Universal Serial Bus
Audio Device Class Specification
for
Basic Audio Devices

Release 1.0

November 24, 2009

Scope of This Release

This document is the Release 1.0 of this specification.

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1 Introduction

1.1 Scope

The *USB Audio Device Class Specification for Basic Audio Devices* applies to all USB audio devices or functions – either stand-alone or embedded in composite devices – that are based on the *Universal Serial Bus Device Class Definition for Audio Devices Release 1.0* and that are intended to reproduce and/or capture audio and/or voice and whose primary purpose is to be either worn on the human head or be in close proximity to the human head. From an audio perspective, they are simple devices with limited functionality. Examples of such devices include headphones, microphones, and headsets. Other (simple) sound-related functionality may also be included in these devices, such as volume and mute control functionality. More complex audio devices, such as USB soundcard devices are not part of this specification. A device that complies with the *USB Audio Device Class Specification for Basic Audio Devices* (this specification) is called a USB Basic Audio Device.

This specification explicitly does not address audio devices that are based on the *Universal Serial Bus Device Class Definition for Audio Devices Release 2.0*. As a consequence, High Speed Basic Audio Devices are not supported by this specification.

1.2 Purpose

The purpose of this document is to describe the capabilities and characteristics a USB Basic Audio Device shall support. This document also provides recommendations for optional features.

1.3 Related Documents

- *Universal Serial Bus Specification, Revision 2.0* (referred to in this document as the *USB Specification*). April 27, 2000. In particular, see Chapter 5, "USB Data Flow Model" and Chapter 9, "USB Device Framework."
- *Universal Serial Bus Device Class Definition for Audio Devices* Release 1.0 (referred to in this document as Audio 1.0 Specification or Audio 1.0 in short). March 18, 1998.
- *Universal Serial Bus Device Class Definition for Audio Data Formats* (referred to in this document as Audio 1.0 Data Formats). March 18, 1998.
- *Universal Serial Bus Device Class Definition for Terminal Types* (referred to in this document as Audio 1.0 Terminal Types). March 18, 1998.
- *Device Class Definition for Human Interface Devices (HID)* Version 1.11. June 27, 2001.
- *HID Usage Tables* Version 1.12. October 28, 2004. Please visit www.usb.org for the latest additions to the HID Usage Tables.

1.4 Terms and Abbreviations

This section defines terms used throughout this document. For additional terms that pertain to the Universal Serial Bus, see Chapter 2, "Terms and Abbreviations," in the *USB Specification* and for terms that pertain to the Audio Device Class, see Section 1.4, "Terms and Abbreviations," in the *Audio 1.0 Specification*.

HT1, HT2, HT3:	Headphone Topology 1, 2, 3.
HS1, HS2, HS3:	Headset Topology 1, 2, 3.
MT:	Microphone topology.
SID:	Source ID.
TID:	Terminal ID.
TT:	Terminal Type.
UID:	Unit ID.

2 Management Overview

The *USB Device Class Definition for Audio Devices Release 1.0* is a very rich specification, designed to cover virtually all Audio Devices and make them controllable via USB. As a result, a generic Audio Device Class driver tends to become rather complex, as it needs to be able to handle all the mandatory and optional features that are available in the specification.

For some audio applications where on one hand, the Host capabilities are inherently limited (such as handheld devices) and on the other hand the peripheral device complexity is limited (such as a headset), it is worthwhile to create a derived *Basic Audio Device Definition*, based on the existing *Audio 1.0 Specification*. The *Basic Audio Device Definition* defines a subclass specification to which compliant devices shall adhere. Since the *Basic Audio Device Definition* is only defining restrictions and limitations on the existing *Audio 1.0 Specification*, any device that is compliant with the *Basic Audio Device Definition* is automatically also compliant with the standard Audio Device Class specification. However, Host devices that declare compliance only with the *Basic Audio Device Definition* might not be able to interoperate with a device that is designed in compliance with the full Audio Device Class specification.

3 Classification

At the writing of this specification, there are 2 USB Audio Device Class specifications in existence:

- *Audio 1.0 Specification*
- *Audio 2.0 Specification*

Unfortunately, although both specifications address the same device categories, the *Audio 2.0 Specification* is not backwards compatible with the *Audio 1.0 Specification*

The *Audio 1.0 Specification* was developed before the USB 2.0 Core Specification was available. Consequently, the *Audio 1.0 Specification* has no notion of the High Speed mode that was added to the USB 2.0 Core Specification. Since the *Audio 1.0 Specification* contains definitions and requirements that directly relate to USB frames, it is obvious that it had to be revised to include definitions and requirements pertaining to USB microframes as well. The result of this revision is the *Audio 2.0 Specification*.

Given the absence of the notion of USB microframes in the *Audio 1.0 Specification*, it is in general not possible to build USB 2.0 High Speed Audio Devices that comply with that specification.

Note: *Audio 1.0*-compliant devices have been shown to work in High Speed mode on certain Operating Systems by observing a set of (empirical) rules, such as specifying a value of 4 in the *bInterval* field of the isochronous endpoint descriptor. However, the exhaustive set of rules that would guarantee operation on all Operating Systems is unknown at this time.

This specification creates the *Basic Audio Device Definition*, which is based on, compliant with, and a subset of the *Audio 1.0 specification*. It defines a baseline behavior for Basic Audio Devices and contains a set of rules, normative limitations, and informative descriptions that are applied to the *Audio 1.0 specification* to define a specific scope and use for this specification. It does not create new requirements that are not already part of the *Audio 1.0 specification* so that any device that complies with the *Basic Audio Device Definition* is intrinsically compliant with the *Audio 1.0 specification*. In other words, it always defines a *subset specification* and never extends the *Audio 1.0 specification*.

The *Basic Audio Device Definition* is specifically applicable to Full Speed-only devices. Its use in High Speed-capable devices is prohibited. It defines a Device Configuration that supports one (and only one) basic audio function. The default[1] Device Configuration shall not have multiple instances of the basic audio function since this would complicate the basic audio device driver.

Although additional Device Configurations are allowed (but not recommended), the Device Configuration as specified above shall be the default Device Configuration.

[1] A default Device Configuration is the Device Configuration that is returned in response of a GetDescriptor(CONFIGURATION, 0) request.

Vendors may choose to extend the baseline behavior by defining additional functions besides the audio and the optional HID function and add them to the baseline Device Configuration.

However, it is not allowed to extend or modify the baseline Default Device Configuration by adding basic building blocks to the baseline topologies or by adding additional Audio Controls to existing baseline building blocks of the audio function.

Only three types of devices are allowed under the *Basic Audio Device Definition*. These are:

- USB Headphone devices
- USB Microphone devices
- USB Headset devices

Each device type is further defined in detail in subsequent sections below.

4 Host and Basic Audio Device Interoperability

A Host can claim interoperability with the *Basic Audio Device Definition* when it supports at least Full Speed operation of its USB and when it provides driver support for the *Basic Audio Device Definition*.

Devices shall be constructed in such a fashion that there are no controls present in the device that would conflict with the controls that are defined by this specification (most likely producing undesirable side effects). For example, it is not allowed to include an analog volume control in the device that is not controllable by the Host (in addition to the Volume Control(s) as mandated by this specification).

It is highly recommended that a Basic Audio Device assume default values for all of its settings that provide a good user experience without the need for prior Host intervention. For example, in the case of a Headset device, the Volume Control of the Sidetone Feature Unit (see further) should have a default value (out-of-the-box) such that a comfortable sidetone level (for most users) is mixed into the output path.

4.1 Power Considerations

For Basic Audio Device to be compliant with this specification, it shall consume no more than one unit load of power from VBUS for the entire device (including any other functionality that may be part of the composite device). In other words, a compliant device is restricted to be a low-power USB device.

5 USB Headphone Device

5.1 Headphone Definition

A USB Headphone device contains one or more transducers that convert electrical signals into sound. These electrical signals are generated from digital data streams that are delivered over the USB to the Headphone device. Some basic audio control functionality is also provided.

5.2 Headphone Topology

This specification supports the three topologies presented below. No other topologies are allowed.

5.2.1 Headphone Topology 1

Headphone Topology 1 (HT1) is the basic Headphone topology. Input Terminal ID1 represents the AudioStreaming Interface that is used to stream the Headphone data from the Host to the Headphone device (mono or stereo). The Output Pin of Input Terminal ID1 is connected to the Input Pin of Feature Unit ID2. The Output Pin of Feature Unit ID2 is connected to the Input Pin of Output Terminal ID3, which represents the physical speaker(s).

All building blocks (Input Terminal, Feature Unit, etc.) shall be present as indicated in Figure 5-1 and Figure 5-2 below and the **bTerminalID** and **bUnitID** fields of the respective Entity descriptors shall be assigned as indicated.

There are two variations allowed for HT1, one supports a monophonic signal path whereas the second supports a stereophonic signal path.

Figure 5-1 represents the mono version of HT1. The spatial location of the single audio channel shall be Center Front.

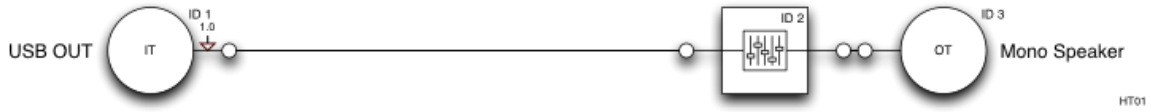

Figure 5-1: Mono Headphone Device

Figure 5-2 represents the stereo version of HT1. The spatial locations of the two audio channels shall be Left Front and Right Front respectively.

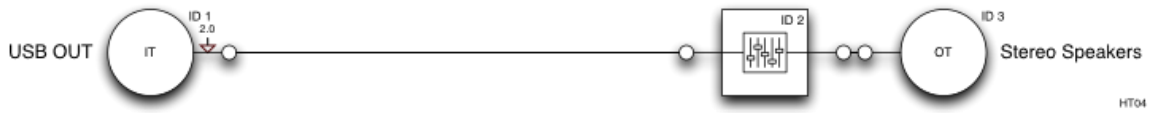

Figure 5-2: Stereo Headphone Device

5.2.2 Headphone Topology 2

Headphone Topology 2 (HT2) adds an additional auxiliary input to HT1 as follows: a Mixer Unit ID8 is inserted between Input Terminal ID1 and Feature Unit ID2 and the Output Pin of Input Terminal ID1 is connected to Input Pin 1 of Mixer Unit ID8. The Output Pin of Mixer Unit ID 8 is connected to the Input Pin of Feature Unit ID2. Input Terminal ID10 is added and represents an additional audio input to the device. The usage of this input shall be accurately indicated in the **wTerminalType** field of its Input Terminal Descriptor. Feature Unit ID11 is also added and the Output Pin of Input Terminal ID10 is connected to the Input Pin of Feature Unit ID11. The Output Pin of Feature Unit ID11 is connected to Input Pin 2 of Mixer Unit ID8.

All building blocks (Input Terminals, Feature Units, etc.) shall be present as indicated in Figure 5-3 and Figure 5-4 below and the **TerminalID** and **UnitID** fields of the respective Entities shall be assigned as indicated. Also, Pin numbers shall be assigned as indicated.

There are two variations allowed for HT2, one supports a monophonic main signal path (USB OUT to Mono Speaker) whereas the second supports a stereophonic main signal path.

Figure 5-3 represents the mono version of HT2. The spatial location of the single channel in the auxiliary signal path (Aux 1 to Mixer Unit ID8) shall be Center Front.

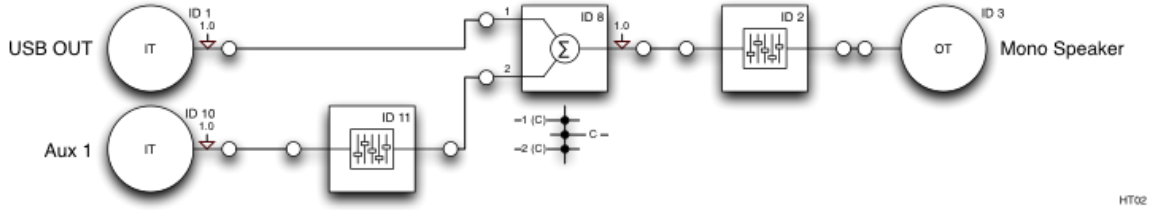

Figure 5-3: Mono Headphone Device with One Auxiliary Input

Figure 5-4 represents the stereo version of HT2. The auxiliary signal path is allowed to be either mono (x=1) with a spatial location of Center Front or stereo (x=2) with spatial locations of Left Front and Right Front respectively.

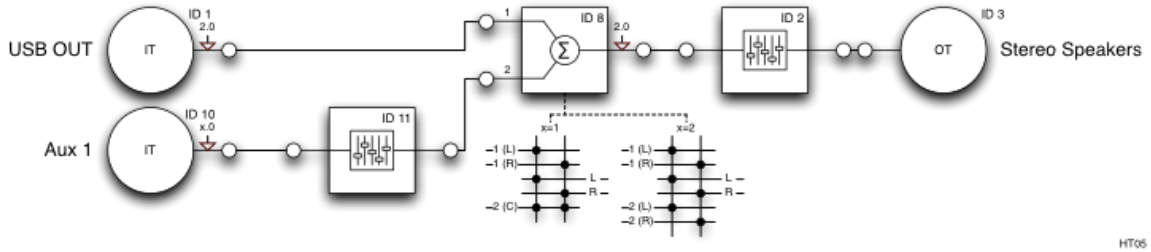

Figure 5-4: Stereo Headphone Device with One Auxiliary Input

5.2.3 Headphone Topology 3

Headphone Topology 3 (HT3) adds an additional auxiliary input to HT2 as follows: Input Terminal ID13 is added and represents an additional audio input to the device. The usage of this input shall be accurately indicated in the **wTerminalType** field of its Input

Terminal Descriptor. Feature Unit ID14 is also added and the Output Pin of Input Terminal ID13 is connected to the Input Pin of Feature Unit ID14. The Output Pin of Feature Unit ID14 is connected to Input Pin 3 of Mixer Unit ID8.

All building blocks (Input Terminals, Feature Units, etc.) shall be present as indicated in Figure 5-5 and Figure 5-6 below and the **TerminalID** and **UnitID** fields of the respective Entities shall be assigned as indicated. Also, Pin numbers shall be assigned as indicated.

There are two variations allowed for HT3, one supports a monophonic main signal path (USB OUT to Mono Speaker) whereas the second supports a stereophonic main signal path.

Figure 5-5 represents the mono version of HT3. The spatial location of the single channel in the second auxiliary signal path (Aux 2 to Mixer Unit ID8) shall be Center Front.

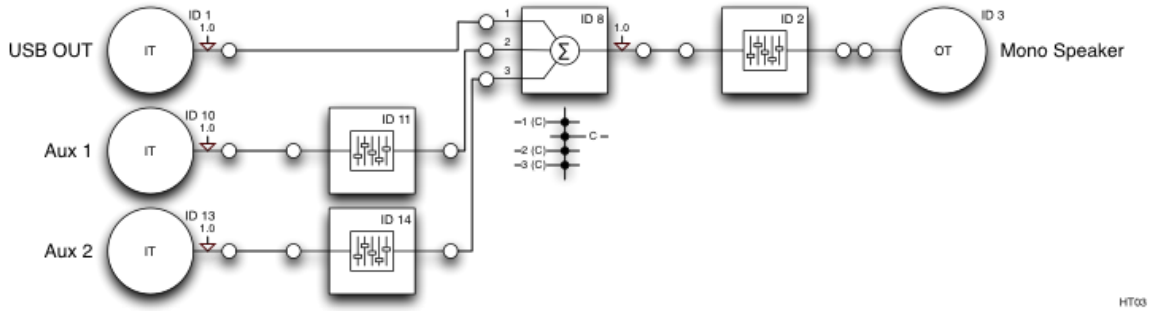

Figure 5-5: Mono Headphone Device with Two Auxiliary Inputs

Figure 5-6 represents the stereo version of HT3. The second auxiliary signal path is allowed to be either mono (y=1) with a spatial location of Center Front or stereo (y=2) with spatial locations of Left Front and Right Front respectively.

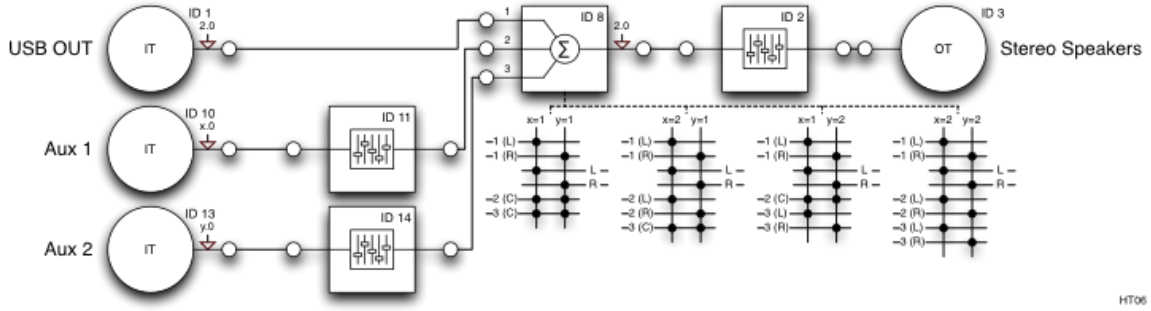

Figure 5-6: Stereo Headphone Device with Two Auxiliary Inputs

5.3 Headphone Descriptors

To allow for backward compatible extensions, additional fields may be added to the class-specific descriptors in future versions of this specification. Therefore, descriptor parsers should be tolerant of descriptor lengths that are larger than currently specified in the **bLength** fields of these descriptors.

5.3.1 Headphone Device Descriptor

Because audio functionality is always considered to reside at the interface level, this class specification does not define a specific audio device descriptor. For *audio-only* devices, the device descriptor shall indicate that class information is to be found at the interface level. Therefore, the **bDeviceClass** field of the device descriptor shall contain zero so that enumeration software looks down at the interface level to determine the Interface Class, and the **bDeviceSubClass** and **bDeviceProtocol** fields shall also be set to zero.

All other fields of the device descriptor shall comply with the definitions in Section 9.6.1, "Descriptor" of the *USB Specification*. There is no class-specific device descriptor.

Table 5-1: Device Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x12	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x01	DEVICE descriptor.
2	bcdUSB	2	0x0200	USB Specification Release Number in Binary-Coded Decimal.
4	bDeviceClass	1	Class	See *USB Specification*.
5	bDeviceSubClass	1	Subclass	See *USB Specification*.
6	bDeviceProtocol	1	Protocol	See *USB Specification*.
7	bMaxPacketSize0	1	Number	See *USB Specification*.
8	idVendor	2	ID	See *USB Specification*.
10	idProduct	2	ID	See *USB Specification*.
12	bcdDevice	2	BCD	See *USB Specification*.
14	iManufacturer	1	Index	See *USB Specification*.
15	iProduct	1	Index	See *USB Specification*.
16	iSerialNumber	1	Index	See *USB Specification*.
17	bNumConfigurations	1	Number	Shall contain a value greater than or equal to 0x01.

5.3.2 Headphone Configuration Descriptor

The Configuration descriptor describes information about a specific configuration of the device.

As indicated in Section 3, "Classification", this specification requires that a Basic Audio device support one (and only one) compliant basic audio function in its default Device Configuration. This section outlines this default Device Configuration descriptor.

If a HID interface is present then the **bNumInterfaces** field shall contain a value greater than or equal to 0x03. Otherwise, the **bNumInterfaces** field shall contain a value greater than or equal to 0x02.

The **bmAttributes** field indicates whether the device is self-powered (D6=0b1) or bus-powered (D6=0b0) and also whether the device supports Remote Wakeup (D5=0b1) or not (d5=0b0). Bit D7 shall be set to 0b1 for historical reasons while bits D4..0 shall be reset to 0b00000.

Table 5-2: Configuration Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x02	CONFIGURATION descriptor.
2	wTotalLength	2	Number	Length of the total configuration block, including this descriptor, in bytes.
4	bNumInterfaces	1	Number	At least two interfaces for a Headphone device: one AudioControl interface, one AudioStreaming interface. Additional functions, such as HID, may require additional interfaces.
5	bConfigurationValue	1	Number	ID of this configuration.
6	iConfiguration	1	Index	Index of string descriptor describing this Configuration.
7	bmAttributes	1	0b1xx00000	Self- or bus-powered device, Remote Wakeup capability can be supported.
8	bMaxPower	1	Number	See *USB Specification*. The value shall indicate no more than one unit load.

5.3.3 Headphone Interface Descriptors

For a general description and overview of the Audio Device Class Interface descriptors, refer to the *Audio 1.0 Specification*. The following sections describe the standard and class-specific USB Interface descriptors as they relate to a USB Headphone Device.

5.3.3.1 Headphone AudioControl Interface Descriptors

The AudioControl interface describes the device structure (audio function topology) and is used to manipulate the Audio Controls, present in the Headphone device.

5.3.3.1.1 Headphone Standard AC Interface Descriptor

The standard AC interface descriptor is identical to the standard interface descriptor defined in Section 9.6.3, “Interface” of the *USB Specification*, except that most fields have now dedicated values.

The AudioControl interface has no dedicated endpoints associated with it. It uses the default pipe (endpoint 0) for all communication purposes. Class-specific AudioControl Requests are sent using the default pipe. A Status Interrupt endpoint is not allowed.

The **bInterfaceProtocol** field contains a value that fully describes the nature of the Headphone device. Only those codes pertaining to Headphones are allowed. This value can potentially be used by driver software to bypass the process of parsing the entire set of Headphone descriptors.

Note: Some descriptor field values, such as endpoint addresses, certain parameter values, etc. and also some descriptor lengths may vary among implementations so that a rudimentary form of parsing cannot be avoided entirely.

Table 5-1: Headphone Standard AC Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor type
2	bInterfaceNumber	1	0x00	Number of the AudioControl interface. The AudioControl interface shall be the first interface in the collection.
3	bAlternateSetting	1	0x00	The AudioControl interface of the Headphone only supports the default Alternate Setting zero.
4	bNumEndpoints	1	0x00	A status interrupt endpoint is not allowed.
5	bInterfaceClass	1	0x01	AUDIO. Audio Interface Class code.
6	bInterfaceSubClass	1	0x01	AUDIOCONTROL. Audio Interface Subclass code.
7	bInterfaceProtocol	1	Number	Number that fully describes the nature of the Headphone device. See Appendix A.1, “Audio Function Basic Audio Device Codes” for allowed values.
8	iInterface	1	Index	Index of a string descriptor that describes this interface. If no string is provided, shall be set to 0x00.

5.3.3.1.2 Headphone Class-Specific AC Interface Descriptor

The Class-specific AC interface descriptor is always headed by a Header descriptor that contains general information about the AudioControl interface. It contains all the pointers needed to describe the Audio Interface Collection, associated with the described audio function. The following table defines the class-specific AC interface header descriptor.

Table 5-2: Headphone Class-Specific AC Interface Header Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x01	HEADER descriptor subtype.
3	bcdADC	2	0x0100	Audio 1.0.
5	wTotalLength	2	Number	Total number of bytes returned for the class-specific AudioControl interface descriptor.
7	bInCollection	1	0x01	One OUT AudioStreaming interface in the Collection.
8	baInterfaceNr(1)	1	Number	Interface number of the OUT AudioStreaming interface in the Collection. Shall be one greater than the interface number of the associated AudioControl interface.

For HT1, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Feature Unit ID2 descriptor, and the Output Terminal ID3 descriptor, in that order.

For HT2, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Mixer Unit ID8 descriptor, the Feature Unit ID2 descriptor, the Output Terminal ID3 descriptor, the Input Terminal ID10 descriptor, and the Feature Unit ID11 descriptor, in that order.

For HT3, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Mixer Unit ID8 descriptor, the Feature Unit ID2 descriptor, the Output Terminal ID3 descriptor, the Input Terminal ID10 descriptor, the Feature Unit ID11 descriptor, the Input Terminal ID13, and the Feature Unit ID14 descriptor, in that order.

5.3.3.1.3 Headphone Input Terminal ID1 Descriptor

This descriptor describes the Input Terminal that represents the USB pipe from the Host. The digital audio stream leaves the Input Terminal through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x01 and the **wTerminalType** field shall be set to 0x0101 (USB Streaming Terminal Type).

Refer to Section 5.3.3.1.6, “Generic Input Terminal Descriptor” for the actual descriptor(s) with TID=0x01 and TT=0x0101.

5.3.3.1.4 Headphone Input Terminal ID10 Descriptor

This descriptor is only present in the case of HT2 or HT3 and describes the Input Terminal that represents the first auxiliary input for HT2 and HT3. The digital audio stream leaves Input Terminal ID10 through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x0A and the **wTerminalType** field shall be set to a value that accurately describes the usage of this Input Terminal.

Allowed values for the **wTerminalType** field can be found in the Audio 1.0 Terminal Types Specification.

Refer to Section 5.3.3.1.6, "Generic Input Terminal Descriptor" for the actual descriptor(s) with TID=0x0A and TT set to the appropriate value for the **wTerminalType** field.

5.3.3.1.5 Headphone Input Terminal ID13 Descriptor

This descriptor is only present in the case of HT3 and describes the Input Terminal that represents the second auxiliary input for HT3. The digital audio stream leaves Input Terminal ID13 through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x0D and the **wTerminalType** field shall be set to a value that accurately describes the usage of this Input Terminal. Allowed values for the **wTerminalType** field can be found in the Audio 1.0 Terminal Types Specification.

Refer to Section 5.3.3.1.6, "Generic Input Terminal Descriptor" for the actual descriptor(s) with TID=0x0D and TT set to the appropriate value for the **wTerminalType** field.

5.3.3.1.6 Generic Input Terminal Descriptor

Depending on the number of channels in the signal path (mono or stereo), the Input Terminal descriptor is slightly different. In the mono case, the audio channel cluster contains a single logical channel (**bNrChannels**=0x01) and the spatial location associated with this mono channel is Center Front (**wChannelConfig**=0x0004). The following table presents the Mono Input Terminal descriptor.

Table 5-3: Mono Input Terminal Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0C	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x02	INPUT_TERMINAL descriptor subtype.
3	bTerminalID	1	TID	ID of this Input Terminal.
4	wTerminalType	2	TT	Terminal Type.
6	bAssocTerminal	1	0x00	No association.
7	bNrChannels	1	0x01	Mono signal path.
8	wChannelConfig	2	0x0004	Center Front channel.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	iTerminal	1	Index	Index of a string descriptor, describing the Input Terminal. If no string is provided, shall be set to 0x00.

In the stereo case, the audio channel cluster contains two logical channels (**bNrChannels**=0x02) and the spatial locations associated with these two channels are Left Front and Right Front (**wChannelConfig**=0x0003). The following table presents the Stereo Input Terminal descriptor.

Table 5-4: Stereo Input Terminal Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0C	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x02	INPUT_TERMINAL descriptor subtype.
3	bTerminalID	1	TID	ID of this Input Terminal.
4	wTerminalType	2	TT	Terminal Type.
6	bAssocTerminal	1	0x00	No association.
7	bNrChannels	1	0x02	Stereo signal path.
8	wChannelConfig	2	0x0003	Left Front and Right Front channels.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	iTerminal	1	Index	Index of a string descriptor, describing the Input Terminal If no string is provided, shall be set to 0x00.

5.3.3.1.7 Headphone Feature Unit ID2 Descriptor

This descriptor describes the Audio Controls that are present in the Feature Unit that is either connected to the Output Pin of Input Terminal ID1 in the case of HT1 or to the Output Pin of Mixer Unit ID8 in the case of HT2 and HT3. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x02 and the **bSourceID** field shall be set to 0x01 in the case of HT1 and to 0x08 in the case of HT2 and HT3.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x02 and SID=0x01 in the case of HT1 and SID=0x08 in the case of HT2 and HT3.

5.3.3.1.8 Headphone Feature Unit ID11 Descriptor

This descriptor is only present in the case of HT2 or HT3 and describes the Audio Controls that are present in the Feature Unit ID11 that is connected to the Output Pin of Input Terminal ID10. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0B and the **bSourceID** field shall be set to 0x0A.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x0B and SID=0x0A.

5.3.3.1.9 Headphone Feature Unit ID14 Descriptor

This descriptor is only present in the case of HT3 and describes the Audio Controls that are present in the Feature Unit ID14 that is connected to the Output Pin of Input Terminal ID13. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0E and the **bSourceID** field shall be set to 0x0D.

Refer to Section 5.3.3.1.10, "Generic Feature Unit Descriptor" for the actual descriptor(s) with UID=0x0E and SID=0x0D.

5.3.3.1.10 Generic Feature Unit Descriptor

A Mute Control and a Volume Control shall be present in the Master channel.

In the mono case, a Mute Control shall be present in the Master channel and a Volume Control shall be present in the Center Front channel.

In the stereo case, a Mute Control shall be present in the Master channel and a Volume Control shall be present in both the Left Front and Right Front channels.

No other Audio Controls shall be present.

Depending on the number of channels in the signal path (mono or stereo), the Feature Unit descriptor is slightly different. The following table presents the Mono Feature Unit descriptor.

Table 5-5: Mono Feature Unit Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0B	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x06	FEATURE_UNIT descriptor subtype.
3	bUnitID	1	UID	ID of this Feature Unit
4	bSourceID	1	SID	The ID of the Entity to which this Feature Unit is connected.
5	bControlSize	1	0x02	2 bytes for each element of the bmaControls array.
6	bmaControls(0)	2	0x0001	Mute Control on Master Channel.
8	bmaControls(1)	2	0x0002	Volume Control on Center Front channel.
10	iFeature	1	Index	Index of a string descriptor, describing the Feature Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Feature Unit descriptor.

Table 5-6: Stereo Feature Unit Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0D	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x06	FEATURE_UNIT descriptor subtype.
3	bUnitID	1	UID	ID of this Feature Unit.
4	bSourceID	1	SID	The ID of the Entity to which this Feature Unit is connected.
5	bControlSize	1	0x02	2 bytes for each element of the bmaControls array.
6	bmaControls(0)	2	0x0001	Mute Control on Master Channel.
8	bmaControls(1)	2	0x0002	Volume Control on Left Front channel.
10	bmaControls(2)	2	0x0002	Volume Control on Right Front channel.
12	iFeature	1	Index	Index of a string descriptor, describing the Feature Unit. If no string is provided, shall be set to 0x00.

5.3.3.1.11 Headphone Output Terminal ID3 Descriptor

This descriptor describes the Output Terminal ID3 that represents the speaker(s) (including D-to-A converter, power amplifier, etc.) of the Headphone device. Its Input Pin is directly connected to the Output Pin of Feature Unit ID2. The **bTerminalID** field of this Output Terminal descriptor shall be set to 0x03. The **wTerminalType** field shall indicate the Headphones Terminal Type (0x0302).

The Headphone Output Terminal ID3 descriptor is independent of the number of channels in the signal path and is presented in the following table.

Table 5-7: Headphone Output Terminal ID3 Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x03	OUTPUT_TERMINAL descriptor subtype.
3	bTerminalID	1	0x03	ID of this Input Terminal. Shall be set to 0x03.
4	wTerminalType	2	0x0302	Headphones Terminal Type.
6	bAssocTerminal	1	0x00	No association.

Offset	Field	Size	Value	Description
7	bSourceID	1	0x02	From Feature Unit ID2.
8	iTerminal	1	Index	Index of a string descriptor, describing the Output Terminal. If no string is provided, shall be set to 0x00.

5.3.3.1.12 Headphone Mixer Unit ID8 Descriptor

This descriptor is only present in the case of HT2 or HT3. In the case of HT2, it describes the Mixer Unit ID8 that is connected to the Output Pin of Input Terminal ID1 on its Input Pin 1 and to the Output Pin of Feature Unit ID11 on its Input Pin 2. Additionally, in the case of HT3, Input Pin 3 of the Mixer Unit ID8 is connected to the Output Pin of Feature Unit ID14.

In the case of HT2 and HT3, the **bUnitID** field of this Mixer Unit descriptor shall be set to 0x08, the **baSourceID(1)** field shall be set to 0x01, and the **baSourceID(2)** field shall be set to 0x0B. Additionally, in the case of HT3, the **baSourceID(3)** field shall be set to 0x0E.

The headphone signal path coming from Input Terminal ID1 can be either monophonic (Center Front channel) or stereophonic (Left and Right Front channels).

All Mixer Controls are non-programmable and shall be set to either 0 dB (to indicate a connection) or to -∞ dB (to indicate the absence of a connection).

In the case of a mono headphone signal path, the auxiliary signal paths (for both HT2 and HT3) can only be mono as well (Center Front channel).

The total number of Mixer Controls (N) is 2 for HT2, and 3 for HT3. Therefore, the **bmControls** field always occupies one byte.

The following table presents the Mono Headphone Mixer Unit ID8 descriptor for HT2.

Table 5-8: Mono Headphone Mixer Unit ID8 Descriptor for HT2

Offset	Field	Size	Value	Description
0	bLength	1	0x0D	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x02	Two Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x0B	From Feature Unit ID11.
7	bNrChannels	1	0x01	Mono signal path on Mixer Output Pin.

Offset	Field	Size	Value	Description
8	wChannelConfig	2	0x0004	Center Front channel.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	bmControls	1	0x00	No programmable Mixer Controls.
12	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Mono Headphone Mixer Unit ID8 descriptor for HT3.

Table 5-9: Mono Headphone Mixer Unit ID8 Descriptor for HT3

Offset	Field	Size	Value	Description
0	bLength	1	0x0E	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x0B	From Feature Unit ID11.
7	baSourceID(3)	1	0x0E	From Feature Unit ID14.
8	bNrChannels	1	0x01	Mono signal path on Mixer Output Pin.
9	wChannelConfig	2	0x0004	Center Front channel.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	1	0x00	No programmable Mixer Controls.
13	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

In the case of a stereo main signal path, the auxiliary signal paths (for both HT2 and HT3) can be either mono (Center Front channel) or stereo (Left Front and Right Front).

For HT2, the total number of Mixer Controls (N) is 6 when the auxiliary signal path is mono, and 8 when the auxiliary signal path is stereo. Therefore, the **bmControls** field occupies one byte.

For HT3, N is 8 when both auxiliary signal paths are mono. Therefore, the **bmControls** field occupies one byte. N is 10 when one of the auxiliary signal paths is mono and the

other is stereo, and 12 when both auxiliary signal paths are stereo. Therefore, the **bmControls** field occupies two bytes.

The following table presents the Stereo Headphone Mixer Unit ID8 descriptor for HT2.

Table 5-10: Stereo Headphone Mixer Unit ID8 Descriptor for HT2

Offset	Field	Size	Value	Description
0	bLength	1	0x0D	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x02	Two Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x0B	From Feature Unit ID11.
7	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
8	wChannelConfig	2	0x0003	Left Front and Right Front channels.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	bmControls	1	0x00	No programmable Mixer Controls.
12	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Headphone Mixer Unit ID8 descriptor for HT3 when both auxiliary signal paths are mono.

Table 5-11: Stereo Headphone Mixer Unit ID8 Descriptor for HT3 & mono Aux1 & Aux2

Offset	Field	Size	Value	Description
0	bLength	1	0x0E	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x0B	From Feature Unit ID11.

Offset	Field	Size	Value	Description
7	baSourceID(3)	1	0x0E	From Feature Unit ID14.
8	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
9	wChannelConfig	2	0x0003	Left Front and Right Front channels.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	1	0x00	No programmable Mixer Controls.
13	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Headphone Mixer Unit ID8 descriptor for HT3 when one or both auxiliary signal paths are stereo.

Table 5-12: Stereo Headphone Mixer Unit ID8 Descriptor for HT3 & stereo Aux1 &/or Aux2

Offset	Field	Size	Value	Description
0	bLength	1	0x0F	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x0B	From Feature Unit ID11.
7	baSourceID(3)	1	0x0E	From Feature Unit ID14.
8	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
9	wChannelConfig	2	0x0003	Left Front and Right Front channels.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	2	0x0000	No programmable Mixer Controls.
14	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

5.3.3.2 Headphone AudioControl Endpoint Descriptors

Because endpoint 0 is used as the AudioControl control endpoint, there is no dedicated standard and class-specific control endpoint descriptor. Furthermore, since an interrupt endpoint is not allowed in the AudioControl interface, there is no standard and class-specific interrupt endpoint descriptor.

5.3.3.3 Headphone AudioStreaming Interface Descriptors

The AudioStreaming Interface descriptors shall follow the AudioControl Interface descriptors. These descriptors shall appear in the same order as they are listed in this specification.

The AudioStreaming interface has two possible alternate settings.

5.3.3.3.1 Zero-bandwidth Alternate Setting 0

Alternate setting 0 is a zero-bandwidth setting, used to relinquish the claimed bandwidth on the bus when the headphone is not in use. It is the default setting after power-up. The zero bandwidth is implemented by specifying that this alternate setting of the interface has no endpoints associated with it (bNumEndpoints=0). The collection of descriptors for this alternate setting reduces to the standard interface descriptor.

5.3.3.3.1.1 Headphone Standard AS Interface Descriptor

Table 5-13: Headphone Standard AS Interface Descriptor (Alt. Set. 0)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor.
2	bInterfaceNumber	1	0x01	Number of the AudioStreaming interface. The AudioStreaming interface shall be the second interface in the collection.
3	bAlternateSetting	1	0x00	Index of this alternate setting.
4	bNumEndpoints	1	0x00	0 endpoints.
5	bInterfaceClass	1	0x01	AUDIO.
6	bInterfaceSubclass	1	0x02	AUDIO_STREAMING.
7	bInterfaceProtocol	1	0x00	Unused. Shall be set to 0x00.
8	iInterface	1	Index	Index of a string descriptor, describing the interface. If no string is provided, shall be set to 0x00.

5.3.3.3.2 Operational Alternate Setting 1

Alternate setting 1 is the operational setting of the interface. It contains the standard and class-specific interface and endpoint descriptors.

5.3.3.3.2.1 Headphone Standard AS Interface Descriptor

Table 5-14: Headphone Standard AS Interface Descriptor (Alt. Set .1)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor.
2	bInterfaceNumber	1	0x01	Number of the AudioStreaming interface. The AudioStreaming interface shall be the second interface in the collection.
3	bAlternateSetting	1	0x01	Index of this alternate setting.
4	bNumEndpoints	1	0x01	One isochronous data endpoint.
5	bInterfaceClass	1	0x01	AUDIO.
6	bInterfaceSubclass	1	0x02	AUDIO_STREAMING.
7	bInterfaceProtocol	1	0x00	Unused. Shall be set to 0x00.
8	iInterface	1	Index	Index of a string descriptor, describing the interface. If no string is provided, shall be set to 0x00.

5.3.3.3.2.2 Headphone Class-specific AS General Interface Descriptor

The bDelay field is not used by this specification and shall be set to 0x00.

Table 5-15: Headphone Class-specific AS General Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x01	AS_GENERAL subtype.
3	bTerminalLink	1	0x01	Terminal ID of the Input Terminal, associated with this interface.
4	bDelay	1	0x00	Total interface delay, expressed in frames. Not used and shall be set to 0x00.
5	wFormatTag	2	0x0001	PCM Format.

5.3.3.3.2.3 Headphone Type I Format Type Descriptor

Depending on the number of channels in the signal path (mono or stereo), the Type I Format Type descriptor is slightly different. The following table presents the Mono Headphone Type I Format Type descriptor.

Table 5-16: Mono Headphone Type I Format Type Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0B	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x02	FORMAT_TYPE subtype.
3	bFormatType	1	0x01	FORMAT_TYPE_I.
4	bNrChannels	1	0x01	One channel.
5	bSubFrameSize	1	0x02	Two bytes per audio subframe.
6	bBitResolution	1	0x10	16 bits per sample.
7	bSamFreqType	1	0x01	One frequency supported.
8	tSamFreq	3	0x00BB80	48000 Hz.

The following table presents the Stereo Headphone Type I Format Type descriptor.

Table 5-17: Stereo Headphone Type I Format Type Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0B	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x02	FORMAT_TYPE subtype.
3	bFormatType	1	0x01	FORMAT_TYPE_I.
4	bNrChannels	1	0x02	Two channels.
5	bSubFrameSize	1	0x02	Two bytes per audio subframe.
6	bBitResolution	1	0x10	16 bits per sample.
7	bSamFreqType	1	0x01	One frequency supported.
8	tSamFreq	3	0x00BB80	48000 Hz.

5.3.3.3.2.4 Headphone Standard AS Audio Data Endpoint Descriptor

Depending on the number of channels in the signal path (mono or stereo), the Standard AS Audio Data Endpoint descriptor is slightly different. The following table presents the Mono Headphone Standard AS Audio Data Endpoint descriptor.

Table 5-18: Mono Headphone Standard AS Audio Data Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x05	ENDPOINT descriptor.
2	bEndpointAddress	1	0b0000xxxx	OUT Endpoint.
3	bmAttributes	1	0b00001101	Isochronous, Synchronous.
4	wMaxPacketSize	2	0x0060	96 bytes per packet.
6	bInterval	1	0x01	One packet per frame.
7	bRefresh	1	0x00	Unused. Shall be set to 0x00.
8	bSynchAddress	1	0x00	Unused. Shall be set to 0x00.

The following table presents the Stereo Headphone Standard AS Audio Data Endpoint descriptor.

Table 5-19: Stereo Headphone Standard AS Audio Data Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x05	ENDPOINT descriptor.
2	bEndpointAddress	1	0b0000xxxx	OUT Endpoint.
3	bmAttributes	1	0b00001101	Isochronous, Synchronous.
4	wMaxPacketSize	2	0x00C0	192 bytes per packet.
6	bInterval	1	0x01	One packet per frame.
7	bRefresh	1	0x00	Unused. Shall be set to 0x00.
8	bSynchAddress	1	0x00	Unused. Shall be set to 0x00.

5.3.3.3.2.5 Headphone Class-specific Isochronous Audio Data Endpoint Descriptor

Table 5-20: Headphone Class-specific Isoc. Audio Data Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x25	CS_ENDPOINT descriptor
2	bDescriptorSubtype	1	0x01	EP_GENERAL subtype.

Offset	Field	Size	Value	Description
3	bmAttributes	1	0x00	No sampling frequency control, no pitch control, no packet padding.
4	bLockDelayUnits	1	0x00	Unused. Shall be set to 0x00.
5	wLockDelay	2	0x0000	Unused. Shall be set to 0x0000.

5.3.4 String Descriptors

String descriptors are optional. They can be used to provide additional descriptive information about certain components of the device. See *USB Specification* Section 9.5.

5.4 Headphone Requests

5.4.1 Standard Requests

The Headphone shall support at a minimum the following standard requests:

- Clear Feature
- Get Configuration
- Get Descriptor
- Get Interface
- Get Status
- Set Address
- Set Configuration
- Set Feature
- Set Interface

See *USB Specification* Section 9.4.

5.4.2 Class-specific Requests

The following sections define the class-specific requests a Headphone device shall support.

5.4.2.1 Feature Unit Requests

The Headphone device shall support the Set and Get Feature Unit Control request for all Feature Units for the following Controls:

- Mute Control
- Volume Control

5.4.2.1.1 Mute Control

The SET_CUR and GET_CUR attribute shall be supported. All other attributes shall not be supported.

Only the first form of the Set/Get Mute Control request shall be supported.

5.4.2.1.2 Volume Control

All Volume Control attributes (CUR, MIN, MAX, and RES) shall be supported. For the RES attribute, it is up to the manufacturer to provide a (single) value that best reflects a useful resolution over the entire range of the Volume Control.

Only the first form of the Set/Get Volume Control request shall be supported.

5.4.2.2 Mixer Unit Requests

The Headphone device shall only support the Get Mixer Unit Control request since all Mixer Controls are non-programmable. The only available Control for a Mixer Unit is the Mixer Control.

5.4.2.2.1 Mixer Control

Only the Mixer Control attribute CUR shall be supported. All other attributes shall not be supported. Since all Mixer Controls are non-programmable and fixed, a value of 0x0000 (0 dB) shall be returned for a Mixer Control that connects an input channel to an output channel and a value of 0x8000 (-∞ dB) shall be returned for a Mixer Control that does not connect an input channel to an output channel.

Only the first form of the Get Mixer Control request shall be supported.

6 USB Microphone Device

6.1 Microphone Definition

A USB Microphone device contains one or more transducers that convert sound into electrical signals. These electrical signals are then converted into digital data streams that are delivered over the USB to a Host device. Some basic audio control functionality is also provided.

6.2 Microphone Topology

This specification only supports the Microphone Topology (MT) presented below. There are two variations allowed, one supports a monophonic signal path (see Figure 6-1) whereas the second supports a stereophonic signal path (see Figure 6-2).

Input Terminal ID4 represents the physical microphone (mono or stereo). The Output Pin of Input Terminal ID4 is connected to the Input Pin of Feature Unit ID5. The Output Pin of Feature Unit ID5 is connected to the Input Pin of Output Terminal ID6, which represents the AudioStreaming Interface that is used to stream the microphone data to the Host.

All building blocks (Input Terminal, Feature Unit, etc.) shall be present as indicated in Figure 6-1 and Figure 6-2 below and the **bTerminalID** and **bUnitID** fields of the respective Entity descriptors shall be assigned as indicated.

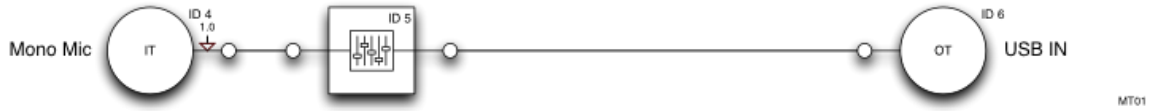

Figure 6-1: Mono Microphone Device

Figure 6-2: Stereo Microphone Device

6.3 Microphone Descriptors

To allow for backward compatible extensions, additional fields may be added to the class-specific descriptors in future versions of this specification. Therefore, descriptor parsers should be tolerant of descriptor lengths that are larger than currently specified in the **bLength** fields of these descriptors.

6.3.1 Microphone Device Descriptor

Because audio functionality is always considered to reside at the interface level, this class specification does not define a specific audio device descriptor. For *audio-only* devices, the device descriptor shall indicate that class information is to be found at the interface level. Therefore, the **bDeviceClass** field of the device descriptor shall contain zero so that

enumeration software looks down at the interface level to determine the Interface Class, and the **bDeviceSubClass** and **bDeviceProtocol** fields shall also be set to zero.

All other fields of the device descriptor shall comply with the definitions in Section 9.6.1, "Descriptor" of the *USB Specification*. There is no class-specific device descriptor.

Table 6-1: Device Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x12	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x01	DEVICE descriptor.
2	bcdUSB	2	0x0200	USB Specification Release Number in Binary-Coded Decimal.
4	bDeviceClass	1	Class	See *USB Specification*.
5	bDeviceSubClass	1	Subclass	See *USB Specification*.
6	bDeviceProtocol	1	Protocol	See *USB Specification*.
7	bMaxPacketSize0	1	Number	See *USB Specification*.
8	idVendor	2	ID	See *USB Specification*.
10	idProduct	2	ID	See *USB Specification*.
12	bcdDevice	2	BCD	See *USB Specification*.
14	iManufacturer	1	Index	See *USB Specification*.
15	iProduct	1	Index	See *USB Specification*.
16	iSerialNumber	1	Index	See *USB Specification*.
17	bNumConfigurations	1	Number	Shall contain a value greater than or equal to 0x01.

6.3.2 Microphone Configuration Descriptor

The Configuration descriptor describes information about a specific configuration of the device.

As indicated in Section 3, "Classification", this specification requires that a Basic Audio device support one (and only one) compliant basic audio function in its default Device Configuration. This section outlines this default Device Configuration descriptor.

If a HID interface is present then the **bNumInterfaces** field shall contain a value greater than or equal to 0x03. Otherwise, the **bNumInterfaces** field shall contain a value greater than or equal to 0x02.

The **bmAttributes** field indicates whether the device is self-powered (D6=0b1) or bus-powered (D6=0b0) and also whether the device supports Remote Wakeup (D5=0b1) or

not (d5=0b0). Bit D7 shall be set to 0b1 for historical reasons while bits D4..0 shall be reset to 0b00000.

Table 6-2: Configuration Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x02	CONFIGURATION descriptor.
2	wTotalLength	2	Number	Length of the total configuration block, including this descriptor, in bytes.
4	bNumInterfaces	1	Number	At least two interfaces for a Microphone device: one AudioControl interface, one AudioStreaming interface. Additional functions, such as HID, may require additional interfaces.
5	bConfigurationValue	1	Number	ID of this configuration.
6	iConfiguration	1	Index	Index of string descriptor describing this Configuration.
7	bmAttributes	1	0b1xx00000	Self- or bus-powered device, Remote Wakeup capability can be supported.
8	bMaxPower	1	Number	See *USB Specification*. The value shall indicate no more than one unit load.

6.3.3 Microphone Interface Descriptors

For a general description and overview of the Audio Device Class Interface descriptors, refer to the *Audio 1.0 Specification*. The following sections describe the standard and class-specific USB Interface descriptors as they relate to a USB Microphone Device.

6.3.3.1 Microphone AudioControl Interface Descriptors

The AudioControl interface describes the device structure (audio function topology) and is used to manipulate the Audio Controls, present in the Microphone device.

6.3.3.1.1 Microphone Standard AC Interface Descriptor

The standard AC interface descriptor is identical to the standard interface descriptor defined in Section 9.6.3, “Interface” of the *USB Specification*, except that most fields have now dedicated values.

The AudioControl interface has no dedicated endpoints associated with it. It uses the default pipe (endpoint 0) for all communication purposes. Class-specific AudioControl Requests are sent using the default pipe. A Status Interrupt endpoint is not allowed.

The **bInterfaceProtocol** field contains a value that fully describes the nature of the Microphone device. Only those codes pertaining to Microphones are allowed. This value can potentially be used by driver software to bypass the process of parsing the entire set of Microphone descriptors.

Note: Some descriptor field values, such as endpoint addresses, certain parameter values, etc. and also some descriptor lengths may vary among implementations so that a rudimentary form of parsing cannot be avoided entirely.

Table 6-3: Microphone Standard AC Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor type
2	bInterfaceNumber	1	0x00	Number of the AudioControl interface. The AudioControl interface shall be the first interface in the collection.
3	bAlternateSetting	1	0x00	The AudioControl interface of the Microphone only supports the default Alternate Setting zero.
4	bNumEndpoints	1	0x00	A status interrupt endpoint is not allowed.
5	bInterfaceClass	1	0x01	AUDIO. Audio Interface Class code.
6	bInterfaceSubClass	1	0x01	AUDIOCONTROL. Audio Interface Subclass code.
7	bInterfaceProtocol	1	Number	Number that fully describes the nature of the Microphone device. See Appendix A.1, “Audio Function Basic Audio Device Codes” for allowed values.
8	iInterface	1	Index	Index of a string descriptor that describes this interface. If no string is provided, shall be set to 0x00.

6.3.3.1.2 Microphone Class-Specific AC Interface Descriptor

The Class-specific AC interface descriptor is always headed by a Header descriptor that contains general information about the AudioControl interface. It contains all the pointers needed to describe the Audio Interface Collection, associated with the described audio function. The following table defines the class-specific AC interface header descriptor.

Table 6-4: Microphone Class-Specific AC Interface Header Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x01	HEADER descriptor subtype.
3	bcdADC	2	0x0100	Audio 1.0.

Offset	Field	Size	Value	Description
5	wTotalLength	2	Number	Total number of bytes returned for the class-specific AudioControl interface descriptor.
7	bInCollection	1	0x01	One IN AudioStreaming interface in the Collection.
8	baInterfaceNr(1)	1	Number	Interface number of the IN AudioStreaming interface in the Collection. Shall be one greater than the interface number of the associated AudioControl interface.

This Header descriptor is followed by the Input Terminal ID4 descriptor, the Feature Unit ID5 descriptor, and the Output Terminal ID6 descriptor, in that order.

6.3.3.1.3 Microphone Input Terminal ID4 Descriptor

This descriptor describes the Input Terminal that represents the microphone capsule (including preamp, A-to-D converter, etc.). The resulting digital audio stream leaves the Input Terminal through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x04 and the **wTerminalType** field shall be set to 0x0201 (Microphone Terminal Type).

Refer to Section 5.3.3.1.6, “Generic Input Terminal Descriptor” for the actual descriptor(s) with TID=0x04 and TT=0x0201.

6.3.3.1.4 Microphone Feature Unit ID5 Descriptor

This descriptor describes the Audio Controls that are present in the Feature Unit that is connected to the Output Pin of Input Terminal ID4 of the Microphone device. The **bUnitID** field of this Feature Unit shall be set to 0x05 and the **bSourceID** field shall be set to 0x04.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x05 and SID=0x04.

6.3.3.1.5 Microphone Output Terminal ID6 Descriptor

This descriptor describes the Output Terminal that represents the USB pipe to the Host. Its Input Pin is directly connected to the Output Pin of Feature Unit ID5 of the Microphone device. The **bTerminalID** field of this Output Terminal descriptor shall be set to 0x06 and the **bSourceID** field shall be set to 0x05.

The Microphone Output Terminal descriptor is independent of the number of channels in the signal path and is presented in the following table.

Table 6-5: Microphone Output Terminal Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.

Offset	Field	Size	Value	Description
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x03	OUTPUT_TERMINAL descriptor subtype.
3	bTerminalID	1	0x06	ID of this Input Terminal. Shall be set to 0x06.
4	wTerminalType	2	0x0101	USB Streaming Terminal Type.
6	bAssocTerminal	1	0x00	No association.
7	bSourceID	1	0x05	From Feature Unit ID5.
8	iTerminal	1	Index	Index of a string descriptor, describing the Output Terminal. If no string is provided, shall be set to 0x00.

6.3.3.2 Microphone AudioControl Endpoint Descriptors

Because endpoint 0 is used as the AudioControl control endpoint, there is no dedicated standard and class-specific control endpoint descriptor. Furthermore, since an interrupt endpoint is not allowed in the AudioControl interface, there is no standard and class-specific interrupt endpoint descriptor.

6.3.3.3 Microphone AudioStreaming Interface Descriptors

The AudioStreaming Interface descriptors shall follow the AudioControl Interface descriptors. These descriptors shall appear in the same order as they are listed in this specification.

The AudioStreaming interface has three possible alternate settings. Alternate setting zero is the mandatory zero-bandwidth setting. Alternate setting 1 is the mono setting and alternate setting 2 is the stereo setting for the AudioStreaming interface. Note that the selection of alternate setting 1 or 2 is completely independent of and has no influence on the mono or stereo setting of the internal signal path that flows into the Input Pin of Output Terminal ID6. The device shall perform the correct transform, depending on the situation:

- If the internal signal path is stereo and alternate setting 1 (mono) is selected in the AudioStreaming interface, then the device shall downmix the stereo stream into a mono stream ((Left/2+Right/2) before sending the stream to the mono IN endpoint.
- If the internal signal path is mono and alternate setting 2 (stereo) is selected in the AudioStreaming interface, then the device shall duplicate the mono samples into the Left and Right channel of a stereo stream before sending the stream to the stereo IN endpoint.
- If the internal signal path is mono and alternate setting 1 (mono) is selected or if the internal signal path is stereo and alternate setting 2 (stereo) is selected in the

AudioStreaming interface, then the device can simply pass the stream to the IN endpoint unaltered.

6.3.3.3.1 Zero-bandwidth Alternate Setting 0

Alternate setting 0 is a zero-bandwidth setting, used to relinquish the claimed bandwidth on the bus when the microphone is not in use. It is the default setting after power-up. The zero bandwidth is implemented by specifying that this alternate setting of the interface has no endpoints associated with it (bNumEndpoints=0). The collection of descriptors for this alternate setting reduces to the standard interface descriptor.

6.3.3.3.1.1 Microphone Standard AS Interface Descriptor

Table 6-6: Microphone Standard AS Interface Descriptor (Alt. Set. 0)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor.
2	bInterfaceNumber	1	0x01	Number of the AudioStreaming interface. The AudioStreaming interface shall be the second interface in the collection.
3	bAlternateSetting	1	0x00	Index of this alternate setting.
4	bNumEndpoints	1	0x00	0 endpoints.
5	bInterfaceClass	1	0x01	AUDIO.
6	bInterfaceSubclass	1	0x02	AUDIO_STREAMING.
7	bInterfaceProtocol	1	0x00	Unused. Shall be set to 0x00.
8	iInterface	1	0x00	Index of a string descriptor, describing the interface. If no string is provided, shall be set to 0x00.

6.3.3.3.2 Operational Alternate Setting 1

Alternate setting 1 is the mono operational setting of the interface. It contains the standard and class-specific interface and endpoint descriptors.

6.3.3.3.2.1 Mono Microphone Standard AS Interface Descriptor

Table 6-7: Mono Microphone Standard AS Interface Descriptor (Alt. Set. 1)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor.

Offset	Field	Size	Value	Description
2	bInterfaceNumber	1	0x01	Number of the AudioStreaming interface. The AudioStreaming interface shall be the second interface in the collection.
3	bAlternateSetting	1	0x01	Index of this alternate setting.
4	bNumEndpoints	1	0x01	One isochronous data endpoint.
5	bInterfaceClass	1	0x01	AUDIO.
6	bInterfaceSubclass	1	0x02	AUDIO_STREAMING.
7	bInterfaceProtocol	1	0x00	Unused. Shall be set to 0x00.
8	iInterface	1	0x00	Index of a string descriptor, describing the interface. If no string is provided, shall be set to 0x00.

6.3.3.3.2.2 Mono Microphone Class-specific AS General Interface Descriptor

The bDelay field is not used by this specification and shall be set to 0x00.

Table 6-8: Mono Mic Class-specific AS General Interface Descriptor (Alt. Set. 1)

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x01	AS_GENERAL subtype.
3	bTerminalLink	1	0x06	Terminal ID of the Output Terminal, associated with this interface.
4	bDelay	1	0x00	Total interface delay, expressed in frames. Not used and shall be set to 0x00.
5	wFormatTag	2	0x0001	PCM Format.

6.3.3.3.2.3 Mono Microphone Type I Format Type Descriptor

The following table presents the Mono Microphone Type I Format Type descriptor.

Table 6-9: Mono Microphone Type I Format Type Descriptor (Alt. Set. 1)

Offset	Field	Size	Value	Description
0	bLength	1	0x0B	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x02	FORMAT_TYPE subtype.

Offset	Field	Size	Value	Description
3	bFormatType	1	0x01	FORMAT_TYPE_I.
4	bNrChannels	1	0x01	One channel.
5	bSubFrameSize	1	0x02	Two bytes per audio subframe.
6	bBitResolution	1	0x10	16 bits per sample.
7	bSamFreqType	1	0x01	One frequency supported.
8	tSamFreq	3	0x00BB80	48000 Hz.

6.3.3.3.2.4 Mono Microphone Standard AS Audio Data Endpoint Descriptor

The following table presents the Mono Microphone Standard AS Audio Data Endpoint descriptor.

Table 6-10: Mono Mic Standard AS Audio Data Endpoint Descriptor (Alt. Set. 1)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x05	ENDPOINT descriptor.
2	bEndpointAddress	1	0b1000xxxx	IN Endpoint.
3	bmAttributes	1	0b00001101	Isochronous, Synchronous.
4	wMaxPacketSize	2	0x0060	96 bytes per packet.
6	bInterval	1	0x01	One packet per frame.
7	bRefresh	1	0x00	Unused. Shall be set to 0x00.
8	bSynchAddress	1	0x00	Unused. Shall be set to 0x00.

6.3.3.3.2.5 Microphone Class-specific Isochronous Audio Data Endpoint Descriptor

Table 6-11: Mic Class-specific Isoc. Audio Data Endpoint Descriptor (Alt. Set. 1)

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x25	CS_ENDPOINT descriptor
2	bDescriptorSubtype	1	0x01	AS_GENERAL subtype.
3	bmAttributes	1	0x00	No sampling frequency control, no pitch control, no packet padding.

Offset	Field	Size	Value	Description
4	bLockDelayUnits	1	0x00	Unused. Shall be set to 0x00.
5	wLockDelay	2	0x0000	Unused. Shall be set to 0x0000.

6.3.3.3.3 Operational Alternate Setting 2

Alternate setting 2 is the stereo operational setting of the interface. It contains the standard and class-specific interface and endpoint descriptors.

6.3.3.3.3.1 Stereo Microphone Standard AS Interface Descriptor

Table 6-12: Stereo Microphone Standard AS Interface Descriptor (Alt. Set. 2)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor.
2	bInterfaceNumber	1	0x01	Number of the AudioStreaming interface. The AudioStreaming interface shall be the second interface in the collection.
3	bAlternateSetting	1	0x02	Index of this alternate setting.
4	bNumEndpoints	1	0x01	One isochronous data endpoint.
5	bInterfaceClass	1	0x01	AUDIO.
6	bInterfaceSubclass	1	0x02	AUDIO_STREAMING.
7	bInterfaceProtocol	1	0x00	Unused. Shall be set to 0x00.
8	iInterface	1	0x00	Index of a string descriptor, describing the interface. If no string is provided, shall be set to 0x00.

6.3.3.3.3.2 Stereo Microphone Class-specific AS General Interface Descriptor

The bDelay field is not used by this specification and shall be set to 0x00.

Table 6-13: Stereo Mic Class-specific AS General Interface Descriptor (Alt. Set. 2)

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x01	AS_GENERAL subtype.
3	bTerminalLink	1	0x06	Terminal ID of the Output Terminal, associated with this interface.

Offset	Field	Size	Value	Description
4	bDelay	1	0x00	Total interface delay, expressed in frames. Not used and shall be set to 0x00.
5	wFormatTag	2	0x0001	PCM Format.

6.3.3.3.3.3 Stereo Microphone Type I Format Type Descriptor

The following table presents the Stereo Microphone Type I Format Type descriptor.

Table 6-14: Stereo Microphone Type I Format Type Descriptor (Alt. Set. 2)

Offset	Field	Size	Value	Description
0	bLength	1	0x0B	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor.
2	bDescriptorSubtype	1	0x02	FORMAT_TYPE subtype.
3	bFormatType	1	0x01	FORMAT_TYPE_I.
4	bNrChannels	1	0x02	Two channels.
5	bSubFrameSize	1	0x02	Two bytes per audio subframe.
6	bBitResolution	1	0x10	16 bits per sample.
7	bSamFreqType	1	0x01	One frequency supported.
8	tSamFreq	3	0x00BB80	48000Hz.

6.3.3.3.3.4 Stereo Microphone Standard AS Audio Data Endpoint Descriptor

The following table presents the Stereo Microphone Standard Endpoint descriptor.

Table 6-15: Stereo Mic Standard AS Audio Data Endpoint Descriptor (Alt. Set. 2)

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x05	ENDPOINT descriptor.
2	bEndpointAddress	1	0b1000xxxx	IN Endpoint.
3	bmAttributes	1	0b00001101	Isochronous, Synchronous.
4	wMaxPacketSize	2	0x00C0	192 bytes per packet.
6	bInterval	1	0x01	One packet per frame.
7	bRefresh	1	0x00	Unused. Shall be set to 0x00.

Offset	Field	Size	Value	Description
8	bSynchAddress	1	0x00	Unused. Shall be set to 0x00.

6.3.3.3.3.5 Microphone Class-specific Isochronous Audio Data Endpoint Descriptor

Table 6-16: Mic Class-specific Isoc. Audio Data Endpoint Descriptor (Alt. Set. 2)

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x25	CS_ENDPOINT descriptor
2	bDescriptorSubtype	1	0x01	AS_GENERAL subtype.
3	bmAttributes	1	0x00	No sampling frequency control, no pitch control, no packet padding.
4	bLockDelayUnits	1	0x00	Unused. Shall be set to 0x00.
5	wLockDelay	2	0x0000	Unused. Shall be set to 0x0000.

6.3.4 String Descriptors

String descriptors are optional. They can be used to provide additional descriptive information about certain components of the device. See *USB Specification* Section 9.5.

6.4 Microphone Requests

6.4.1 Standard Requests

The Microphone shall support at a minimum the following standard requests:

- Clear Feature
- Get Configuration
- Get Descriptor
- Get Interface
- Get Status
- Set Address
- Set Configuration
- Set Feature
- Set Interface

See *USB Specification* Section 9.4.

6.4.2 Class-specific Requests

The following sections define the class-specific requests a Microphone shall support.

6.4.2.1 Feature Unit Requests

The Microphone Feature Unit requests are identical to the Headphone Feature Unit requests.

Refer to Section 5.4.2.1, “Feature Unit Requests” for details.

7 USB Headset Device

7.1 Headset Definition

A USB Headset device is a combination of a USB Microphone device (see Section 6.1, “Microphone Definition”) and a USB Headphone device (see Section 5.1, “Headphone Definition”) into a single device. In addition to the components found in a USB Microphone and Headphone device, a USB Headset device also contains a signal path from the Microphone input signal path to the Headphone output signal path so that the sound picked up by the microphone is also audible through the Headset’s speaker(s) (Side-tone mixing).

7.2 Headset Topology

This specification supports the three topologies presented below. No other topologies are allowed.

7.2.1 Headset Topology 1

Headset Topology 1 (HS1) is the basic Headset topology. Input Terminal ID4 represents the physical mono microphone. The Output Pin of Input Terminal ID4 is connected to the Input Pin of Feature Unit ID5. The Output Pin of Feature Unit ID5 is connected to the Input Pin of Output Terminal ID6, which represents the AudioStreaming Interface that is used to stream the microphone data to the Host.

Input Terminal ID1 represents the AudioStreaming Interface that is used to stream the speaker data from the Host to the Headset device (mono or stereo). The Output Pin of Input Terminal ID1 is connected to Input Pin 1 of Mixer Unit ID8. The Output Pin of Mixer Unit ID8 is connected to the Input Pin of Feature Unit ID2. The Output Pin of Feature Unit ID2 is connected to the Input Pin of Output Terminal ID3, which represents the physical speaker(s).

Input Terminal ID4 (the microphone) is also connected to the Input Pin of Feature Unit ID7. The Output Pin of Feature Unit ID7 is connected to Input Pin 2 of Mixer Unit ID8. This connection creates the ‘side tone’-mixing signal path between microphone and speaker(s).

All building blocks (Input Terminals, Feature Units, etc.) shall be present as indicated in Figure 7-1 and Figure 7-2 below and the **bTerminalID** and **bUnitID** fields of the respective Entity descriptors shall be assigned as indicated. Also, Pin numbers shall be assigned as indicated.

There are two variations allowed, one supports a monophonic headphone signal path (see Figure 7-1) whereas the second supports a stereophonic headphone signal path (see Figure 7-2). The microphone signal path is always monophonic.

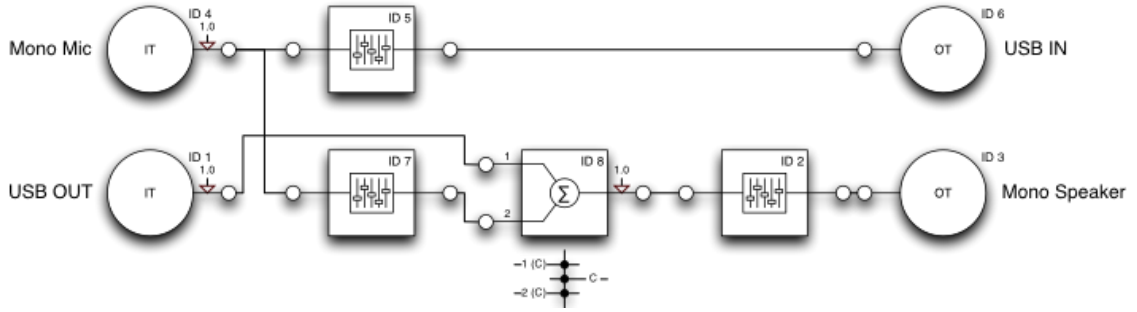

Figure 7-1: Mono Headset Device (mono mic; mono headphone)

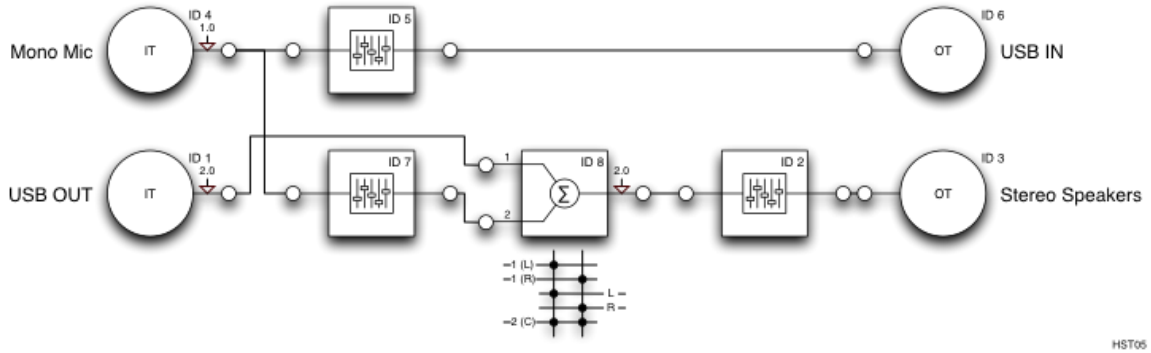

Figure 7-2: Stereo Headset Device (mono mic; stereo headphone)

Note: Although not considered to be part of the baseline Headset Topology 1, it is allowed to insert a Selector Unit ID9 between Feature Unit ID5 and Output Terminal ID6. This Selector Unit ID9 shall only have one Input Pin and therefore has no operational functionality. Some existing Operating System implementations require the presence of this Selector Unit to operate properly.

7.2.2 Headset Topology 2

Headset Topology 2 (HS2) adds an additional auxiliary input to HS1 as follows: a Selector Unit ID9 is inserted between the Output Pin of Feature Unit ID5 and Output Terminal ID6 and the Output Pin of Feature Unit ID5 is connected to Input Pin 1 of Selector Unit ID9. The Output Pin of Selector Unit ID9 is connected to the Input Pin of Output Terminal ID6.

Input Terminal ID10 is added and represents an additional audio input to the device. The usage of this input shall be accurately indicated in the **wTerminalType** field of its Input Terminal Descriptor. Feature Unit ID11 is also added and the Output Pin of Input Terminal ID10 is connected to the Input Pin of Feature Unit ID11. The Output Pin of Feature Unit ID11 is connected to Input Pin 3 of Mixer Unit ID8.

The Output Pin of Input Terminal ID10 is also connected to the Input Pin of Feature Unit ID12. The Output Pin of Feature Unit ID12 is connected to Input Pin 2 of Selector Unit ID9. This creates a signal path for the auxiliary input to be recorded on the Host.

All building blocks (Input Terminals, Feature Units, etc.) shall be present as indicated in Figure 7-3 and Figure 7-4 below and the **bTerminalID** and **bUnitID** fields of the respective Entity descriptors shall be assigned. Also, Pin numbers shall be assigned as indicated.

There are two variations allowed for HS2, one supports a monophonic headphone signal path (USB OUT to Mono Speaker) whereas the second supports a stereophonic headphone signal path. The microphone signal path is always monophonic.

Figure 7-3 represents the mono version of HS2. The spatial location of the single channel in the auxiliary signal path (Aux 1 to Mixer Unit ID8) shall be Center Front.

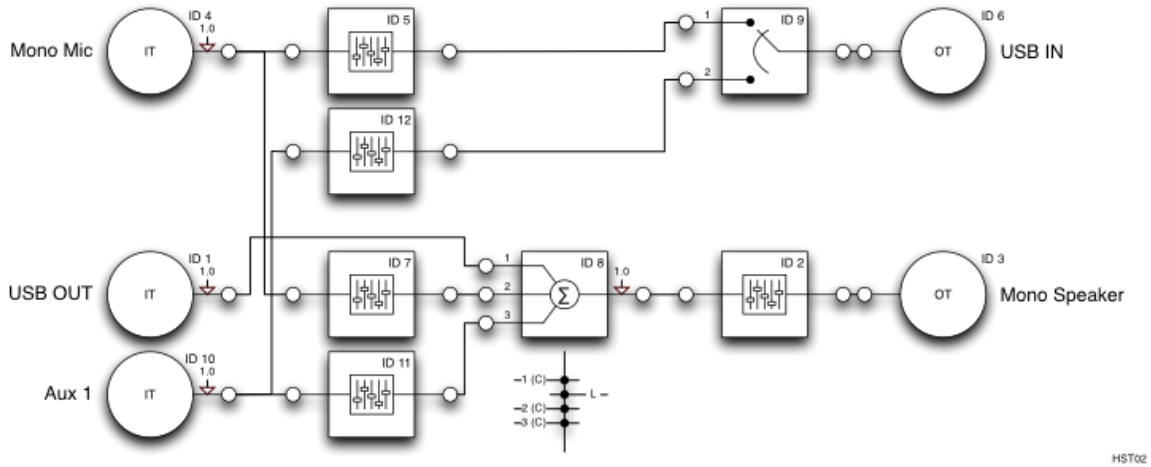

Figure 7-3: Mono Headset Device (mono mic; mono hp) with One Auxiliary Input

Figure 7-4 represents the stereo version of HS2. The auxiliary signal path is allowed to be either mono (x=1) with a spatial location of Center Front or stereo (x=2) with spatial locations of Left Front and Right Front respectively.

Note that in the case where the auxiliary signal path is stereo (x=2), an additional Up/Down-mix Processing Unit ID20 shall be inserted between the Output Pin of Feature Unit ID5 and Input Pin 1 of Selector Unit ID9 to convert the mono signal from the microphone into a stereo signal. The mono microphone signal coming into the Up/Down-mix Processing Unit ID20 shall simply be duplicated into the Left Front and Right Front channels of the output.

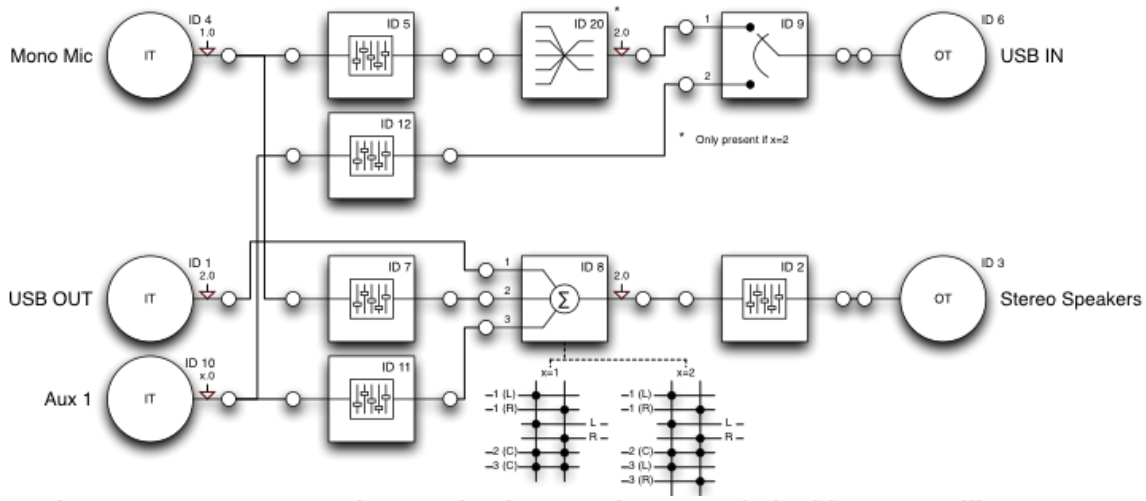

Figure 7-4: Stereo Headset Device (mono mic; stereo hp) with One Auxiliary Input

7.2.3 Headset Topology 3

Headset Topology 3 (HS3) adds an additional auxiliary input to HS2 as follows: Input Terminal ID13 is added and represents an additional audio input to the device. The usage of this input shall be accurately indicated in the **wTerminalType** field of its Input Terminal Descriptor. Feature Unit ID14 is also added and the Output Pin of Input Terminal ID13 is connected to the Input Pin of Feature Unit ID14. The Output Pin of Feature Unit ID14 is connected to Input Pin 4 of Mixer Unit ID8.

The Output Pin of Input Terminal ID13 is also connected to the Input Pin of Feature Unit ID15. The Output Pin of Feature Unit ID15 is connected to Input Pin 3 of Selector Unit ID9. This creates a signal path for the second auxiliary input to be recorded on the Host.

All building blocks (Input Terminals, Feature Units, etc.) shall be present as indicated in Figure 7-5 and Figure 7-6 below and the **bTerminalID** and **bUnitID** fields of the respective Entity descriptors shall be assigned. Also, Pin numbers shall be assigned as indicated.

There are two variations allowed for HS3, one supports a monophonic headphone signal path (USB OUT to Mono Speaker) whereas the second supports a stereophonic headphone signal path. The microphone signal path is always monophonic.

Figure 7-5 represents the mono version of HS3. The spatial location of the single channel in the second auxiliary signal path (Aux 2 to Mixer Unit ID8) shall be Center Front.

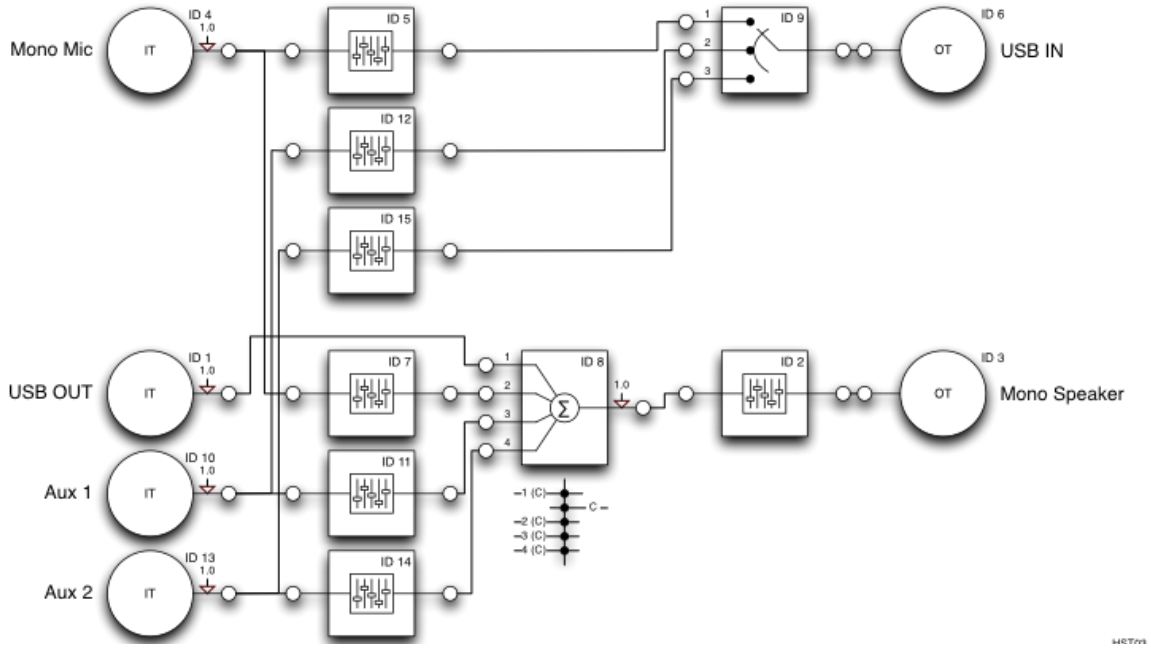

Figure 7-5: Mono Headset Device (mono mic; mono hp) with Two Auxiliary Inputs

Figure 7-6 represents the stereo version of HS3. The second auxiliary signal path is allowed to be either mono (y=1) with a spatial location of Center Front or stereo (y=2) with spatial locations of Left Front and Right Front respectively.

Note that in the case where one or both of the auxiliary signal paths are stereo (x=2 or y=2), an additional Up/Down-mix Processing Unit ID20 shall be inserted between the Output Pin of Feature Unit ID5 and Input Pin 1 of Selector Unit ID9 to convert the mono signal from the microphone into a stereo signal. The mono microphone signal coming into the Up/Down-mix Processing Unit ID20 shall simply be duplicated into the Left Front and Right Front channels of the output.

Also note that in the case where the first auxiliary signal path is mono (x=1) and the second auxiliary signal path is stereo (y=2), an additional Up/Down-mix Processing Unit ID21 shall be inserted between the Output Pin of Feature Unit ID12 and Input Pin 2 of Selector Unit ID9 to convert the mono signal from the first auxiliary input into a stereo signal. The mono auxiliary signal coming into the Up/Down-mix Processing Unit ID20 shall simply be duplicated into the Left Front and Right Front channels of the output.

Further note that in the case where the second auxiliary signal path is mono (y=1) and the first auxiliary signal path is stereo (x=2), an additional Up/Down-mix Processing Unit ID22 shall be inserted between the Output Pin of Feature Unit ID15 and Input Pin 3 of Selector Unit ID9 to convert the mono signal from the second auxiliary input into a stereo signal. The mono auxiliary signal coming into the Up/Down-mix Processing Unit ID20 shall simply be duplicated into the Left Front and Right Front channels of the output.

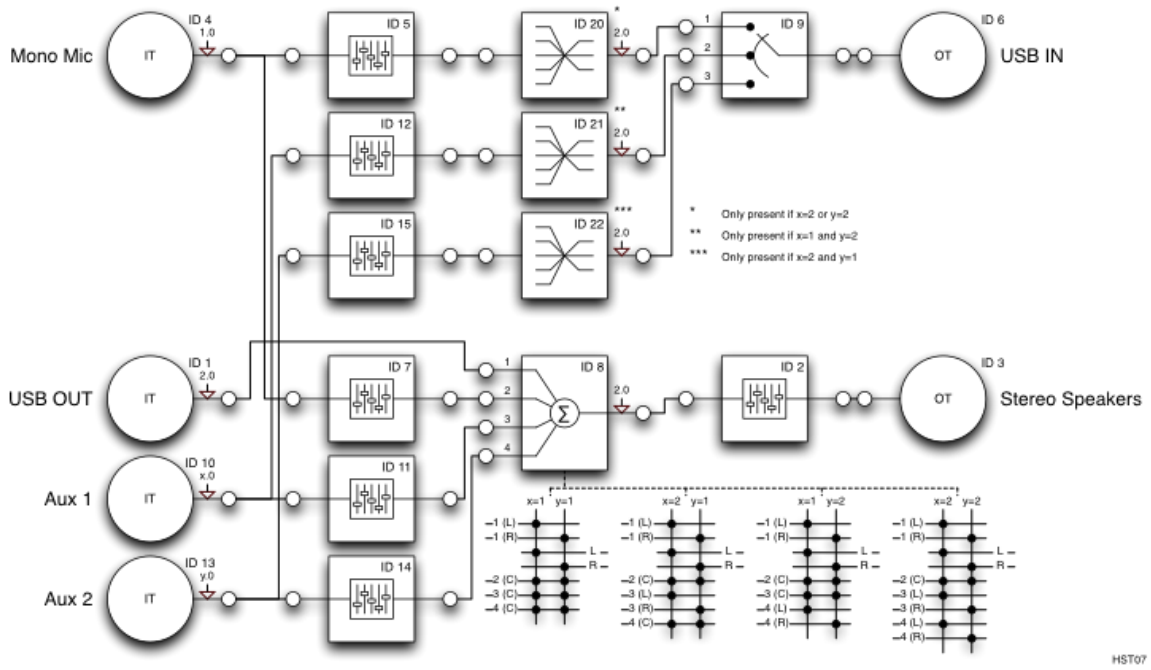

Figure 7-6: Stereo Headset Device (mono mic; stereo hp) with Two Auxiliary Inputs

7.3 Headset Descriptors

To allow for backward compatible extensions, additional fields may be added to the class-specific descriptors in future versions of this specification. Therefore, descriptor parsers should be tolerant of descriptor lengths that are larger than currently specified in the **bLength** fields of these descriptors.

7.3.1 Headset Device Descriptor

Because audio functionality is always considered to reside at the interface level, this class specification does not define a specific audio device descriptor. For *audio-only* devices, the device descriptor shall indicate that class information is to be found at the interface level. Therefore, the **bDeviceClass** field of the device descriptor shall contain zero so that enumeration software looks down at the interface level to determine the Interface Class, and the **bDeviceSubClass** and **bDeviceProtocol** fields shall also be set to zero.

All other fields of the device descriptor shall comply with the definitions in Section 9.6.1, "Descriptor" of the *USB Specification*. There is no class-specific device descriptor.

Table 7-1: Device Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x12	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x01	DEVICE descriptor.
2	bcdUSB	2	0x0200	USB Specification Release Number in

				Binary-Coded Decimal.
4	bDeviceClass	1	Class	See *USB Specification*.
5	bDeviceSubClass	1	Subclass	See *USB Specification*.
6	bDeviceProtocol	1	Protocol	See *USB Specification*.
7	bMaxPacketSize0	1	Number	See *USB Specification*.
8	idVendor	2	ID	See *USB Specification*.
10	idProduct	2	ID	See *USB Specification*.
12	bcdDevice	2	BCD	See *USB Specification*.
14	iManufacturer	1	Index	See *USB Specification*.
15	iProduct	1	Index	See *USB Specification*.
16	iSerialNumber	1	Index	See *USB Specification*.
17	bNumConfigurations	1	Number	Shall contain a value greater than or equal to 0x01.

7.3.2 Headset Configuration Descriptor

The Configuration descriptor describes information about a specific configuration of the device.

As indicated in Section 3, “Classification”, this specification requires that a Basic Audio device support one (and only one) compliant basic audio function in its default Device Configuration. This section outlines this default Device Configuration descriptor.

If a HID interface is present then the **bNumInterfaces** field shall contain a value greater than or equal to 0x04. Otherwise, the **bNumInterfaces** field shall contain a value greater than or equal to 0x03.

The **bmAttributes** field indicates whether the device is self-powered (D6=0b1) or bus-powered (D6=0b0) and also whether the device supports Remote Wakeup (D5=0b1) or not (d5=0b0). Bit D7 shall be set to 0b1 for historical reasons while bits D4..0 shall be reset to 0b00000.

Table 7-2: Configuration Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x02	CONFIGURATION descriptor.
2	wTotalLength	2	Number	Length of the total configuration block, including this descriptor, in bytes.

Offset	Field	Size	Value	Description
4	bNumInterfaces	1	Number	At least three interfaces for a Headset device: one AudioControl interface, two AudioStreaming interfaces. Additional functions, such as HID, may require additional interfaces.
5	bConfigurationValue	1	Number	ID of this configuration.
6	iConfiguration	1	Index	Index of string descriptor describing this Configuration.
7	bmAttributes	1	0b1xx00000	Self- or bus-powered device, Remote Wakeup capability can be supported.
8	bMaxPower	1	Number	See *USB Specification*. The value shall indicate no more than one unit load.

7.3.3 Headset Interface Descriptors

For a general description and overview of the Audio Device Class Interface descriptors, refer to the *Audio 1.0 Specification*. The following sections describe the standard and class-specific USB Interface descriptors as they relate to a USB Headset Device.

7.3.3.1 Headset AudioControl Interface Descriptors

The AudioControl interface describes the device structure (audio function topology) and is used to manipulate the Audio Controls, present in the Headset device.

7.3.3.1.1 Headset Standard AC Interface Descriptor

The standard AC interface descriptor is identical to the standard interface descriptor defined in Section 9.6.3, "Interface" of the *USB Specification*, except that most fields have now dedicated values.

The AudioControl interface has no dedicated endpoints associated with it. It uses the default pipe (endpoint 0) for all communication purposes. Class-specific AudioControl Requests are sent using the default pipe. A Status Interrupt endpoint is not allowed.

The **bInterfaceProtocol** field contains a value that fully describes the nature of the Headset device. Only those codes pertaining to Headsets are allowed. This value can potentially be used by driver software to bypass the process of parsing the entire set of Headset descriptors.

Note: Some descriptor field values, such as endpoint addresses, certain parameter values, etc. and also some descriptor lengths may vary among implementations so that a rudimentary form of parsing cannot be avoided entirely.

Table 7-3: Headset Standard AC Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.

Offset	Field	Size	Value	Description
1	bDescriptorType	1	0x04	INTERFACE descriptor type
2	bInterfaceNumber	1	0x00	Number of the AudioControl interface. The AudioControl interface shall be the first interface in the collection.
3	bAlternateSetting	1	0x00	The AudioControl interface of the Headphone only supports the default Alternate Setting zero.
4	bNumEndpoints	1	0x00	A status interrupt endpoint is not allowed.
5	bInterfaceClass	1	0x01	AUDIO. Audio Interface Class code.
6	bInterfaceSubClass	1	0x01	AUDIOCONTROL. Audio Interface Subclass code.
7	bInterfaceProtocol	1	Number	Number that fully describes the nature of the Headset device. See Appendix A.1, “Audio Function Basic Audio Device Codes” for allowed values.
8	iInterface	1	Index	Index of a string descriptor that describes this interface. If no string is provided, shall be set to 0x00.

7.3.3.1.2 Headset Class-Specific AC Interface Descriptor

The Class-specific AC interface descriptor is always headed by a Header descriptor that contains general information about the AudioControl interface. It contains all the pointers needed to describe the Audio Interface Collection, associated with the described audio function. The following table defines the class-specific AC interface header descriptor.

Table 7-4: Headset Class-Specific AC Interface Header Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x0A	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x01	HEADER descriptor subtype.
3	bcdADC	2	0x0100	Audio 1.0.
5	wTotalLength	2	Number	Total number of bytes returned for the class-specific AudioControl interface descriptor (including this descriptor).
7	bInCollection	1	0x02	Two AudioStreaming interface in the Collection.

Offset	Field	Size	Value	Description
8	baInterfaceNr(1)	1	Number	Interface number of the OUT AudioStreaming interface in the Collection. Shall be one greater than the interface number of the associated AudioControl interface.
9	baInterfaceNr(2)	1	Number	Interface number of the IN AudioStreaming interface in the Collection. Shall be two greater than the interface number of the associated AudioControl interface.

For HS1, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Mixer Unit ID8 descriptor, the Feature Unit ID2 descriptor, the Output Terminal ID3 descriptor, the Input Terminal ID4 descriptor, the Feature Unit ID5 descriptor, [the optional Selector Unit ID9 descriptor,] the Output Terminal ID6 descriptor, and the Feature Unit ID7 descriptor, in that order.

For HS2, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Mixer Unit ID8 descriptor, the Feature Unit ID2 descriptor, the Output Terminal ID3 descriptor, the Input Terminal ID4 descriptor, the Feature Unit ID5 descriptor, the Selector Unit ID9, the Output Terminal ID6 descriptor, the Feature Unit ID7 descriptor, the Input Terminal ID10 descriptor, the Feature Unit ID11 descriptor, and the Feature Unit ID12 descriptor, in that order. If necessary, the Up/Down-mix Processing Unit ID20 descriptor is appended to the HS2 set.

For HS3, the Header descriptor is followed by the Input Terminal ID1 descriptor, the Mixer Unit ID8 descriptor, the Feature Unit ID2 descriptor, the Output Terminal ID3 descriptor, the Input Terminal ID4 descriptor, the Feature Unit ID5 descriptor, the Selector Unit ID9 descriptor, the Output Terminal ID6 descriptor, the Feature Unit ID7 descriptor, the Input Terminal ID10 descriptor, the Feature Unit ID11 descriptor, the Feature Unit ID12 descriptor, the Input Terminal ID13 descriptor, the Feature Unit ID14 descriptor, and the Feature Unit ID15 descriptor, in that order. If necessary, the Up/Down-mix Processing Unit ID20 descriptor, the Up/Down-mix Processing Unit ID21 descriptor, and/or the Up/Down-mix Processing Unit ID22 descriptor are appended to the HS3 set in that order.

7.3.3.1.3 Headset Input Terminal ID1 Descriptor

This descriptor is identical to the Headphone Input Terminal ID1 descriptor (see Section 5.3.3.1.3, “Headphone Input Terminal ID1 Descriptor”).

7.3.3.1.4 Headset Input Terminal ID10 Descriptor

This descriptor is only present in the case of HS2 or HS3 and describes the Input Terminal that represents the first auxiliary input for HS2 and HS3. The digital audio stream leaves Input Terminal ID10 through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x0A and the **wTerminalType** field shall be set to a value that accurately describes the usage of this Input Terminal.

Allowed values for the **wTerminalType** field can be found in the Audio 1.0 Terminal Types Specification.

Refer to Section 5.3.3.1.6, “Generic Input Terminal Descriptor” for the actual descriptor(s) with TID=0x0A and TT set to the appropriate value for the **wTerminalType** field.

7.3.3.1.5 Headset Input Terminal ID13 Descriptor

This descriptor is only present in the case of HS3 and describes the Input Terminal that represents the second auxiliary input for HS3. The digital audio stream leaves Input Terminal ID13 through the single Output Pin. The **bTerminalID** field for this Input Terminal descriptor shall be set to 0x0D and the **wTerminalType** field shall be set to a value that accurately describes the usage of this Input Terminal. Allowed values for the **wTerminalType** field can be found in the Audio 1.0 Terminal Types Specification.

Refer to Section 5.3.3.1.6, “Generic Input Terminal Descriptor” for the actual descriptor(s) with TID=0x0D and TT set to the appropriate value for the **wTerminalType** field.

7.3.3.1.6 Headset Microphone Input Terminal ID4 Descriptor

This descriptor is identical to the *Mono* Microphone Input Terminal descriptor (see Section 6.3.3.1.3, “Microphone Input Terminal ID4 Descriptor”).

7.3.3.1.7 Headset Feature Unit ID2 Descriptor

This descriptor describes the Audio Controls that are present in the Feature Unit that is connected to the Output Pin of Mixer Unit ID8 of the Headset device. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x02 and the **bSourceID** field shall be set to 0x08.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x02 and SID=0x08.

7.3.3.1.8 Headset Feature Unit ID11 Descriptor

This descriptor is only present in the case of HS2 or HS3 and describes the Audio Controls that are present in the Feature Unit ID11 that is connected to the Output Pin of Input Terminal ID10. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0B and the **bSourceID** field shall be set to 0x0A.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x0B and SID=0x0A.

7.3.3.1.9 Headset Feature Unit ID14 Descriptor

This descriptor is only present in the case of HS3 and describes the Audio Controls that are present in the Feature Unit ID14 that is connected to the Output Pin of Input Terminal ID13. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0E and the **bSourceID** field shall be set to 0x0D.

Refer to Section 5.3.3.1.10, “Generic Feature Unit Descriptor” for the actual descriptor(s) with UID=0x0E and SID=0x0D.

7.3.3.1.10 Headset Feature Unit ID5 Descriptor

This descriptor describes the Audio Controls that are present in the Feature Unit that is connected to the Output Pin of Input Terminal ID4 of the Headset device. The **bUnitID** field of this Feature Unit shall be set to 0x05 and the **bSourceID** field shall be set to 0x04. Since only a mono microphone is supported, this Feature Unit descriptor is always a *Mono* Feature Unit descriptor

Refer to Section 5.3.3.1.10, "Generic Feature Unit Descriptor" for the actual *Mono* descriptor with UID=0x05 and SID=0x04.

7.3.3.1.11 Headset Feature Unit ID7 Descriptor

This descriptor describes the Audio Controls that are present in the Feature Unit that is also connected to the Output Pin of Input Terminal ID4 of the Headset device. This Feature Unit provides the Sidetone capability of the Headset device. The **bUnitID** field of this Feature Unit shall be set to 0x07 and the **bSourceID** field shall be set to 0x04. Since only a mono microphone is supported, this Feature Unit descriptor is always a *Mono* Feature Unit descriptor.

Refer to Section 5.3.3.1.10, "Generic Feature Unit Descriptor" for the actual *Mono* descriptor with UID=0x07 and SID=0x04.

7.3.3.1.12 Headset Feature Unit ID12 Descriptor

This descriptor is only present in the case of HS2 or HS3 and describes the Audio Controls that are present in the Feature Unit ID12 that is connected to the Output Pin of Input Terminal ID10. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0C and the **bSourceID** field shall be set to 0x0A.

Refer to Section 5.3.3.1.10, "Generic Feature Unit Descriptor" for the actual descriptor(s) with UID=0x0C and SID=0x0A.

7.3.3.1.13 Headset Feature Unit ID15 Descriptor

This descriptor is only present in the case of HS3 and describes the Audio Controls that are present in the Feature Unit ID15 that is connected to the Output Pin of Input Terminal ID13. The **bUnitID** field of this Feature Unit descriptor shall be set to 0x0F and the **bSourceID** field shall be set to 0x0D.

Refer to Section 5.3.3.1.10, "Generic Feature Unit Descriptor" for the actual descriptor(s) with UID=0x0F and SID=0x0D.

7.3.3.1.14 Headset Mixer Unit ID8 Descriptor

This descriptor describes the Mixer Unit ID8 that is connected to the Output Pin of Input Terminal ID1 on its Input Pin 1 and to the Output Pin of Sidetone Feature Unit ID7 on its Input Pin 2. The Output Pin of Feature Unit ID11 is connected to its Input Pin 3 in the case of HS2 and, additionally, the Output Pin of Feature Unit ID14 is connected to its Input Pin 4 in the case of HS3. The **bUnitID** field of this Mixer Unit descriptor shall be set to 0x08, the **baSourceID(1)** field shall be set to 0x01, and the **baSourceID(2)** field shall be set to 0x07. In the case of HS2 and HS3, the **baSourceID(3)** field shall be set to 0x0B, and in the case of HS3, the **baSourceID(4)** field shall be set to 0x0E.

The headphone signal path coming from Input Terminal ID1 can be either monophonic (Center Front channel) or stereophonic (Left and Right Front channels).

The signal path coming from Sidetone Feature Unit ID7 is always monophonic (Center Front channel).

All Mixer Controls are non-programmable and shall be set to either 0 dB (to indicate a connection) or to -∞ dB (to indicate the absence of a connection).

In the case of a mono headphone signal path, the auxiliary signal paths (for both HS2 and HS3) can only be mono as well (Center Front channel).

The total number of Mixer Controls (N) is 2 for HS1, 3 for HS2, and 4 for HS3. Therefore, the **bmControls** field always occupies one byte.

The following table presents the Mono Headset Mixer Unit ID8 descriptor for HS1.

Table 7-5: Mono Headset Mixer Unit ID8 Descriptor for HS1

Offset	Field	Size	Value	Description
0	bLength	1	0x0D	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x02	Two Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	bNrChannels	1	0x01	Mono signal path on Mixer Output Pin.
8	wChannelConfig	2	0x0004	Center Front channel.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	bmControls	1	0x00	No programmable Mixer Controls.
12	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Mono Headset Mixer Unit ID8 descriptor for HS2.

Table 7-6: Mono Headset Mixer Unit ID8 Descriptor for HS2

Offset	Field	Size	Value	Description
0	bLength	1	0x0E	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.

Offset	Field	Size	Value	Description
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	baSourceID(3)	1	0x0B	From Feature Unit ID11.
8	bNrChannels	1	0x01	Mono signal path on Mixer Output Pin.
9	wChannelConfig	2	0x0004	Center Front channel.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	1	0x00	No programmable Mixer Controls.
13	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Mono Headset Mixer Unit ID8 descriptor for HS3.

Table 7-7: Mono Headset Mixer Unit ID8 Descriptor for HS3

Offset	Field	Size	Value	Description
0	bLength	1	0x0F	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x04	Four Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	baSourceID(3)	1	0x0B	From Feature Unit ID11.
8	baSourceID(4)	1	0x0E	From Feature Unit ID14.
9	bNrChannels	1	0x01	Mono signal path on Mixer Output Pin.
10	wChannelConfig	2	0x0004	Center Front channel.
12	iChannelNames	1	0x00	Unused. Shall be set to 0x00.

Offset	Field	Size	Value	Description
13	bmControls	1	0x00	No programmable Mixer Controls.
14	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

In the case of a stereo headphone signal path, the auxiliary signal paths (for both HS2 and HS3) can be either mono (Center Front channel) or stereo (Left Front and Right Front).

The total number of Mixer Controls (N) is 6 for HS1, and 8 for HS2 when the auxiliary signal path is mono. For these two cases, the **bmControls** field occupies one byte.

N is 10 for HS2 when the auxiliary signal path is stereo. For HS3, N is 10 when both auxiliary signal paths are mono and 12 when one of the auxiliary signal paths is mono and the other is stereo, and 14 when both auxiliary signal paths are stereo. Therefore, the **bmControls** field occupies two bytes.

The following table presents the Stereo Headphone Mixer Unit ID8 descriptor for HS1.

Table 7-8: Stereo Headset Mixer Unit ID8 Descriptor for HS1

Offset	Field	Size	Value	Description
0	bLength	1	0x0D	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x02	Two Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
8	wChannelConfig	2	0x0003	Left Front and Right Front channels.
10	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
11	bmControls	1	0x00	No programmable Mixer Controls.
12	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Headset Mixer Unit ID8 descriptor for HS2 when the auxiliary signal path is mono.

Table 7-9: Stereo Headset Mixer Unit ID8 Descriptor for HS2 and mono Aux 1

Offset	Field	Size	Value	Description
0	bLength	1	0x0E	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	baSourceID(3)	1	0x0B	From Feature Unit ID11.
8	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
9	wChannelConfig	2	0x0003	Left Front and Right Front channels.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	1	0x00	No programmable Mixer Controls.
13	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Headset Mixer Unit ID8 descriptor for HS2 when the auxiliary signal path is stereo.

Table 7-10: Stereo Headset Mixer Unit ID8 Descriptor for HS2 and stereo Aux 1

Offset	Field	Size	Value	Description
0	bLength	1	0x0F	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	baSourceID(3)	1	0x0B	From Feature Unit ID11.
8	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.

Offset	Field	Size	Value	Description
9	wChannelConfig	2	0x0003	Left Front and Right Front channels.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bmControls	2	0x0000	No programmable Mixer Controls.
14	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

The following table presents the Stereo Headset Mixer Unit ID8 descriptor for HS3.

Table 7-11: Stereo Headset Mixer Unit ID8 Descriptor for HS3

Offset	Field	Size	Value	Description
0	bLength	1	0x10	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x04	MIXER_UNIT descriptor subtype.
3	bUnitID	1	0x08	ID of this Mixer Unit. Shall be set to 0x08.
4	bNrInPins	1	0x04	Four Input Pins.
5	baSourceID(1)	1	0x01	From Input Terminal ID1.
6	baSourceID(2)	1	0x07	From Feature Unit ID7.
7	baSourceID(3)	1	0x0B	From Feature Unit ID11.
8	baSourceID(4)	1	0x0E	From Feature Unit ID14.
9	bNrChannels	1	0x02	Stereo signal path on Mixer Output Pin.
10	wChannelConfig	2	0x0003	Left Front and Right Front channels.
12	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
13	bmControls	2	0x0000	No programmable Mixer Controls.
15	iMixer	1	Index	Index of a string descriptor, describing the Mixer Unit. If no string is provided, shall be set to 0x00.

7.3.3.1.15 Headset Selector Unit ID9 Descriptor

This descriptor is only present in the case of HS2 or HS3 and describes the Selector Unit that can be used to switch recording sources between the microphone input and the auxiliary input in the case of HS2. In the case of HS3, the second auxiliary input can be selected as well. The **bUnitID** field for this Selector Unit descriptor shall be set to 0x09.

The Selector Unit ID9 descriptor is independent of the number of channels in the signal path.

The following table presents the Selector Unit ID9 descriptor for HS2.

The **baSourceID(1)** field shall be set to either 0x05 if the auxiliary signal path is mono (x=1) or to 0x14 if the auxiliary signal path is stereo (x=2), therefore requiring the presence of Up/Down-mix Processing Unit ID20.

The **baSourceID(2)** fields shall be set to 0x0C.

Table 7-12: Headset Selector Unit ID9 Descriptor for HS2

Offset	Field	Size	Value	Description
0	bLength	1	0x08	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x05	SELECTOR_UNIT descriptor subtype.
3	bUnitID	1	0x09	ID of this Selector Unit. Shall be set to 0x09.
4	bNrInPins	1	0x02	Two Input Pins.
5	baSourceID(1)	1	0x05 or 0x14	From Feature Unit ID5 or from Up/Down-mix Unit ID20, if present.
6	baSourceID(2)	1	0x0C	From Feature Unit ID12.
7	iSelector	1	Index	Index of a string descriptor, describing the Selector Unit. If no string is provided, shall be set to 0x00.

The following table presents the Selector Unit ID9 descriptor for HS3.

The **baSourceID(1)** field shall be set to either 0x05 if both auxiliary signal paths are mono (x=1 and y=1) or to 0x14 if any of the auxiliary signal paths are stereo (x=2 or y=2), therefore requiring the presence of Up/Down-mix Processing Unit ID20.

The **baSourceID(2)** field shall be set to 0x15 if the first auxiliary signal path is mono and the second auxiliary signal path is stereo (x=1 or y=2), therefore requiring the presence of Up/Down-mix Processing Unit ID21, and to 0x0C in all other cases (x=1, y=1), (x=2, y=1), (x=2, y=2).

The **baSourceID(3)** field shall be set to 0x16 if the first auxiliary signal path is stereo and the second auxiliary signal path is mono (x=2 or y=1), therefore requiring the presence of Up/Down-mix Processing Unit ID22, and to 0x0E in all other cases (x=1, y=1), (x=1, y=2), (x=2, y=2).

Table 7-13: Headset Selector Unit ID9 Descriptor for HS3

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x05	SELECTOR_UNIT descriptor subtype.
3	bUnitID	1	0x09	ID of this Selector Unit. Shall be set to 0x09.
4	bNrInPins	1	0x03	Three Input Pins.
5	baSourceID(1)	1	0x05 or 0x14	From Feature Unit ID5 or from Up/Down-mix Unit ID20, if present.
6	baSourceID(2)	1	0x0C or 0x15	From Feature Unit ID12 or from Up/Down-mix Processing Unit ID21, if present.
7	baSourceID(3)	1	0x0E or 0x16	From Feature Unit ID15 or from Up/Down-mix Processing Unit ID22, if present.
8	iSelector	1	Index	Index of a string descriptor, describing the Selector Unit. If no string is provided, shall be set to 0x00.

7.3.3.1.16 Headset Output Terminal ID3 Descriptor

This descriptor is identical to the Headphone Output Terminal ID3 descriptor (see Section 5.3.3.1.11, “Headphone Output Terminal ID3 Descriptor”).

7.3.3.1.17 Headset Output Terminal ID6 Descriptor

This descriptor describes the Output Terminal that represents the USB pipe to the Host. Its Input Pin is connected to the Output Pin of Feature Unit ID5 in the case of HS1 and to the Output Pin of the Selector Unit ID9 in the case of HS2 and HS3. The **bTerminalID** field of this Output Terminal descriptor shall be set to 0x06 and the **bSourceID** field shall be set to 0x05 in the case of HS1 and to 0x09 in the case of HS2 and HS3.

The Headset Output Terminal ID6 descriptor is independent of the number of channels in the signal path and is presented in the following table.

Table 7-14: Headset Output Terminal ID6 Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.

Offset	Field	Size	Value	Description
2	bDescriptorSubtype	1	0x03	OUTPUT_TERMINAL descriptor subtype.
3	bTerminalID	1	0x06	ID of this Input Terminal. Shall be set to 0x06.
4	wTerminalType	2	0x0101	USB Streaming Terminal Type.
6	bAssocTerminal	1	0x00	No association.
7	bSourceID	1	0x05 or 0x09	From Feature Unit ID5 or from Selector Unit ID9.
8	iTerminal	1	Index	Index of a string descriptor, describing the Output Terminal. If no string is provided, shall be set to 0x00.

7.3.3.1.18 Headset Up/Down-mix Processing Unit ID20 Descriptor

This descriptor describes the Up/Down-mix Processing Unit that is used to convert the mono signal path coming from the microphone into a stereo signal path, if necessary. If present, its Input Pin is directly connected to the Output Pin of Feature Unit ID5 of the Headset device. The **bUnitID** field of this Up/Down-mix Processing Unit descriptor shall be set to 0x14 and the **bSourceID** field shall be set to 0x05.

Refer to Section 7.3.3.1.21, “Generic Up/Down-mix Processing Unit Descriptor” for the actual descriptor with UID=0x14 and SID=0x05.

7.3.3.1.19 Headset Up/Down-mix Processing Unit ID21 Descriptor

This descriptor describes the Up/Down-mix Processing Unit that is used to convert the mono signal path coming from the first auxiliary input into a stereo signal path, if necessary. If present, its Input Pin is directly connected to the Output Pin of Feature Unit ID12 of the Headset device. The **bUnitID** field of this Up/Down-mix Processing Unit descriptor shall be set to 0x15 and the **bSourceID** field shall be set to 0x0C.

Refer to Section 7.3.3.1.21, “Generic Up/Down-mix Processing Unit Descriptor” for the actual descriptor with UID=0x15 and SID=0x0C.

7.3.3.1.20 Headset Up/Down-mix Processing Unit ID22 Descriptor

This descriptor describes the Up/Down-mix Processing Unit that is used to convert the mono signal path coming from the second auxiliary input into a stereo signal path, if necessary. If present, its Input Pin is directly connected to the Output Pin of Feature Unit ID15 of the Headset device. The **bUnitID** field of this Up/Down-mix Processing Unit descriptor shall be set to 0x15 and the **bSourceID** field shall be set to 0x0F.

Refer to Section 7.3.3.1.21, “Generic Up/Down-mix Processing Unit Descriptor” for the actual descriptor with UID=0x15 and SID=0x0F.

7.3.3.1.21 Generic Up/Down-mix Processing Unit Descriptor

The Headset Up/Down-mix Processing Unit only has one mode and converts a mono Center Front input signal into a stereo Left Front and Right Front output signal. Since there is no point in bypassing the Processing Unit (it is only present when needed), the Enable Processing Control shall not be present. Since there is only one mode supported, the Mode Select Control shall not be present.

The Headset Up/Down-mix Processing Unit descriptor is presented in the following table.

Table 7-15: Generic Up/Down-mix Processing Unit Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x12	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x24	CS_INTERFACE descriptor type.
2	bDescriptorSubtype	1	0x07	PROCESSING_UNIT descriptor subtype.
3	bUnitID	1	UID	ID of this Up/Down-mix Processing Unit.
4	wProcessType	2	0x0001	UP/DOWNMIX_PROCESS Process Type.
6	bNrInPins	1	0x01	Number of Input Pins of this Unit.
7	bSourceID	1	SID	ID of the Entity to which this Unit is connected.
8	bNrChannels	1	0x02	Stereo signal path on Up/Down-mix Processing Unit Output Pin.
9	wChannelConfig	2	0x0003	Left Front and Right Front channels.
11	iChannelNames	1	0x00	Unused. Shall be set to 0x00.
12	bControlSize	1	0x01	Size, in bytes of the bmControls field.
13	bmControls	1	0x00	Enable Processing Control and Mode Select Controls shall not be present.
14	iProcessing	1	Index	Index of a string descriptor, describing the Processing Unit. If no string is provided, shall be set to 0x00.
15	bNrModes	1	0x01	Only Mono to Stereo Up-mix is supported.
16	waModes(1)	2	0x0003	Left Front and Right Front channels.

7.3.3.2 Headset AudioControl Endpoint Descriptors

Because endpoint 0 is used as the AudioControl control endpoint, there is no dedicated standard and class-specific control endpoint descriptor. Furthermore, since an interrupt

endpoint is not allowed in the AudioControl interface, there is no standard and class-specific interrupt endpoint descriptor.

7.3.3.3 Headset OUT AudioStreaming Interface Descriptors

The OUT AudioStreaming interface receives the data stream from the Host that is targeted to the speaker(s) of the Headset device. The Headset OUT AudioStreaming interface Descriptors are identical to the Headphone AudioStreaming Interface descriptors as defined in Section 5.3.3.3, "Headphone AudioStreaming Interface Descriptors".

7.3.3.4 Headset IN AudioStreaming Interface Descriptors

The IN AudioStreaming interface provides the data stream from the microphone or the auxiliary inputs of the Headset device to the Host. The Headset IN AudioStreaming interface Descriptors are identical to the Microphone AudioStreaming Interface descriptors as defined in Section 6.3.3.3, "Microphone AudioStreaming Interface Descriptors", except that the **bInterfaceNumber** field of the Microphone Standard AudioStreaming interface descriptor shall be set to 0x02 in all the appropriate descriptors (see Table 6-6, Table 6-7, and Table 6-12). The Headset IN AudioStreaming interface is the third interface in the collection.

7.3.4 String Descriptors

String descriptors are optional. They can be used to provide additional descriptive information about certain components of the device. See *USB Specification* Section 9.5.

7.4 Headset Requests

7.4.1 Standard Requests

The Headset shall support at a minimum the following standard requests:

- Clear Feature
- Get Configuration
- Get Descriptor
- Get Interface
- Get Status
- Set Address
- Set Configuration
- Set Feature
- Set Interface

See *USB Specification* Section 9.4.

7.4.2 Class-specific Requests

The following sections define the class-specific requests a Headset shall support.

7.4.2.1 Feature Unit Requests

The Headset Feature Unit requests are identical to the Headphone Feature Unit requests.

Refer to Section 5.4.2.1, “Feature Unit Requests” for details.

7.4.2.2 Mixer Unit Requests

The Headset Mixer Unit requests are identical to the Headphone Mixer Unit requests.

Refer to Section 5.4.2.2, “Mixer Unit Requests” for details.

7.4.2.3 Selector Unit Requests

The only available Control for a Selector Unit is the Selector Control.

7.4.2.3.1 Selector Control

Only the Selector Control attributes CUR and MAX shall be supported. All other attributes shall not be supported.

7.4.2.4 Up/Down-mix Processing Unit Requests

The Up/Down-mix Processing Units defined in this specification do not have any Controls incorporated. Therefore, there is no need for any Up/Down-mix Processing Unit request.

8 HID Support in Basic Audio Devices

8.1 Introduction

Headphone, Microphone, and Headset Basic Audio Devices that implement one or more buttons as defined in the sections below, shall expose an HID interface to provide functionality for the associated HID Controls as defined in this specification. Since there are no mandatory buttons defined for Basic Audio Devices, they only need to expose an HID interface if any of the optional buttons (as defined in this specification) are present.

8.2 Classification

There are two different types of HID Controls (buttons) recognized by this specification:

- Type I: Optional HID Controls, defined by this specification. Hosts shall provide support for all of these Controls and devices may choose to implement any of these Controls. If they do, they shall use the definitions, descriptors and the Reports as defined in this specification.
- Type II: Other optional HID Controls. If a device uses other HID feature(s), it may use standard HID usages, or a vendor specific definition. These shall be defined as additions to the HID Report descriptor and shall generate one or more separate HID Reports. The Host shall ignore unknown HID Controls, and shall ignore all HID Controls within unknown HID Collections.

A single Report (ID1) is defined below for the Type I HID Controls.

Hosts may ignore Type II Controls and/or Reports. Type I Controls shall not be defined in vendor-specific Reports (Reports with a report ID $\neq$ 0x01).

This specification defines three types of button presses: Short, Long, and Double. The Host may detect the type of button press from the Report. The duration of a Short or Long press is not specified in this document and is entirely defined by the Host. Also, the duration between two presses to constitute a Double press is not specified here and is entirely defined by the Host. The Host may act differently depending upon the type of button press.

HID Controls in the context of this specification have a Report Size of 1, a Logical Minimum of 0, and a Logical Maximum of 1. This makes them binary Controls. A value of 0 is reported when the Control is not active (not pressed) and a value of 1 is reported when the Control is active (pressed).

HID Reports are only generated when the state of a Control in the Report changes. (Keyboards support the use of the HID Idle function, but this function is not intended for non-Keyboards). Thus, when a button is pressed, a Report is generated with the corresponding HID Control having a value of 1, and when a button is released, a new Report is generated with the corresponding HID Control having a value of 0. A Report always contains the current state of *all* HID Controls in the Report.

8.3 Type I Optional HID Controls

8.3.1 All Basic Audio Devices

A Basic Audio Device (Headphone, Microphone, or Headset) may commonly support the following optional HID Controls. If present, they are provided in the same Report (ID1) as the Type I HID Controls (see Section 8.5.3, "HID Report Descriptor and Associated HID Report").

- Volume Up at HID Consumer Usage Page 0x0C, Usage 0xE9
- Volume Down at HID consumer Usage Page 0x0C, Usage 0x0EA
- Send/End i.e. Hook Switch at HID Telephony Device Usage Page 0x0B, Usage 0x20
- Microphone (Phone) Mute at HID Telephony Device Usage Page 0x0B, Usage 0x2F
- Play/Pause i.e. Play at HID Consumer Usage Page 0x0C, Usage 0xCD
- Scan Next Track at HID Consumer Usage Page 0x0C, Usage 0xB5
- Scan Previous Track at HID Consumer Usage Page 0x0C, Usage 0xB6
- Stop at HID Consumer Usage Page 0x0C, Usage 0xB7
- Fast Forward at HID Consumer Usage Page 0x0C, Usage 0xB3
- Rewind at HID Consumer Usage Page 0x0C, Usage 0xB4
- Redial at HID Telephony Usage Page 0x0B, Usage 0x24

A Short press on all buttons except Microphone Mute shall cause the specified action to be completed once. Other features may be attributed to Long and Double presses.

8.3.1.1 Volume Up and Down

For Headphone and Headset devices, Volume Up and Volume Down HID Controls shall cause the Host to increment (for Volume Up) and decrement (for Volume Down) the associated Audio Volume Control(s) in Feature Unit ID2 that control the volume of the Headphone or Headset speaker(s).

For Microphone devices, Volume Up and Volume Down HID Controls shall cause the Host to increment (for Volume Up) and decrement (for Volume Down) the associated Audio Volume Control(s) in Feature Unit ID5 that control the input level (input gain) of the microphone(s).

Note that for Headset devices, there is no method defined by this specification to control the input sensitivity of the microphone. If such functionality is desired, it should be implemented as a Type II HID Control.

A Short press shall cause the Host to increment or decrement the value of the Audio Volume Control(s) by one step. A Long press may cause the Host to repeatedly increment or decrement the value of the Audio Volume Control(s) until the Control returns to the unpressed state or until the Headset speaker volume reaches the maximum

or minimum value. The size of these increments (or decrements) is not specified in this document and is ultimately controlled by Host software. The time between the increments or decrements for either Short or Long presses is also not specified in this document.

A Double press of the Volume Up and Volume Down HID Controls shall be interpreted as multiple single Short presses of the Volume Up or Volume Down Controls.

8.3.1.2 Hook Switch

The behavior corresponding to a Long or Double press of the Hook Switch is unspecified. Examples of Host features corresponding to such button presses may include activating the voice dialing application or redialing the last called number.

8.3.1.3 Microphone Mute

The Microphone Mute button shall be implemented as a relative HID control. A Short press of the Microphone Mute button shall cause the Host to toggle the current state of the Audio Mute Control in Feature Unit ID5. Mute HID Controls (buttons) work as toggles. Whenever a Mute HID Control transitions from a 0 state to a 1 state, the Host shall cause the associated Audio Mute Control to toggle (from Off to On if the Audio Mute Control was Off, or from On to Off if the Audio Mute Control was On), and shall record that the Mute HID Control is now in the 1 state. When a Mute HID Control transitions from a 1 to a 0 state, the Host shall take no action other than to update its internal copy of the Mute HID Control state.

8.3.1.4 Scan Next and Scan Previous Track

A Long press of Scan Next Track or Scan Previous Track may activate the Fast Forward or Rewind feature on the Host application.

8.4 Type II Optional HID Controls

As a composite HID/Audio device, a Basic Audio device may support other HID Controls, not defined in this specification. However, those Controls shall be placed in one or more separate Reports, other than the Report (ID1) defined in Section 8.5.3, “HID Report Descriptor and Associated HID Report”. Format and descriptors for such Reports are beyond the scope of this specification.

8.5 HID Interface Descriptors

If a Basic Audio Device implements any of the optional HID Controls, it shall expose an HID interface and provide the configuration descriptors as presented below.

8.5.1 HID Standard Interface Descriptors

Table 8-1: HID Standard Interface Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x04	INTERFACE descriptor type

Offset	Field	Size	Value	Description
2	bInterfaceNumber	1	0x02 or 0x03	Number of the HID interface. For Headphone and Microphone devices, the HID interface is the third interface in the collection (0x02). For Headset devices, the HID interface is the fourth interface in the collection (0x03).
3	bAlternateSetting	1	0x00	The HID interface only supports the default Alternate Setting zero.
4	bNumEndpoints	1	0x01	One interrupt endpoint.
5	bInterfaceClass	1	0x03	HID. HID Interface Class code.
6	bInterfaceSubClass	1	0x00	Subclass code not used. Shall be set to 0x00.
7	bInterfaceProtocol	1	0x00	Protocol code not used. Shall be set to 0x00.
8	iInterface	1	Index	Index of a string descriptor that describes this interface. If no string is provided, shall be set to 0x00.

8.5.2 HID Descriptor

Table 8-2: HID Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	Number	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x21	Class-specific HID descriptor type.
2	bcdHID	2	0x0111	HID Class Specification release – 1.11.
4	bCountryCode	1	0x00	Hardware target country – None.
5	bNumDescriptors	1	Number	Number of HID class descriptors to follow. Shall be at least 0x01 for the mandatory Report descriptor.
6	bDescriptorType	1	0x22	Descriptor type.
7	wDescriptorLength	2	Number	Total length of the Report descriptor. If the recommended Report descriptor from Table 8-4, “Recommended Report Descriptor for Report (ID1)” is used, this value shall be set to 0x43.
9	[bDescriptorType]	1	Number	Descriptor type. Optional field if there are more HID class descriptors present than the mandatory Report descriptor.

Offset	Field	Size	Value	Description
10	[wDescriptorLength]	2	Number	Length of the descriptor. Optional field if there are more HID class descriptors present than the mandatory Report descriptor.
12	…	…	…	Extended as needed. (See HID specification)

8.5.3 HID Report Descriptor and Associated HID Report

The mandatory HID Report (ID1) has the following format:

Table 8-3: HID Report (ID1)

Input	D7	D6	D5	D4	D3	D2	D1	D0
Byte 0	Report ID (0x01)							
Byte 1	Rewind	Fast Forward	Stop	Scan Previous	Scan Next	Play	Volume Down	Volume Up
Byte 2	Reserved (shall be reported as 0 and ignored by Host)					Mic Mute	Hook Switch	Redial

There are a variety of ways to write Report descriptors for a given Report. A recommended Report descriptor is given below, with simple instructions about how to modify it for unimplemented Controls. This Report descriptor trades size for ease of modification for unimplemented Controls. More compact Report descriptors are possible.

If an implementation uses a different Report descriptor, that Report descriptor shall maintain the exact Report ID and bit positions of the implemented Controls within the Report defined above, and may not extend the Report in any way or replace unimplemented Controls with other Controls.

Table 8-4: Recommended Report Descriptor for Report (ID1)

Value (Hex)	Item
0x05, 0x0C	USAGE_PAGE (Consumer Devices)
0x09, 0x01	USAGE (Consumer Remote Control)
0xA1, 0x01	COLLECTION (Application)
0x85, 0x01	Report ID (0x01)
0x15, 0x00	LOGICAL_MINIMUM (0)
0x25, 0x01	LOGICAL_MAXIMUM (1)
0x75, 0x01	REPORT_SIZE (1)
0x95, 0x01	REPORT_COUNT(1)
0x09, 0xE9	USAGE (Volume Up)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xEA	USAGE (Volume Down)
0x81, 0x02	INPUT (Data, Var, Abs)

Value (Hex)	Item
0x09, 0xCD	USAGE (Play/Pause)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xB5	USAGE (Scan Next Track)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xB6	USAGE (Scan Previous Track)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xB7	USAGE (Stop)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xB3	USAGE (Fast Forward)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xB4	USAGE (Rewind)
0x81, 0x02	INPUT (Data, Var, Abs)
0x05, 0x0B	USAGE_PAGE (Telephony Devices)
0x09, 0x24	USAGE (Redial)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0x20	USAGE (Hook Switch)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0x2F	USAGE (Microphone Mute)
0x81, 0x06	INPUT (Data, Var, Rel)
0x95, 0x05	REPORT_COUNT(5)
0x81, 0x01	INPUT (Cnst) (Pad report to 8 bits)
0xC0	END_COLLECTION

If a Control is not present, the Report descriptor may be modified as follows for each missing Control:

1. Remove the two rows, USAGE (**) and the following INPUT (Data, Var, Abs) that define the unimplemented Control.

Table 8-5: Remove Rows

Value (Hex)	Item
0x09, 0x**	USAGE (**)
0x81, 0x02	INPUT (Data, Var, Abs)

2. Replace with:

Table 8-6: Add Row

Value (Hex)	Item
0x81, 0x01	INPUT (Cnst)

3. Modify the **wDescriptorLength** field of the Interface HID Descriptor with the new length of the Report descriptor.

Examples for Headphone, Microphone and Headset Report descriptors can be found in Appendix A.2, “Example HID Descriptor and Report Descriptor for Headphone”, Appendix A.3, “Example HID Descriptor and Report Descriptor for Microphone”, and Appendix A.4, “Example HID Descriptor and Report Descriptor for Headset” respectively.

8.5.4 HID Interrupt Endpoint Descriptor

Table 8-7: HID Interrupt Endpoint Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x07	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x05	ENDPOINT descriptor.
2	bEndpointAddress	1	0b1000xxxx	IN Endpoint.
3	bmAttributes	1	0b00000011	Interrupt endpoint.
4	wMaxPacketSize	2	Number	Maximum packet size this endpoint is capable of sending when this configuration is selected. For this endpoint, this value shall be greater than or equal to the size of the largest HID Report defined on the interface. If the only Report defined is the mandatory Report (ID1), the proper value for this field is 0x03.
6	bInterval	1	Number	Interval for polling endpoint for data transfers, in ms.

Appendix A. Basic Audio Device Class Codes

A.1 Audio Function Basic Audio Device Codes

Table A-1: Audio Function Basic Audio Device Codes

Code	Value	Description
BASIC_CODE_UNDEFINED	0x00	No Basic Audio Device Code provided. See full Configuration description for device details.
M_HP_HT1	0x01	Mono Headphone using HT1 topology (no auxiliary inputs).
M_HP_HT2	0x02	Mono Headphone using HT2 topology (no auxiliary inputs).
M_HP_HT3	0x03	Mono Headphone using HT3 topology (no auxiliary inputs).
S_HP_HT1	0x04	Stereo Headphone using HT1 topology (no auxiliary inputs).
S_HP_HT2_MAUX1	0x05	Stereo Headphone using HT2 topology with mono auxiliary signal path.
S_HP_HT2_SAUX1	0x06	Stereo Headphone using HT2 topology with stereo auxiliary signal path.
S_HP_HT3_MAUX1_MAUX2	0x07	Stereo Headphone using HT3 topology with mono first auxiliary signal path and mono second auxiliary signal path.
S_HP_HT3_SAUX1_MAUX2	0x08	Stereo Headphone using HT3 topology with stereo first auxiliary signal path and mono second auxiliary signal path.
S_HP_HT3_MAUX1_SAUX2	0x09	Stereo Headphone using HT3 topology with mono first auxiliary signal path and stereo second auxiliary signal path.
S_HP_HT3_SAUX1_SAUX2	0x0A	Stereo Headphone using HT3 topology with stereo first auxiliary signal path and stereo second auxiliary signal path.
M_MIC	0x0B	Mono Microphone.
S_MIC	0x0C	Stereo microphone.
M_HS_HS1	0x0D	Mono Headset using HS1 topology.
M_HS_HS2	0x0E	Mono Headset using HS2 topology.
M_HS_HS3	0x0F	Mono Headset using HS3 topology.
S_HS_HS1	0x10	Stereo Headset using HS1 topology.

Code	Value	Description
S_HS_HS2_MAUX1	0x11	Stereo Headset using HS2 topology with mono auxiliary signal path.
S_HS_HS2_SAUX1	0x12	Stereo Headset using HS2 topology with stereo auxiliary signal path.
S_HS_HS3_MAUX1_MAUX2	0x13	Stereo Headset using HS3 topology with mono first auxiliary signal path and mono second auxiliary signal path.
S_HS_HS3_SAUX1_MAUX2	0x14	Stereo Headset using HS3 topology with stereo first auxiliary signal path and mono second auxiliary signal path.
S_HS_HS3_MAUX1_SAUX2	0x15	Stereo Headset using HS3 topology with mono first auxiliary signal path and stereo second auxiliary signal path.
S_HS_HS3_SAUX1_SAUX2	0x16	Stereo Headset using HS3 topology with stereo first auxiliary signal path and stereo second auxiliary signal path.

A.2 Example HID Descriptor and Report Descriptor for Headphones

The following HID descriptor and HID Report descriptor can be used in Headphone devices to indicate support for Volume Up, Volume Down and Phone Mute Controls only.

Table A-2: Example HID Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x21	Class-specific HID descriptor type..
2	bcdHID	2	0x0111	HID Class Specification release – 1.11.
4	bCountryCode	1	0x00	Hardware target country – None.
5	bNumDescriptors	1	0x01	Number of HID class descriptors to follow.
6	bDescriptorType	1	0x22	Descriptor type.
7	wDescriptorLength	2	0x29	Total length of the Report descriptor.

Table A-3: Example Report Descriptor for Report (ID1) for Headphone

Value (Hex)	Item
0x05, 0x0C	USAGE_PAGE (Consumer Devices)
0x09, 0x01	USAGE (Consumer Remote Control)

Value (Hex)	Item
0xA1, 0x01	COLLECTION (Application)
0x85, 0x01	Report ID (0x01)
0x15, 0x00	LOGICAL_MINIMUM (0)
0x25, 0x01	LOGICAL_MAXIMUM (1)
0x75, 0x01	REPORT_SIZE (1)
0x95, 0x01	REPORT_COUNT(1)
0x09, 0xE9	USAGE (Volume Up)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xEA	USAGE (Volume Down)
0x81, 0x02	INPUT (Data, Var, Abs)
0x95, 0x08	REPORT_COUNT(8)
0x81, 0x01	INPUT (Cnst)
0x95, 0x01	REPORT_COUNT(1)
0x05, 0x0B	USAGE_PAGE (Telephony Devices)
0x09, 0x2F	USAGE (Microphone Mute)
0x81, 0x06	INPUT (Data, Var, Rel)
0x95, 0x05	REPORT_COUNT(5)
0x81, 0x01	INPUT (Cnst)
0xC0	END_COLLECTION

A.3 Example HID Descriptor and Report Descriptor for Microphones

The following HID descriptor and HID Report descriptor can be used in Microphone devices to indicate support for Phone Mute Control only.

Table A-4: Example HID Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x21	Class-specific HID descriptor type.
2	bcdHID	2	0x0111	HID Class Specification release – 1.11.
4	bCountryCode	1	0x00	Hardware target country – None.
5	bNumDescriptors	1	0x01	Number of HID class descriptors to follow.
6	bDescriptorType	1	0x22	Descriptor type.
7	wDescriptorLength	2	0x1F	Total length of the Report descriptor.

Table A-5: Example Report Descriptor for Report (ID1) for Microphone

Value (Hex)	Item
0x05, 0x0B	USAGE_PAGE (Consumer Devices)
0x09, 0x01	USAGE (Consumer Remote Control)
0xA1, 0x01	COLLECTION (Application)
0x85, 0x01	Report ID (0x01)
0x15, 0x00	LOGICAL_MINIMUM (0)
0x25, 0x01	LOGICAL_MAXIMUM (1)
0x75, 0x01	REPORT_SIZE (1)
0x95, 0x0A	REPORT_COUNT(10)
0x81, 0x01	INPUT (Cnst)
0x95, 0x01	REPORT_COUNT(1)
0x05, 0x0B	USAGE_PAGE (Telephony Devices)
0x09, 0x2F	USAGE (Microphone Mute)
0x81, 0x06	INPUT (Data, Var, Rel)
0x95, 0x05	REPORT_COUNT(5)
0x81, 0x01	INPUT (Cnst)
0xC0	END_COLLECTION

A.4 Example HID Descriptor and Report Descriptor for Headsets

The following HID descriptor and HID Report descriptor can be used in Headset devices to indicate support for Volume Up, Volume Down, Redial, Hook Switch and Microphone Mute Controls.

Table A-6: Example HID Descriptor

Offset	Field	Size	Value	Description
0	bLength	1	0x09	Size of this descriptor, in bytes.
1	bDescriptorType	1	0x21	Class-specific HID descriptor type.
2	bcdHID	2	0x0111	HID Class Specification release – 1.11.
4	bCountryCode	1	0x00	Hardware target country – None.
5	bNumDescriptors	1	0x01	Number of HID class descriptors to follow.
6	bDescriptorType	1	0x22	Descriptor type.
7	wDescriptorLength	2	0x31	Total length of the Report descriptor.

Table A-7: Example Report Descriptor for Report (ID1) for Headset

Value (Hex)	Item
0x05, 0x0C	USAGE_PAGE (Consumer Devices)
0x09, 0x01	USAGE (Consumer Remote Control)
0xA1, 0x01	COLLECTION (Application)
0x85, 0x01	Report ID (0x01)
0x15, 0x00	LOGICAL_MINIMUM (0)
0x25, 0x01	LOGICAL_MAXIMUM (1)
0x75, 0x01	REPORT_SIZE (1)
0x95, 0x01	REPORT_COUNT(1)
0x09, 0xE9	USAGE (Volume Up)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0xEA	USAGE (Volume Down)
0x81, 0x02	INPUT (Data, Var, Abs)
0x95, 0x08	REPORT_COUNT(6)
0x81, 0x01	INPUT (Cnst)
0x95, 0x01	REPORT_COUNT(1)
0x05, 0x0B	USAGE_PAGE (Telephony Devices)
0x09, 0x24	USAGE (Redial)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0x20	USAGE (Hook Switch)
0x81, 0x02	INPUT (Data, Var, Abs)
0x09, 0x2F	USAGE (Microphone Mute)
0x81, 0x06	INPUT (Data, Var, Rel)
0x95, 0x05	REPORT_COUNT(5)
0x81, 0x01	INPUT (Cnst) (Pad report to 8 bits)
0xC0	END_COLLECTION