

# USB Device Audio Class Driver User Guide

Version 1.30

For use with USBD Audio Class Driver versions 3.04  
and above

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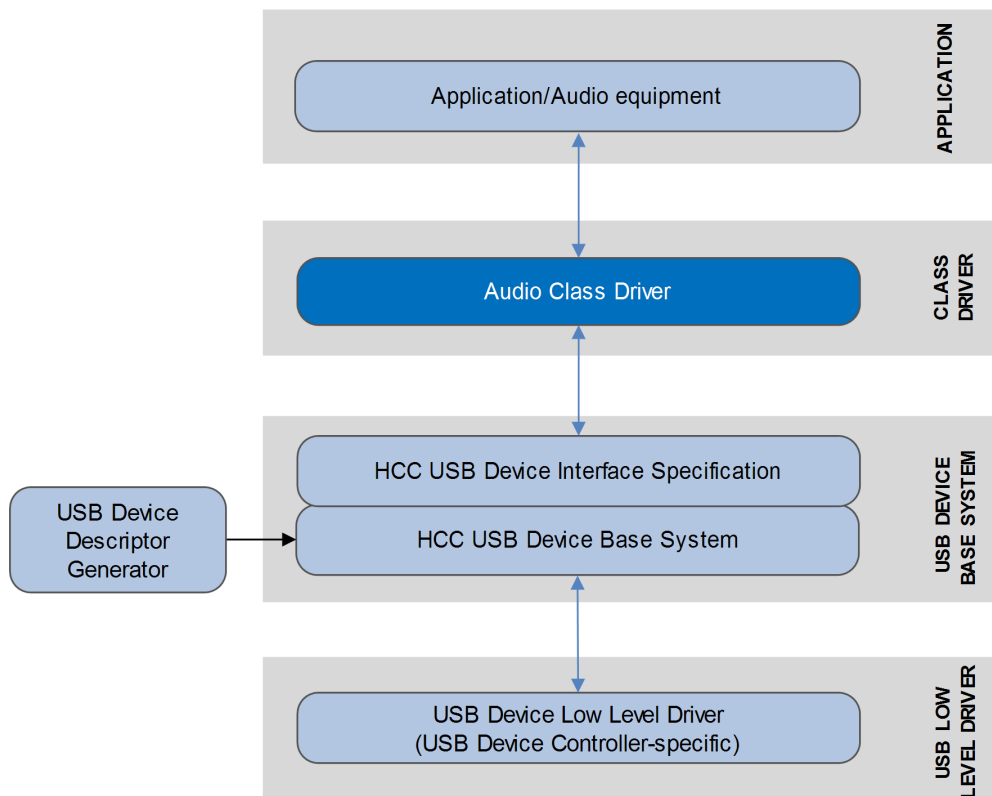
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# 1 System Overview

## 1.1 Introduction

This guide is for those who want to implement an embedded USB class driver to control audio devices. The audio class driver enables the device to act as a microphone and/or speaker when connected to a USB host over USB.

The system structure is shown in the diagram below:



### Note:

- This module is part of HCC's Embedded USB Device (EUSBD) system, as described in the *HCC Embedded USB Device Base System User Guide*. This module communicates with the EUSBD base system through the EUSBD device interface, as described in the above manual.
- Other types of HCC class driver can be added to the system, for example CDC-ACM, mass storage, and printer. For the current list of supported class drivers, contact [sales@hcc-embedded.com](mailto:sales@hcc-embedded.com).

The package provides a set of API functions. The API description in this manual has separate sections describing module management and the audio functions.

## 1.2 Feature Check

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The main features of the class driver are the following:

- Conforms to the HCC Advanced Embedded Framework.
- Designed for integration with both RTOS and non-RTOS based systems.
- Supports all devices that conform to the USB 1.0 audio interface specification.
- Supports the asynchronous, synchronous, and adaptive transfer modes.
- Compatible with sample device files produced by using the HCC USB Device Descriptor Generator.
- Uses a system of callbacks for user-specified events.

## 1.3 Packages and Documents

### Packages

The table below lists the packages that you need in order to use this module:

Package	Description
<code>hcc_base_doc</code>	This contains the two guides that will help you get started.
<code>usbd_base</code>	The USB device base package. This is the framework used by USB class drivers to communicate over USB using a specific USB device controller package.
<code>usbd_cd_audio</code>	The audio class driver described in this document.
<code>usbd_softmr</code>	The SOF timer event functions required by this class driver.
<code>util_ring_buffer</code>	The ring buffer utility.
<code>util_hcc_mem</code>	The HCC memory management utility.

### Documents

For an overview of HCC's embedded USB stacks, see [Product Information](#) on the main HCC website.

Readers should note the points in the [HCC Documentation Guidelines](#) on the HCC documentation website.

#### HCC Firmware Quick Start Guide

This document describes how to install packages provided by HCC in the target development environment. Also follow the *Quick Start Guide* when HCC provides package updates.

#### HCC Source Tree Guide

This document describes the HCC source tree. It gives an overview of the system to make clear the logic behind its organization.

#### HCC Embedded USB Device Base System User Guide

This document describes the Embedded USB Device base system.

#### HCC USB Device Audio Class Driver User Guide

This is this document.

#### HCC USB Device Descriptor Generator User Guide

This document describes the tool for creating USB descriptor files for inclusion in a project that uses the EUSBD stack.

## 1.4 Change History

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This section describes past changes to this manual.

- To view or download earlier manuals, see [Archive: Embedded USB Device Audio Class Driver User Guide](#).
- For the history of changes made to the package code itself, see [History: usbd\\_cd\\_audio](#).

The current version of this manual is 1.30. The full list of versions is as follows:

Manual version	Date	Software version	Reason for change
1.30	2017-08-29	3.04	Corrected <i>Packages</i> list.
1.20	2017-06-16	3.04	New <i>Change History</i> format.
1.10	2016-04-21	3.04	Added function group descriptions to API.
1.00	2015-04-17	3.04	First release.

## 2 Source File List

This section describes all the source code files included in the system. These files follow the HCC Embedded standard source tree system, described in the [HCC Source Tree Guide](#). All references to file pathnames refer to locations within this standard source tree, not within the package you initially receive.

**Note:** Do not modify any files except the configuration files.

### 2.1 API Header Files

These files in the directory `src/api` are the only files that should be included by an application using this module. For details of the API functions, see [Application Programming Interface](#).

File	Description
<code>api_usbd_audio.h</code>	Base audio module API.
<code>api_usbd_audio_map.h</code>	Audio map API.
<code>api_usbd_mic.h</code>	Microphone API.
<code>api_usbd_speaker.h</code>	Speaker API.

### 2.2 Configuration Files

These files in the directory `src/config` contain all the configurable parameters of the system. Configure these as required. For details of these options, see [Configuration Options](#).

File	Description
<code>config_usbd_audio.h</code>	Base audio configuration file.
<code>config_usbd_mic.h</code>	Microphone configuration file.
<code>config_usbd_speaker.h</code>	Speaker configuration file.



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## 2.3 Source Code Files

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These files are in the directory **src/usb-device/class-drivers/audio**. **These files should only be modified by HCC.**

File	Description
<b>usbd_audio.c</b>	Audio device source code.
<b>usbd_audio.h</b>	Audio header file.
<b>usbd_audio_feat_unit.c</b>	Feature unit control code.
<b>usbd_audio_feat_unit.h</b>	Feature unit control header file.
<b>usbd_audio_map.c</b>	Audio map source code.
<b>usbd_audio_map.h</b>	Audio map header file.
<b>usbd_fifo_init.c</b>	FIFO source code.
<b>usbd_fifo_init.h</b>	FIFO header file.
<b>usbd_mic.c</b>	Microphone source code.
<b>usbd_mic.h</b>	Microphone header file.
<b>usbd_speaker.c</b>	Speaker source code.
<b>usbd_speaker.h</b>	Speaker header file.

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## 2.4 Version File

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The file **src/version/ver\_usbd\_audio.h** contains the version number of this module. This version number is checked by all modules that use this module to ensure system consistency over upgrades.

## 3 Configuration Options

Set the system configuration options in the three configuration files described in this section. The available configuration options and their default values are described.

### 3.1 Audio Configuration

---

Set the audio configuration options in the file `src/config/config_usbd_audio.h`.

#### **AUDIO\_MIC\_SUPPORT**

Set this to 0 if microphone support is not needed. The default is 1.

#### **AUDIO\_SPK\_SUPPORT**

Set this to 0 if speaker support is not needed. The default is 1.

#### **USB\_AUDIO\_MAX\_NO\_OF\_CHANNELS**

The number of audio channels supported by the audio streams (left, right, and so on). The default is 2.

### 3.2 Microphone Configuration

---

Set the single microphone configuration option in the file `src/config/config_usbd_mic.h`.

#### **USB\_MIC\_BUFFER\_PER\_EP**

The number of packets the audio sample FIFO can hold. The default is 4.

### 3.3 Speaker Configuration

---

Set the speaker configuration options in the file `src/config/config_usbd_speaker.h`.

#### **USB\_SPK\_BUFFER\_PER\_EP**

The number of packets the audio sample FIFO can hold. The default is 4.

#### **USB\_SPK\_SR\_REFRESH\_PERIOD**

The sample rate refresh period. The default is 0. There are two options:

- Synchronization type 1 (for proper operation, use this) – defines a synchronization endpoint for an audio stream to notify the host of the actual sampling rate. Set this parameter to non-zero to use this. The value specified must match the periodicity of this endpoint.

- Disable type 1 synchronization (the default) – the device performs its own sample rate synchronization, dropping or repeating samples when needed. Use this if no synchronization endpoint is defined.

**USB\_D\_SPK\_VOLUME\_UNIT\_ID**

The unit ID of the feature unit which is responsible for the speaker's volume control. Set this to 0 (the default) to disable volume control.

**USB\_D\_SPK\_VOLUME\_MIN**

If volume control is enabled, this is the minimum volume level supported by the device. The value is a signed fixed point number where the fractional part is 8 bits wide. The default is 0x0000 (0dB).

**USB\_D\_SPK\_VOLUME\_MAX**

If volume control is enabled, this is the maximum volume level supported by the device. The value is a signed fixed point number where the fractional part is 8 bits wide. The default is 0x1500 (21dB).

**USB\_D\_SPK\_VOLUME\_RES**

If volume control is enabled, this is the resolution it uses. The value is a signed fixed point number where the fractional part is 8 bits wide. The value must be greater than or equal to zero. The default is 0x0100 (1dB).

## 4 Application Programming Interface

This section documents the Application Programming Interface (API). It includes all the functions that are available to an application program.

### 4.1 Module Management

---

The functions are the following:

Function	Description
<code>usbd_audio_init()</code>	Initializes the module and allocates the required resources.
<code>usbd_audio_start()</code>	Starts the module.
<code>usbd_audio_stop()</code>	Stops the module.
<code>usbd_audio_delete()</code>	Deletes the module and releases the resources it used.

## usbd\_audio\_init

Use this function to initialize the audio class driver and allocate the required resources.

**Note:** You must call this before any other function.

### Format

```
int usbd_audio_init ( void )
```

### Arguments

#### Parameter

None.

### Return Values

Return value	Description
USB_D_AUDIO_SUCCESS	Successful execution.
USB_D_AUDIO_ERROR	Operation failed.

## usb\_audio\_start

Use this function to start the audio class driver.

**Note:** You must call **usb\_audio\_init()** before this function to initialize the module.

### Format

```
int usb_audio_start ( void )
```

### Arguments

#### Parameter

None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usbd\_audio\_stop

Use this function to stop the audio class driver.

### Format

```
int usbd_audio_stop ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_D_AUDIO_SUCCESS	Successful execution.
USB_D_AUDIO_ERROR	Operation failed.

## usbd\_audio\_delete

Use this function to remove the class driver and release the associated resources.

### Format

```
int usbd_audio_delete ( void )
```

### Arguments

Argument
None.

### Return Values

Return value	Description
USB_D_AUDIO_SUCCESS	Successful execution.
USB_D_AUDIO_ERROR	Operation failed.



## 4.2 Packet Size Management

---

The functions are the following:

Function	Description
<code>get_pkt_size_in()</code>	Returns the packet size of the specified input stream (microphone).
<code>get_pkt_size_out()</code>	Returns the packet size of the specified output stream (speaker).

## get\_pkt\_size\_in

Use this function to return the packet size of the specified input stream (microphone).

### Format

```
unsigned short get_pkt_size_in ( unsigned char stream )
```

### Arguments

Parameter	Description	Type
stream	The stream ID.	unsigned char

### Return Values

Return value	Description
The packet size.	Successful execution.
USB_D_AUDIO_ERROR	Operation failed.

## get\_pkt\_size\_out

Use this function to return the packet size of the specified output stream (speaker).

### Format

```
unsigned short get_pkt_size_out ( unsigned char stream )
```

### Arguments

Parameter	Description	Type
stream	The stream ID.	unsigned char

### Return Values

Return value	Description
The packet size.	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## 4.3 Microphone Management

The functions are the following:

Function	Description
<b>usbdc_mic_get_in_stream()</b>	Returns a pointer to the FIFO of the specified audio stream.
<b>usbdc_mic_get_sr()</b>	Finds the sample rate set by the host.
<b>usbdc_mic_is_active()</b>	Finds whether the specified microphone stream is active.
<b>usbdc_mic_set_onoff_notify()</b>	Registers a callback function that is called when the microphone is activated or deactivated.
<b>usbdc_mic_set_sr_notify()</b>	Registers a callback function that is called when the host changes the sample rate of the microphone.

## usb\_mic\_get\_in\_stream

Use this function to return a pointer to the FIFO of the specified audio stream.

### Format

```
rngbuf_t * usb_mic_get_in_stream ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usb\_d\_mic\_get\_sr

Use this function to find the sample rate set by the host.

This function can be called from the sample rate change notification callback to get the new value.

### Format

```
uint32_t usb_d_mic_get_sr ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_D_AUDIO_SUCCESS	Successful execution.
USB_D_AUDIO_ERROR	Operation failed.

## usbd\_mic\_is\_active

Use this function to find whether the specified microphone stream is active.

### Format

```
int usbd_mic_is_active ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
0	Stream is inactive.
Non-zero	Stream is active.

## usbd\_mic\_set\_onoff\_notify

Use this function to register a callback function which is called when the microphone is activated or deactivated.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_mic_set_onoff_notify (
    int (* fn)( uint32_t param ),
    uint32_t param )
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USBDAUDIO_SUCCESS	Successful execution.
USBDAUDIO_ERROR	Operation failed.



## usbd\_mic\_set\_sr\_notify

Use this function to specify a callback function which is called when the host changes the sample rate of the microphone.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_mic_set_sr_notify (
    int (*fn)(uint32_t param),
    uint32_t param)
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## 4.4 Speaker Management

The functions are the following:

Function	Description
<b>usbd_spk_get_out_stream()</b>	Returns a pointer to the FIFO of the audio stream assigned to the specified stream.
<b>usbd_spk_is_active()</b>	Determines whether the specified speaker stream is active.
<b>usbd_spk_get_sr()</b>	Gets the sample rate set by the host.
<b>usbd_spk_set_synch_rate()</b>	Tells the USB host the actual sample rate.
<b>usbd_spk_get_volume_info()</b>	Returns a pointer to an array that holds the current volume level of all audio channels.
<b>usbd_spk_get_mute_info()</b>	Returns a pointer to an array that holds the mute states of all audio channels.
<b>usbd_spk_set_onoff_notify()</b>	Registers a callback function which is called when the speaker is activated or deactivated.
<b>usbd_spk_set_mute_notify()</b>	Registers a callback function which is called when the host mutes or unmutes any audio channel.
<b>usbd_spk_set_sr_notify()</b>	Registers a callback function which is called when the host changes the sample rate of the speaker.
<b>usbd_spk_set_volume_notify()</b>	Registers a callback function which is called when the host changes the volume level of any audio channel.

## usbd\_spk\_get\_out\_stream

Use this function to return a pointer to the FIFO of the audio stream assigned to the specified stream.

The FIFO can be used to receive audio samples from the host.

### Format

```
rngbuf_t * usbd_spk_get_out_stream ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usbd\_spk\_is\_active

Use this function to determine whether the specified speaker stream is active.

### Format

```
int usbd_spk_is_active ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
0	The speaker stream is inactive
Non-zero.	The speaker stream is active.

## usb\_spk\_get\_sr

Use this function to get the sample rate set by the host.

This function can be called from the sample rate change notification callback to get the new value.

### Format

```
uint32_t usb_spk_get_sr ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usb\_spk\_set\_synth\_rate

Use this function to tell the USB host the actual sample rate.

The reported value is used by the host during sample rate synchronization.

**Note:** This function is only available if sample rate [synchronization type 1](#) is enabled.

### Format

```
void usb_spk_set_synth_rate ( uint32_t rate )
```

### Arguments

Parameter	Description	Type
rate	Returns the sample rate.	uint32_t

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usbd\_spk\_get\_volume\_info

Use this function to get a pointer to an array that holds the current volume level for all audio channels.

The array has [USB\\_AUDIO\\_MAX\\_NO\\_OF\\_CHANNELS](#) elements.

### Format

```
uint16_t * usbd_spk_get_volume_info ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.

## usb\_spk\_get\_mute\_info

Use this function to get a pointer to an array that holds the mute states for all audio channels.

The number of elements in the array is [USB\\_AUDIO\\_MAX\\_NO\\_OF\\_CHANNELS](#).

### Format

```
uint8_t * usb_spk_get_mute_info ( void )
```

### Arguments

Parameter
None.

### Return Values

Return value	Description
USB_AUDIO_SUCCESS	Successful execution.
USB_AUDIO_ERROR	Operation failed.



## usbd\_spk\_set\_onoff\_notify

Use this function to register a callback function which is called when the speaker is activated or deactivated.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_spk_set_onoff_notify (
    int      ( * fn )( uint32_t param ),
    uint32_t  param )
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USBBD_AUDIO_SUCCESS	Successful execution.
USBBD_AUDIO_ERROR	Operation failed.

## usbd\_spk\_set\_mute\_notify

Use this function to specify a callback function which is called when the host mutes or unmutes any audio channel.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_spk_set_mute_notify (
    int (* fn)( uint32_t param ),
    uint32_t param )
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USBDAUDIO_SUCCESS	Successful execution.
USBDAUDIO_ERROR	Operation failed.

## usbd\_spk\_set\_sr\_notify

Use this function to specify a callback function which is called when the host changes the sample rate of the speaker.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_spk_set_sr_notify (
    int (* fn )( uint32_t param ),
    uint32_t param )
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USBDAUDIO_SUCCESS	Successful execution.
USBDAUDIO_ERROR	Operation failed.

## usbd\_spk\_set\_volume\_notify

Use this function to specify a callback function which is called when the host changes the volume level of any audio channel.

**Note:** It is the user's responsibility to provide any callback functions required by the application. Providing such functions is optional.

### Format

```
void usbd_spk_set_volume_notify (
    int (* fn)( uint32_t param ),
    uint32_t param )
```

### Arguments

Parameter	Description	Type
fn	A pointer to the callback function.	int *
param	The value of the parameter passed to the callback.	uint32_t

### Return Values

Return value	Description
USBDAUDIO_SUCCESS	Successful execution.
USBDAUDIO_ERROR	Operation failed.

## 4.5 Error Codes

---

If a function executes successfully it returns with `USBD_AUDIO_SUCCESS`, a value of zero.

Return Value	Value	Description
<code>USBD_AUDIO_SUCCESS</code>	0	Successful execution.
<code>USBD_AUDIO_ERROR</code>	1	Operation failed.

## 5 Integration

This section specifies the elements of this package that need porting, depending on the target environment.

### 5.1 PSP Porting

The Platform Support Package (PSP) is designed to hold all platform-specific functionality, either because it relies on specific features of a target system, or because this provides the most efficient or flexible solution for the developer. For full details of its functions, see the *HCC Base Platform Support Package User Guide*.

The audio module makes use of the following standard PSP functions:

Function	Package	Component	Description
<b>psp_memcpy()</b>	psp_base	psp_string	Copies a block of memory. The result is a binary copy of the data.
<b>psp_memset()</b>	psp_base	psp_string	Sets the specified area of memory to the defined value.