# Embedded USB Host Raw Class Driver User Guide

Version 1.10

For use with USBH Raw Class Driver versions 4.01 and above

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# Table of Contents

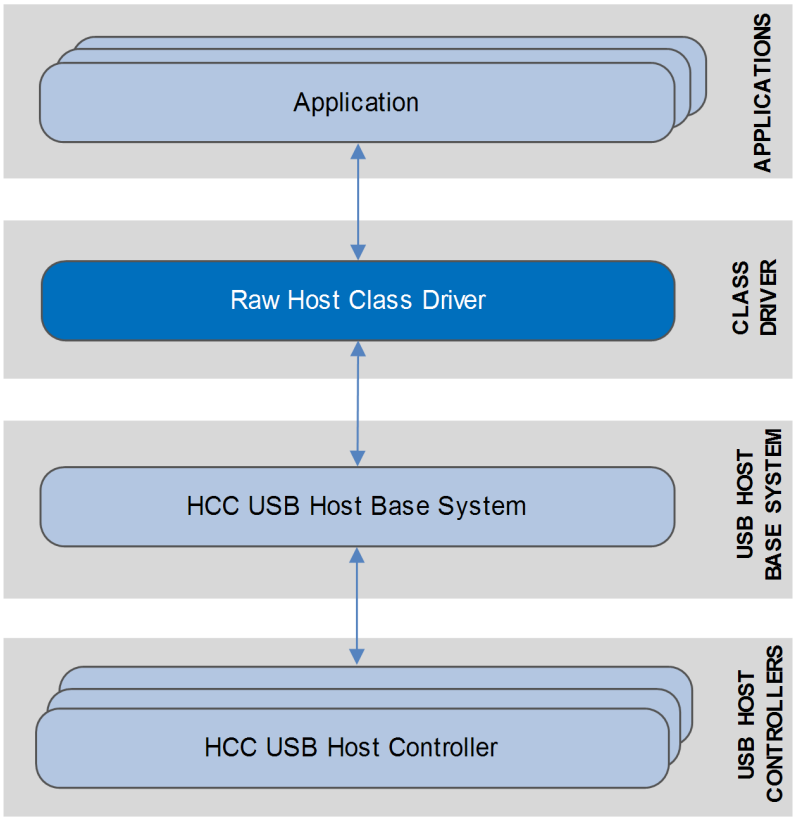
# 1 System Overview

## 1.1 Introduction

This guide is for those who want to implement an embedded USB host class driver to control Raw transfers. The **usbh_cd_raw** package provides a Raw host class driver for a USB stack. Typically this is used for connecting devices over a USB link to a host.

Raw transfers are used for infrequent transfers of larger amounts of data. The transfer takes place only when bandwidth is available, so may be delayed when other applications are using the bandwidth. Raw transfers may be used to support devices like printers and scanners. Data delivery is guaranteed by means of CRC error detection and limited retries. Raw transfers are only supported by full and high speed devices. Multiple channels can be used on the same interface.

The system structure is shown in the diagram below:




The lower layer interface is designed to use HCC Embedded's USB Host Interface Layer. This layer is standard over different host controller implementations; this means that the code is unchanged, whichever HCC USB host controller it is interfaced to. For detailed information about this layer, refer to the *HCC USB Host Base System User Guide* that is shipped with the base system.

The package provides a set of API functions for controlling access to a device. These are described here, with separate sections for module management and channel management functions.

## 1.2 Feature Check

The main features of the class driver are the following:

- It conforms to the HCC Advanced Embedded Framework.
- It can be used with or without an RTOS.
- It is compatible with all HCC USB host controllers.
- It supports multiple devices connected simultaneously.
- It supports a raw interface to a connected USB device.
- It uses a system of callbacks for user-specified events.

## 1.3 Packages and Documents

### Packages

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

| Package | Description |
|---|---|
| **hcc_base_doc** | This contains the two guides that will help you get started. |
| **usbh_base** | The USB host base package. This is the framework used by USB class drivers to communicate over USB using a specific USB host controller package. |
| **usbh_cd_raw** | The USB device Raw host class driver package described by this document. |

### Documents

For an overview of HCC's embedded USB stacks, refer to the Product Information section of 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 document defines the USB host base system upon which the complete USB stack is built.

**HCC Embedded USB Host Raw Class Driver User Guide**

This is this document.

## 1.4 Change History

This section includes recent changes to this product. For a list of all the changes, refer to the file **src/history/usb-host/usbh_cd_raw.txt** in the distribution package.

| Version | Changes |
|---|---|
| 4.01 | Added a new parameter to the send/receive functions, allowing these calls to skip zero length packets. |
| 3.01 | Added support for multiple channels on the same interface. |
| 2.01 | Renamed class driver raw instead of bulk.<br><br>Added new functions **usbh_raw_write_ctrl()** and **usbh_raw_read_ctrl()** for sending and receiving data on the control channel. |

# 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 File

The file **src/api/api_usbh_raw.h** should be included by any application using the system. This 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_usbh_raw.h** contains all the configurable parameters of the system. Configure these as required. For details of these options, see Configuration Options.

## 2.3 Source Code File

The file **src/usb-host/class-drivers/raw/usbh_raw.c** is the main code for the Raw class driver. **This file should only be modified by HCC.**

## 2.4 Version File

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

# 3 Configuration Options

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

**USBH_RAW_MAX_UNITS**

The maximum number of device instances the class driver can handle concurrently. This is the maximum number of devices allowed to run in parallel. The default is 2.

**USBH_RAW_MAX_CHANNELS_PER_INTERFACE**

The maximum number of channels per interface. The default is 2.

**USBH_RAW_CLASS**

The USB class value used to identify compatible interfaces this class driver can handle. The default is 0xFE.

**USBH_RAW_SUBCLASS**

The USB subclass value used to identify compatible interfaces this class driver can handle. The default is 0x01.

**USBH_RAW_PROTOCOL**

The USB protocol value used to identify compatible interfaces this class driver can handle. The default is 0x07.

**USBH_RAW_CTRL_REQUEST**

The request value to use in the setup packet when a read or write request is sent over the control channel. The default is 0x078.

**USBH_RAW_CTRL_VALUE**

The value to use in the setup packet when a read or write request is sent over the control channel. The default is 0x079.

**USBH_RAW_CTRL_INDEX**

The index value to use in the setup packet when a read or write request is sent over the control channel. The default is 0.

# 4 Application Programming Interface

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

## 4.1 Module Management

### usbh_raw_init

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

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

#### Format

```
int usbh_raw_init ( void )
```

#### Arguments

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

#### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_start

Use this function to start the class driver.

> **Note:** You must call **usbh_raw_init()** before this to initialize the module.

### Format

```
int usbh_raw_start ( void )
```

### Arguments

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

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_stop

Use this function to stop the class driver.

### Format

```
int usbh_raw_stop ( void )
```

### Arguments

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

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_delete

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

### Format

```
int usbh_raw_delete ( void )
```

### Arguments

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

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## 4.2 Channel Management

### usbh_raw_read

Use this function to start a read transfer (from device to host).

> **Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_read_state()**.

#### Format

```
int usbh_raw_read (
    t_usbh_unit_id   uid,
    uint8_t          channel,
    uint8_t *        pc_dst,
    uint32_t         blen,
    uint8_t          skip_zlp )
```

#### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| channel | The channel number. The range is 0 .. 3. | uint8_t |
| pc_dst | A pointer to the destination buffer. | uint8_t * |
| blen | The size of the buffer. | uint32_t |
| skip_zlp | If the requested receive length is a multiple of the USB packet size then:<br>• If this is not set, the receive will only return after a terminating zero length packet is received.<br>• If this is set, the receive will complete as soon as the requested data length has been received. | uint8_t |

#### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_read_ctrl

Use this function to start a read transfer (from device to host) on the Control channel.

**Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_read_state()**.

### Format

```
int usbh_raw_read_ctrl (
    t_usbh_unit_id   uid,
    uint8_t *        pc_dst,
    uint32_t         blen,
    uint32_t *       p_rlen )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| pc_dst | A pointer to the destination buffer. | uint8_t * |
| blen | The length of the buffer. | uint32_t |
| p_rlen | On return, the number of bytes read. | uint32_t * |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_read_ep

Use this function to start a read transfer (from device to host) by endpoint number instead of the channel.

> **Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_read_state_ep()**.

### Format

```
int usbh_raw_read_ep (
    t_usbh_unit_id   uid,
    uint8_t          ep
    uint8_t *        pc_dst,
    uint32_t         blen,
    uint8_t          skip_zlp )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| ep | The endpoint number. The range is 0x81 .. 0x84. | uint8_t |
| pc_dst | A pointer to the destination buffer. | uint8_t * |
| blen | The length of the buffer. | uint32_t |
| skip_zlp | If the requested receive length is a multiple of the USB packet size then:<br>• If this is not set, the receive will only return after a terminating zero length packet is received.<br>• If this is set, the receive will complete as soon as the requested data length has been received. | uint8_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_read_state

Use this function to check the status of the ongoing read operation.

### Format

```
int usbh_raw_read_state (
    t_usbh_unit_id   uid,
    uint8_t          channel,
    uint8_t          b_block,
    uint32_t *       p_rlen )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| channel | The channel number. The range is 0 .. 3. | uint8_t |
| b_block | Set this to 1 if this call needs to block (wait until the read finishes). Ignore this in non-OS mode. | uint8_t |
| p_rlen | A pointer to the number of bytes read. | uint32_t * |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_read_state_ep

Use this function to check the status of the ongoing **usbh_raw_read_ep()** operation..

### Format

```
int usbh_raw_read_state_ep (
    t_usbh_unit_id   uid,
    uint8_t          ep
    uint8_t          b_block,
    uint32_t *       p_rlen  )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| ep | The endpoint number. The range is 0x81 .. 0x84. | uint8_t |
| b_block | Set this to 1 if this call needs to block (wait until the read finishes). Ignore this in non-OS mode. | uint8_t |
| p_rlen | A pointer to the number of bytes read. | uint32_t * |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_BUSY | Operation is still ongoing. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_write

Use this function to start a write transfer (from host to device).

**Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_write_state()**.

### Format

```
int usbh_raw_write (
    t_usbh_unit_id   uid,
    uint8_t          channel,
    uint8_t *        pc_buf,
    uint32_t         blen,
    uint8_t          skip_zlp )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| channel | The channel number. The range is 0 .. 3. | uint8_t |
| pc_buf | A pointer to the buffer. This buffer preserves data until the end of the transfer. | uint8_t * |
| blen | The length of the buffer. | uint32_t |
| skip_zlp | If the requested transmit length is a multiple of the USB packet size then:<br>• If this is not set the transfer will be terminated with an additional zero length packet after the data.<br>• If it is set then only the requested data is sent. | uint8_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_write_ctrl

Use this function to start a write transfer (from host to device) on the Control channel.

> **Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_write_state()**.

### Format

```
int usbh_raw_write_ctrl (
    t_usbh_unit_id   uid,
    uint8_t *        pc_buf,
    uint32_t         blen )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| pc_buf | A pointer to the buffer. This buffer preserves data until the end of the transfer. | uint8_t * |
| blen | The length of the buffer, the number of bytes to send. | uint32_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_write_ep

Use this function to start a write transfer (from host to device) by endpoint number instead of the channel.

> **Note:** This function starts the transfer but does not wait for it to end. To check for completion, call **usbh_raw_write_state_ep()**.

### Format

```
int usbh_raw_write_ep (
    t_usbh_unit_id   uid,
    uint8_t          ep
    uint8_t *        pc_buf,
    uint32_t         blen,
    uint8_t          skip_zlp )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| ep | The endpoint number. The range is 0x01 .. 0x04. | uint8_t |
| pc_buf | A pointer to the buffer holding the data. This buffer preserves data until the transfer ends. | uint8_t * |
| blen | The number of bytes to write. | uint32_t |
| skip_zlp | If the requested transmit length is a multiple of the USB packet size then:<br>• If this is not set the transfer will be terminated with an additional zero length packet after the data.<br>• If it is set then only the requested data is sent. | uint8_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_write_state

Use this function to check the status of the ongoing write operation.

### Format

```
int usbh_raw_write_state (
    t_usbh_unit_id   uid,
    uint8_t          channel,
    uint8_t          b_block )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| channel | The channel number. The range is 0 .. 3. | uint8_t |
| b_block | Set this to 1 if this call needs to block (wait until the write finishes). Ignore this in non-OS mode. | uint8_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_write_state_ep

Use this function to check the status of the ongoing **usbh_raw_write_ep()** operation.

### Format

```
int usbh_raw_write_state_ep (
    t_usbh_unit_id   uid,
    uint8_t          ep
    uint8_t          b_block )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_idt |
| ep | The endpoint number. The range is 0x01 .. 0x04. | uint8_t |
| b_block | Set this to 1 if this call needs to block (wait until the write finishes). Ignore this in non-OS mode. | uint8_t |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_RAW_BUSY | Operation is still ongoing. |
| USBH_RAW_ERR_NOT_PRESENT | No active device is connected. |
| Else | See Error Codes. |

## usbh_raw_get_ep_number

Use this function to get a channel's endpoint number.

### Format

```
int usbh_raw_get_ep_number (
    t_usbh_unit_id   uid,
    uint8_t          channel,
    uint8_t          direction,
    uint8_t *        ep )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| channel | The channel number. The range is 0 .. 3. | uint8_t |
| direction | USBH_DIR_IN or USBH_DIR_OUT. | uint8_t |
| ep | The endpoint number. | uint8_t * |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## usbh_raw_present

Use this function to check whether a compatible device is connected.

### Format

```
int usbh_raw_present ( t_usbh_unit_id uid )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |

### Return Values

| Return value | Description |
|---|---|
| 0 | No compatible device is connected. |
| Non-zero. | At least one compatible device is connected. |

## usbh_raw_get_port_hdl

Use this function to get a port handle.

### Format

```
t_usbh_port_hdl usbh_raw_get_port_hdl ( t_usbh_unit_id uid )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| USBH_PORT_HDL_INVALID | Invalid port handle. |

## usbh_raw_register_ntf

Use this function to register a notification function for a specified event notification type.

When a device is connected or disconnected, or one of the specific events for this type of device occurs, the notification function is called.

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

### Format

```
usbh_raw_register_ntf (
    t_usbh_unit_id   uid,
    t_usbh_ntf       ntf,
    t_usbh_ntf_fn    pf_xx_ntf )
```

### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| ntf | The notification type. | t_usbh_ntf |
| pf_xx_ntf | The notification function. | t_usbh_ntf_fn |

### Return Values

| Return value | Description |
|---|---|
| USBH_RAW_SUCCESS | Successful execution. |
| Else | See Error Codes. |

## 4.3 Error Codes

The first table below shows the meaning of the error codes specific to this raw class driver, the second table shows the generic USB host error codes.

### Raw-specific Error Codes

| Return Code | Value | Description |
|---|---|---|
| USBH_RAW_SUCCESS | 0U | Operation ended with no error. |
| USBH_RAW_BUSY | 1U | Operation is still ongoing. |
| USBH_RAW_NOT_PRESENT | 2U | No active device is connected. |
| USBH_RAW_NOT_STARTED | 3U | Class driver is not started. |
| USBH_RAW_ERROR | 4U | Operation failed. |

## Generic USB Host Error Codes

If a function executes successfully it returns with a USBH_SUCCESS code, a value of zero. 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 | Item not available. |
| USBH_ERR_INVALID_SIZE | 16 | Invalid size. |
| USBH_ERR_NOT_ALLOWED | 17 | Operation not allowed. |
| USBH_ERROR | 18 | General error. |

## 4.4 Types and Definitions

### t_usbh_ntf_fn

The **t_usbh_ntf_fn** definition specifies the format of the notification function. It is defined in the USB host base system in the file **api_usb_host.h**.

#### Format

```
int  ( * t_usbh_ntf_fn )(
    t_usbh_unit_id   uid,
    t_usbh_ntf       ntf )
```

#### Arguments

| Parameter | Description | Type |
|---|---|---|
| uid | The unit ID. | t_usbh_unit_id |
| ntf | The notification code. | t_usbh_ntf |

### Notification Codes

The standard notification codes shown below are defined in the USB host base system in the file **api_usb_host.h**.

| Notification | Value | Description |
|---|---|---|
| USBH_NTF_CONNECT | 1 | Connection notification code. |
| USBH_NTF_DISCONNECT | 2 | Disconnection notification code. |

The additional notification codes provided by this module are as follows:

| Notification | Value | Description |
|---|---|---|
| USBH_NTF_RAW_RX (ch) | ( USBH_NTF_CD_BASE + ch ) | RX notification. |
| USBH_NTF_RAW_TX (ch) | ( USBH_NTF_CD_BASE + USBH_RAW_MAX_CHANNELS + ch ) | TX notification. |

# 5 Integration

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

## 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 module uses the following OAL components:

| OAL Resource | Number Required |
|---|---|
| Tasks | 0 |
| Mutexes | 1 |
| Events | 1 |

## 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.

The module makes use of the following standard PSP macro:

| Macro | Package | Element | Description |
|---|---|---|---|
| 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 section shows example code for the class driver.

## 6.1 Initialization

This example shows the code used to initialize a USB host with the class driver.

```
/*
** Initialize the USB host with the Raw class driver.
*/

int usb_host_init ( void )
{
    int  rc;
    rc = hcc_mem_init();

    /* Initialize the USB host module */
    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_init();
    }

    /* Initialize a specific USB host controller */
    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_hc_init( 0, usbh_stm32uh_hc, 0 );
    }

    /* Initialize the Raw class driver module */
    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_raw_init();
    }

    /* Start the Raw class driver */
    if ( rc == USBH_SUCCESS )
    {
        rc = usbh_raw_start();
    }

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

    return rc;

} /* usb_host_init */
```