



# USB Host Base System User Guide

Version 1.60

For use with USB Host Base System versions 3.15 and above

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## Table of Contents

|  |           |
|--|-----------|
| <b>1 System Overview.....</b>                    | <b>4</b>  |
| 1.1 Introduction .....                           | 5         |
| 1.2 Feature Check .....                          | 6         |
| 1.3 Packages and Documents .....                 | 7         |
| Packages.....                                    | 7         |
| Documents .....                                  | 10        |
| 1.4 Change History .....                         | 11        |
| <b>2 Source File List .....</b>                  | <b>12</b> |
| 2.1 API Header Files .....                       | 12        |
| 2.2 Configuration File.....                      | 12        |
| 2.3 Version File .....                           | 12        |
| 2.4 USB Host System.....                         | 12        |
| <b>3 Configuration Options .....</b>             | <b>13</b> |
| <b>4 Application Programming Interface .....</b> | <b>15</b> |
| 4.1 Module Management .....                      | 15        |
| usbh_init.....                                   | 16        |
| usbh_start .....                                 | 17        |
| usbh_stop.....                                   | 18        |
| usbh_delete.....                                 | 19        |
| 4.2 Host Controller Management.....              | 20        |
| usbh_hc_init.....                                | 21        |
| usbh_hc_start .....                              | 22        |
| usbh_hc_stop.....                                | 23        |
| usbh_hc_delete.....                              | 24        |
| 4.3 Class Driver Management.....                 | 25        |
| usbh_add_cd.....                                 | 26        |
| usbh_delete_cd.....                              | 27        |
| usbh_add_hub .....                               | 28        |
| usbh_delete_hub.....                             | 29        |
| 4.4 Application Functions.....                   | 30        |
| usbh_delay .....                                 | 31        |
| usbh_get_port_inf .....                          | 32        |

|  |           |
|--|-----------|
| usbh_get_port_inf_port .....           | 33        |
| usbh_get_string .....                  | 34        |
| usbh_reenumerate .....                 | 35        |
| usbh_suspend .....                     | 36        |
| usbh_resume.....                       | 37        |
| usbh_test_mode_device .....            | 38        |
| usbh_test_mode_port.....               | 39        |
| <b>4.5 Callback Functions.....</b>     | <b>40</b> |
| t_usbh_cd_connect_fn.....              | 41        |
| t_usbh_cd_disconnect_fn .....          | 42        |
| t_usbh_cd_check_fn.....                | 43        |
| t_usbh_cd_descriptor_fn .....          | 44        |
| t_usbh_hub_fn.....                     | 45        |
| t_usbh_hub_reset_fn .....              | 46        |
| t_usbh_hub_scan_fn .....               | 47        |
| t_usbh_hub_test_fn .....               | 48        |
| usbh_register_config_select_cb .....   | 49        |
| usbh_register_enum_failed_cb .....     | 50        |
| <b>4.6 Error Codes.....</b>            | <b>51</b> |
| <b>4.7 Types and Definitions .....</b> | <b>52</b> |
| t_usbh_port_inf .....                  | 52        |
| t_usbh_cd.....                         | 53        |
| t_usbh_hub .....                       | 54        |
| Test Modes .....                       | 55        |
| Connection States.....                 | 56        |
| Notification Codes .....               | 56        |
| t_usbh_config_select_cb .....          | 57        |
| t_usbh_enum_failed_cb.....             | 58        |
| String Descriptors .....               | 59        |
| <b>5 Integration.....</b>              | <b>60</b> |
| 5.1 OS Abstraction Layer .....         | 60        |
| 5.2 PSP Porting .....                  | 60        |
| <b>6 Sample Code .....</b>             | <b>61</b> |

# 1 System Overview

This chapter contains the fundamental information for this module.

The component sections are as follows:

- [Introduction](#) – describes the main elements of the module.
- [Feature Check](#) – summarizes the main features of the module as bullet points.
- [Packages and Documents](#) – the *Packages* section lists the packages that you need in order to use this module. The *Documents* section lists the relevant user guides.
- [Change History](#) – lists the earlier versions of this manual, giving the software version that each manual describes.

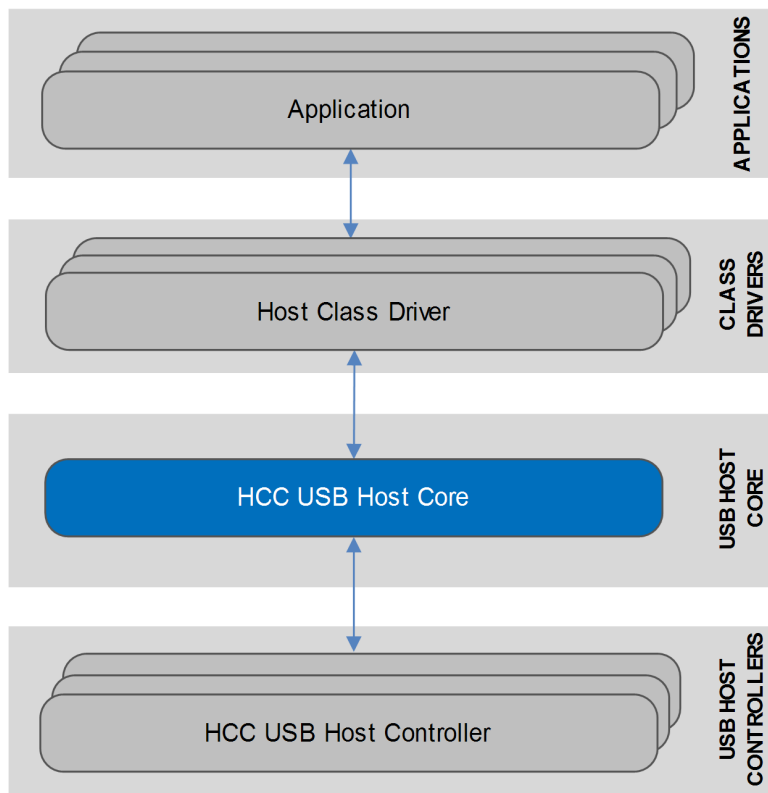
## 1.1 Introduction

This guide is for those who want to implement an embedded USB host stack using one or more HCC host controllers with one or more host class drivers. The HCC Embedded USB Host base system forms the core of HCC's USB host stack solution.

The system supports any number of USB host controllers, each of which may have multiple units. Supported host controllers include any combination of Enhanced Host Controller Interface (EHCI), Open Host Controller Interface (OHCI), and proprietary host controller types. HCC has many host controller implementations and can add new host controllers on request.

The system provides an interface for any number of USB host class drivers to communicate with their corresponding USB device class drivers. The system supports all USB transfer types (control, interrupt, bulk, and isochronous). This manual also defines how each USB host class driver using this system should be structured.

The system structure is shown in the diagram below:



HCC provides a wide range of USB class drivers to use with the system and other supporting software, such as file systems for Mass Storage (MST) solutions. Any number of HCC class drivers can be added to the system.

## 1.2 Feature Check

The main features of the system are the following:

- Conforms to the HCC Advanced Embedded Framework.
- Designed for integration with both RTOS and non-RTOS based systems.
- Supports multiple host controllers, each with multiple instances.
- Provides a range of HCC host controllers for EHCI, OHCI, and other types.
- Supports internal or external host controllers.
- Supports all USB endpoint types: control, bulk, interrupt, and isochronous.
- Supports USB low, full, and high speed interfaces.
- Supports external hubs.
- Supports USB On-The-Go (OTG) Service Request Protocol (SRP) and Host Negotiation Protocol (HNP).
- Supported by a range of standard HCC class drivers.
- Supports USB device test modes.
- Provides API functions for reading USB device properties.

## 1.3 Packages and Documents

### Packages

This table lists the packages that you need in order to use this module, and also optional modules that may interact with this module, depending on your particular system's design:

| Package                  | Description   |
|--------------------------|---|
| <b>hcc_base_doc</b>      | This contains the two guides that will help you get started.  |
| <b>usbh_base</b>         | The package described in this guide, the USB host base system package that host class drivers use for communication.  |
| <b>usbh_cd_xxxx</b>      | Individual USB host class drivers that are included as required by the system design (see the table below).   |
| <b>usbh_drv_xxxx</b>     | Individual USB host controllers as required (see the table below). The system must include at least one of these and supports the use of multiple controllers of different types. |
| <b>psp_template_base</b> | The base Platform Support Package (PSP).  |
| <b>oal_base</b>          | The base OS Abstraction Layer (OAL) package.  |
| <b>util_hcc_mem</b>      | The HCC memory management utility; this must be ported if the target system uses cached memory.   |

One or more of the following class drivers may be included in a system:

| Package                               | Class driver   |
|---------------------------------------|--|
| <b>usbh_cd_audio</b>                  | Audio 1.0.   |
| <b>usbh_cd_ccid</b>                   | Chip Card Interface Device (CCID) USB devices.   |
| <b>usbh_cd_cdc_acm</b>                | Communications Device Class - Abstract Control Model (CDC-ACM).  |
| <b>usbh_cd_cdc_ecm</b>                | Communications Device Class - Ethernet Control Model (CDC-ECM).  |
| <b>usbh_cd_cdc_eem</b>                | Communications Device Class - Ethernet Emulation Model (CDC-EEM).  |
| <b>usbh_cd_cdc_ncm</b>                | Communications Device Class - Network Control Model (CDC-NCM).   |
| <b>usbh_cd_cp210x</b>                 | Class Driver for Silicon Labs CP2102/CP2103/CP2105/CP2109 devices.   |
| <b>usbd_cd_ftdi</b>                   | Future Technology Devices International (FTDI) devices.  |
| <b>usbd_cd_hid</b>                    | Human Interface Device (HID) class driver for devices including keyboards, joysticks, mice, and "generic devices" (pointers, buttons, sliders, and so on). |
| <b>usbd_cd_hub</b>                    | USB hub.   |
| <b>usbh_cd_microchip_lan7500</b>      | Class Driver for Microchip LAN7500 and LAN9500.  |
| <b>usbd_cd_midi</b>                   | Musical Instrument Digital Interface (MIDI).   |
| <b>usbd_cd_mst</b>                    | Mass Storage (MST).  |
| <b>usbd_cd_printer</b>                | Printer.   |
| <b>usbh_cd_printer_fujitsu_ftp6xx</b> | Fujitsu FTP-6xx Printer.   |
| <b>usbd_cd_raw</b>                    | Raw or Vendor-specific.  |
| <b>usbd_cd_rndis</b>                  | Remote Network Driver Interface Standard (RNDIS).  |

This is the current list of supported class drivers; contact [sales@hcc-embedded.com](mailto:sales@hcc-embedded.com) for possible updates.



One or more of the following host controllers may be included in a system:

| Package  | Host Controller   |
|--|---|
| <b>usbh_drv_ehci</b>                                   | Enhanced Host Controller Interface (EHCI).                                      |
| <b>usbh_drv_ohci</b>                                   | Open Host Controller Interface (OHCI).  |
| <b>usbh_drv_atmel</b>                                  | Atmel Host Controller   |
| <b>usbh_drv_atmel_usbhc</b>                            | Atmel USBHC Host Controller   |
| <b>usbh_drv_isp1161</b>                                | USB ISP1161 Host Controller.  |
| <b>usbh_drv_isp1362</b>                                | USB ISP1362 Host Controller.  |
| <b>usbh_drvc_lms</b>                                   | LM3S and TM4C devices.  |
| <b>usbh_drv_max3421</b>                                | MAX3421 devices.  |
| <b>usbh_drv_musb_cpipi</b>                             | Devices that have the Mentor Graphics® USB core and CPPI DMA (DM814x/DM816x).   |
| <b>usbh_drv_musb_dma</b>                               | Analog Devices Blackfin® BF60x MCUs with the Mentor Graphics® MUSB device core. |
| <b>usbh_drv_renesas</b>                                | Renesas devices.  |
| <b>usbh_drv_isp176x,<br/>usbhc_drv_isp1582_isp176x</b> | USB SAF1761 Host Controller.  |
| <b>usbh_drv_stm32_otg</b>                              | USB STM32 OTG Host Controller.  |
| <b>usbh_drv_synopsys_otg</b>                           | Synopsys® OTG devices.  |
| <b>usbh_drv_template</b>                               | USB Template host controller for new developments with the USB host stack.      |
| <b>usbh_drv_vusb</b>                                   | USB VUSB Host Controller.   |

## Documents

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

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

### **HCC Firmware Quick Start Guide**

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

### **HCC Source Tree Guide**

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

### **HCC USB Host Base System User Guide**

This is this document.

## 1.4 Change History

This section describes past changes to this manual.

- To download this manual or a PDF describing an [earlier software version](#), see [USB Host PDFs](#).
- For the history of changes made to the package code itself, see [History: usbh\\_base](#).

The current version of this manual is 1.60. The full list of versions is as follows:

| Manual version | Date       | Software version | Reason for change  |
|----------------|------------|------------------|--|
| 1.60           | 2019-05-31 | 3.15             | Added USBH_OTG_SRP_HNP_SUPPORT configuration option for SRP and HNP support. |
| 1.50           | 2017-09-07 | 3.11             | Updated <i>Packages</i> list and subsidiary tables.                          |
| 1.40           | 2017-06-19 | 3.11             | New <i>Change History</i> format.  |
| 1.30           | 2015-11-16 | 3.09             | Added <i>String Descriptors</i> , other small changes.                       |
| 1.20           | 2015-07-17 | 3.09             | Added many more functions.   |
| 1.10           | 2015-05-12 | 3.08             | Added class driver table to <i>System Overview</i> .                         |
| 1.00           | 2015-03-06 | 3.08             | First release.   |

## 2 Source File List

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

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

### 2.1 API Header Files

The file `src/api/api_usb_host.h` is the only file that should be included by an application using this module. For details of the API functions, see [Application Programming Interface](#).

### 2.2 Configuration File

The file `src/config/config_usb_host.h` contains all the configurable parameters. Configure this as required. For details of these options, see [Configuration Options](#).

### 2.3 Version File

The file `src/version/ver_usb_host.h` contains the version number of this module. This version number is checked by all modules that use this module to ensure system consistency over upgrades.

### 2.4 USB Host System

These files are in `src/usb-host/usb-driver/common`. **These files should only be modified by HCC.**

| File                      | Description                             |
|---------------------------|---|
| <code>usb_host.c</code>   | Main code for USB host.                 |
| <code>usb_host.h</code>   | Internal main header file.              |
| <code>usbh_desc.h</code>  | USB descriptors header file.            |
| <code>usbh_hc.h</code>    | Host controller descriptor header file. |
| <code>usbh_hdl.h</code>   | USB host handlers header file.          |
| <code>usbh_utils.c</code> | Utility functions.                      |
| <code>usbh_utils.h</code> | Utility header file.                    |

## 3 Configuration Options

Set the system configuration options in the file `src/config/config_usb_host.h`. This section lists the available configuration options and their default values.

### **USBH\_PMGR\_TASK\_STACK\_SIZE**

The stack size of the port manager task. The default is 1024.

### **USBH\_PMGR\_REQ\_TASK\_STACK\_SIZE**

The stack size of the port manager request task. The default is 1024.

### **USBH\_MAX\_HOST\_CONTROLLERS**

The maximum number of host controllers supported. The default is 1.

This depends on the target platform and should reflect the number of host controllers available. For example, if an external ISP1561 is used, this has to be 3 (2 OHCI controllers + 1 EHCI).

### **USBH\_MAX\_CLASS\_DRIVERS**

The maximum number of class drivers supported. The default is 2.

### **USBH\_MAX\_EXT\_HUBS**

The maximum number of external hubs supported. The default is 2.

### **USBH\_MAX\_PORTS**

The maximum number of host ports supported. The default is 8. Calculate this as:

- number of root hub ports + total number of ports available on the attached hub(s).

### **USBH\_MAX\_INTERFACE\_PER\_DEVICE**

The maximum number of interfaces on a device. The default is 2.

### **USBH\_TIMEOUT\_CHECK\_INTERVAL**

The check interval of the timeout task which handles timeouts for all active USB transfers in the system. This task wakes up after every `USBH_TIMEOUT_CHECK_INTERVAL` milliseconds and checks whether the transfer has timed out. The default is 10 ms.

Increasing this number reduces load on the system but provides less accurate timeouts (though this is not really critical). Note that:

- Setting it to 0 disables timeout handling completely.
- Setting it to 1 provides exact timeout handling but a task that wakes up every ms.

**USBH\_CFG\_DESC\_BUF\_SIZE**

The configuration descriptor buffer size. This buffer contains part of the configuration descriptor processed at enumeration. The default is 128, which should always be enough.

Set this to:

- maximum EP0 size (64) + the maximum size of a descriptor within the configuration descriptor.

**USBH\_OTG\_SRPHNP\_SUPPORT**

Set this to 1 if On-The-Go Service Request Protocol (SRP) and Host Negotiation Protocol (HNP) are supported. The default is 0.

## 4 Application Programming Interface

This section documents the Application Programming Interface (API). There are several sets of functions:

- Module management – these initialize, start, stop, and delete the USB host stack.
- Host controller management – these initialize, start, stop, and delete a host controller.
- Class driver management – these create and delete a class driver.
- Application functions – these are used by applications (normally USB class drivers) to communicate using a USB host controller.
- Callback functions – these are used to register user-written callback functions.

### 4.1 Module Management

The functions are the following:

| Function             | Description  |
|----------------------|--|
| <b>usbh_init()</b>   | Initializes the host stack and allocates the required resources. |
| <b>usbh_start()</b>  | Starts the host stack.   |
| <b>usbh_stop()</b>   | Stops the host stack.  |
| <b>usbh_delete()</b> | Deletes the host stack and releases the resources it used.       |

## usbh\_init

Use this function to initialize the USB host stack.

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

### Format

```
int usbh_init ( void )
```

### Arguments

| Parameter |
|-----------|
| None.     |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |



## usbh\_start

Use this function to start the USB host stack.

**Note:** You must call **usbh\_init()** before this to initialize the stack.

### Format

```
int usbh_start ( void )
```

### Arguments

| Parameter |
|-----------|
| None.     |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_stop

Use this function to stop the USB host stack.

### Format

```
int usbh_stop ( void )
```

### Arguments

| Parameter |
|-----------|
| None.     |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_delete

Use this function to delete the USB host stack and release the associated resources.

### Format

```
int usbh_delete ( void )
```

### Arguments

| Parameter |
|-----------|
| None.     |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## 4.2 Host Controller Management

The functions are the following:

| Function                | Description   |
|-------------------------|---|
| <b>usbh_hc_init()</b>   | Initializes the host controller and allocates the required resources. |
| <b>usbh_hc_start()</b>  | Starts the host controller.   |
| <b>usbh_hc_stop()</b>   | Stops the host controller.  |
| <b>usbh_hc_delete()</b> | Deletes the host controller and releases the resources it used.       |

## usbh\_hc\_init

Use this function to add a USB host controller to the system.

You can add up to [USBH\\_MAX\\_HOST\\_CONTROLLERS](#) host controllers to the system; each host controller is addressed by the ID given in this call.

### Format

```
int usbh_hc_init (
    uint8_t      id,
    void *       hc,
    t_usbh_unit_id unit )
```

### Arguments

| Parameter | Description  | Type           |
|-----------|--|----------------|
| id        | The ID of the host controller.   | uint8_t        |
| hc        | A pointer to the host controller descriptor.<br>To obtain this, include the specific host controller API file and add " <b>_hc</b> " to the end of its name. For example, you would change <b>api_usbh_ohci.h</b> to <b>api_usbh_ohci_hc.h</b> . | void *         |
| unit      | The unit number of the host controller. For example, one host controller might be able to handle several controllers of the same type.   | t_usbh_unit_id |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_hc\_start

Use this function to start a USB host controller.

**Note:** You must call **usbh\_hc\_init()** before this to initialize the host controller.

### Format

```
int usbh_hc_start ( uint8_t id )
```

### Arguments

| Parameter | Description                    | Type    |
|-----------|--------------------------------|---------|
| id        | The ID of the host controller. | uint8_t |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_hc\_stop

Use this function to stop a USB host controller.

### Format

```
int usbh_hc_stop ( uint8_t id )
```

### Arguments

| Parameter | Description                    | Type    |
|-----------|--------------------------------|---------|
| id        | The ID of the host controller. | uint8_t |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_hc\_delete

Use this function to delete a USB host controller and release the associated resources.

### Format

```
int usbh_hc_delete ( uint8_t id )
```

### Arguments

| Parameter | Description                    | Type    |
|-----------|--------------------------------|---------|
| id        | The ID of the host controller. | uint8_t |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |



## 4.3 Class Driver Management

The functions are the following:

| Function                 | Description   |
|--------------------------|---|
| <b>usbh_add_cd()</b>     | The function each class driver (except a hub class driver) must call to register itself with the host system. |
| <b>usbh_delete_cd()</b>  | Deletes a class driver (but not a hub class driver).  |
| <b>usbh_add_hub()</b>    | The function a hub class driver must call to register itself with the host system.                            |
| <b>usbh_delete_hub()</b> | Deletes a hub class driver.   |

**Note:**

- These functions are only to be used by those who are developing class drivers.
- These functions are only called by class drivers that include the **usbh\_host.h** header file that includes the prototypes of these functions.

## usbh\_add\_cd

This is the function each class driver (except for a hub class driver) must call to register itself with the host system.

When the class driver registers itself with the host system, it uses the `t_usbh_cd` structure to provide a set of callback functions for the host to call if certain events occur. The class driver must provide these functions, although some of them may be null.

The class driver implementation calls the `usbh_add_cd()` function with the set of callbacks it has provided for the host to carry out the functions of the class driver.

### Format

```
int usbh_add_cd ( const t_usbh_cd * cd )
```

### Arguments

| Parameter | Description   | Type                     |
|-----------|---|--------------------------|
| cd        | A pointer to the class driver callback information. | <code>t_usbh_cd *</code> |

### Return Values

| Return value           | Description                                    |
|------------------------|--|
| USBH_SUCCESS           | Successful execution.                          |
| USBH_ERR_NOT_AVAILABLE | The class driver information is not available. |

## usbh\_delete\_cd

Use this function to delete a class driver (but not a hub class driver).

### Format

```
int usbh_delete_cd ( const t_usbh_cd * cd )
```

### Arguments

| Parameter | Description                                | Type        |
|-----------|--|-------------|
| cd        | A pointer to the class driver information. | t_usbh_cd * |

### Return Values

| Return value           | Description                                    |
|------------------------|--|
| USBH_SUCCESS           | Successful execution.                          |
| USBH_ERR_NOT_AVAILABLE | The class driver information is not available. |

## usbh\_add\_hub

This is the function a hub class driver must call to register itself with the host system.

When the class driver registers itself with the host system, it uses the `t_usbh_hub` structure to provide a set of callback functions for the host to call if certain events occur. The class driver must provide these functions, although some of them may be null.

The class driver implementation calls the **usbh\_add\_hub()** function with the set of callbacks it has provided for the host to carry out the functions of the class driver.

**Note:** This function can only be called from the port manager task, so mutex protection is not required.

### Format

```
t_usbh_hub_hdl usbh_add_hub (
    t_usbh_ifc_hdl ifc_hdl,
    t_usbh_hub *   hub )
```

### Arguments

| Parameter | Description   | Type           |
|-----------|---|----------------|
| ifc_hdl   | The interface handle.                                   | t_usbh_ifc_hdl |
| hub       | A pointer to the hub class driver callback information. | t_usbh_hub *   |

### Return Values

| Return value   | Description                    |
|----------------|--------------------------------|
| t_usbh_hub_hdl | The hub handle.                |
| NULL           | No more entries are available. |

## usbh\_delete\_hub

Use this function to delete a hub class driver.

**Note:** This function can only be called from the port manager task, so mutex protection is not required.

### Format

```
int usbh_delete_hub ( t_usbh_hub_hdl hub_hdl )
```

### Arguments

| Parameter | Description     | Type           |
|-----------|-----------------|----------------|
| hub_hdl   | The hub handle. | t_usbh_hub_hdl |

### Return Values

| Return value | Description   |
|--------------|---|
| USBH_SUCCESS | Successful execution.   |
| USBH_ERROR   | Deletion of one of the devices previously attached to the hub failed. |

## 4.4 Application Functions

These are functions used by applications (normally USB class drivers) to communicate using a USB host controller.

| Function                        | Description   |
|---------------------------------|---|
| <b>usbh_delay()</b>             | Delays for a number of milliseconds.                                  |
| <b>usbh_get_port_inf()</b>      | Gets port information identified by the port handle.                  |
| <b>usbh_get_port_inf_port()</b> | Gets port information identified by host controller ID and port path. |
| <b>usbh_get_string()</b>        | Gets a string descriptor.   |
| <b>usbh_reenumerate()</b>       | Requests reenumeration of a device.                                   |
| <b>usbh_suspend()</b>           | Called from the host, suspends a device.                              |
| <b>usbh_resume()</b>            | Resumes a device previously suspended by the host.                    |
| <b>usbh_test_mode_device()</b>  | Puts a device into test mode.   |
| <b>usbh_test_mode_port()</b>    | Enters test mode on a high speed root hub or an external hub port.    |

## usbh\_delay

Use this function to delay for a number of milliseconds.

This function checks all the registered host controllers and uses the frame counter of the first one it finds that has started.

**Note:** This is guaranteed to work only if all host controllers have the frame counter running, even if no device is connected.

### Format

```
void usbh_delay ( uint32_t ms )
```

### Arguments

| Parameter | Description                              | Type     |
|-----------|--|----------|
| ms        | The number of milliseconds to delay for. | uint32_t |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_get\_port\_inf

Use this function to get port information identified by the port handle.

### Format

```
int usbh_get_port_inf(  
    t_usbh_port_hdl    port_hdl,  
    t_usbh_port_inf *  p_port_inf )
```

### Arguments

| Parameter  | Description                                   | Type              |
|------------|---|-------------------|
| port_hdl   | The port handle.                              | t_usbh_port_hdl   |
| p_port_inf | Where to write the returned port information. | t_usbh_port_inf * |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |



## usbh\_get\_port\_inf\_port

Use this function to get port information identified by host controller ID and port path.

### Format

```
int usbh_get_port_inf_port (
    uint8_t          id,
    uint8_t *        p_path,
    uint8_t          path_len,
    t_usbh_port_inf * p_port_inf )
```

### Arguments

| Parameter  | Description                                   | Type              |
|------------|---|-------------------|
| id         | The host controller ID.                       | uint8_t           |
| p_path     | A pointer to the path to the port.            | uint8_t *         |
| path_len   | The length of the path.                       | uint8_t           |
| p_port_inf | Where to write the returned port information. | t_usbh_port_inf * |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_get\_string

Use this function to get a string descriptor.

### Format

```
int usbh_get_string (
    t_usbh_port_hdl port_hdl,
    uint16_t        idx,
    uint16_t        lang_id,
    uint8_t *       str,
    uint16_t        mlen )
```

### Arguments

| Parameter | Description                           | Type            |
|-----------|---------------------------------------|-----------------|
| port_hdl  | The port handle of the device.        | t_usbh_port_hdl |
| idx       | The string index.                     | uint16_t        |
| lang_id   | The language ID.                      | uint16_t        |
| str       | Where to write the string descriptor. | uint8_t *       |
| mlen      | The maximum length of the string.     | uint16_t        |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_reenumerate

Use this function to request re-enumeration of a device.

You can use this function if the software decides to use a configuration index different from the active one.

### Format

```
int usbh_reenumerate ( t_usbh_port_hdl port_hdl )
```

### Arguments

| Parameter | Description      | Type            |
|-----------|------------------|-----------------|
| port_hdl  | The port handle. | t_usbh_port_hdl |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_suspend

Use this function from the host to suspend a device.

When this is called the device must suspend itself and draw less than 500µA from the bus. You can use **usbh\_resume()** to re-activate the device.

### Format

```
int usbh_suspend (
    t_usbh_port_hdl port_hdl,
    uint8_t         rwkup_en )
```

### Arguments

| Parameter | Description   | Type            |
|-----------|---|-----------------|
| port_hdl  | The port handle.  | t_usbh_port_hdl |
| rwkup_en  | Set this to enable the device's remote wakeup capability.<br>If the remote wakeup flag is set the device is allowed to wake itself up normally in response to a key being pressed or similar input. The device achieves this wakeup by using a special signalling sequence on the bus, which the host controller can detect, to tell the host it is active again. | uint8_t         |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_resume

Use this function to resume a device previously suspended by the host.

### Format

```
int usbh_resume ( t_usbh_port_hdl port_hdl )
```

### Arguments

| Parameter | Description      | Type            |
|-----------|------------------|-----------------|
| port_hdl  | The port handle. | t_usbh_port_hdl |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_test\_mode\_device

Use this function to put a device into test mode.

### Format

```
int usbh_test_mode_device (  
    t_usbh_port_hdl    port_hdl,  
    t_usbh_test_mode   mode )
```

### Arguments

| Parameter | Description                     | Type             |
|-----------|---------------------------------|------------------|
| port_hdl  | The port handle.                | t_usbh_port_hdl  |
| mode      | The <a href="#">test mode</a> . | t_usbh_test_mode |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_test\_mode\_port

Use this function to enter test mode on a high speed root hub or an external hub port.

The port is identified by the host controller ID and port path.

### Format

```
int usbh_test_mode_port (
    uint8_t          id,
    uint8_t *        p_path,
    uint8_t          path_len,
    t_usbh_test_mode mode )
```

### Arguments

| Parameter | Description  | Type             |
|-----------|--|------------------|
| id        | The host controller ID.  | uint8_t          |
| p_path    | A pointer to the path to the port.<br>For example, "1,2,4" means the fourth port of the external hub, connected to the second port of another external hub which is connected to the first port of the root hub. | uint8_t *        |
| path_len  | The number of entries in the path array.   | uint8_t          |
| mode      | The <a href="#">test mode</a> .  | t_usbh_test_mode |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## 4.5 Callback Functions

Use these to register user-written callback functions.

**Note:**

- It is the class driver's responsibility to provide the **t\_usbh\_cd\_xxx()** or **t\_usbh\_hub\_xxx()** functions.
- It is the user's responsibility to provide the **usbh\_register\_xxx()** functions.

The functions are the following:

| Function                                | Description   |
|---|---|
| <b>t_usbh_cd_connect_fn()</b>           | Connects a device.                                    |
| <b>t_usbh_cd_disconnect_fn()</b>        | Disconnects a device.                                 |
| <b>t_usbh_cd_check_fn()</b>             | Checks the device's configuration.                    |
| <b>t_usbh_cd_descriptor_fn()</b>        | Gets a device descriptor.                             |
| <b>t_usbh_hub_fn()</b>                  | Disables, suspends, or resumes a hub.                 |
| <b>t_usbh_hub_reset_fn()</b>            | Resets a hub.   |
| <b>t_usbh_hub_scan_fn()</b>             | Scans for a device status change.                     |
| <b>t_usbh_hub_test_fn()</b>             | Sets a hub's test mode.                               |
| <b>usbh_register_config_select_cb()</b> | Registers a "select configuration" callback function. |
| <b>usbh_register_enum_failed_cb()</b>   | Registers an "enumeration failed" callback function.  |



## t\_usbh\_cd\_connect\_fn

This defines the class driver callback function that may be called to connect a device.

### Format

```
int ( * t_usbh_cd_connect_fn )(  
    t_usbh_dev_hdl    dev_hdl,  
    t_usbh_ifc_hdl    ifc_hdl )
```

### Arguments

| Argument | Description                        | Type           |
|----------|------------------------------------|----------------|
| dev_hdl  | The device handle.                 | t_usbh_dev_hdl |
| ifc_hdl  | A pointer to the interface handle. | t_usbh_ifc_hdl |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_cd\_disconnect\_fn

This defines the class driver callback function that may be called to disconnect a device.

### Format

```
int ( * t_usbh_cd_disconnect_fn )( t_usbh_dev_hdl dev_hdl )
```

### Arguments

| Argument | Description        | Type           |
|----------|--------------------|----------------|
| dev_hdl  | The device handle. | t_usbh_dev_hdl |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_cd\_check\_fn

This defines the class driver callback function that may be called to check the device's configuration.

### Format

```
t_usbh_ep_hdl *( * t_usbh_cd_check_fn )(
    t_usbh_port_hdl    port_hdl,
    t_usbh_dsc_par *   dsc,
    t_usbh_ep_hdl      ep0_hdl,
    t_usbh_dev_hdl *   dev_hdl )
```

### Arguments

| Argument | Description                     | Type             |
|----------|---------------------------------|------------------|
| port_hdl | The port handle.                | t_usbh_port_hdl  |
| dsc      | A pointer to the descriptor.    | t_usbh_dsc_par * |
| ep0_hdl  | The endpoint 0 handle.          | t_usbh_ep_hdl    |
| dev_hdl  | A pointer to the device handle. | t_usbh_dev_hdl * |

### Return Values

A pointer to the endpoint handle.

## t\_usbh\_cd\_descriptor\_fn

This defines the class driver callback function that may be called to get a device descriptor.

### Format

```
int * t_usbh_cd_descriptor_fn )(
    t_usbh_dev_hdl dev_hdl,
    uint8_t *      dsc )
```

### Arguments

| Argument | Description                  | Type           |
|----------|------------------------------|----------------|
| dev_hdl  | The device handle.           | t_usbh_dev_hdl |
| dsc      | A pointer to the descriptor. | uint8_t *      |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_hub\_fn

This defines the class driver callback function that may be called to disable, suspend, or resume a hub.

### Format

```
int ( * t_usbh_hub_fn )(
    t_usbh_dev_hdl dev_hdl,
    uint8_t port )
```

### Arguments

| Argument | Description                       | Type           |
|----------|-----------------------------------|----------------|
| dev_hdl  | The device handle.                | t_usbh_dev_hdl |
| port     | The port the hub is connected to. | uint8_t        |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_hub\_reset\_fn

This defines the class driver callback function that may be called to reset a hub.

### Format

```
int ( * t_usbh_hub_reset_fn )(
    t_usbh_dev_hdl dev_hdl,
    uint8_t port,
    uint8_t * speed )
```

### Arguments

| Argument | Description                                   | Type           |
|----------|---|----------------|
| dev_hdl  | The device handle.                            | t_usbh_dev_hdl |
| port     | The port the hub is connected to.             | uint8_t        |
| speed    | A pointer to the speed of the new connection. | uint8_t *      |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_hub\_scan\_fn

This defines the class driver callback function that may be called to scan for a device status change.

### Format

```
int ( * t_usbh_hub_scan_fn )(
    t_usbh_dev_hdl    dev_hdl,
    t_hub_scan_inf *  hsi,
    uint8_t *         hsi_cnt )
```

### Arguments

| Argument | Description                        | Type             |
|----------|------------------------------------|------------------|
| dev_hdl  | The device handle.                 | t_usbh_dev_hdl   |
| hsi      | A pointer to the scan information. | t_hub_scan_inf * |
| hsi_cnt  | A pointer to the scan count.       | uint8_t *        |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |

## t\_usbh\_hub\_test\_fn

This defines the class driver callback function that may be called to set a hub's test mode.

### Format

```
int ( * t_usbh_hub_test_fn )(
    t_usbh_dev_hdl    dev_hdl,
    uint8_t           port,
    t_usbh_test_mode  mode )
```

### Arguments

| Argument | Description                       | Type             |
|----------|-----------------------------------|------------------|
| dev_hdl  | The device handle.                | t_usbh_dev_hdl   |
| port     | The port the hub is connected to. | uint8_t          |
| mode     | The <a href="#">test mode</a> .   | t_usbh_test_mode |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| USBH_SUCCESS | Successful execution. |
| USBH_ERROR   | Operation failed.     |



## usbh\_register\_config\_select\_cb

Use this function to register a "select configuration" callback function.

After it is registered, the system calls this function every time a device is enumerated. This allows you to select which configuration to activate on the device, based on its vendor and product IDs.

### Format

```
int usbh_register_config_select_cb ( t_usbh_config_select_cb p_cb )
```

### Arguments

| Parameter | Description            | Type                    |
|-----------|------------------------|-------------------------|
| p_cb      | The callback function. | t_usbh_config_select_cb |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## usbh\_register\_enum\_failed\_cb

Use this function to register an "enumeration failed" callback function.

After it is registered, the enumeration failed callback is executed if a device is attached without any class driver being able to mount any interface on it.

### Format

```
int usbh_register_enum_failed_cb ( t_usbh_enum_failed_cb p_cb );
```

### Arguments

| Parameter | Description            | Type                  |
|-----------|------------------------|-----------------------|
| p_cb      | The callback function. | t_usbh_enum_failed_cb |

### Return Values

| Return value | Description                       |
|--------------|-----------------------------------|
| USBH_SUCCESS | Successful execution.             |
| Else         | See <a href="#">Error Codes</a> . |

## 4.6 Error Codes

If a function executes successfully it returns with USBH\_SUCCESS, a value of 0. The following table shows the meaning of the error codes.

| Return code            | Value | Description   |
|------------------------|-------|---|
| USBH_SUCCESS           | 0     | Successful execution.   |
| USBH_SHORT_PACKET      | 1     | IN transfer completed with short packet.                            |
| USBH_PENDING           | 2     | Transfer still pending.   |
| USBH_ERR_BUSY          | 3     | Another transfer in progress.                                       |
| USBH_ERR_DIR           | 4     | Transfer direction error.   |
| USBH_ERR_TIMEOUT       | 5     | Transfer timed out.   |
| USBH_ERR_TRANSFER      | 6     | Transfer failed to complete.  |
| USBH_ERR_TRANSFER_FULL | 7     | Cannot process more transfers.                                      |
| USBH_ERR_SUSPENDED     | 8     | Host controller is suspended.                                       |
| USBH_ERR_HC_HALTED     | 9     | Host controller is halted.  |
| USBH_ERR_REMOVED       | 10    | Transfer finished due to device removal.                            |
| USBH_ERR_PERIODIC_LIST | 11    | Periodic list error.  |
| USBH_ERR_RESET_REQUEST | 12    | Reset request during enumeration.                                   |
| USBH_ERR_RESOURCE      | 13    | OS resource error.  |
| USBH_ERR_INVALID       | 14    | Invalid identifier/type (HC, EP HDL, and so on).                    |
| USBH_ERR_NOT_AVAILABLE | 15    | The resource is not available.                                      |
| USBH_ERR_INVALID_SIZE  | 16    | Invalid size.   |
| USBH_ERR_NOT_ALLOWED   | 17    | Operation not allowed. The function cannot be called at this stage. |
| USBH_ERROR             | 18    | General error.  |

## 4.7 Types and Definitions

This section describes the main elements that are defined in the API Header file.

### t\_usbh\_port\_inf

This information is returned by the **usbh\_get\_port\_inf()** function.

| Element                     | Type     | Description  |
|-----------------------------|----------|--|
| state                       | uint16_t | See <a href="#">Connection States</a> .                          |
| hc_uid                      | uint8_t  | The host controller ID.  |
| path_len                    | uint8_t  | The number of elements in the path.                              |
| path[USBH_MAX_EXT_HUBS + 1] | uint8_t  | The port path, starting from the root hub.                       |
| speed                       | uint8_t  | The speed (USBH_LOW_SPEED, USBH_FULL_SPEED, or USBH_HIGH_SPEED). |
| rwkup                       | uint8_t  | The device on the port supports remote wakeup.                   |
| vid                         | uint16_t | The vendor ID.   |
| pid                         | uint16_t | The product ID.  |

## t\_usbh\_cd

For all class drivers except for hub class drivers, the *t\_usbh\_cd* structure lists the set of callback functions the host can call if certain events occur.

**Note:** The class driver must provide these functions, although some of them may be null.

The structure takes this form:

| Element    | Type                    | Description                                   |
|------------|-------------------------|---|
| vid        | uint16_t                | The vendor ID.                                |
| pid        | uint16_t                | The product ID.                               |
| check      | t_usbh_cd_check_fn      | The function used to perform a check.         |
| connect    | t_usbh_cd_connect_fn    | The function used to make a connection.       |
| disconnect | t_usbh_cd_disconnect_fn | The function used to disconnect a device.     |
| descriptor | t_usbh_cd_descriptor_fn | The function used to get a device descriptor. |
| ep_dsc     | t_usbh_cd_ep_dsc *      | The endpoint descriptor.                      |

## t\_usbh\_hub

For hub class drivers, the *t\_usbh\_hub* structure lists the set of callback functions the host can call if certain events occur.

**Note:** The class driver must provide these functions, although some of them may be null.

The structure takes this form:

| Element | Type                | Description   |
|---------|---------------------|---|
| scan    | t_usbh_hub_scan_fn  | The function used to scan for a device status change. |
| reset   | t_usbh_hub_reset_fn | The function used to reset a hub port.                |
| disable | t_usbh_hub_fn       | The function used to disable a hub port.              |
| suspend | t_usbh_hub_fn       | The function used to suspend a hub port.              |
| resume  | t_usbh_hub_fn       | The function used to resume a hub port.               |
| test    | t_usbh_hub_test_fn  | The function used to set test mode on a hub port.     |

## Test Modes

The test modes are as follows:

| Mode                        | Description  |
|-----------------------------|--|
| USBH_TEST_MODE_OFF          | Test mode disabled (used for internal purposes).   |
| USBH_TEST_MODE_J_STATE      | J state test mode. The port's transceiver enters the high speed J state and remains in this mode throughout. This lets you test the high output drive level on the D+ line.  |
| USBH_TEST_MODE_K_STATE      | K state test mode. The port's transceiver enters the high speed K state and remains in this mode throughout. This lets you test the high output drive level on the D- line.  |
| USBH_TEST_MODE_SE0_NAK      | <p>SE0/NAK test mode.</p> <p>The port's transceiver enters high speed receive mode and remains in this mode throughout. This lets you test output impedance, low level output voltage, and loading characteristics.</p> <p>In this mode upstream facing ports must respond to any IN token packet (that has a correct packet CRC) with a NAK handshake within the allowed device response time. This lets you test the device squelch level circuitry and also provides a stimulus/response test for general functional testing.</p> |
| USBH_TEST_MODE_PACKET       | <p>Packet test mode. A port transmits a test packet repeatedly. This lets you test rise and fall times, eye patterns, jitter, and any other dynamic waveform specifications.</p> <p>The inter-packet timing must not be less than the minimum allowed inter-packet gap and must not exceed 125 <math>\mu</math>s.</p>  |
| USBH_TEST_MODE_FORCE_ENABLE | Force enable test mode. Here downstream-facing hub ports are enabled in high speed mode, whether or not a device is attached. Packets that arrive at the hub's upstream-facing port are repeated on the port that is in force enable test mode. This lets you test the hub's disconnect detection: by polling the disconnect detect bit while varying the loading on the port, you can measure the disconnect detection threshold voltage.   |

## Connection States

The connection states are as follows:

| State                   | Description  |
|-------------------------|--|
| USBH_STATE_FREE         | The port is free (this is not seen from the user space). |
| USBH_STATE_INVALID      | Invalid state.   |
| USBH_STATE_DISCONNECTED | Disconnected.  |
| USBH_STATE_CONNECTED    | Connected.   |
| USBH_STATE_SUSPENDED    | Suspended.   |
| USBH_STATE_ISUSPENDED   | Indirectly suspended.                                    |
| USBH_STATE_RWKUP        | Remote wakeup request not processed yet.                 |
| USBH_STATE_OVERCURRENT  | Overcurrent.   |
| USBH_STATE_ENUM         | Enumeration request.                                     |
| USBH_STATE_CHANGED      | Changed.   |
| USBH_STATE_OPERATIONAL  | Operational.   |

## Notification Codes

The standard notification codes shown below are defined in the file **api\_usb\_host.h**.

| Notification        | Description  |
|---------------------|--|
| USBH_NTF_CONNECT    | Connection notification code.                          |
| USBH_NTF_DISCONNECT | Disconnection notification code.                       |
| USBH_NTF_CD_BASE    | This is the first notification a class driver can use. |



## t\_usbh\_config\_select\_cb

The **t\_usbh\_config\_select\_cb** definition specifies the format of the [select configuration callback function](#).

### Format

```
typedef uint8_t ( * t_usbh_config_select_cb )(
    t_usbh_port_hdl    port_hdl,
    uint16_t           vid,
    uint16_t           pid )
```

### Arguments

| Parameter | Description   | Type            |
|-----------|---|-----------------|
| port_hdl  | The port handle. This is used to specify the device if <b>usbh_reenumerate()</b> is to be called. | t_usbh_port_hdl |
| vid       | The vendor ID.  | uint16_t        |
| pid       | The product ID.   | uint16_t        |

### Return Codes

| Parameter              | Description   |
|------------------------|---|
| Index.                 | The index of the configuration to use.  |
| USBH_CONFIG_SELECT_ALL | Any configuration can be used. This is returned if the system needs to parse all the configurations and select the first one that has a valid interface (depending on the available class drivers). |

## t\_usbh\_enum\_failed\_cb

The **t\_usbh\_config\_select\_cb** definition specifies the format of the [enumeration failed callback function](#).

### Format

```
typedef void ( * t_usbh_enum_failed_cb )(
    t_usbh_port_hdl    port_hdl,
    uint16_t          vid,
    uint16_t          pid )
```

### Arguments

| Parameter | Description      | Type            |
|-----------|------------------|-----------------|
| port_hdl  | The port handle. | t_usbh_port_hdl |
| vid       | The vendor ID.   | uint16_t        |
| pid       | The product ID.  | uint16_t        |

## String Descriptors

String descriptors provide human-readable information and are optional.

The string descriptors are as follows:

| Mode                  | Description   |
|-----------------------|---|
| USBH_STR_MANUFACTURER | The index to use to get the manufacturer ID string. |
| USBH_STR_PRODUCT      | The index to use to get the product ID string.      |
| USBH_STR_SERIAL       | The index to use to get the serial number string.   |
| USBH_LANG_ID_DEFAULT  | The default language ID when requesting a string.   |

**Note:** If any descriptors are not used, their index fields must be set to zero to indicate that no string descriptor is available.

## 5 Integration

This section describes all aspects of the module that require integration with your target project. This includes porting and configuration of external resources.

### 5.1 OS Abstraction Layer

All HCC modules use the OS Abstraction Layer (OAL) that allows the module to run seamlessly with a wide variety of RTOSes, or without an RTOS.

The USB host base system uses the following OAL components:

| OAL Resource | Number Required |
|--------------|-----------------|
| Tasks        | 2               |
| Mutexes      | 4               |
| Events       | 4               |

### 5.2 PSP Porting

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

The USB host base system makes use of the following standard PSP functions:

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

The USB host base system makes use of the following standard PSP macros:

| Macro       | Package  | Component      | Description   |
|-------------|----------|----------------|---|
| PSP_RD_LE16 | psp_base | psp_endianness | Reads a 16 bit value stored as little-endian from a memory location.      |
| PSP_WR_LE16 | psp_base | psp_endianness | Writes a 16 bit value to be stored as little-endian to a memory location. |

## 6 Sample Code

This example shows code that you can use to start the USB host stack:

```
void setup_usb_host_stack()
{
    int rc;

    rc = usbh_init();           /* Initialize the USB host stack */

    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_hc_init( 0, usbh_stm32uh_hc, 0 ); /* Add a host controller (0) */
    }
    /* Add more host controllers as required.... */

    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_cdc_acm(); /* Initialize class driver (here it's CDC-ACM) */
    }
    /* Add more class drivers as required.... */

    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_cdc_acm_start(); /* Start class driver */
    }

    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_start(); /* Start the USB host stack */
    }

    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_hc_start( 0 ); /* Start the USB host controller */
    }

    /* USB host stack is now ready to use */

    return rc;
}
```