimalOptions* will automatically add the appropriate option based on querying the current OpenGL context's extension support (preferring the *ARB* extension) and specify the proper limit.

## DATA TYPES

### Samplers

This profile has additional samplers for texture arrays (1D and 2D) and texture buffers.

Standard OpenGL textures formats (*GL\_RGBA8*, etc.) return floating-point sampled results, but new signed and unsigned integer texture formats require samplers that return signed and unsigned integer vectors respectively. Sampler variants for fetching signed and unsigned integer vectors are prefixed by **i** and **u** respectively. Your application is required to make sure the bound textures have the appropriate texture format. So a 3D texture specified with the *GL\_RGBA32UI\_EXT* internal format (see the *EXT\_texture\_integer* OpenGL extension) must be used with a **usampler3D** sampler. Otherwise, texture sampling returns undefined results.

**sampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **float** vectors.

**isampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **int** vectors.

**usampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **unsigned int** vectors.

**sampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

**isampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

**usampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

**sampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **float** vectors.

**isampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **int** vectors.

**usampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **unsigned int** vectors.

**sampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

**isampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

**usampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

**sampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **float** vectors.

**isampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **int** vectors.

**usampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **unsigned int** vectors.

**samplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **float** vectors.

**isamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **int** vectors.

**usamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **unsigned int** vectors.

**samplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **float** vectors.

**isamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **int** vectors.

**usamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **unsigned int** vectors.

**samplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **float** vectors.

**isamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **int** vectors.

**usamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **unsigned int** vectors.

**Floating-point**

float     32-bit IEEE floating-point  
 half     32-bit IEEE floating-point  
 double   32-bit IEEE floating-point  
 fixed     Floating-point restricted to  $[-2,2)$  range.

**Integer**

This profile supports “true” integer data types. Shifting and bitwise operators are supported for integer data types.

int       32-bit signed integer  
 unsigned int     32-bit unsigned integer  
 short     16-bit signed integer  
 unsigned short   16-bit unsigned integer  
 char       8-bit signed integer  
 unsigned char     8-bit unsigned integer

**SEMANTICS****VARYING INPUT SEMANTICS***Interpolated Input Semantics*

The varying input semantics in the **gp4fp** profile correspond to the respectively named varying output semantics of the **gp4vp** profile (or **gp4gp** if a geometry shader is present).

Binding Semantics Name	Corresponding Data
COLOR COLOR0 COL COL0	Input primary color
COLOR1 COL1	Input secondary color
WPOS	Window position (with lower-left origin)
TEX0 TEXCOORD0	Input texture coordinate sets 0
TEX1 TEXCOORD1	Input texture coordinate sets 1

TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)

### *Interpolation Semantic Modifiers*

A number of interpolation semantic modifiers control how interpolation happens for the interpolated input semantics above. These modifiers are suffixed to the semantic name with a “.” (period) separator. Without a modifier, perspective-correct interpolation applies.

Semantic Modifier Name	Meaning
CENTROID	Interpolate at the centroid of the covered sample (only applies when rendering to multisampled surf
FLAT	Flat shading using provoking vertex’s value
NOPERSPECTIVE	Interpolate without perspective correction

### *Examples:*

```
float4 a : TEXCOORD0
float4 b : TEXCOORD1.CENTROID
float4 c : TEXCOORD2.FLAT
float4 d : TEXCOORD3.NOPERSPECTIVE
```

### *Per-primitive Input Semantics*

FACE	Polygon facing. +1 for front-facing polygon or line or point -1 for back-facing polygon
PRIMITIVEID	Primitive ID (int)

If a geometry program is active, parameters given the PRIMITIVEID semantic obtained their integer value from the primitive ID value emitted by the geometry program for the provoking vertex. If no geometry program is active, the value is the number of primitives processed by the rasterizer since the last time glBegin was called (directly or indirectly via vertex array functions). The first primitive generated after a glBegin is numbered zero, and the primitive ID counter is incremented after every individual point, line, or polygon primitive is processed. For polygons drawn in point or line mode, the primitive ID counter is



incremented only once, even though multiple points or lines may be drawn. For QUADS and QUAD\_STRIP primitives that are decomposed into triangles, the primitive ID is incremented after each complete quad is processed. For POLYGON primitives, the primitive ID counter is zero. The primitive ID is zero for fragments generated by DrawPixels or Bitmap. Restarting a primitive topology using the primitive restart index has no effect on the primitive ID counter.

## UNIFORM INPUT SEMANTICS

### *Buffer Semantics*

gp4 profiles can specify that uniforms be specified to reside within binable buffers.

Example of automatic, compiler-determined specification of a uniform's location within a buffer:

```
uniform float2 location    : BUFFER[3]; // compiler positions within buffer 3
uniform float4 brickColor : BUFFER[3]; // compiler positions within buffer 3
```

Example of absolute byte offset specification of a uniform's location within a buffer:

```
uniform float4 mustBeHere : BUFFER[7][20]; // locate 20 bytes into buffer 7
```

### *Constant Register Semantics*

```
C0-C255          Constant register [0..255].
                  The aliases c0-c255 (lowercase) are also accepted.
```

If used with a variable that requires more than one constant register (e.g. a matrix), the semantic specifies the first register that is used.

Example:

```
uniform float4 array[20] : C14; // uses c14 through c33
```

### *Texture Unit Semantics*

```
TEXUNIT0-TEXUNIT15 Texture unit (but only 4 distinct texture units
                        are allowed)
```

Example:

```
uniform sampler2DARRAY texArray : TEXUNIT7;
```

## OUTPUT SEMANTICS

COLOR	Output color (float4 or int4)
COL	
COLOR0-COLOR7	Output color (float4 or int4) for draw buffers 0
COL0-COL7	
DEPTH	Output depth (float)
DEPR	

## STANDARD LIBRARY ISSUES

### **Raw Cast from Floating-point to Integer Functions**

It is possible to convert the raw bit patterns of IEEE single-precision floating-point to 32-bit unsigned integer.

floatToRawIntBits, floatToIntBits, intBitsToFloat

**Texture Array Functions**

New sampler data types for texture arrays and texture buffers lead to new standard library routines to access these samplers.

New standard library functions are used to access 1D texture array samplers (sampler1DARRAY).

tex1DARRAY, tex1DARRAYbias, tex1DARRAYcmpbias, tex1DARRAYlod, tex1DARRAYcmlod, and tex1DARRAYproj

The dimensions of a texture array level can be determined.

tex1DARRAYsize

New standard library functions are used to access 2D texture array samplers (sampler2DARRAY).

tex2DARRAY, tex2DARRAYbias, tex2DARRAYcmpbias, tex2DARRAYlod, tex2DARRAYcmlod, and tex2DARRAYproj

The dimensions of a texture array level can be determined.

tex2DARRAYsize

**SEE ALSO**

gp4fp, gp4vp, texBUF, texBUFsize, floatToRawIntBits, floatToIntBits, intBitsToFloat

tex1DARRAY, tex1DARRAYbias, tex1DARRAYcmpbias, tex1DARRAYlod, tex1DARRAYcmlod, tex1DARRAYproj, tex1DARRAYsize

tex2DARRAY, tex2DARRAYbias, tex2DARRAYcmpbias, tex2DARRAYlod, tex2DARRAYcmlod, tex2DARRAYproj, tex2DARRAYsize

**NAME**

**gp4gp** – OpenGL geometry profile for G8x (GeForce 8xxx & 9xxx Series, G8x-based Quadro FX, etc.)

**SYNOPSIS**

gp4gp

**DESCRIPTION**

This OpenGL profile corresponds to the per-primitive functionality introduced by the GeForce 8800 and other G8x-based NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_gpu\_program4** and **ARB\_vertex\_program**.

Note that the **NV\_gpu\_program4** extension has its geometry domain-specific aspects documented in the **NV\_geometry\_program4** specification.

Data-dependent loops and branching *are* allowed.

Relative indexing of uniform arrays *is* supported.

Parameter buffer objects (also known as “constant buffers” in DirectX 10 or “bindable uniform” in GLSL’s EXT\_bindable\_uniform extension) provide a way to source uniform values from OpenGL buffer objects.

Texture accesses include support for texture arrays (see the EXT\_texture\_array OpenGL extension for more details) and texture buffer objects (see the EXT\_texture\_buffer\_object extension for details). Texture results can be either conventional floating-point vectors or integer vectors (see the EXT\_texture\_integer extension for details).

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_gpu\_program4** extension. This extension was introduced by the GeForce 8800 and other G8x-based GPUs.

**OpenGL Extension Specifications**

Programmability:

[http://www.opengl.org/registry/specs/NV/gpu\\_program4.txt](http://www.opengl.org/registry/specs/NV/gpu_program4.txt)  
[http://www.opengl.org/registry/specs/NV/geometry\\_program4.txt](http://www.opengl.org/registry/specs/NV/geometry_program4.txt)

New texture samplers:

[http://www.opengl.org/registry/specs/EXT/texture\\_array.txt](http://www.opengl.org/registry/specs/EXT/texture_array.txt)  
[http://www.opengl.org/registry/specs/EXT/texture\\_buffer\\_object.txt](http://www.opengl.org/registry/specs/EXT/texture_buffer_object.txt)

New integer texture formats:

[http://www.opengl.org/registry/specs/EXT/texture\\_integer.txt](http://www.opengl.org/registry/specs/EXT/texture_integer.txt)

**PROFILE OPTIONS****Common GP4 Options**

fastimul

Assume integer multiply inputs have at most 24 significant bits. Example: “-po fastimul”

**Geometry Domain-specific GP4 Options**

Normally the options below to specify primitive input and output type are better specified as a profile modifier preceding the Cg entry function.

Vertices=*val*

Maximum number of output vertices. Emitting more than this number of vertices results in the extra vertices being discarded. Example “-po Vertices=3”

On NVIDIA GPUs, the throughput for geometry shaders is inverse proportional to the maximum number of vertices output times the number of scalar components per vertex. For this reason, keep the maximum number of output vertices as small as possible for best performance.

#### POINT

The entry function inputs point primitives. Example: “-po POINT”

If an output primitive is not also specified with a command line profile option, POINT\_OUT is assumed.

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### LINE

The entry function inputs line primitives. Example: “-po LINE”

If an output primitive is not also specified with a command line profile option, LINE\_OUT is assumed.

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### LINE\_ADJ

The entry function inputs line adjacency primitives. Example: “-po LINE\_ADJ”

If an output primitive is not also specified with a command line profile option, LINE\_OUT is assumed.

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### TRIANGLE

The entry function inputs triangle primitives. Example: “-po TRIANGLE”

If an output primitive is not also specified with a command line profile option, TRIANGLE\_OUT is assumed.

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### TRIANGLE\_ADJ

The entry function inputs triangle adjacency primitives. Example: “-po TRIANGLE\_ADJ”

If an output primitive is not also specified with a command line profile option, TRIANGLE\_OUT is assumed.

#### POINT\_OUT

The entry function outputs point primitives. Example: “-po POINT\_OUT”

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### LINE\_OUT

The entry function outputs line primitives. Example: “-po LINE\_OUT”

Normally this option is better specified as a profile modifier preceding the Cg entry function.

#### TRIANGLE\_OUT

The entry function outputs triangle primitives. Example: “-po TRIANGLE\_OUT”

Normally this option is better specified as a profile modifier preceding the Cg entry function.

## DATA TYPES

### Samplers

This profile has additional samplers for texture arrays (1D and 2D) and texture buffers.

Standard OpenGL textures formats (GL\_RGBA8, etc.) return floating-point sampled results, but new signed and unsigned integer texture formats require samplers that return signed and unsigned integer vectors respectively. Sampler variants for fetching signed and unsigned integer vectors are prefixed by **i** and **u** respectively. Your application is required to make sure the bound textures have the appropriate texture format. So a 3D texture specified with the GL\_RGBA32UI\_EXT internal format (see the EXT\_texture\_integer OpenGL extension) must be used with a **usampler3D** sampler. Otherwise, texture sampling returns undefined results.

**sampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **float** vectors.

**isampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **int** vectors.

**usampler1D**

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **unsigned int** vectors.

**sampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

**isampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

**usampler1DARRAY**

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

**sampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **float** vectors.

**isampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **int** vectors.

**usampler2D**

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **unsigned int** vectors.

**sampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

**isampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

**usampler2DARRAY**

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

**sampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **float** vectors.

**isampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **int** vectors.

**usampler3D**

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **unsigned int** vectors.

**samplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **float** vectors.

**isamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **int** vectors.

**usamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **unsigned int** vectors.

**samplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **float** vectors.

**isamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **int** vectors.

**isamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **unsigned int** vectors.

**samplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **float** vectors.

**isamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **int** vectors.

**usamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **unsigned int** vectors.

**Floating-point**

float	32-bit IEEE floating-point
half	16-bit IEEE floating-point
double	64-bit IEEE floating-point
fixed	Floating-point restricted to $[-2, 2)$ range.

**Integer**

This profile supports “true” integer data types. Shifting and bitwise operators are supported for integer data types.

int	32-bit signed integer
unsigned int	32-bit unsigned integer
short	16-bit signed integer
unsigned short	16-bit unsigned integer
char	8-bit signed integer
unsigned char	8-bit unsigned integer

**SEMANTICS**

## VARYING INPUT SEMANTICS

### *Primitive Instance Input Semantic*

Within a batch of primitives (defined in OpenGL by a glBegin/glEnd sequence or an implied glBegin/glEnd performed by glDrawElements, glDrawArrays, etc.) a counter tracks each assembled primitive instance. The geometry shader has access to this counter through the INSTANCEID semantic.

Binding Semantics Name	Corresponding Data
INSTANCEID	Integer instance ID of the primitive within the current batch

The first primitive generated after a glBegin is numbered zero, and the instance ID counter is incremented after every individual point, line, or polygon primitive is processed. For QUADS and QUAD\_STRIP primitives that are decomposed into triangles, the instance ID is incremented after each complete quad is processed. For POLYGON primitives, the instance ID counter is zero. Restarting a primitive topology using the primitive restart index has no effect on the instance ID counter.

Example:

```
int primID : INSTANCEID
```

### *Vertex Instance Input Semantic*

The geometry shader can identify the vertex index (when using vertex buffer objects) that sourced each vertex making up the primitive.

The vertex instance input semantic must be declared with the **AttribArray** template-style syntax because a geometry shader accepts an attribute array of vertex instance IDs.

Binding Semantics Name	Corresponding Data
VERTEXID	Integer ID of the vertex's index for vertex pulling

The vertex ID is equal to value effectively passed to glArrayElement (or routines that implicitly call glArrayElements such as glDrawElements or glDrawArrays) when the vertex is specified, and is defined only if vertex arrays are used with buffer objects (VBOs).

Example defining a varying parameter for the position vertex attribute:

```
AttribArray<int> vertexID : VERTEXID
```

### *Vertex Attribute Input Semantics*

For geometry shader profiles such as gp4gp, varying parameters with vertex attribute input semantics must be declared with the **AttribArray** template-style syntax because a geometry shader accepts an attribute array of vertex attributes (rather than individual vertex attributes as a vertex shader does).

Example defining a varying parameter for the position vertex attribute:

```
AttribArray<float4> position : POSITION
```

The set of binding semantics for varying input vertex attributes to gp4gp consists of POSITION, BLENDWEIGHT, NORMAL, COLOR0, COLOR1, TESSFACTOR, PSIZE, BLENDINDICES, and TEXCOORD0–TEXCOORD7. One can also use TANGENT and BINORMAL instead of TEXCOORD6 and TEXCOORD7.

Additionally, a set of binding semantics ATTR0–ATTR15 can be used. These binding semantics map to NV\_gpu\_program4 input attribute parameters as described in the NV\_geometry\_program4 document.

The two sets act as aliases to each other on NVIDIA GPUs excluding Apple Macs. ATI GPUs and NVIDIA

Mac GPUs do *not* alias the conventional vertex attributes with the generic attributes.

Binding Semantics Name	Corresponding Data
POSITION, ATTR0	Input Vertex, Generic Attribute 0
BLENDWEIGHT, ATTR1	Input vertex weight, Generic Attribute 1
NORMAL, ATTR2	Input normal, Generic Attribute 2
DIFFUSE, COLOR0, ATTR3	Input primary color, Generic Attribute 3
SPECULAR, COLOR1, ATTR4	Input secondary color, Generic Attribute 4
TESSFACTOR, FOGCOORD, ATTR5	Input fog coordinate, Generic Attribute 5
PSIZE, ATTR6	Input point size, Generic Attribute 6
BLENDINDICES, ATTR7	Generic Attribute 7
TEXCOORD0-TEXCOORD7, ATTR8-ATTR15	Input texture coordinates (texcoord0-texcoord7) Generic Attributes 8-15
TANGENT, ATTR14	Generic Attribute 14
BINORMAL, ATTR15	Generic Attribute 15
VERTEXID	Input vertex ID (integer) Vertex index when using vertex arrays
PRIMITIVEID	Input primitive ID (integer)

These vertex attribute semantics should match with the semantics of the outputs of the vertex shader feeding the geometry shader.

## UNIFORM INPUT SEMANTICS

### *Buffer Semantics*

gp4 profiles can specify that uniforms be specified to reside within binable buffers.

Example of automatic, compiler-determined specification of a uniform's location within a buffer:

```
uniform float2 location    : BUFFER[3]; // compiler positions within buffer 3
uniform float4 brickColor : BUFFER[3]; // compiler positions within buffer 3
```

Example of absolute byte offset specification of a uniform's location within a buffer:

```
uniform float4 mustBeHere : BUFFER[7][20]; // locate 20 bytes into buffer 7
```

### *Constant Register Semantics*

```
C0-C255          Constant register [0..255].
                  The aliases c0-c255 (lowercase) are also accepted.
```

If used with a variable that requires more than one constant register (e.g. a matrix), the semantic specifies the first register that is used.

Example:



```
uniform float4 array[20] : C14; // uses c14 through c33
```

#### *Texture Unit Semantics*

TEXTUNIT0-TEXTUNIT15 Texture unit (but only 4 distinct texture units are allowed)

Example:

```
uniform sampler2DARRAY texArray : TEXTUNIT7;
```

### **OUTPUT SEMANTICS**

These vertex attribute output semantics match the output semantics for gp4vp.

Binding Semantics Name	Corresponding Data
POSITION, HPOS	Output position
PSIZE, PSIZ	Output point size
FOG, FOGC	Output fog coordinate
COLOR0, COL0	Output primary color
COLOR1, COL1	Output secondary color
BCOL0	Output backface primary color
BCOL1	Output backface secondary color
TEXCOORD0-TEXCOORD7, TEX0-TEX7	Output texture coordinates
CLP0-CL5	Output Clip distances
PRIMITIVEID	Output primitive ID (integer)
LAYER	Output layer (integer) Output 0 through 5 for cube map faces Output 0 through N for 2D texture arrays

### **STANDARD LIBRARY ISSUES**

#### **Raw Cast from Floating-point to Integer Functions**

It is possible to convert the raw bit patterns of IEEE single-precision floating-point to 32-bit unsigned integer.

floatToRawIntBits, floatToIntBits, intBitsToFloat

#### **Texture Array Functions**

New sampler data types for texture arrays and texture buffers lead to new standard library routines to access these samplers.

New standard library functions are used to access 1D texture array samplers (sampler1DARRAY).

tex1DARRAY, tex1DARRAYbias, tex1DARRAYcmpbias, tex1DARRAYlod, tex1DARRAYcmlod, and tex1DARRAYproj

The dimensions of a texture array level can be determined.

`tex1DARRAYsize`

New standard library functions are used to access 2D texture array samplers (`sampler2DARRAY`).

`tex2DARRAY`, `tex2DARRAYbias`, `tex2DARRAYcmpbias`, `tex2DARRAYlod`, `tex2DARRAYcmlod`, and `tex2DARRAYproj`

The dimensions of a texture array level can be determined.

`tex2DARRAYsize`

## **SEE ALSO**

`gp4fp`, `gp4vp`, `texBUF`, `texBUFsize`, `floatToRawIntBits`, `floatToIntBits`, `intBitsToFloat`

`tex1DARRAY`, `tex1DARRAYbias`, `tex1DARRAYcmpbias`, `tex1DARRAYlod`, `tex1DARRAYcmlod`, `tex1DARRAYproj`, `tex1DARRAYsize`

`tex2DARRAY`, `tex2DARRAYbias`, `tex2DARRAYcmpbias`, `tex2DARRAYlod`, `tex2DARRAYcmlod`, `tex2DARRAYproj`, `tex2DARRAYsize`

**NAME**

**gp4vp** – OpenGL vertex profile for G8x (GeForce 8xxx Series, G8x-based Quadro FX, etc.)

**SYNOPSIS**

gp4vp

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by the GeForce 8800 and other G8x-based NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_gpu\_program4** and **ARB\_vertex\_program**.

Note that the **NV\_gpu\_program4** extension has its vertex domain-specific aspects documented in the **NV\_vertex\_program4** specification.

Data-dependent loops and branching *are* allowed.

Relative indexing of uniform arrays *is* supported.

Texture accesses are supported. While the prior **vp40** profile has substantial limitations on vertex texturing, the **gp4vp** profile eliminates all the limitations.

Texture accesses include support for texture arrays (see the EXT\_texture\_array OpenGL extension for more details) and texture buffer objects (see the EXT\_texture\_buffer\_object extension for details). Texture results can be either conventional floating-point vectors or integer vectors (see the EXT\_texture\_integer extension for details).

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_gpu\_program4** extension. This extension was introduced by the GeForce 8800 and other G8x-based GPUs.

Programmability:

[http://www.opengl.org/registry/specs/NV/gpu\\_program4.txt](http://www.opengl.org/registry/specs/NV/gpu_program4.txt)

[http://www.opengl.org/registry/specs/NV/vertex\\_program4.txt](http://www.opengl.org/registry/specs/NV/vertex_program4.txt)

New texture samplers:

[http://www.opengl.org/registry/specs/EXT/texture\\_array.txt](http://www.opengl.org/registry/specs/EXT/texture_array.txt)

[http://www.opengl.org/registry/specs/EXT/texture\\_buffer\\_object.txt](http://www.opengl.org/registry/specs/EXT/texture_buffer_object.txt)

New integer texture formats:

[http://www.opengl.org/registry/specs/EXT/texture\\_integer.txt](http://www.opengl.org/registry/specs/EXT/texture_integer.txt)

**PROFILE OPTIONS****Common GP4 Options**

fastimul

Assume integer multiply inputs have at most 24 significant bits. Example: “–po fastimul”

**DATA TYPES****Samplers**

This profile has additional samplers for texture arrays (1D and 2D) and texture buffers.

Standard OpenGL textures formats (GL\_RGBA8, etc.) return floating-point sampled results, but new signed and unsigned integer texture formats require samplers the return signed and unsigned integer vectors respectively. Sampler variants for fetching signed and unsigned integer vectors are prefixed by **i** and **u** respectively. Your application is required to make sure the bound textures have the appropriate texture format. So a 3D texture specified with the GL\_RGBA32UI\_EXT internal format (see the EXT\_texture\_integer OpenGL extension) must be used with a **usampler3D** sampler. Otherwise, texture

sampling returns undefined results.

#### sampler1D

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **float** vectors.

#### isampler1D

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **int** vectors.

#### usampler1D

1D texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D** target. Sampling returns **unsigned int** vectors.

#### sampler1DARRAY

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

#### isampler1DARRAY

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

#### usampler1DARRAY

1D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_1D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

#### sampler2D

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **float** vectors.

#### isampler2D

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **int** vectors.

#### usampler2D

2D texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D** target. Sampling returns **unsigned int** vectors.

#### sampler2DARRAY

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **float** vectors.

#### isampler2DARRAY

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **int** vectors.

#### usampler2DARRAY

2D array texture unit corresponding to OpenGL's **GL\_TEXTURE\_2D\_ARRAY\_EXT** target provided by the **EXT\_texture\_array** extension. Sampling returns **unsigned int** vectors.

#### sampler3D

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **float** vectors.

#### isampler3D

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **int** vectors.

#### usampler3D

3D texture unit corresponding to OpenGL's **GL\_TEXTURE\_3D** target. Sampling returns **unsigned int** vectors.

**samplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **float** vectors.

**isamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **int** vectors.

**usamplerCUBE**

Cube map texture unit corresponding to OpenGL's **GL\_TEXTURE\_CUBE\_MAP** target. Sampling returns **unsigned int** vectors.

**samplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **float** vectors.

**isamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **int** vectors.

**isamplerRECT**

Rectangle texture unit corresponding to OpenGL's **GL\_TEXTURE\_RECTANGLE\_ARB** target. Sampling returns **unsigned int** vectors.

**samplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **float** vectors.

**isamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **int** vectors.

**usamplerBUF**

Buffer texture unit corresponding to OpenGL's **GL\_TEXTURE\_BUFFER\_EXT** target provided by the **EXT\_texture\_buffer\_object** extension. Sampling returns **unsigned int** vectors.

**Floating-point**

float	32-bit IEEE floating-point
half	32-bit IEEE floating-point
double	32-bit IEEE floating-point
fixed	Floating-point restricted to $[-2,2)$ range.

**Integer**

This profile supports “true” integer data types. Shifting and bitwise operators are supported for integer data types.

int        32-bit signed integer

unsigned int  
          32-bit unsigned integer

short     16-bit signed integer

unsigned short  
          16-bit unsigned integer

char      8-bit signed integer

unsigned char  
8-bit unsigned integer

## SEMANTICS

### VARYING INPUT SEMANTICS

#### *Vertex Attribute Input Semantics*

For geometry shader profiles such as gp4gp, varying parameters with vertex attribute input semantics must be declared with the **AttribArray** template-style syntax because a geometry shader accepts an attribute array of vertex attributes (rather than individual vertex attributes as a vertex shader does).

Example defining a varying parameter for the position vertex attribute:

```
AttribArray<float4> position : POSITION
```

The set of binding semantics for varying input vertex attributes to gp4gp consists of POSITION, BLENDWEIGHT, NORMAL, COLOR0, COLOR1, TESSFACTOR, PSIZE, BLENDINDICES, and TEXCOORD0-TEXCOORD7. One can also use TANGENT and BINORMAL instead of TEXCOORD6 and TEXCOORD7.

Additionally, a set of binding semantics ATTR0-ATTR15 can be used. These binding semantics map to NV\_gpu\_program4 input attribute parameters as described in the NV\_geometry\_program4 document.

The two sets act as aliases to each other on NVIDIA GPUs excluding Apple Macs. ATI GPUs and NVIDIA Mac GPUs do *not* alias the conventional vertex attributes with the generic attributes.

Binding Semantics Name	Corresponding Data
POSITION, ATTR0	Input Vertex, Generic Attribute 0
BLENDWEIGHT, ATTR1	Input vertex weight, Generic Attribute 1
NORMAL, ATTR2	Input normal, Generic Attribute 2
DIFFUSE, COLOR0, ATTR3	Input primary color, Generic Attribute 3
SPECULAR, COLOR1, ATTR4	Input secondary color, Generic Attribute 4
TESSFACTOR, FOGCOORD, ATTR5	Input fog coordinate, Generic Attribute 5
PSIZE, ATTR6	Input point size, Generic Attribute 6
BLENDINDICES, ATTR7	Generic Attribute 7
TEXCOORD0-TEXCOORD7, ATTR8-ATTR15	Input texture coordinates (texcoord0-texcoord7) Generic Attributes 8-15
TANGENT, ATTR14	Generic Attribute 14
BINORMAL, ATTR15	Generic Attribute 15
VERTEXID	Input vertex ID (integer) Vertex index when using vertex arrays

These vertex attribute semantics should match with the semantics of the outputs of the vertex shader feeding the geometry shader.

**UNIFORM INPUT SEMANTICS***Buffer Semantics*

gp4 profiles can specify that uniforms be specified to reside within binable buffers.

Example of automatic, compiler-determined specification of a uniform's location within a buffer:

```
uniform float2 location    : BUFFER[3]; // compiler positions within buffer 3
uniform float4 brickColor  : BUFFER[3]; // compiler positions within buffer 3
```

Example of absolute byte offset specification of a uniform's location within a buffer:

```
uniform float4 mustBeHere : BUFFER[7][20]; // locate 20 bytes into buffer 7
```

*Constant Register Semantics*

```
C0-C255          Constant register [0..255].
                  The aliases c0-c255 (lowercase) are also accepted.
```

If used with a variable that requires more than one constant register (e.g. a matrix), the semantic specifies the first register that is used.

Example:

```
uniform float4 array[20] : C14; // uses c14 through c33
```

*Texture Unit Semantics*

```
TEXTUNIT0-TEXTUNIT15 Texture unit (but only 4 distinct texture units
                        are allowed)
```

Example:

```
uniform sampler2DARRAY texArray : TEXTUNIT7;
```

**OUTPUT SEMANTICS**

These vertex attribute output semantics match the output semantics for gp4vp.

Binding Semantics Name	Corresponding Data
POSITION, HPOS	Output position
PSIZE, PSIZ	Output point size
FOG, FOGC	Output fog coordinate
COLOR0, COL0	Output primary color
COLOR1, COL1	Output secondary color
BCOL0	Output backface primary color
BCOL1	Output backface secondary color
TEXCOORD0-TEXCOORD7, TEX0-TEX7	Output texture coordinates
CLP0-CL5	Output Clip distances

## STANDARD LIBRARY ISSUES

### Raw Cast from Floating-point to Integer Functions

It is possible to convert the raw bit patterns of IEEE single-precision floating-point to 32-bit unsigned integer.

floatToRawIntBits, floatToIntBits, intBitsToFloat

### Texture Array Functions

New sampler data types for texture arrays and texture buffers lead to new standard library routines to access these samplers.

New standard library functions are used to access 1D texture array samplers (sampler1DARRAY).

tex1DARRAY, tex1DARRAYbias, tex1DARRAYcmpbias, tex1DARRAYlod, tex1DARRAYcmlod, and tex1DARRAYproj

The dimensions of a texture array level can be determined.

tex1DARRAYsize

New standard library functions are used to access 2D texture array samplers (sampler2DARRAY).

tex2DARRAY, tex2DARRAYbias, tex2DARRAYcmpbias, tex2DARRAYlod, tex2DARRAYcmlod, and tex2DARRAYproj

The dimensions of a texture array level can be determined.

tex2DARRAYsize

## SEE ALSO

gp4fp, gp4gp, texBUF, texBUFsize, floatToRawIntBits, floatToIntBits, intBitsToFloat

tex1DARRAY, tex1DARRAYbias, tex1DARRAYcmpbias, tex1DARRAYlod, tex1DARRAYcmlod, tex1DARRAYproj, tex1DARRAYsize

tex2DARRAY, tex2DARRAYbias, tex2DARRAYcmpbias, tex2DARRAYlod, tex2DARRAYcmlod, tex2DARRAYproj, tex2DARRAYsize



**NAME**

**hlslf** – Translation profile to DirectX 9’s High Level Shader Language for pixel shaders.

**SYNOPSIS**

hlslf

**DESCRIPTION**

This Direct3D profile translates Cg into DirectX 9’s High Level Shader Language (HLSL) for pixel shaders.

The compiler output for this profile conforms to the textual high-level language defined by DirectX 9’s High Level Shading Language. See:

<http://msdn2.microsoft.com/en-us/library/bb509561.aspx>

The limitations of the **hlslf** profile depend on what HLSL profile to which the translated HLSL code is compiled.

**3D API DEPENDENCIES**

Requires Direct3D 9 support.

**PROFILE OPTIONS**

None.

**DATA TYPES**

In general, the Cg data types translate to the HLSL data types with the same name.

**half** NVIDIA GPUs may use half-precision floating-point when the Partial Precision instruction modifier is specified. Half-precision floating-point is encoded with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** The **float** data type corresponds to a floating-point representation with at least 24 bits.

NVIDIA GPUs supporting **hlslf** use standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

Older ATI GPUs use 24-bit floating-point.

**fixed** The **fixed** data type is treated like **half**.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **hlslf** profile correspond to the respectively named varying output semantics of the **vs\_2\_0** profile.

Binding Semantics Name	Corresponding Data
COLOR COLOR0 COL COL0	Input primary color
COLOR1 COL1	Input secondary color
TEX0 TEXCOORD0	Input texture coordinate sets 0
TEX1 TEXCOORD1	Input texture coordinate sets 1

TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)

### UNIFORM INPUT SEMANTICS

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

### OUTPUT SEMANTICS

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

### STANDARD LIBRARY ISSUES

This profile is limited to standard library support available in HLSL. In general, the Cg and HLSL standard libraries are very similar.

### SEE ALSO

The **hlslf** profile is similar to the OpenGL glslf profile that translates Cg into the OpenGL Shading Language (GLSL) for fragment shaders.

**NAME**

**hlslv** – Translation profile to DirectX 9’s High Level Shader Language for vertex shaders.

**SYNOPSIS**

hlslv

**DESCRIPTION**

This Direct3D profile translates Cg into DirectX 9’s High Level Shader Language (HLSL) for pixel shaders.

The compiler output for this profile conforms to the textual high-level language defined by DirectX 9’s High Level Shading Language. See:

<http://msdn2.microsoft.com/en-us/library/bb509561.aspx>

The limitations of the **hlslv** profile depend on what HLSL profile to which the translated HLSL code is compiled.

**3D API DEPENDENCIES**

Requires Direct3D 9 support.

**PROFILE OPTIONS**

None.

**DATA TYPES**

In general, the Cg data types translate to the HLSL data types with the same name.

float, half, fixed

These numeric data types all correspond to standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *single5*.

int      This integral data type operates like an integer over the  $-2^{24}$  to  $2^{24}$  range. The result of int by int division is an integer (rounding down) to match C.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **hlslv** profile correspond to the respectively named varying output semantics of the **ps\_2\_0** profile.

Binding Semantics Name	Corresponding Data
POSITION	Object-space position
NORMAL	Object-space normal
COLOR	Primary color (float4)
COLOR0	
DIFFUSE	
COLOR1	Secondary color (float4)
SPECULAR	
FOGCOORD	Fog coordinate
TEXCOORD#	Texture coordinate set #

**UNIFORM INPUT SEMANTICS***to-be-written***OUTPUT SEMANTICS**

Binding Semantics Name	Corresponding Data
POSITION HPOS	Clip-space position
COLOR COLOR0 COL0 COL	Front primary color
COLOR1 COL1	Front secondary color
TEXCOORD# TEX#	Texture coordinate set #
FOGC FOG	Fog coordinate
PSIZE PSIZ	Point size

**STANDARD LIBRARY ISSUES**

This profile is limited to standard library support available in HLSL for vertex shaders. In general, the Cg and HLSL standard libraries are very similar.

**SEE ALSO**

The hlslf profile is a similar translation profile for HLSL but for pixel (fragment) shaders.

The **hlslv** profile is similar to the OpenGL glslv profile that translates Cg into the OpenGL Shading Language (GLSL) for vertex shaders.

**NAME**

**ps\_1\_1** – Direct3D Shader Model 1.1 fragment profile for DirectX 8

**SYNOPSIS**

ps\_1\_1

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce 2 (NV1x) for DirectX 8.

The compiler output for this profile conforms to the textual assembly defined by DirectX 8's Pixel Shader 1.1 shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219842.aspx>

**3D API DEPENDENCIES**

Requires Direct3D 8 or 9 support.

**PROFILE OPTIONS**

*to-be-written*

**DATA TYPES**

*to-be-written*

**SEMANTICS****INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives are *not* supported.

**SEE ALSO**

The OpenGL fp20 profile is roughly equivalent but more powerful than the **ps\_1\_1** profile.

The Direct3D ps\_1\_2 and ps\_1\_3 profiles extend the **ps\_1\_1** profile.

**NAME**

**ps\_1\_2** – Direct3D Shader Model 1.2 fragment profile for DirectX 8

**SYNOPSIS**

ps\_1\_2

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce 2 (NV1x) for DirectX 8.

The compiler output for this profile conforms to the textual assembly defined by DirectX 8's Pixel Shader 1.2 shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219842.aspx>

**3D API DEPENDENCIES**

Requires Direct3D 8 or 9 support.

**PROFILE OPTIONS**

*to-be-written*

**DATA TYPES**

*to-be-written*

**SEMANTICS****INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives are *not* supported.

**SEE ALSO**

The OpenGL fp20 profile is roughly equivalent but more powerful than the **ps\_1\_2** profile.

The Direct3D ps\_1\_3 profile extends the **ps\_1\_2** profile.

**NAME**

**ps\_1\_3** – Direct3D Shader Model 1.1 fragment profile for DirectX 8

**SYNOPSIS**

ps\_1\_3

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce 3 (NV2x) for DirectX 8.

The compiler output for this profile conforms to the textual assembly defined by DirectX 8's Pixel Shader 1.3 shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219842.aspx>

**3D API DEPENDENCIES**

Requires Direct3D 8 or 9 support.

**PROFILE OPTIONS**

*to-be-written*

**DATA TYPES**

*to-be-written*

**SEMANTICS****INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives are *not* supported.

**SEE ALSO**

The OpenGL fp20 profile is roughly equivalent to the **ps\_1\_3** profile.

**NAME**

**ps\_2\_0** – Direct3D Shader Model 2.0 fragment profile for DirectX 9

**SYNOPSIS**

ps\_2\_0

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce FX (NV3x) for DirectX 9.

The compiler output for this profile conforms to the textual assembly defined by DirectX 9's Pixel Shader 2.0 shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219843.aspx>

**3D API DEPENDENCIES**

Requires Direct3D 9 support.

**PROFILE OPTIONS**

NumTemps=*val*

Number of 4-component vector temporaries the target implementation supports.

NumInstructionSlots=*val*

Number of instructions the target implementation supports.

MaxDrawBuffers=*val*

Number of draw buffers or Multiple Render Targets (MRT) the target implementation supports.

**DATA TYPES**

**half** The **half** data type makes use of the Partial Precision instruction modifier to request less precision.

NVIDIA GPUs may use half-precision floating-point when the Partial Precision instruction modifier is specified. Half-precision floating-point is encoded with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** The **float** data type corresponds to a floating-point representation with at least 24 bits.

NVIDIA GPUs supporting **ps\_2\_0** use standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

Older ATI GPUs use 24-bit floating-point.

**fixed** The **fixed** data type is treated like **half**.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **ps\_2\_0** profile correspond to the respectively named varying output semantics of the **vs\_2\_0** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COL0	
COLOR1	Input secondary color
COL1	



TEX0 TEXCOORD0	Input texture coordinate sets 0
TEX1 TEXCOORD1	Input texture coordinate sets 1
TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)

### UNIFORM INPUT SEMANTICS

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

### OUTPUT SEMANTICS

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

### STANDARD LIBRARY ISSUES

Functions that compute partial derivatives are *not* supported.

This profile may have limits on the number of dependent texture fetches.

**SEE ALSO**

The OpenGL arbfp1 profile is roughly equivalent to the **ps\_2\_0** profile.

The Direct3D ps\_2\_x profile extends the **ps\_2\_0**.

**NAME**

**ps\_2\_x** – Direct3D Shader Model 2.0 Extended fragment profile for DirectX 9

**SYNOPSIS**

`ps_2_x`

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce FX (NV3x) for DirectX 9.

The compiler output for this profile conforms to the textual assembly defined by DirectX 9's Pixel Shader 2.0 Extended shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219844.aspx>

This profile supports static and structured dynamic flow control.

**3D API DEPENDENCIES**

Requires Direct3D 9 support.

This profile generates code assuming the following Direct3D 9 pixel shader capability bits are set:

```
D3DD3DPSHADERCAPS2_0_ARBITRARYSWIZZLE
D3DD3DPSHADERCAPS2_0_GRADIENTINSTRUCTIONS
D3DD3DPSHADERCAPS2_0_PREDICATION
D3DD3DPSHADERCAPS2_0_NODEPENDENTREADLIMIT
D3DD3DPSHADERCAPS2_0_NOTEXINSTRUCTIONLIMIT
```

**PROFILE OPTIONS**

`NumTemps=val`

Number of 4-component vector temporaries the target implementation supports.

`NumInstructionSlots=val`

Number of instructions the target implementation supports.

`MaxDrawBuffers=val`

Number of draw buffers or Multiple Render Targets (MRT) the target implementation supports.

**DATA TYPES**

**half** The **half** data type makes use of the Partial Precision instruction modifier to request less precision.

NVIDIA GPUs may use half-precision floating-point when the Partial Precision instruction modifier is specified. Half-precision floating-point is encoded with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** The **float** data type corresponds to a floating-point representation with at least 24 bits.

NVIDIA GPUs supporting **ps\_2\_x** use standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

Older ATI GPUs use 24-bit floating-point.

**fixed** The **fixed** data type is treated like **half**.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **ps\_2\_x** profile correspond to the respectively named varying output semantics of the **vs\_2\_x** profile.

Binding Semantics Name	Corresponding Data
------------------------	--------------------

COLOR	Input primary color
COLOR0	
COL	
COL0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	
TEX1	Input texture coordinate sets 1
TEXCOORD1	
TEX2	Input texture coordinate sets 2
TEXCOORD2	
TEX3	Input texture coordinate sets 3
TEXCOORD3	
TEX4	Input texture coordinate sets 4
TEXCOORD4	
TEX5	Input texture coordinate sets 5
TEXCOORD5	
TEX6	Input texture coordinate sets 6
TEXCOORD6	
TEX7	Input texture coordinate sets 7
TEXCOORD7	
FOGP	Input fog color (XYZ) and factor (W)
FOG	

**UNIFORM INPUT SEMANTICS**

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

**OUTPUT SEMANTICS**

COLOR	Output color (float4)
COLOR0	
COL0	
COL	

DEPTH  
DEPR

Output depth (float)

### **STANDARD LIBRARY ISSUES**

Functions that compute partial derivatives are *not* supported.

There are no restrictions on dependent texture reads (up to the instruction limit) for this profile.

**NAME**

**ps\_3\_0** – Direct3D Shader Model 3.0 fragment profile for DirectX 9

**SYNOPSIS**

ps\_3\_0

**DESCRIPTION**

This Direct3D profile corresponds to the per-fragment functionality introduced by GeForce FX (NV3x) for DirectX 9.

The compiler output for this profile conforms to the textual assembly defined by DirectX 9's Pixel Shader 3.0 shader format. See:

<http://msdn2.microsoft.com/en-us/library/bb219845.aspx>

Data-dependent loops *are* allowed with a limit of 256 iterations maximum. Four levels of nesting are allowed.

Conditional expressions *can be* supported with data-dependent branching.

Relative indexing of uniform arrays is not supported; use texture accesses instead.

**3D API DEPENDENCIES**

Requires Direct3D 9 support.

**PROFILE OPTIONS**

None.

**DATA TYPES**

**half** The **half** data type makes use of the Partial Precision instruction modifier to request less precision.

NVIDIA GPUs may use half-precision floating-point when the Partial Precision instruction modifier is specified. Half-precision floating-point is encoded with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** **float** values in **ps\_3\_0** require standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

**fixed** The **fixed** data type is treated like **half**.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **ps\_3\_0** profile correspond to the respectively named varying output semantics of the **vs\_3\_0** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COLOR0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	

TEX1 TEXCOORD1	Input texture coordinate sets 1
TEX2 TEXCOORD2	Input texture coordinate sets 2
TEX3 TEXCOORD3	Input texture coordinate sets 3
TEX4 TEXCOORD4	Input texture coordinate sets 4
TEX5 TEXCOORD5	Input texture coordinate sets 5
TEX6 TEXCOORD6	Input texture coordinate sets 6
TEX7 TEXCOORD7	Input texture coordinate sets 7
FOGP FOG	Input fog color (XYZ) and factor (W)

**UNIFORM INPUT SEMANTICS**

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

**OUTPUT SEMANTICS**

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

**STANDARD LIBRARY ISSUES**

This profile may have limits on the number of dependent texture fetches.

**SEE ALSO**

The OpenGL fp40 profile is roughly equivalent to the **ps\_3\_0** profile.

**NAME**

**ps\_4\_0** – Translation profile to DirectX 10's High Level Shader Language for pixel shaders.

**SYNOPSIS**

ps\_4\_0

**DESCRIPTION**

This Direct3D profile translates Cg into DirectX 10's High Level Shader Language (HLSL10) for pixel shaders.

The compiler output for this profile conforms to the textual high-level language defined by DirectX 10's High Level Shading Language.

The limitations of the **ps\_4\_0** profile depend on what HLSL10 profile to which the translated HLSL code is compiled.

**3D API DEPENDENCIES**

Requires Direct3D 10 support.

**PROFILE OPTIONS**

-po pad16

This will add padding variables to the cbuffer declarations to match the 16 byte padding the GP4 OpenGL profiles use. This makes sure each variable in the cbuffer uses an entire float4 constant instead of the tight packing HLSL10 normally uses.

**DATA TYPES**

In general, the Cg data types translate to the HLSL10 data types with the same name.

**half** NVIDIA GPUs may use half-precision floating-point when the Partial Precision instruction modifier is specified. Half-precision floating-point is encoded with a sign bit, 10 mantissa bits, and 5 exponent bits (biased by 16), sometimes called *s10e5*.

**float** The **float** data type corresponds to a floating-point representation with at least 24 bits.

NVIDIA GPUs supporting **ps\_4\_0** use standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *s10e5*.

Older ATI GPUs use 24-bit floating-point.

**fixed** The **fixed** data type is treated like **half**.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **ps\_4\_0** profile correspond to the respectively named varying output semantics of the **vs\_4\_0** profile.

Binding Semantics Name	Corresponding Data
COLOR	Input primary color
COLOR0	
COL	
COLOR0	
COLOR1	Input secondary color
COL1	
TEX0	Input texture coordinate sets 0
TEXCOORD0	
	TEX# translates to TEXCOORD#



TEX1 TEXCOORD1	Input texture coordinate sets 1 TEX# translates to TEXCOORD#
TEX2 TEXCOORD2	Input texture coordinate sets 2 TEX# translates to TEXCOORD#
TEX3 TEXCOORD3	Input texture coordinate sets 3 TEX# translates to TEXCOORD#
TEX4 TEXCOORD4	Input texture coordinate sets 4 TEX# translates to TEXCOORD#
TEX5 TEXCOORD5	Input texture coordinate sets 5 TEX# translates to TEXCOORD#
TEX6 TEXCOORD6	Input texture coordinate sets 6 TEX# translates to TEXCOORD#
TEX7 TEXCOORD7	Input texture coordinate sets 7 TEX# translates to TEXCOORD#
FOGP FOG	Input fog color (XYZ) and factor (W)

### UNIFORM INPUT SEMANTICS

Sixteen texture units are supported:

Binding Semantic Name	Corresponding Data
TEXUNIT0	Texture unit 0
TEXUNIT1	Texture unit 1
...	
TEXUNIT15	Texture unit 15

### OUTPUT SEMANTICS

COLOR COLOR0 COL0 COL	Output color (float4)
DEPTH DEPR	Output depth (float)

### STANDARD LIBRARY ISSUES

This profile is limited to standard library support available in HLSL10. In general, the Cg and HLSL10 standard libraries are very similar.

### SEE ALSO

The vs\_4\_0 profile is a similar translation profile for HLSL10 but for vertex shaders.

The **ps\_4\_0** profile is similar to the DirectX 9 hlslf profile that translates Cg into the DirectX 9's HLSL for pixel (fragment) shaders.

**NAME**

**vp20** – OpenGL fragment profile for NV2x (GeForce3, GeForce4 Ti, Quadro DCC, etc.)

**SYNOPSIS**

vp20

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by GeForce3.

The compiler output for this profile conforms to the assembly format defined by **NV\_vertex\_program1\_1** (which assumes **NV\_vertex\_program**).

Data-dependent loops are not allowed; all loops must be unrollable.

Conditional expressions are supported without branching so both conditions must be evaluated.

Relative indexing of uniform arrays *is* supported; but texture accesses are not supported.

**3D API DEPENDENCIES**

Requires OpenGL support for **NV\_vertex\_program** and **NV\_vertex\_program1\_1** extensions. These extensions were introduced by GeForce3 and Quadro DCC GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/vertex\\_program.txt](http://www.opengl.org/registry/specs/NV/vertex_program.txt)

[http://www.opengl.org/registry/specs/NV/vertex\\_program1\\_1.txt](http://www.opengl.org/registry/specs/NV/vertex_program1_1.txt)

**PROFILE OPTIONS**

PosInv=*val*

Non-zero means generates code for position-invariant (with fixed-function) position transformation.

MaxLocalParams=*val*

Maximum number of local parameters the implementation supports.

**DATA TYPES**

*to-be-written*

**SEMANTICS****VARYING INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**OUTPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

*to-be-written*

**SEE ALSO**

arbvp1, fp20, vp30

**NAME**

**vp30** – OpenGL fragment profile for NV3x (GeForce FX, Quadro FX, etc.)

**SYNOPSIS**

vp30

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by the GeForce FX and Quadro FX line of NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_vertex\_program2**.

Data-dependent loops and branching *are* allowed.

Relative indexing of uniform arrays *is* supported; but texture accesses are not supported.

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_vertex\_program2** extension. These extensions were introduced by the GeForce FX and Quadro FX GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/vertex\\_program2.txt](http://www.opengl.org/registry/specs/NV/vertex_program2.txt)

**PROFILE OPTIONS**

PosInv=*val*

Non-zero means generates code for position-invariant (with fixed-function) position transformation.

MaxLocalParams=*val*

Maximum number of local parameters the implementation supports.

**DATA TYPES**

*to-be-written*

**SEMANTICS****VARYING INPUT SEMANTICS**

*to-be-written*

**UNIFORM INPUT SEMANTICS**

*to-be-written*

**OUTPUT SEMANTICS**

*to-be-written*

**STANDARD LIBRARY ISSUES**

*to-be-written*

**SEE ALSO**

arbp1, fp30, vp20, vp40

**NAME**

**vp40** – OpenGL vertex profile for NV4x (GeForce 6xxx and 7xxx Series, NV4x-based Quadro FX, etc.)

**SYNOPSIS**

vp40

**DESCRIPTION**

This OpenGL profile corresponds to the per-vertex functionality introduced by the GeForce 6800 and other NV4x-based NVIDIA GPUs.

The compiler output for this profile conforms to the assembly format defined by **NV\_vertex\_program3** and **ARB\_vertex\_program**.

Data-dependent loops and branching *are* allowed.

Relative indexing of uniform arrays *is* supported.

Texture accesses are supported. However substantial limitations on vertex texturing exist for hardware acceleration by NV4x hardware.

NV4x hardware accelerates vertex fetches only for 1-, 3-, and 4-component floating-point textures. NV4x hardware does not accelerated vertex-texturing for cube maps or 3D textures. NV4x does allow non-power-of-two sizes (width and height).

**3D API DEPENDENCIES**

Requires OpenGL support for the **NV\_fragment\_program3** extension. These extensions were introduced by the GeForce 6800 and other NV4x-based GPUs.

**OpenGL Extension Specifications**

[http://www.opengl.org/registry/specs/NV/vertex\\_program3.txt](http://www.opengl.org/registry/specs/NV/vertex_program3.txt)

[http://www.opengl.org/registry/specs/ARB/vertex\\_program.txt](http://www.opengl.org/registry/specs/ARB/vertex_program.txt)

**PROFILE OPTIONS**

PosInv=*val*

Non-zero means generates code for position-invariant (with fixed-function) position transformation.

NumTemps=*val*

Maximum number of temporary registers the implementation supports. Set to the implementation-dependent value of GL\_MAX\_NATIVE\_TEMPORARIES\_ARB for best performance.

MaxAddressRegs=*val*

Maximum number of address registers the implementation supports. Set to the implementation-dependent value of GL\_MAX\_NATIVE\_ADDRESS\_REGISTERS\_ARB for best performance.

MaxInstructions=*val*

Maximum number of instructions the implementation supports. Set to the implementation-dependent value of GL\_MAX\_NATIVE\_INSTRUCTIONS\_ARB for best performance.

MaxLocalParams=*val*

Maximum number of local parameters the implementation supports.

**DATA TYPES**

float

This profile implements the float data type as IEEE 32-bit single precision.

half

double

half and double data types are treated as float.

**int** The `int` data type is supported using floating point operations, which adds extra instructions for proper truncation for divides, modulus and casts from floating point types. Because integer values are simulated with IEEE single-precision floating-point, they are accurate over the range  $-2^{24}$  to  $2^{24}$  but will not overflow like true integers.

**fixed**

**sampler\***

This profile does not support any operations on the `fixed` or `sampler*` data types, but does provide the minimal *partial support* that is required for these data types by the core language spec (i.e. it is legal to declare variables using these types, as long as no operations are performed on the variables).

## SEMANTICS

### VARYING INPUT SEMANTICS

The set of binding semantics for varying input data to vp40 consists of POSITION, BLENDWEIGHT, NORMAL, COLOR0, COLOR1, TESSFACTOR, PSIZE, BLENDINDICES, and TEXCOORD0–TEXCOORD7. One can also use TANGENT and BINORMAL instead of TEXCOORD6 and TEXCOORD7.

Additionally, a set of binding semantics ATTR0–ATTR15 can be used. These binding semantics map to NV\_vertex\_program3 input attribute parameters.

The two sets act as aliases to each other on NVIDIA GPUs excluding Apple Macs. ATI GPUs and NVIDIA Mac GPUs do *not* alias the conventional vertex attributes with the generic attributes.

Binding Semantics Name	Corresponding Data
POSITION, ATTR0	Input Vertex, Generic Attribute 0
BLENDWEIGHT, ATTR1	Input vertex weight, Generic Attribute 1
NORMAL, ATTR2	Input normal, Generic Attribute 2
DIFFUSE, COLOR0, ATTR3	Input primary color, Generic Attribute 3
SPECULAR, COLOR1, ATTR4	Input secondary color, Generic Attribute 4
TESSFACTOR, FOGCOORD, ATTR5	Input fog coordinate, Generic Attribute 5
PSIZE, ATTR6	Input point size, Generic Attribute 6
BLENDINDICES, ATTR7	Generic Attribute 7
TEXCOORD0–TEXCOORD7, ATTR8–ATTR15	Input texture coordinates (texcoord0–texcoord7) Generic Attributes 8–15
TANGENT, ATTR14	Generic Attribute 14
BINORMAL, ATTR15	Generic Attribute 15

### UNIFORM INPUT SEMANTICS

C0–C255                      Constant register [0..255].  
The aliases c0–c255 (lowercase) are also accepted.

If used with a variable that requires more than one constant register (e.g. a matrix), the semantic specifies the first register that is used.

TEXUNIT0-TEXUNIT15 Texture unit (but only 4 distinct texture units are allowed)

### OUTPUT SEMANTICS

Binding Semantics Name	Corresponding Data
POSITION, HPOS	Output position
PSIZE, PSIZ	Output point size
FOG, FOGC	Output fog coordinate
COLOR0, COL0	Output primary color
COLOR1, COL1	Output secondary color
BCOL0	Output backface primary color
BCOL1	Output backface secondary color
TEXCOORD0-TEXCOORD7, TEX0-TEX7	Output texture coordinates
CLP0-CL5	Output Clip distances

### STANDARD LIBRARY ISSUES

Standard library routines for texture cube map and rectangle samplers are not supported by vp40.

### SEE ALSO

arbvpl, fp40, gp4vp

**NAME**

**vs\_4\_0** – Translation profile to DirectX 10's High Level Shader Language for vertex shaders.

**SYNOPSIS**

vs\_4\_0

**DESCRIPTION**

This Direct3D profile translates Cg into DirectX 10's High Level Shader Language (HLSL10) for vertex shaders.

The compiler output for this profile conforms to the textual high-level language defined by DirectX 10's High Level Shading Language.

The limitations of the **vs\_4\_0** profile depend on what HLSL profile to which the translated HLSL code is compiled.

**3D API DEPENDENCIES**

Requires Direct3D 10 support.

**PROFILE OPTIONS**

-po pad16

This will add padding variables to the cbuffer declarations to match the 16 byte padding the GP4 OpenGL profiles use. This makes sure each variable in the cbuffer uses an entire float4 constant instead of the tight packing HLSL10 normally uses.

**DATA TYPES**

In general, the Cg data types translate to the HLSL10 data types with the same name.

float, half, fixed

These numeric data types all correspond to standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *single5*.

int This integral data type operates like an integer over the  $-2^{24}$  to  $2^{24}$  range. The result of int by int division is an integer (rounding down) to match C.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **vs\_4\_0** profile correspond to the respectively named varying output semantics of the **ps\_4\_0** profile.

Binding Semantics Name	Corresponding Data
POSITION	Object-space position (SV_Position)
NORMAL	Object-space normal
COLOR	Primary color (float4) (SV_Target)
COLOR0	
DIFFUSE	
COLOR1	Secondary color (float4)
SPECULAR	
FOGCOORD	Fog coordinate
TEXCOORD#	Texture coordinate set #

**UNIFORM INPUT SEMANTICS****OUTPUT SEMANTICS**

Binding Semantics Name	Corresponding Data
POSITION HPOS	Clip-space position (SV_Position)
COLOR COLOR0 COL0 COL	Front primary color (SV_Target)
COLOR1 COL1	Front secondary color
TEXCOORD# TEX#	Texture coordinate set # TEX# is translated to TEXCOORD#
FOGC FOG	Fog coordinate
PSIZE PSIZ	Point size

**STANDARD LIBRARY ISSUES**

This profile is limited to standard library support available in HLSL10 for vertex shaders. In general, the Cg and HLSL10 standard libraries are very similar.

**SEE ALSO**

The ps\_4\_0 profile is a similar translation profile for HLSL10 but for pixel (fragment) shaders.

The **vs\_4\_0** profile is similar to the DirectX 9 hlslv profile that translates Cg into the DirectX 9's HLSL for vertex shaders.



**NAME**

**gs\_4\_0** – Translation profile to DirectX 10's High Level Shader Language for geometry shaders.

**SYNOPSIS**

gs\_4\_0

**DESCRIPTION**

This Direct3D profile translates Cg into DirectX 10's High Level Shader Language (HLSL10) for geometry shaders.

The compiler output for this profile conforms to the textual high-level language defined by DirectX 10's High Level Shading Language.

The limitations of the **gs\_4\_0** profile depend on what HLSL profile to which the translated HLSL code is compiled.

**3D API DEPENDENCIES**

Requires Direct3D 10 support.

**PROFILE OPTIONS**

-po pad16

This will add padding variables to the cbuffer declarations to match the 16 byte padding the GP4 OpenGL profiles use. This makes sure each variable in the cbuffer uses an entire float4 constant instead of the tight packing HLSL10 normally uses.

**DATA TYPES**

In general, the Cg data types translate to the HLSL10 data types with the same name.

float, half, fixed

These numeric data types all correspond to standard IEEE 754 single-precision floating-point encoding with a sign bit, 23 mantissa bits, and 8 exponent bits (biased by 128), sometimes called *single5*.

int This integral data type operates like an integer over the  $-2^{24}$  to  $2^{24}$  range. The result of int by int division is an integer (rounding down) to match C.

**SEMANTICS****INPUT SEMANTICS**

The varying input semantics in the **gs\_4\_0** profile correspond to the respectively named varying output semantics of the **vs\_4\_0** profile.

Binding Semantics Name	Corresponding Data
POSITION	Object-space position (SV_Position)
NORMAL	Object-space normal
COLOR	Primary color (float4) (SV_Target)
COLOR0	
DIFFUSE	
COLOR1	Secondary color (float4)
SPECULAR	
FOGCOORD	Fog coordinate
TEXCOORD#	Texture coordinate set #

**UNIFORM INPUT SEMANTICS****OUTPUT SEMANTICS**

Binding Semantics Name	Corresponding Data
POSITION HPOS	Clip-space position (SV_Position)
COLOR COLOR0 COL0 COL	Front primary color (SV_Target)
COLOR1 COL1	Front secondary color
TEXCOORD# TEX#	Texture coordinate set # TEX# is translated to TEXCOORD#
FOGC FOG	Fog coordinate
PSIZE PSIZ	Point size

**STANDARD LIBRARY ISSUES**

This profile is limited to standard library support available in HLSL10 for vertex shaders. In general, the Cg and HLSL10 standard libraries are very similar.

**SEE ALSO**

The ps\_4\_0 profile is a similar translation profile for HLSL10 but for pixel (fragment) shaders.

The vs\_4\_0 profile is a similar translation profile for HLSL10 but for vertex shaders.

The **gs\_4\_0** profile is similar to the OpenGL glslg profile that translates Cg into the OpenGL Shading Language for geometry shaders.

**NAME**

**abs** – returns absolute value of scalars and vectors.

**SYNOPSIS**

```
float  abs(float  a);  
float1 abs(float1 a);  
float2 abs(float2 a);  
float3 abs(float3 a);  
float4 abs(float4 a);
```

```
half   abs(half   a);  
half1  abs(half1  a);  
half2  abs(half2  a);  
half3  abs(half3  a);  
half4  abs(half4  a);
```

```
fixed  abs(fixed  a);  
fixed1 abs(fixed1 a);  
fixed2 abs(fixed2 a);  
fixed3 abs(fixed3 a);  
fixed4 abs(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the absolute value.

**DESCRIPTION**

Returns the absolute value of a scalar or vector.

For vectors, the returned vector contains the absolute value of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**abs** for a **float** scalar could be implemented like this.

```
float abs(float a)  
{  
    return max(-a, a);  
}
```

**PROFILE SUPPORT**

**abs** is supported in all profiles.

Support in the fp20 is limited.

Consider **abs** to be free or extremely inexpensive.

**SEE ALSO**

max

**NAME**

**acos** – returns arccosine of scalars and vectors.

**SYNOPSIS**

```
float   acos(float a);
float1  acos(float1 a);
float2  acos(float2 a);
float3  acos(float3 a);
float4  acos(float4 a);
```

```
half    acos(half a);
half1   acos(half1 a);
half2   acos(half2 a);
half3   acos(half3 a);
half4   acos(half4 a);
```

```
fixed   acos(fixed a);
fixed1  acos(fixed1 a);
fixed2  acos(fixed2 a);
fixed3  acos(fixed3 a);
fixed4  acos(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the arccosine.

**DESCRIPTION**

Returns the arccosine of *a* in the range [0,pi], expecting *a* to be in the range [-1,+1].

For vectors, the returned vector contains the arccosine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**acos** for a **float** scalar could be implemented like this.

```
// Handbook of Mathematical Functions
// M. Abramowitz and I.A. Stegun, Ed.

// Absolute error <= 6.7e-5
float acos(float x) {
    float negate = float(x < 0);
    x = abs(x);
    float ret = -0.0187293;
    ret = ret * x;
    ret = ret + 0.0742610;
    ret = ret * x;
    ret = ret - 0.2121144;
    ret = ret * x;
    ret = ret + 1.5707288;
    ret = ret * sqrt(1.0-x);
    ret = ret - 2 * negate * ret;
    return negate * 3.14159265358979 + ret;
}
```

**PROFILE SUPPORT**

**acos** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

abs, asin, cos, sqrt

**NAME**

**all** – returns true if a boolean scalar or all components of a boolean vector are true.

**SYNOPSIS**

```
bool all(bool a);  
bool all(bool1 a);  
bool all(bool2 a);  
bool all(bool3 a);  
bool all(bool4 a);
```

**PARAMETERS**

a            Boolean vector or scalar of which to determine if any component is true.

**DESCRIPTION**

Returns true if a boolean scalar or all components of a boolean vector are true.

**REFERENCE IMPLEMENTATION**

**all** for a **bool4** vector could be implemented like this.

```
bool all(bool4 a)  
{  
    return a.x && a.y && a.z && a.w;  
}
```

**PROFILE SUPPORT**

**all** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

any

**NAME**

**any** – returns true if a boolean scalar or any component of a boolean vector is true.

**SYNOPSIS**

```
bool any(bool a);  
bool any(bool1 a);  
bool any(bool2 a);  
bool any(bool3 a);  
bool any(bool4 a);
```

**PARAMETERS**

a            Boolean vector or scalar of which to determine if any component is true.

**DESCRIPTION**

Returns true if a boolean scalar or any component of a boolean vector is true.

**REFERENCE IMPLEMENTATION**

**any** for a **bool4** vector could be implemented like this.

```
bool any(bool4 a)  
{  
    return a.x || a.y || a.z || a.w;  
}
```

**PROFILE SUPPORT**

**any** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

all

**NAME**

**asin** – returns arcsine of scalars and vectors.

**SYNOPSIS**

```
float   asin(float a);
float1  asin(float1 a);
float2  asin(float2 a);
float3  asin(float3 a);
float4  asin(float4 a);
```

```
half    asin(half a);
half1   asin(half1 a);
half2   asin(half2 a);
half3   asin(half3 a);
half4   asin(half4 a);
```

```
fixed   asin(fixed a);
fixed1  asin(fixed1 a);
fixed2  asin(fixed2 a);
fixed3  asin(fixed3 a);
fixed4  asin(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the arcsine.

**DESCRIPTION**

Returns the arcsine of *a* in the range  $[-\pi/2, +\pi/2]$ , expecting *a* to be in the range  $[-1, +1]$ .

For vectors, the returned vector contains the arcsine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**asin** for a **float** scalar could be implemented like this.

```
// Handbook of Mathematical Functions
// M. Abramowitz and I.A. Stegun, Ed.

float asin(float x) {
    float negate = float(x < 0);
    x = abs(x);
    float ret = -0.0187293;
    ret *= x;
    ret += 0.0742610;
    ret *= x;
    ret -= 0.2121144;
    ret *= x;
    ret += 1.5707288;
    ret = 3.14159265358979*0.5 - sqrt(1.0 - x)*ret;
    return ret - 2 * negate * ret;
}
```

**PROFILE SUPPORT**

**asin** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

abs, acos, sin, sqrt



**NAME**

**atan** – returns arctangent of scalars and vectors.

**SYNOPSIS**

```
float   atan(float a);  
float1  atan(float1 a);  
float2  atan(float2 a);  
float3  atan(float3 a);  
float4  atan(float4 a);
```

```
half    atan(half a);  
half1   atan(half1 a);  
half2   atan(half2 a);  
half3   atan(half3 a);  
half4   atan(half4 a);
```

```
fixed   atan(fixed a);  
fixed1  atan(fixed1 a);  
fixed2  atan(fixed2 a);  
fixed3  atan(fixed3 a);  
fixed4  atan(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the arctangent.

**DESCRIPTION**

Returns the arctangent of *x* in the range of  $-\pi/2$  to  $\pi/2$  radians.

For vectors, the returned vector contains the arctangent of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**atan** for a **float** scalar could be implemented like this.

```
float atan(float x) {  
    return atan2(x, float(1));  
}
```

atan2 is typically implemented as an approximation.

**PROFILE SUPPORT**

**atan** is supported in all profiles but fp20.

**SEE ALSO**

abs, acos, asin, atan2, sqrt, tan

**NAME**

**atan2** – returns arctangent of scalars and vectors.

**SYNOPSIS**

```
float   atan2(float y, float x);
float1  atan2(float1 y, float1 x);
float2  atan2(float2 y, float2 x);
float3  atan2(float3 y, float3 x);
float4  atan2(float4 y, float4 x);

half    atan2(half y, half x);
half1   atan2(half1 y, half1 x);
half2   atan2(half2 y, half2 x);
half3   atan2(half3 y, half3 x);
half4   atan2(half4 y, half4 x);

fixed   atan2(fixed y, fixed x);
fixed1  atan2(fixed1 y, fixed1 x);
fixed2  atan2(fixed2 y, fixed2 x);
fixed3  atan2(fixed3 y, fixed3 x);
fixed4  atan2(fixed4 y, fixed4 x);
```

**PARAMETERS**

y        Vector or scalar for numerator of ratio of which to determine the arctangent.  
x        Vector or scalar of denominator of ratio of which to determine the arctangent.

**DESCRIPTION**

**atan2** calculates the arctangent of y/x. **atan2** is well defined for every point other than the origin, even if x equals 0 and y does not equal 0.

For vectors, the returned vector contains the arctangent of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**atan2** for a **float2** scalar could be implemented as an approximation like this.

```
float2 atan2(float2 y, float2 x)
{
    float2 t0, t1, t2, t3, t4;

    t3 = abs(x);
    t1 = abs(y);
    t0 = max(t3, t1);
    t1 = min(t3, t1);
    t3 = float(1) / t0;
    t3 = t1 * t3;

    t4 = t3 * t3;
    t0 = - float(0.013480470);
    t0 = t0 * t4 + float(0.057477314);
    t0 = t0 * t4 - float(0.121239071);
    t0 = t0 * t4 + float(0.195635925);
    t0 = t0 * t4 - float(0.332994597);
    t0 = t0 * t4 + float(0.999995630);
    t3 = t0 * t3;
```

```
t3 = (abs(y) > abs(x)) ? float(1.570796327) - t3 : t3;  
t3 = (x < 0) ? float(3.141592654) - t3 : t3;  
t3 = (y < 0) ? -t3 : t3;  
  
return t3;  
}
```

**PROFILE SUPPORT**

**atan2** is supported in all profiles but fp20.

**SEE ALSO**

abs, acos, asin, atan. sqrt, tan

**NAME**

**ceil** – returns smallest integer not less than a scalar or each vector component.

**SYNOPSIS**

```
float   ceil(float a);
float1  ceil(float1 a);
float2  ceil(float2 a);
float3  ceil(float3 a);
float4  ceil(float4 a);
```

```
half    ceil(half a);
half1   ceil(half1 a);
half2   ceil(half2 a);
half3   ceil(half3 a);
half4   ceil(half4 a);
```

```
fixed   ceil(fixed a);
fixed1  ceil(fixed1 a);
fixed2  ceil(fixed2 a);
fixed3  ceil(fixed3 a);
fixed4  ceil(fixed4 a);
```

**PARAMETERS**

a            Vector or scalar of which to determine the ceiling.

**DESCRIPTION**

Returns the ceiling or smallest integer not less than a scalar or each vector component.

**REFERENCE IMPLEMENTATION**

**ceil** for a **float** scalar could be implemented like this.

```
float ceil(float v)
{
    return -floor(-v);
}
```

**PROFILE SUPPORT**

**ceil** is supported in all profiles except fp20.

**SEE ALSO**

floor

**NAME**

**clamp** – returns smallest integer not less than a scalar or each vector component.

**SYNOPSIS**

```
float   clamp(float x, float a, float b);
float1  clamp(float1 x, float1 a, float1 b);
float2  clamp(float2 x, float2 a, float2 b);
float3  clamp(float3 x, float3 a, float3 b);
float4  clamp(float4 x, float4 a, float4 b);

half    clamp(half x, half a, half b);
half1   clamp(half1 x, half1 a, half1 b);
half2   clamp(half2 x, half2 a, half2 b);
half3   clamp(half3 x, half3 a, half3 b);
half4   clamp(half4 x, half4 a, half4 b);

fixed   clamp(fixed x, fixed a, fixed b);
fixed1  clamp(fixed1 x, fixed1 a, fixed1 b);
fixed2  clamp(fixed2 x, fixed2 a, fixed2 b);
fixed3  clamp(fixed3 x, fixed3 a, fixed3 b);
fixed4  clamp(fixed4 x, fixed4 a, fixed4 b);
```

**PARAMETERS**

**x**        Vector or scalar to clamp.  
**a**        Vector or scalar for bottom of clamp range.  
**b**        Vector or scalar for top of clamp range.

**DESCRIPTION**

Returns  $x$  clamped to the range  $[a,b]$  as follows:

- 1) Returns  $a$  if  $x$  is less than  $a$ ; else
- 2) Returns  $b$  if  $x$  is greater than  $b$ ; else
- 3) Returns  $x$  otherwise.

For vectors, the returned vector contains the clamped result of each element of the vector  $x$  clamped using the respective element of vectors  $a$  and  $b$ .

**REFERENCE IMPLEMENTATION**

**clamp** for **float** scalars could be implemented like this.

```
float clamp(float x, float a, float b)
{
    return max(a, min(b, x));
}
```

**PROFILE SUPPORT**

**clamp** is supported in all profiles except fp20.

**SEE ALSO**

max, min, saturate

**NAME**

**clip** – conditionally kill a pixel before output

**SYNOPSIS**

```
void clip(float4 x);  
void clip(float3 x);  
void clip(float2 x);  
void clip(float1 x);  
void clip(float x);
```

**PARAMETERS**

x            Vector/scalar condition to clip on

**DESCRIPTION**

kills the current pixel output if any component of the given vector, or the given scalar, is negative

**REFERENCE IMPLEMENTATION**

**clip** is equivalent to

```
void clip(float4 x)  
{  
    if (any(x < 0))  
        discard;  
}
```

**PROFILE SUPPORT**

**clip** is supported in all pixel/fragment profiles.

**SEE ALSO**

**NAME**

**cos** – returns cosine of scalars and vectors.

**SYNOPSIS**

```
float   cos(float a);
float1  cos(float1 a);
float2  cos(float2 a);
float3  cos(float3 a);
float4  cos(float4 a);

half    cos(half a);
half1   cos(half1 a);
half2   cos(half2 a);
half3   cos(half3 a);
half4   cos(half4 a);

fixed   cos(fixed a);
fixed1  cos(fixed1 a);
fixed2  cos(fixed2 a);
fixed3  cos(fixed3 a);
fixed4  cos(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the cosine.

**DESCRIPTION**

Returns the cosine of *a* in radians. The return value is in the range  $[-1,+1]$ .

For vectors, the returned vector contains the cosine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**cos** is best implemented as a native cosine instruction, however **cos** for a **float** scalar could be implemented by an approximation like this.

```
cos(float a)
{
    /* C simulation gives a max absolute error of less than 1.8e-7 */
    const float4 c0 = float4( 0.0,          0.5,
                              1.0,          0.0          );
    const float4 c1 = float4( 0.25,         -9.0,
                              0.75,         0.159154943091 );
    const float4 c2 = float4( 24.9808039603, -24.9808039603,
                              -60.1458091736, 60.1458091736 );
    const float4 c3 = float4( 85.4537887573, -85.4537887573,
                              -64.9393539429, 64.9393539429 );
    const float4 c4 = float4( 19.7392082214, -19.7392082214,
                              -1.0,          1.0          );

    /* r0.x = cos(a) */
    float3 r0, r1, r2;
```

```

r1.x = c1.w * a; // normalize input
r1.y = frac( r1.x ); // and extract fraction
r2.x = (float) ( r1.y < c1.x ); // range check: 0.0 to 0.25
r2.yz = (float2) ( r1.yy >= c1.yz ); // range check: 0.75 to 1.0
r2.y = dot( r2, c4.zwz ); // range check: 0.25 to 0.75
r0 = c0.xyz - r1.yyy; // range centering
r0 = r0 * r0;
r1 = c2.xyx * r0 + c2.zwz; // start power series
r1 = r1 * r0 + c3.xyx;
r1 = r1 * r0 + c3.zwz;
r1 = r1 * r0 + c4.xyx;
r1 = r1 * r0 + c4.zwz;
r0.x = dot( r1, -r2 ); // range extract

return r0.x;

```

## PROFILE SUPPORT

**cos** is fully supported in all profiles unless otherwise specified.

**cos** is supported via an approximation (shown above) in the vs\_1, vp20, and arbvp1 profiles.

**cos** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, and ps\_1\_3 profiles.

## SEE ALSO

acos, dot, frac, sin, sincos, tan



**NAME**

**cosh** – returns hyperbolic cosine of scalars and vectors.

**SYNOPSIS**

```
float   cosh(float a);  
float1  cosh(float1 a);  
float2  cosh(float2 a);  
float3  cosh(float3 a);  
float4  cosh(float4 a);
```

```
half    cosh(half a);  
half1   cosh(half1 a);  
half2   cosh(half2 a);  
half3   cosh(half3 a);  
half4   cosh(half4 a);
```

```
fixed   cosh(fixed a);  
fixed1  cosh(fixed1 a);  
fixed2  cosh(fixed2 a);  
fixed3  cosh(fixed3 a);  
fixed4  cosh(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the hyperbolic cosine.

**DESCRIPTION**

Returns the hyperbolic cosine of *a*.

For vectors, the returned vector contains the hyperbolic cosine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**cosh** for a scalar **float** could be implemented like this.

```
float cosh(float x)  
{  
    return 0.5 * (exp(x)+exp(-x));  
}
```

**PROFILE SUPPORT**

**cosh** is supported in all profiles except fp20.

**SEE ALSO**

acos, cos, exp, sinh, tanh

**NAME**

**cross** – returns the cross product of two three-component vectors

**SYNOPSIS**

```
float3 cross(float3 a, float3 b);
```

```
half3 cross(half3 a, half3 b);
```

```
fixed3 cross(fixed3 a, fixed3 b);
```

**PARAMETERS**

**a** Three-component vector.

**b** Three-component vector.

**DESCRIPTION**

Returns the cross product of three-component vectors *a* and *b*. The result is a three-component vector.

**REFERENCE IMPLEMENTATION**

**cross** for **float3** vectors could be implemented this way:

```
float3 cross(float3 a, float3 b)
{
    return a.yzx * b.zxy - a.zxy * b.yzx;
}
```

**PROFILE SUPPORT**

**cross** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

dot

**NAME**

**ddx** – returns approximate partial derivative with respect to window-space X

**SYNOPSIS**

```
float   ddx(float a);
float1  ddx(float1 a);
float2  ddx(float2 a);
float3  ddx(float3 a);
float4  ddx(float4 a);

half    ddx(half a);
half1   ddx(half1 a);
half2   ddx(half2 a);
half3   ddx(half3 a);
half4   ddx(half4 a);

fixed   ddx(fixed a);
fixed1  ddx(fixed1 a);
fixed2  ddx(fixed2 a);
fixed3  ddx(fixed3 a);
fixed4  ddx(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to approximate the partial derivative with respect to window-space X.

**DESCRIPTION**

Returns approximate partial derivative of *a* with respect to the window-space (horizontal) *x* coordinate.

For vectors, the returned vector contains the approximate partial derivative of each element of the input vector.

This function is only available in fragment program profiles (but not all of them).

The specific way the partial derivative is computed is implementation-dependent. Typically fragments are rasterized in 2x2 arrangements of fragments (called quad-fragments) and the partial derivatives of a variable is computed by differencing with the adjacent horizontal fragment in the quad-fragment.

The partial derivative computation may incorrect when **ddx** is used in control flow paths where not all the fragments within a quad-fragment have branched the same way.

The partial derivative computation may be less exact (wobbly) when the variable is computed based on varying parameters interpolated with centroid interpolation.

**REFERENCE IMPLEMENTATION**

**ddx** is not expressible in Cg code.

**PROFILE SUPPORT**

**ddx** is supported only in fragment profiles. Vertex and geometry profiles lack the concept of window space.

**ddx** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, ps\_1\_3, and arbfpl profiles.

**SEE ALSO**

ddy, fp30, fp40, fwidth, gp4fp

**NAME**

**ddy** – returns approximate partial derivative with respect to window-space Y

**SYNOPSIS**

```
float   ddy(float a);
float1  ddy(float1 a);
float2  ddy(float2 a);
float3  ddy(float3 a);
float4  ddy(float4 a);

half    ddy(half a);
half1   ddy(half1 a);
half2   ddy(half2 a);
half3   ddy(half3 a);
half4   ddy(half4 a);

fixed   ddy(fixed a);
fixed1  ddy(fixed1 a);
fixed2  ddy(fixed2 a);
fixed3  ddy(fixed3 a);
fixed4  ddy(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to approximate the partial derivative with respect to window-space Y.

**DESCRIPTION**

Returns approximate partial derivative of *a* with respect to the window-space (vertical) y coordinate.

For vectors, the returned vector contains the approximate partial derivative of each element of the input vector.

This function is only available in fragment program profiles (but not all of them).

The specific way the partial derivative is computed is implementation-dependent. Typically fragments are rasterized in 2x2 arrangements of fragments (called quad-fragments) and the partial derivatives of a variable is computed by differencing with the adjacent horizontal fragment in the quad-fragment.

The partial derivative computation may incorrect when **ddy** is used in control flow paths where not all the fragments within a quad-fragment have branched the same way.

The partial derivative computation may be less exact (wobbly) when the variable is computed based on varying parameters interpolated with centroid interpolation.

**REFERENCE IMPLEMENTATION**

**ddy** is not expressible in Cg code.

**PROFILE SUPPORT**

**ddy** is supported only in fragment profiles. Vertex and geometry profiles lack the concept of window space.

**ddy** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, ps\_1\_3, and arbfpl profiles.

**SEE ALSO**

ddx, fp30, fp40, fwidth, gp4fp

**NAME**

**degrees** – converts values of scalars and vectors from radians to degrees

**SYNOPSIS**

```
float  degrees(float  a);
float1 degrees(float1 a);
float2 degrees(float2 a);
float3 degrees(float3 a);
float4 degrees(float4 a);

half   degrees(half   a);
half1  degrees(half1  a);
half2  degrees(half2  a);
half3  degrees(half3  a);
half4  degrees(half4  a);

fixed  degrees(fixed  a);
fixed1 degrees(fixed1 a);
fixed2 degrees(fixed2 a);
fixed3 degrees(fixed3 a);
fixed4 degrees(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to convert from radians to degrees.

**DESCRIPTION**

Returns the scalar or vector converted from radians to degrees.

For vectors, the returned vector contains each element of the input vector converted from radians to degrees.

**REFERENCE IMPLEMENTATION**

**degrees** for a **float** scalar could be implemented like this.

```
float degrees(float a)
{
    return 57.29577951 * a;
}
```

**PROFILE SUPPORT**

**degrees** is supported in all profiles except fp20.

**SEE ALSO**

cos, radians, sin, tan

**NAME**

**determinant** – returns the scalar determinant of a square matrix

**SYNOPSIS**

```
float determinant(float1x1 A);
float determinant(float2x2 A);
float determinant(float3x3 A);
float determinant(float4x4 A);
```

**PARAMETERS**

A        Square matrix of which to compute the determinant.

**DESCRIPTION**

Returns the determinant of the square matrix A.

**REFERENCE IMPLEMENTATION**

The various **determinant** functions can be implemented like this:

```
float determinant(float1x1 A)
{
    return A._m00;
}

float determinant(float2x2 A)
{
    return A._m00*A._m11 - A._m01*A._m10;
}

float determinant(float3x3 A)
{
    return dot(A._m00_m01_m02,
               A._m11_m12_m10 * A._m22_m20_m21
               - A._m12_m10_m11 * A._m21_m22_m20);
}

float determinant(float4x4 A) {
    return dot(float4(1,-1,1,-1) * A._m00_m01_m02_m03,
               A._m11_m12_m13_m10*( A._m22_m23_m20_m21*A._m33_m30_m31_m32
                                     - A._m23_m20_m21_m22*A._m32_m33_m30_m31)
               + A._m12_m13_m10_m11*( A._m23_m20_m21_m22*A._m31_m32_m33_m30
                                     - A._m21_m22_m23_m20*A._m33_m30_m31_m32)
               + A._m13_m10_m11_m12*( A._m21_m22_m23_m20*A._m32_m33_m30_m31
                                     - A._m22_m23_m20_m21*A._m31_m32_m33_m30) );
}
```

**PROFILE SUPPORT**

**determinant** is supported in all profiles. However profiles such as fp20 and ps\_2 without native floating-point will have problems computing the larger determinants and may have ranges issues computing even small determinants.

**SEE ALSO**

mul, transpose

**NAME**

**distance** – return the Euclidean distance between two points

**SYNOPSIS**

```
float distance(float pt1, float pt2);
float distance(float1 pt1, float1 pt2);
float distance(float2 pt1, float2 pt2);
float distance(float3 pt1, float3 pt2);
float distance(float4 pt1, float4 pt2);

half distance(half pt1, half pt2);
half distance(half1 pt1, half1 pt2);
half distance(half2 pt1, half2 pt2);
half distance(half3 pt1, half3 pt2);
half distance(half4 pt1, half4 pt2);

fixed distance(fixed pt1, fixed pt2);
fixed distance(fixed1 pt1, fixed1 pt2);
fixed distance(fixed2 pt1, fixed2 pt2);
fixed distance(fixed3 pt1, fixed3 pt2);
fixed distance(fixed4 pt1, fixed4 pt2);
```

**PARAMETERS**

pt1      First point.  
pt2      Second point.

**DESCRIPTION**

Returns the Euclidean distance from a first point *pt1* to a second point *pt2*.

**REFERENCE IMPLEMENTATION**

**distance** for a **float3** vector could be implemented like this.

```
float distance(float3 pt1, float3 pt2)
{
    float3 v = pt2 - pt1;
    return sqrt(dot(v,v));
}
```

**PROFILE SUPPORT**

**distance** is supported in all profiles except fp20.

**SEE ALSO**

dot, length, normalize, sqrt

**NAME**

**dot** – returns the scalar dot product of two vectors

**SYNOPSIS**

```
float   dot(float  a, float  b);
float1  dot(float1 a, float1 b);
float2  dot(float2 a, float2 b);
float3  dot(float3 a, float3 b);
float4  dot(float4 a, float4 b);

half    dot(half   a, half   b);
half1   dot(half1  a, half1  b);
half2   dot(half2  a, half2  b);
half3   dot(half3  a, half3  b);
half4   dot(half4  a, half4  b);

fixed   dot(fixed  a, fixed  b);
fixed1  dot(fixed1 a, fixed1 b);
fixed2  dot(fixed2 a, fixed2 b);
fixed3  dot(fixed3 a, fixed3 b);
fixed4  dot(fixed4 a, fixed4 b);
```

**PARAMETERS**

**a**        First vector.  
**b**        Second vector.

**DESCRIPTION**

Returns the scalar dot product of two same-typed vectors *a* and *b*.

**REFERENCE IMPLEMENTATION**

**dot** for **float4** vectors could be implemented this way:

```
float dot(float4 a, float4 b)
{
    return a.x*b.x + a.y*b.y + a.z*b.z + a.w*b.w;
}
```

**PROFILE SUPPORT**

**dot** is supported in all profiles.

The **fixed3** dot product is very efficient in the fp20 and fp30 profiles.

The **float3** and **float4** dot products are very efficient in the vp20, vp30, vp40, arbvp1, fp30, fp40, and arbfpl profiles.

The **float2** dot product is very efficient in the fp40 profile. In optimal circumstances, two two-component dot products can sometimes be performed at the four-component and three-component dot product rate.

**SEE ALSO**

cross, lit, mul



**NAME**

**exp** – returns the base-e exponential of scalars and vectors

**SYNOPSIS**

```
float   exp(float a);
float1  exp(float1 a);
float2  exp(float2 a);
float3  exp(float3 a);
float4  exp(float4 a);
```

```
half    exp(half a);
half1   exp(half1 a);
half2   exp(half2 a);
half3   exp(half3 a);
half4   exp(half4 a);
```

```
fixed   exp(fixed a);
fixed1  exp(fixed1 a);
fixed2  exp(fixed2 a);
fixed3  exp(fixed3 a);
fixed4  exp(fixed4 a);
```

**PARAMETERS**

**a**        Vector or scalar of which to determine the base-e exponential. The value e is approximately 2.71828182845904523536.

**DESCRIPTION**

Returns the base-e exponential *a*.

For vectors, the returned vector contains the base-e exponential of each element of the input vector.

**REFERENCE IMPLEMENTATION**

```
float3 exp(float3 a)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = exp(a[i]); // this is the ANSI C standard library exp()
    }
    return rv;
}
```

**exp** is typically implemented with either a native base-2 exponential instruction or pow.

**PROFILE SUPPORT**

**exp** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp2, log, pow

**NAME**

**exp2** – returns the base-2 exponential of scalars and vectors

**SYNOPSIS**

```
float   exp2(float a);
float1  exp2(float1 a);
float2  exp2(float2 a);
float3  exp2(float3 a);
float4  exp2(float4 a);
```

```
half    exp2(half a);
half1   exp2(half1 a);
half2   exp2(half2 a);
half3   exp2(half3 a);
half4   exp2(half4 a);
```

```
fixed   exp2(fixed a);
fixed1  exp2(fixed1 a);
fixed2  exp2(fixed2 a);
fixed3  exp2(fixed3 a);
fixed4  exp2(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the base-2 exponential.

**DESCRIPTION**

Returns the base-2 exponential *a*.

For vectors, the returned vector contains the base-2 exponential of each element of the input vector.

**REFERENCE IMPLEMENTATION**

```
float3 exp2(float3 a)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = exp2(a[i]); // this is the ANSI C standard library exp2()
    }
    return rv;
}
```

**exp2** is typically implemented with a native base-2 exponential instruction.

**PROFILE SUPPORT**

**exp2** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp, log, pow

**NAME**

**faceforward** – returns a normal as-is if a vertex's eye-space position vector points in the opposite direction of a geometric normal, otherwise return the negated version of the normal

**SYNOPSIS**

```
float   faceforward(float   N, float   I, float   Ng);
float1  faceforward(float1  N, float1  I, float1  Ng);
float2  faceforward(float2  N, float2  I, float2  Ng);
float3  faceforward(float3  N, float3  I, float3  Ng);
float4  faceforward(float4  N, float4  I, float4  Ng);

half    faceforward(half    N, half    I, half    Ng);
half1   faceforward(half1   N, half1   I, half1   Ng);
half2   faceforward(half2   N, half2   I, half2   Ng);
half3   faceforward(half3   N, half3   I, half3   Ng);
half4   faceforward(half4   N, half4   I, half4   Ng);

fixed   faceforward(fixed   N, fixed   I, fixed   Ng);
fixed1  faceforward(fixed1  N, fixed1  I, fixed1  Ng);
fixed2  faceforward(fixed2  N, fixed2  I, fixed2  Ng);
fixed3  faceforward(fixed3  N, fixed3  I, fixed3  Ng);
fixed4  faceforward(fixed4  N, fixed4  I, fixed4  Ng);
```

**PARAMETERS**

**N**        Peturbed normal vector.

**I**        Incidence vector (typically a direction vector from the eye to a vertex).

**Ng**       Geometric normal vector (for some facet the peturbed normal belongs).

**DESCRIPTION**

Returns a (peturbed) normal as-is if a vertex's eye-space position vector points in the opposite direction of a geometric normal, otherwise return the negated version of the (peturbed) normal

Mathematically, if the dot product of *I* and *Ng* is negative, *N* is returned unchanged; otherwise *-N* is returned.

This function is inspired by a RenderMan function of the same name though the RenderMan version has only two parameters.

**REFERENCE IMPLEMENTATION**

**faceforward** for **float3** vectors could be implemented this way:

```
float3 faceforward( float3 N, float3 I, float Ng )
{
    return dot(I, Ng) < 0 ? N : -N;
}
```

**PROFILE SUPPORT**

**refract** is supported in all profiles.

**SEE ALSO**

dot, reflect, refract, normalize

**NAME**

**floatToIntBits** – returns the 32-bit integer representation of an IEEE 754 floating-point scalar or vector

**SYNOPSIS**

```
int  floatToIntBits(float  x);
int1 floatToIntBits(float1 x);
int2 floatToIntBits(float2 x);
int3 floatToIntBits(float3 x);
int4 floatToIntBits(float4 x);
```

**PARAMETERS**

x            Floating-point vector or scalar to cast to a scalar int or vector of ints.

**DESCRIPTION**

Returns a representation of the specified floating-point scalar value or vector values according to the IEEE 754 floating-point “single format” bit layout.

Not-A-Number (NaN) floating-point values are canonicalized to the integer value 0x7fc00000 regardless of the specific NaN encoding. The sign bit of the NaN is discarded.

This function is based on Java’s java.lang.Float method of the same name. See:

<http://java.sun.com/j2se/1.4.2/docs/api/java/lang/Float.html>

**floatToIntBits** requires instructions to be generated to canonicalize NaN values so **floatToIntBits** is typically more expensive than **floatToRawIntBits**.

**REFERENCE IMPLEMENTATION**

**floatToIntBits** operates consistent with the following ANSI C code:

```
int floatToIntBits(float  x)
{
    union {
        float f;  // assuming 32-bit IEEE 754 single-precision
        int i;    // assuming 32-bit 2's complement int
    } u;

    if (isnan(x)) {
        return 0x7fc00000;
    } else {
        u.f = x;
        return u.i;
    }
}
```

**PROFILE SUPPORT**

**floatToIntBits** is supported by the gp4vp, gp4gp, and gp4vp profiles.

**floatToIntBits** is *not* supported by pre-G80 profiles.

**SEE ALSO**

ceil, floatToRawIntBits, floor, intBitsToFloat, round, trunc

**NAME**

**floatToRawIntBits** – returns the raw 32-bit integer representation of an IEEE 754 floating-point scalar or vector

**SYNOPSIS**

```
int  floatToRawIntBits(float  x);
int1 floatToRawIntBits(float1 x);
int2 floatToRawIntBits(float2 x);
int3 floatToRawIntBits(float3 x);
int4 floatToRawIntBits(float4 x);
```

**PARAMETERS**

x Floating-point vector or scalar to raw cast to a scalar int or vector of ints.

**DESCRIPTION**

Returns a representation of the specified floating-point scalar value or vector values according to the IEEE 754 floating-point “single format” bit layout, preserving Not-a-Number (NaN) values.

This function is based on Java’s `java.lang.Float` method of the same name. See:

<http://java.sun.com/j2se/1.4.2/docs/api/java/lang/Float.html>

The Cg compiler can typically optimize **floatToRawIntBits** so it has no instruction cost.

**REFERENCE IMPLEMENTATION**

**floatToRawIntBits** operates consistent with the following ANSI C code:

```
int floatToRawIntBits(float  x)
{
    union {
        float f; // assuming 32-bit IEEE 754 single-precision
        int i;   // assuming 32-bit 2’s complement int
    } u;

    u.f = x;
    return u.i;
}
```

**PROFILE SUPPORT**

**floatToRawIntBits** is supported by the gp4vp, gp4gp, and gp4vp profiles.

**floatToRawIntBits** is *not* supported by pre-G80 profiles.

**SEE ALSO**

`ceil`, `floatToIntBits`, `floor`, `intBitsToFloat`, `round`, `trunc`

**NAME**

**floor** – returns largest integer not greater than a scalar or each vector component.

**SYNOPSIS**

```
float   floor(float a);
float1  floor(float1 a);
float2  floor(float2 a);
float3  floor(float3 a);
float4  floor(float4 a);
```

```
half    floor(half a);
half1   floor(half1 a);
half2   floor(half2 a);
half3   floor(half3 a);
half4   floor(half4 a);
```

```
fixed   floor(fixed a);
fixed1  floor(fixed1 a);
fixed2  floor(fixed2 a);
fixed3  floor(fixed3 a);
fixed4  floor(fixed4 a);
```

**PARAMETERS**

a            Vector or scalar of which to determine the floor.

**DESCRIPTION**

Returns the floor or largest integer not greater than a scalar or each vector component.

**REFERENCE IMPLEMENTATION**

**floor** for a **float3** vector could be implemented like this.

```
float3 floor(float3 v)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = v[i] - frac(v[i]);
    }
    return rv;
}
```

**PROFILE SUPPORT**

**floor** is supported in all profiles except fp20.

**SEE ALSO**

ceil, round

**NAME**

**fmod** – returns the remainder of  $x/y$  with the same sign as  $x$

**SYNOPSIS**

```
float   fmod(float x, float y);
float1  fmod(float1 x, float1 y);
float2  fmod(float2 x, float2 y);
float3  fmod(float3 x, float3 y);
float4  fmod(float4 x, float4 y);
```

```
half    fmod(half x, half y);
half1   fmod(half1 x, half1 y);
half2   fmod(half2 x, half2 y);
half3   fmod(half3 x, half3 y);
half4   fmod(half4 x, half4 y);
```

```
fixed   fmod(fixed x, fixed y);
fixed1  fmod(fixed1 x, fixed1 y);
fixed2  fmod(fixed2 x, fixed2 y);
fixed3  fmod(fixed3 x, fixed3 y);
fixed4  fmod(fixed4 x, fixed4 y);
```

**PARAMETERS**

$x$         Vector or scalar numerator  
 $y$         Vector or scalar denominator

**DESCRIPTION**

**fmod** returns the remainder of  $x$  divided by  $y$  with the same sign as  $x$ . If  $y$  is zero, the result is implementation-defined because of division by zero.

For vectors, the returned vector contains the signed remainder of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**fmod** for an **float2** vector could be implemented as:

```
float2 fmod(float2 a, float2 b)
{
    float2 c = frac(abs(a/b))*abs(b);
    return (a < 0) ? -c : c;    /* if ( a < 0 ) c = 0-c */
}
```

**PROFILE SUPPORT**

**fmod** is supported in all profiles but fp20.

**SEE ALSO**

abs, frac

**NAME**

**frac** – returns the fractional portion of a scalar or each vector component.

**SYNOPSIS**

```
float   frac(float a);
float1  frac(float1 a);
float2  frac(float2 a);
float3  frac(float3 a);
float4  frac(float4 a);
```

```
half    frac(half a);
half1   frac(half1 a);
half2   frac(half2 a);
half3   frac(half3 a);
half4   frac(half4 a);
```

```
fixed   frac(fixed a);
fixed1  frac(fixed1 a);
fixed2  frac(fixed2 a);
fixed3  frac(fixed3 a);
fixed4  frac(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to return its fractional portion.

**DESCRIPTION**

Returns the fractional portion of a scalar or each vector component.

**REFERENCE IMPLEMENTATION**

**frac** for a **float** scalar could be implemented like this.

```
float frac(float v)
{
    return v - floor(v);
}
```

**PROFILE SUPPORT**

**frac** is supported in all profiles except fp20.

**SEE ALSO**

ceil, floor, round, trunc



**NAME**

**frexp** – splits scalars and vectors into normalized fraction and a power of 2

**SYNOPSIS**

```
float   frexp(float x, out float e);
float1  frexp(float1 x, out float1 e);
float2  frexp(float2 x, out float2 e);
float3  frexp(float3 x, out float3 e);
float4  frexp(float4 x, out float4 e);
```

```
half    frexp(half x, out half e);
half1   frexp(half1 x, out half1 e);
half2   frexp(half2 x, out half2 e);
half3   frexp(half3 x, out half3 e);
half4   frexp(half4 x, out half4 e);
```

```
fixed   frexp(fixed x, out fixed e);
fixed1  frexp(fixed1 x, out fixed1 e);
fixed2  frexp(fixed2 x, out fixed2 e);
fixed3  frexp(fixed3 x, out fixed3 e);
fixed4  frexp(fixed4 x, out fixed4 e);
```

**PARAMETERS**

*x*        Vector or scalar of which to split.  
*e*        Vector or scalar where the exponent of *x* is output.

**DESCRIPTION**

This function decomposes *x* into two parts: a mantissa between 0.5 and 1 (returned by the function) and an exponent output as *e*.

If the value *x* is zero, both parts of the result are zero.

For vectors, the returned vector contains the mantissa of each element of the input vector and the output vector contains the exponent of each element of the input vector.

**REFERENCE IMPLEMENTATION**

The example below is not legal Cg because it uses the & address-of operator not supported by Cg in order to call the ANSI C frexp routine.

```
float3 frexp(float3 x, out float3 e)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        float eout;

        rv[i] = frexp(a[i], &eout); // this is the ANSI C standard library frexp()
        e[i] = eout;
    }
    return rv;
}
```

**PROFILE SUPPORT**

**frexp** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp2, log, pow

**NAME**

**fwidth** – returns sum of approximate window-space partial derivatives magnitudes

**SYNOPSIS**

```
float   fwidth(float a);
float1  fwidth(float1 a);
float2  fwidth(float2 a);
float3  fwidth(float3 a);
float4  fwidth(float4 a);

half    fwidth(half a);
half1   fwidth(half1 a);
half2   fwidth(half2 a);
half3   fwidth(half3 a);
half4   fwidth(half4 a);

fixed   fwidth(fixed a);
fixed1  fwidth(fixed1 a);
fixed2  fwidth(fixed2 a);
fixed3  fwidth(fixed3 a);
fixed4  fwidth(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to sum its approximate window-space partial derivative magnitudes. with respect to window-space X and Y.

**DESCRIPTION**

Returns sum of the absolute values of each approximate partial derivative of *a* with respect to both the window-space (horizontal) *x* and (vertical) *y* coordinate.

.PP For vectors, the returned vector contains the sum of partial derivative magnitudes of each element of the input vector.

This function can be used to approximate the *fragment width* (hence the name “fwidth”) for level-of-detail computations dependent on change in window-space.

This function is only available in fragment program profiles (but not all of them).

The specific way the partial derivative is computed is implementation-dependent. Typically fragments are rasterized in 2x2 arrangements of fragments (called quad-fragments) and the partial derivatives of a variable is computed by differencing with the adjacent horizontal fragment in the quad-fragment.

The partial derivative computation may incorrect when **fwidth** is used in control flow paths where not all the fragments within a quad-fragment have branched the same way.

The partial derivative computation may be less exact (wobbly) when the variable is computed based on varying parameters interpolated with centroid interpolation.

**REFERENCE IMPLEMENTATION**

**fmod** for **float3** vectors could be implemented this way:

```
float3 fwidth(float3 a)
{
    return abs(ddx(a)) + abs(ddy(a));
}
```

**PROFILE SUPPORT**

**fwidth** is supported only in fragment profiles. Vertex and geometry profiles lack the concept of window space.

**fwidth** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, ps\_1\_3, and arbf1 profiles.

**SEE ALSO**

ddx, ddy, fp30, fp40, gp4fp

**NAME**

**intBitsToFloat** – returns the float value corresponding to a given bit representation of a scalar int value or vector of int values

**SYNOPSIS**

```
float   intBitsToFloat(int   x);
float1  intBitsToFloat(int1  x);
float2  intBitsToFloat(int2  x);
float3  intBitsToFloat(int3  x);
float4  intBitsToFloat(int4  x);
```

**PARAMETERS**

x            Integer vector or scalar to raw cast to a scalar float or vector of floats

**DESCRIPTION**

Returns the IEEE 754 float scalar value or vector values corresponding to a given 32-bit integer bit representation for a scalar int value or vector of int values.

This function is based on Java's `java.lang.Float` method of the same name. See:

<http://java.sun.com/j2se/1.4.2/docs/api/java/lang/Float.html>

The Cg compiler can typically optimize **intBitsToFloat** so it has no instruction cost.

**REFERENCE IMPLEMENTATION**

**intBitsToFloat** operates consistent with the following ANSI C code:

```
float floatToRawIntBits(int x)
{
    union {
        float f; // assuming 32-bit IEEE 754 single-precision
        int i;   // assuming 32-bit 2's complement int
    } u;

    u.i = x;
    return u.f;
}
```

**PROFILE SUPPORT**

**intBitsToFloat** is supported by the gp4vp, gp4gp, and gp4vp profiles.

**intBitsToFloat** is *not* supported by pre-G80 profiles.

**SEE ALSO**

`ceil`, `floatToIntBits`, `floatToRawIntBits`, `floor`, `round`, `trunc`

**NAME**

**isfinite** – test whether or not a scalar or each vector component is a finite value

**SYNOPSIS**

```
bool  isfinite(float x);
bool1 isfinite(float1 x);
bool2 isfinite(float2 x);
bool3 isfinite(float3 x);
bool4 isfinite(float4 x);

bool  isfinite(half x);
bool1 isfinite(half1 x);
bool2 isfinite(half2 x);
bool3 isfinite(half3 x);
bool4 isfinite(half4 x);

bool  isfinite(fixed x);
bool1 isfinite(fixed1 x);
bool2 isfinite(fixed2 x);
bool3 isfinite(fixed3 x);
bool4 isfinite(fixed4 x);
```

**PARAMETERS**

**x**            Vector or scalar to test for finiteness.

**DESCRIPTION**

Returns whether or not a scalar or each vector component is a finite value. Infinity and not-a-number (NaN) values are not finite.

**REFERENCE IMPLEMENTATION**

**isfinite** for **float3** vectors could be implemented like this.

```
bool3 isfinite(float3 s)
{
    // By IEEE 754 rule, 2*Inf equals Inf
    return (s == s) && ((s == 0) || (s != 2*s));
}
```

**PROFILE SUPPORT**

**isfinite** is supported in all profiles except fp20.

**SEE ALSO**

isinf, isnan

**NAME**

**isinf** – test whether or not a scalar or each vector component is infinite

**SYNOPSIS**

```
bool  isinf(float x);
bool1 isinf(float1 x);
bool2 isinf(float2 x);
bool3 isinf(float3 x);
bool4 isinf(float4 x);
```

```
bool  isinf(half x);
bool1 isinf(half1 x);
bool2 isinf(half2 x);
bool3 isinf(half3 x);
bool4 isinf(half4 x);
```

```
bool  isinf(fixed x);
bool1 isinf(fixed1 x);
bool2 isinf(fixed2 x);
bool3 isinf(fixed3 x);
bool4 isinf(fixed4 x);
```

**PARAMETERS**

x            Vector or scalar to test if infinite.

**DESCRIPTION**

Returns whether or not a scalar or each vector component is a (negative or positive) infinite value. Finite and not-a-number (NaN) values are not infinite.

**REFERENCE IMPLEMENTATION**

**isinf** for **float3** vectors could be implemented like this.

```
bool3 isinf(float3 s)
{
    // By IEEE 754 rule, 2*Inf equals Inf
    return (2*s == s) && (s != 0);
}
```

**PROFILE SUPPORT**

**isinf** is supported in all profiles except fp20.

**SEE ALSO**

isfinite, isnan

**NAME**

**isnan** – test whether or not a scalar or each vector component is not-a-number

**SYNOPSIS**

```
bool   isnan(float x);
bool1  isnan(float1 x);
bool2  isnan(float2 x);
bool3  isnan(float3 x);
bool4  isnan(float4 x);
```

```
bool   isnan(half x);
bool1  isnan(half1 x);
bool2  isnan(half2 x);
bool3  isnan(half3 x);
bool4  isnan(half4 x);
```

```
bool   isnan(fixed x);
bool1  isnan(fixed1 x);
bool2  isnan(fixed2 x);
bool3  isnan(fixed3 x);
bool4  isnan(fixed4 x);
```

**PARAMETERS**

x            Vector or scalar to test for being NaN.

**DESCRIPTION**

Returns whether or not a scalar or each vector component is not-a-number (NaN) Finite and infinite values are not NaN.

**REFERENCE IMPLEMENTATION**

**isnan** for **float3** vectors could be implemented like this.

```
bool3 isnan(float3 s)
{
    // By IEEE 754 rule, NaN is not equal to NaN
    return s != s;
}
```

**PROFILE SUPPORT**

**isnan** is supported in all profiles except fp20.

**SEE ALSO**

isfinite, isinf



**NAME**

**ldexp** – returns  $x$  times 2 raised to  $n$

**SYNOPSIS**

```
float  ldexp(float x, float n);
float1 ldexp(float1 x, float1 n);
float2 ldexp(float2 x, float2 n);
float3 ldexp(float3 x, float3 n);
float4 ldexp(float4 x, float4 n);

half   ldexp(half x, half n);
half1  ldexp(half1 x, half1 n);
half2  ldexp(half2 x, half2 n);
half3  ldexp(half3 x, half3 n);
half4  ldexp(half4 x, half4 n);

fixed  ldexp(fixed x, fixed n);
fixed1 ldexp(fixed1 x, fixed1 n);
fixed2 ldexp(fixed2 x, fixed2 n);
fixed3 ldexp(fixed3 x, fixed3 n);
fixed4 ldexp(fixed4 x, fixed4 n);
```

**PARAMETERS**

$x$         Vector or scalar.  
 $n$         Vector or scalar for power with which to raise 2.

**DESCRIPTION**

**ldexp** returns  $x$  times 2 raised to the power  $n$ .

**REFERENCE IMPLEMENTATION**

**ldexp** for **float2** vectors  $x$  and  $n$  could be implemented as:

```
float2 ldexp(float2 x, float2 n)
{
    return x * exp2(n);
}
```

**PROFILE SUPPORT**

**ldexp** is supported in all profiles but fp20.

**SEE ALSO**

exp2, modf, pow

**NAME**

**length** – return scalar Euclidean length of a vector

**SYNOPSIS**

```
float length(float v);  
float length(float1 v);  
float length(float2 v);  
float length(float3 v);  
float length(float4 v);
```

```
half length(half v);  
half length(half1 v);  
half length(half2 v);  
half length(half3 v);  
half length(half4 v);
```

```
fixed length(fixed v);  
fixed length(fixed1 v);  
fixed length(fixed2 v);  
fixed length(fixed3 v);  
fixed length(fixed4 v);
```

**PARAMETERS**

**v**            Vector of which to determine the length.

**DESCRIPTION**

Returns the Euclidean length of a vector.

**REFERENCE IMPLEMENTATION**

**length** for a **float3** vector could be implemented like this.

```
float length(float3 v)  
{  
    return sqrt(dot(v,v));  
}
```

**PROFILE SUPPORT**

**length** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

max, normalize, sqrt, dot

**NAME**

**lerp** – returns linear interpolation of two scalars or vectors based on a weight

**SYNOPSIS**

```
float   lerp(float a, float b, float w);
float1  lerp(float1 a, float1 b, float1 w);
float2  lerp(float2 a, float2 b, float2 w);
float3  lerp(float3 a, float3 b, float3 w);
float4  lerp(float4 a, float4 b, float4 w);

float1  lerp(float1 a, float1 b, float w);
float2  lerp(float2 a, float2 b, float w);
float3  lerp(float3 a, float3 b, float w);
float4  lerp(float4 a, float4 b, float w);

half    lerp(half a, half b, half w);
half1   lerp(half1 a, half1 b, half1 w);
half2   lerp(half2 a, half2 b, half2 w);
half3   lerp(half3 a, half3 b, half3 w);
half4   lerp(half4 a, half4 b, half4 w);

half1   lerp(half1 a, half1 b, half w);
half2   lerp(half2 a, half2 b, half w);
half3   lerp(half3 a, half3 b, half w);
half4   lerp(half4 a, half4 b, half w);

fixed   lerp(fixed a, fixed b, fixed w);
fixed1  lerp(fixed1 a, fixed1 b, fixed1 w);
fixed2  lerp(fixed2 a, fixed2 b, fixed2 w);
fixed3  lerp(fixed3 a, fixed3 b, fixed3 w);
fixed4  lerp(fixed4 a, fixed4 b, fixed4 w);

fixed1  lerp(fixed1 a, fixed1 b, fixed w);
fixed2  lerp(fixed2 a, fixed2 b, fixed w);
fixed3  lerp(fixed3 a, fixed3 b, fixed w);
fixed4  lerp(fixed4 a, fixed4 b, fixed w);
```

**PARAMETERS**

**a**        Vector or scalar to weight; returned with *w* is one.  
**b**        Vector or scalar to weight; returned with *w* is zero.  
**w**        Vector or scalar weight.

**DESCRIPTION**

Returns the linear interpolation of *a* and *b* based on weight *w*.

*a* and *b* are either both scalars or both vectors of the same length. The weight *w* may be a scalar or a vector of the same length as *a* and *b*. *w* can be any value (so is not restricted to be between zero and one); if *w* has values outside the [0,1] range, it actually extrapolates.

**lerp** returns *a* when *w* is one and returns *b* when *w* is zero.

**REFERENCE IMPLEMENTATION**

**lerp** for **float3** vectors for *a* and *b* and a **float** *w* could be implemented like this:

```
float3 lerp(float3 a, float3 b, float w)
{
    return a + w*(b-a);
}
```

**PROFILE SUPPORT**

**lerp** is supported in all profiles.

**SEE ALSO**

saturate, smoothstep, step

**NAME**

**lit** – computes lighting coefficients for ambient, diffuse, and specular lighting contributions

**SYNOPSIS**

```
float4 lit(float NdotL, float NdotH, float m);
```

```
half4 lit(half NdotL, half NdotH, half m);
```

```
fixed4 lit(fixed NdotL, fixed NdotH, fixed m);
```

**PARAMETERS**

**NdotL** The dot product of a normalized surface normal and a normalized light vector.

**NdotH** The dot product of a normalized surface normal and a normalized half-angle vector (for Blinn-style specular) where the half-angle vector is the sum of the normalized view vector and normalized light vector. Alternatively, the dot product of a normalized light vector and a normalized view vector reflected by a normalized surface normal could be used (for Phong-style specular).

**m** A specular exponent, typically described as a measure of shininess. The larger the exponent, the shinier the specular highlight, the smaller the exponent, the duller the specular highlight.

**DESCRIPTION**

The **lit** function is a helper function useful to compute lighting coefficients for ambient, diffuse, and specular lighting contributions. The function efficiently maps to a native instruction for most GPUs.

**lit** returns a 4-component vector arranged as follows:

**x** The ambient coefficient that is always 1.0.

**y** The diffuse coefficient that is zero if *NdotL* is less than zero, and *NdotL* otherwise.

**z** The specular coefficient that is zero if either *NdotL* or *NdotH* are less than zero, and otherwise *NdotH* raised to the power *m*.

**w** Always 1.0.

**REFERENCE IMPLEMENTATION**

**lit** accepting <float> parameters could be implemented this way:

```
float4 lit(float NdotL, float NdotH, float m)
{
    float specular = (NdotL > 0) ? pow(max(0.0, NdotH), m);
    return float4(1.0, max(0.0, NdotL), specular, 1.0);
}
```

**PROFILE SUPPORT**

**lit** is supported in all profiles.

**SEE ALSO**

dot, max, normalize, pow

**NAME**

**log** – returns the natural logarithm of scalars and vectors

**SYNOPSIS**

```
float   log(float a);
float1  log(float1 a);
float2  log(float2 a);
float3  log(float3 a);
float4  log(float4 a);

half    log(half a);
half1   log(half1 a);
half2   log(half2 a);
half3   log(half3 a);
half4   log(half4 a);

fixed   log(fixed a);
fixed1  log(fixed1 a);
fixed2  log(fixed2 a);
fixed3  log(fixed3 a);
fixed4  log(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the natural logarithm.

**DESCRIPTION**

Returns the natural logarithm *a*.

For vectors, the returned vector contains the natural logarithm of each element of the input vector.

**REFERENCE IMPLEMENTATION**

```
float3 log(float3 a)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = log(a[i]); // this is the ANSI C standard library log()
    }
    return rv;
}
```

**log** is typically implemented with a native base-2 logarithm instruction.

**PROFILE SUPPORT**

**log** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp, log10, log2, pow

**NAME****log10** – returns the base-10 logarithm of scalars and vectors**SYNOPSIS**

```

float  log10(float a);
float1 log10(float1 a);
float2 log10(float2 a);
float3 log10(float3 a);
float4 log10(float4 a);

half   log10(half a);
half1  log10(half1 a);
half2  log10(half2 a);
half3  log10(half3 a);
half4  log10(half4 a);

fixed  log10(fixed a);
fixed1 log10(fixed1 a);
fixed2 log10(fixed2 a);
fixed3 log10(fixed3 a);
fixed4 log10(fixed4 a);

```

**PARAMETERS**

*a*            Vector or scalar of which to determine the base-10 logarithm.

**DESCRIPTION**

Returns the base-10 logarithm *a*.

For vectors, the returned vector contains the base-10 logarithm of each element of the input vector.

**REFERENCE IMPLEMENTATION**

```

float3 log10(float3 a)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = log10(a[i]); // this is the ANSI C standard library log10()
    }
    return rv;
}

```

**log10** is typically implemented with a native base-10 logarithm instruction.

**PROFILE SUPPORT**

**log10** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp, log, log2, pow

**NAME**

**log2** – returns the base-2 logarithm of scalars and vectors

**SYNOPSIS**

```
float   log2(float a);
float1  log2(float1 a);
float2  log2(float2 a);
float3  log2(float3 a);
float4  log2(float4 a);
```

```
half    log2(half a);
half1   log2(half1 a);
half2   log2(half2 a);
half3   log2(half3 a);
half4   log2(half4 a);
```

```
fixed   log2(fixed a);
fixed1  log2(fixed1 a);
fixed2  log2(fixed2 a);
fixed3  log2(fixed3 a);
fixed4  log2(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the base-2 logarithm.

**DESCRIPTION**

Returns the base-2 logarithm *a*.

For vectors, the returned vector contains the base-2 logarithm of each element of the input vector.

**REFERENCE IMPLEMENTATION**

```
float3 log2(float3 a)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        rv[i] = log2(a[i]); // this is the ANSI C standard library log2()
    }
    return rv;
}
```

**log2** is typically implemented with a native base-2 logarithm instruction.

**PROFILE SUPPORT**

**log2** is fully supported in all profiles unless otherwise specified.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp, log, log10, pow



**NAME**

**max** – returns the maximum of two scalars or each respective component of two vectors

**SYNOPSIS**

```
float  max(float  a, float  b);
float1 max(float1 a, float1 b);
float2 max(float2 a, float2 b);
float3 max(float3 a, float3 b);
float4 max(float4 a, float4 b);

half   max(half   a, half   b);
half1  max(half1  a, half1  b);
half2  max(half2  a, half2  b);
half3  max(half3  a, half3  b);
half4  max(half4  a, half4  b);

fixed  max(fixed  a, fixed  b);
fixed1 max(fixed1 a, fixed1 b);
fixed2 max(fixed2 a, fixed2 b);
fixed3 max(fixed3 a, fixed3 b);
fixed4 max(fixed4 a, fixed4 b);
```

**PARAMETERS**

*a*        Scalar or vector.  
*b*        Scalar or vector.

**DESCRIPTION**

Returns the maximum of two same-typed scalars *a* and *b* or the respective components of two same-typed vectors *a* and *b*. The result is a three-component vector.

**REFERENCE IMPLEMENTATION**

**max** for **float3** vectors could be implemented this way:

```
float3 max(float3 a, float3 b)
{
    return float3(a.x > b.x ? a.x : b.x,
                  a.y > b.y ? a.y : b.y,
                  a.z > b.z ? a.z : b.z);
}
```

**PROFILE SUPPORT**

**max** is supported in all profiles. **max** is implemented as a compiler built-in.

Support in the fp20 is limited.

**SEE ALSO**

clamp, min

**NAME**

**min** – returns the minimum of two scalars or each respective component of two vectors

**SYNOPSIS**

```
float  min(float  a, float  b);
float1 min(float1 a, float1 b);
float2 min(float2 a, float2 b);
float3 min(float3 a, float3 b);
float4 min(float4 a, float4 b);

half   min(half   a, half   b);
half1  min(half1  a, half1  b);
half2  min(half2  a, half2  b);
half3  min(half3  a, half3  b);
half4  min(half4  a, half4  b);

fixed  min(fixed  a, fixed  b);
fixed1 min(fixed1 a, fixed1 b);
fixed2 min(fixed2 a, fixed2 b);
fixed3 min(fixed3 a, fixed3 b);
fixed4 min(fixed4 a, fixed4 b);
```

**PARAMETERS**

*a*        Scalar or vector.  
*b*        Scalar or vector.

**DESCRIPTION**

Returns the minimum of two same-typed scalars *a* and *b* or the respective components of two same-typed vectors *a* and *b*. The result is a three-component vector.

**REFERENCE IMPLEMENTATION**

**min** for **float3** vectors could be implemented this way:

```
float3 min(float3 a, float3 b)
{
    return float3(a.x < b.x ? a.x : b.x,
                  a.y < b.y ? a.y : b.y,
                  a.z < b.z ? a.z : b.z);
}
```

**PROFILE SUPPORT**

**min** is supported in all profiles. **min** is implemented as a compiler built-in.

Support in the fp20 is limited.

**SEE ALSO**

clamp, max

**NAME**

**mul** – multiply a matrix by a column vector, row vector by a matrix, or matrix by a matrix

**SYNOPSIS**

```
float4 mul(float4x4 M, float4 v);
float4 mul(float4x3 M, float3 v);
float4 mul(float4x2 M, float2 v);
float4 mul(float4x1 M, float1 v);
float3 mul(float3x4 M, float4 v);
float3 mul(float3x3 M, float3 v);
float3 mul(float3x2 M, float2 v);
float3 mul(float3x1 M, float1 v);
float2 mul(float2x4 M, float4 v);
float2 mul(float2x3 M, float3 v);
float2 mul(float2x2 M, float2 v);
float2 mul(float2x1 M, float1 v);
float1 mul(float1x4 M, float4 v);
float1 mul(float1x3 M, float3 v);
float1 mul(float1x2 M, float2 v);
float1 mul(float1x1 M, float1 v);
```

```
float4 mul(float4 v, float4x4 M);
float4 mul(float3 v, float3x4 M);
float4 mul(float2 v, float2x4 M);
float4 mul(float1 v, float1x4 M);
float3 mul(float4 v, float4x3 M);
float3 mul(float3 v, float3x3 M);
float3 mul(float2 v, float2x3 M);
float3 mul(float1 v, float1x3 M);
float2 mul(float4 v, float4x2 M);
float2 mul(float3 v, float3x2 M);
float2 mul(float2 v, float2x2 M);
float2 mul(float1 v, float1x2 M);
float1 mul(float4 v, float4x1 M);
float1 mul(float3 v, float3x1 M);
float1 mul(float2 v, float2x1 M);
float1 mul(float1 v, float1x1 M);
```

```
half4 mul(half4x4 M, half4 v);
half4 mul(half4x3 M, half3 v);
half4 mul(half4x2 M, half2 v);
half4 mul(half4x1 M, half1 v);
half3 mul(half3x4 M, half4 v);
half3 mul(half3x3 M, half3 v);
half3 mul(half3x2 M, half2 v);
half3 mul(half3x1 M, half1 v);
half2 mul(half2x4 M, half4 v);
half2 mul(half2x3 M, half3 v);
half2 mul(half2x2 M, half2 v);
half2 mul(half2x1 M, half1 v);
half1 mul(half1x4 M, half4 v);
half1 mul(half1x3 M, half3 v);
half1 mul(half1x2 M, half2 v);
half1 mul(half1x1 M, half1 v);
```

```
half4 mul(half4 v, half4x4 M);
half4 mul(half3 v, half3x4 M);
half4 mul(half2 v, half2x4 M);
half4 mul(half1 v, half1x4 M);
half3 mul(half4 v, half4x3 M);
half3 mul(half3 v, half3x3 M);
half3 mul(half2 v, half2x3 M);
half3 mul(half1 v, half1x3 M);
half2 mul(half4 v, half4x2 M);
half2 mul(half3 v, half3x2 M);
half2 mul(half2 v, half2x2 M);
half2 mul(half1 v, half1x2 M);
half1 mul(half4 v, half4x1 M);
half1 mul(half3 v, half3x1 M);
half1 mul(half2 v, half2x1 M);
half1 mul(half1 v, half1x1 M);
```

```
fixed4 mul(fixed4x4 M, fixed4 v);
fixed4 mul(fixed4x3 M, fixed3 v);
fixed4 mul(fixed4x2 M, fixed2 v);
fixed4 mul(fixed4x1 M, fixed1 v);
fixed3 mul(fixed3x4 M, fixed4 v);
fixed3 mul(fixed3x3 M, fixed3 v);
fixed3 mul(fixed3x2 M, fixed2 v);
fixed3 mul(fixed3x1 M, fixed1 v);
fixed2 mul(fixed2x4 M, fixed4 v);
fixed2 mul(fixed2x3 M, fixed3 v);
fixed2 mul(fixed2x2 M, fixed2 v);
fixed2 mul(fixed2x1 M, fixed1 v);
fixed1 mul(fixed1x4 M, fixed4 v);
fixed1 mul(fixed1x3 M, fixed3 v);
fixed1 mul(fixed1x2 M, fixed2 v);
fixed1 mul(fixed1x1 M, fixed1 v);
```

```
fixed4 mul(fixed4 v, fixed4x4 M);
fixed4 mul(fixed3 v, fixed3x4 M);
fixed4 mul(fixed2 v, fixed2x4 M);
fixed4 mul(fixed1 v, fixed1x4 M);
fixed3 mul(fixed4 v, fixed4x3 M);
fixed3 mul(fixed3 v, fixed3x3 M);
fixed3 mul(fixed2 v, fixed2x3 M);
fixed3 mul(fixed1 v, fixed1x3 M);
fixed2 mul(fixed4 v, fixed4x2 M);
fixed2 mul(fixed3 v, fixed3x2 M);
fixed2 mul(fixed2 v, fixed2x2 M);
fixed2 mul(fixed1 v, fixed1x2 M);
fixed1 mul(fixed4 v, fixed4x1 M);
fixed1 mul(fixed3 v, fixed3x1 M);
fixed1 mul(fixed2 v, fixed2x1 M);
fixed1 mul(fixed1 v, fixed1x1 M);
```

```
float1x1 mul(float1x1 A, float1x1 B);  
float1x2 mul(float1x1 A, float1x2 B);  
float1x3 mul(float1x1 A, float1x3 B);  
float1x4 mul(float1x1 A, float1x4 B);
```

```
float1x1 mul(float1x2 A, float2x1 B);  
float1x2 mul(float1x2 A, float2x2 B);  
float1x3 mul(float1x2 A, float2x3 B);  
float1x4 mul(float1x2 A, float2x4 B);
```

```
float1x1 mul(float1x3 A, float3x1 B);  
float1x2 mul(float1x3 A, float3x2 B);  
float1x3 mul(float1x3 A, float3x3 B);  
float1x4 mul(float1x3 A, float3x4 B);
```

```
float1x1 mul(float1x4 A, float4x1 B);  
float1x2 mul(float1x4 A, float4x2 B);  
float1x3 mul(float1x4 A, float4x3 B);  
float1x4 mul(float1x4 A, float4x4 B);
```

```
float2x1 mul(float2x1 A, float1x1 B);  
float2x2 mul(float2x1 A, float1x2 B);  
float2x3 mul(float2x1 A, float1x3 B);  
float2x4 mul(float2x1 A, float1x4 B);
```

```
float2x1 mul(float2x2 A, float2x1 B);  
float2x2 mul(float2x2 A, float2x2 B);  
float2x3 mul(float2x2 A, float2x3 B);  
float2x4 mul(float2x2 A, float2x4 B);
```

```
float2x1 mul(float2x3 A, float3x1 B);  
float2x2 mul(float2x3 A, float3x2 B);  
float2x3 mul(float2x3 A, float3x3 B);  
float2x4 mul(float2x3 A, float3x4 B);
```

```
float2x1 mul(float2x4 A, float4x1 B);  
float2x2 mul(float2x4 A, float4x2 B);  
float2x3 mul(float2x4 A, float4x3 B);  
float2x4 mul(float2x4 A, float4x4 B);
```

```
float3x1 mul(float3x1 A, float1x1 B);  
float3x2 mul(float3x1 A, float1x2 B);  
float3x3 mul(float3x1 A, float1x3 B);  
float3x4 mul(float3x1 A, float1x4 B);
```

```
float3x1 mul(float3x2 A, float2x1 B);  
float3x2 mul(float3x2 A, float2x2 B);  
float3x3 mul(float3x2 A, float2x3 B);  
float3x4 mul(float3x2 A, float2x4 B);
```

```
float3x1 mul(float3x3 A, float3x1 B);  
float3x2 mul(float3x3 A, float3x2 B);  
float3x3 mul(float3x3 A, float3x3 B);  
float3x4 mul(float3x3 A, float3x4 B);
```

```

float3x1 mul(float3x4 A, float4x1 B);
float3x2 mul(float3x4 A, float4x2 B);
float3x3 mul(float3x4 A, float4x3 B);
float3x4 mul(float3x4 A, float4x4 B);

float4x1 mul(float4x1 A, float1x1 B);
float4x2 mul(float4x1 A, float1x2 B);
float4x3 mul(float4x1 A, float1x3 B);
float4x4 mul(float4x1 A, float1x4 B);

float4x1 mul(float4x2 A, float2x1 B);
float4x2 mul(float4x2 A, float2x2 B);
float4x3 mul(float4x2 A, float2x3 B);
float4x4 mul(float4x2 A, float2x4 B);

float4x1 mul(float4x3 A, float3x1 B);
float4x2 mul(float4x3 A, float3x2 B);
float4x3 mul(float4x3 A, float3x3 B);
float4x4 mul(float4x3 A, float3x4 B);

float4x1 mul(float4x4 A, float4x1 B);
float4x2 mul(float4x4 A, float4x2 B);
float4x3 mul(float4x4 A, float4x3 B);
float4x4 mul(float4x4 A, float4x4 B);

```

## PARAMETERS

**M**      Matrix  
**v**        Vector  
**A**        Matrix  
**B**        Matrix

## DESCRIPTION

Returns the vector result of multiplying a matrix *M* by a column vector *v*; a row vector *v* by a matrix *M*; or a matrix *A* by a second matrix *B*.

The following are algebraically equal (if not necessarily numerically equal):

```

mul(M,v) == mul(v, transpose(M))
mul(v,M) == mul(transpose(M), v)

```

## REFERENCE IMPLEMENTATION

**mul** for a **float4x3** matrix by a **float3** column vector could be implemented this way:

```

float4 mul(float4x3 M, float3 v)
{
    float4 r;

    r.x = dot( M._m00_m01_m02, v );
    r.y = dot( M._m10_m11_m12, v );
    r.z = dot( M._m20_m21_m22, v );
    r.w = dot( M._m30_m31_m32, v );

    return r;
}

```

**PROFILE SUPPORT**

**mul** is supported in all profiles.

The **fixed3** matrix-by-vector and vector-by-matrix multiplies are very efficient in the fp20 and fp30 profiles.

**SEE ALSO**

cross, dot, transpose

**NAME**

**normalize** – normalizes a vector

**SYNOPSIS**

```
float normalize(float v);  
float normalize(float1 v);  
float normalize(float2 v);  
float normalize(float3 v);  
float normalize(float4 v);
```

```
half normalize(half v);  
half normalize(half1 v);  
half normalize(half2 v);  
half normalize(half3 v);  
half normalize(half4 v);
```

```
fixed normalize(fixed v);  
fixed normalize(fixed1 v);  
fixed normalize(fixed2 v);  
fixed normalize(fixed3 v);  
fixed normalize(fixed4 v);
```

**PARAMETERS**

**v**            Vector to normalize.

**DESCRIPTION**

Returns the normalized version of a vector, meaning a vector in the same direction as the original vector but with a Euclidean length of one.

**REFERENCE IMPLEMENTATION**

**normalize** for a **float3** vector could be implemented like this.

```
float3 normalize(float3 v)  
{  
    return rsqrt(dot(v,v))*v;  
}
```

**PROFILE SUPPORT**

**normalize** is supported in all profiles except fp20.

**SEE ALSO**

distance, dot, length, rsqrt, sqrt



**NAME**

**pow** – returns  $x$  to the  $y$ -th power of scalars and vectors

**SYNOPSIS**

```
float   pow(float   x, float   y);
float1  pow(float1  x, float1  y);
float2  pow(float2  x, float2  y);
float3  pow(float3  x, float3  y);
float4  pow(float4  x, float4  y);

half    pow(half    x, half    y);
half1   pow(half1   x, half1   y);
half2   pow(half2   x, half2   y);
half3   pow(half3   x, half3   y);
half4   pow(half4   x, half4   y);

fixed   pow(fixed   x, fixed   y);
fixed1  pow(fixed1  x, fixed1  y);
fixed2  pow(fixed2  x, fixed2  y);
fixed3  pow(fixed3  x, fixed3  y);
fixed4  pow(fixed4  x, fixed4  y);
```

**PARAMETERS**

$x$         A base value.

$y$         The power to raise the base.

**DESCRIPTION**

Returns  $x$  to the power  $y$ .

For vectors, the returned vector contains the power of each element of the base vector raised to the respective element of the exponent vector.

**REFERENCE IMPLEMENTATION**

**pow** for **float3** vectors could be implemented this way:

```
float3 pow(float3 x, float3 y)
{
    float3 rv;

    for (int i=0; i<3; i++) {
        rv[i] = exp(x[i] * log(y[i]));
    }
    return rv;
}
```

**PROFILE SUPPORT**

**exp** is supported in all profiles.

Support in the fp20 is limited to constant compile-time evaluation.

**SEE ALSO**

exp, lit, log, rsqrt, sqrt

**NAME**

**radians** – converts values of scalars and vectors from degrees to radians

**SYNOPSIS**

```
float  radians(float  a);
float1 radians(float1 a);
float2 radians(float2 a);
float3 radians(float3 a);
float4 radians(float4 a);
```

```
half   radians(half   a);
half1  radians(half1  a);
half2  radians(half2  a);
half3  radians(half3  a);
half4  radians(half4  a);
```

```
fixed  radians(fixed  a);
fixed1 radians(fixed1 a);
fixed2 radians(fixed2 a);
fixed3 radians(fixed3 a);
fixed4 radians(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to convert from degrees to radians.

**DESCRIPTION**

Returns the scalar or vector converted from degrees to radians.

For vectors, the returned vector contains each element of the input vector converted from degrees to radians.

**REFERENCE IMPLEMENTATION**

**radians** for a **float** scalar could be implemented like this.

```
float radians(float a)
{
    return 0.017453292 * a;
}
```

**PROFILE SUPPORT**

**radians** is supported in all profiles except fp20.

**SEE ALSO**

cos, degrees, sin, tan

**NAME**

**reflect** – returns the reflectiton vector given an incidence vector and a normal vector.

**SYNOPSIS**

```
float  reflect(float  i, float  n);  
float2 reflect(float2 i, float2 n);  
float3 reflect(float3 i, float3 n);  
float4 reflect(float4 i, float4 n);
```

**PARAMETERS**

*i*           Incidence vector.  
*n*           Normal vector.

**DESCRIPTION**

Returns the reflectiton vector given an incidence vector *i* and a normal vector *n*. The resulting vector is the identical number of components as the two input vectors.

The normal vector *n* should be normalized. If *n* is normalized, the output vector will have the same length as the input incidence vector *i*.

**REFERENCE IMPLEMENTATION**

**reflect** for **float3** vectors could be implemented this way:

```
float3 reflect( float3 i, float3 n )  
{  
    return i - 2.0 * n * dot(n,i);  
}
```

**PROFILE SUPPORT**

**reflect** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

dot, length, refract

**NAME**

**refract** – computes a refraction vector.

**SYNOPSIS**

```
fixed3 refract(fixed3 i, fixed3 n, fixed eta);  
half3   refract(half3 i, half3 n, half eta);  
float3 refract(float3 i, float3 n, float eta);
```

**PARAMETERS**

*i*            Incidence vector.  
*n*            Normal vector.  
*eta*          Ratio of indices of refraction at the surface interface.

**DESCRIPTION**

Returns a refraction vector given an incidence vector, a normal vector for a surface, and a ratio of indices of refraction at the surface's interface.

The incidence vector *i* and normal vector *n* should be normalized.

**REFERENCE IMPLEMENTATION**

**reflect** for **float3** vectors could be implemented this way:

```
float3 refract( float3 i, float3 n, float eta )  
{  
    float cosi = dot(-i, n);  
    float cost2 = 1.0f - eta * eta * (1.0f - cosi*cosi);  
    float3 t = eta*i + ((eta*cosi - sqrt(abs(cost2))) * n);  
    return t * (float3)(cost2 > 0);  
}
```

**PROFILE SUPPORT**

**refract** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

abs, cos, dot, reflect, sqrt

## NAME

**round** – returns the rounded value of scalars or vectors

## SYNOPSIS

```
float  round(float  a);
float1 round(float1 a);
float2 round(float2 a);
float3 round(float3 a);
float4 round(float4 a);
```

```
half   round(half   a);
half1  round(half1  a);
half2  round(half2  a);
half3  round(half3  a);
half4  round(half4  a);
```

```
fixed  round(fixed  a);
fixed1 round(fixed1 a);
fixed2 round(fixed2 a);
fixed3 round(fixed3 a);
fixed4 round(fixed4 a);
```

## PARAMETERS

*a*            Scalar or vector.

## DESCRIPTION

Returns the rounded value of a scalar or vector.

For vectors, the returned vector contains the rounded value of each element of the input vector.

The round operation returns the nearest integer to the operand. The value returned by *round()* if the fractional portion of the operand is 0.5 is profile dependent. On older profiles without built-in *round()* support, round-to-nearest up rounding is used. On profiles newer than fp40/vp40, round-to-nearest even is used.

## REFERENCE IMPLEMENTATION

**round** for **float** could be implemented this way:

```
// round-to-nearest even profiles
float round(float a)
{
    float x = a + 0.5;
    float f = floor(x);
    float r;
    if (x == f) {
        if (a > 0)
            r = f - fmod(f, 2);
        else
            r = f + fmod(f, 2);
    } else
        r = f;
    return r;
}
```

```
// round-to-nearest up profiles
float round(float a)
{
    return floor(x + 0.5);
}
```

**PROFILE SUPPORT**

**round** is supported in all profiles except fp20.

**SEE ALSO**

ceil, floor, fmod, trunc

## NAME

**rsqrt** – returns reciprocal square root of scalars and vectors.

## SYNOPSIS

```
float   rsqrt(float a);
float1  rsqrt(float1 a);
float2  rsqrt(float2 a);
float3  rsqrt(float3 a);
float4  rsqrt(float4 a);
```

```
half    rsqrt(half a);
half1   rsqrt(half1 a);
half2   rsqrt(half2 a);
half3   rsqrt(half3 a);
half4   rsqrt(half4 a);
```

```
fixed   rsqrt(fixed a);
fixed1  rsqrt(fixed1 a);
fixed2  rsqrt(fixed2 a);
fixed3  rsqrt(fixed3 a);
fixed4  rsqrt(fixed4 a);
```

## PARAMETERS

*a*            Vector or scalar of which to determine the reciprocal square root.

## DESCRIPTION

Returns an approximation to the reciprocal square root of *a*.

For vectors, the returned vector contains the reciprocal square root of each element of the input vector.

The reciprocal square root of zero is ideally infinity. The square root of negative values ideally returns *NaN* (Not a Number).

## REFERENCE IMPLEMENTATION

**rsqrt** is best implemented as a native reciprocal square root instruction, however **rsqrt** may be implemented via a **pow** function:

```
float3 rsqrt(float3 a)
{
    return pow(a, -0.5);
}
```

## PROFILE SUPPORT

**rsqrt** is supported in all profiles unless otherwise specified. **rsqrt** is unsupported in the fp20 profile.

In certain profiles such as vp20, **rsqrt** computes the absolute value of *a* so negative values of *a* will not return *NaN*.

## SEE ALSO

normalize, pow, sqrt

## NAME

**saturate** – returns smallest integer not less than a scalar or each vector component.

## SYNOPSIS

```
float   saturate(float x);
float1  saturate(float1 x);
float2  saturate(float2 x);
float3  saturate(float3 x);
float4  saturate(float4 x);
```

```
half    saturate(half x);
half1   saturate(half1 x);
half2   saturate(half2 x);
half3   saturate(half3 x);
half4   saturate(half4 x);
```

```
fixed   saturate(fixed x);
fixed1  saturate(fixed1 x);
fixed2  saturate(fixed2 x);
fixed3  saturate(fixed3 x);
fixed4  saturate(fixed4 x);
```

## PARAMETERS

*x*            Vector or scalar to saturate.

## DESCRIPTION

Returns *x* saturated to the range [0,1] as follows:

- 1) Returns 0 if *x* is less than 0; else
- 2) Returns 1 if *x* is greater than 1; else
- 3) Returns *x* otherwise.

For vectors, the returned vector contains the saturated result of each element of the vector *x* saturated to [0,1].

## REFERENCE IMPLEMENTATION

**saturate** for **float** scalars could be implemented like this.

```
float saturate(float x)
{
    return max(0, min(1, x));
}
```

## PROFILE SUPPORT

**saturate** is supported in all profiles.

**saturate** is very efficient in the fp20, fp30, and fp40 profiles.

## SEE ALSO

clamp, max, min



## NAME

**sign** – returns sign of scalar or each vector component.

## SYNOPSIS

```
float   sign(float x);
float1  sign(float1 x);
float2  sign(float2 x);
float3  sign(float3 x);
float4  sign(float4 x);
```

```
half    sign(half x);
half1   sign(half1 x);
half2   sign(half2 x);
half3   sign(half3 x);
half4   sign(half4 x);
```

```
fixed   sign(fixed x);
fixed1  sign(fixed1 x);
fixed2  sign(fixed2 x);
fixed3  sign(fixed3 x);
fixed4  sign(fixed4 x);
```

## PARAMETERS

*x*            Vector or scalar to determine its sign.

## DESCRIPTION

Returns positive one, zero, or negative one for each of the components of *x* based on the component's sign.

- 1) Returns -1 component if the respective component of *x* is negative.
- 2) Returns 0 component if the respective component of *x* is zero.
- 3) Returns 1 component if the respective component of *x* is positive.
- 4) Ideally, NaN returns NaN.

## REFERENCE IMPLEMENTATION

**sign** for **float3** could be implemented like this.

```
float3 sign(float x)
{
    float3 val = a > 0;
    return val - (a < 0);
}
```

## PROFILE SUPPORT

**sign** is supported in all profiles except fp20.

**sign** is very efficient in the gp4vp, gp4gp, gp4fp, vp40, and vp30 profiles that support the native SSG instruction.

## SEE ALSO

max, min, saturate, step

**NAME**

**sin** – returns sine of scalars and vectors.

**SYNOPSIS**

```
float   sin(float a);
float1  sin(float1 a);
float2  sin(float2 a);
float3  sin(float3 a);
float4  sin(float4 a);
```

```
half    sin(half a);
half1   sin(half1 a);
half2   sin(half2 a);
half3   sin(half3 a);
half4   sin(half4 a);
```

```
fixed   sin(fixed a);
fixed1  sin(fixed1 a);
fixed2  sin(fixed2 a);
fixed3  sin(fixed3 a);
fixed4  sin(fixed4 a);
```

**PARAMETERS**

**a**            Vector or scalar of which to determine the sine.

**DESCRIPTION**

Returns the sine of *a* in radians. The return value is in the range  $[-1,+1]$ .

For vectors, the returned vector contains the sine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**sin** is best implemented as a native sine instruction, however **sin** for a **float** scalar could be implemented by an approximation like this.

```
float sin(float a)
{
    /* C simulation gives a max absolute error of less than 1.8e-7 */
    float4 c0 = float4( 0.0,          0.5,
                       1.0,          0.0 );
    float4 c1 = float4( 0.25,         -9.0,
                       0.75,         0.159154943091 );
    float4 c2 = float4( 24.9808039603, -24.9808039603,
                       -60.1458091736, 60.1458091736 );
    float4 c3 = float4( 85.4537887573, -85.4537887573,
                       -64.9393539429, 64.9393539429 );
    float4 c4 = float4( 19.7392082214, -19.7392082214,
                       -1.0,          1.0 );

    /* r0.x = sin(a) */
    float3 r0, r1, r2;
```

```

    r1.x = c1.w * a - c1.x;           // only difference from cos!
    r1.y = frac( r1.x );              // and extract fraction
    r2.x = (float) ( r1.y < c1.x );   // range check: 0.0 to 0.25
    r2.yz = (float2) ( r1.yy >= c1.yz ); // range check: 0.75 to 1.0
    r2.y = dot( r2, c4.zwz );         // range check: 0.25 to 0.75
    r0 = c0.xyz - r1.yyy;             // range centering
    r0 = r0 * r0;
    r1 = c2.xyxy * r0 + c2.zwz;       // start power series
    r1 = r1 * r0 + c3.xyxy;
    r1 = r1 * r0 + c3.zwz;
    r1 = r1 * r0 + c4.xyxy;
    r1 = r1 * r0 + c4.zwz;
    r0.x = dot( r1, -r2 );            // range extract

    return r0.x;
}

```

## PROFILE SUPPORT

**sin** is fully supported in all profiles unless otherwise specified.

**sin** is supported via an approximation (shown above) in the vs\_1, vp20, and arbvpl profiles.

**sin** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, and ps\_1\_3 profiles.

## SEE ALSO

asin, cos, dot, frac, sincos, tan

**NAME**

**sincos** – returns sine of scalars and vectors.

**SYNOPSIS**

```
void sincos(float a, out float s, out float c);
void sincos(float1 a, out float1 s, out float1 c);
void sincos(float2 a, out float2 s, out float2 c);
void sincos(float3 a, out float3 s, out float3 c);
void sincos(float4 a, out float4 s, out float4 c);

void sincos(half a, out half s, out half c);
void sincos(half1 a, out half1 s, out half1 c);
void sincos(half2 a, out half2 s, out half2 c);
void sincos(half3 a, out half3 s, out half3 c);
void sincos(half4 a, out half4 s, out half4 c);

void sincos(fixed a, out fixed s, out fixed c);
void sincos(fixed1 a, out fixed1 s, out fixed1 c);
void sincos(fixed2 a, out fixed2 s, out fixed2 c);
void sincos(fixed3 a, out fixed3 s, out fixed3 c);
void sincos(fixed4 a, out fixed4 s, out fixed4 c);
```

**PARAMETERS**

**a** Input vector or scalar of which to determine the sine and cosine.  
**s** Output vector or scalar for sine results.  
**c** Output vector or scalar for cosine results.

**DESCRIPTION**

Outputs to *s* the sine of *a* in radians, and outputs to *c* the cosine of *a* in radians. The output values are in the range  $[-1,+1]$ .

For vectors, the output vectors contains the sine or cosine respectively of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**sin** is best implemented as a native sine instruction, however **sin** for a **float** scalar could be implemented by an approximation like this.

```
void sincos(float3 a, out float3 s, float3 out c)
{
    int i;

    for (i=0; i<3; i++) {
        s[i] = sin(a[i]);
        c[i] = cos(a[i]);
    }
}
```

**PROFILE SUPPORT**

**sincos** is fully supported in all profiles unless otherwise specified.

**sincos** is supported via an approximation (shown above) in the vs\_1, vp20, and arbvp1 profiles.

**sincos** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, and ps\_1\_3 profiles.

**SEE ALSO**

cos, sin

**NAME**

**sinh** – returns hyperbolic sine of scalars and vectors.

**SYNOPSIS**

```
float   sinh(float a);
float1  sinh(float1 a);
float2  sinh(float2 a);
float3  sinh(float3 a);
float4  sinh(float4 a);
```

```
half    sinh(half a);
half1   sinh(half1 a);
half2   sinh(half2 a);
half3   sinh(half3 a);
half4   sinh(half4 a);
```

```
fixed   sinh(fixed a);
fixed1  sinh(fixed1 a);
fixed2  sinh(fixed2 a);
fixed3  sinh(fixed3 a);
fixed4  sinh(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the hyperbolic sine.

**DESCRIPTION**

Returns the hyperbolic sine of *a*.

For vectors, the returned vector contains the hyperbolic sine of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**sinh** for a scalar **float** could be implemented like this.

```
float sinh(float x)
{
    return 0.5 * (exp(x)-exp(-x));
}
```

**PROFILE SUPPORT**

**sinh** is supported in all profiles except fp20.

**SEE ALSO**

acos, cos, cosh, exp, tanh

**NAME**

**sqrt** – returns square root of scalars and vectors.

**SYNOPSIS**

```
float   sqrt(float a);
float1  sqrt(float1 a);
float2  sqrt(float2 a);
float3  sqrt(float3 a);
float4  sqrt(float4 a);
```

```
half    sqrt(half a);
half1   sqrt(half1 a);
half2   sqrt(half2 a);
half3   sqrt(half3 a);
half4   sqrt(half4 a);
```

```
fixed   sqrt(fixed a);
fixed1  sqrt(fixed1 a);
fixed2  sqrt(fixed2 a);
fixed3  sqrt(fixed3 a);
fixed4  sqrt(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the square root.

**DESCRIPTION**

Returns the square root of *a*.

For vectors, the returned vector contains the square root of each element of the input vector.

The square root of zero is zero.

Ideally, the square root of negative values returns *NaN* (Not a Number).

**sqrt** often implemented as the reciprocal of a reciprocal square root approximation in older profiles.

**REFERENCE IMPLEMENTATION**

**sqrt** is best implemented as a native square root instruction, however **sqrt** may be implemented via a **rsqrt** function:

```
float3 sqrt(float3 a)
{
    return 1.0 / rsqrt(a);
}
```

**PROFILE SUPPORT**

**sqrt** is fully supported in all profiles unless otherwise specified. **sqrt** is unsupported in the fp20 profile.

**SEE ALSO**

normalize, pow, rsqrt

**NAME**

**step** – implement a step function returning either zero or one

**SYNOPSIS**

```
float   step(float  a, float  x);
float1  step(float1 a, float1 x);
float2  step(float2 a, float2 x);
float3  step(float3 a, float3 x);
float4  step(float4 a, float4 x);

half    step(half   a, half   x);
half1   step(half1  a, half1  x);
half2   step(half2  a, half2  x);
half3   step(half3  a, half3  x);
half4   step(half4  a, half4  x);

fixed   step(fixed  a, fixed  x);
fixed1  step(fixed1 a, fixed1 x);
fixed2  step(fixed2 a, fixed2 x);
fixed3  step(fixed3 a, fixed3 x);
fixed4  step(fixed4 a, fixed4 x);
```

**PARAMETERS**

*a*        Scalar or vector reference value.  
*x*        Scalar or vector.

**DESCRIPTION**

Implements a step function returning one for each component of *x* that is greater than or equal to the corresponding component in the reference vector *a*, and zero otherwise.

**REFERENCE IMPLEMENTATION**

**step** for **float3** vectors could be implemented this way:

```
float3 step(float3 a, float3 x)
{
    return x >= a;
}
```

**PROFILE SUPPORT**

**step** is supported in all profiles.

Support in the fp20 is limited.

**SEE ALSO**

max, min, saturate, smoothstep

## NAME

**tan** – returns tangent of scalars and vectors.

## SYNOPSIS

```
float   tan(float a);
float1  tan(float1 a);
float2  tan(float2 a);
float3  tan(float3 a);
float4  tan(float4 a);
```

```
half    tan(half a);
half1   tan(half1 a);
half2   tan(half2 a);
half3   tan(half3 a);
half4   tan(half4 a);
```

```
fixed   tan(fixed a);
fixed1  tan(fixed1 a);
fixed2  tan(fixed2 a);
fixed3  tan(fixed3 a);
fixed4  tan(fixed4 a);
```

## PARAMETERS

*a*            Vector or scalar of which to determine the tangent.

## DESCRIPTION

Returns the tangent of *a* in radians.

For vectors, the returned vector contains the tangent of each element of the input vector.

## REFERENCE IMPLEMENTATION

**tan** can be implemented in terms of the **sin** and **cos** functions like this:

```
float tan(float a) {
    float s, c;
    sincos(a, s, c);
    return s / c;
}
```

## PROFILE SUPPORT

**tan** is fully supported in all profiles unless otherwise specified.

**tan** is supported via approximations of **sin** and **cos** functions (see the respective sin and cos manual pages for details) in the vs\_1, vp20, and arbvpl profiles.

**tan** is unsupported in the fp20, ps\_1\_1, ps\_1\_2, and ps\_1\_3 profiles.

## SEE ALSO

atan, atan2, cos, dot, frac, sin, sincos



**NAME**

**tanh** – returns hyperbolic tangent of scalars and vectors.

**SYNOPSIS**

```
float   tanh(float a);  
float1  tanh(float1 a);  
float2  tanh(float2 a);  
float3  tanh(float3 a);  
float4  tanh(float4 a);
```

```
half    tanh(half a);  
half1   tanh(half1 a);  
half2   tanh(half2 a);  
half3   tanh(half3 a);  
half4   tanh(half4 a);
```

```
fixed   tanh(fixed a);  
fixed1  tanh(fixed1 a);  
fixed2  tanh(fixed2 a);  
fixed3  tanh(fixed3 a);  
fixed4  tanh(fixed4 a);
```

**PARAMETERS**

*a*            Vector or scalar of which to determine the hyperbolic tangent.

**DESCRIPTION**

Returns the hyperbolic tangent of *a*.

For vectors, the returned vector contains the hyperbolic tangent of each element of the input vector.

**REFERENCE IMPLEMENTATION**

**tanh** for a scalar **float** could be implemented like this.

```
float tanh(float x)  
{  
    float exp2x = exp(2*x);  
    return (exp2x - 1) / (exp2x + 1);  
}
```

**PROFILE SUPPORT**

**tanh** is supported in all profiles except fp20.

**SEE ALSO**

atan, atan2, cosh, exp, sinh, tan

**NAME**

**tex1D** – performs a texture lookup in a given 1D sampler and, in some cases, a shadow comparison. May also use pre computed derivatives if those are provided.

**SYNOPSIS**

```
float4 tex1D(sampler1D samp, float s)
float4 tex1D(sampler1D samp, float s, int texelOff)
float4 tex1D(sampler1D samp, float2 s)
float4 tex1D(sampler1D samp, float2 s, int texelOff)

float4 tex1D(sampler1D samp, float s, float dx, float dy)
float4 tex1D(sampler1D samp, float s, float dx, float dy, int texelOff)
float4 tex1D(sampler1D samp, float2 s, float dx, float dy)
float4 tex1D(sampler1D samp, float2 s, float dx, float dy, int texelOff)

int4 tex1D(isampler1D samp, float s);
int4 tex1D(isampler1D samp, float s, int texelOff);

int4 tex1D(isampler1D samp, float s, float dx, float dy)
int4 tex1D(isampler1D samp, float s, float dx, float dy, int texelOff)

unsigned int4 tex1D(usampler1D samp, float s);
unsigned int4 tex1D(usampler1D samp, float s, int texelOff);

unsigned int4 tex1D(usampler1D samp, float s, float dx, float dy)
unsigned int4 tex1D(usampler1D samp, float s, float dx, float dy,
                    int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. If an extra coordinate compared to the texture dimensionality is present it is used to perform a shadow comparison. The value used in the shadow comparison is always the last component of the coordinate vector.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, may use and derivatives *dx* and *dy*, also may perform shadow comparison and use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex1D** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles, variants with integer textures are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dbias, tex1Dlod, tex1Dproj

**NAME**

**tex1DARRAY** – performs a texture lookup in a given sampler array may use pre computed derivatives and, in some cases, perform a shadow comparison.

**SYNOPSIS**

```
float4 tex1DARRAY(sampler1DARRAY samp, float2 s)
float4 tex1DARRAY(sampler1DARRAY samp, float2 s, int texelOff)
float4 tex1DARRAY(sampler1DARRAY samp, float3 s)
float4 tex1DARRAY(sampler1DARRAY samp, float3 s, int texelOff)

float4 tex1DARRAY(sampler1DARRAY samp, float2 s, float dx, float dy)
float4 tex1DARRAY(sampler1DARRAY samp, float2 s, float dx, float dy,
                  int texelOff)
float4 tex1DARRAY(sampler1DARRAY samp, float3 s, float dx, float dy)
float4 tex1DARRAY(sampler1DARRAY samp, float3 s, float dx, float dy,
                  int texelOff)

int4 tex1DARRAY(isampler1DARRAY samp, float2 s)
int4 tex1DARRAY(isampler1DARRAY samp, float2 s, int texelOff)

int4 tex1DARRAY(isampler1DARRAY samp, float2 s, float dx, float dy)
int4 tex1DARRAY(isampler1DARRAY samp, float2 s, float dx, float dy,
                  int texelOff)

unsigned int4 tex1DARRAY(usampler1DARRAY samp, float2 s)
unsigned int4 tex1DARRAY(usampler1DARRAY samp, float2 s, int texelOff)

unsigned int4 tex1DARRAY(usampler1DARRAY samp, float2 s, float dx, float dy)
unsigned int4 tex1DARRAY(usampler1DARRAY samp, float2 s, float dx, float dy,
                          int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to look up.

**s**        Coordinates to perform the lookup. The value used to select the layer is passed immediately after the regular coordinates, if an extra coordinate is present it is used to perform a shadow comparison.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates. Also may use the derivatives *dx* and *dy*, the lookup may involve a shadow comparison and use texel offset *texelOff* to compute the final texel.

**PROFILE SUPPORT**

**tex1DARRAY** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1DARRAYbias, tex1DARRAYlod

**NAME**

**tex1DARRAYbias** – performs a texture lookup with bias in a given sampler array.

**SYNOPSIS**

```
float4 tex1DARRAYbias(sampler1DARRAY samp, float4 s)
float4 tex1DARRAYbias(sampler1DARRAY samp, float4 s, int texelOff)

int4 tex1DARRAYbias(isampler1DARRAY samp, float4 s)
int4 tex1DARRAYbias(isampler1DARRAY samp, float4 s, int texelOff)

unsigned int4 tex1DARRAYbias(usampler1DARRAY samp, float4 s)
unsigned int4 tex1DARRAYbias(usampler1DARRAY samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup. The value used to select the layer should be passed in the vector component right after the regular coordinates. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates.

**PROFILE SUPPORT**

**tex1DARRAYbias** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1DARRAY, tex1DARRAYlod

**NAME**

**tex1DARRAYcmpbias** – performs a texture lookup with shadow compare and bias in a given sampler array.

**SYNOPSIS**

```
float4 tex1DARRAYcmpbias(sampler1DARRAY samp, float4 s)
float4 tex1DARRAYcmpbias(sampler1DARRAY samp, float4 s, int texelOff)
```

**PARAMETERS**

samp     Sampler array to lookup.

s        Coordinates to perform the lookup. The value used to select the layer is the second coordinate, the third is the value used in the shadow comparison, the fourth corresponds to the bias value.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates, the lookup involves a shadow comparison and may use texel offset *texelOff* to compute the final texel.

**PROFILE SUPPORT**

**tex1DARRAYcmpbias** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1DARRAYbias, tex1DARRAYlod, tex1DARRAYcmplod

**NAME**

**tex1DARRAYcmlod** – performs a texture lookup with shadow compare and a level of detail in a given sampler array.

**SYNOPSIS**

```
float4 tex1DARRAYcmlod(sampler1DARRAY samp, float4 s)
float4 tex1DARRAYcmlod(sampler1DARRAY samp, float4 s, int texelOff)
```

samp     Sampler array to look up.

s        Coordinates to perform the lookup. The value used to select the layer is the second coordinate, the third is the value used in the shadow comparison, the fourth corresponds to the level of detail.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with level of detail in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates, the lookup involves a shadow comparison and may use texel offset *texelOff* to compute the final texel.

**PROFILE SUPPORT**

**tex1DARRAYcmlod** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1DARRAYlod, tex1DARRAYbias, tex1DARRAYcmlbias

**NAME**

**tex1DARRAYfetch** – performs an unfiltered texture lookup in a given sampler array.

**SYNOPSIS**

```
float4 tex1DARRAYfetch(sampler1DARRAY samp, int4 s)
float4 tex1DARRAYfetch(sampler1DARRAY samp, int4 s, int texelOff)

int4 tex1DARRAYfetch(isampler1DARRAY samp, int4 s)
int4 tex1DARRAYfetch(isampler1DARRAY samp, int4 s, int texelOff)

unsigned int4 tex1DARRAYfetch(usampler1DARRAY samp, int4 s)
unsigned int4 tex1DARRAYfetch(usampler1DARRAY samp, int4 s, int texelOff)
```

**PARAMETERS**

**samp**      Sampler array to lookup.

**s**          Coordinates to perform the lookup, the layer is selected by the component right after the regular coordinates, the level of detail is provided by the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler array *samp* using coordinates *s*. The layer to be accessed is selected by the component right after the regular coordinates, the level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex1DARRAYfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dfetch

**NAME**

**tex1DARRAYlod** – performs a texture lookup with a specified level of detail in a given sampler array.

**SYNOPSIS**

```
float4 tex1DARRAYlod(sampler1DARRAY samp, float4 s)
float4 tex1DARRAYlod(sampler1DARRAY samp, float4 s, int texelOff)

int4 tex1DARRAYlod(isampler1DARRAY samp, float4 s)
int4 tex1DARRAYlod(isampler1DARRAY samp, float4 s, int texelOff)

unsigned int4 tex1DARRAYlod(usampler1DARRAY samp, float4 s)
unsigned int4 tex1DARRAYlod(usampler1DARRAY samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup. The value used to select the layer should be passed in the vector component right after the regular coordinates. The level of detail value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates.

**PROFILE SUPPORT**

**tex1DARRAYlod** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1DARRAY, tex1DARRAYbias



**NAME**

**tex1DARRAYproj** – performs a texture lookup with projection in a given sampler array. May perform a shadow comparison if argument for shadow comparison is provided.

**SYNOPSIS**

```
float4 tex1DARRAYproj(sampler1DARRAY samp, float3 s)
float4 tex1DARRAYproj(sampler1DARRAY samp, float3 s, int texelOff)
float4 tex1DARRAYproj(sampler1DARRAY samp, float4 s)
float4 tex1DARRAYproj(sampler1DARRAY samp, float4 s, int texelOff)

int4 tex1DARRAYproj(isampler1DARRAY samp, float3 s)
int4 tex1DARRAYproj(isampler1DARRAY samp, float3 s, int texelOff)

unsigned int4 tex1DARRAYproj(usampler1DARRAY samp, float3 s)
unsigned int4 tex1DARRAYproj(usampler1DARRAY samp, float3 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup. The value used to select the layer should be passed as the component right after the lookup coordinates. The value used in the projection should be passed as the last component of the coordinate vector. The value used in the shadow comparison, if present, should be passed as the next-to-last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler array *samp* using coordinates *s*, the layer used in the lookup is first selected using the coordinate component right after the regular coordinates. The coordinates used in the lookup are then projected, that is, divided by the last component of the coordinate vector and then used in the lookup. If an extra coordinate is present it is used to perform a shadow comparison, the value used in the shadow comparison is always the next-to-last component in the coordinate vector.

**PROFILE SUPPORT**

**tex1DARRAYproj** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1D, tex1Dproj

**NAME**

**tex1DARRAYsize** – returns the size of a given texture array image for a given level of detail.

**SYNOPSIS**

```
int3 tex1DARRAYsize(sampler1DARRAY samp, int lod)

int3 tex1DARRAYsize(isampler1DARRAY samp, int lod)

int3 tex1DARRAYsize(usampler1DARRAY samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.  
lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler array and a level of detail the size of one element of the corresponding texture array for a given level of detail is returned as a result of the operation.

**PROFILE SUPPORT**

**tex1DARRAYsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dsize

**NAME**

**tex1Dbias** – performs a texture lookup with bias in a given sampler.

**SYNOPSIS**

```
float4 tex1Dbias(sampler1D samp, float4 s)
float4 tex1Dbias(sampler1D samp, float4 s, int texelOff)

int4 tex1Dbias(isampler1D samp, float4 s)
int4 tex1Dbias(isampler1D samp, float4 s, int texelOff)

unsigned int4 tex1Dbias(usampler1D samp, float4 s)
unsigned int4 tex1Dbias(usampler1D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex1Dbias** is supported in fragment profiles starting with fp30 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dlod, tex1Dcmpbias

**NAME**

**tex1Dcmpbias** – performs a texture lookup with bias and shadow compare in a given sampler.

**SYNOPSIS**

```
float4 tex1Dcmpbias(sampler1D samp, float4 s)
float4 tex1Dcmpbias(sampler1D samp, float4 s, int texelOff)
```

**PARAMETERS**

samp     Sampler to lookup.

s        Coordinates to perform the lookup. The value used in the shadow comparison should be passed right after the normal coordinates. The bias value should be passed as the last component of the coordinate vector.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with shadow compare and bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex1Dcmpbias** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dcmlod, tex1Dbias

**NAME**

**tex1Dcmlod** – performs a texture lookup with a specified level of detail and a shadow compare in a given sampler.

**SYNOPSIS**

```
float4 tex1Dcmlod(sampler1D samp, float4 s)
float4 tex1Dcmlod(sampler1D samp, float4 s, int texelOff)

int4 tex1Dcmlod(isampler1D samp, float4 s)
int4 tex1Dcmlod(isampler1D samp, float4 s, int texelOff)

unsigned int4 tex1Dcmlod(usampler1D samp, float4 s)
unsigned int4 tex1Dcmlod(usampler1D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the shadow comparison should be passed right after the normal coordinates. The level of detail corresponds to the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with shadow compare and a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex1Dcmlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dlod, tex1Dcmlbias

**NAME**

**tex1Dfetch** – performs an unfiltered texture lookup in a given sampler.

**SYNOPSIS**

```
float4 tex1Dfetch(sampler1D samp, int4 s)
float4 tex1Dfetch(sampler1D samp, int4 s, int texelOff)

int4 tex1Dfetch(isampler1D samp, int4 s)
int4 tex1Dfetch(isampler1D samp, int4 s, int texelOff)

unsigned int4 tex1Dfetch(usampler1D samp, int4 s)
unsigned int4 tex1Dfetch(usampler1D samp, int4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail is stored in the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler *samp* using coordinates *s*. The level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex1Dfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1D, tex1DARRAYfetch

**NAME**

**tex1Dlod** – performs a texture lookup with a specified level of detail in a given sampler.

**SYNOPSIS**

```
float4 tex1Dlod(sampler1D samp, float4 s)
float4 tex1Dlod(sampler1D samp, float4 s, int texelOff)

int4 tex1Dlod(isampler1D samp, float4 s)
int4 tex1Dlod(isampler1D samp, float4 s, int texelOff)

unsigned int4 tex1Dlod(usampler1D samp, float4 s)
unsigned int4 tex1Dlod(usampler1D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex1Dlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex1Dbias, tex1Dcmlod

**NAME**

**tex1Dproj** – performs a texture lookup with projection in a given sampler. May perform a shadow comparison if argument for shadow comparison is provided.

**SYNOPSIS**

```
float4 tex1Dproj(sampler1D samp, float2 s)
float4 tex1Dproj(sampler1D samp, float2 s, int texelOff)
float4 tex1Dproj(sampler1D samp, float3 s)
float4 tex1Dproj(sampler1D samp, float3 s, int texelOff)

int4 tex1Dproj(isampler1D samp, float2 s)
int4 tex1Dproj(isampler1D samp, float2 s, int texelOff)

unsigned int4 tex1Dproj(usampler1D samp, float2 s)
unsigned int4 tex1Dproj(usampler1D samp, float2 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the projection should be passed as the last component of the coordinate vector. The value used in the shadow comparison, if present, should be passed as the next-to-last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the coordinates used in the lookup are first projected, that is, divided by the last component of the coordinate vector and then used in the lookup. If an extra coordinate is present it is used to perform a shadow comparison, the value used in the shadow comparison is always the next-to-last component in the coordinate vector.

**PROFILE SUPPORT**

**tex1Dproj** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles.

**SEE ALSO**

tex1D, tex1DARRAYproj



**NAME**

**tex1Dsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 tex1Dsize(sampler1D samp, int lod)
int3 tex1Dsize(isampler1D samp, int lod)
int3 tex1Dsize(usampler1D samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size of the corresponding texture image is returned as the result of the operation.

**PROFILE SUPPORT**

**tex1Dsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex1D, tex1DARRAYsize

**NAME**

**tex2D** – performs a texture lookup in a given 2D sampler and, in some cases, a shadow comparison. May also use pre computed derivatives if those are provided.

**SYNOPSIS**

```
float4 tex2D(sampler2D samp, float2 s)
float4 tex2D(sampler2D samp, float2 s, int texelOff)
float4 tex2D(sampler2D samp, float3 s)
float4 tex2D(sampler2D samp, float3 s, int texelOff)

float4 tex2D(sampler2D samp, float2 s, float2 dx, float2 dy)
float4 tex2D(sampler2D samp, float2 s, float2 dx, float2 dy, int texelOff)
float4 tex2D(sampler2D samp, float3 s, float2 dx, float2 dy)
float4 tex2D(sampler2D samp, float3 s, float2 dx, float2 dy, int texelOff)

int4 tex2D(isampler2D samp, float2 s)
int4 tex2D(isampler2D samp, float2 s, int texelOff)

int4 tex2D(isampler2D samp, float2 s, float2 dx, float2 dy)
int4 tex2D(isampler2D samp, float2 s, float2 dx, float2 dy, int texelOff)

unsigned int4 tex2D(usampler2D samp, float2 s)
unsigned int4 tex2D(usampler2D samp, float2 s, int texelOff)

unsigned int4 tex2D(usampler2D samp, float2 s, float2 dx, float2 dy)
unsigned int4 tex2D(usampler2D samp, float2 s, float2 dx, float2 dy,
                    int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. If an extra coordinate compared to the texture dimensionality is present it is used to perform a shadow comparison. The value used in the shadow comparison is always the last component of the coordinate vector.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, may use and derivatives *dx* and *dy*, also may perform shadow comparison and use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex2D** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles. Variants with integer textures are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dbias, tex2Dlod, tex2Dproj

**NAME**

**tex2DARRAY** – performs a texture lookup in a given sampler array may use pre computed derivatives and, in some cases, perform a shadow comparison.

**SYNOPSIS**

```
float4 tex2DARRAY(sampler2DARRAY samp, float3 s)
float4 tex2DARRAY(sampler2DARRAY samp, float3 s, int texelOff)
float4 tex2DARRAY(sampler2DARRAY samp, float4 s)
float4 tex2DARRAY(sampler2DARRAY samp, float4 s, int texelOff)

float4 tex2DARRAY(sampler2DARRAY samp, float3 s, float dx, float dy)
float4 tex2DARRAY(sampler2DARRAY samp, float3 s, float dx, float dy,
                  int texelOff)
float4 tex2DARRAY(sampler2DARRAY samp, float4 s, float dx, float dy)
float4 tex2DARRAY(sampler2DARRAY samp, float4 s, float dx, float dy,
                  int texelOff)

int4 tex2DARRAY(isampler2DARRAY samp, float3 s)
int4 tex2DARRAY(isampler2DARRAY samp, float3 s, int texelOff)

int4 tex2DARRAY(isampler2DARRAY samp, float3 s, float dx, float dy)
int4 tex2DARRAY(isampler2DARRAY samp, float3 s, float dx, float dy,
                  int texelOff)

unsigned int4 tex2DARRAY(usampler2DARRAY samp, float3 s)
unsigned int4 tex2DARRAY(usampler2DARRAY samp, float3 s, int texelOff)

unsigned int4 tex2DARRAY(usampler2DARRAY samp, float3 s, float dx, float dy)
unsigned int4 tex2DARRAY(usampler2DARRAY samp, float3 s, float dx, float dy,
                          int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to look up.

**s**        Coordinates to perform the lookup. The value used to select the layer is passed immediately after the regular coordinates, if an extra coordinate is present it is used to perform a shadow comparison.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates. Also may use the derivatives *dx* and *dy*, the lookup may involve a shadow comparison and use texel offset *texelOff* to compute the final texel.

**PROFILE SUPPORT**

**tex2DARRAY** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2DARRAYbias, tex2DARRAYlod

**NAME**

**tex2DARRAYbias** – performs a texture lookup with bias in a given sampler array.

**SYNOPSIS**

```
float4 tex2DARRAYbias(sampler2DARRAY samp, float4 s)
float4 tex2DARRAYbias(sampler2DARRAY samp, float4 s, int texelOff)

int4 tex2DARRAYbias(isampler2DARRAY samp, float4 s)
int4 tex2DARRAYbias(isampler2DARRAY samp, float4 s, int texelOff)

unsigned int4 tex2DARRAYbias(usampler2DARRAY samp, float4 s)
unsigned int4 tex2DARRAYbias(usampler2DARRAY samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup. The value used to select the layer should be passed in the vector component right after the regular coordinates. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates.

**PROFILE SUPPORT**

**tex2DARRAYbias** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2DARRAY, tex2DARRAYlod

**NAME**

**tex2DARRAYfetch** – performs an unfiltered texture lookup in a given sampler array.

**SYNOPSIS**

```
float4 tex2DARRAYfetch(sampler2DARRAY samp, int4 s)
float4 tex2DARRAYfetch(sampler2DARRAY samp, int4 s, int texelOff)

int4 tex2DARRAYfetch(isampler2DARRAY samp, int4 s)
int4 tex2DARRAYfetch(isampler2DARRAY samp, int4 s, int texelOff)

unsigned int4 tex2DARRAYfetch(usampler2DARRAY samp, int4 s)
unsigned int4 tex2DARRAYfetch(usampler2DARRAY samp, int4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup, the layer is selected by the component right after the regular coordinates, the level of detail is provided by the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler array *samp* using coordinates *s*. The layer to be accessed is selected by the component right after the regular coordinates, the level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex2DARRAYfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dfetch

**NAME**

**tex2DARRAYlod** – performs a texture lookup with a specified level of detail in a given sampler array.

**SYNOPSIS**

```
float4 tex2DARRAYlod(sampler2DARRAY samp, float4 s)
float4 tex2DARRAYlod(sampler2DARRAY samp, float4 s, int texelOff)

int4 tex2DARRAYlod(isampler2DARRAY samp, float4 s)
int4 tex2DARRAYlod(isampler2DARRAY samp, float4 s, int texelOff)

unsigned int4 tex2DARRAYlod(usampler2DARRAY samp, float4 s)
unsigned int4 tex2DARRAYlod(usampler2DARRAY samp, float4 s, int texelOff)
```

**PARAMETERS**

samp     Sampler array to lookup.

s        Coordinates to perform the lookup. The value used to select the layer should be passed in the vector component right after the regular coordinates. The level of detail value should be passed as the last component of the coordinate vector.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates.

**PROFILE SUPPORT**

**tex2DARRAYlod** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2DARRAY, tex2DARRAYbias

**NAME**

**tex2DARRAYproj** – performs a texture lookup with projection in a given sampler array.

**SYNOPSIS**

```
float4 tex2DARRAYproj(sampler2DARRAY samp, float3 s)
float4 tex2DARRAYproj(sampler2DARRAY samp, float3 s, int texelOff)

int4 tex2DARRAYproj(isampler2DARRAY samp, float3 s)
int4 tex2DARRAYproj(isampler2DARRAY samp, float3 s, int texelOff)

unsigned int4 tex2DARRAYproj(usampler2DARRAY samp, float3 s)
unsigned int4 tex2DARRAYproj(usampler2DARRAY samp, float3 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler array to lookup.

**s**        Coordinates to perform the lookup. The value used to select the layer should be passed as the component right after the lookup coordinates. The value used in the projection should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler array *samp* using coordinates *s*, the layer used in the lookup is first selected using the coordinate component right after the regular coordinates. The coordinates used in the lookup are then projected, that is, divided by the last component of the coordinate vector and then used in the lookup.

**PROFILE SUPPORT**

**tex2DARRAYproj** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2D, tex2Dproj

**NAME**

**tex2DARRAYsize** – returns the size of a given texture array image for a given level of detail.

**SYNOPSIS**

```
int3 tex2DARRAYsize(sampler2DARRAY samp, int lod)
int3 tex2DARRAYsize(isampler2DARRAY samp, int lod)
int3 tex2DARRAYsize(usampler2DARRAY samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler array and a level of detail the size of one element of the corresponding texture array for a given level of detail is returned as a result of the operation.

**PROFILE SUPPORT**

**tex2DARRAYsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dsize



**NAME**

**tex2Dbias** – performs a texture lookup with bias in a given sampler.

**SYNOPSIS**

```
float4 tex2Dbias(sampler2D samp, float4 s)
float4 tex2Dbias(sampler2D samp, float4 s, int texelOff)

int4 tex2Dbias(isampler2D samp, float4 s)
int4 tex2Dbias(isampler2D samp, float4 s, int texelOff)

unsigned int4 tex2Dbias(usampler2D samp, float4 s)
unsigned int4 tex2Dbias(usampler2D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex2Dbias** is supported in fragment profiles starting with fp30 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dlod, tex2Dcmpbias

**NAME**

**tex2Dcmpbias** – performs a texture lookup with bias and shadow compare in a given sampler.

**SYNOPSIS**

```
float4 tex2Dcmpbias(sampler2D samp, float4 s)
float4 tex2Dcmpbias(sampler2D samp, float4 s, int texelOff)
```

**PARAMETERS**

samp     Sampler to lookup.

s        Coordinates to perform the lookup. The value used in the shadow comparison should be passed right after the normal coordinates. The bias value should be passed as the last component of the coordinate vector.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with shadow compare and bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex2Dcmpbias** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dcmlod, tex2Dbias

**NAME**

**tex2Dcmlod** – performs a texture lookup with a specified level of detail and a shadow compare in a given sampler.

**SYNOPSIS**

```
float4 tex2Dcmlod(sampler2D samp, float4 s)
float4 tex2Dcmlod(sampler2D samp, float4 s, int texelOff)
```

**PARAMETERS**

samp     Sampler to lookup.

s        Coordinates to perform the lookup. The value used in the shadow comparison should be passed right after the normal coordinates. The level of detail corresponds to the last component of the coordinate vector.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with shadow compare and a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex2Dcmlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dlod, tex2Dcmpbias

**NAME**

**tex2Dfetch** – performs an unfiltered texture lookup in a given sampler.

**SYNOPSIS**

```
float4 tex2Dfetch(sampler2D samp, int4 s)
float4 tex2Dfetch(sampler2D samp, int4 s, int texelOff)

int4 tex2Dfetch(isampler2D samp, int4 s)
int4 tex2Dfetch(isampler2D samp, int4 s, int texelOff)

unsigned int4 tex2Dfetch(usampler2D samp, int4 s)
unsigned int4 tex2Dfetch(usampler2D samp, int4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail is stored in the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler *samp* using coordinates *s*. The level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex2Dfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2D, tex2DARRAYfetch

**NAME**

**tex2Dlod** – performs a texture lookup with a specified level of detail in a given sampler.

**SYNOPSIS**

```
float4 tex2Dlod(sampler2D samp, float4 s)
float4 tex2Dlod(sampler2D samp, float4 s, int texelOff)

int4 tex2Dlod(isampler2D samp, float4 s)
int4 tex2Dlod(isampler2D samp, float4 s, int texelOff)

unsigned int4 tex2Dlod(usampler2D samp, float4 s)
unsigned int4 tex2Dlod(usampler2D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex2Dlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex2Dbias, tex2Dcmlod

**NAME**

**tex2Dproj** – performs a texture lookup with projection in a given sampler. May perform a shadow comparison if argument for shadow comparison is provided.

**SYNOPSIS**

```
float4 tex2Dproj(sampler2D samp, float3 s)
float4 tex2Dproj(sampler2D samp, float3 s, int texelOff)
float4 tex2Dproj(sampler2D samp, float4 s)
float4 tex2Dproj(sampler2D samp, float4 s, int texelOff)

int4 tex2Dproj(isampler2D samp, float3 s)
int4 tex2Dproj(isampler2D samp, float3 s, int texelOff)

unsigned int4 tex2Dproj(usampler2D samp, float3 s)
unsigned int4 tex2Dproj(usampler2D samp, float3 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the projection should be passed as the last component of the coordinate vector. The value used in the shadow comparison, if present, should be passed as the next-to-last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the coordinates used in the lookup are first projected, that is, divided by the last component of the coordinate vector and then used in the lookup. If an extra coordinate is present it is used to perform a shadow comparison, the value used in the shadow comparison is always the next-to-last component in the coordinate vector.

**PROFILE SUPPORT**

**tex2Dproj** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles.

**SEE ALSO**

tex2D, tex2DARRAYproj

**NAME**

**tex2Dsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 tex2Dsize(sampler2D samp, int lod)
int3 tex2Dsize(isampler2D samp, int lod)
int3 tex2Dsize(usampler2D samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size of the corresponding texture image is returned as the result of the operation.

**PROFILE SUPPORT**

**tex2Dsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex2D, tex2DARRAYsize

**NAME**

**tex3D** – performs a texture lookup in a given 3D sampler. May also use pre computed derivatives if those are provided.

**SYNOPSIS**

```
float4 tex3D(sampler3D samp, float3 s)
float4 tex3D(sampler3D samp, float3 s, int texelOff)

float4 tex3D(sampler3D samp, float3 s, float3 dx, float3 dy)
float4 tex3D(sampler3D samp, float3 s, float3 dx, float3 dy, int texelOff)

int4 tex3D(isampler3D samp, float3 s)
int4 tex3D(isampler3D samp, float3 s, int texelOff)

int4 tex3D(isampler3D samp, float3 s, float3 dx, float3 dy)
int4 tex3D(isampler3D samp, float3 s, float3 dx, float3 dy, int texelOff)

unsigned int4 tex3D(usampler3D samp, float3 s)
unsigned int4 tex3D(usampler3D samp, float3 s, int texelOff)

unsigned int4 tex3D(usampler3D samp, float3 s, float3 dx, float3 dy)
unsigned int4 tex3D(usampler3D samp, float3 s, float3 dx, float3 dy,
                    int texelOff)
```

**PARAMETERS**

samp     Sampler to lookup.

s        Coordinates to perform the lookup.

dx       Pre computed derivative along the x axis.

dy       Pre computed derivative along the y axis.

texelOff   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, may use and derivatives *dx* and *dy*, also may use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex3D** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with texel offsets are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex3Dbias, tex3Dlod, tex3Dproj



**NAME**

**tex3Dbias** – performs a texture lookup with bias in a given sampler.

**SYNOPSIS**

```
float4 tex3Dbias(sampler3D samp, float4 s)
float4 tex3Dbias(sampler3D samp, float4 s, int texelOff)

int4 tex3Dbias(isampler3D samp, float4 s)
int4 tex3Dbias(isampler3D samp, float4 s, int texelOff)

unsigned int4 tex3Dbias(usampler3D samp, float4 s)
unsigned int4 tex3Dbias(usampler3D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex3Dbias** is supported in fragment profiles starting with fp30 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex3Dlod

**NAME**

**tex3Dfetch** – performs an unfiltered texture lookup in a given sampler.

**SYNOPSIS**

```
float4 tex3Dfetch(sampler3D samp, int4 s)
float4 tex3Dfetch(sampler3D samp, int4 s, int texelOff)

int4 tex3Dfetch(isampler3D samp, int4 s)
int4 tex3Dfetch(isampler3D samp, int4 s, int texelOff)

unsigned int4 tex3Dfetch(usampler3D samp, int4 s)
unsigned int4 tex3Dfetch(usampler3D samp, int4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail is stored in the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler *samp* using coordinates *s*. The level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**tex3Dfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex3D

**NAME**

**tex3Dlod** – performs a texture lookup with a specified level of detail in a given sampler.

**SYNOPSIS**

```
float4 tex3Dlod(sampler3D samp, float4 s)
float4 tex3Dlod(sampler3D samp, float4 s, int texelOff)

int4 tex3Dlod(isampler3D samp, float4 s)
int4 tex3Dlod(isampler3D samp, float4 s, int texelOff)

unsigned int4 tex3Dlod(usampler3D samp, float4 s)
unsigned int4 tex3Dlod(usampler3D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**tex3Dlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

tex3Dbias

**NAME**

**tex3Dproj** – performs a texture lookup with projection in a given sampler. May perform a shadow comparison if argument for shadow comparison is provided.

**SYNOPSIS**

```
float4 tex3Dproj(sampler3D samp, float4 s)
float4 tex3Dproj(sampler3D samp, float4 s, int texelOff)

int4 tex3Dproj(isampler3D samp, float4 s)
int4 tex3Dproj(isampler3D samp, float4 s, int texelOff)

unsigned int4 tex3Dproj(usampler3D samp, float4 s)
unsigned int4 tex3Dproj(usampler3D samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the projection should be passed as the last component of the coordinate vector. The value used in the shadow comparison, if present, should be passed as the next-to-last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the coordinates used in the lookup are first projected, that is, divided by the last component of the coordinate vector and then used in the lookup. If an extra coordinate is present it is used to perform a shadow comparison, the value used in the shadow comparison is always the next-to-last component in the coordinate vector.

**PROFILE SUPPORT**

**tex3Dproj** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles.

**SEE ALSO**

tex3D

**NAME**

**tex3Dsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 tex3Dsize(sampler3D samp, int lod)
int3 tex3Dsize(isampler3D samp, int lod)
int3 tex3Dsize(usampler3D samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size of the corresponding texture image is returned as the result of the operation.

**PROFILE SUPPORT**

**tex3Dsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

tex3D

**NAME**

**texBUF** – performs an unfiltered texture lookup in a given texture buffer sampler.

**SYNOPSIS**

```
float4 texBUF(samplerBUF samp, int s)

int4 texBUF(isamplerBUF samp, int s)

unsigned int4 texBUF(usamplerBUF samp, int s)
```

**PARAMETERS**

samp     Sampler to lookup.  
s        Coordinates to perform the lookup.

**DESCRIPTION**

Performs an unfiltered texture lookup in texture buffer sampler *samp* using coordinates *s*.

Texture buffer samplers are created with the **EXT\_texture\_buffer\_object** extension. See:

[http://developer.download.nvidia.com/opengl/specs/GL\\_EXT\\_texture\\_buffer\\_object.txt](http://developer.download.nvidia.com/opengl/specs/GL_EXT_texture_buffer_object.txt)

Texture buffer object samplers roughly correspond to the *tbuffer* functionality of DirectX 10.

**PROFILE SUPPORT**

**texBUF** is supported in gp4vp, gp4gp, and gp4fp profiles.

**SEE ALSO**

tex1D, texBUFsize

**NAME**

**texBUFsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 texBUFsize(samplerBUF samp, int lod)

int3 texBUFsize(isamplerBUF samp, int lod)

int3 texBUFsize(usamplerBUF samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.  
lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size (width in *x*, height in *y*, and depth in *z*) of the corresponding texture buffer is returned as the result of the operation.

Because texture buffers lack mipmaps, the *lod* parameter is unused.

Texture buffer samplers are created with the **EXT\_texture\_buffer\_object** extension. See:

[http://developer.download.nvidia.com/opengl/specs/GL\\_EXT\\_texture\\_buffer\\_object.txt](http://developer.download.nvidia.com/opengl/specs/GL_EXT_texture_buffer_object.txt)

Texture buffer object samplers roughly correspond to the *tbuffer* functionality of DirectX 10.

**PROFILE SUPPORT**

**texBUF** is supported in gp4vp, gp4gp, and gp4fp profiles.

**SEE ALSO**

tex1Dsize, texBUF

**NAME**

**texCUBE** – performs a texture lookup in a given CUBE sampler and, in some cases, a shadow comparison. May also use pre computed derivatives if those are provided.

**SYNOPSIS**

```
float4 texCUBE(samplerCUBE samp, float3 s)
float4 texCUBE(samplerCUBE samp, float4 s)

float4 texCUBE(samplerCUBE samp, float3 s, float3 dx, float3 dy)
float4 texCUBE(samplerCUBE samp, float4 s, float3 dx, float3 dy)

int4 texCUBE(isamplerCUBE samp, float3 s)

int4 texCUBE(isamplerCUBE samp, float3 s, float3 dx, float3 dy)

unsigned int4 texCUBE(usamplerCUBE samp, float3 s)

unsigned int4 texCUBE(usamplerCUBE samp, float3 s, float3 dx, float3 dy)
```

**PARAMETERS**

samp	Sampler to lookup.
s	Coordinates to perform the lookup. If an extra coordinate compared to the texture dimensionality is present it is used to perform a shadow comparison. The value used in the shadow comparison is always the last component of the coordinate vector.
dx	Pre computed derivative along the x axis.
dy	Pre computed derivative along the y axis.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, may use and derivatives *dx* and *dy*, also may perform shadow comparison.

**PROFILE SUPPORT**

**texCUBE** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBEbias, texCUBElod, texCUBEproj



**NAME**

**texCUBEARRAY** – performs a texture lookup in a given sampler array may use pre computed derivatives.

**SYNOPSIS**

```
float4 texCUBEARRAY(samplerCUBEARRAY samp, float4 s)
float4 texCUBEARRAY(samplerCUBEARRAY samp, float4 s, float3 dx, float3 dy)

int4 texCUBEARRAY(isamplerCUBEARRAY samp, float4 s)
int4 texCUBEARRAY(isamplerCUBEARRAY samp, float4 s, float3 dx, float3 dy)

unsigned int4 texCUBEARRAY(usamplerCUBEARRAY samp, float4 s)
unsigned int4 texCUBEARRAY(usamplerCUBEARRAY samp, float4 s, float3 dx, float3 dy)
```

**PARAMETERS**

**samp**     Sampler array to look up.

**s**        Coordinates to perform the lookup. The value used to select the layer is passed immediately after the regular coordinates.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff** Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the texture to be sampled is selected from the layer specified in the coordinates. Also may use the derivatives *dx* and *dy*, the lookup may use texel offset *texelOff* to compute the final texel.

**PROFILE SUPPORT**

**texCUBEARRAY** is only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBEARRAYbias, texCUBEARRAYlod

**NAME**

**texCUBEARRAYsize** – returns the size of a given texture array image for a given level of detail.

**SYNOPSIS**

```
int3 texCUBEARRAYsize(samplerCUBEARRAY samp, int lod)
int3 texCUBEARRAYsize(isamplerCUBEARRAY samp, int lod)
int3 texCUBEARRAYsize(usamplerCUBEARRAY samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler array and a level of detail the size of one element of the corresponding texture array for a given level of detail is returned as a result of the operation.

**PROFILE SUPPORT**

**texCUBEARRAYsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBEsize

**NAME**

**texCUBEbias** – performs a texture lookup with bias in a given sampler.

**SYNOPSIS**

```
float4 texCUBEbias(samplerCUBE samp, float4 s)

int4 texCUBEbias(isamplerCUBE samp, float4 s)

unsigned int4 texCUBEbias(usamplerCUBE samp, float4 s)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**texCUBEbias** is supported in fragment profiles starting with fp30 and in vertex profiles starting with vp40. Variants with integer samplers are only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBElod

**NAME**

**texCUBElod** – performs a texture lookup with a specified level of detail in a given sampler.

**SYNOPSIS**

```
float4 texCUBElod(samplerCUBE samp, float4 s)
```

```
int4 texCUBElod(isamplerCUBE samp, float4 s)
```

```
unsigned int4 texCUBElod(usamplerCUBE samp, float4 s)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail should be passed as the last component of the coordinate vector.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**texCUBElod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40.

Variants with integer samplers are only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBEbias

**NAME**

**texCUBEproj** – performs a texture lookup with projection in a given sampler.

**SYNOPSIS**

```
float4 texCUBEproj(samplerCUBE samp, float4 s)

int4 texCUBEproj(isamplerCUBE samp, float4 s)

unsigned int4 texCUBEproj(usamplerCUBE samp, float4 s)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the projection should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the coordinates used in the lookup are first projected, that is, divided by the last component of the coordinate vector and then used in the lookup.

**PROFILE SUPPORT**

**texCUBEproj** is supported in all fragment profiles and all vertex profiles starting with vp40. Variants with integer samplers are only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBE

**NAME**

**texCUBEsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 texCUBEsize(samplerCUBE samp, int lod)
int3 texCUBEsize(isamplerCUBE samp, int lod)
int3 texCUBEsize(usamplerCUBE samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod     Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size of the corresponding texture image is returned as the result of the operation.

**PROFILE SUPPORT**

**texCUBEsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

texCUBE

**NAME**

**texRECT** – performs a texture lookup in a given RECT sampler and, in some cases, a shadow comparison. May also use pre computed derivatives if those are provided.

**SYNOPSIS**

```
float4 texRECT(samplerRECT samp, float2 s)
float4 texRECT(samplerRECT samp, float2 s, int texelOff)
float4 texRECT(samplerRECT samp, float3 s)
float4 texRECT(samplerRECT samp, float3 s, int texelOff)

float4 texRECT(samplerRECT samp, float2 s, float2 dx, float2 dy)
float4 texRECT(samplerRECT samp, float2 s, float2 dx, float2 dy, int texelOff)
float4 texRECT(samplerRECT samp, float3 s, float2 dx, float2 dy)
float4 texRECT(samplerRECT samp, float3 s, float2 dx, float2 dy, int texelOff)

int4 texRECT(isamplerRECT samp, float2 s)
int4 texRECT(isamplerRECT samp, float2 s, int texelOff)

int4 texRECT(isamplerRECT samp, float2 s, float2 dx, float2 dy)
int4 texRECT(isamplerRECT samp, float2 s, float2 dx, float2 dy, int texelOff)

unsigned int4 texRECT(usamplerRECT samp, float2 s)
unsigned int4 texRECT(usamplerRECT samp, float2 s, int texelOff)

unsigned int4 texRECT(usamplerRECT samp, float2 s, float2 dx, float2 dy)
unsigned int4 texRECT(usamplerRECT samp, float2 s, float2 dx, float2 dy,
                      int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. If an extra coordinate compared to the texture dimensionality is present it is used to perform a shadow comparison. The value used in the shadow comparison is always the last component of the coordinate vector.

**dx**       Pre computed derivative along the x axis.

**dy**       Pre computed derivative along the y axis.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, may use and derivatives *dx* and *dy*, also may perform shadow comparison and use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**texRECT** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles. Variants with integer samplers are only supported in gp4 and newer profiles.

**SEE ALSO**

texRECTbias, texRECTlod, texRECTproj

**NAME**

**texRECTbias** – performs a texture lookup with bias in a given sampler.

**SYNOPSIS**

```
float4 texRECTbias(samplerRECT samp, float4 s)
float4 texRECTbias(samplerRECT samp, float4 s, int2 texelOff)

int4 texRECTbias(isamplerRECT samp, float4 s)
int4 texRECTbias(isamplerRECT samp, float4 s, int2 texelOff)

unsigned int4 texRECTbias(usamplerRECT samp, float4 s)
unsigned int4 texRECTbias(usamplerRECT samp, float4 s, int2 texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The bias value should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with bias in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**texRECTbias** is supported in fragment profiles starting with fp30 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

texRECTlod



**NAME**

**texRECTfetch** – performs an unfiltered texture lookup in a given sampler.

**SYNOPSIS**

```
float4 texRECTfetch(samplerRECT samp, int4 s)
float4 texRECTfetch(samplerRECT samp, int4 s, int2 texelOff)

int4 texRECTfetch(isamplerRECT samp, int4 s)
int4 texRECTfetch(isamplerRECT samp, int4 s, int2 texelOff)

unsigned int4 texRECTfetch(usamplerRECT samp, int4 s)
unsigned int4 texRECTfetch(usamplerRECT samp, int4 s, int2 texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail is stored in the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs an unfiltered texture lookup in sampler *samp* using coordinates *s*. The level of detail is provided by the last component of the coordinate vector. May use texel offset *texelOff* to compute final texel.

**PROFILE SUPPORT**

**texRECTfetch** is only supported in gp4 and newer profiles.

**SEE ALSO**

texRECT, texRECTARRAYfetch

**NAME**

**texRECTlod** – performs a texture lookup with a specified level of detail in a given sampler.

**SYNOPSIS**

```
float4 texRECTlod(samplerRECT samp, float4 s)
float4 texRECTlod(samplerRECT samp, float4 s, int texelOff)

int4 texRECTlod(isamplerRECT samp, float4 s)
int4 texRECTlod(isamplerRECT samp, float4 s, int texelOff)

unsigned int4 texRECTlod(usamplerRECT samp, float4 s)
unsigned int4 texRECTlod(usamplerRECT samp, float4 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The level of detail should be passed as the last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup with a specified level of detail in sampler *samp* using coordinates *s*.

**PROFILE SUPPORT**

**texRECTlod** is supported in fragment profiles starting with fp40 and in vertex profiles starting with vp40. Variants with *texelOff* are only supported in gp4 and newer profiles. Variants with integer samplers are also only supported in gp4 and newer profiles.

**SEE ALSO**

texRECTbias

**NAME**

**texRECTproj** – performs a texture lookup with projection in a given sampler. May perform a shadow comparison if argument for shadow comparison is provided.

**SYNOPSIS**

```
float4 texRECTproj(samplerRECT samp, float3 s)
float4 texRECTproj(samplerRECT samp, float3 s, int texelOff)
float4 texRECTproj(samplerRECT samp, float4 s)
float4 texRECTproj(samplerRECT samp, float4 s, int texelOff)

int4 texRECTproj(isamplerRECT samp, float3 s)
int4 texRECTproj(isamplerRECT samp, float3 s, int texelOff)

unsigned int4 texRECTproj(usamplerRECT samp, float3 s)
unsigned int4 texRECTproj(usamplerRECT samp, float3 s, int texelOff)
```

**PARAMETERS**

**samp**     Sampler to lookup.

**s**        Coordinates to perform the lookup. The value used in the projection should be passed as the last component of the coordinate vector. The value used in the shadow comparison, if present, should be passed as the next-to-last component of the coordinate vector.

**texelOff**   Offset to be added to obtain the final texel.

**DESCRIPTION**

Performs a texture lookup in sampler *samp* using coordinates *s*, the coordinates used in the lookup are first projected, that is, divided by the last component of the coordinate vector and then used in the lookup. If an extra coordinate is present it is used to perform a shadow comparison, the value used in the shadow comparison is always the next-to-last component in the coordinate vector.

**PROFILE SUPPORT**

**texRECTproj** is supported in all fragment profiles and all vertex profiles starting with vp40, variants with shadow comparison are only supported in fp40 and newer profiles, variants with texel offsets are only supported in gp4 and newer profiles.

**SEE ALSO**

texRECT

**NAME**

**texRECTsize** – returns the size of a given texture image for a given level of detail.

**SYNOPSIS**

```
int3 texRECTsize(samplerRECT samp, int lod)
```

```
int3 texRECTsize(isamplerRECT samp, int lod)
```

```
int3 texRECTsize(usamplerRECT samp, int lod)
```

**PARAMETERS**

samp     Sampler to be queried for size.

lod      Level of detail to obtain size.

**DESCRIPTION**

Given a sampler and a level of detail the size of the corresponding texture image is returned as the result of the operation.

**PROFILE SUPPORT**

**texRECTsize** is only supported in gp4 and newer profiles.

**SEE ALSO**

texRECT

**NAME**

**transpose** – returns transpose matrix of a matrix

**SYNOPSIS**

```
float4x4 transpose(float4x4 A)
float3x4 transpose(float4x3 A)
float2x4 transpose(float4x2 A)
float1x4 transpose(float4x1 A)

float4x3 transpose(float3x4 A)
float3x3 transpose(float3x3 A)
float2x3 transpose(float3x2 A)
float1x3 transpose(float3x1 A)

float4x2 transpose(float2x4 A)
float3x2 transpose(float2x3 A)
float2x2 transpose(float2x2 A)
float1x2 transpose(float2x1 A)

float4x1 transpose(float1x4 A)
float3x1 transpose(float1x3 A)
float2x1 transpose(float1x2 A)
float1x1 transpose(float1x1 A)
```

**PARAMETERS**

A        Matrix to tranpose.

**DESCRIPTION**

Returns the transpose of the matrix A.

**REFERENCE IMPLEMENTATION**

**transpose** for a **float4x3** matrix can be implemented like this:

```
float4x3 transpose(float3x4 A)
{
    float4x3 C;

    C[0] = A._m00_m10_m20;
    C[1] = A._m01_m11_m21;
    C[2] = A._m02_m12_m22;
    C[3] = A._m03_m13_m23;

    return C;
}
```

**PROFILE SUPPORT**

**transpose** is supported in all profiles.

**SEE ALSO**

determinant, mul

**NAME**

**trunc** – returns largest integer not greater than a scalar or each vector component.

**SYNOPSIS**

```
float   trunc(float x);
float1  trunc(float1 x);
float2  trunc(float2 x);
float3  trunc(float3 x);
float4  trunc(float4 x);
```

```
half    trunc(half x);
half1   trunc(half1 x);
half2   trunc(half2 x);
half3   trunc(half3 x);
half4   trunc(half4 x);
```

```
fixed   trunc(fixed x);
fixed1  trunc(fixed1 x);
fixed2  trunc(fixed2 x);
fixed3  trunc(fixed3 x);
fixed4  trunc(fixed4 x);
```

**PARAMETERS**

x            Vector or scalar which to truncate.

**DESCRIPTION**

Returns the integral value nearest to but no larger in magnitude than x.

**REFERENCE IMPLEMENTATION**

**trunc** for a **float3** vector could be implemented like this.

```
float3 trunc(float3 v)
{
    float3 rv;
    int i;

    for (i=0; i<3; i++) {
        float x = v[i];

        rv[i] = x < 0 ? -floor(-x) : floor(x);
    }
    return rv;
}
```

**PROFILE SUPPORT**

**trunc** is supported in all profiles except fp20.

**SEE ALSO**

ceil, floor, round

**NAME**

**AlphaFunc** – 3D API alpha function

**USAGE**

AlphaFunc = float2(function, reference\_value)

**VALID ENUMERANTS**

function: Never, Less, LEqual, Equal, Greater, NotEqual, GEqual, Always

**DESCRIPTION**

Set the OpenGL or Direct3D alpha function and reference value state. See the OpenGL glAlphaFunc manual page for details. See the D3DRS\_ALPHAREF and D3DRS\_ALPHAFUNC render state descriptions for DirectX 9.

The standard reset callback sets the AlphaFunc state to float2(Always, 0.0).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

AlphaTestEnable, DepthFunc, StencilFunc

**NAME**

**AlphaTestEnable** – 3D API alpha test enable

**USAGE**

AlphaTestEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D alpha test enable. See the GL\_ALPHA\_TEST description on the OpenGL glEnable manual page for details. See the D3DRS\_ALPHATESTENABLE render state description for DirectX 9.

The standard reset callback sets the AlphaTestEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

BlendEnable, DepthTestEnable, StencilTestEnable



**NAME**

**AutoNormalEnable** – 3D API auto normal test enable

**USAGE**

AutoNormalEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL auto normal enable for evaluators. See the GL\_AUTO\_NORMAL description on the OpenGL glEnable manual page for details.

The standard reset callback sets the AutoNormalEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Evaluators are not supported by Direct3D so this state is parsed but has no effect.

**SEE ALSO**

BlendEnable, DepthTestEnable, StencilTestEnable

**NAME**

**BlendEnable** – 3D API blend enable

**USAGE**

BlendEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D blend enable. See the GL\_BLEND description on the OpenGL glEnable manual page for details. See the D3DRS\_ALPHABLENDENABLE render state description for DirectX 9.

The standard reset callback sets the BlendEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

AlphaTestEnable, DepthTestEnable, StencilTestEnable

**NAME**

**BlendFunc** – 3D API blend function

**USAGE**

BlendFunc = float2(srcFactor, dstFactor)

**VALID ENUMERANTS**

srcFactor, dstFactor: Zero, One, DestColor, OneMinusDestColor, SrcAlpha, OneMinusSrcAlpha, DstAlpha, OneMinusDstAlpha, SrcAlphaSaturate, SrcColor, OneMinusSrcColor, ConstantColor, OneMinusConstantColor, ConstantAlpha, OneMinusConstantAlpha

**DESCRIPTION**

Set the OpenGL or Direct3D source and destination blend function state. See the OpenGL glBlendFunc manual page for details.

The standard reset callback sets the BlendFunc state to float2(One, Zero).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.4 or NV\_blend\_square for SrcColor or OneMinusSrcColor for srcFactor, and DestColor or OneMinusDestColor for dstFactor

Otherwise OpenGL 1.0.

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

BlendColor, BlendFuncSeparate, BlendEnable, BlendEquation, BlendEquationSeparate, AlphaFunc, StencilFunc

**NAME**

**ClipPlaneEnable** – 3D API clip plane enable

**USAGE**

ClipPlaneEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D clip plane enable. See the GL\_CLIP\_PLANEn description on the OpenGL glEnable manual page for details. See the D3DRS\_CLIPPLANEENABLE render state description.

The standard reset callback sets the ClipPlaneEnable state to bool(false).

The index ndx identifies the clip plane must be greater or equal to zero and less than the value of GL\_MAX\_CLIP\_PLANES (typically 6). DirectX 9 supports 6 clip planes.

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LightingEnable, LightEnable

**NAME**

**ColorLogicOpEnable** – 3D API color logical operation enable

**USAGE**

ColorLogicOpEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL color logical operation (logic-op) enable. See the GL\_COLOR\_LOGIC\_OP description on the OpenGL glEnable manual page for details.

The standard reset callback sets the ColorLogicOpEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.1

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported.

**SEE ALSO**

BlendEnable, DepthTestEnable, LogicOp, StencilTestEnable

**NAME**

**CullFaceEnable** – 3D API cull face enable

**USAGE**

CullFaceEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL cull face enable. See the GL\_CULL\_FACE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the CullFaceEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9 Not supported. DirectX 9 has D3DRS\_CULLMODE rather than a cull face enable.

**SEE ALSO**

ClipPlaneEnable, DepthTestEnable

**NAME**

**DepthBoundsEnable** – 3D API depth bounds enable

**USAGE**

DepthBoundsEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL depth bounds enable. See the GL\_DEPTH\_BOUNDS\_TEST\_EXT description on the OpenGL glEnable manual page for details.

The standard reset callback sets the DepthBoundsEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported.

**SEE ALSO**

DepthTestEnable, StencilTestEnable

**NAME**

**DepthClampEnable** – 3D API depth clamp enable

**USAGE**

DepthClampEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D depth clamp enable. See the GL\_DEPTH\_CLAMP\_EXT description on the OpenGL glEnable manual page for details.

The standard reset callback sets the DepthClampEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported; ignored.

**SEE ALSO**

DepthBoundsEnable, DepthTestEnable, StencilTestEnable



**NAME**

**DepthTestEnable** – 3D API depth test enable

**USAGE**

DepthTestEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D depth test enable. See the GL\_DEPTH\_TEST description on the OpenGL glEnable manual page for details. See the D3DRS\_ZENABLE render state description for DirectX 9.

The standard reset callback sets the DepthTestEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

DepthBoundsEnable, DepthClampEnable, DepthTestEnable

**NAME**

**DitherEnable** – 3D API color dithering enable

**USAGE**

DitherEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D dither enable. See the GL\_DITHER description on the OpenGL glEnable manual page for details. See the D3DRS\_DITHERENABLE render state description for DirectX 9.

The standard reset callback sets the DitherEnable state to bool(true).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

ColorMask

**NAME**

**FogEnable** – 3D API fog enable

**USAGE**

FogEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D fog enable. See the GL\_FOG description on the OpenGL glEnable manual page for details. See the D3DRS\_FOGENABLE render state description for DirectX 9.

The standard reset callback sets the FogEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

BlendEnable, FogMode, FogColor, FogDensity, FogStart, FogEnd

**NAME**

**LightEnable** – 3D API per-vertex light source enable

**USAGE**

LightEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D per-vertex light source enable. See the GL\_LIGHTn description on the OpenGL glEnable manual page for details.

The standard reset callback sets the LightEnable state to bool(false).

The index ndx identifies the light source and must be greater or equal to zero and less than the value of GL\_MAX\_LIGHTS (typically 8). DirectX 9 supports 8 light sources.

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LightingEnable, DepthTestEnable, StencilTestEnable

**NAME**

**LightModelLocalViewerEnable** – 3D API local viewer light model enable

**USAGE**

LightModelLocalViewerEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D local viewer light model enable. See the GL\_LIGHT\_MODEL\_LOCAL\_VIEWER description on the OpenGL glLightModeli manual page for details. See the D3DRS\_LOCALVIEWER render state description for DirectX 9.

The standard reset callback sets the LightModelLocalViewerEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LightEnable, LightingEnable

**NAME**

**LightModelTwoSideEnable** – 3D API two-sided lighting enable

**USAGE**

LightModelTwoSideEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D two-sided lighting enable. See the GL\_LIGHT\_MODEL\_TWO\_SIDE description on the OpenGL glLightModeli manual page for details.

The standard reset callback sets the LightModelTwoSideEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

LightEnable, LightingEnable, LightModelLocalViewer

**NAME**

**LightingEnable** – 3D API per-vertex lighting enable

**USAGE**

LightingEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D per-vertex lighting enable. See the GL\_LIGHTING description on the OpenGL glEnable manual page for details. See the D3DRS\_LIGHTING render state description for DirectX 9.

The standard reset callback sets the LightingEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LightEnable

**NAME**

**LineSmoothEnable** – 3D API line smooth enable

**USAGE**

LineSmoothEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D line smooth enable. See the GL\_LINE\_SMOOTH description on the OpenGL glEnable manual page for details. See the D3DRS\_ANTIALIASEDLINEENABLE render state description for DirectX 9.

The standard reset callback sets the LineSmoothEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

BlendEnable, PolygonSmoothEnable, PointSmoothEnable



**NAME**

**LineStippleEnable** – 3D API line stipple enable

**USAGE**

LineStippleEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL line stipple enable. See the GL\_LINE\_STIPPLE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the LineStippleEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

LineStipple, LineSmoothEnable, LineWidth

**NAME**

**LogicOpEnable** – 3D API index logical operation enable

**USAGE**

LogicOpEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL color index logical operation (logic-op) enable. See the GL\_INDEX\_LOGIC\_OP (or GL\_LOGIC\_OP) description on the OpenGL glEnable manual page for details.

The standard reset callback sets the LogicOpEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported.

**SEE ALSO**

BlendEnable, ColorLogicOp

**NAME**

**MultisampleEnable** – 3D API multisample enable

**USAGE**

MultisampleEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D multisample enable. See the GL\_MULTISAMPLE description on the OpenGL glEnable manual page for details. See the D3DRS\_MULTISAMPLEANTIALIAS render state description for DirectX 9.

The standard reset callback sets the MultisampleEnable state to bool(true).

This state is ignored if the color buffer/surface is not multisample capable.

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.3 or ARB\_multisample

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LineSmoothEnable, PointSmoothEnable, PolygonSmoothEnable

**NAME**

**NormalizeEnable** – 3D API surface normal vector normalization enable

**USAGE**

NormalizeEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D surface normal vector normalization enable. See the GL\_NORMALIZE description on the OpenGL glEnable manual page for details. See the D3DRS\_NORMALIZENORMALS render state description for DirectX 9.

The standard reset callback sets the NormalizeEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

LightingEnable

**NAME**

**PointSmoothEnable** – 3D API smooth point rasterization enable

**USAGE**

PointSmoothEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL smooth point rasterization enable. See the GL\_POINT\_SMOOTH description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PointSmoothEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported; consider using PointSpriteEnable as an alternative.

**SEE ALSO**

PointSpriteEnable, PolygonSmoothEnable, PointSmoothEnable

**NAME**

**PointSpriteEnable** – 3D API point sprite enable

**USAGE**

PointSpriteEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D point sprite enable. See the GL\_POINT\_SPRITE description on the OpenGL glEnable manual page for details. See the D3DRS\_POINTSPRITEENABLE render state description for DirectX 9.

The standard reset callback sets the PointSpriteEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 2.0 or ARB\_point\_sprite

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

SmoothPointEnable, PointSize

**NAME**

**PolygonOffsetFillEnable** – 3D API polygon offset fill enable

**USAGE**

PolygonOffsetFillEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL polygon offset fill enable. See the GL\_POLYGON\_OFFSET\_FILL description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PolygonOffsetFillEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported; effectively always enabled.

**SEE ALSO**

PolygonOffsetPointEnable, PolygonOffsetLineEnable, PolygonMode, PolygonOffset, DepthTestEnable

**NAME**

**PolygonOffsetLineEnable** – 3D API polygon offset line enable

**USAGE**

PolygonOffsetLineEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL polygon offset line enable. See the GL\_POLYGON\_OFFSET\_FILL description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PolygonOffsetLineEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported; effectively always enabled.

**SEE ALSO**

PolygonOffsetPointEnable, PolygonOffsetFillEnable, PolygonMode, PolygonOffset, DepthTestEnable



**NAME**

**PolygonOffsetPointEnable** – 3D API polygon offset point enable

**USAGE**

PolygonOffsetPointEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL polygon offset point enable. See the GL\_POLYGON\_OFFSET\_FILL description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PolygonOffsetPointEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported; effectively always enabled.

**SEE ALSO**

PolygonOffsetLineEnable, PolygonOffsetFillEnable, PolygonMode, PolygonOffset, DepthTestEnable

**NAME**

**PolygonSmoothEnable** – 3D API polygon smooth enable

**USAGE**

PolygonSmoothEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL polygon smooth enable. See the GL\_POLYGON\_SMOOTH description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PolygonSmoothEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

BlendEnable, DepthTestEnable, StencilTestEnable

**NAME**

**PolygonStippleEnable** – 3D API polygon stipple enable

**USAGE**

PolygonStippleEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL polygon stipple enable. See the GL\_POLYGON\_STIPPLE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the PolygonStippleEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

LineStippleEnable, PolygonMode, ShadeModel

**NAME**

**RescaleNormalEnable** – 3D API rescale normal enable

**USAGE**

RescaleNormalEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL rescale normal enable. See the GL\_RESCALE\_NORMAL description on the OpenGL glEnable manual page for details.

The standard reset callback sets the RescaleNormalEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.2

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported.

**SEE ALSO**

NormalizeEnable, LightingEnable

**NAME**

**SampleAlphaToCoverageEnable** – 3D API sample alpha to coverage enable

**USAGE**

SampleAlphaToCoverageEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL sample alpha to coverage enable. See the GL\_SAMPLE\_ALPHA\_TO\_COVERAGE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the SampleAlphaToCoverageEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.3 or ARB\_multisample

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

MultisampleEnable, SampleAlphaToCoverageEnable, SampleCoverageEnable

**NAME**

**SampleAlphaToOneEnable** – 3D API sample alpha to coverage enable

**USAGE**

SampleAlphaToOneEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL sample alpha to coverage enable. See the GL\_SAMPLE\_ALPHA\_TO\_ONE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the SampleAlphaToOneEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.3 or ARB\_multisample

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

MultisampleEnable, SampleAlphaToCoverageEnable, SampleCoverageEnable

**NAME**

**SampleCoverageEnable** – 3D API sample alpha to coverage enable

**USAGE**

SampleCoverageEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL sample alpha to coverage enable. See the GL\_SAMPLE\_ALPHA\_TO\_COVERAGE description on the OpenGL glEnable manual page for details.

The standard reset callback sets the SampleCoverageEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.3 or ARB\_multisample

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

MultisampleEnable, SampleAlphaToCoverageEnable, SampleAlphaToOneCoverageEnable

**NAME**

**ScissorTestEnable** – 3D API scissor test enable

**USAGE**

ScissorTestEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D scissor test enable. See the GL\_SCISSOR\_TEST description on the OpenGL glEnable manual page for details. See the D3DRS\_SCISSORTESTENABLE render state description for DirectX 9.

The standard reset callback sets the ScissorTestEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

AlphaTestEnable, DepthTestEnable



**NAME**

**StencilTestEnable** – 3D API stencil test enable

**USAGE**

StencilTestEnable = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL or Direct3D stencil test enable. See the GL\_STENCIL\_TEST description on the OpenGL glEnable manual page for details. See the D3DRS\_STENCILENABLE render state description for DirectX 9.

The standard reset callback sets the StencilTestEnable state to bool(false).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

DirectX 9

**SEE ALSO**

AlphaTestEnable, BlendEnable, DepthTestEnable

**NAME**

**TexGenQEnable** – 3D API texture coordinate generation for Q enable

**USAGE**

TexGenQEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture coordinate generation for Q enable for the given texture coordinate set. See the GL\_TEXTURE\_GEN\_Q description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TexGenQEnable state to bool(false).

The index ndx identifies the texture coordinate set and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not applicable; D3DTSS\_TEXCOORDINDEX texture stage state determines texture coordinate generation without regard to enable state.

**SEE ALSO**

TexGenSEnable, TexGenTEnable, TexGenREnable

**NAME**

**TexGenREnable** – 3D API texture coordinate generation for R enable

**USAGE**

TexGenREnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture coordinate generation for R enable for the given texture coordinate set index. See the GL\_TEXTURE\_GEN\_R description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TexGenREnable state to bool(false).

The index ndx identifies the texture coordinate set and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not applicable; D3DTSS\_TEXCOORDINDEX texture stage state determines texture coordinate generation without regard to enable state.

**SEE ALSO**

TexGenSEnable, TexGenTEnable, TexGenQEnable

**NAME**

**TexGenSEnable** – 3D API texture coordinate generation for S enable

**USAGE**

TexGenSEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture coordinate generation for S enable for the given texture coordinate set index. See the GL\_TEXTURE\_GEN\_S description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TexGenSEnable state to bool(false).

The index ndx identifies the texture coordinate set and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not applicable; D3DTSS\_TEXCOORDINDEX texture stage state determines texture coordinate generation without regard to enable state.

**SEE ALSO**

TexGenTEnable, TexGenREnable, TexGenQEnable

**NAME**

**TexGenTEnable** – 3D API texture coordinate generation for T enable

**USAGE**

TexGenTEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture coordinate generation for T enable for the given texture coordinate set index. See the GL\_TEXTURE\_GEN\_T description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TexGenTEnable state to bool(false).

The index ndx identifies the texture coordinate set and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not applicable; D3DTSS\_TEXCOORDINDEX texture stage state determines texture coordinate generation without regard to enable state.

**SEE ALSO**

TexGenSEnable, TexGenREnable, TexGenQEnable

**NAME**

**Texture1DEnable** – 3D API one-dimensional texture enable

**USAGE**

Texture1DEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL one-dimensional texture enable for the given texture unit. See the GL\_TEXTURE\_1D description on the OpenGL glEnable manual page for details.

The standard reset callback sets the Texture1DEnable state to bool(false).

This state should not be used in combination with a FragmentProgram state assignment.

The index ndx identifies the texture unit and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

Texture2DEnable, Texture3DEnable, TextureCubeMapEnable, TextureRectangleEnable

**NAME**

**Texture2DEnable** – 3D API two-dimensional texture enable

**USAGE**

Texture2DEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL two-dimensional texture enable for the given texture unit. See the GL\_TEXTURE\_2D description on the OpenGL glEnable manual page for details.

The standard reset callback sets the Texture2DEnable state to bool(false).

This state should not be used in combination with a FragmentProgram state assignment.

The index ndx identifies the texture unit and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.0

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

Texture1DEnable, Texture3DEnable, TextureCubeMapEnable, TextureRectangleEnable

**NAME**

**Texture3DEnable** – 3D API three-dimensional texture enable

**USAGE**

Texture3DEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL three-dimensional texture enable for the given texture unit. See the GL\_TEXTURE\_3D description on the OpenGL glEnable manual page for details.

The standard reset callback sets the Texture3DEnable state to bool(false).

This state should not be used in combination with a FragmentProgram state assignment.

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.2

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

Texture1DEnable, Texture2DEnable, TextureCubeMapEnable, TextureRectangleEnable



**NAME**

**TextureRectangleEnable** – 3D API texture cube map enable

**USAGE**

TextureRectangleEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture cube map enable for the given texture unit. See the GL\_TEXTURE\_RECTANGLE\_ARB description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TextureRectangleEnable state to bool(false).

This state should not be used in combination with a FragmentProgram state assignment.

The index ndx identifies the texture unit and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

OpenGL 1.3, ARB\_texture\_cube map, or EXT\_texture\_cube map

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

Texture1DEnable, Texture2DEnable, Texture3DEnable, TextureRectangleEnable

**NAME**

**TextureRectangleEnable** – 3D API texture rectangle enable

**USAGE**

TextureRectangleEnable[ndx] = bool(enable)

**VALID ENUMERANTS**

enable: true, false

**DESCRIPTION**

Set the OpenGL texture rectangle enable for the given texture unit. See the GL\_TEXTURE\_RECTANGLE\_ARB description on the OpenGL glEnable manual page for details.

The standard reset callback sets the TextureRectangleEnable state to bool(false).

This state should not be used in combination with a FragmentProgram state assignment.

The index ndx identifies the texture unit and must be greater or equal to zero and less than the value of GL\_MAX\_TEXTURE\_UNITS (typically 2 or 4).

**OPENGL FUNCTIONALITY REQUIREMENTS**

ARB\_texture\_rectangle, EXT\_texture\_rectangle, or NV\_texture\_rectangle

**DIRECT3D FUNCTIONALITY REQUIREMENTS**

Not supported

**SEE ALSO**

Texture1DEnable, Texture2DEnable, Texture3DEnable, TextureCubeMapEnable