



*CLOSED LOOP DESIGN LLC*

**USB BF70x Audio 1.0 Library v.1.1 Users Guide**

*Users Guide Revision 1.2*

**For Use With Analog Devices ADSP-BF70x Series Processors**

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## Disclaimer

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## Introduction

The Closed Loop Design (CLD) Audio 1.0 library creates a simplified interface for developing a USB Audio v1.0 device using the Analog Devices ADSP-BF707 EZ-Board and Analog Devices Audio EI3 Extender Board. The CLD BF70x Audio 1.0 library also includes support for a serial console and timer functions that facilitate creating timed events quickly and easily. The library's User application interface is comprised of parameters used to customize the library's functionality as well as callback functions used to notify the User application of events. These parameters and functions are described in greater detail in the CLD BF70x Audio 1.0 Library API section of this document.

## USB Background

The following is a very basic overview of some of the USB concepts that are necessary to use the CLD BF70x Audio 1.0 Library. However, it is still recommended that developers have at least a basic understanding of the USB 2.0 protocol. The following are some resources to refer to when working with USB and USB Audio v1.0:

- The USB 2.0 Specification: [http://www.usb.org/developers/docs/usb20\\_docs/](http://www.usb.org/developers/docs/usb20_docs/)
- The USB Device Class Definition for Audio Devices: [http://www.usb.org/developers/docs/devclass\\_docs/audio10.pdf](http://www.usb.org/developers/docs/devclass_docs/audio10.pdf)
- The USB Device Class Definition for Audio Data Formats: [http://www.usb.org/developers/docs/devclass\\_docs/frmts10.pdf](http://www.usb.org/developers/docs/devclass_docs/frmts10.pdf)
- USB in a Nutshell: A free online wiki that explains USB concepts. <http://www.beyondlogic.org/usbnutshell/usb1.shtml>
- "USB Complete" by Jan Axelson ISBN: 1931448086

USB is a polling based protocol where the Host initiates all transfers, all USB terminology is from the Host's perspective. For example an 'IN' transfer is when data is sent from a Device to the Host, and an 'OUT' transfer is when the Host sends data to a Device.

The USB 2.0 protocol defines a basic framework that devices must implement in order to work correctly. This framework is defined in the Chapter 9 of the USB 2.0 protocol, and is often referred to as the USB 'Chapter 9' functionality. Part of the Chapter 9 framework is standard USB requests that a USB Host uses to control the Device. Another part of the Chapter 9 framework is the USB Descriptors. These USB Descriptors are used to notify the Host of the Device's capabilities when the Device is attached. The USB Host uses the descriptors and the Chapter 9 standard requests to configure the Device. This process is called USB Enumeration. The CLD BF70x Audio 1.0 Library includes support for the USB standard requests and USB Enumeration using some of the parameters specified by the User application when initializing the library. These parameters are discussed in the `clد_bf70x_audio_1_0_lib_init` section of this document. The CLD BF70x Audio 1.0 Library facilitates USB enumeration and is Chapter 9 compliant without User Application intervention as shown in the flow chart below. For additional

information on USB Chapter 9 functionality or USB Enumeration please refer to one of the USB resources listed above.

### CLD BF70x Audio 1.0 Library USB Enumeration Flow Chart



All USB data is transferred using Endpoints that act as a source or sink for data based on the endpoint's direction (IN or OUT). The USB protocol defines four types of Endpoints, each of which has unique characteristics that dictate how they are used. The four Endpoint types are: Control, Interrupt, Bulk and

Isochronous. Data that is transmitted over USB is broken up into blocks of data called packets. For each endpoint type there are restrictions on the allowed max packet size. The allowed max packet sizes also vary based on the USB connection speed. Please refer to the USB 2.0 protocol for more information about the max packet size supported by the four endpoint types.

The CLD BF70x Audio 1.0 Library uses Control and Isochronous endpoints, these endpoint types will be discussed in more detail below.

A Control Endpoint is the only bi-directional endpoint type, and is typically used for command and status transfers. A Control Endpoint transfer is made up of three stages (Setup Stage, Data Stage and Status Stage). The Setup Stage sets the direction and size of the optional Data Stage. The Data Stage is where any data is transferred between the Host and Device. The Status Stage gives the Device the opportunity to report if an error was detected during the transfer. All USB Devices are required to include a default Control Endpoint at endpoint number 0, referred to as Endpoint 0. Endpoint 0 is used to implement all the USB Protocol defined Chapter 9 framework and USB Enumeration. In the CLD BF70x Audio 1.0 Library Endpoint 0 is also used to handle USB Audio Device Class v1.0 defined Set and Get requests. These requests are discussed in more detail in the USB Audio Device Class v1.0 Background section of this document

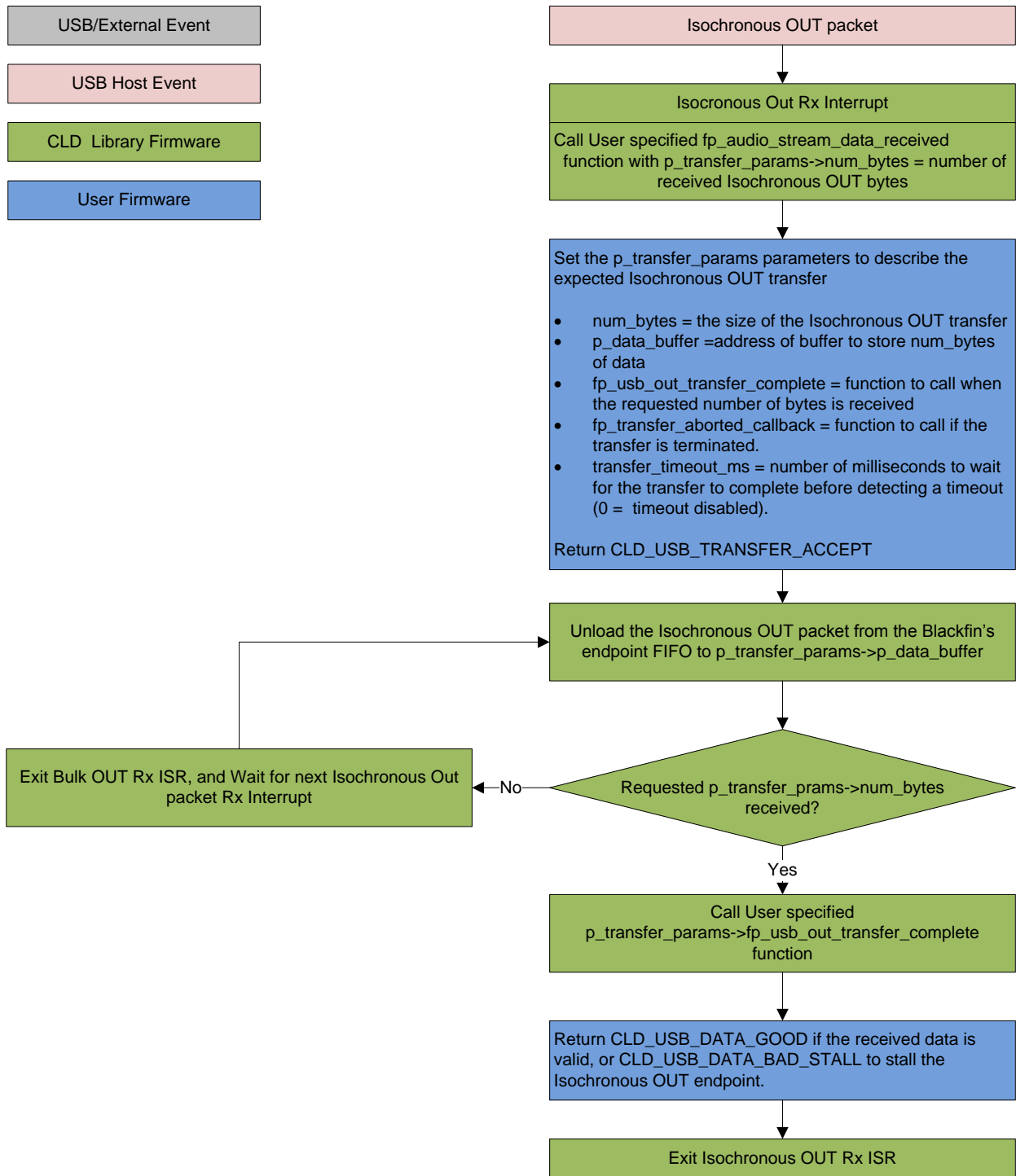
Isochronous Endpoints have the following characteristics which make them well suited for streaming audio data:

- Guaranteed USB bandwidth with bounded latency
- Constant data rate as long as data is provided to the endpoint.
- In the event of a transport error there is no retrying.

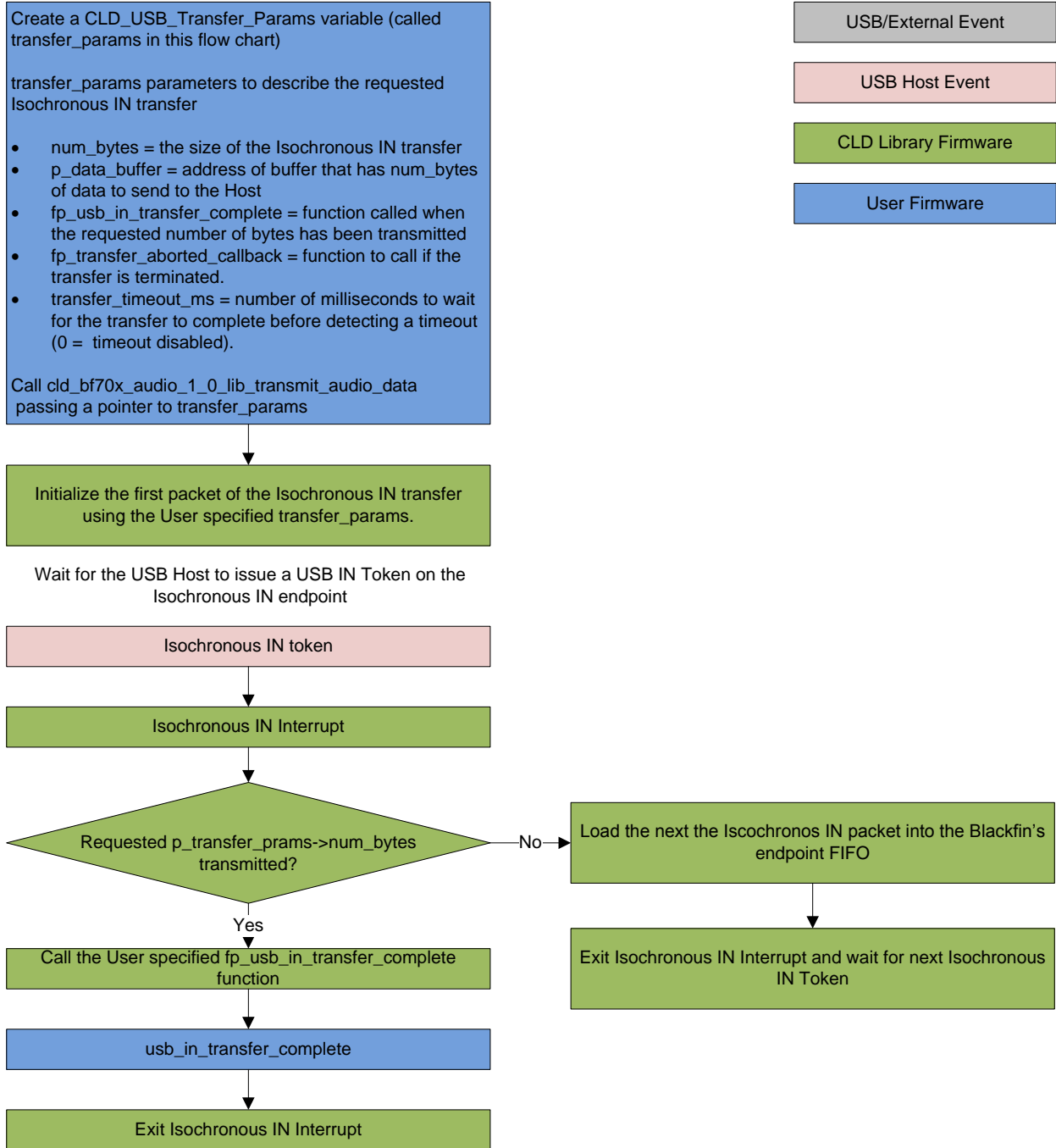
These characteristics allow for streaming audio data to be transmitted with deterministic timing. In the event of a USB transport error the audio data is dropped instead of being retried like a Bulk or Interrupt endpoint. This allows the streaming audio data to remain in sync. The CLD BF70x Audio 1.0 Library supports an Isochronous IN and Isochronous OUT endpoint, which are used to send and receive streaming audio data with the USB Host, respectively.

The flow charts below give an overview of how the CLD BF70x Audio Library and the User firmware interact to process Isochronous OUT and Isochronous IN transfers. Additionally, the User firmware code snippets included at the end of this document provide a basic framework for implementing a USB Audio v1.0 device using the CLD BF70x Audio 1.0 Library.

## CLD BF70x Audio 1.0 Library Isochronous OUT Flow Chart



## CLD BF70x Audio 1.0 Library Isochronous IN Flow Chart



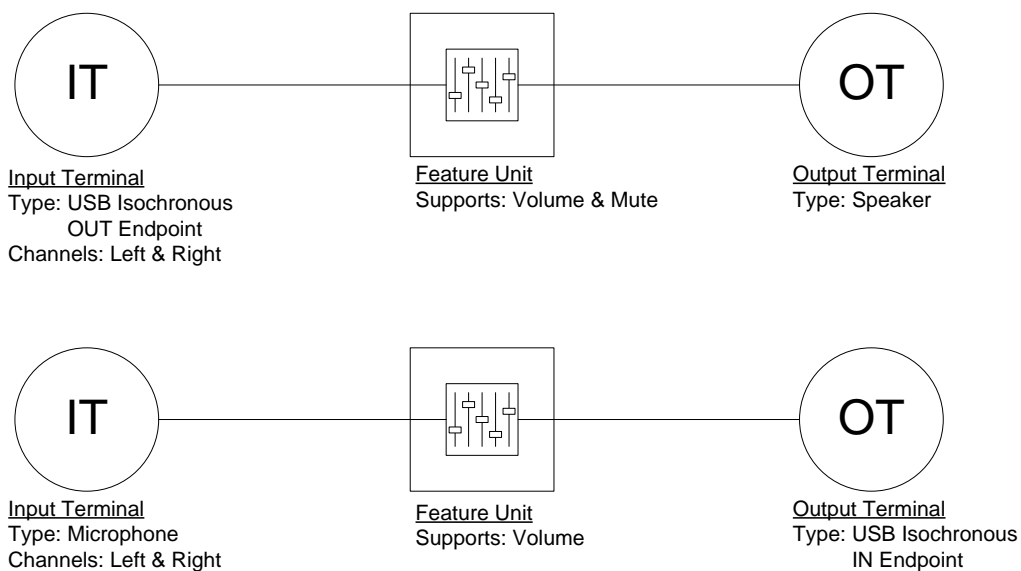


## USB Audio Device Class v1.0 Background

The following is a basic overview of some USB Audio Device v1.0 concepts that are necessary to use the CLD BF70x Audio 1.0 Library. However, it is recommended that developers have at least a basic understanding of the USB Audio Device Class v1.0 protocol.

The USB Audio Device Class v1.0 protocol is a USB Standard Class released by the USB IF committee, and it provides a standardized way for a device that is capable of audio input/output to communicate with a USB Host. The USB Audio Device Class v1.0 USB descriptors provide a detailed description of the Device's capabilities. This information includes the Device's supported audio sample rate(s), audio data format, input and output terminals and how the various audio processing components are connected and controlled.

The Device's audio processing capabilities are described using a series of USB Audio Class Terminal and Unit Descriptors. The Terminal Descriptors define how audio data is input and output (speakers, microphones, USB Isochronous endpoints, etc). The Unit Descriptors describe the Device's audio processing capabilities and how they connect to the input/output Terminals. The diagram below shows how the audio Terminal and Unit entities are connected in the CLD Audio 1.0 example project to implement a basic device with a stereo speaker output, and stereo microphone input.



More complex audio devices are created by connecting multiple Unit entities together to describe the Device's capabilities. For more information about the available Unit and Terminal entities, and how they are used please refer to the USB Audio Class Device v1.0 specification.

In order to successfully communicate with a USB Audio device the USB Host needs to know how the audio data is formatted. This is done using a audio stream format descriptor, which is part of the Streaming Audio Interface configuration. The USB Audio Device Class v1.0 specification supports multiple audio data formats which are described in the USB Device Class Definition for Audio Data Formats v1.0 specification. ([www.usb.org/developers/docs/devclass\\_docs/frmts10.pdf](http://www.usb.org/developers/docs/devclass_docs/frmts10.pdf))

## **Isochronous Endpoint Bandwidth Allocation**

As mentioned previously, one of the advantages of Isochronous endpoints is that they provide guaranteed USB bandwidth. However, this can also be a disadvantage when the bandwidth isn't being used as it is wasted.

To avoid this disadvantage the USB Audio Device Class v1.0 protocol requires that audio data streaming interfaces include two settings. The default setting does not have any Isochronous endpoints so its bandwidth requirement is zero. The alternate interface setting includes the required Isochronous endpoint. This allows the USB Host to enable the Isochronous endpoints when it needs to send or receive audio data, and disable them when the audio device is idle. This switch is done using the USB Chapter 9 Set Interface standard request.

When the CLD BF70x Audio 1.0 Library receives a Set Interface request a appropriate User callback function is called. Please refer to the `fp_audio_streaming_rx_endpoint_enabled` and `fp_audio_streaming_tx_endpoint_enabled` function pointer descriptions in the `cld_bf70x_audio_1_0_lib_init` section of this document for more information.

## **USB Audio Device Class v1.0 Control Endpoint Requests**

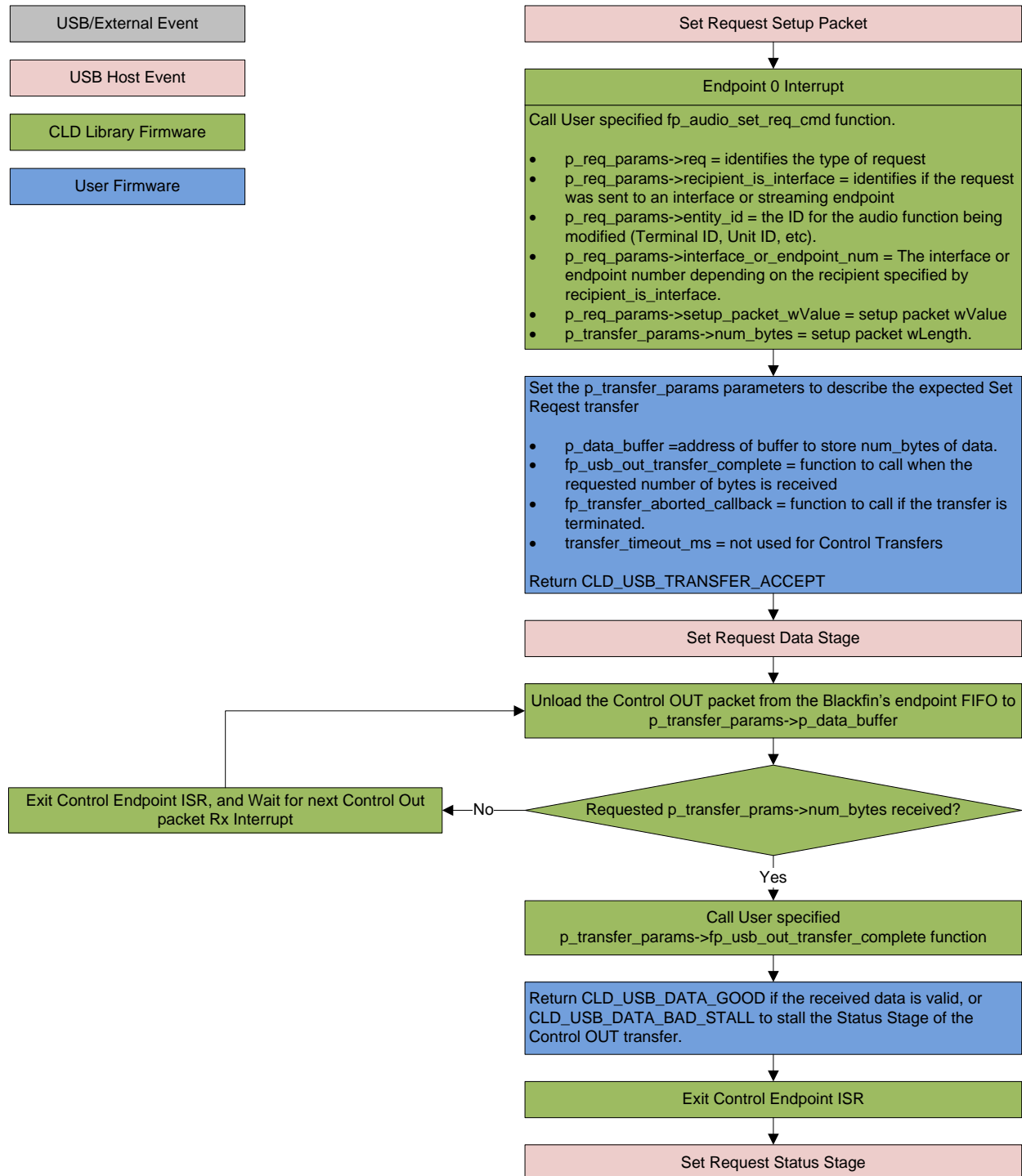
The USB Audio Device Class v1.0 control endpoint requests are broken down into Set and Get requests. These requests are used to control the various Terminal and Unit entities defined in the Configuration Descriptor. The CLD BF70x Audio 1.0 Library support for these requests is explained in the following sections.

Additionally, the User firmware code snippets included at the end of this document provide a basic framework for implementing the USB audio Control Endpoint requests using the CLD BF70x Audio 1.0 Library.

## USB Audio Device Class v1.0 Set Request

The USB Audio Device Class v1.0 Set Request is used to control the audio functions supported by the Device. This includes modifying the attributes of the Unit and Terminal entities as well as controlling features of the streaming audio endpoints.

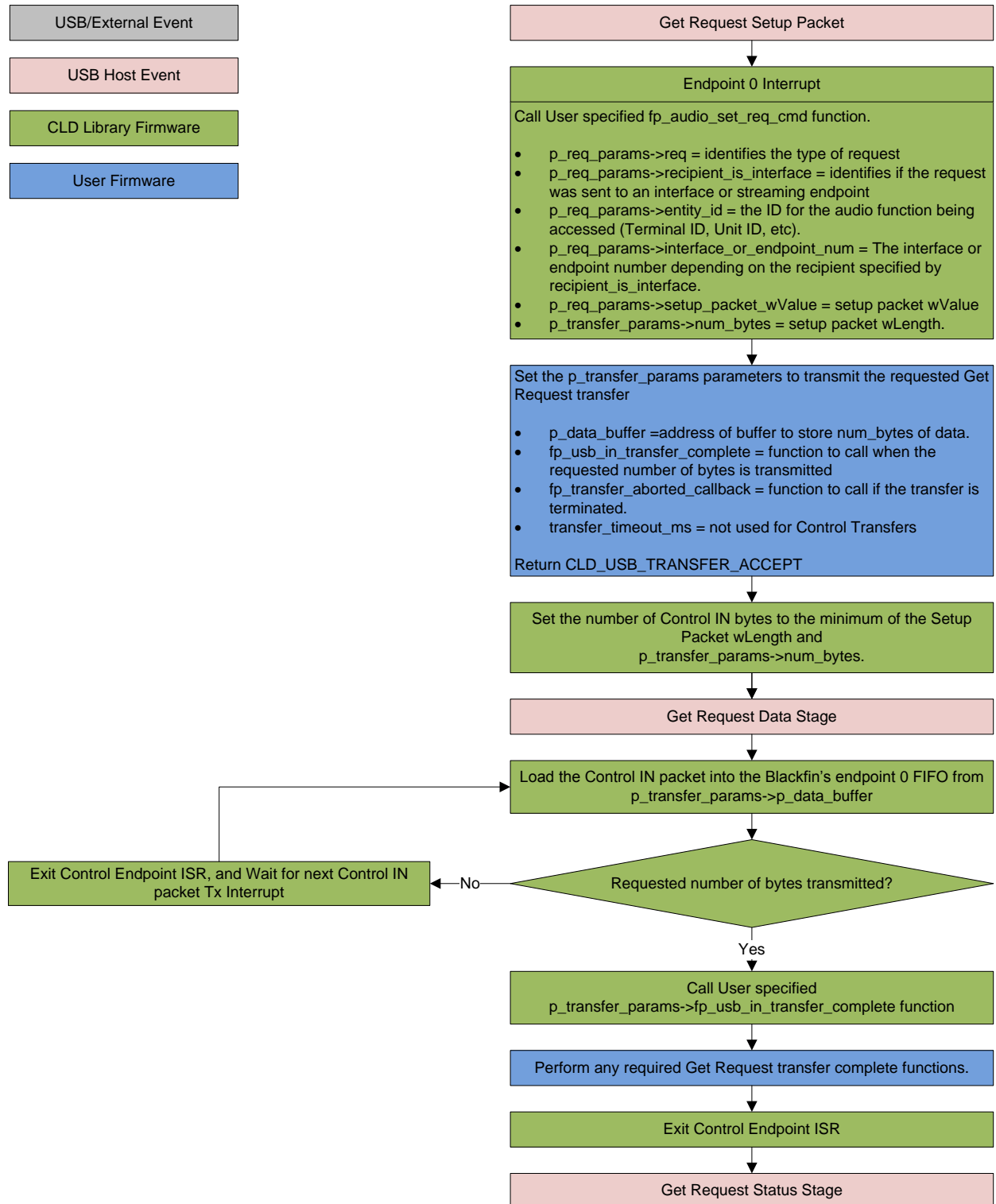
### CLD BF70x Audio Device Class v1.0 Set Request Flow Chart



## USB Audio Device Class v1.0 Get Request

The Get Request is a Control IN request used by the Host to request data from the audio functions supported by the Device. This includes requesting the attributes of the Unit and Terminal entities as well as features of the audio stream endpoints.

CLD BF70x Audio Device Class v1.0 Get Request Flow Chart



## Dependencies

In order to function properly, the CLD BF70x Audio 1.0 Library requires the following Blackfin resources:

- One Blackfin General Purpose Timer.
- 24Mhz clock input connected to the Blackfin USB0\_CLKIN pin.
- Optionally, the CLD BF70x Audio 1.0 Library can use one of the Blackfin UARTs to implement a serial console interface.
- The User firmware is responsible for setting up the Blackfin clocks, as well as enabling the Blackfin's System Event Controller (SEC) and configuring SEC Core Interface (SCI) interrupts to be sent to the Blackfin core.

## Memory Footprint

The CLD BF70x Audio 1.0 Library approximate memory footprint is as follows:

Code memory:	29464 bytes
Data memory:	5364 bytes
Total:	34828 bytes or 34.01k

Heap memory: 1152 bytes (only malloc'ed if optional `cld_console` is enabled)

Note: The CLD BF70x Audio 1.0 Library is currently optimized for speed (not space).

## CLD BF70x Audio 1.0 Library Scope and Intended Use

The CLD BF70x Audio 1.0 Library implements the USB Audio Device Class v1.0 required functionality to implement a USB Audio device, as well as providing time measurements and optional bi-directional UART console functionality. The CLD BF70x Audio 1.0 Library is designed to be added to an existing User project, and as such only includes the functionality needed to implement the above mentioned USB, timer and UART console features. All other aspects of Blackfin processor configuration must be implemented by the User code.

## CLD Audio 1.0 Example v1.2 Description

The `CLD_Audio_1_0_Ex_v1_2` project provided with the CLD BF70x Audio 1.0 Library implements a basic USB audio device that supports a single stereo microphone input and stereo headphone output. This example is designed to run on the ADSP-BF707 Ez-Board coupled with the Analog Devices Audio EI3 Extender (<http://www.analog.com/en/evaluation/eval-bfext-audei3/eb.html>), and requires the Audio EI3 Extender board support package to be installed.

For additional information about connecting and using the Audio EI3 Extender please refer to the "Using the ADI Audio EI3 Extender" section of this Users Guide.

## CLD BF70x Audio 1.0 Library API

The following CLD library API descriptions include callback functions that are called by the library based on USB events. The following color code is used to identify if the callback function is called from the USB interrupt service routine, or from mainline. The callback functions called from the USB interrupt service routine are also italicized so they can be identified when printed in black and white.

Callback called from the mainline context

*Callback called from the USB interrupt service routine*

### cld\_bf70x\_audio\_1\_0\_lib\_init

CLD\_RV **cld\_bf70x\_audio\_1\_0\_lib\_init** (CLD\_BF70x\_Audio\_1\_0\_Lib\_Init\_Params \*  
cld\_audio\_1\_0\_lib\_params)

Initialize the CLD BF70x Audio 1.0 Library.

#### Arguments

cld_audio_1_0_lib_params	Pointer to a CLD_BF70x_Audio_1_0_Lib_Init_Params structure that has been initialized with the User Application specific data.
--------------------------	---

#### Return Value

This function returns the CLD\_RV type which represents the status of the CLD BF70x Audio 1.0 Library initialization process. The CLD\_RV type has the following values:

CLD_SUCCESS	The library was initialized successfully
CLD_FAIL	There was a problem initializing the library
CLD_ONGOING	The library initialization is being processed

#### Details

The cld\_bf70x\_audio\_1\_0\_lib\_init function is called as part of the device initialization and must be repeatedly called until the function returns CLD\_SUCCESS or CLD\_FAIL. If CLD\_FAIL is returned the library will output an error message identifying the cause of the failure using the cld\_console UART if enabled by the User application. Once the library has been initialized successfully the main program loop can start.

The CLD\_BF70x\_Audio\_1\_0\_Lib\_Init\_Params structure is described below:

#### typedef struct

```
{  
    CLD_Timer_Num timer_num;  
    CLD_Uart_Num uart_num;  
    unsigned long uart_baud;  
    unsigned long sclk0;  
    void (*fp_console_rx_byte) (unsigned char byte);  
  
    unsigned short vendor_id;  
    unsigned short product_id;
```

```

unsigned char * p_unit_and_terminal_descriptors;
unsigned short unit_and_terminal_descriptors_length;

CLD_BF70x_Audio_1_0_Stream_Interface_Params *
    p_audio_streaming_rx_interface_params;

CLD_BF70x_Audio_1_0_Stream_Interface_Params *
    p_audio_streaming_tx_interface_params;

CLD_USB_Transfer_Request_Return_Type (*fp_audio_stream_data_received)
    (CLD_USB_Transfer_Params * p_transfer_data);

CLD_USB_Transfer_Request_Return_Type (*fp_audio_set_req_cmd)
    (CLD_BF70x_Audio_1_0_Cmd_Req_Parameters * p_req_params,
    CLD_USB_Transfer_Params * p_transfer_data);

CLD_USB_Transfer_Request_Return_Type (*fp_audio_get_req_cmd)
    (CLD_BF70x_Audio_1_0_Cmd_Req_Parameters * p_req_params,
    CLD_USB_Transfer_Params * p_transfer_data);

void (*fp_audio_streaming_rx_endpoint_enabled) (CLD_Boolean enabled);
void (*fp_audio_streaming_tx_endpoint_enabled) (CLD_Boolean enabled);

unsigned char usb_bus_max_power
unsigned short device_descriptor_bcdDevice

const char * p_usb_string_manufacturer;
const char * p_usb_string_product;
const char * p_usb_string_serial_number;
const char * p_usb_string_configuration;
const char * p_usb_string_audio_control_interface;
const char * p_usb_string_audio_streaming_out_interface;
const char * p_usb_string_audio_streaming_in_interface;

unsigned char user_string_descriptor_table_num_entries;
CLD_BF70x_Audio_1_0_Lib_User_String_Descriptors *
    p_user_string_descriptor_table;

unsigned short usb_string_language_id;

void (*fp_cld_usb_event_callback) (CLD_USB_Event event);
} CLD_BF70x_Audio_1_0_Lib_Init_Params;

```

A description of the CLD\_BF70x\_Audio\_1\_0\_Lib\_Init\_Params structure elements is included below:

Structure Element	Description
timer_num	<p>Identifies which of the ADSP-BF707 timers should be used by the CLD BF70x Audio 1.0 Library. The valid timer_num values are listed below:</p> <p>CLD_TIMER_0            CLD_TIMER_1            CLD_TIMER_2            CLD_TIMER_3            CLD_TIMER_4</p>

	<p>CLD_TIMER_5 CLD_TIMER_6 CLD_TIMER_7</p> <p>Any other timer_num values will result in the cld_bf70x_audio_1_0_lib_init function returning CLD_FAIL.</p>				
uart_num	<p>Identifies which of the ADSP-BF70x UARTs should be used by the CLD BF70x Audio 1.0 Library to implement the cld_console (refer to the cld_console API description for additional information). The valid uart_num values are listed below:</p> <p>CLD_UART_0 CLD_UART_1 CLD_UART_DISABLE</p> <p>If uart_num is set to CLD_UART_DISABLE the CLD BF70x Audio 1.0 Library will not use a UART, and the cld_console functionality is disabled.</p>				
uart_baud	<p>Sets the desired UART baud rate used for the cld_console. The remaining cld_console UART parameters are as follows:</p> <p>Number of data bits: 8 Number of stop bits: 1 No Parity No Hardware Flow Control</p>				
sclk0	Used to tell the CLD BF70x Audio 1.0 Library the frequency of the ADSP_BF70x SCLK0 clock.				
fp_console_rx_byte	<p>Pointer to the function that is called when a byte is received by the cld_console UART. This function has a single parameter ('byte') which is the value received by the UART.</p> <p><b>Note:</b> Set to NULL if not required by application</p>				
vendor_id	<p>The 16-bit USB vendor ID that is returned to the USB Host in the USB Device Descriptor.</p> <p>USB Vendor ID's are assigned by the USB-IF and can be purchased through their website (<a href="http://www.usb.org">www.usb.org</a>).</p>				
product_id	The 16-bit product ID that is returned to the USB Host in the USB Device Descriptor.				
p_unit_and_terminal_descriptors	Pointer to the Unit and Terminal Descriptors which are part of the Audio Control interface in the USB Configuration Descriptor.				
unit_and_terminal_descriptors_length	The length of the Unit and Terminal Descriptors addressed by p_unit_and_terminal_descriptors.				
p_audio_streaming_rx_interface_params	<p>Pointer to a CLD_BF70x_Audio_1_0_Stream_Interface_Params structure that describes how the Isochronous IN endpoint and related USB Audio Streaming interface should be configured. The a CLD_BF70x_Audio_1_0_Stream_Interface_Params structure contains the following elements:</p> <table border="1" data-bbox="630 1751 1422 1885"> <thead> <tr> <th>Structure Element</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>endpoint_num</td> <td>Sets the USB endpoint number of the Isochronous endpoint. The endpoint number must be</td> </tr> </tbody> </table>	Structure Element	Description	endpoint_num	Sets the USB endpoint number of the Isochronous endpoint. The endpoint number must be
Structure Element	Description				
endpoint_num	Sets the USB endpoint number of the Isochronous endpoint. The endpoint number must be				



		within the following range: $1 \leq \text{endpoint\_num} \leq 12$ . Any other endpoint number will result in the <code>cld_bf70x_audio_1_0_lib_init</code> function returning <code>CLD_FAIL</code> .
	<code>max_packet_size_full_speed</code>	Sets the Isochronous endpoint's max packet size when operating at Full Speed. The maximum max packet size is 1023 bytes.
	<code>max_packet_size_high_speed</code>	Sets the Isochronous endpoint's max packet size when operating at High Speed. The maximum max packet size is 1024 bytes.
	<code>b_interval_full_speed</code>	Full-Speed polling interval in the USB Endpoint Descriptor. (See USB 2.0 section 9.6.6)
	<code>b_interval_high_speed</code>	High-Speed polling interval in the USB Endpoint Descriptor. (See USB 2.0 section 9.6.6)
	<code>synchronization_type</code>	Sets the Isochronous endpoint synchronization type. 1 = Asynchronous 2 = Adaptive 3 = Synchronous
	<code>b_terminal_link</code>	The Terminal ID of the Terminal connected to this endpoint.
	<code>b_delay</code>	Delay in frames introduced by this endpoint's data path.
	<code>w_format_tag</code>	Identifies the audio data format use by this interface.
	<code>p_format_type_descriptor</code>	Pointer to the format descriptor defined in the USB Device Class Definition for Audio Data Formats v1.0 specification.
	<code>p_audio_stream_endpoint_data_descriptor</code>	Pointer to the Audio Streaming endpoint data descriptor (See USB Device Class Definition for Audio Devices v1.0 section 4.6.1.2).
<code>p_audio_streaming_tx_interface_params</code>	Pointer to a <code>CLD_BF70x_Audio_1_0_Stream_Interface_Params</code> structure that describes how the Isochronous OUT endpoint and related USB Audio Streaming interface should be configured. Refer to the <code>p_audio_streaming_rx_interface_params</code> description for information about the <code>CLD_BF70x_Audio_1_0_Stream_Interface_Params</code> structure.	

*fp\_audio\_stream\_data\_received*

Pointer to the function that is called when the Isochronous OUT endpoint receives data. This function takes a pointer to the CLD\_USB\_Transfer\_Params structure ('p\_transfer\_data') as a parameter.

The following CLD\_USB\_Transfer\_Params structure elements are used to processed a Isochronous OUT transfer:

Structure Element	Description
num_bytes	<p>The number of bytes to transfer to p_data_buffer before calling the fp_usb_out_transfer_complete callback function.</p> <p>When the fp_audio_stream_data_received function is called num_bytes is set the number of bytes in the current Isochronous OUT packet. If the Isochronous OUT total transfer size is known num_bytes can be set to the transfer size, and the CLD BF70x Audio 1.0 Library will complete the entire transfer before calling fp_audio_stream_data_received again. If num_bytes isn't modified the fp_audio_stream_data_received function will be called for each Isochronous OUT packet.</p>
p_data_buffer	Pointer to the data buffer to store the received Isochronous OUT data. The size of the buffer should be greater than or equal to the value in num_bytes.
<i>fp_usb_out_transfer_compelete</i>	Function called when num_bytes of data has been transferred to the p_data_buffer memory.
<i>fp_transfer_aborted_callback</i>	Function called if there is a problem transferring the requested Isochronous OUT data.
transfer_timeout_ms	Isochronous OUT transfer timeout in milliseconds. If the Isochronous OUT transfer takes

		<p>longer then this timeout the transfer is aborted and the <code>fp_transfer_aborted_callback</code> is called.</p> <p>Setting the timeout to 0 disables the timeout</p>										
<p><i>fp_audio_set_req_cmd</i></p>	<p>The <code>fp_audio_stream_data_received</code> function returns the <code>CLD_USB_Transfer_Request_Return_Type</code>, which has the following values:</p>											
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<p>Pointer to the function that is called when a USB Audio Device Class v1.0 Set Request is received. This function has a pointer to the <code>CLD_USB_Transfer_Params</code> structure (<code>'p_transfer_data'</code>), and a pointer to the <code>CLD_BF70x_Audio_1_0_Cmd_Req_Parameters</code> (<code>p_req_params</code>) as its parameters.</p> <p>The following <code>CLD_BF70x_Audio_1_0_Cmd_Req_Parameters</code> structure elements are used to processed a Set Request:</p>												
<table border="1"> <thead> <tr> <th data-bbox="618 1745 1036 1780">Structure Element</th> <th data-bbox="1036 1745 1442 1780">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="618 1780 1036 1885"> <p><code>req</code></p> </td> <td data-bbox="1036 1780 1442 1885"> <p>Identifies the type of request. The valid types if requests are listed below:</p> </td> </tr> </tbody> </table>	Structure Element	Description	<p><code>req</code></p>	<p>Identifies the type of request. The valid types if requests are listed below:</p>								
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	CLD_SET_CURRENT CLD_SET_MIN CLD_SET_MAX CLD_SET_RESOLUTION CLD_SET_MEMORY
recipient_is_interface	Identifies if the request was sent to an interface or Audio streaming endpoint
entity_id	The ID for the audio function being modified (Terminal ID, Unit ID, etc)
interface_or_endpoint_num	The interface or endpoint number for the request depending on the recipient specified by the recipient_is_interface parameter.
setup_packet_wValue	wValue field from the USB Setup Packet.

The following CLD\_USB\_Transfer\_Params structure elements are used to processed a Set Request:

Structure Element	Description
num_bytes	The number of bytes from the Setup Packet wLength field, which is the number of bytes that will be transferred to p_data_buffer before calling the fp_usb_out_transfer_complete callback function.
p_data_buffer	Pointer to the data buffer to store the Set Request data. The size of the buffer should be greater than or equal to the value in num_bytes.
<i>fp_usb_out_transfer_complete</i>	Function called when num_bytes of data has been written to the p_data_buffer memory.
<i>fp_transfer_aborted_callback</i>	Function called if there is a problem receiving the data, or if the transfer is interrupted.
transfer_timeout_ms	Not used for Control Requests since the Host has the ability to interrupt any Control transfer.

The fp\_audio\_set\_req\_cmd function returns the CLD\_USB\_Transfer\_Request\_Return\_Type, which has the

	following values:										
	<table border="1"> <thead> <tr> <th>Return Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>CLD_USB_TRANSFER_ACCEPT</td> <td>Notifies the CLD BF70x Audio 1.0 Library that the Set Request data should be accepted using the <code>p_transfer_data</code> values.</td> </tr> <tr> <td>CLD_USB_TRANSFER_PAUSE</td> <td>Requests that the CLD BF70x Audio 1.0 Library pause the Set Request transfer. This causes the Control Endpoint to be nak'ed until the transfer is resumed by calling <code>cld_bf70x_audio_1_0_lib_resume_paused_control_transfer</code>.</td> </tr> <tr> <td>CLD_USB_TRANSFER_DISCARD</td> <td>Requests that the CLD BF70x Audio 1.0 Library discard the number of bytes specified in <code>p_transfer_params-&gt;num_bytes</code>. In this case the library accepts the Set Request from the USB Host but discards the data.</td> </tr> <tr> <td>CLD_USB_TRANSFER_STALL</td> <td>This notifies the CLD BF70x Audio 1.0 Library that there is an error and the request should be stalled.</td> </tr> </tbody> </table>	Return Value	Description	CLD_USB_TRANSFER_ACCEPT	Notifies the CLD BF70x Audio 1.0 Library that the Set Request data should be accepted using the <code>p_transfer_data</code> values.	CLD_USB_TRANSFER_PAUSE	Requests that the CLD BF70x Audio 1.0 Library pause the Set Request transfer. This causes the Control Endpoint to be nak'ed until the transfer is resumed by calling <code>cld_bf70x_audio_1_0_lib_resume_paused_control_transfer</code> .	CLD_USB_TRANSFER_DISCARD	Requests that the CLD BF70x Audio 1.0 Library discard the number of bytes specified in <code>p_transfer_params-&gt;num_bytes</code> . In this case the library accepts the Set Request from the USB Host but discards the data.	CLD_USB_TRANSFER_STALL	This notifies the CLD BF70x Audio 1.0 Library that there is an error and the request should be stalled.
	Return Value	Description									
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	CLD_USB_TRANSFER_PAUSE	Requests that the CLD BF70x Audio 1.0 Library pause the Set Request transfer. This causes the Control Endpoint to be nak'ed until the transfer is resumed by calling <code>cld_bf70x_audio_1_0_lib_resume_paused_control_transfer</code> .									
CLD_USB_TRANSFER_DISCARD	Requests that the CLD BF70x Audio 1.0 Library discard the number of bytes specified in <code>p_transfer_params-&gt;num_bytes</code> . In this case the library accepts the Set Request from the USB Host but discards the data.										
CLD_USB_TRANSFER_STALL	This notifies the CLD BF70x Audio 1.0 Library that there is an error and the request should be stalled.										
<i>fp_audio_get_req_cmd</i>	<p>Pointer to the function that is called when a USB Audio Device Class v1.0 Get Request is received. This function has a pointer to the CLD_USB_Transfer_Params structure ('p_transfer_data'), and a pointer to the CLD_BF70x_Audio_1_0_Cmd_Req_Parameters (p_req_params) as its parameters.</p> <p>The following CLD_BF70x_Audio_1_0_Cmd_Req_Parameters structure elements are used to processed a Set Request:</p> <table border="1"> <thead> <tr> <th>Structure Element</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>req</td> <td>Identifies the type of request. The valid types if requests are listed below: CLD_GET_CURRENT CLD_GET_MIN CLD_GET_MAX CLD_GET_RESOLUTION CLD_GET_MEMORY CLD_GET_STATUS</td> </tr> <tr> <td>recipient_is_interface</td> <td>Identifies if the request was sent to an interface or Audio streaming endpoint</td> </tr> <tr> <td>entity_id</td> <td>The ID for the audio function being accessed (Terminal ID,</td> </tr> </tbody> </table>	Structure Element	Description	req	Identifies the type of request. The valid types if requests are listed below: CLD_GET_CURRENT CLD_GET_MIN CLD_GET_MAX CLD_GET_RESOLUTION CLD_GET_MEMORY CLD_GET_STATUS	recipient_is_interface	Identifies if the request was sent to an interface or Audio streaming endpoint	entity_id	The ID for the audio function being accessed (Terminal ID,		
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recipient_is_interface	Identifies if the request was sent to an interface or Audio streaming endpoint										
entity_id	The ID for the audio function being accessed (Terminal ID,										

	Unit ID, etc)
interface_or_endpoint_num	The interface or endpoint number for the request depending on the recipient specified by the recipient_is_interface parameter.
setup_packet_wValue	wValue field from the USB Setup Packet.

The following CLD\_USB\_Transfer\_Params structure elements are used to processed a Set Request:

Structure Element	Description
num_bytes	The number of bytes from the Setup Packet wLength field, which is the number of bytes that the device can send from p_data_buffer before calling the fp_usb_out_transfer_complete callback function.
p_data_buffer	Pointer to the data buffer used to source the Get Request data. The size of the buffer should be greater than or equal to the value in num_bytes.
<i>fp_usb_in_transfer_complete</i>	Function called when num_bytes of data has been transmitted to the USB Host.
<i>fp_transfer_aborted_callback</i>	Function called if there is a problem transmitting the data, or if the transfer is interrupted.
transfer_timeout_ms	Not used for Control Requests since the Host has the ability to interrupt any Control transfer.

The fp\_audio\_get\_req\_cmd function returns the CLD\_USB\_Transfer\_Request\_Return\_Type, which has the following values:

Return Value	Description
CLD_USB_TRANSFER_ACCEPT	Notifies the CLD BF70x Audio 1.0 Library that the Get Request data should be transmitted using the p_transfer_data values.
CLD_USB_TRANSFER_PAUSE	Requests that the CLD BF70x Audio 1.0 Library pause the Get Request transfer. This

		causes the Control Endpoint to be nak'ed until the transfer is resumed by calling <code>cld_bf70x_audio_1_0_lib_resume_paused_control_transfer</code> .
	CLD_USB_TRANSFER_DISCARD	Requests that the CLD BF70x Audio 1.0 Library to return a zero length packet in response to the Get Request.
	CLD_USB_TRANSFER_STALL	This notifies the CLD BF70x Audio 1.0 Library that there is an error and the request should be stalled.
<i>fp_audio_streaming_rx_endpoint_enabled</i>	Function called when the Isochronous OUT streaming interface is enabled/disabled by the USB Host using the Set Interface command.	
<i>fp_audio_streaming_tx_endpoint_enabled</i>	Function called when the Isochronous IN streaming interface is enabled/disabled by the USB Host using the Set Interface command.	
usb_bus_max_power	USB Configuration Descriptor <code>bMaxPower</code> value (0 = self powered). Refer to the USB 2.0 protocol section 9.6.3.	
device_descriptor_bcd_device	USB Device Descriptor <code>bcdDevice</code> value. Refer to the USB 2.0 protocol section 9.6.1.	
p_usb_string_manufacturer	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Manufacturer USB String Descriptor. If the Manufacturer String Descriptor is not used set <code>p_usb_string_manufacturer</code> to <code>CLD_NULL</code> .	
p_usb_string_product	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Product USB String Descriptor. If the Product String Descriptor is not used set <code>p_usb_string_product</code> to <code>CLD_NULL</code> .	
p_usb_string_serial_number	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Serial Number USB String Descriptor. If the Serial Number String Descriptor is not used set <code>p_usb_string_serial_number</code> to <code>CLD_NULL</code> .	
p_usb_string_configuration	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Configuration USB String Descriptor. If the Configuration String Descriptor is not used set <code>p_usb_string_configuration</code> to <code>CLD_NULL</code> .	
p_usb_string_audio_control_interface	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Audio Control Interface USB String Descriptor. If this interface String Descriptor is not used set it to <code>CLD_NULL</code> .	
p_usb_string_audio_streaming_out_interface	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Audio OUT Streaming Interface USB String Descriptor. If this interface String Descriptor is not used set it to <code>CLD_NULL</code> .	
p_usb_string_audio_streaming_in_interface	Pointer to the null-terminated string. This string is used by the CLD BF70x Audio 1.0 Library to generate the Audio IN Streaming	

	Interface USB String Descriptor. If this interface String Descriptor is not used set it to CLD_NULL.												
user_string_descriptor_table_num_entries	The number of entries in the array of CLD_BF70x_Audio_1_0_Lib_User_String_Descriptors structures addressed by p_user_string_descriptor_table. Set to 0 if p_user_string_descriptor_table is set to CLD_NULL.												
p_user_string_descriptor_table	<p>Pointer to an array of CLD_BF70x_Audio_1_0_Lib_User_String_Descriptors structures used to define any custom User defined USB string descriptors. This table is used to define any USB String descriptors for any string descriptor indexes that are used in the Terminal or Unit Descriptors.</p> <p>Set to CLD_NULL is not used.</p> <p>The CLD_BF70x_Audio_1_0_Lib_User_String_Descriptors structure elements are explained below:</p> <table border="1"> <thead> <tr> <th>Structure Element</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>string_index</td> <td>The USB String Descriptor index for the string. The string_index value is set to the index specified in the Terminal or Unit Descriptor associated with this string.</td> </tr> <tr> <td>p_string</td> <td>Pointer to a null terminated string.</td> </tr> </tbody> </table>	Structure Element	Description	string_index	The USB String Descriptor index for the string. The string_index value is set to the index specified in the Terminal or Unit Descriptor associated with this string.	p_string	Pointer to a null terminated string.						
Structure Element	Description												
string_index	The USB String Descriptor index for the string. The string_index value is set to the index specified in the Terminal or Unit Descriptor associated with this string.												
p_string	Pointer to a null terminated string.												
usb_string_language_id	16-bit USB String Descriptor Language ID Code as defined in the USB Language Identifiers (LANGIDs) document ( <a href="http://www.usb.org/developers/docs/USB_LANGIDs.pdf">www.usb.org/developers/docs/USB_LANGIDs.pdf</a> ). 0x0409 = English (United States)												
fp_cld_usb_event_callback	<p>Function that is called when one of the following USB events occurs. This function has a single CLD_USB_Event parameter.</p> <p>Note: This callback can be called from the USB interrupt or mainline context depending on which USB event was detected. The CLD_USB_Event values in the table below are highlighted to show the context the callback is called for each event.</p> <p>The CLD_USB_Event has the following values:</p> <table border="1"> <thead> <tr> <th>Return Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>CLD_USB_CABLE_CONNECTED</td> <td>USB Cable Connected.</td> </tr> <tr> <td>CLD_USB_CABLE_DISCONNECTED</td> <td>USB Cable Disconnected</td> </tr> <tr> <td>CLD_USB_ENUMERATED_CONFIGURED</td> <td>USB device enumerated (USB Configuration set to a non-zero value)</td> </tr> <tr> <td>CLD_USB_UN_CONFIGURED</td> <td>USB Configuration set to 0</td> </tr> <tr> <td>CLD_USB_BUS_RESET</td> <td>USB Bus reset received</td> </tr> </tbody> </table>	Return Value	Description	CLD_USB_CABLE_CONNECTED	USB Cable Connected.	CLD_USB_CABLE_DISCONNECTED	USB Cable Disconnected	CLD_USB_ENUMERATED_CONFIGURED	USB device enumerated (USB Configuration set to a non-zero value)	CLD_USB_UN_CONFIGURED	USB Configuration set to 0	CLD_USB_BUS_RESET	USB Bus reset received
Return Value	Description												
CLD_USB_CABLE_CONNECTED	USB Cable Connected.												
CLD_USB_CABLE_DISCONNECTED	USB Cable Disconnected												
CLD_USB_ENUMERATED_CONFIGURED	USB device enumerated (USB Configuration set to a non-zero value)												
CLD_USB_UN_CONFIGURED	USB Configuration set to 0												
CLD_USB_BUS_RESET	USB Bus reset received												



<b>Note:</b> Set to CLD_NULL if not required by application
---

### `cld_bf70x_audio_1_0_lib_main`

```
void cld_bf70x_audio_1_0_lib_main (void)
```

CLD BF70x Audio 1.0 Library mainline function

#### **Arguments**

None

#### **Return Value**

None.

#### **Details**

The `cld_bf70x_audio_1_0_lib_main` function is the CLD BF70x Audio 1.0 Library mainline function that must be called in every iteration of the main program loop in order for the library to function properly.

### `cld_bf70x_audio_1_0_lib_transmit_audio_data`

```
CLD_USB_Data_Transmit_Return_Type cld_bf70x_audio_1_0_lib_transmit_audio_data  
    (CLD_USB_Transfer_Params * p_transfer_data)
```

CLD BF70x Audio 1.0 Library function used to send data over the Isochronous IN endpoint.

#### **Arguments**

<code>p_transfer_data</code>	Pointer to a <code>CLD_USB_Transfer_Params</code> structure used to describe the data being transmitted.
------------------------------	--

#### **Return Value**

This function returns the `CLD_USB_Data_Transmit_Return_Type` type which reports if the Isochronous IN transmission request was started. The `CLD_USB_Data_Transmit_Return_Type` type has the following values:

<code>CLD_USB_TRANSMIT_SUCCESSFUL</code>	The library has started the requested Isochronous IN transfer.
<code>CLD_USB_TRANSMIT_FAILED</code>	The library failed to start the requested Isochronous IN transfer. This will happen if the Isochronous IN endpoint is busy, or if the <code>p_transfer_data-&gt;data_buffer</code> is set to <code>CLD_NULL</code>

#### **Details**

The `cld_bf70x_audio_1_0_lib_transmit_audio_data` function transmits the data specified by the `p_transfer_data` parameter to the USB Host using the Device's Isochronous IN endpoint.

The `CLD_USB_Transfer_Params` structure is described below.

```
typedef struct  
{
```

```

unsigned long num_bytes;
unsigned char * p_data_buffer;
union
{
    CLD_USB_Data_Received_Return_Type (*fp_usb_out_transfer_complete) (void);
    void (*fp_usb_in_transfer_complete) (void);
}callback;
void (*fp_transfer_aborted_callback) (void);
CLD_Time transfer_timeout_ms;
} CLD_USB_Transfer_Params;

```

A description of the CLD\_USB\_Transfer\_Params structure elements is included below:

Structure Element	Description
num_bytes	The number of bytes to transfer to the USB Host. Once the specified number of bytes has been transmitted the fp_usb_in_transfer_complete callback function will be called.
p_data_buffer	Pointer to the data to be sent to the USB Host. This buffer must include the number of bytes specified by num_bytes.
fp_usb_out_transfer_complete	Not Used for Isochronous IN transfers
<i>fp_usb_in_transfer_complete</i>	Function called when the specified data has been transmitted to the USB Host. This function pointer can be set to CLD_NULL if the User application doesn't want to be notified when the data has been transferred.
<i>fp_transfer_aborted_callback</i>	Function called if there is a problem transmitting the data to the USB Host. This function can be set to CLD_NULL if the User application doesn't want to be notified if a problem occurs.
transfer_timeout_ms	Isochronous OUT transfer timeout in milliseconds. If the Isochronous OUT transfer takes longer then this timeout the transfer is aborted and the fp_transfer_aborted_callback is called. Setting the timeout to 0 disables the timeout

## **cld\_bf70x\_audio\_1\_0\_lib\_resume\_paused\_audio\_data\_transfer**

**void cld\_bf70x\_audio\_1\_0\_lib\_resume\_paused\_audio\_data\_transfer (void)**

CLD BF70x Audio 1.0 Library function used to resume a paused Isochronous OUT transfer.

### **Arguments**

None

### **Return Value**

None.

### **Details**

The `cld_bf70x_audio_1_0_lib_resume_paused_audio_data_transfer` function is used to resume an Isochronous OUT transfer that was paused by the `fp_audio_stream_data_received` function returning `CLD_USB_TRANSFER_PAUSE`. When called the `cld_bf70x_audio_1_0_lib_resume_paused_audio_data_transfer` function will call the User application's `fp_audio_stream_data_received` function passing the `CLD_USB_Transfer_Params` of the original paused transfer. The `fp_audio_stream_data_received` function can then choose to accept, discard, or stall the Isochronous OUT request.

## **cld\_bf70x\_audio\_1\_0\_lib\_resume\_paused\_control\_transfer**

**void cld\_bf70x\_audio\_1\_0\_lib\_resume\_paused\_control\_transfer (void)**

CLD BF70x Audio 1.0 Library function used to resume a paused Control endpoint transfer.

### **Arguments**

None

### **Return Value**

None.

### **Details**

The `cld_bf70x_audio_1_0_lib_resume_paused_control_transfer` function is used to resume a Control transfer that was paused by the `fp_audio_set_req_cmd` or `fp_audio_get_req_cmd` function returning `CLD_USB_TRANSFER_PAUSE`. When called the `cld_bf70x_audio_1_0_lib_resume_paused_control_transfer` function will call the User application's `fp_audio_set_req_cmd` or `fp_audio_get_req_cmd` function passing the `CLD_USB_Transfer_Params` of the original paused transfer. The User function can then chose to accept, discard, or stall the Control endpoint request.

## **cld\_lib\_usb\_connect**

**void cld\_lib\_usb\_connect (void)**

CLD BF70x Audio 1.0 Library function used to connect to the USB Host.

### ***Arguments***

None

### ***Return Value***

None.

### ***Details***

The `cld_lib_usb_connect` function is called after the CLD BF70x Audio 1.0 Library has been initialized to connect the USB device to the Host.

## **cld\_lib\_usb\_disconnect**

**void cld\_lib\_usb\_disconnect (void)**

CLD BF70x Audio 1.0 Library function used to disconnect from the USB Host.

### ***Arguments***

None

### ***Return Value***

None.

### ***Details***

The `cld_lib_usb_disconnect` function is called after the CLD BF70x Audio 1.0 Library has been initialized to disconnect the USB device to the Host.

## cld\_time\_get

CLD\_Time `cld_time_get(void)`

CLD BF70x Audio 1.0 Library function used to get the current CLD time.

### Arguments

None

### Return Value

The current CLD library time.

### Details

The `cld_time_get` function is used in conjunction with the `cld_time_passed_ms` function to measure how much time has passed between the `cld_time_get` and the `cld_time_passed_ms` function calls.

## cld\_time\_passed\_ms

CLD\_Time `cld_time_passed_ms(CLD_Time time)`

CLD BF70x Audio 1.0 Library function used to measure the amount of time that has passed.

### Arguments

time	A CLD_Time value returned by a <code>cld_time_get</code> function call.
------	---

### Return Value

The number of milliseconds that have passed since the `cld_time_get` function call that returned the CLD\_Time value passed to the `cld_time_passed_ms` function.

### Details

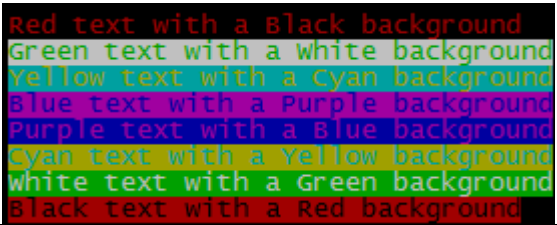
The `cld_time_passed_ms` function is used in conjunction with the `cld_time_get` function to measure how much time has passed between the `cld_time_get` and the `cld_time_passed_ms` function calls.

## cld\_console

CLD\_RV **cld\_console**(CLD\_CONSOLE\_COLOR foreground\_color, CLD\_CONSOLE\_COLOR background\_color, **const char** \*fmt, ...)

CLD Library function that outputs a User defined message using the UART specified in the CLD\_BF70x\_Audio\_1\_0\_Lib\_Init\_Params structure.

### Arguments

foreground_color	<p>The CLD_CONSOLE_COLOR used for the console text.</p> <p>CLD_CONSOLE_BLACK CLD_CONSOLE_RED CLD_CONSOLE_GREEN CLD_CONSOLE_YELLOW CLD_CONSOLE_BLUE CLD_CONSOLE_PURPLE CLD_CONSOLE_CYAN CLD_CONSOLE_WHITE</p>
background_color	<p>The CLD_CONSOLE_COLOR used for the console background.</p> <p>CLD_CONSOLE_BLACK CLD_CONSOLE_RED CLD_CONSOLE_GREEN CLD_CONSOLE_YELLOW CLD_CONSOLE_BLUE CLD_CONSOLE_PURPLE CLD_CONSOLE_CYAN CLD_CONSOLE_WHITE</p> <p>The foreground and background colors allow the User to generate various color combinations like the ones shown below:</p> 
fmt	<p>The User defined ASCII message that uses the same format specifies as the printf function.</p>
...	<p>Optional list of additional arguments</p>

### ***Return Value***

This function returns whether or not the specified message has been added to the `cld_console` transmit buffer.

<code>CLD_SUCCESS</code>	The message was added successfully.
<code>CLD_FAIL</code>	The message was not added, so the message will not be transmitted. This will occur if the CLD Console is disabled, or if the message will not fit into the transmit buffer.

### ***Details***

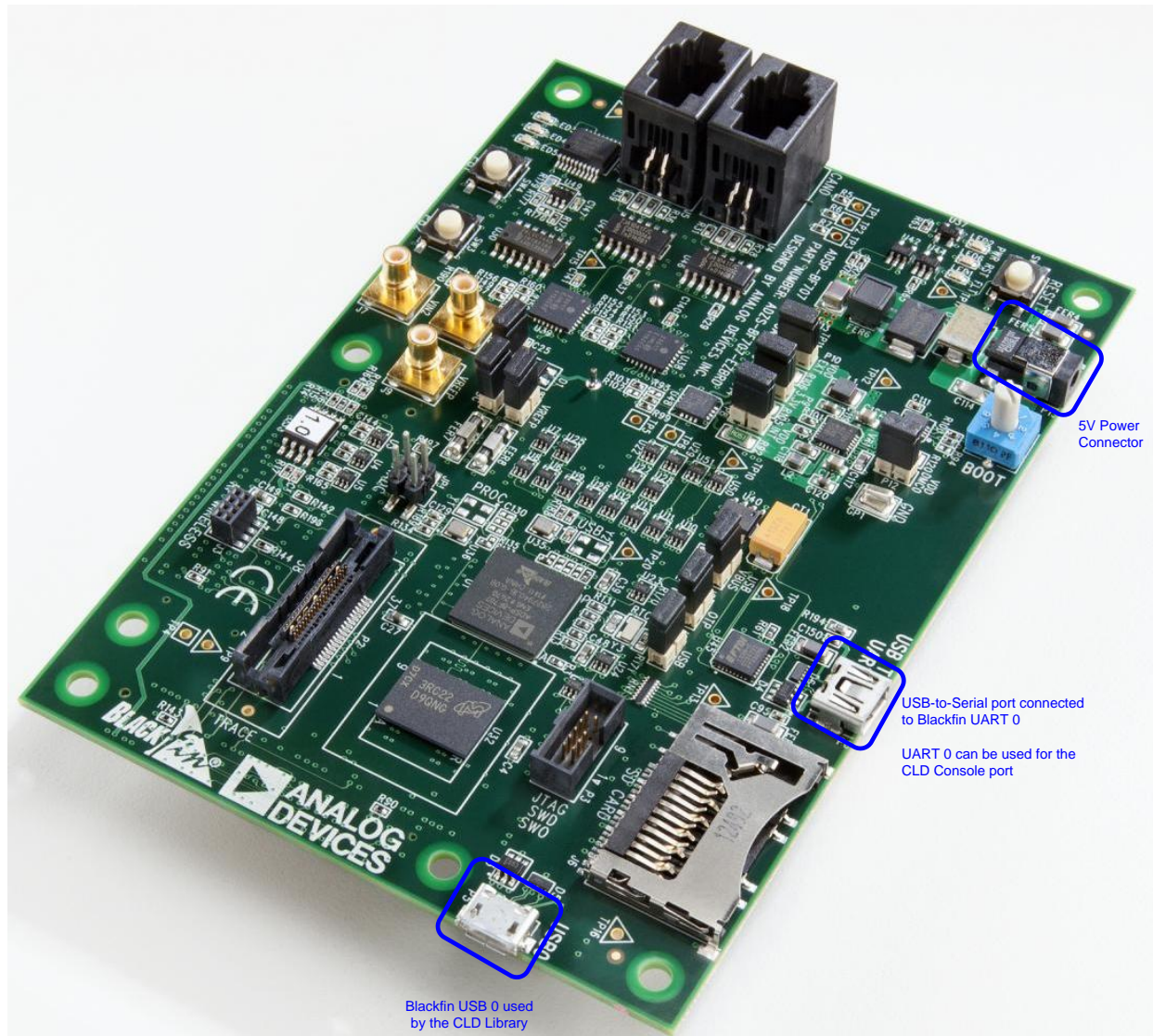
`cld_console` is similar in format to `printf`, and also natively supports setting a foreground and background color.

The following will output 'The quick brown fox' on a black background with green text:

```
cld_console(CLD_CONSOLE_GREEN, CLD_CONSOLE_BLACK, "The quick brown %s\n\r", "fox");
```

## Using the ADSP-BF707 Ez-Board

### Connections:



### Note about using UART0 and the FTDI USB to Serial Converter

On the ADSP-BF707 Ez-Board the Blackfin's UART0 serial port is connected to a FTDI FT232RQ USB-to-Serial converter. By default the UART 0 signals are connected to the FTDI chip. However, the demo program shipped on the Ez-Board disables the UART0 to FTDI connection. If the FTDI converter is used for the CLD BF70x Audio 1.0 Library console change the boot selection switch (located next to the power connector) so the demo program doesn't boot. Once this is done the FTDI USB-to-Serial converter can be used with the CLD BF70x Audio 1.0 Library console connected to UART0.



## Adding the CLD BF70x Audio 1.0 Library to an Existing CrossCore Embedded Studio Project

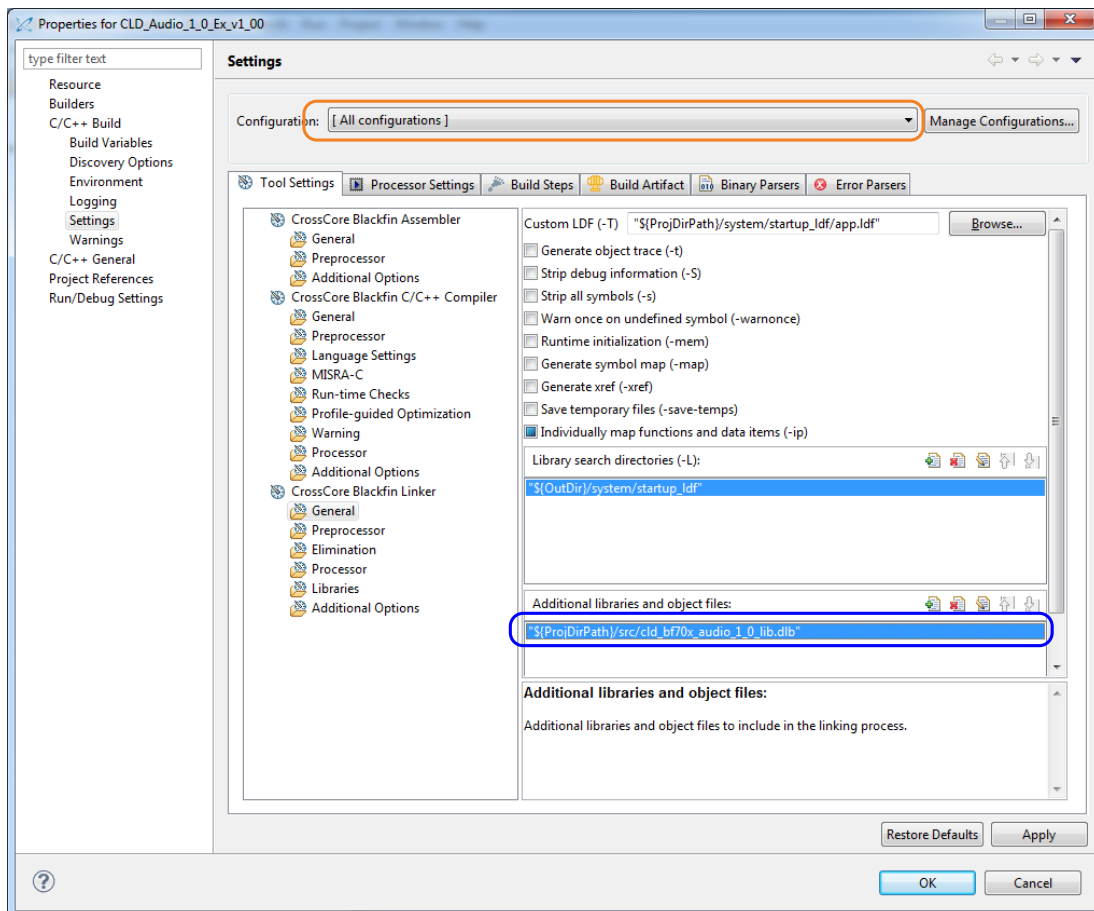
In order to include the CLD BF70x Audio 1.0 Library in a CrossCore Embedded Studio (CCES) project you must configure the project linker settings so it can locate the library. The following steps outline how this is done.

1. Copy the `cld_bf70x_audio_1_0_lib.h` and `cld_bf70x_audio_1_0_lib.dlb` files to the project's `src` directory.
2. Open the project in CrossCore Embedded Studio.
3. Right click the project in the 'C/C++ Projects' window and select Properties.

If you cannot find the 'C/C++ Projects' window make sure C/C++ Perspective is active. If the C/C++ Perspective is active and you still cannot locate the 'C/C++ Projects' window select Window → Show View → C/C++ Projects.

4. You should now see a project properties window similar to the one shown below.

Navigate to the C/C++ Build → Settings page and select the CrossCore Blackfin Linker General page. The CLD BF70x Audio 1.0 Library needs to be included in the projects 'Additional libraries and object files' as shown in the diagram below (circled in blue). This lets the linker know where the `cld_bf70x_audio_1_0_lib.dlb` file is located.

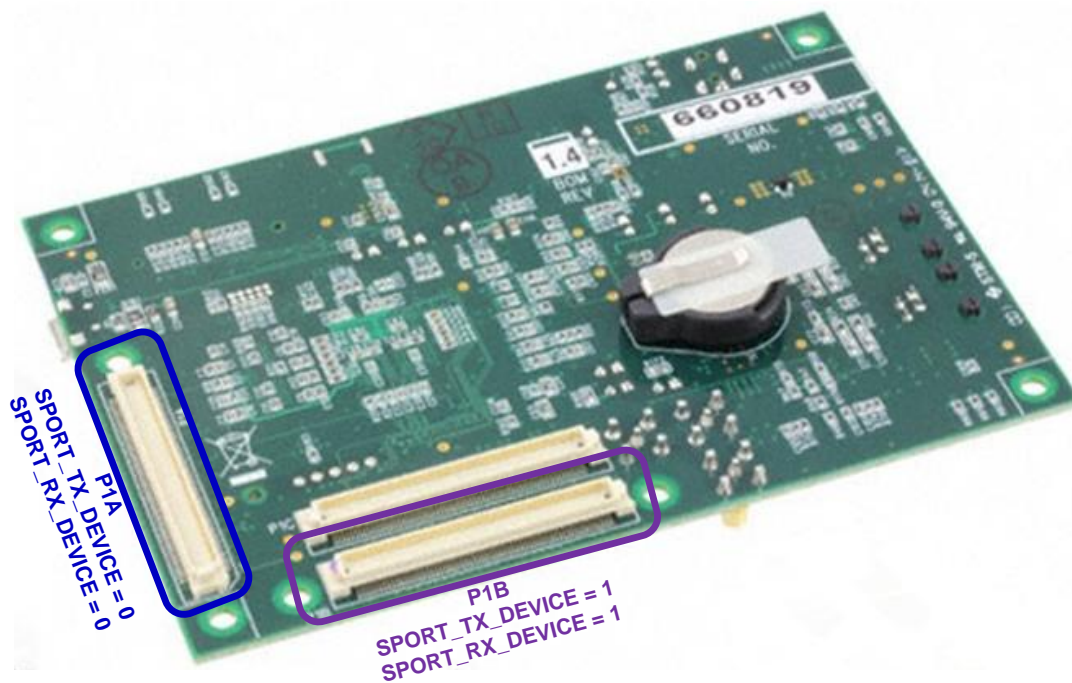


5. The 'Additional libraries and object files' setting needs to be set for all configurations (Debug, Release, etc). This can be done individually for each configuration, or all at once by selecting the [All Configurations] option as shown in the previous figure (circled in orange).

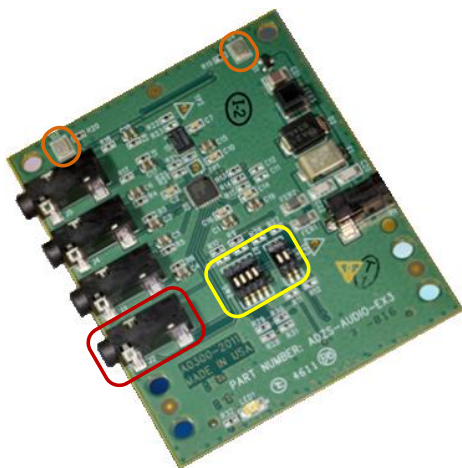
## Using the ADI Audio EI3 Extender

### Connections:

The Audio EI3 Extender can be connected to ADSP-BF707 Ez-Board using the P1A or P1B connector on the bottom of the Ez-Board (see picture below). By default the CLD Audio 1.0 Example is configured to use the P1A port, but can be modified to use P1B by changing the `SPORT_TX_DEVICE` and `SPORT_RX_DEVICE` #define values in `user_adau1761.h` to 1.



For its audio output the CLD Audio 1.0 example uses the Audio EI3 Extender's headphone jack (circled in red in the picture below). The example's audio input comes from the Audio EI3 Extender's two digital microphones (circled in orange in the picture below). All of the Audio EI3 Extender DIP switches (circled in yellow) should be turned OFF.



### **Audio EI3 Extender Board Support Package (Required by CLD Audio Example)**

The CLD Audio 1.0 Example interfaces to the Audio EI3 Extender's ADAU1761 Codec using the Analog Devices driver provided with the Audio EI3 Extender board support package. This board support package can be downloaded from the Audio EI3 Extender's web page, under the "Product Downloads" section (<http://www.analog.com/en/evaluation/eval-bfext-audei3/eb.html>).

## User Firmware Code Snippets

The following code snippets are not complete, and are meant to be a starting point for the User firmware. For a functional User firmware example that uses the CLD BF70x Audio 1.0 Library please refer to the CLD\_Audio\_1\_0\_Ex\_v1\_2 project included with the CLD BF70x Audio 1.0 Library. The CLD\_Audio\_1\_0\_Ex\_v1\_2 project implements a basic USB Audio device used by the Analog Devices Audio EI3 Extender board.

### main.c

```
void main(void)
{
    Main_States main_state = MAIN_STATE_SYSTEM_INIT;

    while (1)
    {
        switch (main_state)
        {
            case MAIN_STATE_SYSTEM_INIT:
                /* Enable and Configure the SEC. */

                /* sec_gctl - unlock the global lock */
                pADI_SEC0->GCTL &= ~BITM_SEC_GCTL_LOCK;
                /* sec_gctl - enable the SEC in */
                pADI_SEC0->GCTL |= BITM_SEC_GCTL_EN;
                /* sec_cctl[n] - unlock */
                pADI_SEC0->CB.CCTL &= ~BITM_SEC_CCTL_LOCK;
                /* sec_cctl[n] - reset sci to default */
                pADI_SEC0->CB.CCTL |= BITM_SEC_CCTL_RESET;
                /* sec_cctl[n] - enable interrupt to be sent to core */
                pADI_SEC0->CB.CCTL = BITM_SEC_CCTL_EN;
                pADI_PORTA->DIR_SET = (3 << 0);
                pADI_PORTB->DIR_SET = (1 << 1);

                main_state = MAIN_STATE_USER_INIT;
                break;
            case MAIN_STATE_USER_INIT:
                rv = user_audio_init();
                if (rv == USER_AUDIO_INIT_SUCCESS)
                {
                    main_state = MAIN_STATE_RUN;
                }
                else if (rv == USER_AUDIO_INIT_FAILED)
                {
                    main_state = MAIN_STATE_ERROR;
                }
                break;
            case MAIN_STATE_RUN:
                user_audio_main();
                break;
            case MAIN_STATE_ERROR:
                break;
        }
    }
}
```

## user\_audio.c

```
#pragma pack (1)
/* USB Audio v1.0 Unit and Terminal descriptors that describe a simple
audio device. */
static const unsigned char user_audio_unit_and_terminal_descriptor[] =
{
    /* Input Terminal Descriptor - USB Endpoint */
    0x0C,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x02,          /* bDescriptorSubType = Input Terminal */
    0x01,          /* bTerminalID */
    0x01, 0x01,    /* wTerminalType = USB Streaming */
    0x00,          /* bAssocTerminal */
    0x02,          /* bNRChannels */
    0x03, 0x00,    /* wChannelConfig (Left & Right Present) */
    0x00,          /* iChannelConfig */
    0x00,          /* iTerminal */
    /* Input Terminal Descriptor - Microphone */
    0x0C,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x02,          /* bDescriptorSubType = Input Terminal */
    0x02,          /* bTerminalID */
    0x01, 0x02,    /* wTerminalType = Microphone */
    0x00,          /* bAssocTerminal */
    0x02,          /* bNRChannels */
    0x03, 0x00,    /* wChannelConfig (Left & Right Present) */
    0x00,          /* iChannelConfig */
    0x00,          /* iTerminal */
    /* Output Terminal Descriptor - Speaker */
    0x09,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x03,          /* bDescriptorSubType = Output Terminal */
    0x06,          /* bTerminalID */
    0x01, 0x03,    /* wTerminalType - Speaker */
    0x00,          /* bAssocTerminal */
    0x09,          /* bSourceID */
    0x00,          /* iTerminal */
    /* Output Terminal Descriptor - USB Endpoint */
    0x09,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x03,          /* bDescriptorSubType = Output Terminal */
    0x07,          /* bTerminalID */
    0x01, 0x01,    /* wTerminalType - USB Streaming */
    0x00,          /* bAssocTerminal */
    0x0a,          /* bSourceID */
    0x00,          /* iTerminal */
    /* Feature Unit Descriptor */
    0x0a,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x06,          /* bDescriptorSubType = Feature Unit */
    0x09,          /* bUnitID */
    0x01,          /* bSourceID */
    0x01,          /* bControlSize */
    0x01,          /* mbaControls(0) - Mute Supported */
    0x02,          /* mbaControls(1) - Volume Supported */
    0x02,          /* mbaControls(2) - Volume Supported */
    0x00,          /* iFeature */
    /* Feature Unit Descriptor */
    0x0a,          /* bLength */
    0x24,          /* bDescriptorType = Class Specific Interface */
    0x06,          /* bDescriptorSubType = Feature Unit */
    0x0a,          /* bUnitID */
}
```

```

    0x02,          /* bSourceID */
    0x01,          /* bControlSize */
    0x02,          /* mbaControls(0) - Volume */
    0x00,          /* mbaControls(1) */
    0x00,          /* mbaControls(2) */
    0x00,          /* iFeature */
};

/* Isochronous IN endpoint PCM format descriptor */
static const unsigned char user_audio_in_stream_format_descriptor[] =
{
    0x0b,          /* bLength */
    0x24,          /* bDescriptorType - Class Specific Interface */
    0x02,          /* bDescriptorSubType - Format Type */
    0x01,          /* bFormatType - Format Type 1 */
    0x02,          /* bNrChannels */
    0x04,          /* bSubFrameSize */
    0x20,          /* bBitResolution */
    0x01,          /* bSamFreqType */
    0x80, 0xBB, 0x00, /* tSamFreq(1) = 48.0Khz */
};

/* Isochronous OUT endpoint PCM format descriptor */
static const unsigned char user_audio_out_stream_format_descriptor[] =
{
    0x0b,          /* bLength */
    0x24,          /* bDescriptorType - Class Specific Interface */
    0x02,          /* bDescriptorSubType - Format Type */
    0x01,          /* bFormatType - Format Type 1 */
    0x02,          /* bNrChannels */
    0x04,          /* bSubFrameSize */
    0x20,          /* bBitResolution */
    0x01,          /* bSamFreqType */
    0x80, 0xBB, 0x00, /* tSamFreq(1) = 48.0Khz */
};

#pragma pack ()

/* IN Audio Stream Interface Endpoint Data Descriptor */
static const CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor
    user_audio_in_stream_endpoint_desc =
{
    .b_length = sizeof(CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor),
    .b_descriptor_type = 0x25,          /* Class Specific Endpoint */
    .b_descriptor_subtype = 0x01,      /* Endpoint - General */
    .bm_attributes = 0x01,             /* sampling freq supported */
    .b_lock_delay_units = 0x00,        /* Undefined */
    .w_lock_delay = 0x00,
};

static const CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor
    user_audio_out_stream_endpoint_desc =
{
    .b_length = sizeof(CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor),
    .b_descriptor_type = 0x25,          /* Class Specific Endpoint */
    .b_descriptor_subtype = 0x01,      /* Endpoint - General */
    .bm_attributes = 0x01,             /* sampling freq supported */
    .b_lock_delay_units = 0x01,        /* Milliseconds */
    .w_lock_delay = 0x01,              /* 1 Millisecond */
};

/* Audio Stream IN Interface parameters */
static CLD_BF70x_Audio_1_0_Stream_Interface_Params user_audio_in_endpoint_params =
{

```

```

.endpoint_number          = 1,          /* Isochronous endpoint number */
.max_packet_size_full_speed = 400,     /* Isochronous endpoint full-speed
                                         max packet size */
.max_packet_size_high_speed = 400,     /* Isochronous endpoint high-speed
                                         max packet size */
.b_interval_full_speed    = 1,          /* Isochronous endpoint full-speed
                                         bInterval */
.b_interval_high_speed    = 4,          /* Isochronous endpoint high-speed
                                         bInterval - 1 millisecond */
.synchronization_type     = 0x1,       /* Isochronous endpoint
                                         synchronization type =
                                         Asynchronous */
.b_terminal_link          = 7,          /* Terminal ID of the associated
                                         Output Terminal */
.b_delay                  = 1,          /* Delay = 1 Frame */
.w_format_tag              = 1,          /* PCM */
                                         /* Pointer to the PCM Format
                                         Descriptor */

.p_format_type_descriptor = (unsigned char*)
                             user_audio_in_stream_format_descriptor,
.p_audio_stream_endpoint_data_descriptor =
                             (CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor*)
                             &user_audio_in_stream_endpoint_desc,
};

/* Audio Stream OUT Interface parameters */
static CLD_BF70x_Audio_1_0_Stream_Interface_Params user_audio_out_endpoint_params =
{
.endpoint_number          = 1,          /* Isochronous endpoint number */
.max_packet_size_full_speed = 400,     /* Isochronous endpoint full-speed
                                         max packet size */
.max_packet_size_high_speed = 400,     /* Isochronous endpoint high-speed
                                         max packet size */
.b_interval_full_speed    = 1,          /* Isochronous endpoint full-speed
                                         bInterval */
.b_interval_high_speed    = 4,          /* Isochronous endpoint high-speed
                                         bInterval - 1 millisecond */
.synchronization_type     = 0x2,       /* Isochronous endpoint
                                         synchronization type = Adaptive
                                         */
.b_terminal_link          = 1,          /* Terminal ID of the associated
                                         Output Terminal */
.b_delay                  = 1,          /* Delay = 1 Frame */
.w_format_tag              = 1,          /* PCM */
                                         /* Pointer to the PCM Format
                                         Descriptor */

.p_format_type_descriptor = (unsigned char*)
                             user_audio_out_stream_format_descriptor,
.p_audio_stream_endpoint_data_descriptor =
                             (CLD_BF70x_Audio_1_0_Lib_Audio_Stream_Data_Endpoint_Descriptor*)
                             &user_audio_out_stream_endpoint_desc,
};

/* CLD BF70x Audio 1.0 library initialization data. */
static CLD_BF70x_Audio_1_0_Lib_Init_Params user_audio_init_params =
{
.timer_num    = CLD_TIMER_0,
.uart_num     = CLD_UART_0,
.uart_baud    = 115200,
.sclk0        = 100000000u,
.fp_console_rx_byte = user_audio_console_rx_byte,
.vendor_id    = 0x064b,
};

```



```

.product_id = 0x0005,

.p_unit_and_terminal_descriptors = (unsigned char*)
    user_audio_unit_and_terminal_descriptor,
.unit_and_terminal_descriptors_length =
    sizeof(user_audio_unit_and_terminal_descriptor),

.p_audio_streaming_rx_interface_params = &user_audio_out_endpoint_params,
.p_audio_streaming_tx_interface_params = &user_audio_in_endpoint_params,

.fp_audio_stream_data_received = user_audio_stream_data_received,

.fp_audio_set_req_cmd = user_audio_set_req_cmd,
.fp_audio_get_req_cmd = user_audio_get_req_cmd,

.fp_audio_streaming_rx_endpoint_enabled = user_audio_streaming_rx_endpoint_enabled,
.fp_audio_streaming_tx_endpoint_enabled = user_audio_streaming_tx_endpoint_enabled,

.usb_bus_max_power = 0,
.device_descriptor_bcdDevice = 0x0100,

/* USB string descriptors - Set to CLD_NULL if not required */
.p_usb_string_manufacturer = "Analog Devices Inc",
.p_usb_string_product = "BF707 Audio v1.0 Device",
.p_usb_string_serial_number = CLD_NULL,
.p_usb_string_configuration = CLD_NULL,
.p_usb_string_audio_control_interface = CLD_NULL,
.p_usb_string_audio_streaming_out_interface = CLD_NULL,
.p_usb_string_audio_streaming_in_interface = CLD_NULL,

.user_string_descriptor_table_num_entries = 0,
.p_user_string_descriptor_table = CLD_NULL,

.usb_string_language_id = 0x0409, /* English (US) language ID */

.fp_cld_usb_event_callback = user_audio_usb_event,
};

```

```

User_Audio_Init_Return_Code user_audio_init (void)
{
    static unsigned char user_init_state = 0;
    CLD_RV cld_rv = CLD_ONGOING;
    User_Audio_Init_Return_Code init_return_code = USER_AUDIO_INIT_ONGOING;

    switch (user_init_state)
    {
        case 0:

            /* TODO: add any custom User firmware initialization */

            user_init_state++;
            break;
        case 1:
            /* Initialize the CLD BF70x Audio 1.0 Library */
            cld_rv = cld_bf70x_audio_1_0_lib_init(&user_audio_init_params);

            if (cld_rv == CLD_SUCCESS)
            {
                /* Connect to the USB Host */
                cld_lib_usb_connect();

                init_return_code = USER_AUDIO_INIT_SUCCESS;
            }
            else if (cld_rv == CLD_FAIL)
            {
                init_return_code = USER_AUDIO_INIT_FAILED;
            }
            else
            {
                init_return_code = USER_AUDIO_INIT_ONGOING;
            }
        }
    }
    return init_return_code;
}

void user_audi_main (void)
{
    cld_bf70x_audio_1_0_lib_main();
}

/* Function called when an Isochronous OUT packet is received */
static CLD_USB_Transfer_Request_Return_Type user_audio_stream_data_received
(CL_D_USB_Transfer_Params * p_transfer_data)
{
    p_transfer_data->num_bytes = /* TODO: Set number of Isochronous OUT bytes to transfer
    */
    p_transfer_data->p_data_buffer = /* TODO: address to store Isochronous OUT data */

    /* User Audio transfer complete callback function. */
    p_transfer_data->fp_callback.usb_out_transfer_complete =
        user_audio_stream_data_rx_done;
    p_transfer_params->fp_transfer_aborted_callback = /* TODO: Set to User callback
        function or CLD_NULL */;
    p_transfer_params->transfer_timeout_ms = /* TODO: Set to desired timeout */;

    /* TODO: Return how the Isochronous OUT transfer should be handled (Accept, Pause,
    Discard, or Stall */
}

```

```

/* The function below is an example if the Isochronous OUT transfer done callback
   specified in the CLD_USB_Transfer_Params structure. */
static CLD_USB_Data_Received_Return_Type user_audio_stream_data_rx_done (void)
{
    /* TODO: Process the received Isochronous OUT transfer and return if the received
       data is good(CLD_USB_DATA_GOOD) or if there is an error
       (CLD_USB_DATA_BAD_STALL) */
}

static void user_audio_console_rx_byte (unsigned char byte)
{
    /* TODO: Add any User firmware to process data received by the CLD Console UART.*/
}

static void user_audio_usb_event (CLD_USB_Event event)
{
    switch (event)
    {
        case CLD_USB_CABLE_CONNECTED:
            /* TODO: Add any User firmware processed when a USB cable is connected. */
            break;
        case CLD_USB_CABLE_DISCONNECTED:
            /* TODO: Add any User firmware processed when a USB cable is
               disconnected.*/
            break;
        case CLD_USB_ENUMERATED_CONFIGURED:
            /* TODO: Add any User firmware processed when a Device has been
               enumerated.*/
            break;
        case CLD_USB_UN_CONFIGURED:
            /* TODO: Add any User firmware processed when a Device USB Configuration
               is set to 0.*/
            break;
        case CLD_USB_BUS_RESET:
            /* TODO: Add any User firmware processed when a USB Bus Reset occurs. */
            break;
    }
}

/* The following function will transmit the specified memory using
   the Isochronous IN endpoint. */
static user_audio_transmit_isochronous_in_data (void)
{
    static CLD_USB_Transfer_Params transfer_params;

    transfer_params.num_bytes = /* TODO: Set number of IN bytes */
    transfer_params.p_data_buffer = /* TODO: address data */
    transfer_params.callback.fp_usb_in_transfer_complete = /* TODO: Set to User
                                                           callback function or
                                                           CLD_NULL */;
    transfer_params.callback.fp_transfer_aborted_callback = /* TODO: Set to User
                                                           callback function or
                                                           CLD_NULL */;
    transfer_params.transfer_timeout_ms = /* TODO: Set to desired timeout */;

    if (cld_bf70x_audio_1_0_lib_transmit_audio_data (&transfer_params) ==
        CLD_USB_TRANSMIT_SUCCESSFUL)
    {
        /* Isochronous IN transfer initiated successfully */
    }
    else /* Isochronous IN transfer was unsuccessful */
    {

```

```

    }
}

/* Function called when a Set Request is received */
static CLD_USB_Transfer_Request_Return_Type user_audio_set_req_cmd
(CLD_BF70x_Audio_1_0_Cmd_Req_Parameters * p_req_params,
 CLD_USB_Transfer_Params * p_transfer_data)
{
    p_transfer_data->p_data_buffer = /* TODO: address to store data */
    p_transfer_data->callback.fp_usb_out_transfer_complete =
        user_audio_set_req_cmd_transfer_complete;
    p_transfer_data->fp_transfer_aborted_callback = /* TODO: Set to User callback
        function or CLD_NULL */
        /* TODO: Return how the Control transfer should be handled (Accept, Pause,
        Discard, or Stall */
}

/* Function called when the Set Request data is received */
static CLD_USB_Data_Received_Return_Type user_audio_set_req_cmd_transfer_complete
(void)
{
    /* TODO: Return if the received data is good (CLD_USB_DATA_GOOD) or bad
    (CLD_USB_DATA_BAD_STALL) */
}

/* Function called when a Get Request is received */
static CLD_USB_Transfer_Request_Return_Type user_audio_get_req_cmd
(CLD_BF70x_Audio_1_0_Cmd_Req_Parameters * p_req_params,
 CLD_USB_Transfer_Params * p_transfer_data)
{
    p_transfer_data->p_data_buffer = /* TODO: address to source data */
    p_transfer_data->callback.fp_usb_in_transfer_complete =
        user_audio_get_req_cmd_transfer_complete;
    p_transfer_data->fp_transfer_aborted_callback = /* TODO: Set to User callback
        function or CLD_NULL */
        /* TODO: Return how the Control transfer should be handled (Accept, Pause,
        Discard, or Stall */
}

/* Function called when the Get Request data has been transmitted */
static void user_audio_get_req_cmd_transfer_complete (void)
{
    /* TODO: The Get Request data has been sent to the Host, add any
    User functionality. */
}

static void user_audio_streaming_rx_endpoint_enabled (CLD_Boolean enabled)
{
    if (enabled == CLD_TRUE)
    {
        /* TODO: Add Isochronous OUT endpoint enabled User functionality. */
    }
    else
    {
        /* TODO: Add Isochronous OUT endpoint disabled User functionality. */
    }
}

```

```
static void user_audio_streaming_tx_endpoint_enabled (CLD_Boolean enabled)
{
    if (enabled == CLD_TRUE)
    {
        /* TODO: Add Isochronous IN endpoint enabled User functionality. */
    }
    else
    {
        /* TODO: Add Isochronous IN endpoint disabled User functionality. */
    }
}
```