OpenAL Programmer's Guide
OpenAL Versions 1.0 and 1.1
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About this Document

Introduction
OpenAL is a cross-platform three-dimensional audio API. The API’s primary purpose is to allow an application to position audio sources in a three-dimensional space around a listener, producing reasonable spatialization of the sources for the audio system (headphones, 2.1 speaker output, 5.1 speaker output, etc.) Through extensions, Creative Labs has also enhanced OpenAL with EAX and other capabilities. OpenAL is appropriate for many audio applications, but was designed to be most appropriate for gaming audio.

Intended Audience
This reference guide is most appropriate for a programmer. Experience with C or C++ is not required to learn the concepts in OpenAL, but will make understanding the OpenAL source as well as sample code easier. Since there are several sample applications included with the OpenAL SDKs as well as with the source distribution, it is recommended that interested programmers take advantage of those resources.

Other OpenAL Resources
The two most important resources for additional information on OpenAL are the websites at www.openal.org and http://developer.creative.com. The main OpenAL site hosts the specification, the open source implementations, and sample code. The Creative developer site has a section dedicated to OpenAL with SDKs showing how to use OpenAL as well as various extensions.
Introduction to OpenAL

Use of OpenAL revolves around the use of three fundamental objects – Buffers, Sources, and a Listener. A buffer can be filled with audio data, and can then be attached to a source. The source can then be positioned and played. How the source is heard is determined by its position and orientation relative to the Listener object (there is only one Listener). Creating a number of sources and buffers and a single listener and then updating the positions and orientations of the sources and listener dynamically can present a convincing 3D audio world.

Objects

Here is a diagram showing the fundamental OpenAL objects and their relationships to the context and device objects:

Device #1:

Listener

Context #1

Source #1    Source #2    Source #3    Source #4

Buffer #1    Buffer #2    Buffer #3    Buffer #4

When initializing OpenAL, at least one device has to be opened. Within that device, at least one context will be created. Within that context, one listener object is implied, and a multitude of source objects can be created. Each source can have one or more buffers objects attached to it. Buffer objects are not part of a specific context – they are shared among all contexts on one device.

Device Enumeration

The function call to open a device, `alcOpenDevice`, takes a string as input. The string should contain either the name of a valid OpenAL rendering device, or NULL to request the default device.
On PC Systems, a number of different OpenAL rendering devices may co-exist. For example a “native” renderer specific to the user’s high-end soundcard, and a host-based software fallback renderer. On platforms where multiple renderers can be present, an OpenAL application may require the ability to identify the different devices available, in order to give the end-user a choice of device. OpenAL’s Enumeration extension makes this possible.

The Enumeration extension allows the programmer to retrieve a string listing the names of available devices. It can also provide the name of the default device. Use alcGetString with the device property set to NULL, and the enum property set to ALC_DEVICE_SPECIFIER to get the list of available devices. To get the default device name, pass in NULL and ALC_DEFAULT_DEVICE_SPECIFIER.

The Enumeration extension also works with capture devices – the equivalent values are ALC_CAPTURE_DEVICE_SPECIFIER and ALC_CAPTURE_DEFAULT_DEVICE_SPECIFIER.

The programmer can find out more about the capabilities of each device by querying to see which extensions it supports using alcIsExtensionPresent and alIsExtensionPresent.

**Initializing/Exiting**

As described above, the first step to initializing OpenAL is to open a device. Once that is successfully done, then a context is opened on that device. Now the fundamental OpenAL objects can be managed – the listener, various sources, and various buffers.

To generate a set of buffers for use, use alGetError to reset the error state, call alGenBuffers to generate the number of buffers desired, and then use alGetError again to detect if an error was generated.

Fill the buffers with PCM data using alBufferData.

To generate a set of sources for use, use alGetError to reset the error state, call alGenSources to generate the number of sources desired, and then use alGetError again to detect if an error was generated.

Buffers are attached to sources using alSource.

Once a buffer has been attached to a source, the source can play the buffer using alSourcePlay.

Source and Listener properties can be updated dynamically using property set and get calls such as alGetListenerfv, alListener3f, alSourcei, and alGetSource3f.

Example:
// Initialization
Device = alcOpenDevice(NULL); // select the "preferred device"

if (Device) {
    Context=alcCreateContext(Device,NULL);
    alcMakeContextCurrent(Context);
}

// Check for EAX 2.0 support
g_bEAX = alIsExtensionPresent("EAX2.0");

// Generate Buffers
alGetError(); // clear error code
alGenBuffers(NUM_BUFFERS, g_Buffers);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alGenBuffers :", error);
    return;
}

// Load test.wav
loadWAVFile("test.wav",&format,&data,&size,&freq,&loop);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alutLoadWAVFile test.wav : ", error);
    alDeleteBuffers(NUM_BUFFERS, g_Buffers);
    return;
}

// Copy test.wav data into AL Buffer 0
alBufferData(g_Buffers[0],format,data,size,freq);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alBufferData buffer 0 : ", error);
    alDeleteBuffers(NUM_BUFFERS, g_Buffers);
    return;
}

// Unload test.wav
unloadWAV(format,data,size,freq);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alutUnloadWAV : ", error);
    alDeleteBuffers(NUM_BUFFERS, g_Buffers);
    return;
}

// Generate Sources
alGenSources(1,source);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alGenSources 1 : ", error);
    return;
}

// Attach buffer 0 to source
alSourcei(source[0], AL_BUFFER, g_Buffers[0]);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alSourcei AL_BUFFER 0 : ", error);
}

// Exit
Context=alcGetCurrentContext();
Device=alcGetContextsDevice(Context);
alcMakeContextCurrent(NULL);
alcDestroyContext(Context);
alcCloseDevice(Device);

Listener Properties
For every context, there is automatically one Listener object. The alListener[f, 3f, fv, i] and
alGetListener[f, 3f, fv, i] families of functions can be used to set or retrieve the following listener
properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_GAIN</td>
<td>f, fv</td>
<td>&quot;master gain&quot;</td>
</tr>
<tr>
<td>AL_POSITION</td>
<td>fv, 3f, iv, 3i</td>
<td>X, Y, Z position</td>
</tr>
<tr>
<td>AL_VELOCITY</td>
<td>fv, 3f, iv, 3i</td>
<td>velocity vector</td>
</tr>
<tr>
<td>AL_ORIENTATION</td>
<td>fv, iv</td>
<td>orientation expressed as “at” and “up” vectors</td>
</tr>
</tbody>
</table>
Example:

```c
ALfloat listenerPos[]={0.0,0.0,0.0};
ALfloat listenerVel[]={0.0,0.0,0.0};
ALfloat listenerOri[]={0.0,0.0,-1.0, 0.0,1.0,0.0};

// Position ... 
alListenerfv(AL_POSITION,listenerPos);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alListenerfv POSITION : ", error);
    return;
}

// Velocity ... 
alListenerfv(AL_VELOCITY,listenerVel);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alListenerfv VELOCITY : ", error);
    return;
}

// Orientation ... 
alListenerfv(AL_ORIENTATION,listenerOri);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alListenerfv ORIENTATION : ", error);
    return;
}
```

### Buffer Properties

Each buffer generated by `alGenBuffers` has properties which can be retrieved. The `alGetBuffer[i, f]` functions can be used to retrieve the following buffer properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_FREQUENCY</td>
<td>i, iv</td>
<td>frequency of buffer in Hz</td>
</tr>
<tr>
<td>AL_BITS</td>
<td>i, iv</td>
<td>bit depth of buffer</td>
</tr>
<tr>
<td>AL_CHANNELS</td>
<td>i, iv</td>
<td>number of channels in buffer</td>
</tr>
<tr>
<td>AL_SIZE</td>
<td>i, iv</td>
<td>size of buffer in bytes</td>
</tr>
<tr>
<td>AL_DATA</td>
<td>i, iv</td>
<td>original location where data was copied from</td>
</tr>
</tbody>
</table>

Example:

```c
// Retrieve Buffer Frequency
alBufferi(g_Buffers[0], AL_FREQUENCY, iFreq);
```

### Source Properties

Each source generated by `alGenSources` has properties which can be set or retrieved. The `alSource[i, f, v, j]` and `alGetSource[i, f, v, j]` families of functions can be used to set or retrieve the following source properties:
<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_PITCH</td>
<td>f, fv</td>
<td>pitch multiplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>always positive</td>
</tr>
<tr>
<td>AL_GAIN</td>
<td>f, fv</td>
<td>source gain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>value should be positive</td>
</tr>
<tr>
<td>AL_MAX_DISTANCE</td>
<td>f, fv, i, iv</td>
<td>used with the Inverse Clamped Distance Model to set the distance where there will no longer be any attenuation of the source</td>
</tr>
<tr>
<td>AL_ROLLOFF_FACTOR</td>
<td>f, fv, i, iv</td>
<td>the rolloff rate for the source default is 1.0</td>
</tr>
<tr>
<td>AL_REFERENCE_DISTANCE</td>
<td>f, fv, i, iv</td>
<td>the distance under which the volume for the source would normally drop by half (before being influenced by rolloff factor or AL_MAX_DISTANCE)</td>
</tr>
<tr>
<td>AL_MIN_GAIN</td>
<td>f, fv</td>
<td>the minimum gain for this source</td>
</tr>
<tr>
<td>AL_MAX_GAIN</td>
<td>f, fv</td>
<td>the maximum gain for this source</td>
</tr>
<tr>
<td>AL_CONE_OUTER_GAIN</td>
<td>f, fv</td>
<td>the gain when outside the oriented cone</td>
</tr>
<tr>
<td>AL_CONE_INNER_ANGLE</td>
<td>f, fv, i, iv</td>
<td>the gain when inside the oriented cone</td>
</tr>
<tr>
<td>AL_CONE_OUTER_ANGLE</td>
<td>f, fv, i, iv</td>
<td>outer angle of the sound cone, in degrees default is 360</td>
</tr>
<tr>
<td>AL_POSITION</td>
<td>fv, 3f</td>
<td>X, Y, Z position</td>
</tr>
<tr>
<td>AL VELOCITY</td>
<td>fv, 3f</td>
<td>velocity vector</td>
</tr>
<tr>
<td>AL_DIRECTION</td>
<td>fv, 3f, iv, 3i</td>
<td>direction vector</td>
</tr>
<tr>
<td>AL_SOURCE_RELATIVE</td>
<td>i, iv</td>
<td>determines if the positions are relative to the listener default is AL_FALSE</td>
</tr>
<tr>
<td>AL_SOURCE_TYPE</td>
<td>i, iv</td>
<td>the source type – AL_UNDETERMINED, AL_STATIC, or AL_STREAMING</td>
</tr>
<tr>
<td>ALLOOPING</td>
<td>i, iv</td>
<td>turns looping on (AL_TRUE) or off (AL_FALSE)</td>
</tr>
<tr>
<td>AL BUFFER</td>
<td>i, iv</td>
<td>the ID of the attached buffer</td>
</tr>
<tr>
<td>AL_SOURCE_STATE</td>
<td>i, iv</td>
<td>the state of the source (AL_STOPPED, AL_PLAYING, ...</td>
</tr>
<tr>
<td>AL_BUFFERS_QUEUED</td>
<td>i, iv</td>
<td>the number of buffers queued on this source</td>
</tr>
<tr>
<td>AL_BUFFERS_PROCESSED</td>
<td>i, iv</td>
<td>the number of buffers in the queue that have been processed</td>
</tr>
<tr>
<td>AL_SEC_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in seconds</td>
</tr>
<tr>
<td>AL_SAMPLE_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in samples</td>
</tr>
<tr>
<td>AL_BYTE_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in bytes</td>
</tr>
</tbody>
</table>

* Read Only (alGetSourcei)

Example:

```c
alGetError(); // clear error state
alSourcef(source[0], AL_PITCH, 1.0f);
if ((error = alGetError()) != AL_NO_ERROR)
    DisplayALError("alSourcef 0 AL_PITCH : \n", error);

alGetError(); // clear error state
alSourcef(source[0], AL_GAIN, 1.0f);
if ((error = alGetError()) != AL_NO_ERROR)
    DisplayALError("alSourcef 0 AL_GAIN : \n", error);

alGetError(); // clear error state
alSourcefv(source[0], AL_POSITION, source0Pos);
if ((error = alGetError()) != AL_NO_ERROR)
    DisplayALError("alSourcefv 0 AL_POSITION : \n", error);
```
Queuing Buffers on a Source

To continuously stream audio from a source without interruption, buffer queuing is required. To use buffer queuing, the buffers and sources are generated in the normal way, but `alSourcei` is not used to attach the buffers to the source. Instead, the functions `alSourceQueueBuffers` and `alSourceUnqueueBuffers` are used. The program can attach a buffer or a set of buffers to a source using `alSourceQueueBuffers`, and then call `alSourcePlay` on that source. While the source is playing, `alSourceUnqueueBuffers` can be called to remove buffers which have already played. Those buffers can then be filled with new data or discarded. New or refilled buffers can then be attached to the playing source using `alSourceQueueBuffers`. As long as there is always a new buffer to play in the queue, the source will continue to play.

Although some 1.0 implementations of OpenAL may not enforce the following restrictions on queuing, it is recommended to observe the following additional rules, which do universally apply to 1.1 implementations:

1) A source that will be used for streaming should not have its first buffer attached using `alSourcei` – always use `alSourceQueueBuffers` to attach buffers to streaming sources. Any source can have all buffers detached from it using `alSourcei(..., AL_BUFFER, 0)`, and can then be used for either streaming or non-streaming buffers depending on how data is then attached to the source (with `alSourcei` or with `alSourceQueueBuffers`).

2) All buffers attached to a source using `alSourceQueueBuffers` should have the same audio format.

Doppler Shift

The Doppler effect depends on the velocities of source and listener relative to the medium, and the propagation speed of sound in that medium. The application might want to emphasize or de-emphasize the Doppler effect as physically accurate calculation might not give the desired results. The amount of frequency shift (pitch change) is proportional to the speed of listener and source along their line of sight.

The Doppler effect as implemented by OpenAL is described by the formula below. Effects of the medium (air, water) moving with respect to listener and source are ignored.

\[
SS: \text{AL\_SPEED\_OF\_SOUND} = \text{speed of sound (default value 343.3)} \\
DF: \text{AL\_DOPPLER\_FACTOR} = \text{Doppler factor (default 1.0)} \\
vls: \text{Listener velocity scalar (scalar, projected on source-to-listener vector)} \\
vss: \text{Source velocity scalar (scalar, projected on source-to-listener vector)} \\
f: \text{Frequency of sample} \\
f': \text{effective Doppler shifted frequency}
\]
Graphic representation of vls and vss:

3D Mathematical representation of vls and vss:

\[
\text{Mag(vector)} = \sqrt{\text{vector.x} \times \text{vector.x} + \text{vector.y} \times \text{vector.y} + \text{vector.z} \times \text{vector.z}}
\]

\[
\text{DotProduct(v1, v2)} = (\text{v1.x} \times \text{v2.x} + \text{v1.y} \times \text{v2.y} + \text{v1.z} \times \text{v2.z})
\]

\[
\text{SL} = \text{source to listener vector}
\]

\[
\text{SV} = \text{Source Velocity vector}
\]

\[
\text{LV} = \text{Listener Velocity vector}
\]

\[
\text{vls} = \text{DotProduct(SL, LV)} / \text{Mag(SL)}
\]

\[
\text{vss} = \text{DotProduct(SL, SV)} / \text{Mag(SL)}
\]

Doppler Calculation:

\[
\text{vss} = \min(\text{vss}, \text{SS}/\text{DF})
\]

\[
\text{vls} = \min(\text{vls}, \text{SS}/\text{DF})
\]

\[
\text{f'} = \text{f} * (\text{SS} - \text{DF} \times \text{vls}) / (\text{SS} - \text{DF} \times \text{vss})
\]

There are two API calls global to the current context that provide control of the speed of sound and Doppler factor. AL_DOPPLER_FACTOR is a simple scaling of source and listener velocities to exaggerate or deemphasize the Doppler (pitch) shift resulting from the calculation.

\text{void alDopplerFactor(ALfloat dopplerFactor);}\

A negative value will result in an AL_INVALID_VALUE error, the command is then ignored. The default value is 1. The current setting can be queried using alGetFloat{v} and AL_DOPPLER_FACTOR.

\text{AL_SPEED_OF_SOUND} allows the application to change the reference (propagation) speed used in the Doppler calculation. The source and listener velocities should be expressed in the same units as the speed of sound.

\text{void alSpeedOfSound(ALfloat speed);}\

A negative or zero value will result in an AL_INVALID_VALUE error, and the command is ignored. The default value is 343.3 (appropriate for velocity units of meters and air as the propagation medium). The current setting can be queried using alGetFloat{v} and AL_SPEED_OF_SOUND.

Distance and velocity units are completely independent of one another (so you could use different units for each if desired). If an OpenAL application doesn't want to use Doppler effects, then leaving all velocities at zero will achieve that result.
**Error Handling**

The error state of OpenAL can be retrieved at any time using `alGetError`. `alGetError` clears the error state of OpenAL when it is called, so it is common for an OpenAL application to call `alGetError` at the beginning of a critical operation to clear the error state, perform the critical operation, and then use `alGetError` again to test whether or not an error occurred.

Error Codes:

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_NO_ERROR</td>
<td>there is not currently an error</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>a bad name (ID) was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>an invalid enum value was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>an invalid value was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>the requested operation is not valid</td>
</tr>
<tr>
<td>AL_OUT_OF_MEMORY</td>
<td>the requested operation resulted in OpenAL running out of memory</td>
</tr>
</tbody>
</table>

Example:

```c
alGetError();  // Clear Error Code

// Generate Buffers
alGenBuffers(NUM_BUFFERS, g_Buffers);
if ((error = alGetError()) != AL_NO_ERROR)
{
    DisplayALError("alGenBuffers :", error);
    exit(-1);
}
```

**Extensions**

OpenAL has an extension mechanism that can be used by OpenAL vendors to add new features to the API. Creative Labs have added a number of extensions including EAX, X-RAM, Multi-Channel Buffer playback, and most recently an Effect Extension (EFX). To determine if an extension is available the application can use either `alIsExtensionPresent` or `alcIsExtensionPresent` depending on the type of extension. The Appendices contain more details about some of Creative’s extensions to OpenAL.
Buffer Functions

Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_FREQ</td>
<td>i, iv</td>
<td>frequency of buffer in Hz</td>
</tr>
<tr>
<td>AL_BITS</td>
<td>i, iv</td>
<td>bit depth of buffer</td>
</tr>
<tr>
<td>AL_CHANNELS</td>
<td>i, iv</td>
<td>number of channels in buffer</td>
</tr>
<tr>
<td>AL_SIZE</td>
<td>i, iv</td>
<td>&gt; 1 is valid, but buffer won't be positioned when played</td>
</tr>
<tr>
<td>AL_DATA</td>
<td>i, iv</td>
<td>original location where data was copied from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>generally useless, as was probably freed after buffer creation</td>
</tr>
</tbody>
</table>

Functions

alGenBuffers
alDeleteBuffers
alIsBuffer
alBufferData
alBufferf
alBuffer3f
alBufferfv
alBufferi
alBuffer3i
alBufferiv
alGetBufferf
alGetBuffer3f
alGenBuffers

Description

This function generates one or more buffers, which contain audio data (see alBufferData). References to buffers are ALuint values, which are used wherever a buffer reference is needed (in calls such as alDeleteBuffers, alSourcei, alSourceQueueBuffers, and alSourceUnqueueBuffers).

```c
void alGenBuffers(
    ALsizei n,
    ALuint *buffers
);
```

Parameters

- **n** the number of buffers to be generated
- **buffers** pointer to an array of ALuint values which will store the names of the new buffers

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The buffer array isn't large enough to hold the number of buffers requested.</td>
</tr>
<tr>
<td>AL_OUT_OF_MEMORY</td>
<td>There is not enough memory available to generate all the buffers requested.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

If the requested number of buffers cannot be created, an error will be generated which can be detected with alGetError. If an error occurs, no buffers will be generated. If n equals zero, alGenBuffers does nothing and does not return an error.

See Also

alDeleteBuffers, alIsBuffer
alDeleteBuffers

Description

This function deletes one or more buffers, freeing the resources used by the buffer. Buffers which are attached to a source cannot be deleted. See alSourcei and alSourceUnqueueBuffers for information on how to detach a buffer from a source.

```c
void alDeleteBuffers(
  ALsizei n,
  ALuint *buffers
);
```

Parameters

- `n` the number of buffers to be deleted
- `buffers` pointer to an array of buffer names identifying the buffers to be deleted

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>The buffer is still in use and cannot be deleted.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>A buffer name is invalid.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The requested number of buffers cannot be deleted.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

If the requested number of buffers cannot be deleted, an error will be generated which can be detected with alGetError. If an error occurs, no buffers will be deleted. If `n` equals zero, alDeleteBuffers does nothing and will not return an error.

See Also

alGenBuffers, alIsBuffer
**alIsBuffer**

**Description**

This function tests if a buffer name is valid, returning AL_TRUE if valid, AL_FALSE if not.

```c
ALboolean alIsBuffer(
    ALuint buffer
);
```

**Parameters**

- `buffer` — a buffer name to be tested for validity

**Possible Error States**

None

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

The NULL buffer is always valid (see `alSourcei` for information on how the NULL buffer is used).

**See Also**

`alGenBuffers`, `alDeleteBuffers`
alBufferData

Description

This function fills a buffer with audio data. All the pre-defined formats are PCM data, but
this function may be used by extensions to load other data types as well.

```c
void alBufferData(
    AUint buffer,
    AEnum format,
    const AVoid *data,
    ASizei size,
    ASizei freq
);
```

Parameters

- **buffer**: buffer name to be filled with data
- **format**: format type from among the following:
  - AL_FORMAT_MONO8
  - AL_FORMAT_MONO16
  - AL_FORMAT_STEREO8
  - AL_FORMAT_STEREO16
- **data**: pointer to the audio data
- **size**: the size of the audio data in bytes
- **freq**: the frequency of the audio data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_OUT_OF_MEMORY</td>
<td>There is not enough memory available to create this buffer.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The size parameter is not valid for the format specified, the buffer is in use, or the data is a NULL pointer.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified format does not exist.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

8-bit PCM data is expressed as an unsigned value over the range 0 to 255, 128 being an audio output level of zero. 16-bit PCM data is expressed as a signed value over the range -32768 to 32767, 0 being an audio output level of zero. Stereo data is expressed in interleaved format, left channel first. Buffers containing more than one channel of data will be played without 3D spatialization.
**alBufferf**

**Description**

This function sets a floating point property of a buffer.

```c
void alBufferf(
    ALuint buffer,
    ALenum param,
    ALfloat value
);
```

**Parameters**

- **buffer** buffer name whose attribute is being retrieved
- **param** the name of the attribute to be set
- **value** the ALfloat value to be set

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

**See Also**

alBuffer3f, alBufferfv, alGetBufferf, alGetBuffer3f, alGetBufferfv
**alBuffer3f**

**Description**

This function sets a floating point property of a buffer.

```c
void alBuffer3f(
    ALuint buffer,
    ALenum param,
    ALfloat v1,
    ALfloat v2,
    ALfloat v3
);
```

**Parameters**

- `buffer` buffer name whose attribute is being retrieved
- `param` the name of the attribute to be set
- `v1, v2, v3` the ALfloat values to be set

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

**See Also**

`alBufferf, alBufferfv, alGetBufferf, alGetBuffer3f, alGetBufferfv`
alBufferfv

Description

This function sets a floating point property of a buffer.

```c
void alBufferfv(
    ALuint buffer,
    ALenum param,
    ALfloat *values
);
```

Parameters

- `buffer`: buffer name whose attribute is being retrieved
- `param`: the name of the attribute to be set
- `values`: a pointer to the ALfloat values to be set

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

See Also

- `alBufferf`, `alBuffer3f`, `alGetBufferf`, `alGetBuffer3f`, `alGetBufferfv`
**alBufferi**

**Description**

This function retrieves an integer property of a buffer.

```c
void alBufferi(
    ALuint buffer,
    ALenum param,
    ALint value
);
```

**Parameters**

- `buffer` buffer name whose attribute is being retrieved
- `param` the name of the attribute to be set
- `value` a pointer to an ALint to hold the retrieved data

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

** Remarks**

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

**See Also**

alBuffer3i, alBufferiv, alGetBufferi, alGetBuffer3i, alGetBufferiv
alBuffer3i

Description

This function sets a floating point property of a buffer.

```c
void alBuffer3i(
    ALuint buffer,
    ALenum param,
    ALint v1,
    ALint v2,
    ALint v3
);
```

Parameters

- `buffer` - buffer name whose attribute is being retrieved
- `param` - the name of the attribute to be set
- `v1, v2, v3` - the ALint values to be set

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

See Also

alBufferi, alBufferiv, alGetBufferi, alGetBuffer3i, alGetBufferiv
**alBufferiv**

**Description**

This function sets a floating point property of a buffer.

```c
void alBufferiv(
    ALuint buffer,
    ALenum param,
    ALint *values
);
```

**Parameters**

- `buffer` buffer name whose attribute is being retrieved
- `param` the name of the attribute to be set
- `values` a pointer to the ALint values to be set

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

There are no relevant buffer properties defined in OpenAL 1.1 which can be affected by this call, but this function may be used by OpenAL extensions.

**See Also**

- `alBufferi`, `alBuffer3i`, `alGetBufferi`, `alGetBuffer3i`, `alGetBufferiv`
alGetBufferf

Description

This function retrieves a floating point property of a buffer.

```c
void alGetBufferf(
    ALuint buffer,
    ALenum pname,
    ALfloat *value
);
```

Parameters

- **buffer**: buffer name whose attribute is being retrieved
- **pname**: the name of the attribute to be retrieved
- **value**: a pointer to an ALfloat to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be retrieved by this call, but this function may be used by OpenAL extensions.

See Also

- alBufferf, alBuffer3f, alBufferfv, alGetBuffer3f, alGetBufferfv
alGetBuffer3f

Description

This function retrieves a floating point property of a buffer.

```c
void alGetBuffer3f(
    ALuint buffer,
    ALenum pname,
    ALfloat *v1,
    ALfloat *v2,
    ALfloat *v3
);
```

Parameters

- `buffer`  
  buffer name whose attribute is being retrieved

- `pname`  
  the name of the attribute to be retrieved

- `v1, v2, v3`  
  pointers to a ALfloat values to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be retrieved by this call, but this function may be used by OpenAL extensions.

See Also

- `alBuffer`, `alBuffer3f`, `alBufferfv`, `alGetBufferf`, `alGetBufferfv`
alGetBufferfv

Description

This function retrieves a floating point property of a buffer.

```c
void alGetBufferfv(
    ALuint buffer,
    ALenum pname,
    ALfloat *values
);
```

Parameters

- `buffer`: buffer name whose attribute is being retrieved
- `pname`: the name of the attribute to be retrieved
- `values`: pointer to an ALfloat vector to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be retrieved by this call, but this function may be used by OpenAL extensions.

See Also

- alBufferf, alBuffer3f, alBufferfv, alGetBufferf, alGetBuffer3f
alGetBufferi

Description

This function retrieves an integer property of a buffer.

```c
void alGetBufferi(
    ALuint buffer,
    ALenum pname,
    ALint *value
);
```

Parameters

- **buffer**: buffer name whose attribute is being retrieved
- **pname**: the name of the attribute to be retrieved:
  - AL_FREQUENCY
  - AL_BITS
  - AL_CHANNELS
  - AL_SIZE
  - AL_DATA
- **value**: a pointer to an ALint to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alBufferi, alBuffer3i, alBufferiv, alGetBuffer3i, alGetBufferiv
alGetBuffer3i

Description

This function retrieves a floating point property of a buffer.

```c
void alGetBuffer3i(
    ALuint buffer,
    ALenum pname,
    ALint *v1,
    ALint *v2,
    ALint *v3
);
```

Parameters

- `buffer` buffer name whose attribute is being retrieved
- `pname` the name of the attribute to be retrieved
- `v1`, `v2`, `v3` pointers to ALint values to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

There are no relevant buffer properties defined in OpenAL 1.1 which can be retrieved by this call, but this function may be used by OpenAL extensions.

See Also

- alBufferi, alBuffer3i, alBufferiv, alGetBufferi, alGetBufferiv
alGetBufferiv

Description

This function retrieves a floating point property of a buffer.

```c
void alGetBufferiv(
    ALuint buffer,
    ALenum pname,
    ALint *values
);
```

Parameters

- **buffer**
  buffer name whose attribute is being retrieved

- **pname**
  the name of the attribute to be retrieved:
  - AL_FREQUENCY
  - AL_BITS
  - AL_CHANNELS
  - AL_SIZE
  - AL_DATA

- **values**
  pointer to an ALint vector to hold the retrieved data

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified buffer doesn't have parameters (the NULL buffer), or doesn't exist.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

alBufferi, alBuffer3i, alBufferiv, alGetBufferi, alGetBuffer3i
## Source Functions

**Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_PITCH</td>
<td>f, fv</td>
<td>pitch multiplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>always positive</td>
</tr>
<tr>
<td>AL_GAIN</td>
<td>f, fv</td>
<td>source gain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>value should be positive</td>
</tr>
<tr>
<td>AL_MAX_DISTANCE</td>
<td>f, fv, i, iv</td>
<td>used with the Inverse Clamped Distance Model to set the distance where there will no longer be any attenuation of the source</td>
</tr>
<tr>
<td>AL_ROLLOFF_FACTOR</td>
<td>f, fv, i, iv</td>
<td>the rolloff rate for the source</td>
</tr>
<tr>
<td></td>
<td></td>
<td>default is 1.0</td>
</tr>
<tr>
<td>AL_REFERENCE_DISTANCE</td>
<td>f, fv, i, iv</td>
<td>the distance under which the volume for the source would normally drop by half (before being influenced by rolloff factor or AL_MAX_DISTANCE)</td>
</tr>
<tr>
<td>AL_MIN_GAIN</td>
<td>f, fv</td>
<td>the minimum gain for this source</td>
</tr>
<tr>
<td>AL_MAX_GAIN</td>
<td>f, fv</td>
<td>the maximum gain for this source</td>
</tr>
<tr>
<td>AL_CONE_OUTER_GAIN</td>
<td>f, fv</td>
<td>the gain when outside the oriented cone</td>
</tr>
<tr>
<td>AL_CONE_INNER_ANGLE</td>
<td>f, fv, i, iv</td>
<td>the gain when inside the oriented cone</td>
</tr>
<tr>
<td>AL_CONE_OUTER_ANGLE</td>
<td>f, fv, i, iv</td>
<td>outer angle of the sound cone, in degrees</td>
</tr>
<tr>
<td></td>
<td></td>
<td>default is 360</td>
</tr>
<tr>
<td>AL_POSITION</td>
<td>fv, 3f</td>
<td>X, Y, Z position</td>
</tr>
<tr>
<td>AL_VELOCITY</td>
<td>fv, 3f</td>
<td>velocity vector</td>
</tr>
<tr>
<td>AL_DIRECTION</td>
<td>fv, 3f, 3i</td>
<td>direction vector</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL_SOURCE_RELATIVE</td>
<td>i, iv</td>
<td>determines if the positions are relative to the listener</td>
</tr>
<tr>
<td></td>
<td></td>
<td>default is AL_FALSE</td>
</tr>
<tr>
<td>AL_SOURCE_TYPE</td>
<td>i, iv</td>
<td>the source type – AL_UNDETERMINED, AL_STATIC, or AL_STREAMING</td>
</tr>
<tr>
<td>AL_LOOPING</td>
<td>i, iv</td>
<td>turns looping on (AL_TRUE) or off (AL_FALSE)</td>
</tr>
<tr>
<td>AL_BUFFER</td>
<td>i, iv</td>
<td>the ID of the attached buffer</td>
</tr>
<tr>
<td>AL_SOURCE_STATE</td>
<td>i, iv</td>
<td>the state of the source (AL_STOPPED, AL_PLAYING, ...)</td>
</tr>
<tr>
<td>AL_BUFFERS_QUEUED</td>
<td>i, iv</td>
<td>the number of buffers queued on this source</td>
</tr>
<tr>
<td>AL_BUFFERS_PROCESSED</td>
<td>i, iv</td>
<td>the number of buffers in the queue that have been processed</td>
</tr>
<tr>
<td>AL_SEC_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in seconds</td>
</tr>
<tr>
<td>AL_SAMPLE_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in samples</td>
</tr>
<tr>
<td>AL_BYTE_OFFSET</td>
<td>f, fv, i, iv</td>
<td>the playback position, expressed in bytes</td>
</tr>
</tbody>
</table>

**Functions**

- alGenSources
- alDeleteSources
- alIsSource
- alSourcef
- alSource3f
- alSourcefv
- alSourcei
- alSource3i
alSourceiv
alGetSourcef
alGetSource3f
alGetSourcefv
alGetSourcei
alGetSource3i
alGetSourceiv
alSourcePlay
alSourcePlayv
alSourcePause
alSourcePausev
alSourceStop
alSourceStopv
alSourceRewind
alSourceRewindv
alSourceQueueBuffers
alSourceUnqueueBuffers
**alGenSources**

**Description**

This function generates one or more sources. References to sources are ALuint values, which are used wherever a source reference is needed (in calls such as `alDeleteSources` and `alSourcei`).

```c
void alGenSources(
    ALsizei n,
    ALuint *sources
);
```

**Parameters**

- `n`: the number of sources to be generated
- `sources`: pointer to an array of ALuint values which will store the names of the new sources

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_OUT_OF_MEMORY</td>
<td>There is not enough memory to generate all the requested sources.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>There are not enough non-memory resources to create all the requested sources, or the array pointer is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no context to create sources in.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

If the requested number of sources cannot be created, an error will be generated which can be detected with `alGetError`. If an error occurs, no sources will be generated. If `n` equals zero, `alGenSources` does nothing and does not return an error.

**See Also**

`alDeleteSources`, `allsSource`
alDeleteSources

Description

This function deletes one or more sources.

void alDeleteSources(
    ALsizei n,
    ALuint *sources
);

Parameters

n      the number of sources to be deleted

sources pointer to an array of source names identifying the sources to be deleted

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>At least one specified source is not valid, or an attempt is being made to delete more sources than exist.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

If the requested number of sources cannot be deleted, an error will be generated which can be detected with alGetError. If an error occurs, no sources will be deleted. If n equals zero, alDeleteSources does nothing and will not return an error.

A playing source can be deleted – the source will be stopped and then deleted.

See Also

alGenSources, alIsSource
**allIsSource**

**Description**

This function tests if a source name is valid, returning AL_TRUE if valid and AL_FALSE if not.

```c
boolean allIsSource(
    ALuint source
);
```

**Parameters**

- `source` a source name to be tested for validity

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

`alGenSources`, `alDeleteSources`
alSourcef

Description

This function sets a floating point property of a source.

```c
void alSourcef(
    ALuint source,
    ALenum param,
    ALfloat value
);
```

Parameters

- **source**: source name whose attribute is being set
- **param**: the name of the attribute to set:
  - `AL_PITCH`
  - `AL_GAIN`
  - `AL_MIN_GAIN`
  - `AL_MAX_GAIN`
  - `AL_MAX_DISTANCE`
  - `AL_ROLLOFF_FACTOR`
  - `AL_CONE_OUTER_GAIN`
  - `AL_CONE_INNER_ANGLE`
  - `AL_CONE_OUTER_ANGLE`
  - `AL_REFERENCE_DISTANCE`
- **value**: the value to set the attribute to

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is out of range.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

`alSource3f, alSourcefv, alGetSourcef, alGetSource3f, alGetSourcefv`
**alSource3f**

**Description**

This function sets a source property requiring three floating point values.

```c
void alSource3f(
    ALuint source,
    ALenum param,
    ALfloat v1,
    ALfloat v2,
    ALfloat v3
);
```

**Parameters**

- **source**
  source name whose attribute is being set
- **param**
  the name of the attribute to set:
  - AL_POSITION
  - AL_VELOCITY
  - AL_DIRECTION
- **v1, v2, v3**
  the three ALfloat values which the attribute will be set to

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is out of range.</td>
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<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

This function is an alternative to `alSourcefv`.

**See Also**

alSourcef, alSourcefv, alGetSourcef, alGetSource3f, alGetSourcefv
**alSourcefv**

**Description**

This function sets a floating point-vector property of a source.

```c
void alSourcefv(
    ALuint source,
    ALenum param,
    ALfloat *values
);
```

**Parameters**

- **source**: source name whose attribute is being set
- **param**: the name of the attribute being set:
  - AL_POSITION
  - AL_VELOCITY
  - AL_DIRECTION
- **values**: a pointer to the vector to set the attribute to

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
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<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
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<td>The specified source name is not valid.</td>
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<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

This function is an alternative to `alSource3f`.

**See Also**

`alSourcef`, `alSource3f`, `alGetSourcef`, `alGetSource3f`, `alGetSourcefv`
alSourcei

Description

This function sets an integer property of a source.

```c
void alSourcei(
    ALuint source,
    ALenum param,
    ALint value
);
```

Parameters

- **source**: source name whose attribute is being set
- **param**: the name of the attribute to set:
  - AL_SOURCE_RELATIVE
  - AL_CONE_INNER_ANGLE
  - AL_CONE_OUTER_ANGLE
  - AL_LOOPING
  - AL_BUFFER
  - AL_SOURCE_STATE
- **value**: the value to set the attribute to

Possible Error States

<table>
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<tr>
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<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
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<td>The specified source name is not valid.</td>
</tr>
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<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The buffer name zero is reserved as a "NULL Buffer" and is accepted by `alSourcei(..., AL_BUFFER, ...)` as a valid buffer of zero length. The NULL Buffer is extremely useful for detaching buffers from a source which were attached using this call or with `alSourceQueueBuffers`.

See Also

- `alSource3i`
- `alSourceiv`
- `alGetSourcei`
- `alGetSource3i`
- `alGetSourceiv`
**alSource3i**

**Description**

This function sets an integer property of a source.

```c
void alSourcei(
    ALuint source,
    ALenum param,
    ALint v1,
    ALint v2,
    ALint v3
);
```

**Parameters**

- `source` source name whose attribute is being set
- `param` the name of the attribute to set:
  - `AL_POSITION`
  - `AL_VELOCITY`
  - `AL_DIRECTION`
- `v1, v2, v3` the values to set the attribute to

**Possible Error States**

<table>
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<tr>
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<td>AL_INVALID_VALUE</td>
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<td>The specified source name is not valid.</td>
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<td>There is no current context.</td>
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</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

`alSourcei`, `alSourceiv`, `alGetSourcei`, `alGetSource3i`, `alGetSourceiv`
**alSourceiv**

**Description**

This function sets an integer property of a source.

```c
void alSourceiv(
    ALuint source,
    ALenum param,
    ALint *values
);
```

**Parameters**

- **source**
  source name whose attribute is being set

- **param**
  the name of the attribute to set:
  - AL_POSITION
  - AL_VELOCITY
  - AL_DIRECTION

- **values**
  the values to set the attribute to

**Possible Error States**

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<td>The specified source name is not valid.</td>
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<tr>
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</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

- `alSourcei`, `alSource3i`, `alGetSourcei`, `alGetSource3i`, `alGetSourceiv`
**alGetSourcef**

**Description**

This function retrieves a floating point property of a source.

```c
void alGetSourcef(
    ALuint source,
    ALenum param,
    ALfloat *value
);
```

**Parameters**

- **source** source name whose attribute is being retrieved
- **param** the name of the attribute to retrieve:
  - AL_PITCH
  - AL_GAIN
  - AL_MIN_GAIN
  - AL_MAX_GAIN
  - AL_MAX_DISTANCE
  - AL_ROLLOFF_FACTOR
  - AL_CONE_OUTER_GAIN
  - AL_CONE_INNER_ANGLE
  - AL_CONE_OUTER_ANGLE
  - AL_REFERENCE_DISTANCE
- **value** a pointer to the floating point value being retrieved

**Possible Error States**

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<tbody>
<tr>
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<tr>
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<td>There is no current context.</td>
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</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alSourcef, alSource3f, alSourcefv, alGetSource3f, alGetSourcefv
**alGetSource3f**

**Description**

This function retrieves three floating point values representing a property of a source.

```c
void alGetSource3f(
    ALuint source,
    ALenum param,
    ALfloat *v1,
    ALfloat *v2,
    ALfloat *v3
);
```

**Parameters**

- **source**  
  source name whose attribute is being retrieved

- **param**  
  the name of the attribute being retrieved:
  - AL_POSITION
  - AL VELOCITY
  - AL DIRECTION

- **v1, v2, v3**  
  pointers to the values to retrieve

**Possible Error States**

<table>
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</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

alSourcef, alSource3f, alSourcefv, alGetSourcef, alGetSourcefv
alGetSourcefv

Description

This function retrieves a floating point-vector property of a source.

```c
void alGetSourcefv(
    ALuint source,
    ALenum param,
    ALfloat *values
);
```

Parameters

source  
source name whose attribute is being retrieved

param  
the name of the attribute being retrieved:

AL_POSITION
AL_VELOCITY
AL_DIRECTION

values  
a pointer to the vector to retrieve

Possible Error States

<table>
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</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alSource, alSource3f, alSourcefv, alGetSource, alGetSource3f
**alGetSourcei**

**Description**

This function retrieves an integer property of a source.

```c
void alGetSourcei(
    ALuint source,
    ALenum pname,
    ALint *value
);
```

**Parameters**

- **source**: source name whose attribute is being retrieved
- **pname**: the name of the attribute to retrieve:
  - AL_SOURCE_RELATIVE
  - AL_BUFFER
  - AL_SOURCE_STATE
  - AL_BUFFERS_QUEUED
  - AL_BUFFERS_PROCESSED
- **value**: a pointer to the integer value being retrieved

**Possible Error States**

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</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alSourcei, alSource3i, alSourceiv, alGetSource3i, alGetSourceiv
alGetSource3i

Description

This function retrieves an integer property of a source.

```c
void alGetSource3i(
    ALuint source,
    ALenum param,
    ALint *v1,
    ALint *v2,
    ALint *v3
);
```

Parameters

- `source` source name whose attribute is being retrieved
- `param` the name of the attribute to retrieve:
  - AL_POSITION
  - AL_VELOCITY
  - AL_DIRECTION
- `v1`, `v2`, `v3` pointers to the integer values being retrieved

Possible Error States

<table>
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</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

alSourcei, alSource3i, alSourceiv, alGetSourcei, alGetSourceiv
alGetSourceiv

Description

This function retrieves an integer property of a source.

```c
void alGetSourceiv(
    ALuint source,
    ALenum param,
    ALint *values
);
```

Parameters

- **source**: source name whose attribute is being retrieved
- **param**: the name of the attribute to retrieve:
  - AL_POSITION
  - AL_VELOCITY
  - AL_DIRECTION
- **values**: pointer to the integer values being retrieved

Possible Error States

<table>
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</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

alSourcei, alSource3i, alSourceiv, alGetSourcei, alGetSource3i
**alSourcePlay**

**Description**

This function plays a source.

```c
void alSourcePlay(
    ALuint source
);
```

**Parameters**

- `source`: the name of the source to be played

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

The playing source will have its state changed to AL_PLAYING. When called on a source which is already playing, the source will restart at the beginning. When the attached buffer(s) are done playing, the source will progress to the AL_STOPPED state.

**See Also**

alSourcePlayv

Description
This function plays a set of sources.

```c
void alSourcePlayv(
    ALsizei n,
    ALuint *sources
);
```

Parameters
- `n` the number of sources to be played
- `sources` a pointer to an array of sources to be played

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
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<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The playing sources will have their state changed to AL_PLAYING. When called on a source which is already playing, the source will restart at the beginning. When the attached buffer(s) are done playing, the source will progress to the AL_STOPPED state.

See Also

alSourcePlay, alSourcePause, alSourcePauseav, alSourceRewind, alSourceRewindy, alSourceStop, alSourceStopv
alSourcePause

Description

This function pauses a source.

```c
void alSourcePause(
    ALuint source
);
```

Parameters

- `source` the name of the source to be paused

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The paused source will have its state changed to AL_PAUSED.

See Also

- alSourcePlay
- alSourcePlayv
- alSourcePause
- alSourceRewind
- alSourceRewindv
- alSourceStop
- alSourceStopv
alSourcePausev

Description

This function pauses a set of sources.

```c
void alSourcePausev(
   ALsizei n,
   ALuint *sources
);
```

Parameters

- `n` the number of sources to be paused
- `sources` a pointer to an array of sources to be paused

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The paused sources will have their state changed to AL_PAUSED.

See Also

alSourcePlay, alSourcePlayv, alSourcePause, alSourceRewind, alSourceRewindy, alSourceStop, alSourceStopv
**alSourceStop**

**Description**

This function stops a source.

```c
void alSourceStop(
    ALuint source
);
```

**Parameters**

- `source` the name of the source to be stopped

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

The stopped source will have its state changed to AL_STOPPED.

**See Also**

alSourcePlay, alSourcePlayv, alSourcePause, alSourcePausev, alSourceRewind, alSourceRewindv, alSourceStopv
alSourceStopv

Description

This function stops a set of sources.

```c
void alSourceStopv(
    ALsizei n,
    ALuint *sources
);
```

Parameters

- `n` the number of sources to stop
- `sources` a pointer to an array of sources to be stopped

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The stopped sources will have their state changed to AL_STOPPED.

See Also

alSourcePlay, alSourcePlayv, alSourcePause, alSourcePausev, alSourceRewind, alSourceRewindv, alSourceStop
alSourceRewind

Description

This function stops the source and sets its state to AL_INITIAL.

```c
void alSourceRewind(
    ALuint source
);
```

Parameters

- `source` the name of the source to be rewound

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alSourcePlay, alSourcePlayv, alSourcePause, alSourcePausev, alSourceRewindv, alSourceStop, alSourceStopv
**alSourceRewindv**

**Description**

This function stops a set of sources and sets all their states to AL_INITIAL.

```c
void alSourceRewindv(
    ALsizei n,
    ALuint *sources
);
```

**Parameters**

- **n** the number of sources to be rewound
- **sources** a pointer to an array of sources to be rewound

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alSourcePlay, alSourcePlayv, alSourcePause, alSourcePausev, alSourceRewind, alSourceStop, alSourceStopv
**alSourceQueueBuffers**

**Description**

This function queues a set of buffers on a source. All buffers attached to a source will be played in sequence, and the number of processed buffers can be detected using an `alSourcei` call to retrieve AL_BUFFERS_PROCESSED.

```c
void alSourceQueueBuffers(
    ALuint source,
    ALsizei n,
    ALuint* buffers
);
```

**Parameters**

- **source** the name of the source to queue buffers onto
- **n** the number of buffers to be queued
- **buffers** a pointer to an array of buffer names to be queued

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_NAME</td>
<td>At least one specified buffer name is not valid, or the specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context, an attempt was made to add a new buffer which is not the same format as the buffers already in the queue, or the source already has a static buffer attached.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

When first created, a source will be of type AL_UNDETERMINED. A successful `alSourceQueueBuffers` call will change the source type to AL_STREAMING.

**See Also**

`alSourceUnqueueBuffers`
**alSourceUnqueueBuffers**

**Description**

This function unqueues a set of buffers attached to a source. The number of processed buffers can be detected using an `alSourcei` call to retrieve `AL_BUFFERS_PROCESSED`, which is the maximum number of buffers that can be unqueued using this call.

```c
void alSourceUnqueueBuffers(
    ALuint source,
    ALsizei n,
    ALuint* buffers
);
```

**Parameters**

- `source`: the name of the source to unqueue buffers from
- `n`: the number of buffers to be unqueued
- `buffers`: a pointer to an array of buffer names that were removed

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>At least one buffer can not be unqueued because it has not been processed yet.</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>The specified source name is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

The unqueue operation will only take place if all `n` buffers can be removed from the queue.

**See Also**

- `alSourceQueueBuffers`
Listener Functions

Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_GAIN</td>
<td>f, fv</td>
<td>&quot;master gain&quot; value should be positive</td>
</tr>
<tr>
<td>AL_POSITION</td>
<td>fv, 3f, 3i</td>
<td>X, Y, Z position</td>
</tr>
<tr>
<td>AL_VELOCITY</td>
<td>fv, 3f, 3i</td>
<td>velocity vector</td>
</tr>
<tr>
<td>AL_ORIENTATION</td>
<td>fv, iv</td>
<td>orientation expressed as &quot;at&quot; and &quot;up&quot; vectors</td>
</tr>
</tbody>
</table>

Functions

alListenerf
alListener3f
alListenerfv
alListeneri
alListener3i
alListeneriv
alGetListenerf
alGetListener3f
alGetListenerfv
alGetListeneri
alGetListener3i
alGetListeneriv
alListenerf

Description

This function sets a floating point property for the listener.

```c
void alListenerf(
    ALenum param,
    ALfloat value
);
```

Parameters:

- `param` the name of the attribute to be set:
  - `AL_GAIN`
- `value` the ALfloat value to set the attribute to

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

- OpenAL 1.0 or higher

Remarks

- None

See Also

- `alListener3f`, `alListenerfv`, `alGetListener`, `alGetListener3f`, `alGetListenerfv`
**alListener3f**

**Description**

This function sets a floating point property for the listener.

```c
void alListener3f(
    ALenum param,
    ALfloat v1,
    ALfloat v2,
    ALfloat v3
);
```

**Parameters**

- `param` the name of the attribute to set:
  - AL_POSITION
  - AL VELOCITY
- `v1`, `v2`, `v3` the value to set the attribute to

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
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<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alListenerf, alListenerfv, alGetListenerf, alGetListener3f, alGetListenerfv
alListenerfv

Description

This function sets a floating point-vector property of the listener.

```c
void alListenerfv(
    ALenum param,
    ALfloat *values
);
```

Parameters

- `param` the name of the attribute to be set:
  - AL_POSITION
  - AL_VELOCITY
  - AL_ORIENTATION

- `values` pointer to floating point-vector values

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alListenerf, alListener3f, alGetListenerf, alGetListener3f, alGetListenerfv
**alListeneri**

**Description**

This function sets an integer property of the listener.

```
void alListeneri(
    ALenum param,
    ALint value
);
```

**Parameters**

- `param`: the name of the attribute to be set
- `value`: the integer value to set the attribute to

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

There are no integer listener attributes defined for OpenAL 1.1, but this function may be used by an extension.

**See Also**

alListener3i, alListeneriv, alGetListeneri, alGetListener3i, alGetListeneriv
**alListener3i**

**Description**

This function sets an integer property of the listener.

```c
void alListener3i(
    ALenum param,
    ALint v1,
    ALint v2,
    ALint v3
);
```

**Parameters**

- `param` the name of the attribute to be set:
  - AL_POSITION
  - AL_VELOCITY
- `v1, v2, v3` the integer values to set the attribute to

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

[alListener], [alListeneriv], [alGetListeneri], [alGetListener3i], [alGetListeneriv]
alListeneriv

Description

This function sets an integer property of the listener.

```c
void alListeneriv(
    ALenum param,
    ALint *values
);
```

Parameters

- **param**: the name of the attribute to be set
  - AL_POSITION
  - AL_VELOCITY
  - AL_ORIENTATION

- **values**: pointer to the integer values to set the attribute to

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

alListener, alListener3i, alGetListener, alGetListener3i, alGetListeneriv
alGetListenerf

Description

This function retrieves a floating point property of the listener.

```c
void alGetListenerf(
    ALenum param,
    ALfloat *value
);
```

Parameters

- `param` the name of the attribute to be retrieved:
  - AL_GAIN

- `value` a pointer to the floating point value being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alListenerf, alListener3f, alListenerfv, alGetListener3f, alGetListenerfv
alGetListener3f

Description

This function retrieves a set of three floating point values from a property of the listener.

```c
void alGetListener3f(
    ALenum param,
    ALfloat *v1,
    ALfloat *v2,
    ALfloat *v3
);
```

Parameters

- `param` the name of the attribute to be retrieved
  - AL_POSITION
  - AL VELOCITY
- `v1`, `v2`, `v3` pointers to the three floating point being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alListenerf, alListener3f, alListenerfv, alGetListenerf, alGetListenerfv
alGetListenerfv

Description

This function retrieves a floating point-vector property of the listener.

```c
void alGetListenerfv(
    ALenum param,
    ALfloat *values
);
```

Parameters

- `param` the name of the attribute to be retrieved
  - AL_POSITION
  - AL_VELOCITY
  - AL_ORIENTATION

- `values` a pointer to the floating point-vector value being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

- alListenerf
- alListener3f
- alListenerf
- alGetListenerf
- alGetListener3f
alGetListeneri

Description

This function retrieves an integer property of the listener.

```c
void alGetListeneri(
    ALenum param,
    ALint *value
);
```

Parameters

- `param` the name of the attribute to be retrieved
- `value` a pointer to the integer value being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

There are no integer listener attributes defined for OpenAL 1.1, but this function may be used by an extension.

See Also

alListeneri, alListener3i, alListeneriv, alGetListener3i, alGetListeneriv
alGetListener3i

Description

This function retrieves an integer property of the listener.

```c
void alGetListener3i(
    ALenum param,
    ALint *v1,
    ALint *v2,
    ALint *v3
);
```

Parameters

- `param` the name of the attribute to be retrieved
  - AL_POSITION
  - AL_VELOCITY
- `v1, v2, v3` pointers to the integer values being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
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<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

alListeneri, alListener3i, alListeneriv, alGetListeneri, alGetListeneriv
alGetListeneriv

Description

This function retrieves an integer property of the listener.

```c
void alGetListeneriv(
    ALenum param,
    ALint *values
);
```

Parameters

- `param` the name of the attribute to be retrieved
  - AL_POSITION
  - AL VELOCITY
  - AL_ORIENTATION

- `values` a pointer to the integer values being retrieved

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The value pointer given is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.1 or higher

Remarks

None

See Also

allListeneri, allListener3i, allListeneriv, alGetListeneri, alGetListener3i
State Functions

Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_DOPPLER_FACTOR</td>
<td>f</td>
<td>Global Doppler factor</td>
</tr>
<tr>
<td>AL_SPEED_OF_SOUND</td>
<td>f</td>
<td>Speed of sound in units per second</td>
</tr>
<tr>
<td>AL_DISTANCE_MODEL</td>
<td>i</td>
<td>Distance model enumeration value</td>
</tr>
</tbody>
</table>

Functions

- alEnable
- alDisable
- alIsEnabled
- alGetBoolean
- alGetDouble
- alGetFloat
- alGetInt
- alGetInteger
- alGetBooleanv
- alGetDoublev
- alGetFloatv
- alGetIntegerv
- alGetString
- alDistanceModel
- alDopplerFactor
- alSpeedOfSound
**alEnable**

**Description**

This function enables a feature of the OpenAL driver.

```c
void alEnable(
    ALenum capability
);
```

**Parameters**

- `capability` the name of a capability to enable

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified capability is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

There are no capabilities defined in OpenAL 1.1 to be used with this function, but it may be used by an extension.

**See Also**

- alDisable, alIsEnabled
alDisable

Description

This function disables a feature of the OpenAL driver.

```c
void alDisable(
    ALEnum capability
);
```

Parameters

- `capability` the name of a capability to disable

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified capability is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

There are no capabilities defined in OpenAL 1.1 to be used with this function, but it may be used by an extension.

See Also

- `alEnable`, `allsEnabled`
**allIsEnabled**

**Description**

This function returns a boolean indicating if a specific feature is enabled in the OpenAL driver.

```c
ALboolean allIsEnabled(
    ALenum capability
);
```

**Parameters**

- `capability` the name of a capability to enable

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified capability is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns AL_TRUE if the capability is enabled, AL_FALSE if the capability is disabled. There are no capabilities defined in OpenAL 1.1 to be used with this function, but it may be used by an extension.

**See Also**

allEnable, allDisable
alGetBoolean

Description

This function returns a boolean OpenAL state.

```c
ALboolean alGetBoolean(
    ALenum  param
);
```

Parameters

`param`     the state to be queried:
AL_DOPPLER_FACTOR
AL_SPEED_OF_SOUND
AL_DISTANCE_MODEL

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The boolean state described by `param` will be returned.

See Also

alGetBoolean, alGetDouble, alGetDoublev, alGetFloat, alGetFloatv, alGetInteger, alGetIntegerv
alGetDouble

Description

This function returns a double precision floating point OpenAL state.

```c
Aldouble alGetDouble(
    ALenum  param
);
```

Parameters

`param` the state to be queried:

- AL_DOPPLER_FACTOR
- AL_SPEED_OF_SOUND
- AL_DISTANCE_MODEL

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The double value described by param will be returned.

See Also

alGetBoolean, alGetBool, alGetDouble, alGetFloat, alGetFloatv, alGetInteger, alGetIntegerv
**alGetFloat**

**Description**

This function returns a floating point OpenAL state.

```c
ALfloat alGetFloat(
    ALenum param
);
```

**Parameters**

- `param`  
  the state to be queried:
  - AL_DOPPLER_FACTOR
  - AL_SPEED_OF_SOUND
  - AL_DISTANCE_MODEL

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

The floating point state described by `param` will be returned.

**See Also**

- alGetBoolean
- alGetBooleanv
- alGetDouble
- alGetDoublev
- alGetFloat
- alGetIntegerv
- alGetInteger
alGetInteger

Description

This function returns an integer OpenAL state.

```c
Alint alGetInteger(
    ALenum  param
);
```

Parameters

`param` the state to be queried:

- AL_DOPPLER_FACTOR
- AL_SPEED_OF_SOUND
- AL_DISTANCE_MODEL

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The integer state described by param will be returned.

See Also

alGetBoolean, alGetBool, alGetDouble, alGetDoublev, alGetFloat, alGetFloatv, alGetIntegerv
**alGetBooleanv**

**Description**

This function retrieves a boolean OpenAL state.

```c
void alGetBooleanv(
    ALenum param,
    ALboolean *data
);
```

**Parameters**

- `param` the state to be returned:
  - AL_DOPPLER_FACTOR
  - AL_SPEED_OF_SOUND
  - AL_DISTANCE_MODEL

- `data` a pointer to the location where the state will be stored

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified data pointer is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alGetBoolean, alGetDouble, alGetDoublev, alGetFloat, alGetFloatv, alGetInteger, alGetIntegerv
**alGetDoublev**

**Description**

This function retrieves a double precision floating point OpenAL state.

```c
void alGetDoublev(
    ALenum param,
    ALdouble *data
);
```

**Parameters**

- **param** the state to be returned:
  - AL_DOPPLER_FACTOR
  - AL_SPEED_OF_SOUND
  - AL_DISTANCE_MODEL

- **data** a pointer to the location where the state will be stored

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified data pointer is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

None

**See Also**

alGetBoolean, alGetBooleanv, alGetDouble, alGetFloat, alGetFloatv, alGetInteger, alGetIntegerv
alGetFloatv

Description

This function retrieves a floating point OpenAL state.

```c
void alGetFloatv(
    ALenum param,
    ALfloat *data
);
```

Parameters

- **param** the state to be returned:
  - AL_DOPPLER_FACTOR
  - AL_SPEED_OF_SOUND
  - AL_DISTANCE_MODEL

- **data** a pointer to the location where the state will be stored

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified data pointer is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

- alGetBoolean
- alGetBooleanv
- alGetDouble
- alGetDoublev
- alGetFloat
- alGetInteger
- alGetIntegerv
alGetIntegerv

Description

This function retrieves an integer OpenAL state.

```c
void alGetIntegerv(
    ALenum param,
    ALint *data
);
```

Parameters

- **param** The state to be returned:
  - AL_DOPPLER_FACTOR
  - AL_SPEED_OF_SOUND
  - AL_DISTANCE_MODEL

- **data** a pointer to the location where the state will be stored

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified data pointer is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

None

See Also

alGetBoolean, alGetBooleanv, alGetDouble, alGetDoublev, alGetFloat, alGetFloatv, alGetInteger
alGetString

Description

This function retrieves an OpenAL string property.

```c
const ALchar * alGetString(
    ALenum param
);
```

Parameters

`param` The property to be returned

- AL_VENDOR
- AL_VERSION
- AL_RENDERER
- AL_EXTENSIONS

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns a pointer to a null-terminated string.
**alDistanceModel**

**Description**

This function selects the OpenAL distance model – AL_INVERSE_DISTANCE, AL_INVERSE_DISTANCE_CLAMPED, AL_LINEAR_DISTANCE, AL_LINEAR_DISTANCE_CLAMPED, AL_EXPONENT_DISTANCE, AL_EXPONENT_DISTANCE_CLAMPED, or AL_NONE.

The AL_INVERSE_DISTANCE model works according to the following formula:

\[
\text{gain} = \frac{\text{AL\_REFERENCE\_DISTANCE}}{\text{AL\_REFERENCE\_DISTANCE} + \text{AL\_ROLLOFF\_FACTOR} \cdot (\text{distance} - \text{AL\_REFERENCE\_DISTANCE})};
\]

The AL_INVERSE_DISTANCE_CLAMPED model works according to the following formula:

\[
\text{distance} = \max(\text{distance}, \text{AL\_REFERENCE\_DISTANCE});
\]

\[
\text{distance} = \min(\text{distance}, \text{AL\_MAX\_DISTANCE});
\]

\[
\text{gain} = \frac{\text{AL\_REFERENCE\_DISTANCE}}{\text{AL\_REFERENCE\_DISTANCE} + \text{AL\_ROLLOFF\_FACTOR} \cdot (\text{distance} - \text{AL\_REFERENCE\_DISTANCE})};
\]

Here is a graph showing the inverse distance curve:
The AL_LINEAR_DISTANCE model works according to the following formula:

\[
\text{distance} = \min(\text{distance}, \text{AL\_MAX\_DISTANCE}) \quad // \quad \text{avoid negative gain}
\]
\[
\text{gain} = (1 - \text{AL\_ROLLOFF\_FACTOR} \times (\text{distance} - \text{AL\_REFERENCE\_DISTANCE}) / (\text{AL\_MAX\_DISTANCE} - \text{AL\_REFERENCE\_DISTANCE}))
\]

The AL_LINEAR_DISTANCE_CLAMPED model works according to the following formula:

\[
\text{distance} = \max(\text{distance}, \text{AL\_REFERENCE\_DISTANCE})
\]
\[
\text{distance} = \min(\text{distance}, \text{AL\_MAX\_DISTANCE})
\]
\[
\text{gain} = (1 - \text{AL\_ROLLOFF\_FACTOR} \times (\text{distance} - \text{AL\_REFERENCE\_DISTANCE}) / (\text{AL\_MAX\_DISTANCE} - \text{AL\_REFERENCE\_DISTANCE}))
\]

Here is a graph showing the linear distance curve:

The AL_EXPONENT_DISTANCE model works according to the following formula:

\[
\text{gain} = (\text{distance} / \text{AL\_REFERENCE\_DISTANCE}) ^ {(- \text{AL\_ROLLOFF\_FACTOR})}
\]

The AL_EXPONENT_DISTANCE_CLAMPED model works according to the following formula:

\[
\text{distance} = \max(\text{distance}, \text{AL\_REFERENCE\_DISTANCE})
\]
\[
\text{distance} = \min(\text{distance}, \text{AL\_MAX\_DISTANCE})
\]
\[
\text{gain} = (\text{distance} / \text{AL\_REFERENCE\_DISTANCE}) ^ {(- \text{AL\_ROLLOFF\_FACTOR})}
\]
Here is a graph showing the exponent distance curve:

The AL_NONE model works according to the following formula:

\[ \text{gain} = 1; \]

```c
void alDistanceModel(
    ALenum value
);
```

**Parameters**

- **value**: the distance model to be set:
  - `AL_INVERSE_DISTANCE`
  - `AL_INVERSE_DISTANCE_CLAMPED`
  - `AL_LINEAR_DISTANCE`
  - `AL_LINEAR_DISTANCE_CLAMPED`
  - `AL_EXPONENT_DISTANCE`
  - `AL_EXPONENT_DISTANCE_CLAMPED`
  - `AL_NONE`

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified distance model is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher
Remarks

The default distance model in OpenAL is AL_INVERSE_DISTANCE_CLAMPED.
alDopplerFactor

Description

This function selects the OpenAL Doppler factor value.

```c
void alDopplerFactor(
    ALfloat value
);
```

Parameters

- `value`: the Doppler scale value to set

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The default Doppler factor value is 1.0.
**alSpeedOfSound**

**Description**

This function selects the speed of sound for use in Doppler calculations.

```c
void alSpeedOfSound(
    ALfloat value
);
```

**Parameters**

- *value* the speed of sound value to set

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified value is not valid.</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>There is no current context.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

The default speed of sound value is 343.3.
Error Functions

Error Codes

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_NO_ERROR</td>
<td>there is not currently an error</td>
</tr>
<tr>
<td>AL_INVALID_NAME</td>
<td>a bad name (ID) was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_ENUM</td>
<td>an invalid enum value was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_VALUE</td>
<td>an invalid value was passed to an OpenAL function</td>
</tr>
<tr>
<td>AL_INVALID_OPERATION</td>
<td>the requested operation is not valid</td>
</tr>
<tr>
<td>AL_OUT_OF_MEMORY</td>
<td>the requested operation resulted in OpenAL running out of memory</td>
</tr>
</tbody>
</table>

Functions

alGetError
alGetError

Description

This function returns the current error state and then clears the error state.

`ALenum alGetError(ALvoid);`

Parameters

None

Possible Error States

None

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns an Alenum representing the error state. When an OpenAL error occurs, the error state is set and will not be changed until the error state is retrieved using alGetError. Whenever alGetError is called, the error state is cleared and the last state (the current state when the call was made) is returned. To isolate error detection to a specific portion of code, alGetError should be called before the isolated section to clear the current error state.
Extension Functions

Functions

- alIsExtensionPresent
- alGetProcAddress
- alGetEnumValue
**alIsExtensionPresent**

**Description**

This function tests if a specific extension is available for the OpenAL driver.

```c
ALboolean alIsExtensionPresent(
    const ALchar *extname
);
```

**Parameters**

- `extname` a null-terminated string describing the desired extension

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL_INVALID_VALUE</td>
<td>The specified extension string is not a valid pointer.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns AL_TRUE if the extension is available, AL_FALSE if the extension is not available.

**See Also**

- `alGetProcAddress`
- `alGetEnumValue`
alGetProcAddress

Description

This function returns the address of an OpenAL extension function.

```c
void * alGetProcAddress(
    const ALchar *fname
);
```

Parameters

- `fname` a null-terminated string containing the function name

Possible Error States

None

Version Requirements

OpenAL 1.0 or higher

Remarks

The return value is a pointer to the specified function. The return value will be NULL if the function is not found.

See Also

`alIsExtensionPresent`, `alGetEnumValue`
alGetEnumValue

Description

This function returns the enumeration value of an OpenAL enum described by a string.

```c
ALenum alGetEnumValue(
    const ALchar *ename
);
```

Parameters

- `ename` a null-terminated string describing an OpenAL enum

Possible Error States

None

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns the actual ALenum described by a string. Returns NULL if the string doesn’t describe a valid OpenAL enum.

See Also

- `alIsExtensionPresent`
- `alGetProcAddress`
Context Management Functions

**Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_FREQUENCY</td>
<td>I</td>
<td>output frequency</td>
</tr>
<tr>
<td>ALC_MONO_SOURCES</td>
<td>I</td>
<td>requested number of mono sources</td>
</tr>
<tr>
<td>ALC_STEREO_SOURCES</td>
<td>I</td>
<td>requested number of stereo sources</td>
</tr>
<tr>
<td>ALC_REFRESH</td>
<td>I</td>
<td>update rate of context processing</td>
</tr>
<tr>
<td>ALC_SYNC</td>
<td>i</td>
<td>flag indicating a synchronous context</td>
</tr>
</tbody>
</table>

**Functions**

- alcCreateContext
- alcMakeContextCurrent
- alcProcessContext
- alcSuspendContext
- alcDestroyContext
- alcGetCurrentContext
- alcGetContextsDevice
**alcCreateContext**

**Description**

This function creates a context using a specified device.

```c
ALCcontext * alcCreateContext(
    ALCdevice *device,
    ALCint* attrlist
);
```

**Parameters**

- `device` a pointer to a device
- `attrlist` a pointer to a set of attributes:
  - `ALC_FREQUENCY`
  - `ALC_MONO_SOURCES`
  - `ALC_REFRESH`
  - `ALC_STEREO_SOURCES`
  - `ALC_SYNC`

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>An additional context can not be created for this device.</td>
</tr>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not a valid output device.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns a pointer to the new context (NULL on failure).

The attribute list can be NULL, or a zero terminated list of integer pairs composed of valid ALC attribute tokens and requested values.

**See Also**

`alcDestroyContext`, `alcMakeContextCurrent`
**alcMakeContextCurrent**

**Description**

This function makes a specified context the current context.

```c
ALCboolean alcMakeContextCurrent(
    ALCcontext *context
);
```

**Parameters**

- `context` a pointer to the new context

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is invalid.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns ALC_TRUE on success, or ALC_FALSE on failure.

**See Also**

- [alcCreateContext](#)
- [alcDestroyContext](#)
**alcProcessContext**

**Description**

This function tells a context to begin processing.

```c
void alcProcessContext(
    ALCcontext *context
);
```

**Parameters**

`context`  a pointer to the new context

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is invalid.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

When a context is suspended, changes in OpenAL state will be accepted but will not be processed. `alcSuspendContext` can be used to suspend a context, and then all the OpenAL state changes can be applied at once, followed by a call to `alcProcessContext` to apply all the state changes immediately. In some cases, this procedure may be more efficient than application of properties in a non-suspended state. In some implementations, process and suspend calls are each a NOP.

**See Also**

`alcSuspendContext`
**alcSuspendContext**

**Description**

This function suspends processing on a specified context.

```c
void alcSuspendContext(
    ALCcontext *context
);
```

**Parameters**

- `context` a pointer to the context to be suspended

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is invalid.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

When a context is suspended, changes in OpenAL state will be accepted but will not be processed. A typical use of alcSuspendContext would be to suspend a context, apply all the OpenAL state changes at once, and then call `alcProcessContext` to apply all the state changes at once. In some cases, this procedure may be more efficient than application of properties in a non-suspended state. In some implementations, process and suspend calls are each a NOP.

**See Also**

`alcProcessContext`
alcDestroyContext

Description

This function destroys a context.

```c
void alcDestroyContext(
    ALCcontext *context
);
```

Parameters

`context` a pointer to the new context

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is invalid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

A context which is not current can be destroyed at any time (all sources within that context will also be deleted). `alcMakeContextCurrent` should be used to make sure the context to be destroyed is not current (NULL is valid for `alcMakeContextCurrent`).

See Also

`alcCreateContext`, `alcMakeContextCurrent`
alcGetCurrentContext

Description

This function retrieves the current context.

```c
ALCcontext * alcGetCurrentContext( ALCvoid );
```

Parameters

None

Possible Error States

None

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns a pointer to the current context.

See Also

alcGetContextsDevice
alcGetContextsDevice

Description

This function retrieves a context's device pointer.

```c
ALCdevice * alcGetContextsDevice( ALCcontext *context );
```

Parameters

- `context` a pointer to a context

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is invalid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns a pointer to the specified context's device.

See Also

- [alcGetCurrentContext](#)
Context Error Functions

Error Codes

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_NO_ERROR</td>
<td>there is not currently an error</td>
</tr>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>a bad device was passed to an OpenAL function</td>
</tr>
<tr>
<td>ALC_INVALIDCONTEXT</td>
<td>a bad context was passed to an OpenAL function</td>
</tr>
<tr>
<td>ALC_INVALID_ENUM</td>
<td>an unknown enum value was passed to an OpenAL function</td>
</tr>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>an invalid value was passed to an OpenAL function</td>
</tr>
<tr>
<td>ALC_OUT_OF_MEMORY</td>
<td>the requested operation resulted in OpenAL running out of memory</td>
</tr>
</tbody>
</table>

Functions

alcGetError
alcGetError

Description

This function retrieves the current context error state.

```c
ALCenum alcGetError( ALCdevice *device );
```

Parameters

- `device` a pointer to the device to retrieve the error state from

Possible Error States

- None

Version Requirements

- OpenAL 1.0 or higher

Remarks

- None
Context Device Functions

Functions

alcOpenDevice
alcCloseDevice
**alcOpenDevice**

**Description**

This function opens a device by name.

```c
ALCdevice *alcOpenDevice(
    const ALCchar *devicename
);
```

**Parameters**

*devicename* a null-terminated string describing a device

**Possible Error States**

The return value will be NULL if there is an error.

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns a pointer to the opened device. Will return NULL if a device can not be opened.

**See Also**

*alcCloseDevice*
alcCloseDevice

Description

This function closes a device by name.

```c
ALCboolean alcCloseDevice(
    ALCdevice *device
);
```

Parameters

- `device` a pointer to an opened device

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device name doesn't exist.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

ALC_TRUE will be returned on success or ALC_FALSE on failure. Closing a device will fail if the device contains any contexts or buffers.

See Also

alcOpenDevice
Context Extension Functions

Functions
alcIsExtensionPresent
alcGetProcAddress
alcGetEnumValue
alciIsExtensionPresent

Description

This function queries if a specified context extension is available.

```c
ALCboolean alcIsExtensionPresent(
    ALCdevice *device,
    const ALCchar *extName
);
```

Parameters

- `device` a pointer to the device to be queried for an extension
- `extName` a null-terminated string describing the extension

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>The string pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns ALC_TRUE if the extension is available, ALC_FALSE if the extension is not available.

See Also

alcGetProcAddress, alcGetEnumValue
alcGetProcAddress

Description

This function retrieves the address of a specified context extension function.

```c
void * alcGetProcAddress(
    ALCdevice *device,
    const ALCchar *funcName
);
```

Parameters

- `device` a pointer to the device to be queried for the function
- `funcName` a null-terminated string describing the function

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>The string pointer is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

Returns the address of the function, or NULL if it is not found.

See Also

alcIsExtensionPresent, alcGetEnumValue
**alcGetEnumValue**

**Description**

This function retrieves the enum value for a specified enumeration name.

```c
ALCenum alcGetEnumValue(
    ALCdevice *device,
    const ALCchar *enumName
);
```

**Parameters**

- `device` a pointer to the device to be queried
- `enumName` a null terminated string describing the enum value

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>The string pointer is not valid.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

Returns the enum value described by the `enumName` string. This is most often used for querying an enum value for an ALC extension.

**See Also**

[alcIsExtensionPresent](#), [alcGetProcAddress](#)
Context State Functions

*Functions*

- alcGetString
- alcGetIntegerv
### alcGetString

**Description**

This function returns pointers to strings related to the context.

```c
const ALCchar * alcGetString(
    ALCdevice *device,
    ALEnum param
);
```

**Parameters**

- `device`: a pointer to the device to be queried
- `param`: an attribute to be retrieved:
  - ALC_DEFAULT_DEVICE_SPECIFIER
  - ALC_CAPTURE_DEFAULT_DEVICE_SPECIFIER
  - ALC_DEVICE_SPECIFIER
  - ALC_CAPTURE_DEVICE_SPECIFIER
  - ALC_EXTENSIONS

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.0 or higher

**Remarks**

ALC_DEFAULT_DEVICE_SPECIFIER will return the name of the default output device.

ALC_CAPTURE_DEFAULT_DEVICE_SPECIFIER will return the name of the default capture device.

ALC_DEVICE_SPECIFIER will return the name of the specified output device if a pointer is supplied, or will return a list of all available devices if a NULL device pointer is supplied. A list is a pointer to a series of strings separated by NULL characters, with the list terminated by two NULL characters. See [Enumeration Extension](#) for more details.

ALC_CAPTURE_DEVICE_SPECIFIER will return the name of the specified capture device if a pointer is supplied, or will return a list of all available devices if a NULL device pointer is supplied.

ALC_EXTENSIONS returns a list of available context extensions, with each extension separated by a space and the list terminated by a NULL character.
alcGetIntegerv

Description

This function returns integers related to the context.

```c
void alcGetIntegerv(
    ALCdevice *device,
    ALCenum param,
    ALCsizei size,
    ALCint *data
);
```

Parameters

- **device**: a pointer to the device to be queried
- **param**: an attribute to be retrieved:
  - ALC_MAJOR_VERSION
  - ALC_MINOR_VERSION
  - ALC_ATTRIBUTES_SIZE
  - ALC_ALL_ATTRIBUTES
- **size**: the size of the destination buffer provided
- **data**: a pointer to the data to be returned

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>The specified data pointer or size is not valid.</td>
</tr>
<tr>
<td>ALC_INVALID_ENUM</td>
<td>The specified parameter is not valid.</td>
</tr>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not valid.</td>
</tr>
<tr>
<td>ALC_INVALID_CONTEXT</td>
<td>The specified context is not valid.</td>
</tr>
</tbody>
</table>

Version Requirements

OpenAL 1.0 or higher

Remarks

The versions returned refer to the specification version that the implementation meets.
Context Capture Functions

Functions

alcCaptureOpenDevice
alcCaptureCloseDevice
alcCaptureStart
alcCaptureStop
alcCaptureSamples
alcCaptureOpenDevice

Description
This function opens a capture device by name.

```c
ALCdevice * alcCaptureOpenDevice(
    const ALCchar *devicename,
    ALCuint frequency,
    ALCenum format,
    ALCsizei buffersize
);
```

Parameters
- `devicename` - a pointer to a device name string
- `frequency` - the frequency that the data should be captured at
- `format` - the requested capture buffer format
- `buffersize` - the size of the capture buffer

Possible Error States

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>One of the parameters has an invalid value.</td>
</tr>
<tr>
<td>ALC_OUT_OF_MEMORY</td>
<td>The specified device is invalid, or can not capture audio.</td>
</tr>
</tbody>
</table>

Version Requirements
OpenAL 1.1 or higher

Remarks
Returns the capture device pointer, or NULL on failure.

See Also

- `alcCaptureCloseDevice`
### alcCaptureCloseDevice

**Description**

This function closes the specified capture device.

```c
ALCboolean alcCaptureCloseDevice(
    ALCdevice *device
);
```

**Parameters**

- `device` a pointer to a capture device

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not a valid capture device.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

Returns ALC_TRUE if the close operation was successful, ALC_FALSE on failure.

**See Also**

[alcCaptureOpenDevice](#)
**alcCaptureStart**

**Description**

This function begins a capture operation.

```c
void alcCaptureStart(
    ALCdevice *device
);
```

**Parameters**

*device*  
A pointer to a capture device

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not a valid capture device.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

`alcCaptureStart` will begin recording to an internal ring buffer of the size specified when opening the capture device. The application can then retrieve the number of samples currently available using the ALC_CAPTURE_SAMPLES token with `alcGetIntegerv`. When the application determines that enough samples are available for processing, then it can obtain them with a call to `alcCaptureSamples`.

**See Also**

`alcCaptureStop`, `alcCaptureSamples`
**alcCaptureStop**

**Description**

This function stops a capture operation.

```c
void alcCaptureStop(
    ALCdevice *device
);
```

**Parameters**

- `device` a pointer to a capture device

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not a valid capture device.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

`alcCaptureStart`, `alcCaptureSamples`
**alcCaptureSamples**

**Description**

This function completes a capture operation, and does not block.

```c
void alcCaptureSamples(
    ALCdevice *device,
    ALCvoid *buffer,
    ALCsizei samples
);
```

**Parameters**

- `device` a pointer to a capture device
- `buffer` a pointer to a data buffer, which must be large enough to accommodate `samples` number of samples
- `samples` the number of samples to be retrieved

**Possible Error States**

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALC_INVALID_VALUE</td>
<td>The specified number of samples is larger than the number of available samples.</td>
</tr>
<tr>
<td>ALC_INVALID_DEVICE</td>
<td>The specified device is not a valid capture device.</td>
</tr>
</tbody>
</table>

**Version Requirements**

OpenAL 1.1 or higher

**Remarks**

None

**See Also**

[alcCaptureStart](#), [alcCaptureStop](#)
**ALC and AL Function Lists**

Functions new to OpenAL 1.1 are *italicized* and **boldface**.

**ALC Functions**

```
alcCreateContext
alcMakeContextCurrent
alcProcessContext
alcSuspendContext
alcDestroyContext
alcGetCurrentContext
alcGetContextsDevice
alcOpenDevice
alcCloseDevice
alcGetError
alcIsExtensionPresent
alcGetProcAddress
alcGetEnumValue
alcGetString
alcGetIntegerv
alcCaptureOpenDevice
alcCaptureCloseDevice
alcCaptureStart
alcCaptureStop
alcCaptureSamples
```

**AL Functions**

```
alEnable
alDisable
alIsEnabled
alGetString
alGetBooleanv
alGetIntegerv
alGetFloatv
alGetDoublev
alGetBoolean
alGetInteger
alGetFloat
alGetDouble
alGetError
alIsExtensionPresent
alGetProcAddress
alGetEnumValue
alListenerf
alListener3f
alListenerfv
alListeneri
alListener3i
alListeneriv
alGetListenerf
alGetListener3f
alGetListenerf
alGetListener3f
```
alGetListenerfv
alGetListeneri
**alGetListener3i**
alGetListeneriv
alGenSources
alDeleteSources
alIsSource
alSourcef
alSource3f
alSourcefv
alSourcei
**alSource3i**
**alSourceiv**
alGetSourcef
alGetSource3f
alGetSourcefv
alGetSourcei
**alGetSource3i**
alGetSourceiv
alSourcePlayv
alSourceStopv
alSourceRewindv
alSourcePausev
alSourcePlay
alSourceStop
alSourceRewind
alSourcePause
alSourceQueueBuffers
alSourceUnqueueBuffers
alGenBuffers
alDeleteBuffers
alIsBuffer
**alBufferf**
**alBuffer3f**
**alBufferfv**
alBufferi
**alBuffer3i**
**alBufferiv**
alGetBufferf
**alGetBuffer3f**
alGetBufferfv
alGetBufferi
**alGetBuffer3i**
alGetBufferiv
alDopplerFactor
alDopplerVelocity
**alSpeedOfSound**
alDistanceModel
Standard Extensions to OpenAL

The Enumeration Extension enables a developer to retrieve a list of device strings, identifying the OpenAL devices present on a system. This allows an application to present the user with a choice of valid rendering devices at run-time.
**Enumeration Extension**

The Enumeration Extension enables the application developer to retrieve a list of device strings identifying the different OpenAL rendering and capture devices present on the user’s PC. The OpenAL router takes care of querying the user’s system to find valid device implementations. Any of the strings returned by the enumeration extension can be used to create a device during initialization via `alcOpenDevice`. This extension is critical if you want to enable the user to select at run-time which device should be used to render your OpenAL audio.

Naturally device enumeration is a very platform-specific topic. The mechanism might not be implemented on platforms such as games consoles with fixed capabilities, where multiple rendering devices are unnecessary.

Note that on PC the standard Enumeration Extension will not identify every potential OpenAL output path. It will not return all the possible outputs in situations where the user has more than one audio device installed, or under Windows Vista where the audio system specifies different “endpoints” for sound such as Speakers, S/PDIF, etc... If you require complete control over the choice of output path, use the “Enumerate All” extension.

For full details on making use of the different devices you might come across on the Windows PC platform, see the accompanying OpenAL Deployment Guide (PC Windows).

**Detecting the Enumeration Extension**

To check whether the OpenAL libraries expose the Enumeration extension, use the OpenAL function call `alcIsExtensionPresent` and the name "ALC_ENUMERATION_EXT".

```c
if (alcIsExtensionPresent(NULL, "ALC_ENUMERATION_EXT") == AL_TRUE)
    // Enumeration Extension Found
```

**Retrieving device names**

If the extension is found, the developer can retrieve a string containing NULL-separated device name strings (the list is terminated with two consecutive NULL characters), and a string containing the name of the default device.

To retrieve the string listing all the devices present, the developer should use the OpenAL function call `alcGetString` with the name “ALC_DEVICE_SPECIFIER”.

To retrieve the string containing the name of the default device, the developer should use the OpenAL function call `alcGetString` with the name “ALC_DEFAULT_DEVICE_SPECIFIER”.

const ALCchar *devices;
const ALCchar *defaultDeviceName;

// Pass in NULL device handle to get list of devices
devices = alcGetString(NULL, ALC_DEVICESpecifier);
// devices contains the device names, separated by NULL
// and terminated by two consecutive NULLs.

defaultDeviceName = alcGetString(NULL,
   ALC_DEFAULT_DEVICESpecifier);
// defaultDeviceName contains the name of the default
// device

Parsing the device string
It is trivial to parse the device string and retrieve the names of the individual devices. Ideally
these will be presented to the user in the application configuration GUI, to enable the user to
select the desired device at initialization time.

Checking the current device name
The developer can check to see the name of the device that was actually opened using the
function call alcGetString with a pointer to an open device and the name
“ALC_DEVICESpecifier”.

ALCdevice *pMyDevice;
const ALCchar *actualDeviceName;

// Open the default device
pMyDevice=alcOpenDevice(NULL)

// Pass in valid device pointer to get the name of the open
// device
actualDeviceName = alcGetString(pMyDevice, ALC_DEVICESpecifier);
// actualDeviceName contains the name of the open device

Enumeration Names

ALC_ENUMERATION_EXT
Use with `alcIsExtensionPresent` to detect if the enumeration extension is available.

**ALC_DEVICE_SPECIFIER**

Use with `alcGetString` and a NULL device pointer to retrieve a string containing the available device names, separated with NULL characters and terminated by two consecutive NULL characters.

Use with `alcGetString` and a pointer to a previously-opened device to ascertain the device’s name.

**ALC_CAPTURE_DEVICE_SPECIFIER**

Use with `alcGetString` and a NULL device pointer to retrieve a string containing the available capture device names, separated with NULL characters and terminated by two consecutive NULL characters.

Use with `alcGetString` and a pointer to a previously-opened capture device to ascertain the device’s name.

**ALC_DEFAULT_DEVICE_SPECIFIER**

Use with `alcGetString` with a NULL Device identifier to retrieve a NULL-terminated string containing the name of the default device.

**ALC_CAPTURE_DEFAULT_DEVICE_SPECIFIER**

Use with `alcGetString` with a NULL Device identifier to retrieve a NULL-terminated string containing the name of the default capture device.
Creative Labs’ Extensions to OpenAL

Creative has introduced a number of extensions to OpenAL, many of which take advantage of the unique features of their soundcards. The “Enumerate All” extension is similar to the Core OpenAL “Enumeration Extension” but is extended to cover all available soundcards (and audio end-points in Windows Vista). The “X-RAM” extension allows a developer to utilize on-board audio RAM for storing OpenAL buffers. The “Multi-Channel Buffers” extension allows a developer to play multi-channel buffers (e.g. 5.1). Finally, the generic “Effects Extension (EFX)” allows an application to use effects such as reverb and low-pass filters to create realistic 3D aural worlds.
**Enumerate All Extension**

The Enumerate All Extension enables the application developer to retrieve a complete list of device strings identifying all the available OpenAL rendering devices and paths present on the user’s PC. It works in exactly the same manner as the Enumeration Extension, but it detects additional audio paths that the standard extension will ignore. For instance, it will return all the possible outputs in situations where the user has more than one audio device installed, or under Windows Vista where the audio system specifies different “endpoints” for sound such as Speakers, S/PDIF, etc... If you don’t require such complete control over the choice of output path, then use the standard Enumeration Extension.

**Detecting the Enumerate All Extension**

To check whether the OpenAL libraries expose the Enumerate All extension, use the OpenAL function call `alcIsExtensionPresent` and the name “ALC_ENUMERATE_ALL_EXT”.

```c
if (alcIsExtensionPresent(NULL, "ALC_ENUMERATE_ALL_EXT") == AL_TRUE)
    // Enumerate All Extension Found
```

**Retrieving device names**

If the extension is found, the developer can retrieve a string containing NULL-separated device name strings (the list is terminated with two consecutive NULL characters), and a string containing the name of the default device.

To retrieve the string listing all the devices present, the developer should use the OpenAL function call `alcGetString` with the name “ALC_ALL_DEVICES_SPECIFIER”.

To retrieve the string containing the name of the default device, the developer should use the OpenAL function call `alcGetString` with the name “ALC_DEFAULT_ALL_DEVICES_SPECIFIER”.

```c
const ALCchar *devices;
const ALCchar *defaultDeviceName;

// Pass in NULL device handle to get list of *all* devices
devices = alcGetString(NULL, ALC_ALL_DEVICES_SPECIFIER);
// devices contains *all* the device names, separated by NULL
// and terminated by two consecutive NULLs.

defaultDeviceName = alcGetString(NULL, ALC_DEFAULT_ALL_DEVICES_SPECIFIER);
// defaultDeviceName contains the name of the default device
```

Any of the strings returned by the Enumerate All extension can be used to create a device during initialization via `alcOpenDevice`.

**Enumeration Names**
**ALC_ENUMERATE_ALL_EXT**

Use with `alcIsExtensionPresent` to detect if the Enumerate All extension is available.

**ALC_ALL_DEVICES_SPECIFIER**

Use with `alcGetString` and a NULL device pointer to retrieve a string containing the names of all available devices and audio output paths, separated with NULL characters and terminated by two consecutive NULL characters.

**ALC_DEFAULT_ALL_DEVICES_SPECIFIER**

Use with `alcGetString` with a NULL Device identifier to retrieve a NULL-terminated string containing the name of the default device.
**X-RAM**

With the introduction of the Sound Blaster X-Fi™ series of audio cards, Creative has launched a range of products that include on-board RAM. ‘X-RAM’ is provided on the top-end Sound Blaster X-Fi solutions (Sound Blaster X-Fi Fatal1ty™ FPS and Sound Blaster X-Fi Elite Pro). These products feature 64MB of X-RAM that can only be used for audio purposes. With the availability of X-RAM, developers can now improve performance issues related to playing audio in their applications and increase the overall quality of their sound when X-RAM is available.

**X-RAM Usage Scenarios**

Detecting the presence of X-RAM offers new possibilities to application developers. As a fixed resource dedicated to storing audio samples, an application can use X-RAM to improve the performance and quality of an application.

When X-RAM could be used: -

**Improving Quality**

An application that detects X-RAM can use higher quality audio assets that it might not be able to use otherwise.

**Improving Performance**

A game that detects X-RAM can decompress compressed audio samples at load time into the X-RAM so that the application does not have to spend precious processor cycles decompressing data during runtime.

When X-RAM should not be used: -

**Streaming**

There is an overhead involved with uploading data to the memory which means that X-RAM is not recommended for storing AL Buffers, whose contents will be constantly changing, e.g. when queuing buffers on an Open AL Source.

**X-RAM Modes**

The X-RAM extension to Open AL has two modes of operation – an ‘automatic’ mode (the default) and a ‘managed’ mode. In automatic mode an application does not need to make any function calls, or even query for any extensions, and Open AL buffers will automatically be loaded into X-RAM if it is found and has enough storage space. In managed mode the application developer has complete control over which Open AL Buffers are uploaded to X-RAM or not. Modes are set on individual Open AL Buffers and must be set before audio data is copied to the buffer. Attempts to change the Mode on a buffer that already has audio data will fail.

**Automatic Mode (AL_STORAGE_AUTOMATIC)**

The default buffer mode allows legacy applications to take advantage of the on-board memory. In automatic mode, the first call to `alBufferData` after a Buffer has been generated, will attempt to allocate the memory in X-RAM. If there is not enough memory available then an attempt to allocate system memory is made. If there is not enough system memory then the AL error AL_OUT_OF_MEMORY will be set as per the OpenAL 1.0 specification.
If a future `alBufferData` call is made on a buffer in automatic mode, the driver will assume that the application is using the AL Buffer for streaming (requiring regular updates to the audio data in the buffer), and the sample data will be moved from X-RAM to host memory. If there is not enough system memory then the AL error `AL_OUT_OF_MEMORY` will be set as per the OpenAL 1.0 specification.

**Manual Mode - Hardware (AL_STORAGE_HARDWARE)**

In hardware mode a buffer will be uploaded to X-RAM. A buffer in this mode is expected to be used as a single shot or looping sound, but can be reloaded if desired.

If an `alBufferData` call is made on a buffer in hardware mode an attempt to allocate X-RAM storage for the buffer data is made. If there is not enough X-RAM then the AL error `AL_OUT_OF_MEMORY` will be set as per the OpenAL 1.0 specification.

**Manual Mode – Accessible (AL_STORAGE_ACCESSIBLE)**

In accessible mode a buffer is to be placed where the overhead of loading the buffer is minimal. Currently this is assumed to be system memory but in future products, with potentially faster busses, the buffer will be allocated wherever is most applicable. When a buffer is put in this mode it is expected that it will be reloaded numerous times as in a streaming situation.

If an `alBufferData` call is made on a buffer in accessible mode an attempt to allocate system memory is always made. If there is not enough system memory then the AL error `AL_OUT_OF_MEMORY` should be set as per the OpenAL 1.0 specification.

**Detecting X-RAM**

To query for the presence of an audio card with X-RAM, use the Open AL `alIsExtensionPresent` function call and the name “EAX-RAM”.

```c
if (alIsExtensionPresent("EAX-RAM") == AL_TRUE) {
    // X-RAM Found
}
```

If the extension is found, an application that wishes to change Buffer Modes should query for the X-RAM extension functions using `alGetProcAddress`.

```c
EAXSetBufferMode g_eaxSetMode;
EAXGetBufferMode g_eaxGetMode;

if (alGetProcAddress("EAXSetBufferMode") != NULL)
    g_eaxSetMode = (EAXSetBufferMode) alGetProcAddress("EAXSetBufferMode");

if (alGetProcAddress("EAXGetBufferMode") != NULL)
    g_eaxGetMode = (EAXGetBufferMode) alGetProcAddress("EAXGetBufferMode");
```

The `EAXSetBufferMode` and `EAXGetBufferMode` function definitions are defined in xram.h.
The final step in preparing an application to use X-RAM functionality is to query for the values of the X-RAM enumerations using alGetEnumValue. `AL_EAX_RAM_SIZE` and `AL_EAX_RAM_FREE` are used with alGetInteger to retrieve the total amount of X-RAM and the amount of free X-RAM. `AL_STORAGE_AUTOMATIC`, `AL_STORAGE_HARDWARE` and `AL_STORAGE_ACCESSIBLE` are used with the `EAXSetBufferMode` and `EAXGetBufferMode` functions.

```c
ALenum g_eXRAMSize, g_eXRAMFree;
ALenum g_eXRAMAuto, g_eXRAMHardware, g_eXRAMAccessible;

g_eXRAMSize = alGetEnumValue("AL_EAX_RAM_SIZE");
g_eXRAMFree = alGetEnumValue("AL_EAX_RAM_FREE");
g_eXRAMAuto = alGetEnumValue("AL_STORAGE_AUTOMATIC");
g_eXRAMHardware = alGetEnumValue("AL_STORAGE_HARDWARE");
g_eXRAMAccessible = alGetEnumValue("AL_STORAGE_ACCESSIBLE");
```

To query for the total amount or available X-RAM on the soundcard, an application can use the alGetInteger function with the `AL_EAX_RAM_SIZE` and `AL_EAX_RAM_FREE` enum values.

```c
ALint iRAMSizeMB;
ALint iRAMFreeMB;

iRAMSizeMB = alGetInteger(g_eXRAMSize) / (1024*1024);
iRAMFreeMB = alGetInteger(g_eXRAMFree) / (1024*1024);
```
**EAXSetBufferMode**

The **EAXSetBufferMode** function is used to set the storage Mode of an array of Open AL Buffers.

```c
ALboolean EAXSetBufferMode(
    ALsizei n,
    ALuint *buffers,
    ALint value
);
```

**Parameters**

- **n**
  The number of Open AL Buffers pointed to by `buffers`.

- **buffers**
  An array of Open AL Buffer handles.

- **value**
  The storage mode that should be used for all the given buffers. Should be the value of one of the following enum names: -
  
  - `AL_STORAGE_AUTOMATIC`
  - `AL_STORAGE_HARDWARE`
  - `AL_STORAGE_ACCESSIBLE`

**Return Values**

- `AL_TRUE` if all the AL Buffers were successfully set to the requested storage mode, `AL_FALSE` otherwise.

**Remarks**

None.

**See Also**

- [EAXGetBufferMode](EAXGetBufferMode)
The EAXGetBufferMode function is used to retrieve the storage Mode of a particular Open AL Buffer.

```c
ALenum EAXGetBufferMode(
    ALuint buffer,
    ALint *pReserved
);
```

**Parameters**

- `buffer`  
  The handle of an Open AL Buffer.

- `pReserved`  
  Should be set to NULL.

**Return Values**

The Storage Mode assigned to this Open AL Buffer. One of the following enum names:

- `AL_STORAGE_AUTOMATIC`
- `AL_STORAGE_HARDWARE`
- `AL_STORAGE_ACCESSIBLE`

**Remarks**

None.

**See Also**

EAXSetBufferMode
Enumeration Names

AL_EAX_RAM_SIZE
Use with alGetInteger to retrieve the total amount of X-RAM in bytes.

AL_EAX_RAM_FREE
Use with alGetInteger to retrieve the amount of free X-RAM in bytes.

AL_STORAGE_AUTOMATIC
See X-RAM Modes.

AL_STORAGE_HARDWARE
See X-RAM Modes.

AL_STORAGE_ACCESSIBLE
See X-RAM Modes.
**Multi-Channel Buffers**

The multi-channel extension provides a mechanism to play multi-channel data via OpenAL. A variety of formats are supported. Multi-channel buffers can be attached or queued on a source. Note that when using the “Generic Software” device, the multi-channel buffers are mixed down to a stereo output. On a hardware device (such as the “Generic Hardware” device or a native device), each channel of a buffer requires a hardware voice. So, for example playing a buffer using the AL_FORMAT_51CHN16 format will require 6 free hardware voices. If the hardware resources are unavailable, the call to `alSourceQueueBuffers` or `alSourcei` will fail.

Formats supported:

- 4 channels, 16 bit data
- 6 channels (5.1), 16 bit data
- 7 channels (6.1), 16 bit data
- 8 channels (7.1), 16 bit data

Before using any of the different multi-channel buffers, use `alGetEnumValue` to check if the format is supported.

```c
ALenum eBufferFormat = 0;
eBufferFormat = alGetEnumValue("AL_FORMAT_51CHN16");
if (!eBufferFormat)
{
    printf("No support for 5.1 playback!\n");
    return 0;
}
```

**AL_FORMAT_QUAD16**

This describes a 4 channels buffer of 16 bit samples.

Data organisation:

- Sample 1, front left speaker
- Sample 1, front right speaker
- Sample 1, back left speaker
- Sample 1, back right speaker

Then

- Sample 2, front left speaker
- Sample 2, front right speaker…

**AL_FORMAT_51CHN16**

This describes a 5.1 (6 channels) buffer of 16 bit samples.

Data organisation:

- Sample 1, front left speaker
- Sample 1, front right speaker
Sample 1, front center speaker
Sample 1, low frequency speaker
Sample 1, back left speaker
Sample 1, back right speaker

Then

Sample 2, front left speaker
Sample 2, front right speaker...

**AL_FORMAT_61CHN16**

This describes a 6.1 (7 channels) buffer of 16 bit samples.

Data organisation:

Sample 1, front left speaker
Sample 1, front right speaker
Sample 1, front center speaker
Sample 1, low frequency speaker
Sample 1, back left speaker
Sample 1, back right speaker
Sample 1, back center speaker

Then

Sample 2, front left speaker
Sample 2, front right speaker...

**AL_FORMAT_71CHN16**

This describes a 7.1 (8 channels) buffer of 16 bit samples.

Data organisation:

Sample 1, front left speaker
Sample 1, front right speaker
Sample 1, front center speaker
Sample 1, low frequency speaker
Sample 1, back left speaker
Sample 1, back right speaker
Sample 1, side left speaker
Sample 1, side right speaker

Then

Sample 2, front left speaker
Sample 2, front right speaker...
**Effects Extension (EFX)**

Information about the Effects Extension to OpenAL can be found in the “Effects Extension Guide”.