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# MCUXpresso SDK USB Stack Device Reference Manual

**NXP Semiconductors**

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## Chapter 1 Overview

The USB device stack is composed of the USB controller driver only, which consists of the common controller driver and the controller (like: xHCI in Kinetis) driver. The device class driver and the USB framework to handle the standard enumeration and request defined by USB specification 2.0 are moved to the application layer. These two parts are example-specific to reduce the footprint of the examples.

Note

The xHCI represents either EHCI or KHCI, not the XHCI for USB 3.0.

In the USB Device stack, there are two different USB applications. One is the lite version and the other is similar to the examples in the previous USB stack.

The whole architecture and components of USB stack are shown below:

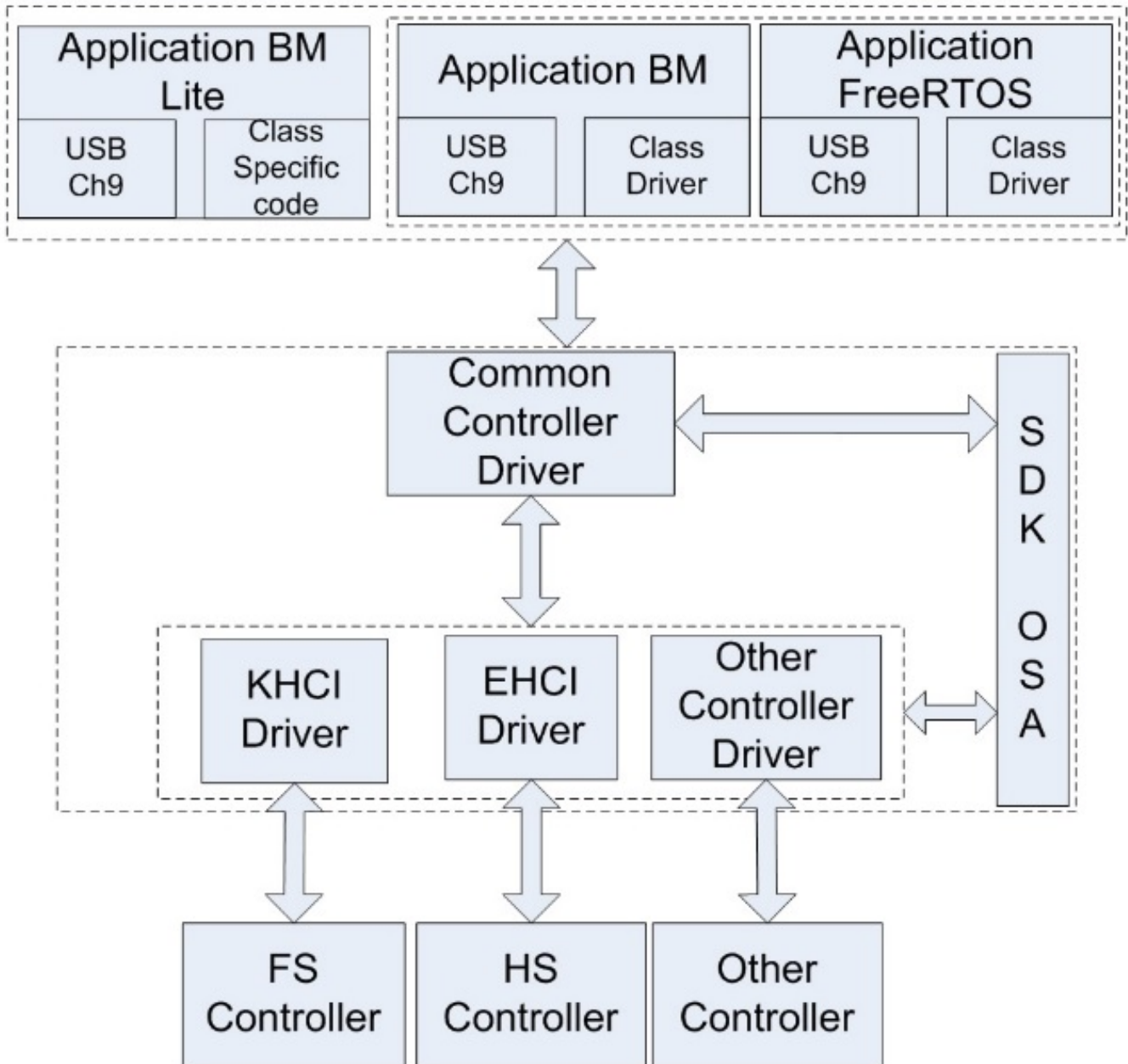


Figure 1: USB device stack architecture

For the lite version application, the code size is smaller than the non-lite version. However, an obvious drawback of the new architecture is that customers need to use the controller driver API to implement the standard enumeration process, the class-specific process, and the customer-specific functionality.

The device stack initialization sequence for the lite version application is as follows:

1. Initialize the Pin Mux, USB clock, and so on. If the SoC has a USB KHCI-dedicated RAM, the RAM memory needs to be clear after the KHCI clock is enabled. When the demo uses USB EHCI IP, the USB KHCI dedicated-RAM can't be used and the memory can't be accessed.

2. Initialize the USB device stack by calling the API `USB_DeviceInit`.
3. When the device task is enabled, create the USB device task by using the device handle, returned from `USB_DeviceInit`, as the task parameter when the environment is an RTOS.
4. Install the USB ISR.
5. Enable the USB interrupt and the interrupt priority.
6. Start the USB device by calling the `USB_DeviceRun`.

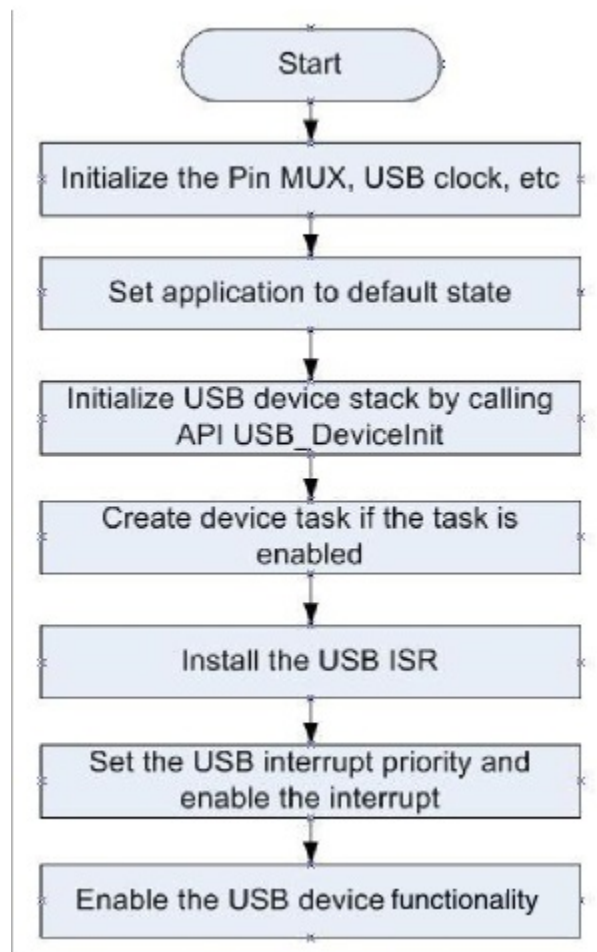


Figure 2: USB device initialization for lite version

To assist customers with less concerns about the footprint and focus on ease of use of the USB stack, a generic `usb_ch9` implementation is provided and the specified class driver, such as HID class driver, CDC class driver, and so on. This implementation is more generic, it can be reused in different examples and the APIs are easier to use. However, some callback functions need to be implemented and the code size is larger.

The device stack initialization sequence for non-lite version application is as follows:

1. Initialize the Pin Mux, USB clock, and so on. If the SOC has the USB KHCI-dedicated RAM, the RAM memory needs to be clear after the KHCI clock is enabled. When the demo uses USB EHCI

IP, the USB KHCI-dedicated RAM can't be used and the memory can't be accessed.

Note

The `USB_GLOBAL`, `USB_BDT`, and `USB_RAM_ADDRESS_ALIGNMENT(n)` are only used for USB device stack. The USB device global variables are put into the section `m_usb_global` or `m_usb_bdt` by using the MACRO `USB_GLOBAL` and `USB_BDT`. In this way, the USB device global variables can be linked into USB dedicated RAM by changing the linker file. This feature can only be enabled when the USB dedicated RAM is not less than 2 K Bytes.

2. Initialize the USB device stack by calling the API `USB_DeviceClassInit`. Initialize each application.
3. Get each class handle from the `usb_device_class_config_struct_t::classHandle`.
4. When the device task is enabled, create the USB device task by using the device handle, returned from `USB_DeviceClassInit`, as the task parameter when the environment is RTOS.
5. Install the USB ISR.
6. Enable the USB interrupt and the interrupt priority.
7. Start the USB device by calling the `USB_DeviceRun`.

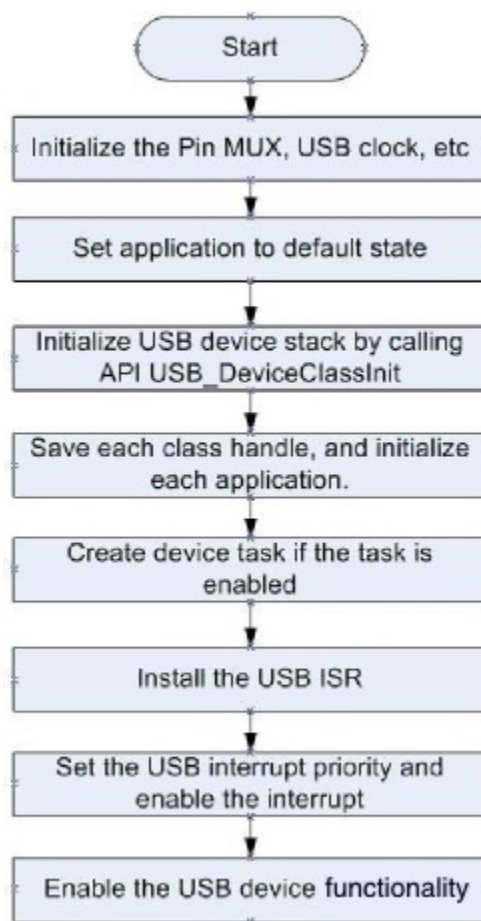


Figure 3: USB device initialization for non-lite version

To support different RTOSes with the same code base, the OSA is used inside the USB stack to wrap the differences between RTOSes.

Note

The OSA should not be used in the USB application. As a result, from the USB application's viewpoint, the OSA is invisible.

### 1.1 USB Device Callback Work Flow

The device callback is registered when the `USB_DeviceInit` function is called.

The following events should be processed in this callback function:

- `kUsbDeviceEventBusReset`  
When the application receives this event, the device has received a BUS RESET signal. In the event, the control pipe should be initialized. See the work flow. The parameter `eventParam` is not used.
- `kUsbDeviceEventSetConfiguration`  
When the application receives this event, the host has sent a set configuration request. The configuration value can be received from the parameter `eventParam`. In the event, the application configuration can be set. Initialize each interface in the current configuration by using zero as an alternate setting.
- `kUsbDeviceEventSetInterface`  
When the application receives this event, the host sent a set alternate setting request of an interface. The interface and alternate setting value can be received from the parameter `eventParam`. The `eventParam` points to a `uint16_t` variable. The high 8-bit is interface value and the low 8-bit is alternate setting. In the event, the application changes the alternate setting of this interface if the new alternate setting is not equal to the current setting.  
Normally, change the steps as follows:
  1. Cancel all transfers of the current alternate setting in this interface.
  2. De-initialize all pipes of the current alternate setting in this interface.
  3. Initialize all pipes of the new alternate setting in this interface.
  4. Prime the transfers of the new setting.

For example,

```
uint16_t*   temp16 = (uint16_t*)eventParam;
uint8_t     interface = (uint8_t)((*temp16&0xFF00)>>0x08);
currentAlternateSetting[interface] = (uint8_t)(*temp16&0x00FF);
```

The device callback event work flow:

## USB Device Class-Specific Request Work Flow

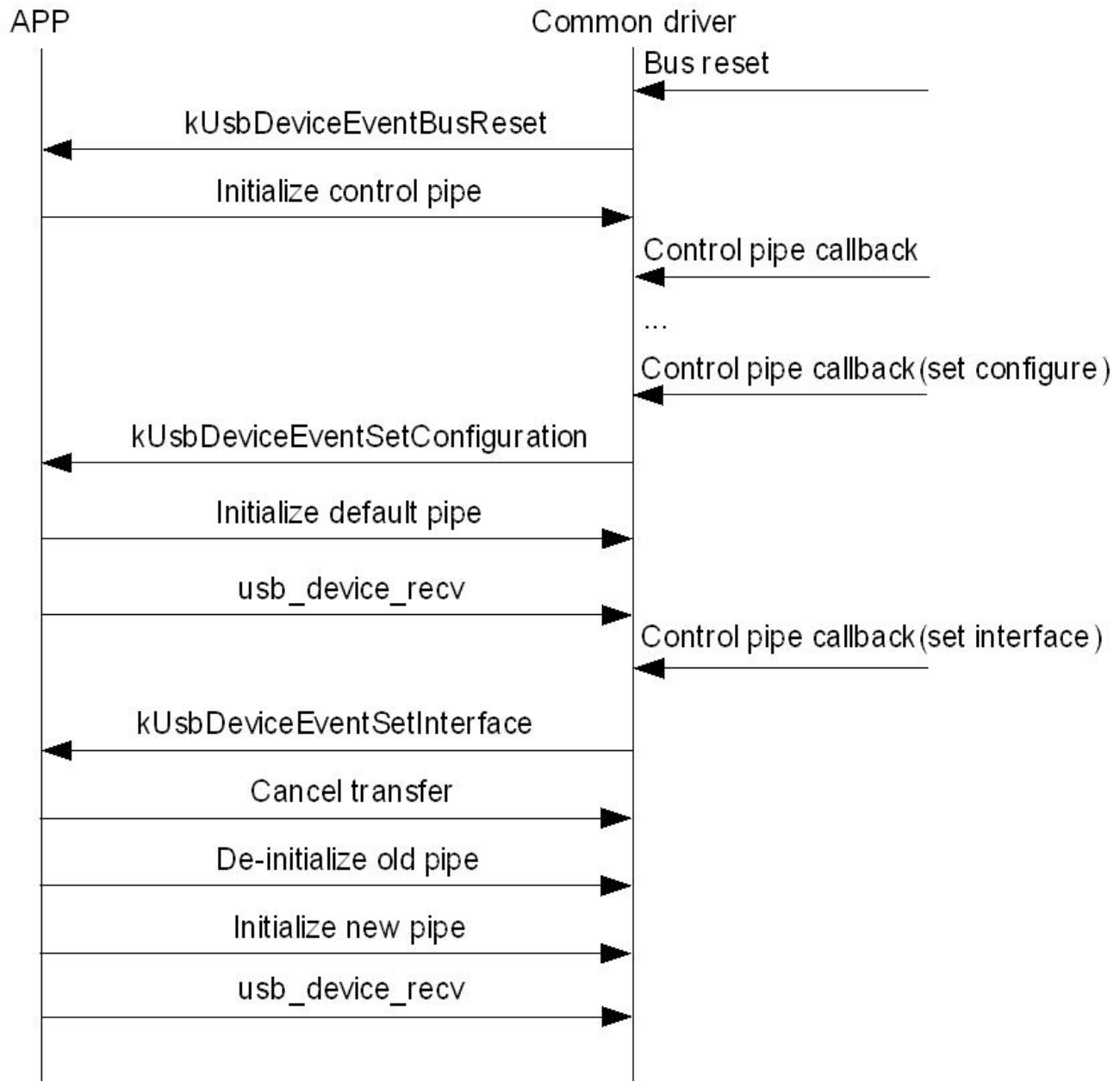


Figure 1.1.1: USB device callback working flow

## 1.2 USB Device Class-Specific Request Work Flow

The class specific request can be classified into two types according to whether these is the data stage in a setup transfer. The section describes class specific request with data stage only. For the class-specific request without data stage, the case is quite simple, we don't describe here. Depend on the data direction, there are two cases, host wants to send data to device and host wants to get data from device.

USB Device Class-Specific Request with Data Sent from Host

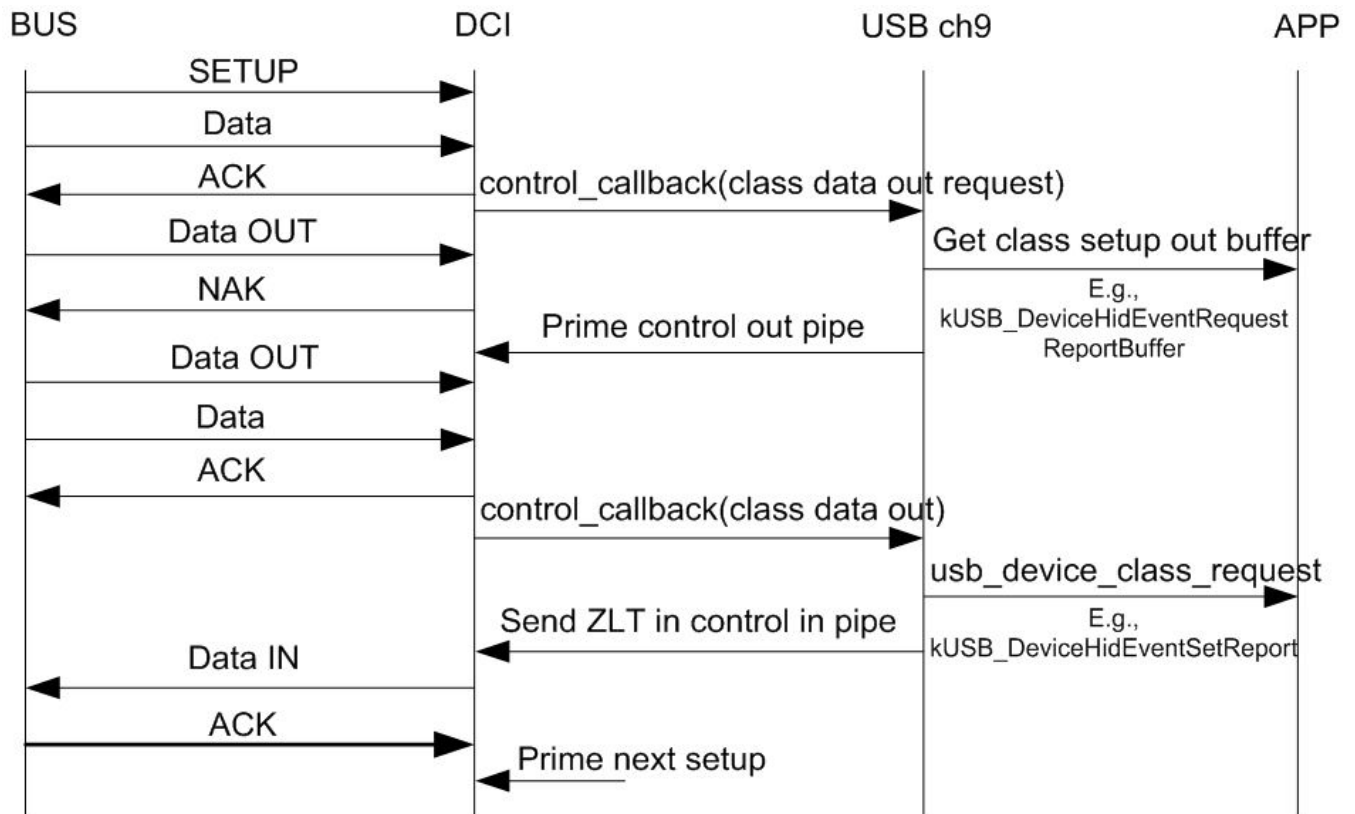


Figure 1.2.1: USB Device Class-Specific Request with Data Sent from Host

## USB Device Class-Specific Request Work Flow

### USB Device Class-Specific Request with Data Sent to Host

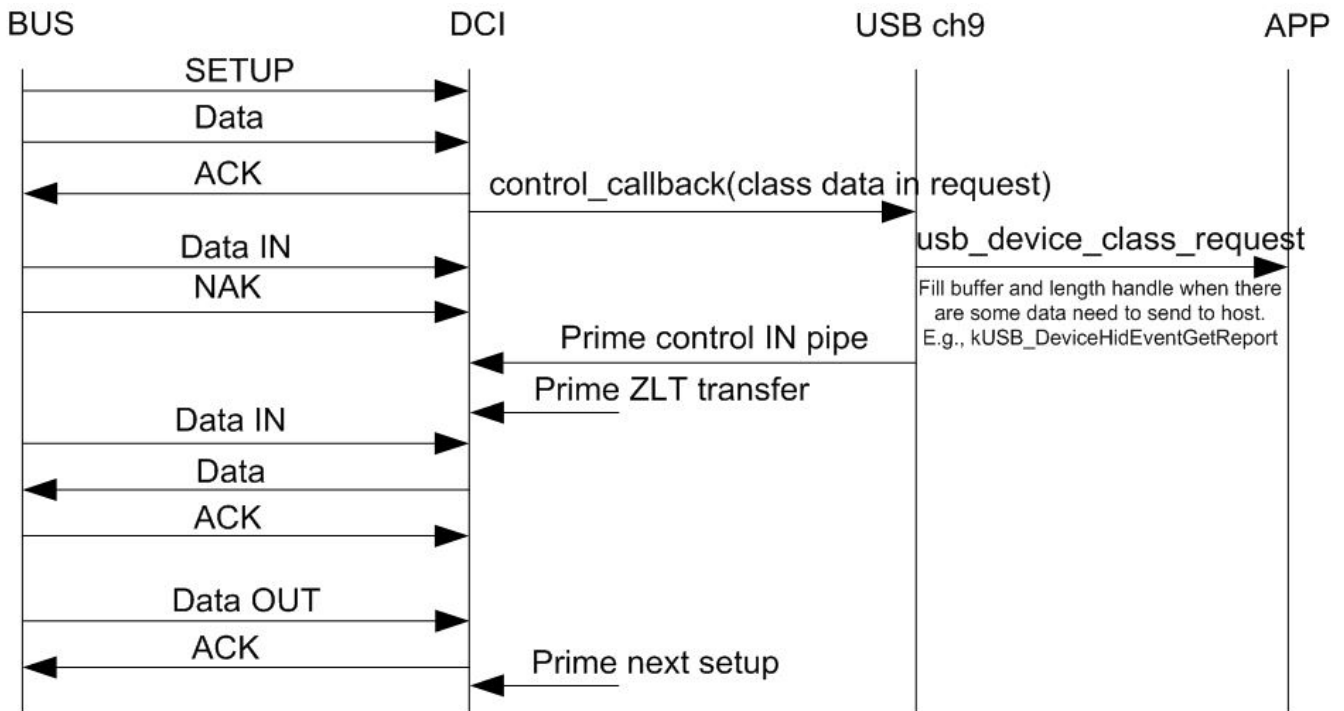


Figure 1.2.2: USB Device Class-Specific Request with Data Sent to Host



## Chapter 2 Definitions and structures

### 2.1 Overview

This lists the common definitions and structures for the USB stack.

#### Data Structures

- struct [usb\\_version\\_t](#)  
*USB stack version fields. [More...](#)*

#### Macros

- #define [USB\\_STACK\\_VERSION\\_MAJOR](#) (0x01U)  
*Defines USB stack major version.*
- #define [USB\\_STACK\\_VERSION\\_MINOR](#) (0x00U)  
*Defines USB stack minor version.*
- #define [USB\\_STACK\\_VERSION\\_BUGFIX](#) (0x00U)  
*Defines USB stack bugfix version.*
- #define [USB\\_MAKE\\_VERSION](#)(major, minor, bugfix) (((major) << 16) | ((minor) << 8) | (bugfix))  
*USB stack version definition.*

#### Typedefs

- typedef void \* [usb\\_host\\_handle](#)  
*USB host handle type define.*
- typedef void \* [usb\\_device\\_handle](#)  
*USB device handle type define.*
- typedef void \* [usb\\_otg\\_handle](#)  
*USB OTG handle type define.*

### Enumerations

- enum `usb_status_t` {  
    `kStatus_USB_Success` = 0x00U,  
    `kStatus_USB_Error`,  
    `kStatus_USB_Busy`,  
    `kStatus_USB_InvalidHandle`,  
    `kStatus_USB_InvalidParameter`,  
    `kStatus_USB_InvalidRequest`,  
    `kStatus_USB_ControllerNotFound`,  
    `kStatus_USB_InvalidControllerInterface`,  
    `kStatus_USB_NotSupported`,  
    `kStatus_USB_Retry`,  
    `kStatus_USB_TransferStall`,  
    `kStatus_USB_TransferFailed`,  
    `kStatus_USB_AllocFail`,  
    `kStatus_USB_LackSwapBuffer`,  
    `kStatus_USB_TransferCancel`,  
    `kStatus_USB_BandwidthFail`,  
    `kStatus_USB_MSDDStatusFail` }

*USB error code.*

- enum `usb_controller_index_t` {  
    `kUSB_ControllerKhci0` = 0U,  
    `kUSB_ControllerKhci1` = 1U,  
    `kUSB_ControllerEhci0` = 2U,  
    `kUSB_ControllerEhci1` = 3U,  
    `kUSB_ControllerLpcIp3511Fs0` = 4U,  
    `kUSB_ControllerLpcIp3511Fs1`,  
    `kUSB_ControllerLpcIp3511Hs0` = 6U,  
    `kUSB_ControllerLpcIp3511Hs1`,  
    `kUSB_ControllerOhci0` = 8U,  
    `kUSB_ControllerOhci1` = 9U,  
    `kUSB_ControllerIp3516Hs0` = 10U,  
    `kUSB_ControllerIp3516Hs1` }

*USB controller ID.*

## 2.2 Data Structure Documentation

### 2.2.1 struct `usb_version_t`

#### Data Fields

- `uint8_t` `major`  
*Major.*
- `uint8_t` `minor`  
*Minor.*

- `uint8_t` [bugfix](#)  
Bug fix.

## 2.3 Typedef Documentation

### 2.3.1 `typedef void* usb_device_handle`

For device stack it is the whole device handle; for host stack it is the attached device instance handle

## 2.4 Enumeration Type Documentation

### 2.4.1 `enum usb_status_t`

Enumerator

*kStatus\_USB\_Success* Success.  
*kStatus\_USB\_Error* Failed.  
*kStatus\_USB\_Busy* Busy.  
*kStatus\_USB\_InvalidHandle* Invalid handle.  
*kStatus\_USB\_InvalidParameter* Invalid parameter.  
*kStatus\_USB\_InvalidRequest* Invalid request.  
*kStatus\_USB\_ControllerNotFound* Controller cannot be found.  
*kStatus\_USB\_InvalidControllerInterface* Invalid controller interface.  
*kStatus\_USB\_NotSupported* Configuration is not supported.  
*kStatus\_USB\_Retry* Enumeration get configuration retry.  
*kStatus\_USB\_TransferStall* Transfer stalled.  
*kStatus\_USB\_TransferFailed* Transfer failed.  
*kStatus\_USB\_AllocFail* Allocation failed.  
*kStatus\_USB\_LackSwapBuffer* Insufficient swap buffer for KHCI.  
*kStatus\_USB\_TransferCancel* The transfer cancelled.  
*kStatus\_USB\_BandwidthFail* Allocate bandwidth failed.  
*kStatus\_USB\_MSDStatusFail* For MSD, the CSW status means fail.

### 2.4.2 `enum usb_controller_index_t`

Enumerator

*kUSB\_ControllerKhci0* KHCI 0U.  
*kUSB\_ControllerKhci1* KHCI 1U, Currently, there are no platforms which have two KHCI IPs, this is reserved to be used in the future.  
*kUSB\_ControllerEhci0* EHCI 0U.  
*kUSB\_ControllerEhci1* EHCI 1U, Currently, there are no platforms which have two EHCI IPs, this is reserved to be used in the future.  
*kUSB\_ControllerLpcIp3511Fs0* LPC USB IP3511 FS controller 0.

## Enumeration Type Documentation

***kUSB\_ControllerLpcIp3511Fs1*** LPC USB IP3511 FS controller 1, there are no platforms which have two IP3511 IPs, this is reserved to be used in the future.

***kUSB\_ControllerLpcIp3511Hs0*** LPC USB IP3511 HS controller 0.

***kUSB\_ControllerLpcIp3511Hs1*** LPC USB IP3511 HS controller 1, there are no platforms which have two IP3511 IPs, this is reserved to be used in the future.

***kUSB\_ControllerOhci0*** OHCI 0U.

***kUSB\_ControllerOhci1*** OHCI 1U, Currently, there are no platforms which have two OHCI IPs, this is reserved to be used in the future.

***kUSB\_ControllerIp3516Hs0*** IP3516HS 0U.

***kUSB\_ControllerIp3516Hs1*** IP3516HS 1U, Currently, there are no platforms which have two IP3516HS IPs, this is reserved to be used in the future.

# Chapter 3

## USB Class driver

### 3.1 Overview

#### Modules

- [USB AUDIO Class driver](#)
- [USB CCID Class driver](#)
- [USB CDC Class driver](#)
- [USB HID Class driver](#)
- [USB MSC Class driver](#)
- [USB PHDC Class driver](#)
- [USB PRINTER Class driver](#)
- [USB VIDEO Class driver](#)

#### Data Structures

- struct [usb\\_device\\_endpoint\\_struct\\_t](#)  
*Obtains the endpoint data structure. [More...](#)*
- struct [usb\\_device\\_endpoint\\_list\\_t](#)  
*Obtains the endpoint group. [More...](#)*
- struct [usb\\_device\\_interface\\_struct\\_t](#)  
*Obtains the interface list data structure. [More...](#)*
- struct [usb\\_device\\_interfaces\\_struct\\_t](#)  
*Obtains the interface data structure. [More...](#)*
- struct [usb\\_device\\_interface\\_list\\_t](#)  
*Obtains the interface group. [More...](#)*
- struct [usb\\_device\\_class\\_struct\\_t](#)  
*Obtains the class data structure. [More...](#)*
- struct [usb\\_device\\_class\\_config\\_struct\\_t](#)  
*Obtains the device class information structure. [More...](#)*
- struct [usb\\_device\\_class\\_config\\_list\\_struct\\_t](#)  
*Obtains the device class configuration structure. [More...](#)*
- struct [usb\\_device\\_control\\_request\\_struct\\_t](#)  
*Obtains the control request structure. [More...](#)*
- struct [usb\\_device\\_get\\_descriptor\\_common\\_struct\\_t](#)  
*Obtains the control get descriptor request common structure. [More...](#)*
- struct [usb\\_device\\_get\\_device\\_descriptor\\_struct\\_t](#)  
*Obtains the control get device descriptor request structure. [More...](#)*
- struct [usb\\_device\\_get\\_device\\_qualifier\\_descriptor\\_struct\\_t](#)  
*Obtains the control get device qualifier descriptor request structure. [More...](#)*
- struct [usb\\_device\\_get\\_configuration\\_descriptor\\_struct\\_t](#)  
*Obtains the control get configuration descriptor request structure. [More...](#)*
- struct [usb\\_device\\_get\\_bos\\_descriptor\\_struct\\_t](#)  
*Obtains the control get bos descriptor request structure. [More...](#)*
- struct [usb\\_device\\_get\\_string\\_descriptor\\_struct\\_t](#)  
*Obtains the control get string descriptor request structure. [More...](#)*

## Overview

- struct `usb_device_get_hid_descriptor_struct_t`  
*Obtains the control get HID descriptor request structure. [More...](#)*
- struct `usb_device_get_hid_report_descriptor_struct_t`  
*Obtains the control get HID report descriptor request structure. [More...](#)*
- struct `usb_device_get_hid_physical_descriptor_struct_t`  
*Obtains the control get HID physical descriptor request structure. [More...](#)*
- union `usb_device_get_descriptor_common_union_t`  
*Obtains the control get descriptor request common union. [More...](#)*
- struct `usb_device_class_map_t`  
*Define class driver interface structure. [More...](#)*
- struct `usb_device_common_class_struct_t`  
*Structure holding common class state information. [More...](#)*

## Macros

- #define `class_handle_t` `uint32_t`  
*Macro to define class handle.*

## Typedefs

- typedef `usb_status_t`(\* `usb_device_class_init_call_t`)(`uint8_t` controllerId, `usb_device_class_config_struct_t` \*classConfig, `class_handle_t` \*classHandle)  
*Define function type for class device instance initialization.*
- typedef `usb_status_t`(\* `usb_device_class_deinit_call_t`)(`class_handle_t` handle)  
*Define function type for class device instance deinitialization, internal.*
- typedef `usb_status_t`(\* `usb_device_class_event_callback_t`)(`void` \*classHandle, `uint32_t` event, `void` \*param)  
*Define function type for class device instance Event change.*

## Enumerations

- enum `usb_device_class_type_t`  
*Available class types.*
- enum `usb_device_class_event_t`  
*Available common class events.*

## Functions

- `usb_status_t` `USB_DeviceClassInit` (`uint8_t` controllerId, `usb_device_class_config_list_struct_t` \*configList, `usb_device_handle` \*handle)  
*Initializes the common class and the supported classes.*
- `usb_status_t` `USB_DeviceClassDeinit` (`uint8_t` controllerId)  
*Deinitializes the common class and the supported classes.*
- `usb_status_t` `USB_DeviceClassGetSpeed` (`uint8_t` controllerId, `uint8_t` \*speed)  
*Gets the USB bus speed.*
- `usb_status_t` `USB_DeviceClassEvent` (`usb_device_handle` handle, `usb_device_class_event_t` event, `void` \*param)  
*Handles the event passed to the class drivers.*
- `usb_status_t` `USB_DeviceClassCallback` (`usb_device_handle` handle, `uint32_t` event, `void` \*param)  
*Handles the common class callback.*

- `usb_status_t USB_DeviceClassGetDeviceHandle` (`uint8_t controllerId`, `usb_device_handle *handle`)  
*Gets the device handle according to the controller ID.*

## 3.2 Data Structure Documentation

### 3.2.1 struct usb\_device\_endpoint\_struct\_t

Define the endpoint data structure.

#### Data Fields

- `uint8_t endpointAddress`  
*Endpoint address.*
- `uint8_t transferType`  
*Endpoint transfer type.*
- `uint16_t maxPacketSize`  
*Endpoint maximum packet size.*

### 3.2.2 struct usb\_device\_endpoint\_list\_t

Structure representing endpoints and the number of endpoints that the user wants.

#### Data Fields

- `uint8_t count`  
*How many endpoints in current interface.*
- `usb_device_endpoint_struct_t * endpoint`  
*Endpoint structure list.*

### 3.2.3 struct usb\_device\_interface\_struct\_t

Structure representing an interface.

#### Data Fields

- `uint8_t alternateSetting`  
*Alternate setting number.*
- `usb_device_endpoint_list_t endpointList`  
*Endpoints of the interface.*
- `void * classSpecific`  
*Class specific structure handle.*

## Data Structure Documentation

### 3.2.4 struct usb\_device\_interfaces\_struct\_t

Structure representing interface.

#### Data Fields

- uint8\_t [classCode](#)  
*Class code of the interface.*
- uint8\_t [subclassCode](#)  
*Subclass code of the interface.*
- uint8\_t [protocolCode](#)  
*Protocol code of the interface.*
- uint8\_t [interfaceNumber](#)  
*Interface number.*
- [usb\\_device\\_interface\\_struct\\_t](#) \* [interface](#)  
*Interface structure list.*
- uint8\_t [count](#)  
*Number of interfaces in the current interface.*

### 3.2.5 struct usb\_device\_interface\_list\_t

Structure representing how many interfaces in one class type.

#### Data Fields

- uint8\_t [count](#)  
*Number of interfaces of the class.*
- [usb\\_device\\_interfaces\\_struct\\_t](#) \* [interfaces](#)  
*All interfaces.*

### 3.2.6 struct usb\_device\_class\_struct\_t

Structure representing how many configurations in one class type.

#### Data Fields

- [usb\\_device\\_interface\\_list\\_t](#) \* [interfaceList](#)  
*Interfaces of the class.*
- [usb\\_device\\_class\\_type\\_t](#) [type](#)  
*Class type.*
- uint8\_t [configurations](#)  
*Number of configurations of the class.*



### 3.2.7 struct usb\_device\_class\_config\_struct\_t

Structure representing the device class information. This structure only can be stored in RAM space.

#### Data Fields

- [usb\\_device\\_class\\_callback\\_t classCallback](#)  
*Class callback function to handle the device status-related event for the specified type of class.*
- [class\\_handle\\_t classHandle](#)  
*The class handle of the class, filled by the common driver.*
- [usb\\_device\\_class\\_struct\\_t \\* classInformation](#)  
*Detailed information of the class.*

#### 3.2.7.0.0.1 Field Documentation

##### 3.2.7.0.0.1.1 class\_handle\_t usb\_device\_class\_config\_struct\_t::classHandle

### 3.2.8 struct usb\_device\_class\_config\_list\_struct\_t

Structure representing the device class configuration information.

#### Data Fields

- [usb\\_device\\_class\\_config\\_struct\\_t \\* config](#)  
*Array of class configuration structures.*
- [usb\\_device\\_callback\\_t deviceCallback](#)  
*Device callback function.*
- [uint8\\_t count](#)  
*Number of class supported.*

### 3.2.9 struct usb\_device\_control\_request\_struct\_t

This structure is used to pass the control request information. The structure is used in following two cases.

1. Case one, the host wants to send data to the device in the control data stage:
  - a. If a setup packet is received, the structure is used to pass the setup packet data and wants to get the buffer to receive data sent from the host. The field isSetup is 1. The length is the requested buffer length. The buffer is filled by the class or application by using the valid buffer address. The setup is the setup packet address.
  - b. If the data received is sent by the host, the structure is used to pass the data buffer address and the data length sent by the host. In this way, the field isSetup is 0. The buffer is the address of the data sent from the host. The length is the received data length. The setup is the setup packet address.
2. Case two, the host wants to get data from the device in control data stage:

## Data Structure Documentation

If the setup packet is received, the structure is used to pass the setup packet data and wants to get the data buffer address to send data to the host. The field `isSetup` is 1. The `length` is the requested data length. The buffer is filled by the class or application by using the valid buffer address. The setup is the setup packet address.

### Data Fields

- `usb_setup_struct_t * setup`  
*The pointer of the setup packet data.*
- `uint8_t * buffer`  
*Pass the buffer address.*
- `uint32_t length`  
*Pass the buffer length or requested length.*
- `uint8_t isSetup`  
*Indicates whether a setup packet is received.*

#### 3.2.9.0.0.2 Field Documentation

**3.2.9.0.0.2.1** `usb_setup_struct_t* usb_device_control_request_struct_t::setup`

**3.2.9.0.0.2.2** `uint8_t* usb_device_control_request_struct_t::buffer`

**3.2.9.0.0.2.3** `uint32_t usb_device_control_request_struct_t::length`

**3.2.9.0.0.2.4** `uint8_t usb_device_control_request_struct_t::isSetup`

#### 3.2.10 struct `usb_device_get_descriptor_common_struct_t`

### Data Fields

- `uint8_t * buffer`  
*Pass the buffer address.*
- `uint32_t length`  
*Pass the buffer length.*

#### 3.2.10.0.0.3 Field Documentation

**3.2.10.0.0.3.1** `uint8_t* usb_device_get_descriptor_common_struct_t::buffer`

**3.2.10.0.0.3.2** `uint32_t usb_device_get_descriptor_common_struct_t::length`

#### 3.2.11 struct `usb_device_get_device_descriptor_struct_t`

### Data Fields

- `uint8_t * buffer`  
*Pass the buffer address.*

- uint32\_t [length](#)  
*Pass the buffer length.*

#### 3.2.11.0.0.4 Field Documentation

3.2.11.0.0.4.1 uint8\_t\* [usb\\_device\\_get\\_device\\_descriptor\\_struct\\_t::buffer](#)

3.2.11.0.0.4.2 uint32\_t [usb\\_device\\_get\\_device\\_descriptor\\_struct\\_t::length](#)

### 3.2.12 struct [usb\\_device\\_get\\_device\\_qualifier\\_descriptor\\_struct\\_t](#)

#### Data Fields

- uint8\_t \* [buffer](#)  
*Pass the buffer address.*
- uint32\_t [length](#)  
*Pass the buffer length.*

#### 3.2.12.0.0.5 Field Documentation

3.2.12.0.0.5.1 uint8\_t\* [usb\\_device\\_get\\_device\\_qualifier\\_descriptor\\_struct\\_t::buffer](#)

3.2.12.0.0.5.2 uint32\_t [usb\\_device\\_get\\_device\\_qualifier\\_descriptor\\_struct\\_t::length](#)

### 3.2.13 struct [usb\\_device\\_get\\_configuration\\_descriptor\\_struct\\_t](#)

#### Data Fields

- uint8\_t \* [buffer](#)  
*Pass the buffer address.*
- uint32\_t [length](#)  
*Pass the buffer length.*
- uint8\_t [configuration](#)  
*The configuration number.*

#### 3.2.13.0.0.6 Field Documentation

3.2.13.0.0.6.1 uint8\_t\* [usb\\_device\\_get\\_configuration\\_descriptor\\_struct\\_t::buffer](#)

3.2.13.0.0.6.2 uint32\_t [usb\\_device\\_get\\_configuration\\_descriptor\\_struct\\_t::length](#)

3.2.13.0.0.6.3 uint8\_t [usb\\_device\\_get\\_configuration\\_descriptor\\_struct\\_t::configuration](#)

### 3.2.14 struct [usb\\_device\\_get\\_bos\\_descriptor\\_struct\\_t](#)

#### Data Fields

- uint8\_t \* [buffer](#)

## Data Structure Documentation

- *Pass the buffer address.*
- `uint32_t` `length`  
*Pass the buffer length.*

### 3.2.14.0.0.7 Field Documentation

3.2.14.0.0.7.1 `uint8_t*` `usb_device_get_bos_descriptor_struct_t::buffer`

3.2.14.0.0.7.2 `uint32_t` `usb_device_get_bos_descriptor_struct_t::length`

## 3.2.15 struct `usb_device_get_string_descriptor_struct_t`

### Data Fields

- `uint8_t *` `buffer`  
*Pass the buffer address.*
- `uint32_t` `length`  
*Pass the buffer length.*
- `uint16_t` `languageId`  
*Language ID.*
- `uint8_t` `stringIndex`  
*String index.*

### 3.2.15.0.0.8 Field Documentation

3.2.15.0.0.8.1 `uint8_t*` `usb_device_get_string_descriptor_struct_t::buffer`

3.2.15.0.0.8.2 `uint32_t` `usb_device_get_string_descriptor_struct_t::length`

3.2.15.0.0.8.3 `uint16_t` `usb_device_get_string_descriptor_struct_t::languageId`

3.2.15.0.0.8.4 `uint8_t` `usb_device_get_string_descriptor_struct_t::stringIndex`

## 3.2.16 struct `usb_device_get_hid_descriptor_struct_t`

### Data Fields

- `uint8_t *` `buffer`  
*Pass the buffer address.*
- `uint32_t` `length`  
*Pass the buffer length.*
- `uint8_t` `interfaceNumber`  
*The interface number.*

**3.2.16.0.0.9 Field Documentation****3.2.16.0.0.9.1** `uint8_t* usb_device_get_hid_descriptor_struct_t::buffer`**3.2.16.0.0.9.2** `uint32_t usb_device_get_hid_descriptor_struct_t::length`**3.2.16.0.0.9.3** `uint8_t usb_device_get_hid_descriptor_struct_t::interfaceNumber`**3.2.17 struct usb\_device\_get\_hid\_report\_descriptor\_struct\_t****Data Fields**

- `uint8_t * buffer`  
*Pass the buffer address.*
- `uint32_t length`  
*Pass the buffer length.*
- `uint8_t interfaceNumber`  
*The interface number.*

**3.2.17.0.0.10 Field Documentation****3.2.17.0.0.10.1** `uint8_t* usb_device_get_hid_report_descriptor_struct_t::buffer`**3.2.17.0.0.10.2** `uint32_t usb_device_get_hid_report_descriptor_struct_t::length`**3.2.17.0.0.10.3** `uint8_t usb_device_get_hid_report_descriptor_struct_t::interfaceNumber`**3.2.18 struct usb\_device\_get\_hid\_physical\_descriptor\_struct\_t****Data Fields**

- `uint8_t * buffer`  
*Pass the buffer address.*
- `uint32_t length`  
*Pass the buffer length.*
- `uint8_t index`  
*Physical index.*
- `uint8_t interfaceNumber`  
*The interface number.*

## Data Structure Documentation

### 3.2.18.0.0.11 Field Documentation

3.2.18.0.0.11.1 `uint8_t* usb_device_get_hid_physical_descriptor_struct_t::buffer`

3.2.18.0.0.11.2 `uint32_t usb_device_get_hid_physical_descriptor_struct_t::length`

3.2.18.0.0.11.3 `uint8_t usb_device_get_hid_physical_descriptor_struct_t::interfaceNumber`

### 3.2.19 `union usb_device_get_descriptor_common_union_t`

#### Data Fields

- `usb_device_get_descriptor_common_struct_t commonDescriptor`  
*Common structure.*
- `usb_device_get_device_descriptor_struct_t deviceDescriptor`  
*The structure to get device descriptor.*
- `usb_device_get_device_qualifier_descriptor_struct_t deviceQualifierDescriptor`  
*The structure to get device qualifier descriptor.*
- `usb_device_get_configuration_descriptor_struct_t configurationDescriptor`  
*The structure to get configuration descriptor.*
- `usb_device_get_string_descriptor_struct_t stringDescriptor`  
*The structure to get string descriptor.*
- `usb_device_get_hid_descriptor_struct_t hidDescriptor`  
*The structure to get HID descriptor.*
- `usb_device_get_hid_report_descriptor_struct_t hidReportDescriptor`  
*The structure to get HID report descriptor.*
- `usb_device_get_hid_physical_descriptor_struct_t hidPhysicalDescriptor`  
*The structure to get HID physical descriptor.*

### 3.2.19.0.0.12 Field Documentation

- 3.2.19.0.0.12.1 `usb_device_get_descriptor_common_struct_t` `usb_device_get_descriptor_common_union_t::commonDescriptor`
- 3.2.19.0.0.12.2 `usb_device_get_device_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::deviceDescriptor`
- 3.2.19.0.0.12.3 `usb_device_get_device_qualifier_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::deviceQualifierDescriptor`
- 3.2.19.0.0.12.4 `usb_device_get_configuration_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::configurationDescriptor`
- 3.2.19.0.0.12.5 `usb_device_get_string_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::stringDescriptor`
- 3.2.19.0.0.12.6 `usb_device_get_hid_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::hidDescriptor`
- 3.2.19.0.0.12.7 `usb_device_get_hid_report_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::hidReportDescriptor`
- 3.2.19.0.0.12.8 `usb_device_get_hid_physical_descriptor_struct_t` `usb_device_get_descriptor_common_union_t::hidPhysicalDescriptor`

### 3.2.20 struct `usb_device_class_map_t`

#### Data Fields

- [usb\\_device\\_class\\_init\\_call\\_t](#) `classInit`  
*Class driver initialization- entry of the class driver.*
- [usb\\_device\\_class\\_deinit\\_call\\_t](#) `classDeinit`  
*Class driver de-initialization.*
- [usb\\_device\\_class\\_event\\_callback\\_t](#) `classEventCallback`  
*Class driver event callback.*
- [usb\\_device\\_class\\_type\\_t](#) `type`  
*Class type.*

### 3.2.21 struct `usb_device_common_class_struct_t`

#### Data Fields

- [usb\\_device\\_handle](#) `handle`  
*USB device handle.*
- [usb\\_device\\_class\\_config\\_list\\_struct\\_t](#) \* `configList`  
*USB device configure list.*

## Function Documentation

- `uint8_t setupBuffer [USB_SETUP_PACKET_SIZE]`  
*Setup packet data buffer.*
- `uint16_t standardTransactionBuffer`  
*This variable is used in: get status request get configuration request get interface request set interface request get sync frame request.*
- `uint8_t controllerId`  
*Controller ID.*

### 3.3 Enumeration Type Documentation

#### 3.3.1 `enum usb_device_class_type_t`

#### 3.3.2 `enum usb_device_class_event_t`

### 3.4 Function Documentation

#### 3.4.1 `usb_status_t USB_DeviceClassInit ( uint8_t controllerId, usb_device_class_config_list_struct_t * configList, usb_device_handle * handle )`

This function is used to initialize the common class and the supported classes.

Parameters

|     |                     |  |
|-----|---------------------|--|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> .  |
| in  | <i>configList</i>   | The class configurations. The pointer must point to the global variable. See the structure <a href="#">usb_device_class_config_list_struct_t</a> .   |
| out | <i>handle</i>       | A parameter used to return pointer of the device handle to the caller. The value of the parameter is a pointer to the device handle. This design is used to make a simple device align with the composite device. For the composite device, there are many kinds of class handles. However, there is only one device handle. Therefore, the handle points to a device instead of a class. The class handle can be received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> after the the function successfully. |

Returns

A USB error code or `kStatus_USB_Success`.

#### 3.4.2 `usb_status_t USB_DeviceClassDeinit ( uint8_t controllerId )`

This function is used to deinitialize the common class and the supported classes.



## Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
|----|---------------------|---|

## Returns

A USB error code or `kStatus_USB_Success`.

### 3.4.3 `usb_status_t USB_DeviceClassGetSpeed ( uint8_t controllerId, uint8_t * speed )`

This function is used to get the USB bus speed.

## Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| out | <i>speed</i>        | It is an OUT parameter, which returns the current speed of the controller.                    |

## Returns

A USB error code or `kStatus_USB_Success`.

### 3.4.4 `usb_status_t USB_DeviceClassEvent ( usb_device_handle handle, usb_device_class_event_t event, void * param )`

This function handles the event passed to the class drivers.

## Parameters

|         |               |   |
|---------|---------------|---|
| in      | <i>handle</i> | The device handle received from the <a href="#">USB_DeviceInit</a> .            |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_class_event_t</a> . |
| in, out | <i>param</i>  | The parameter type is determined by the event code.                             |

## Returns

A USB error code or `kStatus_USB_Success`.

## Function Documentation

Return values

|                                      |  |
|--------------------------------------|--|
| <i>kStatus_USB_Success</i>           | A valid request has been handled.                                      |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle not be found.  |
| <i>kStatus_USB_Invalid-Request</i>   | The request is invalid, and the control pipe is stalled by the caller. |

### 3.4.5 `usb_status_t USB_DeviceClassCallback ( usb_device_handle handle, uint32_t event, void * param )`

This function handles the common class callback.

Parameters

|         |               |   |
|---------|---------------|---|
| in      | <i>handle</i> | The device handle received from the <a href="#">USB_DeviceInit</a> .      |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_event_t</a> . |
| in, out | <i>param</i>  | The parameter type is determined by the event code.                       |

Returns

A USB error code or `kStatus_USB_Success`.

### 3.4.6 `usb_status_t USB_DeviceClassGetDeviceHandle ( uint8_t controllerId, usb_device_handle * handle )`

This function gets the device handle according to the controller ID.

Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| out | <i>handle</i>       | An out parameter used to return the pointer of the device handle to the caller.               |

## Return values

|                                      |                                   |
|--------------------------------------|-----------------------------------|
| <i>kStatus_USB_Success</i>           | Get device handle successfully.   |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle can't be found. |

---

## USB MSC Class driver

### 3.5 USB MSC Class driver

#### 3.5.1 Overview

The USB mass storage device class defines the protocols for file transfers between the host and the device. The MCUXpresso SDK USB stack provides support for MSC class driver which implements the bulk only transport specification and the UFI command specification.

#### Modules

- [USB MSC UFI driver](#)
- [USB MSC driver](#)

## 3.5.2 USB MSC driver

### 3.5.2.1 Overview

#### Data Structures

- struct `usb_device_msc_cbw_t`  
*Command Block Wrapper(CBW) More...*
- struct `usb_device_msc_csw_t`  
*Command Status Wrapper(CSW) More...*
- struct `usb_lba_transfer_information_struct_t`  
*Read/write information. More...*
- struct `usb_device_lba_information_struct_t`  
*device information More...*
- struct `usb_device_lba_app_struct_t`  
*Data transfer information. More...*
- struct `usb_device_ufi_app_struct_t`  
*command and Data transfer information for UFI command More...*
- struct `usb_device_msc_thirteen_case_struct_t`  
*The thirteen possible use cases of host expectations and device intent in the absence of overriding error conditions. More...*
- struct `usb_device_msc_ufi_struct_t`  
*The MSC device UFI command status structure. More...*
- struct `usb_device_msc_struct_t`  
*The MSC device structure. More...*

#### Macros

- #define `USB_DEVICE_CONFIG_MSC_SUPPORT_DISK_LOCKING_MECHANISM` (0U)  
*prevent media removal flag*
- #define `USB_DEVICE_CONFIG_MSC_CLASS_CODE` (0x08U)  
*The class code of the MSC class.*
- #define `USB_DEVICE_MSC_BULK_ONLY_MASS_STORAGE_RESET` (0xFFU)  
*Bulk-Only Mass Storage Reset (class-specific request)*
- #define `USB_DEVICE_MSC_GET_MAX_LUN` (0xFEU)  
*Get Maximum LUN (class-specific request)*
- #define `USB_DEVICE_MSC_DCBWSIGNATURE` `USB_LONG_TO_BIG_ENDIAN(0x55534243-U)`  
*CBW dCBWSignature.*
- #define `USB_DEVICE_MSC_DCSWSIGNATURE` `USB_LONG_TO_BIG_ENDIAN(0x55534253-U)`  
*CSW dCSSWSignature.*
- #define `USB_DEVICE_MSC_CBW_DIRECTION_BIT` (0x80U)  
*CSW bmCBWFlags bit7.*
- #define `USB_DEVICE_MSC_CBW_LENGTH` (31U)  
*CBW command length.*
- #define `USB_DEVICE_MSC_CSW_LENGTH` (13U)  
*CSW command length.*
- #define `USB_DEVICE_MSC_COMMAND_PASSED` (0x00U)

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*Command Block Status Values.*

- #define `USB_DEVICE_MSC_INQUIRY_COMMAND` (0x12U)  
*UFI Commands code.*

### Enumerations

- enum `usb_device_msc_stall_type` {  
    `USB_DEVICE_MSC_STALL_IN_CBW` = 1U,  
    `USB_DEVICE_MSC_STALL_IN_DATA`,  
    `USB_DEVICE_MSC_STALL_IN_CSW` }  
*stall flag*
- enum `USB_DeviceMscEvent_t` {  
    `kUSB_DeviceMscEventReadResponse` = 0x01U,  
    `kUSB_DeviceMscEventWriteResponse`,  
    `kUSB_DeviceMscEventWriteRequest`,  
    `kUSB_DeviceMscEventReadRequest`,  
    `kUSB_DeviceMscEventGetLbaInformation`,  
    `kUSB_DeviceMscEventFormatComplete`,  
    `kUSB_DeviceMscEventTestUnitReady`,  
    `kUSB_DeviceMscEventInquiry`,  
    `kUSB_DeviceMscEventModeSense`,  
    `kUSB_DeviceMscEventModeSelect`,  
    `kUSB_DeviceMscEventModeSelectResponse`,  
    `kUSB_DeviceMscEventRemovalRequest`,  
    `kUSB_DeviceMscEventSendDiagnostic`,  
    `kUSB_DeviceMscEventStopEjectMedia` }

*Available common EVENT types in MSC class callback.*

### USB device MSC class APIs

- `usb_status_t USB_DeviceMscInit` (`uint8_t controllerId`, `usb_device_class_config_struct_t *config`, `class_handle_t *handle`)  
*Initializes the MSC class.*
- `usb_status_t USB_DeviceMscDeinit` (`class_handle_t handle`)  
*Deinitializes the device MSC class.*

### 3.5.2.2 Data Structure Documentation

#### 3.5.2.2.1 struct `usb_device_msc_cbw_t`

##### Data Fields

- `uint32_t signature`  
*Byte 0-3 dCBWSignature.*
- `uint32_t tag`

- *Byte 4-7 dCBWTag.*  
uint32\_t [dataTransferLength](#)
- *Byte 8-11 dCBWDataTransferLength.*  
uint8\_t [flags](#)
- *Byte 12 bmCBWFlags.*  
uint8\_t [logicalUnitNumber](#)
- *Byte 13 bCBWLUN.*  
uint8\_t [cbLength](#)
- *Byte 14 bCBWCBLength.*  
uint8\_t [cbwcb](#) [16]  
*Byte 15-30 CBWCB, CBWCB is used to store UFI command.*

### 3.5.2.2.2 struct usb\_device\_msc\_csw\_t

#### Data Fields

- uint32\_t [signature](#)  
*Byte 0-3 dCSWSignature.*
- uint32\_t [tag](#)  
*Byte 4-7 dCSWTag.*
- uint32\_t [dataResidue](#)  
*Byte 8-11 dCSWDataResidue.*
- uint8\_t [cswStatus](#)  
*Byte 12 bCSWStatus.*

### 3.5.2.2.3 struct usb\_lba\_transfer\_information\_struct\_t

#### Data Fields

- uint32\_t [startingLogicalBlockAddress](#)  
*The logical block at which the read/write operation shall begin.*
- uint32\_t [transferNumber](#)  
*The number of contiguous logical blocks of data that shall be transferred.*

### 3.5.2.2.4 struct usb\_device\_lba\_information\_struct\_t

#### Data Fields

- uint32\_t [totalLbaNumberSupports](#)  
*Total blocks number supported.*
- uint32\_t [lengthOfEachLba](#)  
*Length of each block.*
- uint32\_t [bulkInBufferSize](#)  
*Bulk in buffer size.*
- uint32\_t [bulkOutBufferSize](#)  
*Bulk out buffer size.*
- uint8\_t [logicalUnitNumberSupported](#)  
*Number of LUN.*

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### 3.5.2.2.5 struct usb\_device\_lba\_app\_struct\_t

#### Data Fields

- `uint32_t offset`  
*Offset of the block need to access.*
- `uint32_t size`  
*Size of the transferred data.*
- `uint8_t * buffer`  
*Buffer address of the transferred data.*

### 3.5.2.2.6 struct usb\_device\_ufi\_app\_struct\_t

#### Data Fields

- `uint8_t * cbwcb`  
*current ufi command block stored in the CBW*
- `uint32_t size`  
*Size of the transferred data if commmand has data flow.*
- `uint8_t * buffer`  
*Buffer address of the transferred data if commmand has data flow.*
- `usb_device_request_sense_data_struct_t * requestSense`  
*sense data for the current command*

### 3.5.2.2.7 struct usb\_device\_msc\_thirteen\_case\_struct\_t

#### Data Fields

- `uint32_t hostExpectedDataLength`  
*The number of bytes of data that the host expects to transfer.*
- `uint32_t deviceExpectedDataLength`  
*The number of bytes of data that the device expects to transfer.*
- `uint8_t * buffer`  
*Data buffer.*
- `usb_lba_transfer_information_struct_t lbaInformation`  
*Read/write information.*
- `uint8_t lbaSendRecvSelect`  
*Whether the command is read or write command.*
- `uint8_t hostExpectedDirection`  
*Host expected data direction.*
- `uint8_t deviceExpectedDirection`  
*Device expected data direction.*

### 3.5.2.2.8 struct usb\_device\_msc\_ufi\_struct\_t

#### Data Fields

- `usb_device_request_sense_data_struct_t requestSense`



- *Request Sense Standard Data.*
- `usb_device_msc_thirteen_case_struct_t` `thirteenCase`  
*Thirteen possible cases.*
- `usb_device_read_capacity_struct_t` `readCapacity`  
*READ CAPACITY Data.*
- `usb_device_read_capacity16_data_struct_t` `readCapacity16`  
*READ CAPACITY Data.*
- `usb_device_inquiry_data_fromat_struct_t` `InquiryInfo`  
*Standard INQUIRY Data.*
- `usb_device_mode_parameters_header_struct_t` `ModeParametersHeader`  
*Mode Parameter Header.*
- `uint8_t` `formattedDisk`  
*\*Formatted or unformatted media*
- `uint8_t` `formatCapacityData` [`sizeof(usb_device_capacity_list_header_struct_t)+sizeof(usb_device-_current_max_capacity_descriptor_struct_t)+sizeof(usb_device_formattable_capacity_descriptor-_struct_t)*3`]  
*Capacity List.*

### 3.5.2.2.9 struct usb\_device\_msc\_struct\_t

#### Data Fields

- `usb_device_handle` `handle`  
*The device handle.*
- `usb_device_class_config_struct_t` \* `configurationStruct`  
*The configuration of the class.*
- `usb_device_interface_struct_t` \* `interfaceHandle`  
*Current interface handle.*
- `uint32_t` `transferRemaining`  
*Transfer remaining data.*
- `uint32_t` `currentOffset`  
*Current address offset.*
- `uint32_t` `totalLogicalBlockNumber`  
*Total logical block number of device.*
- `uint32_t` `lengthOfEachLba`  
*Length of logical block.*
- `uint32_t` `implementingDiskDrive`  
*Disk drive.*
- `uint32_t` `bulkInBufferSize`  
*Bulk in buffer size.*
- `uint32_t` `bulkOutBufferSize`  
*Bulk out buffer size.*
- `usb_device_msc_cbw_t` \* `mscCbw`  
*CBW structure.*
- `usb_device_msc_csw_t` \* `mscCsw`  
*CSW structure.*
- `usb_device_msc_ufi_struct_t` `mscUfi`  
*UFI command information structure.*
- `uint8_t` `dataOutFlag`  
*CBW indicating bulk out transfer, clear this flag when data transfer done.*

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- `uint8_t dataInFlag`  
*CBW indicating bulk in transfer, clear this flag when data transfer done.*
- `uint8_t inEndpointStallFlag`  
*In endpoint stall flag.*
- `uint8_t outEndpointStallFlag`  
*Out endpoint stall flag.*
- `uint8_t cbwValidFlag`  
*The CBW was received after the device had sent a CSW or after a reset ,or else it is invalid.*
- `uint8_t performResetRecover`  
*Device need reset command from host.*
- `uint8_t performResetDoneFlag`  
*Device has perform reset command.*
- `uint8_t needInStallFlag`  
*In endpoint should be stalled.*
- `uint8_t needOutStallFlag`  
*Out endpoint should be stalled.*
- `uint8_t cbwPrimeFlag`  
*CBW prime flag, prime means device MSC has been ready to receive CBW, the bulk out endpoint has got the prepared buffer.*
- `uint8_t cswPrimeFlag`  
*CSW prime flag, prime means device MSC has been ready to receive CSW, the bulk in endpoint has got the prepared buffer.*
- `uint8_t stallStatus`  
*Stall status.*
- `uint8_t logicalUnitNumber`  
*Supported logical units number of device.*
- `uint8_t bulkInEndpoint`  
*Bulk in endpoint number.*
- `uint8_t bulkOutEndpoint`  
*Bulk out endpoint number.*
- `uint8_t alternate`  
*Current alternate setting of the interface.*
- `uint8_t configuration`  
*Current configuration.*
- `uint8_t interfaceNumber`  
*The interface number of the class.*

### 3.5.2.2.9.1 Field Documentation

#### 3.5.2.2.9.1.1 `uint8_t usb_device_msc_struct_t::logicalUnitNumber`

See bulk only specification 3.2 Get Maximum LUN (class-specific request)

### 3.5.2.3 Enumeration Type Documentation

#### 3.5.2.3.1 `enum usb_device_msc_stall_type`

Enumerator

`USB_DEVICE_MSC_STALL_IN_CBW` Stall in CBW.

**USB\_DEVICE\_MSC\_STALL\_IN\_DATA** Stall in data transfer.  
**USB\_DEVICE\_MSC\_STALL\_IN\_CSW** Stall in CSW.

### 3.5.2.3.2 enum USB\_DeviceMscEvent\_t

Enumerator

**kUSB\_DeviceMscEventReadResponse** host has already read the whole data from device  
**kUSB\_DeviceMscEventWriteResponse** devcie has already received the data from host.  
**kUSB\_DeviceMscEventWriteRequest** Host want to write data to device through write command, devcie need prepare one buffer to store the data from host.  
**kUSB\_DeviceMscEventReadRequest** Host want to read data from device through read command, device need prepare one buffer containing data pending for transfer.  
**kUSB\_DeviceMscEventGetLbaInformation** Get device information.  
**kUSB\_DeviceMscEventFormatComplete** Format complete.  
**kUSB\_DeviceMscEventTestUnitReady** Test Unit Ready command.  
**kUSB\_DeviceMscEventInquiry** Inquiry Command command.  
**kUSB\_DeviceMscEventModeSense** mode sense command  
**kUSB\_DeviceMscEventModeSelect** mode select command, prepare data buffer and buffer length to store data for mode select  
**kUSB\_DeviceMscEventModeSelectResponse** got data of mode select command  
**kUSB\_DeviceMscEventRemovalRequest** Prevent\_allow\_medium\_command.  
**kUSB\_DeviceMscEventSendDiagnostic** Send Diagnostic command.  
**kUSB\_DeviceMscEventStopEjectMedia** Start\_stop\_unit\_command.

### 3.5.2.4 Function Documentation

#### 3.5.2.4.1 usb\_status\_t USB\_DeviceMscInit ( uint8\_t controllerId, usb\_device\_class\_config\_struct\_t \* config, class\_handle\_t \* handle )

This function is used to initialize the MSC class.

Parameters

|                     |  |
|---------------------|--|
| <i>controllerId</i> | The controller ID of the USB IP. See the enumeration usb_controller_index_t. |
| <i>config</i>       | The class configuration information.   |
| <i>handle</i>       | A parameter used to return pointer of the MSC class handle to the caller.    |

Returns

A USB error code or kStatus\_USB\_Success.

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### 3.5.2.4.2 `usb_status_t USB_DeviceMscDeinit ( class_handle_t handle )`

The function deinitializes the device MSC class.

## Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The MSC class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|---------------|--|

## Returns

A USB error code or `kStatus_USB_Success`.

## USB MSC Class driver

### 3.5.3 USB MSC UFI driver

#### 3.5.3.1 Overview

#### Data Structures

- struct `usb_device_inquiry_command_struct_t`  
*UFI inquiry command structure. More...*
- struct `usb_device_request_sense_command_struct_t`  
*UFI request sense command structure. More...*
- struct `usb_device_read_format_capacities_command_struct_t`  
*UFI read format capacities command structure. More...*
- struct `usb_device_read_capacities_command_struct_t`  
*UFI read capacities command structure. More...*
- struct `usb_device_read_write_10_command_struct_t`  
*UFI read write 10 structure. More...*
- struct `usb_device_inquiry_data_format_struct_t`  
*UFI inquiry data format structure. More...*
- struct `usb_device_request_sense_data_struct_t`  
*UFI request sense data structure. More...*
- struct `usb_device_read_capacity_struct_t`  
*UFI read capacity data structure. More...*
- struct `usb_device_read_capacity16_data_struct_t`  
*UFI read capacity data structure. More...*
- struct `usb_device_capacity_list_header_struct_t`  
*UFI capacity list header structure. More...*
- struct `usb_device_current_max_capacity_descriptor_struct_t`  
*UFI current maximum capacity structure. More...*
- struct `usb_device_formattable_capacity_descriptor_struct_t`  
*UFI formatting capacity structure. More...*
- struct `usb_device_mode_parameters_header_struct_t`  
*UFI mode parameters header structure. More...*
- struct `usb_device_format_capacity_response_data_struct_t`  
*UFI Capacity List structure. More...*

#### Macros

- #define `USB_DEVICE_MSC_UFI_NO_SENSE` 0x00U  
*Indicates that there is no specific sense key information to be reported.*
- #define `USB_DEVICE_MSC_UFI_RECOVERED_ERROR` 0x01U  
*Indicates that the last command completed successfully with some recovery action performed by the UFI device.*
- #define `USB_DEVICE_MSC_UFI_NOT_READY` 0x02U  
*Indicates that the UFI device cannot be accessed.*
- #define `USB_DEVICE_MSC_UFI_MEDIUM_ERROR` 0x03U  
*Indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data.*
- #define `USB_DEVICE_MSC_UFI_HARDWARE_ERROR` 0x04U  
*Indicates that the UFI device detected a non-recoverable hardware failure while performing the command*

- or during a self test.*

  - #define **USB\_DEVICE\_MSC\_UFI\_ILLEGAL\_REQUEST** 0x05U  
*Indicates that there was an illegal parameter in the Command Packet or in the additional parameters supplied as data for some commands.*
  - #define **USB\_DEVICE\_MSC\_UFI\_UNIT\_ATTENTION** 0x06U  
*Indicates that the removable medium may have been changed or the UFI device has been reset.*
  - #define **USB\_DEVICE\_MSC\_UFI\_DATA\_PROTECT** 0x07U  
*Indicates that a command that writes the medium was attempted on a block that is protected from this operation.*
  - #define **USB\_DEVICE\_MSC\_UFI\_BLANK\_CHECK** 0x08U  
*Indicates that a write-once device or a sequential-access device encountered blank medium or format-defined end-of-data indication while reading or a write-once device encountered a non-blank medium while writing.*
  - #define **USB\_DEVICE\_MSC\_UFI\_VENDOR\_SPECIFIC\_ERROR** 0x09U  
*This sense key is available for reporting vendor-specific conditions.*
  - #define **USB\_DEVICE\_MSC\_UFI\_ABORTED\_COMMAND** 0x0BU  
*Indicates that the UFI device has aborted the command The host may be able to recover by trying the command again.*
  - #define **USB\_DEVICE\_MSC\_UFI\_VOLUME\_OVERFLOW** 0x0DU  
*Indicates that a buffered peripheral device has reached the end-of-partition and data may remain in the buffer that has not been written to the medium.*
  - #define **USB\_DEVICE\_MSC\_UFI\_MISCOMPARE** 0x0EU  
*Indicates that the source data did not match the data read from the medium.*
  - #define **USB\_DEVICE\_MSC\_UFI\_INVALID\_COMMAND\_OPCODE** 0x20U  
*Invalid command operation code.*
  - #define **USB\_DEVICE\_MSC\_UFI\_WRITE\_FAULT** 0x03U  
*Write fault.*
  - #define **USB\_DEVICE\_MSC\_UFI\_UNRECOVERED\_READ\_ERROR** 0x11U  
*Not recovered read error.*
  - #define **USB\_DEVICE\_MSC\_UFI\_UNKNOWN\_ERROR** 0xFFU  
*Unknown error.*
  - #define **USB\_DEVICE\_MSC\_UFI\_INVALID\_FIELD\_IN\_COMMAND\_PKT** 0x24U  
*Invalid field in command packet.*
  - #define **USB\_DEVICE\_MSC\_UFI\_LBA\_OUT\_OF\_RANGE** 0x21U  
*Invalid logical block address out of range.*
  - #define **USB\_DEVICE\_MSC\_UFI\_REQ\_SENSE\_VALID\_ERROR\_CODE** 0x70U  
*Valid error code, 70h indicate current errors.*
  - #define **USB\_DEVICE\_MSC\_UFI\_REQ\_SENSE\_ADDITIONAL\_SENSE\_LEN** 0x0AU  
*The UFI device sets the value of this field to ten, to indicate that ten more bytes of sense data follow this field.*
  - #define **USB\_DEVICE\_MSC\_UFI\_PREVENT\_ALLOW\_REMOVAL\_MASK** 0x01U  
*Prevent media removal flag.*
  - #define **USB\_DEVICE\_MSC\_UFI\_LOAD\_EJECT\_START\_MASK** 0x03U  
*LoEj Start flag.*
  - #define **USB\_DEVICE\_MSC\_UFI\_FORMATTED\_MEDIA** 0x02U  
*Formatted Media - Current media capacity.*
  - #define **USB\_DEVICE\_MSC\_UFI\_UNFORMATTED\_MEDIA** 0x01U  
*Unformatted Media - Maximum formatting capacity for this cartridge.*
  - #define **USB\_DEVICE\_MSC\_UFI\_NO\_CARTRIDGE\_IN\_DRIVE** 0x03U  
*No Cartridge in Drive - Maximum formating capacity for any cartridge.*
  - #define **USB\_DEVICE\_MSC\_UFI\_INQUIRY\_ALLOCATION\_LENGTH** 0x24U

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- *INQUIRY Data length of INQUIRY Command.*  
• #define **USB\_DEVICE\_MSC\_UFI\_REQ\_SENSE\_DATA\_LENGTH** 18U
- *Request Sense Data length of REQUEST SENSE Command.*  
• #define **USB\_DEVICE\_MSC\_UFI\_READ\_CAPACITY\_DATA\_LENGTH** 0x08U
- *READ CAPACITY Data length of READ CAPACITY Command.*  
• #define **USB\_DEVICE\_MSC\_UFI\_READ\_CAPACITY16\_DATA\_LENGTH** 0x0CU
- *READ CAPACITY Data length of READ CAPACITY Command.*  
• #define **USB\_DEVICE\_MSC\_UFI\_PERIPHERAL\_QUALIFIER** 0U
- *Reserved.*  
• #define **USB\_DEVICE\_MSC\_UFI\_PERIPHERAL\_QUALIFIER\_SHIFT** 5U
- *Peripheral Device Type shift.*  
• #define **USB\_DEVICE\_MSC\_UFI\_VERSIONS** 4U
- *Version value.*  
• #define **USB\_DEVICE\_MSC\_UFI\_PERIPHERAL\_DEVICE\_TYPE** 0x00U
- *Peripheral Device Type value of INQUIRY Data.*  
• #define **USB\_DEVICE\_MSC\_UFI\_REMOVABLE\_MEDIUM\_BIT** 1U
- *Removable Media Bit value, this shall be set to one to indicate removable media.*  
• #define **USB\_DEVICE\_MSC\_UFI\_REMOVABLE\_MEDIUM\_BIT\_SHIFT** 7U
- *Removable Media Bit shift.*  
• #define **USB\_DEVICE\_MSC\_UFI\_ADDITIONAL\_LENGTH** 0x20U
- *Additional Length.*

### 3.5.3.2 Data Structure Documentation

#### 3.5.3.2.1 struct usb\_device\_inquiry\_command\_struct\_t

##### Data Fields

- uint8\_t **operationCode**  
*Operation Code.*
- uint8\_t **logicalUnitNumber**  
*Specifies the logical unit (0~7) for which Inquiry data should be returned.*
- uint8\_t **pageCode**  
*Page Code.*
- uint8\_t **reserved**  
*Reserved.*
- uint8\_t **allocationLength**  
*Specifies the maximum number of bytes of inquiry data to be returned.*
- uint8\_t **reserved1** [7]  
*Reserved.*

#### 3.5.3.2.2 struct usb\_device\_request\_sense\_command\_struct\_t

##### Data Fields

- uint8\_t **operationCode**  
*Operation Code.*
- uint8\_t **logicalUnitNumber**  
*Logical Unit Number.*



- uint8\_t `reserved` [2]  
*reserved*
- uint8\_t `allocationLength`  
*Allocation Length.*
- uint8\_t `reserved1` [7]  
*reserved*

### 3.5.3.2.3 struct `usb_device_read_format_capacities_command_struct_t`

#### Data Fields

- uint8\_t `operationCode`  
*Operation Code.*
- uint8\_t `logicalUnitNumber`  
*Logical Unit Number.*
- uint8\_t `reserved` [5]  
*reserved*
- uint16\_t `allocationLength`  
*Allocation Length.*
- uint8\_t `reserved1` [3]  
*reserved*

### 3.5.3.2.4 struct `usb_device_read_capacities_command_struct_t`

#### Data Fields

- uint8\_t `operationCode`  
*Operation Code.*
- uint8\_t `logicalUnitNumber`  
*Logical Unit Number.*
- uint32\_t `lba`  
*Logical Block Address.*
- uint8\_t `reserved` [2]  
*Reserved.*
- uint8\_t `pmi`  
*This bit should be set to zero for UFI.*
- uint8\_t `reserved1` [3]  
*Reserved.*

### 3.5.3.2.5 struct `usb_device_read_write_10_command_struct_t`

#### Data Fields

- uint8\_t `operationCode`  
*Operation Code.*
- uint8\_t `lunDpoFuaReladr`  
*Logical Unit Number DPO FUA RelAdr.*
- uint32\_t `lba`

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- *Logical Block Address.*
- uint8\_t **reserved**  
*Reserved.*
- uint8\_t **transferLengthMsb**  
*Transfer Length (MSB)*
- uint8\_t **transferLengthLsb**  
*Transfer Length (LSB)*
- uint8\_t **reserved1** [3]  
*Reserved.*

### 3.5.3.2.6 struct usb\_device\_inquiry\_data\_format\_struct\_t

#### Data Fields

- uint8\_t **peripheralDeviceType**  
*Peripheral Device Type.*
- uint8\_t **rmb**  
*Removable Media Bit.*
- uint8\_t **versions**  
*ISO Version, ECMA Version, ANSI Version.*
- uint8\_t **responseDataFormat**  
*Response Data Format.*
- uint8\_t **additionalLength**  
*The Additional Length field shall specify the length in bytes of the parameters.*
- uint8\_t **reserved** [3]  
*reserved*
- uint8\_t **vendorInformatin** [8]  
*Vendor Identification.*
- uint8\_t **productId** [16]  
*Product Identification.*
- uint8\_t **productVersionLevel** [4]  
*Product Revision Level.*

### 3.5.3.2.7 struct usb\_device\_request\_sense\_data\_struct\_t

#### Data Fields

- uint8\_t **validErrorCode**  
*Error Code.*
- uint8\_t **reserved**  
*reserved*
- uint8\_t **senseKey**  
*Sense Key.*
- uint8\_t **information** [4]  
*Information.*
- uint8\_t **additionalSenseLength**  
*Additional Sense Length.*
- uint8\_t **reserved1** [4]  
*reserved*

- uint8\_t [additionalSenseCode](#)  
*Additional Sense Code.*
- uint8\_t [additionalSenseQualifer](#)  
*Additional Sense Code Qualifier.*
- uint8\_t [reserved2](#) [4]  
*reserved*

### 3.5.3.2.8 struct usb\_device\_read\_capacity\_struct\_t

#### Data Fields

- uint32\_t [lastLogicalBlockAddress](#)  
*Last Logical Block Address.*
- uint32\_t [blockSize](#)  
*Block Length In Bytes.*

### 3.5.3.2.9 struct usb\_device\_read\_capacity16\_data\_struct\_t

#### Data Fields

- uint32\_t [lastLogicalBlockAddress0](#)  
*Last Logical Block Address.*
- uint32\_t [lastLogicalBlockAddress1](#)  
*Last Logical Block Address.*
- uint32\_t [blockSize](#)  
*Block Length In Bytes.*

### 3.5.3.2.10 struct usb\_device\_capacity\_list\_header\_struct\_t

#### Data Fields

- uint8\_t [reserverd](#) [3]  
*reserved*
- uint8\_t [capacityListLength](#)  
*Capacity List Length.*

### 3.5.3.2.11 struct usb\_device\_current\_max\_capacity\_descriptor\_struct\_t

#### Data Fields

- uint32\_t [blockNumber](#)  
*Number of Blocks.*
- uint32\_t [descriptorCodeBlockLength](#)  
*Byte 4 Descriptor Code , byte 5-7 Block Length.*

## USB MSC Class driver

### 3.5.3.2.12 struct usb\_device\_formattable\_capacity\_descriptor\_struct\_t

#### Data Fields

- uint32\_t **blockNumber**  
*Number of Blocks.*
- uint32\_t **blockLength**  
*Block Length.*

### 3.5.3.2.13 struct usb\_device\_mode\_parameters\_header\_struct\_t

#### Data Fields

- uint16\_t **modeDataLength**  
*Mode Data Length.*
- uint8\_t **mediumTypeCode**  
*The Medium Type Code field specifies the inserted medium type.*
- uint8\_t **wpDpfua**  
*WP and DPOFUA bit.*
- uint8\_t **reserved** [4]  
*Reserved.*

### 3.5.3.2.14 struct usb\_device\_format\_capacity\_response\_data\_struct\_t

#### Data Fields

- uint8\_t **capacityListHead** [sizeof(usb\_device\_capacity\_list\_header\_struct\_t)]  
*Capacity List Header.*
- uint8\_t **currentMaxCapacityDescriptor** [sizeof(usb\_device\_current\_max\_capacity\_descriptor\_struct\_t)]  
*Current/Maximum Capacity Header.*
- uint8\_t **formattableCapacityDescriptor** [sizeof(usb\_device\_formattable\_capacity\_descriptor\_struct\_t)\*3]  
*Formatting Capacity Descriptor.*

## 3.6 USB CDC Class driver

### 3.6.1 Overview

The USB communications device class (or USB CDC) is a composite Universal Serial Bus device class. The class may include more than one interface, such as a custom control interface, data interface, audio, or mass storage-related interfaces. The MCUXpresso SDK USB stack provides support for CDC ACM, which is defined in CDC PSTN Subclass. In addition, the Microsoft<sup>®</sup> RNDIS is also implemented upon the CDC ACM driver.

#### Modules

- [USB CDC ACM Class driver](#)
- [USB CDC RNDIS driver](#)

## USB CDC Class driver

### 3.6.2 USB CDC ACM Class driver

#### 3.6.2.1 Overview

This section describes the programming interface of the USB CDC ACM class driver. The USB CDC ACM class driver handles the specific control requests for CDC ACM, transfers data packets to and from the host through the bulk pipe, as well as provides notification to host through the interrupt pipe.

#### 3.6.2.2 USB CDC ACM Device structures

The driver uses an instantiation of the `usb_device_cdc_acm_struct_t` structure to maintain the current state of a particular USB CDC ACM instance module driver. This structure holds the USB device handle and keeps track of the configuration value, alternate setting, pipes and interfaces that are enumerated for this USB ACM device.

The USB CDC ACM class driver populates the structure members.

#### 3.6.2.3 USB CDC ACM Initialization

The `usb_device_cdc_acm_init` is called from `usb_device_class_init` when it matches the class type of CDC with the one in configure structure passed from application. In this function it associates the configure structure with the USB CDC ACM device, resets the configuration value and creates mutex for each pipe.

#### 3.6.2.4 USB CDC ACM Endpoint Initialization

After the enumeration procedure is done, all the endpoints, other than the control endpoint, are initialized with their own attributes, for example, endpoint address, transfer type and maximum packet size. Most of the attributes can be drawn from the configure structure. Each endpoint is assigned a callback function to serve the corresponding event.

#### 3.6.2.5 USB CDC ACM Event Handling

The `usb_device_cdc_acm_event` is called from `usb_device_class_event` when there occurs a class-specific event and it matches the class type of CDC with the one in configure structure. For some events which need to notify the application, the callback function defined in application is invoked with the dedicated event type.

#### 3.6.2.6 USB CDC ACM Send data

The `usb_device_cdc_acm_send` is called to send packet to host through the bulk pipe. Users need to specify the USB CDC ACM class handle, the endpoint address, the buffer address and the length of the

buffer to prime a sending transfer. Note that the transfer is initiated by the host so this transfer is not accomplished until the `kUsbDeviceCdcEventSendResponse` event occurs.

It allows only one transfer at a time, so the call to `usb_device_cdc_acm_send` returns `kStatus_USB_Busy` if the previous transfer is not done yet.

### 3.6.2.7 USB CDC ACM Receive data

The `usb_device_cdc_acm_rcv` is called to receive packet from host through the bulk pipe. Users need to specify the USB CDC ACM class handle, the endpoint address, the buffer address and the length of the buffer to prime a receiving transfer. Note that the transfer is initiated by the host so this transfer is not accomplished until the `kUsbDeviceCdcEventRcvResponse` event occurs.

It allows only one transfer at a time, so the call to `usb_device_cdc_acm_send` returns `kStatus_USB_Busy` if the previous transfer is not done yet.

## Data Structures

- struct `usb_device_cdc_acm_request_param_struct_t`  
*Definition of parameters for CDC ACM request. [More...](#)*
- struct `usb_device_cdc_acm_pipe_t`  
*Definition of pipe structure. [More...](#)*
- struct `usb_device_cdc_acm_struct_t`  
*Definition of structure for CDC ACM device. [More...](#)*

## Macros

- #define `USB_DEVICE_CONFIG_CDC_ACM_MAX_INSTANCE` (1)  
*The maximum number of CDC device instance.*
- #define `USB_DEVICE_CONFIG_CDC_COMM_CLASS_CODE` (0x02)  
*The CDC communication class code.*
- #define `USB_DEVICE_CONFIG_CDC_DATA_CLASS_CODE` (0x0A)  
*The CDC data class code.*
- #define `USB_DEVICE_CDC_REQUEST_SEND_ENCAPSULATED_COMMAND` (0x00)  
*The CDC class request code for SEND\_ENCAPSULATED\_COMMAND.*
- #define `USB_DEVICE_CDC_REQUEST_GET_ENCAPSULATED_RESPONSE` (0x01)  
*The CDC class request code for GET\_ENCAPSULATED\_RESPONSE.*
- #define `USB_DEVICE_CDC_REQUEST_SET_COMM_FEATURE` (0x02)  
*The CDC class request code for SET\_COMM\_FEATURE.*
- #define `USB_DEVICE_CDC_REQUEST_GET_COMM_FEATURE` (0x03)  
*The CDC class request code for GET\_COMM\_FEATURE.*
- #define `USB_DEVICE_CDC_REQUEST_CLEAR_COMM_FEATURE` (0x04)  
*The CDC class request code for CLEAR\_COMM\_FEATURE.*
- #define `USB_DEVICE_CDC_REQUEST_SET_AUX_LINE_STATE` (0x10)  
*The CDC class request code for SET\_AUX\_LINE\_STATE.*
- #define `USB_DEVICE_CDC_REQUEST_SET_HOOK_STATE` (0x11)  
*The CDC class request code for SET\_HOOK\_STATE.*
- #define `USB_DEVICE_CDC_REQUEST_PULSE_SETUP` (0x12)

## USB CDC Class driver

- *The CDC class request code for PULSE\_SETUP.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SEND\_PULSE** (0x13)
- *The CDC class request code for SEND\_PULSE.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_PULSE\_TIME** (0x14)
- *The CDC class request code for SET\_PULSE\_TIME.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_RING\_AUX\_JACK** (0x15)
- *The CDC class request code for RING\_AUX\_JACK.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_LINE\_CODING** (0x20)
- *The CDC class request code for SET\_LINE\_CODING.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_LINE\_CODING** (0x21)
- *The CDC class request code for GET\_LINE\_CODING.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_CONTROL\_LINE\_STATE** (0x22)
- *The CDC class request code for SET\_CONTROL\_LINE\_STATE.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SEND\_BREAK** (0x23)
- *The CDC class request code for SEND\_BREAK.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_RINGER\_PARAMS** (0x30)
- *The CDC class request code for SET\_RINGER\_PARAMS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_RINGER\_PARAMS** (0x31)
- *The CDC class request code for GET\_RINGER\_PARAMS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_OPERATION\_PARAM** (0x32)
- *The CDC class request code for SET\_OPERATION\_PARAM.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_OPERATION\_PARAM** (0x33)
- *The CDC class request code for GET\_OPERATION\_PARAM.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_LINE\_PARAMS** (0x34)
- *The CDC class request code for SET\_LINE\_PARAMS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_LINE\_PARAMS** (0x35)
- *The CDC class request code for GET\_LINE\_PARAMS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_DIAL\_DIGITS** (0x36)
- *The CDC class request code for DIAL\_DIGITS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_UNIT\_PARAMETER** (0x37)
- *The CDC class request code for SET\_UNIT\_PARAMETER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_UNIT\_PARAMETER** (0x38)
- *The CDC class request code for GET\_UNIT\_PARAMETER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_CLEAR\_UNIT\_PARAMETER** (0x39)
- *The CDC class request code for CLEAR\_UNIT\_PARAMETER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_ETHERNET\_MULTICAST\_FILTERS** (0x40)
- *The CDC class request code for SET\_ETHERNET\_MULTICAST\_FILTERS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_ETHERNET\_POW\_PATTER\_FILTER** (0x41)
- *The CDC class request code for SET\_ETHERNET\_POW\_PATTER\_FILTER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_ETHERNET\_POW\_PATTER\_FILTER** (0x42)
- *The CDC class request code for GET\_ETHERNET\_POW\_PATTER\_FILTER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_ETHERNET\_PACKET\_FILTER** (0x43)
- *The CDC class request code for SET\_ETHERNET\_PACKET\_FILTER.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_ETHERNET\_STATISTIC** (0x44)
- *The CDC class request code for GET\_ETHERNET\_STATISTIC.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_ATM\_DATA\_FORMAT** (0x50)
- *The CDC class request code for SET\_ATM\_DATA\_FORMAT.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_ATM\_DEVICE\_STATISTICS** (0x51)
- *The CDC class request code for GET\_ATM\_DEVICE\_STATISTICS.*  
• #define **USB\_DEVICE\_CDC\_REQUEST\_SET\_ATM\_DEFAULT\_VC** (0x52)
- *The CDC class request code for SET\_ATM\_DEFAULT\_VC.*



- #define **USB\_DEVICE\_CDC\_REQUEST\_GET\_ATM\_VC\_STATISTICS** (0x53)  
*The CDC class request code for GET\_ATM\_VC\_STATISTICS.*
- #define **USB\_DEVICE\_CDC\_REQUEST\_MDLM\_SPECIFIC\_REQUESTS\_MASK** (0x7F)  
*The CDC class request code for MDLM\_SPECIFIC\_REQUESTS\_MASK.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_NETWORK\_CONNECTION** (0x00)  
*The CDC class notify code for NETWORK\_CONNECTION.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_RESPONSE\_AVAIL** (0x01)  
*The CDC class notify code for RESPONSE\_AVAIL.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_AUX\_JACK\_HOOK\_STATE** (0x08)  
*The CDC class notify code for AUX\_JACK\_HOOK\_STATE.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_RING\_DETECT** (0x09)  
*The CDC class notify code for RING\_DETECT.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_SERIAL\_STATE** (0x20)  
*The CDC class notify code for SERIAL\_STATE.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_CALL\_STATE\_CHANGE** (0x28)  
*The CDC class notify code for CALL\_STATE\_CHANGE.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_LINE\_STATE\_CHANGE** (0x29)  
*The CDC class notify code for LINE\_STATE\_CHANGE.*
- #define **USB\_DEVICE\_CDC\_NOTIF\_CONNECTION\_SPEED\_CHANGE** (0x2A)  
*The CDC class notify code for CONNECTION\_SPEED\_CHANGE.*
- #define **USB\_DEVICE\_CDC\_FEATURE\_ABSTRACT\_STATE** (0x01)  
*The CDC class feature select code for ABSTRACT\_STATE.*
- #define **USB\_DEVICE\_CDC\_FEATURE\_COUNTRY\_SETTING** (0x02)  
*The CDC class feature select code for COUNTRY\_SETTING.*
- #define **USB\_DEVICE\_CDC\_CONTROL\_SIG\_BITMAP\_CARRIER\_ACTIVATION** (0x02)  
*The CDC class control signal bitmap value for CARRIER\_ACTIVATION.*
- #define **USB\_DEVICE\_CDC\_CONTROL\_SIG\_BITMAP\_DTE\_PRESENCE** (0x01)  
*The CDC class control signal bitmap value for DTE\_PRESENCE.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_RX\_CARRIER** (0x01)  
*The UART state bitmap value of RX\_CARRIER.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_TX\_CARRIER** (0x02)  
*The UART state bitmap value of TX\_CARRIER.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_BREAK** (0x04)  
*The UART state bitmap value of BREAK.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_RING\_SIGNAL** (0x08)  
*The UART state bitmap value of RING\_SIGNAL.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_FRAMING** (0x10)  
*The UART state bitmap value of FRAMING.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_PARITY** (0x20)  
*The UART state bitmap value of PARITY.*
- #define **USB\_DEVICE\_CDC\_UART\_STATE\_OVERRUN** (0x40)  
*The UART state bitmap value of OVERRUN.*

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### Enumerations

- enum `usb_device_cdc_acm_event_t` {  
    `kUSB_DeviceCdcEventSendResponse` = 0x01,  
    `kUSB_DeviceCdcEventRecvResponse`,  
    `kUSB_DeviceCdcEventSerialStateNotif`,  
    `kUSB_DeviceCdcEventSendEncapsulatedCommand`,  
    `kUSB_DeviceCdcEventGetEncapsulatedResponse`,  
    `kUSB_DeviceCdcEventSetCommFeature`,  
    `kUSB_DeviceCdcEventGetCommFeature`,  
    `kUSB_DeviceCdcEventClearCommFeature`,  
    `kUSB_DeviceCdcEventGetLineCoding`,  
    `kUSB_DeviceCdcEventSetLineCoding`,  
    `kUSB_DeviceCdcEventSetControlLineState`,  
    `kUSB_DeviceCdcEventSendBreak` }

*Definition of CDC class event.*

### USB CDC ACM Class Driver

- `usb_status_t USB_DeviceCdcAcmInit` (`uint8_t controllerId`, `usb_device_class_config_struct_t *config`, `class_handle_t *handle`)  
*Initializes the USB CDC ACM class.*
- `usb_status_t USB_DeviceCdcAcmDeinit` (`class_handle_t handle`)  
*Deinitializes the USB CDC ACM class.*
- `usb_status_t USB_DeviceCdcAcmEvent` (`void *handle`, `uint32_t event`, `void *param`)  
*Handles the CDC ACM class event.*
- `usb_status_t USB_DeviceCdcAcmSend` (`class_handle_t handle`, `uint8_t ep`, `uint8_t *buffer`, `uint32_t length`)  
*Primes the endpoint to send packet to host.*
- `usb_status_t USB_DeviceCdcAcmRecv` (`class_handle_t handle`, `uint8_t ep`, `uint8_t *buffer`, `uint32_t length`)  
*Primes the endpoint to receive packet from host.*

### 3.6.2.8 Data Structure Documentation

#### 3.6.2.8.1 struct `usb_device_cdc_acm_request_param_struct_t`

##### Data Fields

- `uint8_t ** buffer`  
*The pointer to the address of the buffer for CDC class request.*
- `uint32_t * length`  
*The pointer to the length of the buffer for CDC class request.*
- `uint16_t interfaceIndex`  
*The interface index of the setup packet.*
- `uint16_t setupValue`  
*The wValue field of the setup packet.*

- `uint8_t isSetup`  
*The flag indicates if it is a setup packet, 1: yes, 0: no.*

### 3.6.2.8.1.1 Field Documentation

3.6.2.8.1.1.1 `uint8_t** usb_device_cdc_acm_request_param_struct_t::buffer`

3.6.2.8.1.1.2 `uint32_t* usb_device_cdc_acm_request_param_struct_t::length`

3.6.2.8.1.1.3 `uint16_t usb_device_cdc_acm_request_param_struct_t::interfaceIndex`

3.6.2.8.1.1.4 `uint16_t usb_device_cdc_acm_request_param_struct_t::setupValue`

3.6.2.8.1.1.5 `uint8_t usb_device_cdc_acm_request_param_struct_t::isSetup`

### 3.6.2.8.2 struct `usb_device_cdc_acm_pipe_t`

#### Data Fields

- `usb_osa_mutex_handle mutex`  
*The mutex of the pipe.*
- `uint8_t ep`  
*The endpoint number of the pipe.*
- `uint8_t isBusy`  
*1: The pipe is transferring packet, 0: The pipe is idle.*

### 3.6.2.8.2.1 Field Documentation

3.6.2.8.2.1.1 `usb_osa_mutex_handle usb_device_cdc_acm_pipe_t::mutex`

3.6.2.8.2.1.2 `uint8_t usb_device_cdc_acm_pipe_t::ep`

3.6.2.8.2.1.3 `uint8_t usb_device_cdc_acm_pipe_t::isBusy`

### 3.6.2.8.3 struct `usb_device_cdc_acm_struct_t`

#### Data Fields

- `usb_device_handle handle`  
*The handle of the USB device.*
- `usb_device_class_config_struct_t * configStruct`  
*The class configure structure.*
- `usb_device_interface_struct_t * commInterfaceHandle`  
*The CDC communication interface handle.*
- `usb_device_interface_struct_t * dataInterfaceHandle`  
*The CDC data interface handle.*
- `usb_device_cdc_acm_pipe_t bulkIn`  
*The bulk in pipe for sending packet to host.*
- `usb_device_cdc_acm_pipe_t bulkOut`  
*The bulk out pipe for receiving packet from host.*
- `usb_device_cdc_acm_pipe_t interruptIn`

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- *The interrupt in pipe for notifying the device state to host.*  
uint8\_t **configuration**
- *The current configuration value.*  
uint8\_t **interfaceNumber**
- *The current interface number.*  
uint8\_t **alternate**
- *The alternate setting value of the interface.*  
uint8\_t **hasSentState**  
*1: The device has primed the state in interrupt pipe, 0: Not primed the state.*



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### 3.6.2.8.3.1 Field Documentation

3.6.2.8.3.1.1 `usb_device_handle usb_device_cdc_acm_struct_t::handle`

3.6.2.8.3.1.2 `usb_device_class_config_struct_t* usb_device_cdc_acm_struct_t::configStruct`

3.6.2.8.3.1.3 `usb_device_interface_struct_t* usb_device_cdc_acm_struct_t::commInterfaceHandle`

3.6.2.8.3.1.4 `usb_device_interface_struct_t* usb_device_cdc_acm_struct_t::dataInterfaceHandle`

3.6.2.8.3.1.5 `usb_device_cdc_acm_pipe_t usb_device_cdc_acm_struct_t::bulkIn`

3.6.2.8.3.1.6 `usb_device_cdc_acm_pipe_t usb_device_cdc_acm_struct_t::bulkOut`

3.6.2.8.3.1.7 `usb_device_cdc_acm_pipe_t usb_device_cdc_acm_struct_t::interruptIn`

3.6.2.8.3.1.8 `uint8_t usb_device_cdc_acm_struct_t::configuration`

3.6.2.8.3.1.9 `uint8_t usb_device_cdc_acm_struct_t::interfaceNumber`

3.6.2.8.3.1.10 `uint8_t usb_device_cdc_acm_struct_t::alternate`

3.6.2.8.3.1.11 `uint8_t usb_device_cdc_acm_struct_t::hasSentState`

### 3.6.2.9 Macro Definition Documentation

3.6.2.9.1 `#define USB_DEVICE_CONFIG_CDC_ACM_MAX_INSTANCE (1)`

3.6.2.9.2 `#define USB_DEVICE_CONFIG_CDC_COMM_CLASS_CODE (0x02)`

3.6.2.9.3 `#define USB_DEVICE_CONFIG_CDC_DATA_CLASS_CODE (0x0A)`

3.6.2.9.4 `#define USB_DEVICE_CDC_REQUEST_SEND_ENCAPSULATED_COMMAND (0x00)`

3.6.2.9.5 `#define USB_DEVICE_CDC_REQUEST_GET_ENCAPSULATED_RESPONSE (0x01)`

3.6.2.9.6 `#define USB_DEVICE_CDC_REQUEST_SET_COMM_FEATURE (0x02)`

3.6.2.9.7 `#define USB_DEVICE_CDC_REQUEST_GET_COMM_FEATURE (0x03)`

3.6.2.9.8 `#define USB_DEVICE_CDC_REQUEST_CLEAR_COMM_FEATURE (0x04)`

3.6.2.9.9 `#define USB_DEVICE_CDC_REQUEST_SET_AUX_LINE_STATE (0x10)`

3.6.2.9.10 `#define USB_DEVICE_CDC_REQUEST_SET_HOOK_STATE (0x11)`

3.6.2.9.11 `#define USB_DEVICE_CDC_REQUEST_PULSE_SETUP (0x12)`

3.6.2.9.12 `#define USB_DEVICE_CDC_REQUEST_SEND_PULSE (0x13)`

3.6.2.9.13 `#define USB_DEVICE_CDC_REQUEST_SET_PULSE_TIME (0x14)`

3.6.2.9.14 `#define USB_DEVICE_CDC_REQUEST_RING_AUX_JACK (0x15)`

- kUSB\_DeviceCdcEventRecvResponse*** This event indicates the bulk receive transfer is complete.
- kUSB\_DeviceCdcEventSerialStateNotif*** This event indicates the serial state has been sent to the host.
- kUSB\_DeviceCdcEventSendEncapsulatedCommand*** This event indicates the device received the SEND\_ENCAPSULATED\_COMMAND request.
- kUSB\_DeviceCdcEventGetEncapsulatedResponse*** This event indicates the device received the GET\_ENCAPSULATED\_RESPONSE request.
- kUSB\_DeviceCdcEventSetCommFeature*** This event indicates the device received the SET\_COMM\_FEATURE request.
- kUSB\_DeviceCdcEventGetCommFeature*** This event indicates the device received the GET\_COMM\_FEATURE request.
- kUSB\_DeviceCdcEventClearCommFeature*** This event indicates the device received the CLEAR\_COMM\_FEATURE request.
- kUSB\_DeviceCdcEventGetLineCoding*** This event indicates the device received the GET\_LINE\_CODING request.
- kUSB\_DeviceCdcEventSetLineCoding*** This event indicates the device received the SET\_LINE\_CODING request.
- kUSB\_DeviceCdcEventSetControlLineState*** This event indicates the device received the SET\_CONTROL\_LINE\_STATE request.
- kUSB\_DeviceCdcEventSendBreak*** This event indicates the device received the SEND\_BREAK request.

### 3.6.2.11 Function Documentation

#### 3.6.2.11.1 `usb_status_t USB_DeviceCdcAcmlnit ( uint8_t controllerId, usb_device_class_config_struct_t * config, class_handle_t * handle )`

This function obtains a USB device handle according to the controller ID, initializes the CDC ACM class with the class configure parameters and creates the mutex for each pipe.

Parameters

|                     |   |
|---------------------|---|
| <i>controllerId</i> | The ID of the controller. The value can be chosen from the <code>kUSB_ControllerKhci0</code> , <code>kUSB_ControllerKhci1</code> , <code>kUSB_ControllerEhci0</code> , or <code>kUSB_ControllerEhci1</code> . |
| <i>config</i>       | The user configuration structure of type <code>usb_device_class_config_struct_t</code> . The user populates the members of this structure and passes the pointer of this structure into this function.        |

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|               |   |
|---------------|---|
| <i>handle</i> | It is out parameter. The class handle of the CDC ACM class. |
|---------------|---|

Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                                      |  |
|--------------------------------------|--|
| <i>kStatus_USB_Success</i>           | The CDC ACM class is initialized successfully.     |
| <i>kStatus_USB_Busy</i>              | No CDC ACM device handle available for allocation. |
| <i>kStatus_USB_Invalid-Handle</i>    | The CDC ACM device handle allocation failure.      |
| <i>kStatus_USB_Invalid-Parameter</i> | The USB device handle allocation failure.          |

### 3.6.2.11.2 `usb_status_t USB_DeviceCdcAcmDeinit ( class_handle_t handle )`

This function destroys the mutex for each pipe, deinitializes each endpoint of the CDC ACM class and frees the CDC ACM class handle.

Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the CDC ACM class. |
|---------------|--|

Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                                   |   |
|-----------------------------------|---|
| <i>kStatus_USB_Success</i>        | The CDC ACM class is de-initialized successfully.                 |
| <i>kStatus_USB_Error</i>          | The endpoint deinitialization failure.                            |
| <i>kStatus_USB_Invalid-Handle</i> | The CDC ACM device handle or the CDC ACM class handle is invalid. |



|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Invalid-Parameter</i> | The endpoint number of the CDC ACM class handle is invalid. |
|--------------------------------------|---|

**3.6.2.11.3 usb\_status\_t USB\_DeviceCdcAcmEvent ( void \* *handle*, uint32\_t *event*, void \* *param* )**

This function responds to various events including the common device events and the class-specific events. For class-specific events, it calls the class callback defined in the application to deal with the class-specific event.

Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the CDC ACM class. |
| <i>event</i>  | The event type.                        |
| <i>param</i>  | The class handle of the CDC ACM class. |

Returns

A USB error code or kStatus\_USB\_Success.

Return values

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Success</i>           | The CDC ACM class is de-initialized successfully.                 |
| <i>kStatus_USB_Error</i>             | The configure structure of the CDC ACM class handle is invalid.   |
| <i>kStatus_USB_Invalid-Handle</i>    | The CDC ACM device handle or the CDC ACM class handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i> | The endpoint number of the CDC ACM class handle is invalid.       |
| <i>Others</i>                        | The error code returned by class callback in application.         |

**3.6.2.11.4 usb\_status\_t USB\_DeviceCdcAcmSend ( class\_handle\_t *handle*, uint8\_t *ep*, uint8\_t \* *buffer*, uint32\_t *length* )**

This function checks whether the endpoint is sending packet, then it primes the endpoint with the buffer address and the buffer length if the pipe is not busy. Otherwise, it ignores this transfer by returning an error code.

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### Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the CDC ACM class.       |
| <i>ep</i>     | The endpoint number of the transfer.         |
| <i>buffer</i> | The pointer to the buffer to be transferred. |
| <i>length</i> | The length of the buffer to be transferred.  |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | Prime to send packet successfully.                                |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in transferring.                             |
| <i>kStatus_USB_Invalid-Handle</i>      | The CDC ACM device handle or the CDC ACM class handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | The controller interface is invalid.                              |

### 3.6.2.11.5 `usb_status_t USB_DeviceCdcAcmRecv ( class_handle_t handle, uint8_t ep, uint8_t * buffer, uint32_t length )`

This function checks whether the endpoint is receiving packet, then it primes the endpoint with the buffer address and the buffer length if the pipe is not busy. Otherwise, it ignores this transfer by returning an error code.

### Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the CDC ACM class.       |
| <i>ep</i>     | The endpoint number of the transfer.         |
| <i>buffer</i> | The pointer to the buffer to be transferred. |
| <i>length</i> | The length of the buffer to be transferred.  |

### Returns

A USB error code or `kStatus_USB_Success`.

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | Prime to receive packet successfully.                             |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in transferring.                             |
| <i>kStatus_USB_Invalid-Handle</i>      | The CDC ACM device handle or the CDC ACM class handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | The controller interface is invalid.                              |

### 3.6.3 USB CDC RNDIS driver

#### 3.6.3.1 Overview

This section describes the programming interface of the USB CDC RNDIS driver. The USB CDC RNDIS driver implements the various control messages and data message defined by Microsoft RNDIS. The control messages is sent through the SEND\_ENCAPSULATED\_COMMAND and GET\_ENCAPSULATED\_COMMAND CDC class request.

#### 3.6.3.2 USB CDC RNDIS Device structures

The driver uses an instantiation of the `usb_device_cdc_rndis_struct_t` structure to maintain the current state of a particular CDC RNDIS instance module driver.

The CDC RNDIS driver populates the structure members.

#### 3.6.3.3 CDC RNDIS Initialization

The CDC RNDIS device is initialized with the configure structure of type `usb_device_cdc_rndis_config_struct_t`. It specifies the RNDIS request specific callback function and the maximum transmit size for device. Besides, the device state, hardware state and the media status is set to their initial value.

#### 3.6.3.4 CDC RNDIS Control Message

The control messages is sent through the SEND\_ENCAPSULATED\_COMMAND and GET\_ENCAPSULATED\_COMMAND CDC class request. Take the RNDIS\_INITIALIZE\_MSG as an example, the host sends a SEND\_ENCAPSULATED\_COMMAND request which carries the message type of RNDIS\_INITIALIZE\_MSG to the device, then the device sends back a notification through interrupt pipe to indicate that the response is available. Next the host sends a GET\_ENCAPSULATED\_COMMAND request which carries the message type of RNDIS\_INITIALIZE\_CMPLT to the device to obtain the proper information.

### Data Structures

- struct `rndis_init_msg_struct_t`  
*Define message structure for REMOTE\_NDIS\_INITIALIZE\_MSG. [More...](#)*
- struct `rndis_init_cmplt_struct_t`  
*Define message structure for REMOTE\_NDIS\_INITIALIZE\_CMPLT. [More...](#)*
- struct `rndis_halt_msg_struct_t`  
*Define message structure for REMOTE\_NDIS\_HALT\_MSG. [More...](#)*
- struct `rndis_query_msg_struct_t`  
*Define message structure for REMOTE\_NDIS\_QUERY\_MSG. [More...](#)*
- struct `rndis_query_cmplt_struct_t`  
*Define message structure for REMOTE\_NDIS\_QUERY\_CMPLT. [More...](#)*
- struct `rndis_set_msg_struct_t`

- *Define message structure for REMOTE\_NDIS\_SET\_MSG. More...*
- struct `rndis_set_cmplt_struct_t`
- *Define message structure for REMOTE\_NDIS\_SET\_CMPLT. More...*
- struct `rndis_reset_msg_struct_t`
- *Define message structure for REMOTE\_NDIS\_RESET\_MSG. More...*
- struct `rndis_reset_cmplt_struct_t`
- *Define message structure for REMOTE\_NDIS\_RESET\_CMPLT. More...*
- struct `rndis_indicate_status_msg_struct_t`
- *Define message structure for REMOTE\_NDIS\_INDICATE\_STATUS\_MSG. More...*
- struct `rndis_keepalive_msg_struct_t`
- *Define message structure for REMOTE\_NDIS\_KEEPALIVE\_MSG. More...*
- struct `rndis_keepalive_cmplt_struct_t`
- *Define message structure for REMOTE\_NDIS\_KEEPALIVE\_CMPLT. More...*
- struct `rndis_packet_msg_struct_t`
- *Define message structure for RNDIS\_PACKET\_MSG. More...*
- struct `usb_device_cdc_rndis_struct_t`
- *Define structure for CDC RNDIS device. More...*
- struct `usb_device_cdc_rndis_config_struct_t`
- *Define structure for CDC RNDIS device. More...*
- struct `usb_device_cdc_rndis_request_param_struct_t`
- *Define parameters for CDC RNDIS request. More...*

## Macros

- #define `USB_DEVICE_CONFIG_CDC_RNDIS_MAX_INSTANCE` (1U)  
*The maximum number of USB CDC RNDIS device instance.*
- #define `RNDIS_DF_CONNECTIONLESS` (0x00000001U)  
*The Miniport driver type is connectionless.*
- #define `RNDIS_DF_CONNECTION_ORIENTED` (0x00000002U)  
*The Miniport driver type is connection-oriented.*
- #define `RNDIS_SINGLE_PACKET_TRANSFER` (0x00000001U)  
*The number of RNDIS data messages that the device can handle in a single transfer.*
- #define `RNDIS_PACKET_ALIGNMENT_FACTOR` (0x00000003U)  
*The byte alignment that the device expects for each RNDIS message that is part of a multmessage transfer.*
- #define `RNDIS_NUM_OIDS_SUPPORTED` (25U)  
*The number of OIDs the RNDIS device supported.*
- #define `RNDIS_VENDOR_ID` (0xFFFFFFFU)  
*The vendor ID of the RNDIS device.*
- #define `RNDIS_NIC_IDENTIFIER_VENDOR` (0x01U)  
*A single byte that the vendor assigns to identify a particular NIC.*
- #define `RNDIS_MAX_EXPECTED_COMMAND_SIZE` (76U)  
*DataLength : Data length of communication feature.*
- #define `RNDIS_MAX_EXPECTED_RESPONSE_SIZE` (`RNDIS_RESPONSE_QUERY_MSG_SIZE + (RNDIS_NUM_OIDS_SUPPORTED << 2U)`)  
*This is the maximum observed command size we get on control endpoint – Memory for commands is allocated at initialization, instead of being dynamically allocated when command is received to avoid memory fragmentation.*
- #define `RNDIS_ETHER_ADDR_SIZE` (6U)  
*Size of Ethernet address.*
- #define `RNDIS_USB_HEADER_SIZE` (44U)

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- *Size of USB header for RNDIS packet.*  
• #define **RNDIS\_MULTICAST\_LIST\_SIZE** (0U)  
*Maximum size of multicast address list.*

## Enumerations

- enum **ndis\_physical\_medium\_enum\_t**  
*Physical Medium Type definitions.*
- enum **rndis\_state\_enum\_t** {  
**RNDIS\_UNINITIALIZED** = 0,  
**RNDIS\_INITIALIZED**,  
**RNDIS\_DATA\_INITIALIZED** }  
*Define RNDIS device state.*
- enum **rndis\_event\_enum\_t** {  
**kUSB\_DeviceCdcEventAppGetLinkSpeed**,  
**kUSB\_DeviceCdcEventAppGetSendPacketSize**,  
**kUSB\_DeviceCdcEventAppGetRecvPacketSize**,  
**kUSB\_DeviceCdcEventAppGetMacAddress**,  
**kUSB\_DeviceCdcEventAppGetLinkStatus**,  
**kUSB\_DeviceCdcEventAppGetMaxFrameSize** }  
*Define RNDIS event.*

## RNDIS Control Message Type

See MSDN for details.

- #define **RNDIS\_PACKET\_MSG** (0x00000001U)
- #define **RNDIS\_INITIALIZE\_MSG** (0x00000002U)
- #define **RNDIS\_HALT\_MSG** (0x00000003U)
- #define **RNDIS\_QUERY\_MSG** (0x00000004U)
- #define **RNDIS\_SET\_MSG** (0x00000005U)
- #define **RNDIS\_RESET\_MSG** (0x00000006U)
- #define **RNDIS\_INDICATE\_STATUS\_MSG** (0x00000007U)
- #define **RNDIS\_KEEPLIVE\_MSG** (0x00000008U)
- #define **RNDIS\_INITIALIZE\_CMPLT** (0x80000002U)
- #define **RNDIS\_QUERY\_CMPLT** (0x80000004U)
- #define **RNDIS\_SET\_CMPLT** (0x80000005U)
- #define **RNDIS\_RESET\_CMPLT** (0x80000006U)
- #define **RNDIS\_KEEPLIVE\_CMPLT** (0x80000008U)

## Object Identifiers used by NdisRequest Query/Set Information

See MSDN for details.

- #define **NDIS\_OID\_GEN\_SUPPORTED\_LIST** (0x00010101U)
- #define **NDIS\_OID\_GEN\_HARDWARE\_STATUS** (0x00010102U)
- #define **NDIS\_OID\_GEN\_MEDIA\_SUPPORTED** (0x00010103U)
- #define **NDIS\_OID\_GEN\_MEDIA\_IN\_USE** (0x00010104U)
- #define **NDIS\_OID\_GEN\_MAXIMUM\_LOOKAHEAD** (0x00010105U)

```

• #define NDIS_OID_GEN_MAXIMUM_FRAME_SIZE (0x00010106U)
• #define NDIS_OID_GEN_LINK_SPEED (0x00010107U)
• #define NDIS_OID_GEN_TRANSMIT_BUFFER_SPACE (0x00010108U)
• #define NDIS_OID_GEN_RECEIVE_BUFFER_SPACE (0x00010109U)
• #define NDIS_OID_GEN_TRANSMIT_BLOCK_SIZE (0x0001010AU)
• #define NDIS_OID_GEN_RECEIVE_BLOCK_SIZE (0x0001010BU)
• #define NDIS_OID_GEN_VENDOR_ID (0x0001010CU)
• #define NDIS_OID_GEN_VENDOR_DESCRIPTION (0x0001010DU)
• #define NDIS_OID_GEN_CURRENT_PACKET_FILTER (0x0001010EU)
• #define NDIS_OID_GEN_CURRENT_LOOKAHEAD (0x0001010FU)
• #define NDIS_OID_GEN_DRIVER_VERSION (0x00010110U)
• #define NDIS_OID_GEN_MAXIMUM_TOTAL_SIZE (0x00010111U)
• #define NDIS_OID_GEN_PROTOCOL_OPTIONS (0x00010112U)
• #define NDIS_OID_GEN_MAC_OPTIONS (0x00010113U)
• #define NDIS_OID_GEN_MEDIA_CONNECT_STATUS (0x00010114U)
• #define NDIS_OID_GEN_MAXIMUM_SEND_PACKETS (0x00010115U)
• #define NDIS_OID_GEN_XMIT_OK (0x00020101U)
• #define NDIS_OID_GEN_RCV_OK (0x00020102U)
• #define NDIS_OID_GEN_XMIT_ERROR (0x00020103U)
• #define NDIS_OID_GEN_RCV_ERROR (0x00020104U)
• #define NDIS_OID_GEN_RCV_NO_BUFFER (0x00020105U)
• #define NDIS_OID_GEN_DIRECTED_BYTES_XMIT (0x00020201U)
• #define NDIS_OID_GEN_DIRECTED_FRAMES_XMIT (0x00020202U)
• #define NDIS_OID_GEN_MULTICAST_BYTES_XMIT (0x00020203U)
• #define NDIS_OID_GEN_MULTICAST_FRAMES_XMIT (0x00020204U)
• #define NDIS_OID_GEN_BROADCAST_BYTES_XMIT (0x00020205U)
• #define NDIS_OID_GEN_BROADCAST_FRAMES_XMIT (0x00020206U)
• #define NDIS_OID_GEN_DIRECTED_BYTES_RCV (0x00020207U)
• #define NDIS_OID_GEN_DIRECTED_FRAMES_RCV (0x00020208U)
• #define NDIS_OID_GEN_MULTICAST_BYTES_RCV (0x00020209U)
• #define NDIS_OID_GEN_MULTICAST_FRAMES_RCV (0x0002020AU)
• #define NDIS_OID_GEN_BROADCAST_BYTES_RCV (0x0002020BU)
• #define NDIS_OID_GEN_BROADCAST_FRAMES_RCV (0x0002020CU)
• #define NDIS_OID_GEN_RCV_CRC_ERROR (0x0002020DU)
• #define NDIS_OID_GEN_TRANSMIT_QUEUE_LENGTH (0x0002020EU)
• #define NDIS_OID_GEN_GET_TIME_CAPS (0x0002020FU)
• #define NDIS_OID_GEN_GET_NETCARD_TIME (0x00020210U)
• #define NDIS_OID_802_3_PERMANENT_ADDRESS (0x01010101U)
• #define NDIS_OID_802_3_CURRENT_ADDRESS (0x01010102U)
• #define NDIS_OID_802_3_MULTICAST_LIST (0x01010103U)
• #define NDIS_OID_802_3_MAXIMUM_LIST_SIZE (0x01010104U)
• #define NDIS_OID_802_3_MAC_OPTIONS (0x01010105U)
• #define NDIS_802_3_MAC_OPTION_PRIORITY (0x00000001U)
• #define NDIS_OID_802_3_RCV_ERROR_ALIGNMENT (0x01020101U)
• #define NDIS_OID_802_3_XMIT_ONE_COLLISION (0x01020102U)
• #define NDIS_OID_802_3_XMIT_MORE_COLLISIONS (0x01020103U)
• #define NDIS_OID_802_3_XMIT_DEFERRED (0x01020201U)
• #define NDIS_OID_802_3_XMIT_MAX_COLLISIONS (0x01020202U)
• #define NDIS_OID_802_3_RCV_OVERRUN (0x01020203U)
• #define NDIS_OID_802_3_XMIT_UNDERRUN (0x01020204U)
• #define NDIS_OID_802_3_XMIT_HEARTBEAT_FAILURE (0x01020205U)
• #define NDIS_OID_802_3_XMIT_TIMES_CR_S_LOST (0x01020206U)
• #define NDIS_OID_802_3_XMIT_LATE_COLLISIONS (0x01020207U)
• #define NDIS_OID_GEN_VENDOR_DRIVER_VERSION (0x00010116U)
• #define NDIS_OID_GEN_SUPPORTED_GUIDS (0x00010117U)
• #define NDIS_OID_GEN_NETWORK_LAYER_ADDRESSES (0x00010118U) /* Set only */

```

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- #define **NDIS\_OID\_GEN\_TRANSPORT\_HEADER\_OFFSET** (0x00010119U) /\* Set only \*/
- #define **NDIS\_OID\_GEN\_MACHINE\_NAME** (0x0001021AU)
- #define **NDIS\_OID\_GEN\_RNDIS\_CONFIG\_PARAMETER** (0x0001021BU) /\* Set only \*/
- #define **NDIS\_OID\_GEN\_VLAN\_ID** (0x0001021CU)
- #define **NDIS\_OID\_GEN\_MEDIA\_CAPABILITIES** (0x00010201U)
- #define **NDIS\_OID\_GEN\_PHYSICAL\_MEDIUM** (0x00010202U)

## NDIS Hardware status codes for OID\_GEN\_HARDWARE\_STATUS

See MSDN for details.

- #define **NDIS\_HARDWARE\_STATUS\_READY** (0x00000000U)  
*Available and capable of sending and receiving data over the wire.*
- #define **NDIS\_HARDWARE\_STATUS\_INITIALIZING** (0x00000001U)  
*Initializing.*
- #define **NDIS\_HARDWARE\_STATUS\_RESET** (0x00000002U)  
*Resetting.*
- #define **NDIS\_HARDWARE\_STATUS\_CLOSING** (0x00000003U)  
*Closing.*
- #define **NDIS\_HARDWARE\_STATUS\_NOT\_READY** (0x00000004U)  
*Not ready.*

## NDIS media types that the NIC can support

See MSDN for details.

- #define **NDIS\_MEDIUM802\_3** (0x00000000U)  
*Ethernet (802.3) is not supported for NDIS 6.0 drivers.*
- #define **NDIS\_MEDIUM802\_5** (0x00000001U)  
*Token Ring (802.5) is not supported for NDIS 6.0 drivers.*
- #define **NDIS\_MEDIUM\_FDDI** (0x00000002U)  
*FDDI is not supported on Windows<sup>®</sup> Vista.*
- #define **NDIS\_MEDIUM\_WAN** (0x00000003U)  
*WAN.*
- #define **NDIS\_MEDIUM\_LOCAL\_TALK** (0x00000004U)  
*LocalTalk.*
- #define **NDIS\_MEDIUM\_DIX** (0x00000005U)  
*DEC/Intel/Xerox (DIX) Ethernet.*
- #define **NDIS\_MEDIUM\_ARCNET\_RAW** (0x00000006U)  
*ARCNET (raw) is not supported on Windows Vista.*
- #define **NDIS\_MEDIUM\_ARCNET878\_2** (0x00000007U)  
*ARCNET (878.2) is not supported on Windows Vista.*
- #define **NDIS\_MEDIUM\_ATM** (0x00000008U)  
*ATM is not supported for NDIS 6.0 drivers.*
- #define **NDIS\_MEDIUM\_NATIVE802\_11** (0x00000009U)  
*Native 802.11.*
- #define **NDIS\_MEDIUM\_WIRELESS\_WAN** (0x0000000AU)  
*Various types of NdisWirelessXxx media Note This media type is not available for use beginning with Windows Vista.*
- #define **NDIS\_MEDIUM\_IRDA** (0x0000000BU)



- *Infrared (IrDA)*
- #define **NDIS\_MEDIUM\_COWAN** (0x0000000CU)  
*Connection-oriented WAN.*
- #define **NDIS\_MEDIUM1394** (0x0000000DU)  
*IEEE 1394 (firewire) bus.*
- #define **NDIS\_MEDIUM\_BPC** (0x0000000EU)  
*Broadcast PC network.*
- #define **NDIS\_MEDIUM\_INFINI\_BAND** (0x0000000FU)  
*InfiniBand network.*
- #define **NDIS\_MEDIUM\_TUNNEL** (0x00000010U)  
*Tunnel network.*
- #define **NDIS\_MEDIUM\_LOOPBACK** (0x00000011U)  
*NDIS loopback network.*

### NDIS Packet Filter Bits for **OID\_GEN\_CURRENT\_PACKET\_FILTER**.

See MSDN for details.

- #define **NDIS\_PACKET\_TYPE\_DIRECTED** (0x0001U)  
*Directed packets.*
- #define **NDIS\_PACKET\_TYPE\_MULTICAST** (0x0002U)  
*Multicast address packets sent to addresses in the multicast address list.*
- #define **NDIS\_PACKET\_TYPE\_ALL\_MULTICAST** (0x0004U)  
*All multicast address packets, not just the ones enumerated in the multicast address list.*
- #define **NDIS\_PACKET\_TYPE\_BROADCAST** (0x0008U)  
*Broadcast packets.*
- #define **NDIS\_PACKET\_TYPE\_SOURCE\_ROUTING** (0x0010U)  
*All source routing packets.*
- #define **NDIS\_PACKET\_TYPE\_PROMISCUOUS** (0x0020U)  
*Specifies all packets.*
- #define **NDIS\_PACKET\_TYPE\_SMT** (0x0040U)  
*SMT packets that an FDDI NIC receives.*
- #define **NDIS\_PACKET\_TYPE\_ALL\_LOCAL** (0x0080U)  
*All packets sent by installed protocols and all packets indicated by the NIC that is identified by a given NdisBindingHandle.*
- #define **NDIS\_PACKET\_TYPE\_MAC\_FRAME** (0x8000U)  
*NIC driver frames that a Token Ring NIC receives.*
- #define **NDIS\_PACKET\_TYPE\_FUNCTIONAL** (0x4000U)  
*Functional address packets sent to addresses included in the current functional address.*
- #define **NDIS\_PACKET\_TYPE\_ALL\_FUNCTIONAL** (0x2000U)  
*All functional address packets, not just the ones in the current functional address.*
- #define **NDIS\_PACKET\_TYPE\_GROUP** (0x1000U)  
*Packets sent to the current group address.*

### RNDIS status values

See MSDN for details.

- #define **RNDIS\_STATUS\_SUCCESS** (0x00000000U)

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- *The requested operation completed successfully.*  
• #define **RNDIS\_STATUS\_NOT\_RECOGNIZED** (0x00010001U)
- *The underlying driver does not support the requested operation.*  
• #define **RNDIS\_STATUS\_NOT\_SUPPORTED** (0xC00000BBU)
- *Unsupported request error (equivalent to STATUS\_NOT\_SUPPORTED).*  
• #define **RNDIS\_STATUS\_NOT\_ACCEPTED** (0x00010003U)
- *The underlying driver attempted the requested operation, usually a set, on its NIC but it was aborted by the Netcard.*  
• #define **RNDIS\_STATUS\_FAILURE** (0xC0000001U)
- *This value usually is a non specific default, returned when none of the more specific NDIS\_STATUS\_XXX causes the underlying driver to fail the request.*  
• #define **RNDIS\_STATUS\_RESOURCES** (0xC000009AU)
- *The request can't be satisfied due to a resource shortage.*  
• #define **RNDIS\_STATUS\_CLOSING** (0xC0010002U)
- *The underlying driver failed the requested operation because a close is in progress.*  
• #define **RNDIS\_STATUS\_CLOSING\_INDICATING** (0xC001000EU)
- *The underlying driver failed the requested operation because indicating a close is in progress.*  
• #define **RNDIS\_STATUS\_RESET\_IN\_PROGRESS** (0xC001000DU)
- *The underlying NIC driver cannot satisfy the request at this time because it is currently resetting the Netcard.*  
• #define **RNDIS\_STATUS\_INVALID\_LENGTH** (0xC0010014U)
- *The value specified in the InformationBufferLength member of the NDIS\_REQUEST-structured buffer at NdisRequest does not match the requirements for the given OID\_XXX code.*  
• #define **RNDIS\_STATUS\_BUFFER\_TOO\_SHORT** (0xC0010016U)
- *The information buffer is too small.*  
• #define **RNDIS\_STATUS\_INVALID\_DATA** (0xC0010015U)
- *The data supplied at InformationBuffer in the given NDIS\_REQUEST structure is invalid for the given OID\_XXX code.*  
• #define **RNDIS\_STATUS\_INVALID\_OID** (0xC0010017U)
- *The OID\_XXX code specified in the OID member of the NDIS\_REQUEST-structured buffer at NdisRequest is invalid or unsupported by the underlying driver.*  
• #define **RNDIS\_STATUS\_MEDIA\_CONNECT** (0x4001000BU)
- *Device is connected to network medium.*  
• #define **RNDIS\_STATUS\_MEDIA\_DISCONNECT** (0x4001000CU)
- *Device is disconnected from network medium.*

## RNDIS Response sizes

Definitions of the size of response of various message types.

- #define **RNDIS\_RESPONSE\_INITIALIZE\_MSG\_SIZE** (52U)  
*Response size of INITIALIZE\_MSG.*
- #define **RNDIS\_RESPONSE\_QUERY\_MSG\_SIZE** (24U)  
*Response size of QUERY\_MSG.*
- #define **RNDIS\_RESPONSE\_SET\_MSG\_SIZE** (16U)  
*Response size of SET\_MSG.*
- #define **RNDIS\_RESPONSE\_RESET\_MSG\_SIZE** (16U)  
*Response size of RESET\_MSG.*
- #define **RNDIS\_RESPONSE\_KEEPALIVE\_MSG\_SIZE** (16U)  
*Response size of KEEPALIVE\_MSG.*

## RNDIS device connection status

Definitions of the status value of NIC connection.

- #define `RNDIS_MEDIA_STATE_CONNECTED` (0x00000000U)  
*The network connection has been lost.*
- #define `RNDIS_MEDIA_STATE_DISCONNECTED` (0x00000001U)  
*The network connection has been restored.*
- #define `RNDIS_MEDIA_STATE_UNKNOWN` (0xFFFFFFFFU)  
*The initial value of the connection status.*

**Reserved for connection oriented devices. Set value to zero.**

- #define `RNDIS_AF_LIST_OFFSET` (0x00000000U)
- #define `RNDIS_AF_LIST_SIZE` (0x00000000U)

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- `usb_status_t USB_DeviceCdcRndisInit` (`class_handle_t classHandle`, `usb_device_cdc_rndis_config_struct_t *config`, `usb_device_cdc_rndis_struct_t **handle`)  
*Initializes the USB CDC RNDIS device.*
- `usb_status_t USB_DeviceCdcRndisDeinit` (`usb_device_cdc_rndis_struct_t *handle`)  
*Deinitializes the USB CDC RNDIS device.*
- `usb_status_t USB_DeviceCdcRndisMessageSet` (`usb_device_cdc_rndis_struct_t *handle`, `uint8_t **message`, `uint32_t *len`)  
*Responds to kUSB\_DeviceCdcEventSendEncapsulatedCommand.*
- `usb_status_t USB_DeviceCdcRndisMessageGet` (`usb_device_cdc_rndis_struct_t *handle`, `uint8_t **message`, `uint32_t *len`)  
*Responds to kUSB\_DeviceCdcEventGetEncapsulatedResponse.*
- `usb_status_t USB_DeviceCdcRndisResetCommand` (`usb_device_cdc_rndis_struct_t *handle`, `uint8_t **message`, `uint32_t *len`)  
*Soft reset the RNDIS device.*
- `usb_status_t USB_DeviceCdcRndisHaltCommand` (`usb_device_cdc_rndis_struct_t *handle`)  
*Halts the RNDIS device.*

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### 3.6.3.5 Data Structure Documentation

- 3.6.3.5.1 struct `rndis_init_msg_struct_t`
- 3.6.3.5.2 struct `rndis_init_cmplt_struct_t`
- 3.6.3.5.3 struct `rndis_halt_msg_struct_t`
- 3.6.3.5.4 struct `rndis_query_msg_struct_t`
- 3.6.3.5.5 struct `rndis_query_cmplt_struct_t`
- 3.6.3.5.6 struct `rndis_set_msg_struct_t`
- 3.6.3.5.7 struct `rndis_set_cmplt_struct_t`
- 3.6.3.5.8 struct `rndis_reset_msg_struct_t`
- 3.6.3.5.9 struct `rndis_reset_cmplt_struct_t`
- 3.6.3.5.10 struct `rndis_indicate_status_msg_struct_t`
- 3.6.3.5.11 struct `rndis_keepalive_msg_struct_t`
- 3.6.3.5.12 struct `rndis_keepalive_cmplt_struct_t`
- 3.6.3.5.13 struct `rndis_packet_msg_struct_t`
- 3.6.3.5.14 struct `usb_device_cdc_rndis_struct_t`

### Data Fields

- [class\\_handle\\_t cdcAcmHandle](#)  
*USB CDC ACM class handle.*
- `uint8_t * rndisCommand`  
*The pointer to the buffer of the RNDIS request.*
- `uint8_t * responseData`  
*The pointer to the buffer of the RNDIS response.*
- `uint32_t rndisHostMaxTxSize`  
*The maximum transmit size in byte of the host.*
- `uint32_t rndisDevMaxTxSize`  
*The maximum transmit size in byte of the device.*
- `uint32_t rndisHwState`  
*The hardware state of the RNDIS device.*
- `uint32_t rndisPacketFilter`  
*The packet filter of the RNDIS device.*
- `uint32_t rndisMediaConnectStatus`  
*The media connection status of the RNDIS device.*

- `uint32_t numFramesTxOk`  
*The number of the frames sent successfully.*
- `uint32_t numFramesRxOk`  
*The number of the frames received successfully.*
- `uint32_t numFramesTxError`  
*The number of the frames sent failed.*
- `uint32_t numFramesRxError`  
*The number of the frames received failed.*
- `uint32_t numRecvFramesMissed`  
*The number of the frames missed to receive.*
- `uint32_t numRecvFramesAlignmentError`  
*The number of the frames received that has alignment error.*
- `uint32_t numFramesTxOneCollision`  
*The number of the frames sent that has one collision.*
- `uint32_t numFramesTxManyCollision`  
*The number of the frames sent that has many collision.*
- `uint8_t rndisDeviceState`  
*The RNDIS device state.*
- `usb_osa_mutex_handle statusMutex`  
*The mutex to guarantee the consistent access to the device state.*
- `usb_status_t(* rndisCallback )(class_handle_t handle, uint32_t event, void *param)`  
*The callback function provided by application for the RNDIS request.*

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### 3.6.3.5.14.1 Field Documentation

- 3.6.3.5.14.1.1 `class_handle_t usb_device_cdc_rndis_struct_t::cdcAcmHandle`
  - 3.6.3.5.14.1.2 `uint8_t* usb_device_cdc_rndis_struct_t::rndisCommand`
  - 3.6.3.5.14.1.3 `uint8_t* usb_device_cdc_rndis_struct_t::responseData`
  - 3.6.3.5.14.1.4 `uint32_t usb_device_cdc_rndis_struct_t::rndisHostMaxTxSize`
  - 3.6.3.5.14.1.5 `uint32_t usb_device_cdc_rndis_struct_t::rndisDevMaxTxSize`
  - 3.6.3.5.14.1.6 `uint32_t usb_device_cdc_rndis_struct_t::rndisHwState`
  - 3.6.3.5.14.1.7 `uint32_t usb_device_cdc_rndis_struct_t::rndisPacketFilter`
  - 3.6.3.5.14.1.8 `uint32_t usb_device_cdc_rndis_struct_t::rndisMediaConnectStatus`
  - 3.6.3.5.14.1.9 `uint32_t usb_device_cdc_rndis_struct_t::numFramesTxOk`
  - 3.6.3.5.14.1.10 `uint32_t usb_device_cdc_rndis_struct_t::numFramesRxOk`
  - 3.6.3.5.14.1.11 `uint32_t usb_device_cdc_rndis_struct_t::numFramesTxError`
  - 3.6.3.5.14.1.12 `uint32_t usb_device_cdc_rndis_struct_t::numFramesRxError`
  - 3.6.3.5.14.1.13 `uint32_t usb_device_cdc_rndis_struct_t::numRecvFramesMissed`
  - 3.6.3.5.14.1.14 `uint32_t usb_device_cdc_rndis_struct_t::numRecvFramesAlignmentError`
  - 3.6.3.5.14.1.15 `uint32_t usb_device_cdc_rndis_struct_t::numFramesTxOneCollision`
  - 3.6.3.5.14.1.16 `uint32_t usb_device_cdc_rndis_struct_t::numFramesTxManyCollision`
  - 3.6.3.5.14.1.17 `uint8_t usb_device_cdc_rndis_struct_t::rndisDeviceState`
  - 3.6.3.5.14.1.18 `usb_osa_mutex_handle usb_device_cdc_rndis_struct_t::statusMutex`
  - 3.6.3.5.14.1.19 `usb_status_t(* usb_device_cdc_rndis_struct_t::rndisCallback)(class_handle_t handle, uint32_t event, void *param)`
- 3.6.3.5.15 `struct usb_device_cdc_rndis_config_struct_t`

### Data Fields

- `uint32_t devMaxTxSize`  
*The maximum transmit size in byte of the device.*
- `usb_status_t(* rndisCallback)(class_handle_t handle, uint32_t event, void *param)`  
*The callback function provided by application for the RNDIS request.*

**3.6.3.5.15.1 Field Documentation****3.6.3.5.15.1.1 uint32\_t usb\_device\_cdc\_rndis\_config\_struct\_t::devMaxTxSize**

This value is configured by application.

**3.6.3.5.15.1.2 usb\_status\_t(\* usb\_device\_cdc\_rndis\_config\_struct\_t::rndisCallback)(class\_handle\_t handle, uint32\_t event, void \*param)****3.6.3.5.16 struct usb\_device\_cdc\_rndis\_request\_param\_struct\_t****Data Fields**

- uint8\_t \* [buffer](#)  
*The pointer to the buffer for RNDIS request.*
- uint32\_t [length](#)  
*The length of the buffer for RNDIS request.*

**3.6.3.5.16.1 Field Documentation****3.6.3.5.16.1.1 uint8\_t\* usb\_device\_cdc\_rndis\_request\_param\_struct\_t::buffer****3.6.3.5.16.1.2 uint32\_t usb\_device\_cdc\_rndis\_request\_param\_struct\_t::length****3.6.3.6 Macro Definition Documentation****3.6.3.6.1 #define NDIS\_MEDIUM802\_3 (0x00000000U)**

Note NDIS 5.x Miniport drivers that conform to the IEEE<sup>®</sup> 802.11 interface must use this media type. For more information about the 802.11 interface, see 802.11 Wireless LAN Miniport Drivers.

**3.6.3.6.2 #define NDIS\_MEDIUM802\_5 (0x00000001U)****3.6.3.6.3 #define NDIS\_MEDIUM\_FDDI (0x00000002U)****3.6.3.6.4 #define NDIS\_MEDIUM\_ARCNET\_RAW (0x00000006U)****3.6.3.6.5 #define NDIS\_MEDIUM\_ARCNET878\_2 (0x00000007U)****3.6.3.6.6 #define NDIS\_MEDIUM\_ATM (0x00000008U)****3.6.3.6.7 #define NDIS\_MEDIUM\_NATIVE802\_11 (0x00000009U)**

This media type is used by Miniport drivers that conform to the Native 802.11 interface. For more information about this interface, see Native 802.11 Wireless LAN Miniport Drivers. Note: Native 802.11 interface is supported in NDIS 6.0 and later versions

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**3.6.3.6.8 #define NDIS\_MEDIUM\_BPC (0x0000000EU)**

**3.6.3.6.9 #define NDIS\_MEDIUM\_INFINI\_BAND (0x0000000FU)**

**3.6.3.6.10 #define NDIS\_MEDIUM\_TUNNEL (0x00000010U)**

**3.6.3.6.11 #define NDIS\_MEDIUM\_LOOPBACK (0x00000011U)**

**3.6.3.6.12 #define NDIS\_PACKET\_TYPE\_DIRECTED (0x0001U)**

Directed packets contain a destination address equal to the station address of the NIC.

**3.6.3.6.13 #define NDIS\_PACKET\_TYPE\_MULTICAST (0x0002U)**

A protocol driver can receive Ethernet (802.3) multicast packets or Token Ring (802.5) functional address packets by specifying the multicast or functional address packet type. Setting the multicast address list or functional address determines which multicast address groups the NIC driver enables.

**3.6.3.6.14 #define NDIS\_PACKET\_TYPE\_BROADCAST (0x0008U)**

**3.6.3.6.15 #define NDIS\_PACKET\_TYPE\_SOURCE\_ROUTING (0x0010U)**

If the protocol driver sets this bit, the NDIS library attempts to act as a source routing bridge.

**3.6.3.6.16 #define NDIS\_PACKET\_TYPE\_PROMISCUOUS (0x0020U)**

**3.6.3.6.17 #define NDIS\_PACKET\_TYPE\_SMT (0x0040U)**

**3.6.3.6.18 #define NDIS\_PACKET\_TYPE\_MAC\_FRAME (0x8000U)**

**3.6.3.6.19 #define NDIS\_PACKET\_TYPE\_GROUP (0x1000U)**

**3.6.3.6.20 #define RNDIS\_STATUS\_SUCCESS (0x00000000U)**

**3.6.3.6.21 #define RNDIS\_STATUS\_NOT\_RECOGNIZED (0x00010001U)**

**3.6.3.6.22 #define RNDIS\_STATUS\_NOT\_SUPPORTED (0xC0000BBU)**

**3.6.3.6.23 #define RNDIS\_STATUS\_NOT\_ACCEPTED (0x00010003U)**

For example, an attempt to set too many multicast addresses might cause the return of this value.



**3.6.3.6.24 #define RNDIS\_STATUS\_RESOURCES (0xC00009AU)**

Usually, this return indicates that an attempt to allocate memory was unsuccessful, but it does not necessarily indicate that the same request, submitted later, it is aborted for the same reason.

**3.6.3.6.25 #define RNDIS\_STATUS\_CLOSING (0xC0010002U)****3.6.3.6.26 #define RNDIS\_STATUS\_CLOSING\_INDICATING (0xC001000EU)****3.6.3.6.27 #define RNDIS\_STATUS\_INVALID\_LENGTH (0xC0010014U)**

If the information buffer is too small, the BytesNeeded member contains the correct value for Information-BufferLength on return from NdisRequest.

**3.6.3.6.28 #define RNDIS\_STATUS\_BUFFER\_TOO\_SHORT (0xC0010016U)****3.6.3.6.29 #define RNDIS\_STATUS\_MEDIA\_CONNECT (0x4001000BU)****3.6.3.6.30 #define RNDIS\_STATUS\_MEDIA\_DISCONNECT (0x4001000CU)****3.6.3.6.31 #define RNDIS\_RESPONSE\_INITIALIZE\_MSG\_SIZE (52U)****3.6.3.6.32 #define RNDIS\_RESPONSE\_QUERY\_MSG\_SIZE (24U)****3.6.3.6.33 #define RNDIS\_RESPONSE\_SET\_MSG\_SIZE (16U)****3.6.3.6.34 #define RNDIS\_RESPONSE\_RESET\_MSG\_SIZE (16U)****3.6.3.6.35 #define RNDIS\_RESPONSE\_KEEPALIVE\_MSG\_SIZE (16U)****3.6.3.6.36 #define RNDIS\_DF\_CONNECTIONLESS (0x00000001U)****3.6.3.6.37 #define RNDIS\_DF\_CONNECTION\_ORIENTED (0x00000002U)****3.6.3.6.38 #define RNDIS\_SINGLE\_PACKET\_TRANSFER (0x00000001U)****3.6.3.6.39 #define RNDIS\_PACKET\_ALIGNMENT\_FACTOR (0x00000003U)****3.6.3.6.40 #define RNDIS\_NUM\_OIDS\_SUPPORTED (25U)****3.6.3.6.41 #define RNDIS\_VENDOR\_ID (0xFFFFFFFFU)**

Vendors without an IEEE-registered code should use the value 0xFFFFFFFF.

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3.6.3.6.42 #define NDIS\_MEDIA\_STATE\_CONNECTED (0x00000000U)

3.6.3.6.43 #define NDIS\_MEDIA\_STATE\_DISCONNECTED (0x00000001U)

3.6.3.6.44 #define NDIS\_MEDIA\_STATE\_UNKNOWN (0xFFFFFFFFU)

3.6.3.6.45 #define RNDIS\_MAX\_EXPECTED\_COMMAND\_SIZE (76U)

3.6.3.6.46 #define RNDIS\_ETHER\_ADDR\_SIZE (6U)

3.6.3.6.47 #define RNDIS\_USB\_HEADER\_SIZE (44U)

3.6.3.6.48 #define RNDIS\_MULTICAST\_LIST\_SIZE (0U)

### 3.6.3.7 Enumeration Type Documentation

#### 3.6.3.7.1 enum ndis\_physical\_medium\_enum\_t

Used with OID\_GEN\_PHYSICAL\_MEDIUM.

#### 3.6.3.7.2 enum rndis\_state\_enum\_t

See MSDN for details.

Enumerator

**RNDIS\_UNINITIALIZED** Following bus-level initialization, the device is said to be in the RNDIS-uninitialized state. If the device receives a REMOTE\_NDIS\_HALT\_MSG, a bus-level disconnects, or a hard-reset at any time, it forces the device to the RNDIS-uninitialized state.

**RNDIS\_INITIALIZED** After the device receives a REMOTE\_NDIS\_INITIALIZE\_MSG and responds with a REMOTE\_NDIS\_INITIALIZE\_CMPLT with a status of RNDIS\_STATUS\_SUCCESS, the device enters the RNDIS-initialized state. If the device is in the RNDIS-data-initialized state when it receives a REMOTE\_NDIS\_SET\_MSG specifying a zero filter value for OID\_GEN\_CURRENT\_PACKET\_FILTER, this event forces the device back to the RNDIS-initialized state.

**RNDIS\_DATA\_INITIALIZED** If the device receives a REMOTE\_NDIS\_SET\_MSG that specifies a non-zero filter value for OID\_GEN\_CURRENT\_PACKET\_FILTER, the device enters the RNDIS-data-initialized state.

#### 3.6.3.7.3 enum rndis\_event\_enum\_t

Enumerator

**kUSB\_DeviceCdcEventAppGetLinkSpeed** This event indicates to get the link speed of the Ethernet.

***kUSB\_DeviceCdcEventAppGetSendPacketSize*** This event indicates to get the USB send packet size.

***kUSB\_DeviceCdcEventAppGetRecvPacketSize*** This event indicates to get the USB receive packet size.

***kUSB\_DeviceCdcEventAppGetMacAddress*** This event indicates to get the mac address of the device.

***kUSB\_DeviceCdcEventAppGetLinkStatus*** This event indicates to get the link status of the Ethernet.

***kUSB\_DeviceCdcEventAppGetMaxFrameSize*** This event indicates to get the Ethernet maximum frame size.

### 3.6.3.8 Function Documentation

#### 3.6.3.8.1 `usb_status_t USB_DeviceCdcRndisInit ( class_handle_t classHandle, usb_device_cdc_rndis_config_struct_t * config, usb_device_cdc_rndis_struct_t ** handle )`

This function sets the initial value for RNDIS device state, hardware state and media connection status, configures the maximum transmit size and the RNDIS request callback according to the user configuration structure. It also creates the mutex for accessing the device state.

Parameters

|                    |   |
|--------------------|---|
| <i>classHandle</i> | The class handle of the CDC ACM class.  |
| <i>config</i>      | The configure structure of the RNDIS device.  |
| <i>handle</i>      | This is a out parameter. It points to the address of the USB CDC RNDIS device handle. |

Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                            |  |
|----------------------------|--|
| <i>kStatus_USB_Success</i> | Initialize the RNDIS device successfully.      |
| <i>kStatus_USB_Error</i>   | Fails to allocate for the RNDIS device handle. |

#### 3.6.3.8.2 `usb_status_t USB_DeviceCdcRndisDeinit ( usb_device_cdc_rndis_struct_t * handle )`

This function destroys the mutex of the device state and frees the RNDIS device handle.

## USB CDC Class driver

### Parameters

|               |   |
|---------------|---|
| <i>handle</i> | This is a pointer to the USB CDC RNDIS device handle. |
|---------------|---|

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                   |  |
|-----------------------------------|--|
| <i>kStatus_USB_Success</i>        | De-Initialize the RNDIS device successfully. |
| <i>kStatus_USB_Error</i>          | Fails to free the RNDIS device handle.       |
| <i>kStatus_USB_Invalid-Handle</i> | The RNDIS device handle is invalid.          |

### 3.6.3.8.3 `usb_status_t USB_DeviceCdcRndisMessageSet ( usb_device_cdc_rndis_struct_t * handle, uint8_t ** message, uint32_t * len )`

This function checks the message length to see if it exceeds the maximum of the RNDIS request size and sets the device state or prepares notification for various message type accordingly.

### Parameters

|                |   |
|----------------|---|
| <i>handle</i>  | This is a pointer to the USB CDC RNDIS device handle.                 |
| <i>message</i> | This is a pointer to the address of the RNDIS request buffer.         |
| <i>len</i>     | This is a pointer to the variable of data size for the RNDIS request. |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                   |  |
|-----------------------------------|--|
| <i>kStatus_USB_Success</i>        | Responds to the host successfully.                           |
| <i>kStatus_USB_Error</i>          | The message length exceeds the maximum of the RNDIS request. |
| <i>kStatus_USB_Invalid-Handle</i> | The RNDIS device handle is invalid.                          |

**3.6.3.8.4** `usb_status_t USB_DeviceCdcRndisMessageGet ( usb_device_cdc_rndis_struct_t *  
handle, uint8_t ** message, uint32_t * len )`

This function prepares the response for various message type which is stored in SendEncapsulated-Command.

## USB CDC Class driver

### Parameters

|                |  |
|----------------|--|
| <i>handle</i>  | This is a pointer to the USB CDC RNDIS device handle.  |
| <i>message</i> | This is an out parameter. It is a pointer to the address of the RNDIS response buffer.         |
| <i>len</i>     | This is an out parameter. It is a pointer to the variable of data size for the RNDIS response. |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                    |   |
|------------------------------------|---|
| <i>kStatus_USB_Success</i>         | Prepares for the response to the host successfully. |
| <i>kStatus_USB_Invalid-Request</i> | The message type is not supported.                  |
| <i>kStatus_USB_Invalid-Handle</i>  | The RNDIS device handle is invalid.                 |

### 3.6.3.8.5 `usb_status_t USB_DeviceCdcRndisResetCommand ( usb_device_cdc_rndis_struct_t * handle, uint8_t ** message, uint32_t * len )`

This function is called to soft reset the RNDIS device.

### Parameters

|                |  |
|----------------|--|
| <i>handle</i>  | This is a pointer to the USB CDC RNDIS device handle.  |
| <i>message</i> | This is an out parameter. It is a pointer to the address of the RNDIS response buffer.         |
| <i>len</i>     | This is an out parameter. It is a pointer to the variable of data size for the RNDIS response. |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                   |   |
|-----------------------------------|---|
| <i>kStatus_USB_Success</i>        | Prepares for the response to the host successfully. |
| <i>kStatus_USB_Invalid-Handle</i> | The RNDIS device handle is invalid.                 |

**3.6.3.8.6 usb\_status\_t USB\_DeviceCdcRndisHaltCommand ( usb\_device\_cdc\_rndis\_struct\_t \* handle )**

This function is called to halt the RNDIS device.

Parameters

|               |   |
|---------------|---|
| <i>handle</i> | This is a pointer to the USB CDC RNDIS device handle. |
|---------------|---|

Returns

A USB error code or *kStatus\_USB\_Success*.

Return values

|                                   |                                     |
|-----------------------------------|-------------------------------------|
| <i>kStatus_USB_Success</i>        | Halt the RNDIS device successfully. |
| <i>kStatus_USB_Invalid-Handle</i> | The RNDIS device handle is invalid. |

### 3.7 USB AUDIO Class driver

#### 3.7.1 Overview

#### Data Structures

- struct `usb_device_audio_entity_struct_t`  
*The audio device class-specific information. [More...](#)*
- struct `usb_device_audio_entities_struct_t`  
*The audio device class-specific information list. [More...](#)*
- struct `usb_device_audio_struct_t`  
*The audio device class status structure. [More...](#)*

#### Enumerations

- enum `usb_device_audio_event_t` {  
`kUSB_DeviceAudioEventStreamSendResponse = 0x01U,`  
`kUSB_DeviceAudioEventStreamRecvResponse,`  
`kUSB_DeviceAudioEventControlSendResponse` }  
*Available common EVENT types in audio class callback.*

#### USB Audio class codes

Enables/disables the Audio Class 2.0

- #define `USB_DEVICE_CONFIG_AUDIO_CLASS_CODE` (0x01)  
*Audio device class code.*
- #define `USB_DEVICE_AUDIO_STREAM_SUBCLASS` (0x02)  
*Audio device subclass code.*
- #define `USB_DEVICE_AUDIO_CONTROL_SUBCLASS` (0x01)
- #define `USB_DESCRIPTOR_TYPE_AUDIO_CS_INTERFACE` (0x24)  
*Audio device class-specific descriptor type.*
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_CONTROL_HEADER` (0x01)  
*Audio device class-specific control interface descriptor subtype.*
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_CONTROL_INPUT_TERMINAL` (0x02)
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_CONTROL_OUTPUT_TERMINAL` (0x03)
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_CONTROL_FEATURE_UNIT` (0x06)
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_STREAMING_GENERAL` (0x01)  
*Audio device class-specific stream interface descriptor subtype.*
- #define `USB_DESCRIPTOR_SUBTYPE_AUDIO_STREAMING_FORMAT_TYPE` (0x02)
- #define `USB_DEVICE_AUDIO_GET_CUR_MUTE_CONTROL` (0x8101)  
*Audio device class-specific GET CUR COMMAND.*
- #define `USB_DEVICE_AUDIO_GET_CUR_VOLUME_CONTROL` (0x8102)
- #define `USB_DEVICE_AUDIO_GET_CUR_BASS_CONTROL` (0x8103)
- #define `USB_DEVICE_AUDIO_GET_CUR_MID_CONTROL` (0x8104)
- #define `USB_DEVICE_AUDIO_GET_CUR_TREBLE_CONTROL` (0x8105)
- #define `USB_DEVICE_AUDIO_GET_CUR_GRAPHIC_EQUALIZER_CONTROL` (0x8106)



- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_AUTOMATIC\_GAIN\_CONTROL** (0x8107)
- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_DELAY\_CONTROL** (0x8108)
- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_BASS\_BOOST\_CONTROL** (0x8109)
- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_LOUDNESS\_CONTROL** (0x810A)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_VOLUME\_CONTROL** (0x8202)
- Audio device class-specific GET MIN COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_BASS\_CONTROL** (0x8203)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_MID\_CONTROL** (0x8204)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_TREBLE\_CONTROL** (0x8205)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_GRAPHIC\_EQUALIZER\_CONTROL** (0x8206)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_DELAY\_CONTROL** (0x8208)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_VOLUME\_CONTROL** (0x8302)
- Audio device class-specific GET MAX COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_BASS\_CONTROL** (0x8303)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_MID\_CONTROL** (0x8304)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_TREBLE\_CONTROL** (0x8305)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_GRAPHIC\_EQUALIZER\_CONTROL** (0x8306)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_DELAY\_CONTROL** (0x8308)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_VOLUME\_CONTROL** (0x8402)
- Audio device class-specific GET RES COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_BASS\_CONTROL** (0x8403)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_MID\_CONTROL** (0x8404)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_TREBLE\_CONTROL** (0x8405)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_GRAPHIC\_EQUALIZER\_CONTROL** (0x8406)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_DELAY\_CONTROL** (0x8408)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_MUTE\_CONTROL** (0x0101)
- Audio device class-specific SET CUR COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_VOLUME\_CONTROL** (0x0102)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_BASS\_CONTROL** (0x0103)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_MID\_CONTROL** (0x0104)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_TREBLE\_CONTROL** (0x0105)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_GRAPHIC\_EQUALIZER\_CONTROL** (0x0106)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_AUTOMATIC\_GAIN\_CONTROL** (0x0107)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_DELAY\_CONTROL** (0x0108)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_BASS\_BOOST\_CONTROL** (0x0109)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_LOUDNESS\_CONTROL** (0x010A)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_PITCH\_CONTROL** (0x010D)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_VOLUME\_CONTROL** (0x0202)
- Audio device class-specific SET MIN COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_BASS\_CONTROL** (0x0203)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_MID\_CONTROL** (0x0204)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_TREBLE\_CONTROL** (0x0205)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_GRAPHIC\_EQUALIZER\_CONTROL** (0x0206)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_DELAY\_CONTROL** (0x0208)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_VOLUME\_CONTROL** (0x0302)
- Audio device class-specific SET MAX COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_BASS\_CONTROL** (0x0303)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_MID\_CONTROL** (0x0304)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_TREBLE\_CONTROL** (0x0305)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_GRAPHIC\_EQUALIZER\_CONTROL** (0x0306)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_DELAY\_CONTROL** (0x0308)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_VOLUME\_CONTROL** (0x0402)
- Audio device class-specific SET RES COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_BASS\_CONTROL** (0x0403)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_MID\_CONTROL** (0x0404)

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- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_TREBLE\_CONTROL** (0x0405)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_GRAPHIC\_EQUALIZER\_CONTROL** (0x0406)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_DELAY\_CONTROL** (0x0408)
- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_SAMPLING\_FREQ\_CONTROL** (0x810C)  
*Audio device class-specific GET SAMPLING\_FREQ CONTROL COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_SAMPLING\_FREQ\_CONTROL** (0x820C)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_SAMPLING\_FREQ\_CONTROL** (0x830C)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_SAMPLING\_FREQ\_CONTROL** (0x840C)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_SAMPLING\_FREQ\_CONTROL** (0x010C)  
*Audio device class-specific SET SAMPLING\_FREQ CONTROL COMMAND.*
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_SAMPLING\_FREQ\_CONTROL** (0x020C)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_SAMPLING\_FREQ\_CONTROL** (0x030C)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_SAMPLING\_FREQ\_CONTROL** (0x040C)
- #define **USB\_DEVICE\_AUDIO\_SET\_CUR\_VOLUME\_REQUEST** (0x01)
- #define **USB\_DEVICE\_AUDIO\_SET\_MIN\_VOLUME\_REQUEST** (0x02)
- #define **USB\_DEVICE\_AUDIO\_SET\_MAX\_VOLUME\_REQUEST** (0x03)
- #define **USB\_DEVICE\_AUDIO\_SET\_RES\_VOLUME\_REQUEST** (0x04)
- #define **USB\_DEVICE\_AUDIO\_GET\_CUR\_VOLUME\_REQUEST** (0x81)
- #define **USB\_DEVICE\_AUDIO\_GET\_MIN\_VOLUME\_REQUEST** (0x82)
- #define **USB\_DEVICE\_AUDIO\_GET\_MAX\_VOLUME\_REQUEST** (0x83)
- #define **USB\_DEVICE\_AUDIO\_GET\_RES\_VOLUME\_REQUEST** (0x84)
- #define **USB\_DEVICE\_AUDIO\_COPY\_PROTECT\_CONTROL\_SELECTOR** (0x01)
- #define **USB\_DEVICE\_AUDIO\_MUTE\_CONTROL\_SELECTOR** (0x01)
- #define **USB\_DEVICE\_AUDIO\_VOLUME\_CONTROL\_SELECTOR** (0x02)
- #define **USB\_DEVICE\_AUDIO\_BASS\_CONTROL\_SELECTOR** (0x03)
- #define **USB\_DEVICE\_AUDIO\_MID\_CONTROL\_SELECTOR** (0x04)
- #define **USB\_DEVICE\_AUDIO\_TREBLE\_CONTROL\_SELECTOR** (0x05)
- #define **USB\_DEVICE\_AUDIO\_GRAPHIC\_EQUALIZER\_CONTROL\_SELECTOR** (0x06)
- #define **USB\_DEVICE\_AUDIO\_AUTOMATIC\_GAIN\_CONTROL\_SELECTOR** (0x07)
- #define **USB\_DEVICE\_AUDIO\_DELAY\_CONTROL\_SELECTOR** (0x08)
- #define **USB\_DEVICE\_AUDIO\_BASS\_BOOST\_CONTROL\_SELECTOR** (0x09)
- #define **USB\_DEVICE\_AUDIO\_LOUDNESS\_CONTROL\_SELECTOR** (0x0A)
- #define **USB\_DEVICE\_AUDIO\_SAMPLING\_FREQ\_CONTROL\_SELECTOR** (0x01)
- #define **USB\_DEVICE\_AUDIO\_PITCH\_CONTROL\_SELECTOR** (0x02)

## USB Audio class setup request types

- #define **USB\_DEVICE\_AUDIO\_SET\_REQUEST\_INTERFACE** (0x21)  
*Audio device class setup request set type.*
- #define **USB\_DEVICE\_AUDIO\_SET\_REQUEST\_ENDPOINT** (0x22)
- #define **USB\_DEVICE\_AUDIO\_GET\_REQUEST\_INTERFACE** (0xA1)  
*Audio device class setup request get type.*
- #define **USB\_DEVICE\_AUDIO\_GET\_REQUEST\_ENDPOINT** (0xA2)

## USB Audio Class Driver

- **usb\_status\_t** **USB\_DeviceAudioInit** (uint8\_t controllerId, **usb\_device\_class\_config\_struct\_t** \*config, **class\_handle\_t** \*handle)  
*Initializes the USB audio class.*
- **usb\_status\_t** **USB\_DeviceAudioDeinit** (**class\_handle\_t** handle)  
*Deinitializes the USB audio class.*

- [usb\\_status\\_t USB\\_DeviceAudioEvent](#) (void \*handle, uint32\_t event, void \*param)  
*Handles the USB audio class event.*
- [usb\\_status\\_t USB\\_DeviceAudioSend](#) (class\_handle\_t handle, uint8\_t ep, uint8\_t \*buffer, uint32\_t length)  
*Primes the endpoint to send a packet to the host.*
- [usb\\_status\\_t USB\\_DeviceAudioRecv](#) (class\_handle\_t handle, uint8\_t ep, uint8\_t \*buffer, uint32\_t length)  
*Primes the endpoint to receive a packet from the host.*

## 3.7.2 Data Structure Documentation

### 3.7.2.1 struct usb\_device\_audio\_entity\_struct\_t

The structure is used to pass the audio entity information filled by application. Such as entity id (unit or terminal ID), entity type (unit or terminal type), and terminal type if the entity is a terminal.

### 3.7.2.2 struct usb\_device\_audio\_entities\_struct\_t

The structure is used to pass the audio entity informations filled by the application. The type of each entity is [usb\\_device\\_audio\\_entity\\_struct\\_t](#). The structure pointer is kept in the [usb\\_device\\_interface\\_struct\\_t::classSpecific](#), such as, if there are three entities (an out terminal, camera terminal, and processing unit), the value of the count field is 3 and the entity field saves the every entity information.

### 3.7.2.3 struct usb\_device\_audio\_struct\_t

#### Data Fields

- [usb\\_device\\_handle](#) handle  
*The device handle.*
- [usb\\_device\\_class\\_config\\_struct\\_t](#) \* configStruct  
*The configuration of the class.*
- [usb\\_device\\_interface\\_struct\\_t](#) \* controlInterfaceHandle  
*Current control interface handle.*
- [usb\\_device\\_interface\\_struct\\_t](#) \* streamInterfaceHandle  
*Current stream interface handle.*
- uint8\_t configuration  
*Current configuration.*
- uint8\_t controlInterfaceNumber  
*The control interface number of the class.*
- uint8\_t controlAlternate  
*Current alternate setting of the control interface.*
- uint8\_t streamInterfaceNumber  
*The stream interface number of the class.*
- uint8\_t streamAlternate  
*Current alternate setting of the stream interface.*
- uint8\_t streamInPipeBusy

## USB AUDIO Class driver

- *Stream IN pipe busy flag.*  
uint8\_t [streamOutPipeBusy](#)  
*Stream OUT pipe busy flag.*

### 3.7.2.3.0.1 Field Documentation

3.7.2.3.0.1.1 [usb\\_device\\_class\\_config\\_struct\\_t](#)\* [usb\\_device\\_audio\\_struct\\_t::configStruct](#)

## 3.7.3 Enumeration Type Documentation

### 3.7.3.1 enum [usb\\_device\\_audio\\_event\\_t](#)

Enumerator

- kUSB\_DeviceAudioEventStreamSendResponse* Send data completed in stream pipe.
- kUSB\_DeviceAudioEventStreamRecvResponse* Data received in stream pipe.
- kUSB\_DeviceAudioEventControlSendResponse* Send data completed in audio control pipe.

## 3.7.4 Function Documentation

3.7.4.1 [usb\\_status\\_t](#) [USB\\_DeviceAudioInit](#) ( [uint8\\_t](#) *controllerId*, [usb\\_device\\_class\\_config\\_struct\\_t](#) \* *config*, [class\\_handle\\_t](#) \* *handle* )

This function obtains a USB device handle according to the controller ID, initializes the audio class with the class configuration parameters, and creates the mutex for each pipe.

Parameters

|                     |   |
|---------------------|---|
| <i>controllerId</i> | The ID of the controller. The value can be chosen from the <a href="#">kUSB_ControllerKhci0</a> , <a href="#">kUSB_ControllerKhci1</a> , <a href="#">kUSB_ControllerEhci0</a> , or <a href="#">kUSB_ControllerEhci1</a> . |
| <i>config</i>       | The user configuration structure of type <a href="#">usb_device_class_config_struct_t</a> . The user populates the members of this structure and passes the pointer of this structure into this function.                 |
| <i>handle</i>       | An out parameter. The class handle of the audio class.  |

Returns

A USB error code or [kStatus\\_USB\\_Success](#).

Return values

|                                      |  |
|--------------------------------------|--|
| <i>kStatus_USB_Success</i>           | The audio class is initialized successfully.     |
| <i>kStatus_USB_Busy</i>              | No audio device handle available for allocation. |
| <i>kStatus_USB_Invalid-Handle</i>    | The audio device handle allocation failure.      |
| <i>kStatus_USB_Invalid-Parameter</i> | The USB device handle allocation failure.        |

### 3.7.4.2 `usb_status_t USB_DeviceAudioDeinit ( class_handle_t handle )`

This function destroys the mutex for each pipe, deinitializes each endpoint of the audio class, and frees the audio class handle.

Parameters

|               |                                      |
|---------------|--------------------------------------|
| <i>handle</i> | The class handle of the audio class. |
|---------------|--------------------------------------|

Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Success</i>           | The audio class is deinitialized successfully.                |
| <i>kStatus_USB_Error</i>             | The endpoint deinitialization failure.                        |
| <i>kStatus_USB_Invalid-Handle</i>    | The audio device handle or the audio class handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i> | The endpoint number of the audio class handle is invalid.     |

### 3.7.4.3 `usb_status_t USB_DeviceAudioEvent ( void * handle, uint32_t event, void * param )`

This function responds to various events including the common device events and the class-specific events. For class-specific events, it calls the class callback defined in the application to deal with the class-specific event.

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### Parameters

|               |                                      |
|---------------|--------------------------------------|
| <i>handle</i> | The class handle of the audio class. |
| <i>event</i>  | The event type.                      |
| <i>param</i>  | The class handle of the audio class. |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Success</i>           | The audio class is deinitialized successfully.                |
| <i>kStatus_USB_Error</i>             | The configure structure of the audio class handle is invalid. |
| <i>kStatus_USB_Invalid-Handle</i>    | The audio device handle or the audio class handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i> | The endpoint number of the audio class handle is invalid.     |
| <i>Others</i>                        | The error code returned by class callback in application.     |

### 3.7.4.4 `usb_status_t USB_DeviceAudioSend ( class_handle_t handle, uint8_t ep, uint8_t * buffer, uint32_t length )`

This function checks whether the endpoint is sending packet, then it primes the endpoint with the buffer address and the buffer length if the pipe is not busy. Otherwise, it ignores this transfer by returning an error code.

### Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the audio class.         |
| <i>ep</i>     | The endpoint number of the transfer.         |
| <i>buffer</i> | The pointer to the buffer to be transferred. |
| <i>length</i> | The length of the buffer to be transferred.  |

### Returns

A USB error code or `kStatus_USB_Success`.

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | Prime to send packet successfully.                            |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in transferring.                         |
| <i>kStatus_USB_Invalid-Handle</i>      | The audio device handle or the audio class handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | The controller interface is invalid.                          |

### 3.7.4.5 **usb\_status\_t USB\_DeviceAudioRecv ( class\_handle\_t handle, uint8\_t ep, uint8\_t \* buffer, uint32\_t length )**

This function checks whether the endpoint is receiving packet, then it primes the endpoint with the buffer address and the buffer length if the pipe is not busy. Otherwise, it ignores this transfer by returning an error code.

Parameters

|               |  |
|---------------|--|
| <i>handle</i> | The class handle of the audio class.         |
| <i>ep</i>     | The endpoint number of the transfer.         |
| <i>buffer</i> | The pointer to the buffer to be transferred. |
| <i>length</i> | The length of the buffer to be transferred.  |

Returns

A USB error code or *kStatus\_USB\_Success*.

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | Prime to receive packet successfully.                         |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in transferring.                         |
| <i>kStatus_USB_Invalid-Handle</i>      | The audio device handle or the audio class handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | The controller interface is invalid.                          |

### 3.8 USB CCID Class driver

#### 3.8.1 Overview

#### Data Structures

- struct `usb_device_ccid_common_command_t`  
*Common command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_power_on_command_t`  
*ICC power on command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_power_off_command_t`  
*ICC power off command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_get_slot_status_command_t`  
*Gets the slot status command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_transfer_block_command_t`  
*Transfer data block command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_get_parameters_command_t`  
*Gets the ICC parameter command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_reset_parameters_command_t`  
*Resets the ICC parameter command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_set_parameters_command_t`  
*Sets the ICC parameter command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_set_parameters_t0_command_t`  
*Sets the ICC(T=0) parameter command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_set_parameters_t1_command_t`  
*Sets the ICC(T=1) parameter command structure of the command message in the bulk-out pipe. [More...](#)*
- union `usb_device_ccid_set_parameters_command_common_t`  
*Sets the ICC parameter command union of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_escape_command_t`  
*Escape command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_clock_command_t`  
*Controls the ICC clock command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_t0_apdu_command_t`  
*Controls the ICC clock command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_secure_command_t`  
*Secures the command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_secure_pin_operation_command_t`  
*Secures the PIN operation command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_seucre_pin_verification_command_t`  
*Secures the PIN verification operation command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_secure_pin_modification_command_t`  
*Secures the PIN modification operation command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_mechanical_command_t`  
*Manages the motorized type CCID functionality command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_abort_command_t`  
*Aborts the command structure of the command message in the bulk-out pipe. [More...](#)*
- struct `usb_device_ccid_set_data_rate_and_clock_frequency_command_t`  
*Sets data rate and clock frequency command structure of the command message in the bulk-out pipe.*



- More...*
- struct `usb_device_ccid_common_response_t`  
*Common response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_data_block_response_t`  
*Data block response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_slot_status_response_t`  
*Sends a slot status response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_parameters_response_t`  
*ICC parameter response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_parameters_T0_response_t`  
*ICC T0 parameter response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_parameters_T1_response_t`  
*ICC T1 parameter response structure to respond a command message in the bulk-in pipe. [More...](#)*
  - union `usb_device_ccid_parameters_response_common_t`  
*ICC parameter response union to respond a command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_escape_response_t`  
*Response structure to respond the "PC\_to\_RDR\_Escape" command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_data_rate_and_clock_frequency_response_t`  
*Response structure to respond the "PC\_to\_RDR\_SetDataRateAndClockFrequency" command message in the bulk-in pipe. [More...](#)*
  - struct `usb_device_ccid_notify_slot_change_notification_t`  
*Notification structure to notify Host the CCID device slot changed. [More...](#)*
  - struct `usb_device_ccid_hardware_error_notification_t`  
*Notification structure to notify Host a hardware error happened in the CCID device. [More...](#)*
  - struct `usb_device_ccid_transfer_struct_t`  
*USB device CCID transfer structure. [More...](#)*
  - struct `usb_device_ccid_control_request_struct_t`  
*The structure is used to get data rates or clock frequencies if the event is `kUSB_DeviceCcidEventGetClockFrequencies` or `kUSB_DeviceCcidEventGetDataRate`. [More...](#)*
  - struct `usb_device_ccid_notification_struct_t`  
*The structure is used to keep the transferred buffer and transferred length if the event is `kUSB_DeviceCcidEventSlotChangeSent` or `kUSB_DeviceCcidEventHardwareErrorSent`. [More...](#)*
  - struct `usb_device_ccid_command_struct_t`  
*The structure is used to keep the command data and length and get response data and length if the event is `kUSB_DeviceCcidEventCommandReceived`. [More...](#)*
  - struct `usb_device_ccid_slot_status_struct_t`  
*The structure is used to get the slot status if the event is `kUSB_DeviceCcidEventGetSlotStatus`. [More...](#)*
  - struct `usb_device_ccid_struct_t`  
*The CCID device class status structure. [More...](#)*

## Macros

- #define `USB_DEVICE_CCID_CLASS_CODE` (0x0BU)  
*CCID device class code.*
- #define `USB_DEVICE_CCID_SUBCLASS_CODE` (0x00U)  
*CCID device subclass code.*
- #define `USB_DEVICE_CCID_PROTOCOL_CODE` (0x00U)  
*CCID device protocol code.*
- #define `USB_DEVICE_CCID_ABORT` (0x01U)  
*CCID device class-specific control pipe requests.*

## USB CCID Class driver

- #define `USB_DEVICE_CCID_PC_TO_RDR_ICCPOWERON` (0x62U)  
*The message type of CCID device class-specific bulk-out pipe (Command pipe)*
- #define `USB_DEVICE_CCID_RDR_TO_PC_DATABLOCK` (0x80U)  
*The message type of CCID device class-specific bulk-in pipe (Response pipe)*
- #define `USB_DEVICE_CCID_RDR_TO_PC_NOTIFYSLOTCHANGE` (0x50U)  
*The message type of CCID device class-specific interrupt-in pipe.*
- #define `USB_DEVICE_CCID_SLOT_ERROR_COMMAND_NOT_SUPPORTED` (0x00U)  
*Reporting slot error and slot status registers in bulk-in messages.*
- #define `USB_DEVICE_CCID_COMMAND_HEADER_LENGTH` (0x0AU)  
*The command header length of the bulk-out pipe message.*
- #define `USB_DEVICE_CCID_RESPONSE_HEADER_LENGTH` (0x0AU)  
*The response header length of the bulk-in pipe message.*
- #define `USB_DEVICE_CCID_BUFFER_4BYTE_ALIGN(n)` (((n - 1U) & 0xFFFFFFFFCU) + 0x00000004U)  
*The definition to make the length aligned to 4-bytes.*

## Enumerations

- enum `usb_device_ccid_event_t` {  
    `kUSB_DeviceCcidEventCommandReceived` = 0x01U,  
    `kUSB_DeviceCcidEventResponseSent`,  
    `kUSB_DeviceCcidEventGetSlotCount`,  
    `kUSB_DeviceCcidEventGetSlotStatus`,  
    `kUSB_DeviceCcidEventCommandAbort`,  
    `kUSB_DeviceCcidEventGetClockFrequencies`,  
    `kUSB_DeviceCcidEventGetDataRate`,  
    `kUSB_DeviceCcidEventSlotChangeSent`,  
    `kUSB_DeviceCcidEventHardwareErrorSent` }  
*Available common EVENT types in CCID class callback.*
- enum `usb_device_ccid_slot_state_t` {  
    `kUSB_DeviceCcidSlotStateNoPresent` = 0x00U,  
    `kUSB_DeviceCcidSlotStatePresent` = 0x01U }  
*Slot status, present or not.*
- enum `usb_device_ccid_hardware_error_t` { `kUSB_DeviceCcidHardwareErrorOverCurrent` = 0x01-U }  
*Hardware error status.*

## Functions

- `usb_status_t USB_DeviceCcidInit` (uint8\_t controllerId, `usb_device_class_config_struct_t` \*config, `class_handle_t` \*handle)  
*Initialize the CCID class.*
- `usb_status_t USB_DeviceCcidDeinit` (`class_handle_t` handle)  
*Deinitializes the device CCID class.*
- `usb_status_t USB_DeviceCcidEvent` (void \*handle, uint32\_t event, void \*param)  
*Handles the event passed to the CCID class.*

## USB CCID device class configuration

- #define **USB\_DEVICE\_CONFIG\_CCID\_SLOT\_MAX** (1U)  
*MAX slot number of the CCID device.*
- #define **USB\_DEVICE\_CONFIG\_CCID\_TRANSFER\_COUNT** (4U)  
*MAX transfer entity number of the CCID device.*
- #define **USB\_DEVICE\_CONFIG\_CCID\_MAX\_MESSAGE\_LENGTH** (271U)  
*MAX maximum message length of the CCID device.*

## USB CCID device class descriptor

- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_LENGTH** (0x36U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_TYPE** (0x21U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_VOLTAGE\_SUPPORT\_BM\_5V** (0x01U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_VOLTAGE\_SUPPORT\_BM\_3V** (0x02U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_VOLTAGE\_SUPPORT\_BM\_1V8** (0x04U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_PROTOCOLS\_BM\_T0** (0x00000001U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_PROTOCOLS\_BM\_T1** (0x00000002U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_MECHANICAL\_BM\_NO** (0x00000000U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_MECHANICAL\_BM\_ACCEPT** (0x00000001U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_MECHANICAL\_BM\_EJECTION** (0x00000002U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_MECHANICAL\_BM\_CAPTURE** (0x00000004U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_MECHANICAL\_BM\_LOCK\_UNLOCK** (0x00000008U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_NO** (0x00000000U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_CONFIG\_BASED\_ON\_ATR** (0x00000002U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_ACTIVE\_ON\_INSERTING** (0x00000004U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_VOLTAGE\_SELECTION** (0x00000008U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_FREQUENCY\_CHANGE** (0x00000010U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_BAUD\_RATE\_CHANGE** (0x00000020U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_NEGOTIATION** (0x00000040U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_PPS** (0x00000080U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_CAN\_SET\_IN\_STOP\_MODE** (0x00000100U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_NAD\_VLAUE** (0x00000200U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_AUTO\_IFSD\_EXCHANGE\_AS\_FIRST** (0x00000400U)
- #define **USB\_DEVICE\_CCID\_DESCRIPTOR\_FEATURES\_BM\_TPDU\_LEVEL\_EXCHA-**

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- `NGES` (0x00010000U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_FEATURES_BM_SHORT_APDU_LEVEL_EXCHANGES` (0x00020000U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_FEATURES_BM_SHORT_EXTENDED_APDU_LEVEL_EXCHANGES` (0x00040000U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_FEATURES_BM_SUPPORT_SUPPEND` (0x00100000U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_PIN_SUPPORT_BM_NO` (0x00U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_PIN_SUPPORT_BM_VERIFICATION_SUPPORTED` (0x01U)
- `#define USB_DEVICE_CCID_DESCRIPTOR_PIN_SUPPORT_BM_MODIFICATION_SUPPORTED` (0x02U)

## USB device CCID class APIs

- `usb_status_t USB_DeviceCcidNotifySlotChange` (`class_handle_t` handle, `uint8_t` slot, `usb_device_ccid_slot_state_t` state)  
*Notifies the slot status changed.*
- `usb_status_t USB_DeviceCcidNotifyHardwareError` (`class_handle_t` handle, `uint8_t` slot, `usb_device_ccid_hardware_error_t` errorCode)  
*Notifies the slot status changed.*

## 3.8.2 Data Structure Documentation

### 3.8.2.1 struct\_usb\_device\_ccid\_common\_command

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*Message-specific data length.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for command.*
- `uint8_t bParameter1`  
*Parameter1 of the message, message-specific.*
- `uint8_t bParameter2`  
*Parameter2 of the message, message-specific.*
- `uint8_t bParameter3`  
*Parameter3 of the message, message-specific.*

### 3.8.2.2 struct\_usb\_device\_ccid\_power\_on\_command

A `PC_to_RDR_IccPowerOn` message to an inactive slot returns an Answer-To-Reset (ATR) data.

The response to this command message is the RDR\_to\_PC\_DataBlock response message and the data returned is the Answer To Reset (ATR) data.

### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **bPowerSelect**  
*Voltage that is applied to the ICC.*
- uint8\_t **BRFU** [2]  
*Reserved for Future Use.*

### 3.8.2.3 struct \_usb\_device\_ccid\_power\_off\_command

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for Future Use.*

### 3.8.2.4 struct \_usb\_device\_ccid\_get\_slot\_status\_command

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**

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- *Identifies the slot number for this command.*  
uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for Future Use.*

### 3.8.2.5 struct \_usb\_device\_ccid\_transfer\_block\_command

The block should never exceed the dwMaxCCIDMessageLength-10 in the Class Descriptor. Parameter bBWI is only used by CCIDs which use the character level and TPDU level of exchange (as reported in the dwFeatures parameter in the CCID Functional Descriptor) and only for protocol T=1 transfers.

The response to this command message is the RDR\_to\_PC\_DataBlock response message.

Note

For reference, the absolute maximum block size for a TPDU T=0 block is 260U bytes (5U bytes command; 255U bytes data), or for a TPDU T=1 block is 259U bytes, or for a short APDU T=1 block is 261U bytes, or for an extended APDU T=1 block is 65544U bytes.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Size of abData field of this message.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **bBWI**  
*Used to extend the CCIDs Block Waiting Timeout for this current transfer.*
- uint16\_t **wLevelParameter**  
*Use changes depending on the exchange level reported by the class descriptor in dwFeatures field.*
- uint8\_t **abData** [1]  
*Data block sent to the CCID.*

### 3.8.2.6 struct \_usb\_device\_ccid\_get\_parameters\_command

The response to this command message is the RDR\_to\_PC\_Parameters response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*

- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for Future use.*

### 3.8.2.7 struct \_usb\_device\_ccid\_reset\_parameters\_command

This command resets the slot parameters to their default values.

The response to this command message is the RDR\_to\_PC\_Parameters response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for Future Use.*

### 3.8.2.8 struct \_usb\_device\_ccid\_set\_parameters\_command

This command is used to change the parameters for a given slot. A CCID which has no automatic features (dwFeatures=0, 100h, 200h, or 300h) depends on the driver to send this command to set the protocol and other parameters to the right values necessary to correctly talk to the ICC located in the selected slot. A CCID which has automatic features automatically sets the protocol and certain parameters based on data received from the ICC (ATR, PPS, IFSD, or proprietary algorithms). The level of automatism and design requirements determines which parameters the CCID allow the driver to change. If this command tries to change a parameter which is not changeable, then the CCID does not change any parameters and the RDR\_to\_PC\_GetParameters response returns a Command Failed status and the bError field contains the offset of the "offending" parameter.

The response to this command message is the RDR\_to\_PC\_Parameters response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Size of abProtocolDataStructure field of this message.*
- uint8\_t **bSlot**

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- `uint8_t bSeq`  
*Identifies the slot number for this command.*
- `uint8_t bProtocolNum`  
*Sequence number for command.*
- `uint8_t bRFU` [2]  
*Specifies what protocol data structure follows.*
- `uint8_t abProtocolDataStructure` [1]  
*Reserved for Future Use.*  
*Protocol Data Structure.*

### 3.8.2.8.0.2 Field Documentation

#### 3.8.2.8.0.2.1 `uint8_t usb_device_ccid_set_parameters_command_t::bProtocolNum`

00h = Structure for protocol T=0, 01h = Structure for protocol T=1

#### 3.8.2.8.0.2.2 `uint8_t usb_device_ccid_set_parameters_command_t::abProtocolDataStructure[1]`

For T = 0U, see `usb_device_ccid_set_parameters_t0_command_t`, for T = 1U, see `usb_device_ccid_set_parameters_t1_command_t`.

### 3.8.2.9 `struct_usb_device_ccid_set_parameters_t0_command`

Protocol Data Structure for Protocol T=0 (`bProtocolNum=0`) (`dwLength=00000005h`).

The response to this command message is the `RDR_to_PC_Parameters` response message.

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*(dwLength = 0x05U)*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for command.*
- `uint8_t bProtocolNum`  
*Structure for protocol T=0.*
- `uint8_t bRFU` [2]  
*Reserved for Future Use.*
- `uint8_t bmFindexDindex`  
*Bit7~4 - Fi, Bit3~0 - Di.*
- `uint8_t bmTCCCKST0`  
*Bit1 - Convention used(0U for direct, 1U for inverse), other bits is 0.*
- `uint8_t bGuardTimeT0`  
*Extra guard time between two characters.*
- `uint8_t bWaitingIntegerT0`  
*WI for T= 0U used to define WWT.*



- uint8\_t **bClockStop**  
*ICC Clock Stop Support.*

### 3.8.2.9.0.3 Field Documentation

3.8.2.9.0.3.1 uint8\_t usb\_device\_ccid\_set\_parameters\_t0\_command\_t::bmFindexDindex

3.8.2.9.0.3.2 uint8\_t usb\_device\_ccid\_set\_parameters\_t0\_command\_t::bGuardTimeT0

### 3.8.2.10 struct\_usb\_device\_ccid\_set\_parameters\_t1\_command

Protocol Data Structure for Protocol T=1 (bProtocolNum=1) (dwLength=00000007h)

The response to this command message is the RDR\_to\_PC\_Parameters response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*(dwLength = 0x07U)*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **bProtocolNum**  
*Structure for protocol T=1.*
- uint8\_t **brFU** [2]  
*Reserved for Future Use.*
- uint8\_t **bmFindexDindex**  
*Bit7~4 - Fi, Bit3~0 - Di.*
- uint8\_t **bmTCKST1**  
*Bit0 - Checksum type(0U for LRC, 1U for CRC).*
- uint8\_t **bGuardTimeT1**  
*Extra guard time.*
- uint8\_t **bmWaitingIntegersT1**  
*Bit7~4 - BWI(0~9 valid), Bit3~0 - CWI(0~0xF valid)*
- uint8\_t **bClockStop**  
*ICC Clock Stop Support.*
- uint8\_t **bIFSC**  
*Size of negotiated IFSC.*
- uint8\_t **bNadValue**  
*Value = 0x00U if CCID doesn't support a value other than the default value.*

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### 3.8.2.10.0.4 Field Documentation

3.8.2.10.0.4.1 `uint8_t usb_device_ccid_set_parameters_t1_command_t::bmFindIndex`

3.8.2.10.0.4.2 `uint8_t usb_device_ccid_set_parameters_t1_command_t::bmTCCKST1`

Bit1 - Convention used(0U for direct, 1U for inverse), Bit7~2 - 0b000100

3.8.2.10.0.4.3 `uint8_t usb_device_ccid_set_parameters_t1_command_t::bGuardTimeT1`

3.8.2.10.0.4.4 `uint8_t usb_device_ccid_set_parameters_t1_command_t::bNadValue`

Else value respects ISO/IEC 7816-3, 9.4.2.1

### 3.8.2.11 `union usb_device_ccid_set_parameters_command_common_t`

#### Data Fields

- `usb_device_ccid_set_parameters_command_t common`  
*Set ICC parameter common structure.*
- `usb_device_ccid_set_parameters_t0_command_t t0`  
*Set ICC parameter structure for T0.*
- `usb_device_ccid_set_parameters_t1_command_t t1`  
*Set ICC parameter structure for T1.*

### 3.8.2.12 `struct _usb_device_ccid_escape_command`

This command allows the CCID manufacturer to define and access extended features. Information sent via this command is processed by the CCID control logic.

The response to this command message is the `RDR_to_PC_Escape` response message.

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*Message-specific data length.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for command.*
- `uint8_t bRFU [3]`  
*Reserved for future use.*
- `uint8_t abData [1]`  
*Size of abData field of this message.*

### 3.8.2.13 struct \_usb\_device\_ccid\_clock\_command

This command stops or restarts the clock.

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **bClockCommand**  
*0x00U - Restart clock, 0x01U - Stop clock in the state shown in the bClockStop field of the PC\_to\_RDR\_SetParameters command and RDR\_to\_PC\_Parameters message.*
- uint8\_t **BRFU** [2]  
*Reserved for future use.*

#### 3.8.2.13.0.5 Field Documentation

##### 3.8.2.13.0.5.1 uint8\_t usb\_device\_ccid\_clock\_command\_t::bClockCommand

### 3.8.2.14 struct \_usb\_device\_ccid\_t0\_apdu\_command

This command changes the parameters used to perform the transportation of APDU messages by the T=0 protocol. It effects the CLA (class) byte used when issuing a Get Response command or a Envelope command to the ICC.

This command is slot-specific. It only effects the slot specified in the bSlot field. Slots, when not powered, do not change back to using the default behaviour defined in the CCID class descriptor. Any newly inserted ICC has the default behaviour until this command is issued for its slot.

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **bmChanges**  
*The value is bitwise OR operation.*

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- `uint8_t bClassGetResponse`  
*Value to force the class byte of the header in a get response command.*
- `uint8_t bClassEnvelope`  
*Value to force the class byte of the header in a envelope command.*

### 3.8.2.14.0.6 Field Documentation

#### 3.8.2.14.0.6.1 `uint8_t usb_device_ccid_t0_apdu_command_t::bmChanges`

Bit 0U is associated with field `bClassGetResponse` Bit 1U is associated with field `bClassEnvelope` Other bits are RFU.

### 3.8.2.15 `struct _usb_device_ccid_secure_command`

This is a command message to allow entering the PIN for verification or modification.

The response to this command message is the `RDR_to_PC_DataBlock` response message.

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*Size of `abData` field of this message.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for command.*
- `uint8_t bBWI`  
*Used to extend the CCIDs Block Waiting Timeout for this current transfer.*
- `uint16_t wLevelParameter`  
*Use changes depending on the exchange level reported by CCID in the functional descriptor.*
- `uint8_t abData [1]`  
*The value depends of `wLevelParameters`.*

#### 3.8.2.15.0.7 Field Documentation

##### 3.8.2.15.0.7.1 `uint8_t usb_device_ccid_secure_command_t::abData[1]`

When `wLevelParameters` is `0000h` or `0001h` `abData` = `abPINOperationDataStructure`. For other values of `wLevelParameters` this field is the continuation of the previously sent `PC_to_RDR_Secure`.

### 3.8.2.16 `struct _usb_device_ccid_secure_pin_operation_command`

This is a command message to allow entering the PIN for verification or modification.

The response to this command message is the `RDR_to_PC_DataBlock` response message.

## Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*1U + Size of abPINDataStructure field of this message*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BBWI**  
*Used to extend the CCIDs Block Waiting Timeout for this current transfer.*
- uint16\_t **wLevelParameter**  
*Use changes depending on the exchange level reported by CCID in the functional descriptor.*
- uint8\_t **bPINOperation**  
*Used to indicate the PIN operation: 00h: PIN Verification 01h: PIN Modification 02h: Transfer PIN from secure CCID buffer 03h: Wait ICC response 04h: Cancel PIN function 05h: Re-send last I-Block, valid only if T = 1.*

### 3.8.2.16.0.8 Field Documentation

#### 3.8.2.16.0.8.1 uint8\_t usb\_device\_ccid\_secure\_pin\_operation\_command\_t::bPINOperation

06h: Send next part of APDU, valid only T = 1.

### 3.8.2.17 struct\_usb\_device\_ccid\_seucre\_pin\_verification\_command

This is a command message to allow entering the PIN for verification.

The response to this command message is the RDR\_to\_PC\_DataBlock response message.

## Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*12U + Size of abPINApdu field of this message*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BBWI**  
*Used to extend the CCIDs Block Waiting Timeout for this current transfer.*
- uint16\_t **wLevelParameter**  
*Use changes depending on the exchange level reported by CCID in the functional descriptor.*
- uint8\_t **bPINOperation**  
*Used to indicate the PIN operation: 00h: PIN Verification 01h: PIN Modification 02h: Transfer PIN from secure CCID buffer 03h: Wait ICC response 04h: Cancel PIN function 05h: Re-send last I-Block, valid only if T = 1.*

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- `uint8_t bTimeOut`  
*Number of seconds.*
- `uint8_t bmFormatString`  
*Several parameters for the PIN format options.*
- `uint8_t bmPINBlockString`  
*Defines the length in bytes of the PIN block to present in the APDU command.*
- `uint8_t bmPINLengthFormat`  
*Allows the insertion of the PIN length in the APDU command.*
- `uint16_t wPINMaxExtraDigit`  
*Bit15~8 - Minimum PIN size in digit, Bit7~0 - Maximum PIN size in digit.*
- `uint8_t bEntryValidationCondition`  
*The value is a bit wise OR operation.*
- `uint8_t bNumberMessage`  
*Number of messages to display for the PIN Verification management.*
- `uint16_t wLangId`  
*Language used to display the messages.*
- `uint8_t bMsgIndex`  
*Message index in the Reader CCID message table (should be 00h).*
- `uint8_t bTeoPrologue`  
*T=1 I-block prologue field to use.*
- `uint8_t abPINApdu [1]`  
*APDU to send to the ICC.*

### 3.8.2.17.0.9 Field Documentation

#### 3.8.2.17.0.9.1 `uint8_t usb_device_ccid_seucre_pin_verification_command_t::bPINOperation`

06h: Send next part of APDU, valid only T = 1.

#### 3.8.2.17.0.9.2 `uint8_t usb_device_ccid_seucre_pin_verification_command_t::bEntryValidationCondition`

01h - Maximum size reached, 02h - Validation key pressed, 04h - Timeout occurred

#### 3.8.2.17.0.9.3 `uint8_t usb_device_ccid_seucre_pin_verification_command_t::bNumberMessage`

#### 3.8.2.17.0.9.4 `uint16_t usb_device_ccid_seucre_pin_verification_command_t::wLangId`

#### 3.8.2.17.0.9.5 `uint8_t usb_device_ccid_seucre_pin_verification_command_t::bMsgIndex`

#### 3.8.2.17.0.9.6 `uint8_t usb_device_ccid_seucre_pin_verification_command_t::bTeoPrologue`

### 3.8.2.18 `struct usb_device_ccid_secure_pin_modification_command`

This is a command message to allow entering the PIN for modification.

The response to this command message is the `RDR_to_PC_DataBlock` response message.

## Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*20U + Size of abPINApdu field of this message*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BBWI**  
*Used to extend the CCIDs Block Waiting Timeout for this current transfer.*
- uint16\_t **wLevelParameter**  
*Use changes depending on the exchange level reported by CCID in the functional descriptor.*
- uint8\_t **bPINOperation**  
*Used to indicate the PIN operation: 00h: PIN Verification 01h: PIN Modification 02h: Transfer PIN from secure CCID buffer 03h: Wait ICC response 04h: Cancel PIN function 05h: Re-send last I-Block, valid only if T = 1.*
- uint8\_t **bTimeOut**  
*Number of seconds.*
- uint8\_t **bmFormatString**  
*Several parameters for the PIN format options.*
- uint8\_t **bmPINBlockString**  
*Define the length of the PIN to present in the APDU command.*
- uint8\_t **bmPINLengthFormat**  
*Allows the length PIN insertion in the APDU command.*
- uint8\_t **bInsertionOffsetOld**  
*Insertion position offset in byte for the current PIN.*
- uint8\_t **bInsertionOffsetNew**  
*Insertion position offset in byte for the new PIN.*
- uint16\_t **wPINMaxExtraDigit**  
*Bit15~8 - Minimum PIN size in digit, Bit7~0 - Maximum PIN size in digit.*
- uint8\_t **bConfirmPIN**  
*Indicates if a confirmation is requested before acceptance of a new PIN.*
- uint8\_t **bEntryValidationCondition**  
*The value is a bit wise OR operation.*
- uint8\_t **bNumberMessage**  
*Number of messages to display for the PIN Verification management.*
- uint16\_t **wLangId**  
*Language used to display the messages.*
- uint8\_t **bMsgIndex1**  
*Message index in the Reader message table(should be 00h or 01h).*
- uint8\_t **bMsgIndex2**  
*Message index in the Reader message table(should be 01h or 02h).*
- uint8\_t **bMsgIndex3**  
*Message index in the Reader message table(should be 02h).*
- uint8\_t **bTeoPrologue** [3]  
*T=1 I-block prologue field to use.*
- uint8\_t **abPINApdu** [1]  
*APDU to send to the ICC.*

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### 3.8.2.18.0.10 Field Documentation

#### 3.8.2.18.0.10.1 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bPINOperation`

06h: Send next part of APDU, valid only T = 1.

#### 3.8.2.18.0.10.2 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bEntryValidation-Condition`

01h - Maximum size reached, 02h - Validation key pressed, 04h - Timeout occurred

#### 3.8.2.18.0.10.3 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bNumber-Message`

#### 3.8.2.18.0.10.4 `uint16_t usb_device_ccid_secure_pin_modification_command_t::wLangId`

#### 3.8.2.18.0.10.5 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bMsgIndex1`

#### 3.8.2.18.0.10.6 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bMsgIndex2`

#### 3.8.2.18.0.10.7 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bMsgIndex3`

#### 3.8.2.18.0.10.8 `uint8_t usb_device_ccid_secure_pin_modification_command_t::bTeoPrologue[3]`

### 3.8.2.19 `struct usb_device_ccid_mechanical_command`

This command is used to manage motorized type CCID functionality.

The response to this command message is the `RDR_to_PC_SlotStatus` response message.

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*Message-specific data length.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for command.*
- `uint8_t bFunction`  
*This value corresponds to the mechanical function being requested.*
- `uint8_t bRFU [2]`  
*Reserved for Future Use.*

### 3.8.2.20 `struct usb_device_ccid_abort_command`

This command is used with the control pipe abort request to tell the CCID to stop any current transfer at the specified slot and return to a state where the slot is ready to accept a new command pipe Bulk-OUT



message.

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for future use.*

### 3.8.2.21 struct\_usb\_device\_ccid\_set\_data\_rate\_and\_clock\_frequency\_command

This command is used to manually set the data rate and clock frequency of a specific slot.

The response to this command message is the RDR\_to\_PC\_SlotStatus response message.

### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length(8U bytes)*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for command.*
- uint8\_t **BRFU** [3]  
*Reserved for Future Use.*
- uint32\_t **dwClockFrequency**  
*ICC clock frequency in kHz.*
- uint32\_t **dwDataRate**  
*ICC data rate in BPD.*

#### 3.8.2.21.0.11 Field Documentation

##### 3.8.2.21.0.11.1 uint32\_t usb\_device\_ccid\_set\_data\_rate\_and\_clock\_frequency\_command\_t::dw-ClockFrequency

This is an integer value

### 3.8.2.22 struct \_usb\_device\_ccid\_common\_response

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*
- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **bParameter1**  
*Parameter1 of the message, message-specific.*

### 3.8.2.23 struct \_usb\_device\_ccid\_data\_block\_response

The device in response to the following command messages: "PC\_to\_RDR\_IccPowerOn", "PC\_to\_RDR-\_Secure" and "PC\_to\_RDR\_XfrBlock" sends this response message. For "PC\_to\_RDR\_IccPowerOn" this response message is the answer to reset (ATR) data associated with the ICC power on. In other use cases, the response message has the following format: the response data contains the optional data returned by the ICC, followed by the 2U byte-size status words SW1-SW2.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*
- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **bChainParameter**  
*Use changes depending on the exchange level reported by the class descriptor in dwFeatures field.*
- uint8\_t **abData** [1]  
*This field contains the data returned by the CCID.*

### 3.8.2.23.0.12 Field Documentation

#### 3.8.2.23.0.12.1 uint8\_t usb\_device\_ccid\_data\_block\_response\_t::abData[1]

### 3.8.2.24 struct\_usb\_device\_ccid\_slot\_status\_response

The device in response to the following command messages: "PC\_to\_RDR\_IccPowerOff", "PC\_to\_RDR\_GetSlotStatus", "PC\_to\_RDR\_IccClock", "PC\_to\_RDR\_T0APDU" and, "PC\_to\_RDR\_Mechanical" sends this response message. Also, the device sends this response message when it has completed aborting a slot after receiving both the Class Specific ABORT request and PC\_to\_RDR\_Abort command message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*
- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **bClockStatus**  
*0x00U - Clock running, 0x01U - Clock stopped in L, 0x02U - clock stopped in H, and 0x03U - clock stopped in an unknown state.*

### 3.8.2.24.0.13 Field Documentation

#### 3.8.2.24.0.13.1 uint8\_t usb\_device\_ccid\_slot\_status\_response\_t::bClockStatus

### 3.8.2.25 struct\_usb\_device\_ccid\_parameters\_response

The device in response to the following command messages: "PC\_to\_RDR\_GetParameters", "PC\_to\_RDR\_ResetParameters", and, "PC\_to\_RDR\_SetParameters" sends this response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Size of abProtocolDataStructure field of this message.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*

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- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **bProtocolNum**  
*0x00U = Structure for protocol T=0, 0x01U = Structure for protocol T=1*
- uint8\_t **abProtocolDataStructure** [1]  
*Protocol Data Structure.*

### 3.8.2.26 struct \_usb\_device\_ccid\_parameters\_T0\_response

The device in response to the following command messages: "PC\_to\_RDR\_GetParameters", "PC\_to\_RDR\_ResetParameters", and, "PC\_to\_RDR\_SetParameters" sends this response message.

#### Data Fields

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*The value is 0x05U.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*
- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **bProtocolNum**  
*0x00U = Structure for protocol T=0*
- uint8\_t **bmFindexDindex**  
*Bit7~4 - Fi, Bit3~0 - Di.*
- uint8\_t **bmTCKKST0**  
*Bit1 - Convention used(0U for direct, 1U for inverse), other bits is 0.*
- uint8\_t **bGuardTimeT0**  
*Extra guard time between two characters.*
- uint8\_t **bWaitingIntegerT0**  
*WI for T= 0U used to define WWT.*
- uint8\_t **bClockStop**  
*ICC Clock Stop Support.*

**3.8.2.26.0.14 Field Documentation****3.8.2.26.0.14.1** `uint8_t usb_device_ccid_parameters_T0_response_t::bmFindexDindex`**3.8.2.26.0.14.2** `uint8_t usb_device_ccid_parameters_T0_response_t::bGuardTimeT0`**3.8.2.27 struct\_usb\_device\_ccid\_parameters\_T1\_response**

The device in response to the following command messages: "PC\_to\_RDR\_GetParameters", "PC\_to\_RDR\_ResetParameters", and "PC\_to\_RDR\_SetParameters" sends this response message.

**Data Fields**

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*The value is 0x07U.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for the corresponding command.*
- `uint8_t bStatus`  
*Slot status register.*
- `uint8_t bError`  
*Slot error register.*
- `uint8_t bProtocolNum`  
*0x00U = Structure for protocol T=1*
- `uint8_t bmFindexDindex`  
*Bit7~4 - Fi, Bit3~0 - Di.*
- `uint8_t bmTCCKST1`  
*Bit0 - Checksum type(0U for LRC, 1U for CRC).*
- `uint8_t bGuardTimeT1`  
*Extra guard time.*
- `uint8_t bmWaitingIntegersT1`  
*Bit7~4 - BWI(0~9 valid), Bit3~0 - CWI(0~0xF valid)*
- `uint8_t bClockStop`  
*ICC Clock Stop Support.*
- `uint8_t bIFSC`  
*Size of negotiated IFSC.*
- `uint8_t bNadValue`  
*Value = 0x00U if CCID doesn't support a value other than the default value.*

**3.8.2.27.0.15 Field Documentation****3.8.2.27.0.15.1** `uint8_t usb_device_ccid_parameters_T1_response_t::bmFindexDindex`**3.8.2.27.0.15.2** `uint8_t usb_device_ccid_parameters_T1_response_t::bmTCCKST1`

Bit1 - Convention used(0U for direct, 1U for inverse), Bit7~2 - 0b000100

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**3.8.2.27.0.15.3** `uint8_t usb_device_ccid_parameters_T1_response_t::bGuardTimeT1`

**3.8.2.27.0.15.4** `uint8_t usb_device_ccid_parameters_T1_response_t::bNadValue`

Else value respects ISO/IEC 7816-3, 9.4.2.1

**3.8.2.28** `union usb_device_ccid_parameters_response_common_t`

### Data Fields

- `usb_device_ccid_parameters_response_t common`  
*Response ICC parameter common structure.*
- `usb_device_ccid_parameters_T0_response_t t0`  
*Response ICC parameter structure for T0.*
- `usb_device_ccid_parameters_T1_response_t t1`  
*Response ICC parameter structure for T1.*

**3.8.2.29** `struct usb_device_ccid_escape_response`

The device in response to the following command messages: "PC\_to\_RDR\_Escape" sends this response message.

### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint32_t dwLength`  
*Size of abData field of this message.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number for the corresponding command.*
- `uint8_t bStatus`  
*Slot status register.*
- `uint8_t bError`  
*Slot error register.*
- `uint8_t bRFU`  
*Reserved for Future Use.*
- `uint8_t abData [1]`  
*Data sent from CCID.*

**3.8.2.30** `struct usb_device_ccid_data_rate_and_clock_frequency_response`

The device in response to the following command messages: "PC\_to\_RDR\_SetDataRateAndClock-Frequency" sends this response message.

**Data Fields**

- uint8\_t **bMessageType**  
*The message type.*
- uint32\_t **dwLength**  
*Message-specific data length.*
- uint8\_t **bSlot**  
*Identifies the slot number for this command.*
- uint8\_t **bSeq**  
*Sequence number for the corresponding command.*
- uint8\_t **bStatus**  
*Slot status register.*
- uint8\_t **bError**  
*Slot error register.*
- uint8\_t **BRFU**  
*Reserved for Future Use.*
- uint32\_t **dwClockFrequency**  
*Current setting of the ICC clock frequency in KHz.*
- uint32\_t **dwDataRate**  
*Current setting of the ICC data rate in bps.*

**3.8.2.30.0.16 Field Documentation****3.8.2.30.0.16.1 uint32\_t usb\_device\_ccid\_data\_rate\_and\_clock\_frequency\_response\_t::dwClock-Frequency**

This is an integer value

**3.8.2.30.0.16.2 uint32\_t usb\_device\_ccid\_data\_rate\_and\_clock\_frequency\_response\_t::dwData-Rate**

This is an integer value

**3.8.2.31 struct\_usb\_device\_ccid\_notify\_slot\_chnage\_notification****Data Fields**

- uint8\_t **bMessageType**  
*The message type.*
- uint8\_t **bmSlotICCState** [1]  
*This field is reported on byte granularity.*

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### 3.8.2.31.0.17 Field Documentation

3.8.2.31.0.17.1 `uint8_t usb_device_ccid_notify_slot_chnage_notification_t::bmSlotICCState[1]`

### 3.8.2.32 `struct usb_device_ccid_hardware_error_notification`

#### Data Fields

- `uint8_t bMessageType`  
*The message type.*
- `uint8_t bSlot`  
*Identifies the slot number for this command.*
- `uint8_t bSeq`  
*Sequence number of bulk out command when the hardware error occurred.*
- `uint8_t bHardwareErrorCode`  
*0x01U - Over current.*

### 3.8.2.32.0.18 Field Documentation

3.8.2.32.0.18.1 `uint8_t usb_device_ccid_hardware_error_notification_t::bHardwareErrorCode`

### 3.8.2.33 `struct usb_device_ccid_transfer_struct_t`

#### Data Fields

- `struct`  
`_usb_device_ccid_transfer_struct * next`  
*Next transfer pointer.*
- `uint8_t * buffer`  
*The transfer buffer address need to be sent.*
- `uint32_t length`  
*The transfer length.*
- `usb_device_ccid_slot_status_response_t response`  
*Response buffer is used when `dwLength = 0`.*

### 3.8.2.33.0.19 Field Documentation

3.8.2.33.0.19.1 `usb_device_ccid_slot_status_response_t usb_device_ccid_transfer_struct_t::response`

### 3.8.2.34 `struct usb_device_ccid_control_request_struct_t`

#### Data Fields

- `uint8_t * buffer`  
*The buffer address.*
- `uint32_t length`  
*The data length.*



**3.8.2.35 struct usb\_device\_ccid\_notification\_struct\_t****Data Fields**

- uint8\_t \* [buffer](#)  
*The transferred buffer address.*
- uint32\_t [length](#)  
*The transferred data length.*

**3.8.2.36 struct usb\_device\_ccid\_command\_struct\_t****Data Fields**

- uint8\_t \* [commandBuffer](#)  
*The buffer address kept the command from host.*
- uint32\_t [commandLength](#)  
*The command length from host.*
- uint8\_t \* [responseBuffer](#)  
*The response data need to be sent to host.*
- uint32\_t [responseLength](#)  
*The response data length.*

**3.8.2.37 struct usb\_device\_ccid\_slot\_status\_struct\_t****Data Fields**

- uint8\_t [slot](#)  
*The slot number need to get.*
- uint8\_t [present](#)  
*Is present or not.*
- uint8\_t [clockStatus](#)  
*The clock status.*

**3.8.2.38 struct usb\_device\_ccid\_struct\_t****Data Fields**

- [usb\\_device\\_handle](#) [handle](#)  
*The device handle.*
- [usb\\_device\\_class\\_config\\_struct\\_t](#) \* [configStruct](#)  
*The configuration of the class.*
- [usb\\_device\\_interface\\_struct\\_t](#) \* [interfaceHandle](#)  
*Current interface handle.*
- [usb\\_device\\_ccid\\_transfer\\_struct\\_t](#) \* [transferHead](#)  
*Transfer queue for busy.*
- [usb\\_device\\_ccid\\_transfer\\_struct\\_t](#) \* [transferFree](#)  
*Transfer queue for idle.*

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- `uint8_t commandBuffer` [`USB_DEVICE_CCID_BUFFER_4BYTE_ALIGN(USB_DEVICE_CONFIG_CCID_MAX_MESSAGE_LENGTH)`]  
*Command buffer for getting command data from host.*
- `usb_device_ccid_transfer_struct_t transfers` [`USB_DEVICE_CONFIG_CCID_TRANSFER_COUNT`]  
*Transfer entity.*
- `uint8_t slotsChangeBuffer` [`((USB_DEVICE_CONFIG_CCID_SLOT_MAX *2-1U)/8+1U+1U)`]  
*The buffer for saving slot status.*
- `uint8_t slotsSendingChangeBuffer` [`((USB_DEVICE_CONFIG_CCID_SLOT_MAX *2-1U)/8+1U+1U)`]  
*The buffer is used to notify host the slot status changed.*
- `uint8_t slotsSequenceNumber` [`USB_DEVICE_CONFIG_CCID_SLOT_MAX`]  
*Save each slot sequence number.*
- `usb_device_ccid_hardware_error_notification_t hardwareError`  
*The buffer is used to notify host the hardware error happened.*
- `uint8_t configuration`  
*Current configuration.*
- `uint8_t interfaceNumber`  
*The interface number of the class.*
- `uint8_t alternate`  
*Current alternate setting of the interface.*
- `uint8_t endpointInterruptIn`  
*The endpoint number of the interrupt IN pipe.*
- `uint8_t endpointBulkIn`  
*The endpoint number of the bulk IN pipe.*
- `uint8_t endpointBulkOut`  
*The endpoint number of the bulk OUT pipe.*
- `uint8_t slots`  
*The slot number of the application.*
- `uint8_t bulkInBusy`  
*The bulk IN pipe is busy or not.*
- `uint8_t interruptInBusy`  
*The interrupt IN pipe is busy or not.*
- `uint8_t slotsChanged`  
*The slot status changed.*

### 3.8.2.38.0.20 Field Documentation

3.8.2.38.0.20.1 `usb_device_class_config_struct_t* usb_device_ccid_struct_t::configStruct`

3.8.2.38.0.20.2 `uint8_t usb_device_ccid_struct_t::bulkInBusy`

3.8.2.38.0.20.3 `uint8_t usb_device_ccid_struct_t::interruptInBusy`

### 3.8.3 Macro Definition Documentation

3.8.3.1 `#define USB_DEVICE_CONFIG_CCID_SLOT_MAX (1U)`

3.8.3.2 `#define USB_DEVICE_CONFIG_CCID_TRANSFER_COUNT (4U)`

3.8.3.3 `#define USB_DEVICE_CONFIG_CCID_MAX_MESSAGE_LENGTH (271U)`

3.8.3.4 `#define USB_DEVICE_CCID_COMMAND_HEADER_LENGTH (0x0AU)`

3.8.3.5 `#define USB_DEVICE_CCID_RESPONSE_HEADER_LENGTH (0x0AU)`

### 3.8.4 Enumeration Type Documentation

#### 3.8.4.1 `enum usb_device_ccid_event_t`

Enumerator

- kUSB\_DeviceCcidEventCommandReceived* Command received in BULK OUT pipe.
- kUSB\_DeviceCcidEventResponseSent* Response sent in BULK IN pipe.
- kUSB\_DeviceCcidEventGetSlotCount* Get the slot count.
- kUSB\_DeviceCcidEventGetSlotStatus* Get the slot status, including clock status, ICC present.
- kUSB\_DeviceCcidEventCommandAbort* Command abort request received from control pipe.
- kUSB\_DeviceCcidEventGetClockFrequencies* Get the clock frequencies.
- kUSB\_DeviceCcidEventGetDataRate* Get the data rate.
- kUSB\_DeviceCcidEventSlotChangeSent* Slot changed notification send completed.
- kUSB\_DeviceCcidEventHardwareErrorSent* Hardware error notification send completed.

#### 3.8.4.2 `enum usb_device_ccid_slot_state_t`

Enumerator

- kUSB\_DeviceCcidSlotStateNoPresent* Not present.
- kUSB\_DeviceCcidSlotStatePresent* Present.

## USB CCID Class driver

### 3.8.4.3 enum usb\_device\_ccid\_hardware\_error\_t

Enumerator

*kUSB\_DeviceCcidHardwareErrorOverCurrent* Over current.

## 3.8.5 Function Documentation

### 3.8.5.1 usb\_status\_t USB\_DeviceCcidInit ( uint8\_t *controllerId*, usb\_device\_class\_config\_struct\_t \* *config*, class\_handle\_t \* *handle* )

This function is used to initialize the CCID class. This function only can be called by [USB\\_DeviceClassInit](#).

Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| in  | <i>config</i>       | The class configuration information.  |
| out | <i>handle</i>       | An out parameter used to return pointer of the video class handle to the caller.              |

Returns

A USB error code or `kStatus_USB_Success`.

### 3.8.5.2 usb\_status\_t USB\_DeviceCcidDeinit ( class\_handle\_t *handle* )

The function deinitializes the device CCID class. This function can only be called by [USB\\_DeviceClassDeinit](#).

Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The CCID class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|----|---------------|---|

Returns

A USB error code or `kStatus_USB_Success`.

**3.8.5.3** `usb_status_t USB_DeviceCcidEvent ( void * handle, uint32_t event, void * param )`

This function handles the event passed to the CCID class. This function can only be called by [USB\\_DeviceClassEvent](#).

## USB CCID Class driver

### Parameters

|         |               |  |
|---------|---------------|--|
| in      | <i>handle</i> | The CCID class handle, received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_class_event_t</a> .                          |
| in, out | <i>param</i>  | The parameter type is determined by the event code.  |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Success</i>           | Free device handle successfully.                                      |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle not be found.                                       |
| <i>kStatus_USB_Invalid-Request</i>   | The request is invalid and the control pipe is stalled by the caller. |

### 3.8.5.4 `usb_status_t USB_DeviceCcidNotifySlotChange ( class_handle_t handle, uint8_t slot, usb_device_ccid_slot_state_t state )`

The function is used to notify that the slot status changed. This is a non-blocking function. The event `kUSB_DeviceCcidEventSlotChangeSent` is asserted when the transfer completed.

The slot status may not be sent to the host if the interrupt IN pipe is busy. The status is saved internally and sent to the host when the interrupt IN pipe callback called. So, the event `kUSB_DeviceCcidEventSlotChangeSent` happened times does not equal to the function call times of this function.

### Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The CCID class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>slot</i>   | The changed slot number.  |
| in | <i>state</i>  | The changed slot status.  |

### Returns

A USB error code or `kStatus_USB_Success`.

### 3.8.5.5 `usb_status_t USB_DeviceCcidNotifyHardwareError ( class_handle_t handle, uint8_t slot, usb_device_ccid_hardware_error_t errorCode )`

The function is used to notify the hardware error. This is a non-blocking function. The event `kUSB_DeviceCcidEventHardwareErrorSent` is asserted when the transfer completed.

If the interrupt IN pipe is busy, the function returns an error `kStatus_USB_Error`.

Parameters

|    |                  |   |
|----|------------------|---|
| in | <i>handle</i>    | The CCID class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>slot</i>      | The changed slot number.  |
| in | <i>errorCode</i> | The hardware error code.  |

Returns

A USB error code or `kStatus_USB_Success`.

### 3.9 USB HID Class driver

#### 3.9.1 Overview

#### Data Structures

- struct `usb_device_hid_report_struct_t`  
*The device HID GET/SET report structure. [More...](#)*
- struct `usb_device_hid_struct_t`  
*The HID device class status structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_CONFIG_HID_CLASS_CODE` (0x03U)  
*The class code of the HID class.*
- #define `USB_DEVICE_HID_REQUEST_GET_REPORT` (0x01U)  
*Request code to get report of HID class.*
- #define `USB_DEVICE_HID_REQUEST_GET_IDLE` (0x02U)  
*Request code to get idle of HID class.*
- #define `USB_DEVICE_HID_REQUEST_GET_PROTOCOL` (0x03U)  
*Request code to get protocol of HID class.*
- #define `USB_DEVICE_HID_REQUEST_SET_REPORT` (0x09U)  
*Request code to set report of HID class.*
- #define `USB_DEVICE_HID_REQUEST_SET_IDLE` (0x0AU)  
*Request code to set idle of HID class.*
- #define `USB_DEVICE_HID_REQUEST_SET_PROTOCOL` (0x0BU)  
*Request code to set protocol of HID class.*

#### Enumerations

- enum `usb_device_hid_event_t` {  
    `kUSB_DeviceHidEventSendResponse` = 0x01U,  
    `kUSB_DeviceHidEventRecvResponse`,  
    `kUSB_DeviceHidEventGetReport`,  
    `kUSB_DeviceHidEventGetIdle`,  
    `kUSB_DeviceHidEventGetProtocol`,  
    `kUSB_DeviceHidEventSetReport`,  
    `kUSB_DeviceHidEventSetIdle`,  
    `kUSB_DeviceHidEventSetProtocol`,  
    `kUSB_DeviceHidEventRequestReportBuffer` }  
*Available common EVENT types in HID class callback.*



## Functions

- `usb_status_t USB_DeviceHidInit` (`uint8_t controllerId`, `usb_device_class_config_struct_t *config`, `class_handle_t *handle`)  
*Initializes the HID class.*
- `usb_status_t USB_DeviceHidDeinit` (`class_handle_t handle`)  
*Deinitializes the device HID class.*
- `usb_status_t USB_DeviceHidEvent` (`void *handle`, `uint32_t event`, `void *param`)  
*Handles the event passed to the HID class.*

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- `usb_status_t USB_DeviceHidSend` (`class_handle_t handle`, `uint8_t ep`, `uint8_t *buffer`, `uint32_t length`)  
*Sends data through a specified endpoint.*
- `usb_status_t USB_DeviceHidRecv` (`class_handle_t handle`, `uint8_t ep`, `uint8_t *buffer`, `uint32_t length`)  
*Receives data through a specified endpoint.*

### 3.9.2 Data Structure Documentation

#### 3.9.2.1 struct usb\_device\_hid\_report\_struct\_t

This structure is used to pass data when the event type is `kUSB_DeviceHidEventGetReport`, `kUSB_DeviceHidEventSetReport`, and `kUSB_DeviceHidEventRequestReportBuffer`.

1. `kUSB_DeviceHidEventGetReport` The structure is used to save the report buffer and report length got from the application. The `reportBuffer` is the report data buffer address filled by the application. The `reportLength` is the report length. The `reportType` is the requested report type. The `reportId` is the requested report ID.
2. `kUSB_DeviceHidEventSetReport` The structure is used to pass the report data received from the host to the application. The `reportBuffer` is buffer address of the report data received from the host. The `reportLength` is the report data length. The `reportType` is the requested report type. The `reportId` is the requested report ID.
3. `kUSB_DeviceHidEventRequestReportBuffer` The structure is used to get the buffer to save the report data sent by the host. The `reportBuffer` is buffer address to receive to report data. It is filled by the application. The `reportLength` is the requested report data buffer length. The `reportType` is the requested report type. The `reportId` is the requested report ID.

## Data Fields

- `uint8_t * reportBuffer`  
*The report buffer address.*
- `uint32_t reportLength`  
*The report data length.*

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- `uint8_t reportType`  
*The report type.*
- `uint8_t reportId`  
*The report ID.*

### 3.9.2.2 struct usb\_device\_hid\_struct\_t

#### Data Fields

- `usb_device_handle handle`  
*The device handle.*
- `usb_device_class_config_struct_t * configStruct`  
*The configuration of the class.*
- `usb_device_interface_struct_t * interfaceHandle`  
*Current interface handle.*
- `uint8_t configuration`  
*Current configuration.*
- `uint8_t interfaceNumber`  
*The interface number of the class.*
- `uint8_t alternate`  
*Current alternate setting of the interface.*
- `uint8_t idleRate`  
*The idle rate of the HID device.*
- `uint8_t protocol`  
*Current protocol.*
- `uint8_t interruptInPipeBusy`  
*Interrupt IN pipe busy flag.*
- `uint8_t interruptOutPipeBusy`  
*Interrupt OUT pipe busy flag.*

### 3.9.2.2.0.21 Field Documentation

3.9.2.2.0.21.1 `usb_device_class_config_struct_t* usb_device_hid_struct_t::configStruct`

## 3.9.3 Macro Definition Documentation

3.9.3.1 `#define USB_DEVICE_HID_REQUEST_GET_REPORT (0x01U)`

3.9.3.2 `#define USB_DEVICE_HID_REQUEST_GET_IDLE (0x02U)`

3.9.3.3 `#define USB_DEVICE_HID_REQUEST_GET_PROTOCOL (0x03U)`

3.9.3.4 `#define USB_DEVICE_HID_REQUEST_SET_REPORT (0x09U)`

3.9.3.5 `#define USB_DEVICE_HID_REQUEST_SET_IDLE (0x0AU)`

3.9.3.6 `#define USB_DEVICE_HID_REQUEST_SET_PROTOCOL (0x0BU)`

## 3.9.4 Enumeration Type Documentation

3.9.4.1 `enum usb_device_hid_event_t`

Enumerator

*kUSB\_DeviceHidEventSendResponse* Send data completed.

*kUSB\_DeviceHidEventRecvResponse* Data received.

*kUSB\_DeviceHidEventGetReport* Get report request.

*kUSB\_DeviceHidEventGetIdle* Get idle request.

*kUSB\_DeviceHidEventGetProtocol* Get protocol request.

*kUSB\_DeviceHidEventSetReport* Set report request.

*kUSB\_DeviceHidEventSetIdle* Set idle request.

*kUSB\_DeviceHidEventSetProtocol* Set protocol request.

*kUSB\_DeviceHidEventRequestReportBuffer* Get buffer to save the data of the set report request.

## 3.9.5 Function Documentation

3.9.5.1 `usb_status_t USB_DeviceHidInit ( uint8_t controllerId, usb_device_class_config_struct_t * config, class_handle_t * handle )`

This function is used to initialize the HID class. This function only can be called by [USB\\_DeviceClassInit](#).

## USB HID Class driver

### Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| in  | <i>config</i>       | The class configuration information.  |
| out | <i>handle</i>       | An parameter used to return pointer of the HID class handle to the caller.                    |

### Returns

A USB error code or `kStatus_USB_Success`.

### 3.9.5.2 `usb_status_t USB_DeviceHidDeinit ( class_handle_t handle )`

The function deinitializes the device HID class. This function only can be called by [USB\\_DeviceClassDeinit](#).

### Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The HID class handle got from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|----|---------------|---|

### Returns

A USB error code or `kStatus_USB_Success`.

### 3.9.5.3 `usb_status_t USB_DeviceHidEvent ( void * handle, uint32_t event, void * param )`

This function handles the event passed to the HID class. This function only can be called by [USB\\_DeviceClassEvent](#).

### Parameters

|         |               |  |
|---------|---------------|--|
| in      | <i>handle</i> | The HID class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_class_event_t</a> .                        |
| in, out | <i>param</i>  | The parameter type is determined by the event code.  |

### Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                                      |  |
|--------------------------------------|--|
| <i>kStatus_USB_Success</i>           | Free device handle successfully.                                       |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle not be found.  |
| <i>kStatus_USB_Invalid-Request</i>   | The request is invalid, and the control pipe is stalled by the caller. |

#### 3.9.5.4 **usb\_status\_t USB\_DeviceHidSend ( class\_handle\_t handle, uint8\_t ep, uint8\_t \* buffer, uint32\_t length )**

The function is used to send data through a specified endpoint. The function calls [USB\\_DeviceSend-Request](#) internally.

Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The HID class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.  |
| in | <i>buffer</i> | The memory address to hold the data need to be sent.   |
| in | <i>length</i> | The data length to be sent.  |

Returns

A USB error code or *kStatus\_USB\_Success*.

Note

The return value indicates whether the sending request is successful or not. The transfer done is notified by *usb\_device\_hid\_interrupt\_in*. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the endpoint callback).

#### 3.9.5.5 **usb\_status\_t USB\_DeviceHidRecv ( class\_handle\_t handle, uint8\_t ep, uint8\_t \* buffer, uint32\_t length )**

The function is used to receive data through a specified endpoint. The function calls [USB\\_DeviceRecv-Request](#) internally.

## USB HID Class driver

### Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The HID class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.  |
| in | <i>buffer</i> | The memory address to save the received data.  |
| in | <i>length</i> | The data length to be received.  |

### Returns

A USB error code or `kStatus_USB_Success`.

### Note

The return value indicates whether the receiving request is successful or not. The transfer done is notified by `usb_device_hid_interrupt_out`. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the endpoint callback).

## 3.10 USB PHDC Class driver

### 3.10.1 Overview

#### Data Structures

- struct `usb_device_phdc_pipe_t`  
*Definition of pipe structure. [More...](#)*
- struct `usb_device_phdc_struct_t`  
*The PHDC device class status structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_CONFIG_PHDC_CLASS_CODE` (0x0F)  
*The class code of the PHDC class.*
- #define `USB_DEVICE_PHDC_REQUEST_SET_FEATURE` (0x03)  
*The PHDC class set Meta-data message preamble feature request.*
- #define `USB_DEVICE_PHDC_REQUEST_CLEAR_FEATURE` (0x01)  
*The PHDC class clear Meta-data message preamble feature request.*
- #define `USB_DEVICE_PHDC_REQUEST_GET_STATUS` (0x00)  
*The PHDC class get data status request.*

#### Enumerations

- enum `usb_device_phdc_event_t` {  
`kUSB_DevicePhdcEventInterruptInSendComplete = 0x01,`  
`kUSB_DevicePhdcEventBulkInSendComplete,`  
`kUSB_DevicePhdcEventDataReceived,`  
`kUSB_DevicePhdcEventSetFeature,`  
`kUSB_DevicePhdcEventClearFeature,`  
`kUSB_DevicePhdcEventGetStatus }`  
*Available common EVENT types in PHDC class callback.*

#### Functions

- `usb_status_t USB_DevicePhdcInit` (uint8\_t controllerId, `usb_device_class_config_struct_t` \*config, `class_handle_t` \*handle)  
*Initializes the PHDC class.*
- `usb_status_t USB_DevicePhdcDeinit` (`class_handle_t` handle)  
*Deinitializes the device PHDC class.*
- `usb_status_t USB_DevicePhdcEvent` (void \*handle, uint32\_t event, void \*param)  
*Handles the event passed to the PHDC class.*

## USB PHDC Class driver

### USB device PHDC class APIs

- [usb\\_status\\_t USB\\_DevicePhdcSend](#) ([class\\_handle\\_t](#) handle, [uint8\\_t](#) ep, [uint8\\_t \\*buffer](#), [uint32\\_t](#) length)  
*Sends data through a specified endpoint.*
- [usb\\_status\\_t USB\\_DevicePhdcRecv](#) ([class\\_handle\\_t](#) handle, [uint8\\_t](#) ep, [uint8\\_t \\*buffer](#), [uint32\\_t](#) length)  
*Receives data through a specified endpoint.*

### 3.10.2 Data Structure Documentation

#### 3.10.2.1 struct [usb\\_device\\_phdc\\_pipe\\_t](#)

##### Data Fields

- [uint8\\_t ep](#)  
*The endpoint number of the pipe.*
- [uint8\\_t isBusy](#)  
*1: The pipe is transferring packet, 0: The pipe is idle.*

##### 3.10.2.1.0.22 Field Documentation

###### 3.10.2.1.0.22.1 [uint8\\_t usb\\_device\\_phdc\\_pipe\\_t::ep](#)

###### 3.10.2.1.0.22.2 [uint8\\_t usb\\_device\\_phdc\\_pipe\\_t::isBusy](#)

#### 3.10.2.2 struct [usb\\_device\\_phdc\\_struct\\_t](#)

##### Data Fields

- [usb\\_device\\_handle](#) handle  
*The device handle.*
- [usb\\_device\\_class\\_config\\_struct\\_t \\* configStruct](#)  
*The configuration of the class.*
- [usb\\_device\\_interface\\_struct\\_t \\* interfaceHandle](#)  
*Current interface handle.*
- [usb\\_device\\_phdc\\_pipe\\_t bulkIn](#)  
*The bulk in pipe for sending data.*
- [usb\\_device\\_phdc\\_pipe\\_t bulkOut](#)  
*The bulk out pipe for receiving data.*
- [usb\\_device\\_phdc\\_pipe\\_t interruptIn](#)  
*The interrupt in pipe for sending data.*
- [uint8\\_t configuration](#)  
*Current configuration.*
- [uint8\\_t interfaceNumber](#)  
*The interface number of the class.*
- [uint8\\_t alternate](#)  
*Current alternate setting of the interface.*



### 3.10.2.2.0.23 Field Documentation

#### 3.10.2.2.0.23.1 `usb_device_class_config_struct_t* usb_device_phdc_struct_t::configStruct`

### 3.10.3 Enumeration Type Documentation

#### 3.10.3.1 `enum usb_device_phdc_event_t`

Enumerator

*kUSB\_DevicePhdcEventInterruptInSendComplete* Send data completed.

*kUSB\_DevicePhdcEventBulkInSendComplete* Send data completed.

*kUSB\_DevicePhdcEventDataReceived* Data received.

*kUSB\_DevicePhdcEventSetFeature* Set feature request.

*kUSB\_DevicePhdcEventClearFeature* Clear feature request.

*kUSB\_DevicePhdcEventGetStatus* Get status request.

### 3.10.4 Function Documentation

#### 3.10.4.1 `usb_status_t USB_DevicePhdcInit ( uint8_t controllerId, usb_device_class_config_struct_t * config, class_handle_t * handle )`

This function is used to initialize the PHDC class.

Parameters

|                     |  |
|---------------------|--|
| <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <code>usb_controller_index_t</code> . |
| <i>config</i>       | The class configuration information.   |
| <i>handle</i>       | An output parameter used to return pointer of the PHDC class handle to the caller.         |

Return values

|                                   |   |
|-----------------------------------|---|
| <i>kStatus_USB_Success</i>        | The PHDC class is initialized successfully.     |
| <i>kStatus_USB_Busy</i>           | No PHDC device handle available for allocation. |
| <i>kStatus_USB_Invalid-Handle</i> | The PHDC device handle allocation failure.      |

## USB PHDC Class driver

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Invalid-Parameter</i> | The USB device handle allocation failure. |
|--------------------------------------|---|

### 3.10.4.2 `usb_status_t USB_DevicePhdcDeinit ( class_handle_t handle )`

The function deinitializes the device PHDC class.

Parameters

|               |   |
|---------------|---|
| <i>handle</i> | The PHDC class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|---------------|---|

Return values

|                                   |  |
|-----------------------------------|--|
| <i>kStatus_USB_Invalid-Handle</i> | The device handle is not found.              |
| <i>kStatus_USB_Success</i>        | The PHDC class is de-initialized successful. |

### 3.10.4.3 `usb_status_t USB_DevicePhdcEvent ( void * handle, uint32_t event, void * param )`

This function handles the event passed to the PHDC class.

Parameters

|         |               |   |
|---------|---------------|---|
| in      | <i>handle</i> | The PHDC class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_class_event_t</a> .                         |
| in, out | <i>param</i>  | The parameter type is determined by the event code.   |

Return values

|                                      |                                  |
|--------------------------------------|----------------------------------|
| <i>kStatus_USB_Success</i>           | Free device handle successfully. |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle is not found.  |

|                                    |   |
|------------------------------------|---|
| <i>kStatus_USB_Invalid-Request</i> | The request is invalid and the control pipe is stalled by the caller. |
|------------------------------------|---|

**3.10.4.4 usb\_status\_t USB\_DevicePhdcSend ( class\_handle\_t handle, uint8\_t ep, uint8\_t \* buffer, uint32\_t length )**

The function is used to send data through a specified endpoint. The function calls [USB\\_DeviceSendRequest](#) internally.

Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The PHDC class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.   |
| in | <i>buffer</i> | The memory address to hold the data to be sent.   |
| in | <i>length</i> | The data length to be sent.   |

Return values

|                                   |                                   |
|-----------------------------------|-----------------------------------|
| <i>kStatus_USB_Invalid-Handle</i> | The device handle is not found.   |
| <i>kStatus_USB_Busy</i>           | The previous transfer is pending. |
| <i>kStatus_USB_Success</i>        | The sending is successful.        |

**3.10.4.5 usb\_status\_t USB\_DevicePhdcRecv ( class\_handle\_t handle, uint8\_t ep, uint8\_t \* buffer, uint32\_t length )**

The function is used to receive data through a specified endpoint. The function calls the [USB\\_DeviceRecvRequest](#) internally.

Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The PHDC class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.   |

## USB PHDC Class driver

|    |               |   |
|----|---------------|---|
| in | <i>buffer</i> | The memory address to save the received data. |
| in | <i>length</i> | The data length want to be received.          |

### Return values

|                                   |                                   |
|-----------------------------------|-----------------------------------|
| <i>kStatus_USB_Invalid-Handle</i> | The device handle is not found.   |
| <i>kStatus_USB_Busy</i>           | The previous transfer is pending. |
| <i>kStatus_USB_Success</i>        | The receiving is successful.      |

## 3.11 USB PRINTER Class driver

### 3.11.1 Overview

#### Data Structures

- struct `usb_device_printer_struct_t`  
*The printer device class instance structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_CONFIG_PRINTER_CLASS_CODE` (0x07)  
*The class code of the printer class.*
- #define `USB_DEVICE_PRINTER_GET_DEVICE_ID` (0x00U)  
*class-specific request GET\_DEVICE\_ID*
- #define `USB_DEVICE_PRINTER_GET_PORT_STATUS` (0x01U)  
*class-specific request GET\_PORT\_STATUS*
- #define `USB_DEVICE_PRINTER_SOFT_RESET` (0x02U)  
*class-specific request SOFT\_RESET*
- #define `USB_DEVICE_PRINTER_PORT_STATUS_PAPER_EMPTY_MASK` (0x20U)  
*Paper empty bit mask for GET\_PORT\_STATUS.*
- #define `USB_DEVICE_PRINTER_PORT_STATUS_SELECT_MASK` (0x10U)  
*Select bit mask for GET\_PORT\_STATUS.*
- #define `USB_DEVICE_PRINTER_PORT_STATUS_NOT_ERROR_MASK` (0x08U)  
*Error bit mask for GET\_PORT\_STATUS.*

#### Enumerations

- enum `usb_device_printer_event_t` {  
`kUSB_DevicePrinterEventRecvResponse` = 0x01U,  
`kUSB_DevicePrinterEventSendResponse`,  
`kUSB_DevicePrinterEventGetDeviceId`,  
`kUSB_DevicePrinterEventGetPortStatus`,  
`kUSB_DevicePrinterEventSoftReset` }  
*Available common EVENT types in printer class callback.*

#### Functions

- `usb_status_t USB_DevicePrinterInit` (uint8\_t controllerId, `usb_device_class_config_struct_t` \*config, `class_handle_t` \*handle)  
*Initializes the printer class.*
- `usb_status_t USB_DevicePrinterDeinit` (`class_handle_t` handle)  
*De-initializes the device printer class.*
- `usb_status_t USB_DevicePrinterEvent` (void \*handle, uint32\_t event, void \*param)  
*Handles the event passed to the printer class.*

## USB PRINTER Class driver

### USB device printer class APIs

- `usb_status_t USB_DevicePrinterSend` (`class_handle_t` handle, `uint8_t` ep, `uint8_t *buffer`, `uint32_t` length)  
*Sends data through a specified endpoint.*
- `usb_status_t USB_DevicePrinterRecv` (`class_handle_t` handle, `uint8_t` ep, `uint8_t *buffer`, `uint32_t` length)  
*Receives data through a specified endpoint.*

### 3.11.2 Data Structure Documentation

#### 3.11.2.1 struct usb\_device\_printer\_struct\_t

##### Data Fields

- `usb_device_handle` deviceHandle  
*The device handle.*
- `usb_device_class_config_struct_t * classConfig`  
*The configuration of the class.*
- `usb_device_interface_struct_t * interfaceHandle`  
*Current interface handle.*
- `uint8_t configuration`  
*Current configuration.*
- `uint8_t interfaceNumber`  
*Interface number in the device descriptor.*
- `uint8_t alternate`  
*Interface alternate value.*
- `uint8_t bulkInBusy`  
*BULK IN pipe busy flag.*
- `uint8_t bulkOutBusy`  
*BULK OUT pipe busy flag.*

#### 3.11.2.1.0.24 Field Documentation

##### 3.11.2.1.0.24.1 usb\_device\_class\_config\_struct\_t\* usb\_device\_printer\_struct\_t::classConfig

### 3.11.3 Enumeration Type Documentation

#### 3.11.3.1 enum usb\_device\_printer\_event\_t

Enumerator

- kUSB\_DevicePrinterEventRecvResponse* Data received.
- kUSB\_DevicePrinterEventSendResponse* Data send done.
- kUSB\_DevicePrinterEventGetDeviceId* Get device ID request.
- kUSB\_DevicePrinterEventGetPortStatus* Get port status request.
- kUSB\_DevicePrinterEventSoftReset* Soft reset request.

### 3.11.4 Function Documentation

**3.11.4.1** `usb_status_t USB_DevicePrinterInit ( uint8_t controllerId, usb-  
_device_class_config_struct_t * config, class_handle_t * handle  
)`

This function is used to initialize the printer class. This function only can be called by [USB\\_DeviceClass-Init](#).

## USB PRINTER Class driver

### Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| in  | <i>config</i>       | The class configuration information.  |
| out | <i>handle</i>       | A parameter used to return a pointer of the printer class handle to the caller.               |

### Returns

A USB error code or `kStatus_USB_Success`.

### 3.11.4.2 `usb_status_t USB_DevicePrinterDeinit ( class_handle_t handle )`

The function de-initializes the device printer class. This function only can be called by [USB\\_DeviceClassDeinit](#).

### Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The printer class handle got from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|----|---------------|---|

### Returns

A USB error code or `kStatus_USB_Success`.

### 3.11.4.3 `usb_status_t USB_DevicePrinterEvent ( void * handle, uint32_t event, void * param )`

This function handles the event passed to the printer class. This function only can be called by [USB\\_DeviceClassEvent](#).

### Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The printer class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|----|---------------|--|



|         |              |  |
|---------|--------------|--|
| in      | <i>event</i> | The event codes. See the enumeration <code>usb_device_class_event_t</code> . |
| in, out | <i>param</i> | The parameter type is determined by the event code.                          |

Returns

A USB error code or `kStatus_USB_Success`.

Return values

|                                    |  |
|------------------------------------|--|
| <i>kStatus_USB_Success</i>         | Process event successfully.  |
| <i>kStatus_USB_Invalid-Handle</i>  | The device handle or parameter is invalid.                             |
| <i>kStatus_USB_Invalid-Request</i> | The request is invalid, and the control pipe is stalled by the caller. |

#### 3.11.4.4 `usb_status_t USB_DevicePrinterSend ( class_handle_t handle, uint8_t ep, uint8_t * buffer, uint32_t length )`

The function is used to send data through a specified endpoint. The function calls [USB\\_DeviceSend-Request](#) internally.

Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The printer class handle received from <code>usb_device_class_config_struct_t::classHandle</code> . |
| in | <i>ep</i>     | Endpoint index.   |
| in | <i>buffer</i> | The memory address to hold the data need to be sent.  |
| in | <i>length</i> | The data length to be sent.   |

Returns

A USB error code or `kStatus_USB_Success`.

Note

The return value indicates whether the sending request is successful or not. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the callback).

## USB PRINTER Class driver

**3.11.4.5** `usb_status_t USB_DevicePrinterRecv ( class_handle_t handle, uint8_t ep,  
uint8_t * buffer, uint32_t length )`

The function is used to receive data through a specified endpoint. The function calls [USB\\_DeviceSend-Request](#) internally.

Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The printer class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.  |
| in | <i>buffer</i> | The memory address to hold the data need to be sent.   |
| in | <i>length</i> | The data length to be sent.  |

Returns

A USB error code or `kStatus_USB_Success`.

Note

The return value indicates whether the sending request is successful or not. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the callback).

## USB VIDEO Class driver

### 3.12 USB VIDEO Class driver

#### 3.12.1 Overview

#### Data Structures

- struct `usb_device_video_mjpeg_payload_header_struct_t`  
*The payload header structure for MJPEG payload format. [More...](#)*
- struct `usb_device_video_probe_and_commit_controls_struct_t`  
*The Video probe and commit controls structure. [More...](#)*
- struct `usb_device_video_still_probe_and_commit_controls_struct_t`  
*The Video still probe and still commit controls structure. [More...](#)*
- struct `usb_device_video_entity_struct_t`  
*The video device class-specific information. [More...](#)*
- struct `usb_device_video_entities_struct_t`  
*The video device class-specific information list. [More...](#)*
- struct `usb_device_video_struct_t`  
*The video device class status structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_VIDEO_STILL_IMAGE_TRIGGER_NORMAL_OPERATION` (0x00U)  
*Video device still image trigger control.*

#### Enumerations

- enum `usb_device_video_event_t` {  
    `kUSB_DeviceVideoEventStreamSendResponse` = 0x01U,  
    `kUSB_DeviceVideoEventStreamRecvResponse`,  
    `kUSB_DeviceVideoEventControlSendResponse`,  
    `kUSB_DeviceVideoEventClassRequestBuffer` }  
*Available common event types in video class callback.*

#### Functions

- `usb_status_t USB_DeviceVideoInit` (uint8\_t controllerId, `usb_device_class_config_struct_t` \*config, `class_handle_t` \*handle)  
*Initializes the video class.*
- `usb_status_t USB_DeviceVideoDeinit` (`class_handle_t` handle)  
*Deinitializes the device video class.*
- `usb_status_t USB_DeviceVideoEvent` (void \*handle, uint32\_t event, void \*param)  
*Handles the event passed to the video class.*

## USB Video class codes

- #define **USB\_DEVICE\_VIDEO\_CC\_VIDEO** (0x0EU)  
*Video device class code.*
- #define **USB\_DEVICE\_VIDEO\_SC\_UNDEFINED** (0x00U)  
*Video device subclass code.*
- #define **USB\_DEVICE\_VIDEO\_SC\_VIDEOCONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_SC\_VIDIOSTREAMING** (0x02U)
- #define **USB\_DEVICE\_VIDEO\_SC\_VIDEO\_INTERFACE\_COLLECTION** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_PC\_PROTOCOL\_UNDEFINED** (0x00U)  
*Video device protocol code.*
- #define **USB\_DEVICE\_VIDEO\_PC\_PROTOCOL\_15** (0x01U)
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_UNDEFINED** (0x20U)  
*Video device class-specific descriptor type.*
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_DEVICE** (0x21U)
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_CONFIGURATION** (0x22U)
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_STRING** (0x23U)
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_INTERFACE** (0x24U)
- #define **USB\_DESCRIPTOR\_TYPE\_VIDEO\_CS\_ENDPOINT** (0x25U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_DESCRIPTOR\_UNDEFINED** (0x00U)  
*Video device class-specific VC interface descriptor subtype.*
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_HEADER** (0x01U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_INPUT\_TERMINAL** (0x02U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_OUTPUT\_TERMINAL** (0x03U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_SELECTOR\_UNIT** (0x04U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_PROCESSING\_UNIT** (0x05U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_EXTENSION\_UNIT** (0x06U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VC\_ENCODING\_UNIT** (0x07U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_UNDEFINED** (0x00U)  
*Video device class-specific VS interface descriptor subtype.*
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_INPUT\_HEADER** (0x01U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_OUTPUT\_HEADER** (0x02U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_STILL\_IMAGE\_FRAME** (0x03U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_UNCOMPRESSED** (0x04-U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FRAME\_UNCOMPRESSED** (0x05U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_MJPEG** (0x06U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FRAME\_MJPEG** (0x07U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_MPEG2TS** (0x0AU)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_DV** (0x0CU)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_COLORFORMAT** (0x0DU)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_FRAME\_BASED** (0x10U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FRAME\_FRAME\_BASED** (0x11U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_STREAM\_BASED** (0x12-U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_H264** (0x13U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FRAME\_H264** (0x14U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_H264\_SIMULCAST** (0x15-U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_VP8** (0x16U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FRAME\_VP8** (0x17U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_VS\_FORMAT\_VP8\_SIMULCAST** (0x18-U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_EP\_UNDEFINED** (0x00U)

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*Video device class-specific VC endpoint descriptor subtype.*

- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_EP\_GENERAL** (0x01U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_EP\_ENDPOINT** (0x02U)
- #define **USB\_DESCRIPTOR\_SUBTYPE\_VIDEO\_EP\_INTERRUPT** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_UNDEFINED** (0x00U)

*Video device class-specific request code.*

- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_SET\_CUR** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_SET\_CUR\_ALL** (0x11U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_CUR** (0x81U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_MIN** (0x82U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_MAX** (0x83U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_RES** (0x84U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_LEN** (0x85U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_INFO** (0x86U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_DEF** (0x87U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_CUR\_ALL** (0x91U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_MIN\_ALL** (0x92U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_MAX\_ALL** (0x93U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_RES\_ALL** (0x94U)
- #define **USB\_DEVICE\_VIDEO\_REQUEST\_CODE\_GET\_DEF\_ALL** (0x97U)
- #define **USB\_DEVICE\_VIDEO\_VC\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific VideoControl interface control selector.*

- #define **USB\_DEVICE\_VIDEO\_VC\_VIDEO\_POWER\_MODE\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_VC\_REQUEST\_ERROR\_CODE\_CONTROL** (0x02U)
- #define **USB\_DEVICE\_VIDEO\_TE\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Terminal control selector.*

- #define **USB\_DEVICE\_VIDEO\_SU\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Selector Unit control selector.*

- #define **USB\_DEVICE\_VIDEO\_SU\_INPUT\_SELECT\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_CT\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Camera Terminal control selector.*

- #define **USB\_DEVICE\_VIDEO\_CT\_SCANNING\_MODE\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_CT\_AE\_MODE\_CONTROL** (0x02U)
- #define **USB\_DEVICE\_VIDEO\_CT\_AE\_PRIORITY\_CONTROL** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x04U)
- #define **USB\_DEVICE\_VIDEO\_CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL** (0x05U)
- #define **USB\_DEVICE\_VIDEO\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x06U)
- #define **USB\_DEVICE\_VIDEO\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x07U)
- #define **USB\_DEVICE\_VIDEO\_CT\_FOCUS\_AUTO\_CONTROL** (0x08U)
- #define **USB\_DEVICE\_VIDEO\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x09U)
- #define **USB\_DEVICE\_VIDEO\_CT\_IRIS\_RELATIVE\_CONTROL** (0x0AU)
- #define **USB\_DEVICE\_VIDEO\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x0BU)
- #define **USB\_DEVICE\_VIDEO\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x0CU)
- #define **USB\_DEVICE\_VIDEO\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x0DU)
- #define **USB\_DEVICE\_VIDEO\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x0EU)
- #define **USB\_DEVICE\_VIDEO\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x0FU)
- #define **USB\_DEVICE\_VIDEO\_CT\_ROLL\_RELATIVE\_CONTROL** (0x10U)
- #define **USB\_DEVICE\_VIDEO\_CT\_PRIVACY\_CONTROL** (0x11U)
- #define **USB\_DEVICE\_VIDEO\_CT\_FOCUS\_SIMPLE\_CONTROL** (0x12U)
- #define **USB\_DEVICE\_VIDEO\_CT\_WINDOW\_CONTROL** (0x13U)
- #define **USB\_DEVICE\_VIDEO\_CT\_REGION\_OF\_INTEREST\_CONTROL** (0x14U)
- #define **USB\_DEVICE\_VIDEO\_PU\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Processing Unit control selector.*

- #define **USB\_DEVICE\_VIDEO\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_PU\_BRIGHTNESS\_CONTROL** (0x02U)

- #define **USB\_DEVICE\_VIDEO\_PU\_CONTRAST\_CONTROL** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_PU\_GAIN\_CONTROL** (0x04U)
- #define **USB\_DEVICE\_VIDEO\_PU\_POWER\_LINE\_FREQUENCY\_CONTROL** (0x05U)
- #define **USB\_DEVICE\_VIDEO\_PU\_HUE\_CONTROL** (0x06U)
- #define **USB\_DEVICE\_VIDEO\_PU\_SATURATION\_CONTROL** (0x07U)
- #define **USB\_DEVICE\_VIDEO\_PU\_SHARPNESS\_CONTROL** (0x08U)
- #define **USB\_DEVICE\_VIDEO\_PU\_GAMMA\_CONTROL** (0x09U)
- #define **USB\_DEVICE\_VIDEO\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x0AU)
- #define **USB\_DEVICE\_VIDEO\_PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL** (0x0BU)
- #define **USB\_DEVICE\_VIDEO\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x0CU)
- #define **USB\_DEVICE\_VIDEO\_PU\_WHITE\_BALANCE\_COMPONENT\_AUTO\_CONTROL** (0x0DU)
- #define **USB\_DEVICE\_VIDEO\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x0EU)
- #define **USB\_DEVICE\_VIDEO\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x0FU)
- #define **USB\_DEVICE\_VIDEO\_PU\_HUE\_AUTO\_CONTROL** (0x10U)
- #define **USB\_DEVICE\_VIDEO\_PU\_ANALOG\_VIDEO\_STANDARD\_CONTROL** (0x11U)
- #define **USB\_DEVICE\_VIDEO\_PU\_ANALOG\_LOCK\_STATUS\_CONTROL** (0x12U)
- #define **USB\_DEVICE\_VIDEO\_PU\_CONTRAST\_AUTO\_CONTROL** (0x13U)
- #define **USB\_DEVICE\_VIDEO\_EU\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Encoding Unit control selector.*

- #define **USB\_DEVICE\_VIDEO\_EU\_SELECT\_LAYER\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_EU\_PROFILE\_TOOLSET\_CONTROL** (0x02U)
- #define **USB\_DEVICE\_VIDEO\_EU\_VIDEO\_RESOLUTION\_CONTROL** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_EU\_MIN\_FRAME\_INTERVAL\_CONTROL** (0x04U)
- #define **USB\_DEVICE\_VIDEO\_EU\_SLICE\_MODE\_CONTROL** (0x05U)
- #define **USB\_DEVICE\_VIDEO\_EU\_RATE\_CONTROL\_MODE\_CONTROL** (0x06U)
- #define **USB\_DEVICE\_VIDEO\_EU\_AVERAGE\_BITRATE\_CONTROL** (0x07U)
- #define **USB\_DEVICE\_VIDEO\_EU\_CPB\_SIZE\_CONTROL** (0x08U)
- #define **USB\_DEVICE\_VIDEO\_EU\_PEAK\_BIT\_RATE\_CONTROL** (0x09U)
- #define **USB\_DEVICE\_VIDEO\_EU\_QUANTIZATION\_PARAMS\_CONTROL** (0x0AU)
- #define **USB\_DEVICE\_VIDEO\_EU\_SYNC\_REF\_FRAME\_CONTROL** (0x0BU)
- #define **USB\_DEVICE\_VIDEO\_EU\_LTR\_BUFFER\_CONTROL** (0x0CU)
- #define **USB\_DEVICE\_VIDEO\_EU\_LTR\_PICTURE\_CONTROL** (0x0DU)
- #define **USB\_DEVICE\_VIDEO\_EU\_LTR\_VALIDATION\_CONTROL** (0x0EU)
- #define **USB\_DEVICE\_VIDEO\_EU\_LEVEL\_IDC\_LIMIT\_CONTROL** (0x0FU)
- #define **USB\_DEVICE\_VIDEO\_EU\_SEI\_PAYLOADTYPE\_CONTROL** (0x10U)
- #define **USB\_DEVICE\_VIDEO\_EU\_QP\_RANGE\_CONTROL** (0x11U)
- #define **USB\_DEVICE\_VIDEO\_EU\_PRIORITY\_CONTROL** (0x12U)
- #define **USB\_DEVICE\_VIDEO\_EU\_START\_OR\_STOP\_LAYER\_CONTROL** (0x13U)
- #define **USB\_DEVICE\_VIDEO\_EU\_ERROR\_RESILIENCY\_CONTROL** (0x14U)
- #define **USB\_DEVICE\_VIDEO\_XU\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific Extension Unit control selector.*

- #define **USB\_DEVICE\_VIDEO\_VS\_CONTROL\_UNDEFINED** (0x00U)

*Video device class-specific VideoStreaming Interface control selector.*

- #define **USB\_DEVICE\_VIDEO\_VS\_PROBE\_CONTROL** (0x01U)
- #define **USB\_DEVICE\_VIDEO\_VS\_COMMIT\_CONTROL** (0x02U)
- #define **USB\_DEVICE\_VIDEO\_VS\_STILL\_PROBE\_CONTROL** (0x03U)
- #define **USB\_DEVICE\_VIDEO\_VS\_STILL\_COMMIT\_CONTROL** (0x04U)
- #define **USB\_DEVICE\_VIDEO\_VS\_STILL\_IMAGE\_TRIGGER\_CONTROL** (0x05U)
- #define **USB\_DEVICE\_VIDEO\_VS\_STREAM\_ERROR\_CODE\_CONTROL** (0x06U)
- #define **USB\_DEVICE\_VIDEO\_VS\_GENERATE\_KEY\_FRAME\_CONTROL** (0x07U)



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- #define **USB\_DEVICE\_VIDEO\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x08U)
- #define **USB\_DEVICE\_VIDEO\_VS\_SYNCH\_DELAY\_CONTROL** (0x09U)

## USB Video class terminal types

- #define **USB\_DEVICE\_VIDEO\_TT\_VENDOR\_SPECIFIC** (0x0100U)  
*Video device USB terminal type.*
- #define **USB\_DEVICE\_VIDEO\_TT\_STREAMING** (0x0101U)
- #define **USB\_DEVICE\_VIDEO\_ITT\_VENDOR\_SPECIFIC** (0x0200U)  
*Video device input terminal type.*
- #define **USB\_DEVICE\_VIDEO\_ITT\_CAMERA** (0x0201U)
- #define **USB\_DEVICE\_VIDEO\_ITT\_MEDIA\_TRANSPORT\_INPUT** (0x0202U)
- #define **USB\_DEVICE\_VIDEO\_OTT\_VENDOR\_SPECIFIC** (0x0300U)  
*Video device output terminal type.*
- #define **USB\_DEVICE\_VIDEO\_OTT\_DISPLAY** (0x0301U)
- #define **USB\_DEVICE\_VIDEO\_OTT\_MEDIA\_TRANSPORT\_OUTPUT** (0x0302U)
- #define **USB\_DEVICE\_VIDEO\_ET\_VENDOR\_SPECIFIC** (0x0400U)  
*Video device external terminal type.*
- #define **USB\_DEVICE\_VIDEO\_ET\_COMPOSITE\_CONNECTOR** (0x0401U)
- #define **USB\_DEVICE\_VIDEO\_ET\_SVIDEO\_CONNECTOR** (0x0402U)
- #define **USB\_DEVICE\_VIDEO\_ET\_COMPONENT\_CONNECTOR** (0x0403U)

## USB Video class setup request types

- #define **USB\_DEVICE\_VIDEO\_SET\_REQUEST\_INTERFACE** (0x21U)  
*Video device class setup request set type.*
- #define **USB\_DEVICE\_VIDEO\_SET\_REQUEST\_ENDPOINT** (0x22U)
- #define **USB\_DEVICE\_VIDEO\_GET\_REQUEST\_INTERFACE** (0xA1U)  
*Video device class setup request get type.*
- #define **USB\_DEVICE\_VIDEO\_GET\_REQUEST\_ENDPOINT** (0xA2U)

## USB Video device class-specific request commands

- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VC\_POWER\_MODE\_CONTROL** (0x8101U)  
*Video device class-specific request GET CUR COMMAND.*
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VC\_ERROR\_CODE\_CONTROL** (0x8102U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x8121U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_BRIGHTNESS\_CONTROL** (0x8122U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_CONTRACT\_CONTROL** (0x8123U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_GAIN\_CONTROL** (0x8124U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_POWER\_LINE\_FREQUENCY\_CONTROL** (0x8125U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_HUE\_CONTROL** (0x8126U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_SATURATION\_CONTROL** (0x8127U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_SHARRNESS\_CONTROL** (0x8128U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_GAMMA\_CONTROL** (0x8129U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x812AU)



- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL** (0x812BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x812CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_WHITE\_BALANCE\_COMPONENT\_AUTO\_CONTROL** (0x812DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x812EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x812FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_HUE\_AUTO\_CONTROL** (0x8130U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_ANALOG\_VIDEO\_STANDARD\_CONTROL** (0x8131U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_PU\_ANALOG\_LOCK\_STATUS\_CONTROL** (0x8132U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_SCANNING\_MODE\_CONTROL** (0x8141U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_AE\_MODE\_CONTROL** (0x8142U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_AE\_PRIORITY\_CONTROL** (0x8143U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x8144U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL** (0x8145U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x8146U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x8147U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_FOCUS\_AUTO\_CONTROL** (0x8148U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x8149U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_IRIS\_RELATIVE\_CONTROL** (0x814AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x814BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x814CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x814DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x814EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x814FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_ROLL\_RELATIVE\_CONTROL** (0x8150U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_CT\_PRIVACY\_CONTROL** (0x8151U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_PROBE\_CONTROL** (0x8161U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_COMMIT\_CONTROL** (0x8162U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_STILL\_PROBE\_CONTROL** (0x8163U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_STILL\_COMMIT\_CONTROL** (0x8164U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_STILL\_IMAGE\_TRIGGER\_CONTROL** (0x8165U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_STREAM\_ERROR\_CODE\_CONTROL** (0x8166U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_GENERATE\_KEY\_FRAME\_CONTROL**

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- L (0x8167U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x8168U)
- #define **USB\_DEVICE\_VIDEO\_GET\_CUR\_VS\_SYNCH\_DELAY\_CONTROL** (0x8169U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x8221U)
- Video device class-specific request GET MIN COMMAND.*
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_BRIGHTNESS\_CONTROL** (0x8222U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_CONTRACT\_CONTROL** (0x8223U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_GAIN\_CONTROL** (0x8224U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_HUE\_CONTROL** (0x8226U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_SATURATION\_CONTROL** (0x8227U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_SHARRNESS\_CONTROL** (0x8228U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_GAMMA\_CONTROL** (0x8229U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x822AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x822CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x822EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x822FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x8244U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x8246U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x8247U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x8249U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x824BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x824CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x824DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x824EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x824FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_CT\_ROLL\_RELATIVE\_CONTROL** (0x8250U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_VS\_PROBE\_CONTROL** (0x8261U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_VS\_STILL\_PROBE\_CONTROL** (0x8263U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_VS\_UPDATE\_FRAME\_SEGMENTCONTROL** (0x8268U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MIN\_VS\_SYNCH\_DELAY\_CONTROL** (0x8269U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_BACKLIGHT\_COMPENSATIONCONTROL** (0x8321U)
- Video device class-specific request GET MAX COMMAND.*
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_BRIGHTNESS\_CONTROL** (0x8322U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_CONTRACT\_CONTROL** (0x8323U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_GAIN\_CONTROL** (0x8324U)

- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_HUE\_CONTROL** (0x8326U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_SATURATION\_CONTROL** (0x8327U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_SHARRNESS\_CONTROL** (0x8328U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_GAMMA\_CONTROL** (0x8329U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x832AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x832CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x832EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x832FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x8344U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x8346U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x8347U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x8349U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x834BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x834CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x834DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x834EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x834FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_CT\_ROLL\_RELATIVE\_CONTROL** (0x8350U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_VS\_PROBE\_CONTROL** (0x8361U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_VS\_STILL\_PROBE\_CONTROL** (0x8363U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x8368U)
- #define **USB\_DEVICE\_VIDEO\_GET\_MAX\_VS\_SYNCH\_DELAY\_CONTROL** (0x8369U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x8421U)

*Video device class-specific request GET RES COMMAND.*

- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_BRIGHTNESS\_CONTROL** (0x8422U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_CONTRACT\_CONTROL** (0x8423U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_GAIN\_CONTROL** (0x8424U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_HUE\_CONTROL** (0x8426U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_SATURATION\_CONTROL** (0x8427U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_SHARRNESS\_CONTROL** (0x8428U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_GAMMA\_CONTROL** (0x8429U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x842AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x842CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_DIGITAL\_MULTIPLIER\_CONTROL**

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- L** (0x842EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x842FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_AE\_MODE\_CONTROL** (0x8442U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x8444U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x8446U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x8447U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x8449U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x844BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x844CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x844DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x844EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x844FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_CT\_ROLL\_RELATIVE\_CONTROL** (0x8450U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_VS\_PROBE\_CONTROL** (0x8461U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_VS\_STILL\_PROBE\_CONTROL** (0x8463U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x8468U)
- #define **USB\_DEVICE\_VIDEO\_GET\_RES\_VS\_SYNCH\_DELAY\_CONTROL** (0x8469U)
- #define **USB\_DEVICE\_VIDEO\_GET\_LEN\_VS\_PROBE\_CONTROL** (0x8561U)
- Video device class-specific request GET LEN COMMAND.*
- #define **USB\_DEVICE\_VIDEO\_GET\_LEN\_VS\_COMMIT\_CONTROL** (0x8562U)
- #define **USB\_DEVICE\_VIDEO\_GET\_LEN\_VS\_STILL\_PROBE\_CONTROL** (0x8563U)
- #define **USB\_DEVICE\_VIDEO\_GET\_LEN\_VS\_STILL\_COMMIT\_CONTROL** (0x8564U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VC\_POWER\_MODE\_CONTROL** (0x8601U)
- Video device class-specific request GET INFO COMMAND.*
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VC\_ERROR\_CODE\_CONTROL** (0x8602U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x8621U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_BRIGHTNESS\_CONTROL** (0x8622U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_CONTRACT\_CONTROL** (0x8623U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_GAIN\_CONTROL** (0x8624U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_POWER\_LINE\_FREQUENCY\_CONTROL** (0x8625U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_HUE\_CONTROL** (0x8626U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_SATURATION\_CONTROL** (0x8627U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_SHARPNES CONTROL** (0x8628U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_GAMMA\_CONTROL** (0x8629U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x862AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL** (0x862BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x862CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_WHITE\_BALANCE\_COMPONENT\_AUTO**

- TO\_CONTROL** (0x862DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x862EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x862FU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_HUE\_AUTO\_CONTROL** (0x8630U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_ANALOG\_VIDEO\_STANDARD\_CONTROL** (0x8631U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_PU\_ANALOG\_LOCK\_STATUS\_CONTROL** (0x8632U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_SCANNING\_MODE\_CONTROL** (0x8641-U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_AE\_MODE\_CONTROL** (0x8642U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_AE\_PRIORITY\_CONTROL** (0x8643U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x8644U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL** (0x8645U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x8646-U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x8647-U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_FOCUS\_AUTO\_CONTROL** (0x8648U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x8649U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_IRIS\_RELATIVE\_CONTROL** (0x864AU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x864-BU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x864-CU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x864-DU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x864-EU)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x864F-U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_ROLL\_RELATIVE\_CONTROL** (0x8650-U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_CT\_PRIVACY\_CONTROL** (0x8651U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_PROBE\_CONTROL** (0x8661U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_COMMIT\_CONTROL** (0x8662U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_STILL\_PROBE\_CONTROL** (0x8663U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_STILL\_COMMIT\_CONTROL** (0x8664U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_STILL\_IMAGE\_TRIGGER\_CONTROL** (0x8665U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_STREAM\_ERROR\_CODE\_CONTROL** (0x8666U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_GENERATE\_KEY\_FRAME\_CONTROL** (0x8667U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x8668U)
- #define **USB\_DEVICE\_VIDEO\_GET\_INFO\_VS\_SYNCH\_DELAY\_CONTROL** (0x8669U)

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- #define `USB_DEVICE_VIDEO_GET_DEF_PU_BACKLIGHT_COMPENSATION_CONTROL` (0x8721U)  
*Video device class-specific request GET DEF COMMAND.*
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_BRIGHTNESS_CONTROL` (0x8722U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_CONTRACT_CONTROL` (0x8723U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_GAIN_CONTROL` (0x8724U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_POWER_LINE_FREQUENCY_CONTROL` (0x8725U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_HUE_CONTROL` (0x8726U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_SATURATION_CONTROL` (0x8727U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_SHARRNESS_CONTROL` (0x8728U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_GAMMA_CONTROL` (0x8729U)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_WHITE_BALANCE_TEMPERATURE_CONTROL` (0x872AU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_WHITE_BALANCE_TEMPERATURE_AUTO_CONTROL` (0x872BU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_WHITE_BALANCE_COMPONENT_CONTROL` (0x872CU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_WHITE_BALANCE_COMPONENT_AUTO_CONTROL` (0x872DU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_DIGITAL_MULTIPLIER_CONTROL` (0x872EU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_DIGITAL_MULTIPLIER_LIMIT_CONTROL` (0x872FU)
- #define `USB_DEVICE_VIDEO_GET_DEF_PU_HUE_AUTO_CONTROL` (0x8730U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_AE_MODE_CONTROL` (0x8742U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_EXPOSURE_TIME_ABSOLUTE_CONTROL` (0x8744U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_FOCUS_ABSOLUTE_CONTROL` (0x8746U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_FOCUS_RELATIVE_CONTROL` (0x8747U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_FOCUS_AUTO_CONTROL` (0x8748U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_IRIS_ABSOLUTE_CONTROL` (0x8749U)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_ZOOM_ABSOLUTE_CONTROL` (0x874BU)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_ZOOM_RELATIVE_CONTROL` (0x874CU)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_PANTILT_ABSOLUTE_CONTROL` (0x874DU)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_PANTILT_RELATIVE_CONTROL` (0x874EU)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_ROLL_ABSOLUTE_CONTROL` (0x874FU)
- #define `USB_DEVICE_VIDEO_GET_DEF_CT_ROLL_RELATIVE_CONTROL` (0x8750U)
- #define `USB_DEVICE_VIDEO_GET_DEF_VS_PROBE_CONTROL` (0x8761U)
- #define `USB_DEVICE_VIDEO_GET_DEF_VS_STILL_PROBE_CONTROL` (0x8763U)
- #define `USB_DEVICE_VIDEO_GET_DEF_VS_UPDATE_FRAME_SEGMENT_CONTROL` (0x8768U)
- #define `USB_DEVICE_VIDEO_GET_DEF_VS_SYNCH_DELAY_CONTROL` (0x8769U)
- #define `USB_DEVICE_VIDEO_SET_CUR_VC_POWER_MODE_CONTROL` (0x0101U)



*Video device class-specific request SET\_CUR COMMAND.*

- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL** (0x0121U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_BRIGHTNESS\_CONTROL** (0x0122U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_CONTRACT\_CONTROL** (0x0123U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_GAIN\_CONTROL** (0x0124U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_POWER\_LINE\_FREQUENCY\_CONTROL** (0x0125U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_HUE\_CONTROL** (0x0126U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_SATURATION\_CONTROL** (0x0127U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_SHARRNESS\_CONTROL** (0x0128U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_GAMMA\_CONTROL** (0x0129U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL** (0x012AU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL** (0x012BU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL** (0x012CU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_WHITE\_BALANCE\_COMPONENT\_AUTO\_CONTROL** (0x012DU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_DIGITAL\_MULTIPLIER\_CONTROL** (0x012EU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL** (0x012FU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_PU\_HUE\_AUTO\_CONTROL** (0x0130U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_SCANNING\_MODE\_CONTROL** (0x0141U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_AE\_MODE\_CONTROL** (0x0142U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_AE\_PRIORITY\_CONTROL** (0x0143U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL** (0x0144U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL** (0x0145U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_FOCUS\_ABSOLUTE\_CONTROL** (0x0146U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_FOCUS\_RELATIVE\_CONTROL** (0x0147U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_FOCUS\_AUTO\_CONTROL** (0x0148U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_IRIS\_ABSOLUTE\_CONTROL** (0x0149U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_IRIS\_RELATIVE\_CONTROL** (0x014AU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_ZOOM\_ABSOLUTE\_CONTROL** (0x014BU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_ZOOM\_RELATIVE\_CONTROL** (0x014CU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_PANTILT\_ABSOLUTE\_CONTROL** (0x014DU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_PANTILT\_RELATIVE\_CONTROL** (0x014EU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_ROLL\_ABSOLUTE\_CONTROL** (0x014FU)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_ROLL\_RELATIVE\_CONTROL** (0x0150U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_CT\_PRIVACY\_CONTROL** (0x0151U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_PROBE\_CONTROL** (0x0161U)

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- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_COMMIT\_CONTROL** (0x0162U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_STILL\_PROBE\_CONTROL** (0x0163U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_STILL\_COMMIT\_CONTROL** (0x0164U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_STILL\_IMAGE\_TRIGGER\_CONTROL** (0x0165U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_STREAM\_ERROR\_CODE\_CONTROL** (0x0166U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_GENERATE\_KEY\_FRAME\_CONTROL** (0x0167U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL** (0x0168U)
- #define **USB\_DEVICE\_VIDEO\_SET\_CUR\_VS\_SYNCH\_DELAY\_CONTROL** (0x0169U)

## USB device video class APIs

- [usb\\_status\\_t USB\\_DeviceVideoSend](#) ([class\\_handle\\_t](#) handle, [uint8\\_t](#) ep, [uint8\\_t](#) \*buffer, [uint32\\_t](#) length)  
*Sends data through a specified endpoint.*
- [usb\\_status\\_t USB\\_DeviceVideoRecv](#) ([class\\_handle\\_t](#) handle, [uint8\\_t](#) ep, [uint8\\_t](#) \*buffer, [uint32\\_t](#) length)  
*Receives data through a specified endpoint.*

### 3.12.2 Data Structure Documentation

#### 3.12.2.1 struct\_usb\_device\_video\_mjpeg\_payload\_header\_struct

##### Data Fields

- [uint8\\_t bHeaderLength](#)  
*The payload header length.*
- [uint32\\_t dwPresentationTime](#)  
*Presentation time stamp (PTS) field.*
- [uint8\\_t bSourceClockReference](#) [6]  
*Source clock reference (SCR) field.*
- [uint8\\_t bmheaderInfo](#)  
*The payload header bitmap field.*
- [uint8\\_t frameIdentifier](#): 1U  
*Frame Identifier.*
- [uint8\\_t endOfFrame](#): 1U  
*End of Frame.*
- [uint8\\_t presentationTimeStamp](#): 1U  
*Presentation Time Stamp.*
- [uint8\\_t sourceClockReference](#): 1U  
*Source Clock Reference.*
- [uint8\\_t reserved](#): 1U  
*Reserved.*
- [uint8\\_t stillImage](#): 1U  
*Still Image.*



- uint8\_t **errorBit**: 1U  
*Error Bit.*
- uint8\_t **endOfHeader**: 1U  
*End of Header.*
- uint8\_t **FID**: 1U  
*Frame Identifier.*
- uint8\_t **EOI**: 1U  
*End of Frame.*
- uint8\_t **PTS**: 1U  
*Presentation Time Stamp.*
- uint8\_t **SCR**: 1U  
*Source Clock Reference.*
- uint8\_t **RES**: 1U  
*Reserved.*
- uint8\_t **STI**: 1U  
*Still Image.*
- uint8\_t **ERR**: 1U  
*Error Bit.*
- uint8\_t **EOH**: 1U  
*End of Header.*

### 3.12.2.1.0.25 Field Documentation

**3.12.2.1.0.25.1** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::bHeaderLength

**3.12.2.1.0.25.2** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::bmheaderInfo

**3.12.2.1.0.25.3** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::frameIdentifier

This bit toggles at each frame start boundary and stays constant for the rest of the frame.

**3.12.2.1.0.25.4** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::endOfFrame

This bit indicates the end of a video frame and is set in the last video sample that belongs to a frame.

**3.12.2.1.0.25.5** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::presentationTime-Stamp

This bit, when set, indicates the presence of a PTS field.

**3.12.2.1.0.25.6** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::sourceClock-Reference

This bit, when set, indicates the presence of a SCR field.

**3.12.2.1.0.25.7** uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::reserved

Set to 0.

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### **3.12.2.1.0.25.8 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::stillImage**

This bit, when set, identifies a video sample that belongs to a still image.

### **3.12.2.1.0.25.9 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::errorBit**

This bit, when set, indicates an error in the device streaming.

### **3.12.2.1.0.25.10 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::endOfHeader**

This bit, when set, indicates the end of the BFH fields.

### **3.12.2.1.0.25.11 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::FID**

This bit toggles at each frame start boundary and stays constant for the rest of the frame.

### **3.12.2.1.0.25.12 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::EOI**

This bit indicates the end of a video frame and is set in the last video sample that belongs to a frame.

### **3.12.2.1.0.25.13 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::PTS**

This bit, when set, indicates the presence of a PTS field.

### **3.12.2.1.0.25.14 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::SCR**

This bit, when set, indicates the presence of a SCR field.

### **3.12.2.1.0.25.15 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::RES**

Set to 0.

### **3.12.2.1.0.25.16 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::STI**

This bit, when set, identifies a video sample that belongs to a still image.

### **3.12.2.1.0.25.17 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::ERR**

This bit, when set, indicates an error in the device streaming.

### **3.12.2.1.0.25.18 uint8\_t usb\_device\_video\_mjpeg\_payload\_header\_struct\_t::EOH**

This bit, when set, indicates the end of the BFH fields.

3.12.2.1.0.25.19 `uint32_t usb_device_video_mjpeg_payload_header_struct_t::dwPresentationTime`

3.12.2.1.0.25.20 `uint8_t usb_device_video_mjpeg_payload_header_struct_t::bSourceClockReference[6]`

### 3.12.2.2 `struct _usb_device_video_probe_and_commit_controls_struct`

#### Data Fields

- `uint8_t bFormatIndex`  
*Video format index from a format descriptor.*
- `uint8_t bFrameIndex`  
*Video frame index from a frame descriptor.*
- `uint32_t dwFrameInterval`  
*Frame interval in 100ns units.*
- `uint16_t wKeyFrameRate`  
*Key frame rate in key-frame per video-frame units.*
- `uint16_t wPFrameRate`  
*PFrame rate in PFrame/key frame units.*
- `uint16_t wCompQuality`  
*Compression quality control in abstract units 0U (lowest) to 10000U (highest).*
- `uint16_t wCompWindowSize`  
*Window size for average bit rate control.*
- `uint16_t wDelay`  
*Internal video streaming interface latency in ms from video data capture to presentation on the USB.*
- `uint32_t dwMaxVideoFrameSize`  
*Maximum video frame or codec-specific segment size in bytes.*
- `uint32_t dwMaxPayloadTransferSize`  
*Specifies the maximum number of bytes that the device can transmit or receive in a single payload transfer.*
- `uint32_t dwClockFrequency`  
*The device clock frequency in Hz for the specified format.*
- `uint8_t bmFramingInfo`  
*Bit-field control supporting the following values: D0 Frame ID, D1 EOF.*
- `uint8_t bPreferredVersion`  
*The preferred payload format version supported by the host or device for the specified bFormatIndex value.*
- `uint8_t bMinVersion`  
*The minimum payload format version supported by the device for the specified bFormatIndex value.*
- `uint8_t bMaxVersion`  
*The maximum payload format version supported by the device for the specified bFormatIndex value.*
- `uint16_t bmHint`  
*Bit-field control indicating to the function what fields shall be kept fixed.*
- `uint8_t dwFrameInterval: 1U`  
*dwFrameInterval field.*
- `uint8_t wKeyFrameRate: 1U`  
*wKeyFrameRate field.*
- `uint8_t wPFrameRate: 1U`  
*wPFrameRate field.*
- `uint8_t wCompQuality: 1U`  
*wCompQuality field.*
- `uint8_t wCompWindowSize: 1U`

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*wCompWindowSize* field.

### 3.12.2.2.0.26 Field Documentation

- 3.12.2.2.0.26.1 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::bmHint`
- 3.12.2.2.0.26.2 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::dwFrameInterval`
- 3.12.2.2.0.26.3 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::wKeyFrameRate`
- 3.12.2.2.0.26.4 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::wPFrameRate`
- 3.12.2.2.0.26.5 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::wCompQuality`
- 3.12.2.2.0.26.6 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::wCompWindowSize`
- 3.12.2.2.0.26.7 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bFormatIndex`
- 3.12.2.2.0.26.8 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bFrameIndex`
- 3.12.2.2.0.26.9 `uint32_t usb_device_video_probe_and_commit_controls_struct_t::dwFrameInterval`
- 3.12.2.2.0.26.10 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::wKeyFrameRate`
- 3.12.2.2.0.26.11 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::wPFrameRate`
- 3.12.2.2.0.26.12 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::wCompQuality`
- 3.12.2.2.0.26.13 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::wCompWindowSize`
- 3.12.2.2.0.26.14 `uint16_t usb_device_video_probe_and_commit_controls_struct_t::wDelay`
- 3.12.2.2.0.26.15 `uint32_t usb_device_video_probe_and_commit_controls_struct_t::dwMaxVideoFrameSize`
- 3.12.2.2.0.26.16 `uint32_t usb_device_video_probe_and_commit_controls_struct_t::dwMaxPayloadTransferSize`
- 3.12.2.2.0.26.17 `uint32_t usb_device_video_probe_and_commit_controls_struct_t::dwClockFrequency`

This specifies the units used for the time information fields in the Video Payload Headers in the data stream.

3.12.2.2.0.26.18 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bmFramingInfo`

3.12.2.2.0.26.19 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bPreferredVersion`

3.12.2.2.0.26.20 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bMinVersion`

3.12.2.2.0.26.21 `uint8_t usb_device_video_probe_and_commit_controls_struct_t::bMaxVersion`

### 3.12.2.3 `struct usb_device_video_still_probe_and_commit_controls_struct`

#### Data Fields

- `uint8_t bFormatIndex`  
*Video format index from a format descriptor.*
- `uint8_t bFrameIndex`  
*Video frame index from a frame descriptor.*
- `uint8_t bCompressionIndex`  
*Compression index from a frame descriptor.*
- `uint32_t dwMaxVideoFrameSize`  
*Maximum still image size in bytes.*
- `uint32_t dwMaxPayloadTransferSize`  
*Specifies the maximum number of bytes that the device can transmit or receive in a single payload transfer.*

#### 3.12.2.3.0.27 Field Documentation

3.12.2.3.0.27.1 `uint8_t usb_device_video_still_probe_and_commit_controls_struct_t::bFormatIndex`

3.12.2.3.0.27.2 `uint8_t usb_device_video_still_probe_and_commit_controls_struct_t::bFrameIndex`

3.12.2.3.0.27.3 `uint8_t usb_device_video_still_probe_and_commit_controls_struct_t::bCompressionIndex`

3.12.2.3.0.27.4 `uint32_t usb_device_video_still_probe_and_commit_controls_struct_t::dwMaxVideoFrameSize`

3.12.2.3.0.27.5 `uint32_t usb_device_video_still_probe_and_commit_controls_struct_t::dwMaxPayloadTransferSize`

### 3.12.2.4 `struct usb_device_video_entity_struct_t`

The structure is used to pass the video entity information filled by application. Such as entity id (unit or terminal ID), entity type (unit or terminal type), and terminal type if the entity is a terminal.

## USB VIDEO Class driver

### 3.12.2.5 struct usb\_device\_video\_entities\_struct\_t

The structure is used to pass the video entity informations filled by the application. The type of each entity is the `usb_device_video_entity_struct_t`. The structure pointer is kept in the `usb_device_interface_struct_t::classSpecific`, such as, if there are three entities(out terminal, camera terminal, and processing unit), the value of the count field is 3U and the entity field saves the every entity information.

### 3.12.2.6 struct usb\_device\_video\_struct\_t

#### Data Fields

- `usb_device_handle` handle  
*The device handle.*
- `usb_device_class_config_struct_t * configStruct`  
*The configuration of the class.*
- `usb_device_interface_struct_t * controlInterfaceHandle`  
*Current control interface handle.*
- `usb_device_interface_struct_t * streamInterfaceHandle`  
*Current stream interface handle.*
- `uint8_t configuration`  
*Current configuration.*
- `uint8_t controlInterfaceNumber`  
*The control interface number of the class.*
- `uint8_t controlAlternate`  
*Current alternate setting of the control interface.*
- `uint8_t streamInterfaceNumber`  
*The stream interface number of the class.*
- `uint8_t streamAlternate`  
*Current alternate setting of the stream interface.*
- `uint8_t streamInPipeBusy`  
*Stream IN pipe busy flag.*
- `uint8_t streamOutPipeBusy`  
*Stream OUT pipe busy flag.*

#### 3.12.2.6.0.28 Field Documentation

##### 3.12.2.6.0.28.1 usb\_device\_class\_config\_struct\_t\* usb\_device\_video\_struct\_t::configStruct

### 3.12.3 Enumeration Type Documentation

#### 3.12.3.1 enum usb\_device\_video\_event\_t

Enumerator

- kUSB\_DeviceVideoEventStreamSendResponse* Send data completed in stream pipe.
- kUSB\_DeviceVideoEventStreamRecvResponse* Data received in stream pipe.
- kUSB\_DeviceVideoEventControlSendResponse* Send data completed in video control pipe.
- kUSB\_DeviceVideoEventClassRequestBuffer* Get buffer to save the data of the video class-specific

request.

### 3.12.4 Function Documentation

#### 3.12.4.1 `usb_status_t USB_DeviceVideoInit ( uint8_t controllerId, usb_device_class_config_struct_t * config, class_handle_t * handle )`

This function is used to initialize the video class. This function can only be called by the [USB\\_Device-ClassInit](#).

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| in | <i>config</i>       | The class configuration information.  |
| in | <i>handle</i>       | An parameter used to return pointer of the video class handle to the caller.                  |

Returns

A USB error code or `kStatus_USB_Success`.

#### 3.12.4.2 `usb_status_t USB_DeviceVideoDeinit ( class_handle_t handle )`

The function deinitializes the device video class. This function can only be called by the [USB\\_Device-ClassDeinit](#).

Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The video class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
|----|---------------|--|

Returns

A USB error code or `kStatus_USB_Success`.

#### 3.12.4.3 `usb_status_t USB_DeviceVideoEvent ( void * handle, uint32_t event, void * param )`

This function handles the event passed to the video class. This function can only be called by the [USB\\_DeviceClassEvent](#).

## USB VIDEO Class driver

### Parameters

|         |               |  |
|---------|---------------|--|
| in      | <i>handle</i> | The video class handle received from the <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in      | <i>event</i>  | The event codes. See the enumeration <a href="#">usb_device_class_event_t</a> .                          |
| in, out | <i>param</i>  | The parameter type is determined by the event code.  |

### Returns

A USB error code or `kStatus_USB_Success`.

### Return values

|                                      |   |
|--------------------------------------|---|
| <i>kStatus_USB_Success</i>           | Free device handle successfully.                                      |
| <i>kStatus_USB_Invalid-Parameter</i> | The device handle is not found.                                       |
| <i>kStatus_USB_Invalid-Request</i>   | The request is invalid and the control pipe is stalled by the caller. |

### 3.12.4.4 `usb_status_t USB_DeviceVideoSend ( class_handle_t handle, uint8_t ep, uint8_t * buffer, uint32_t length )`

The function is used to send data through a specified endpoint. The function calls [USB\\_DeviceSend-Request](#) internally.

### Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The video class handle received from <a href="#">usb_device_class_config_struct_t::classHandle</a> . |
| in | <i>ep</i>     | Endpoint index.  |
| in | <i>buffer</i> | The memory address to hold the data need to be sent.   |
| in | <i>length</i> | The data length to be sent.  |

### Returns

A USB error code or `kStatus_USB_Success`.



## Note

The return value indicates whether the sending request is successful or not. The transfer done is notified by `USB_DeviceVideoStreamIn` or `USB_DeviceVideoControlIn`. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the endpoint callback).

### 3.12.4.5 `usb_status_t USB_DeviceVideoRecv ( class_handle_t handle, uint8_t ep, uint8_t * buffer, uint32_t length )`

The function is used to receive data through a specified endpoint. The function calls the `USB_DeviceRecvRequest` internally.

## Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The video class handle got from <code>usb_device_class_config_struct_t::classHandle</code> . |
| in | <i>ep</i>     | Endpoint index.  |
| in | <i>buffer</i> | The memory address to save the received data.  |
| in | <i>length</i> | The data length want to be received.   |

## Returns

A USB error code or `kStatus_USB_Success`.

## Note

The return value indicates whether the receiving request is successful or not. The transfer done is notified by `USB_DeviceVideoStreamOut`. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the endpoint callback).



## Chapter 4 USB Device driver

### 4.1 Overview

The USB device provides the device APIs to support the class driver and lite/non-lite application. It includes the USB controller driver only which consist of the common controller driver and xHCI driver.

### Modules

- [USB Device Configuration](#)
- [USB Device Controller driver](#)
- [USB Device Spec Chapter 9 driver](#)

### Data Structures

- struct [usb\\_device\\_endpoint\\_callback\\_message\\_struct\\_t](#)  
*Endpoint callback message structure. [More...](#)*
- struct [usb\\_device\\_endpoint\\_callback\\_struct\\_t](#)  
*Endpoint callback structure. [More...](#)*
- struct [usb\\_device\\_endpoint\\_init\\_struct\\_t](#)  
*Endpoint initialization structure. [More...](#)*
- struct [usb\\_device\\_endpoint\\_status\\_struct\\_t](#)  
*Endpoint status structure. [More...](#)*

### Macros

- #define [USB\\_CONTROL\\_ENDPOINT](#) (0U)  
*Control endpoint index.*
- #define [USB\\_CONTROL\\_MAX\\_PACKET\\_SIZE](#) (64U)  
*Control endpoint maxPacketSize.*
- #define [USB\\_SETUP\\_PACKET\\_SIZE](#) (8U)  
*The setup packet size of USB control transfer.*
- #define [USB\\_ENDPOINT\\_NUMBER\\_MASK](#) (0x0FU)  
*USB endpoint mask.*
- #define [USB\\_UNINITIALIZED\\_VAL\\_32](#) (0xFFFFFFFFFU)  
*Default invalid value or the endpoint callback length of cancelled transfer.*

### Typedefs

- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_endpoint\\_callback\\_t](#))([usb\\_device\\_handle](#) handle, [usb\\_device\\_endpoint\\_callback\\_message\\_struct\\_t](#) \*message, void \*callbackParam)  
*Endpoint callback function typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_callback\\_t](#))([usb\\_device\\_handle](#) handle, uint32\_t callbackEvent, void \*eventParam)  
*Device callback function typedef.*

### Enumerations

- enum `usb_device_status_t` {  
    `kUSB_DeviceStatusTestMode` = 1U,  
    `kUSB_DeviceStatusSpeed`,  
    `kUSB_DeviceStatusOtg`,  
    `kUSB_DeviceStatusDevice`,  
    `kUSB_DeviceStatusEndpoint`,  
    `kUSB_DeviceStatusDeviceState`,  
    `kUSB_DeviceStatusAddress`,  
    `kUSB_DeviceStatusSynchFrame`,  
    `kUSB_DeviceStatusBus`,  
    `kUSB_DeviceStatusBusSuspend`,  
    `kUSB_DeviceStatusBusSleep`,  
    `kUSB_DeviceStatusBusResume`,  
    `kUSB_DeviceStatusRemoteWakeup`,  
    `kUSB_DeviceStatusBusSleepResume` }  
    *Defines Get/Set status Types.*
- enum `usb_device_state_t` {  
    `kUSB_DeviceStateConfigured` = 0U,  
    `kUSB_DeviceStateAddress`,  
    `kUSB_DeviceStateDefault`,  
    `kUSB_DeviceStateAddressing`,  
    `kUSB_DeviceStateTestMode` }  
    *Defines USB 2.0 device state.*
- enum `usb_device_endpoint_status_t` {  
    `kUSB_DeviceEndpointStateIdle` = 0U,  
    `kUSB_DeviceEndpointStateStalled` }  
    *Defines endpoint state.*
- enum `usb_device_event_t` {

```

kUSB_DeviceEventBusReset = 1U,
kUSB_DeviceEventSuspend,
kUSB_DeviceEventResume,
kUSB_DeviceEventSlept,
kUSB_DeviceEventLPMResume,
kUSB_DeviceEventError,
kUSB_DeviceEventDetach,
kUSB_DeviceEventAttach,
kUSB_DeviceEventSetConfiguration,
kUSB_DeviceEventSetInterface,
kUSB_DeviceEventGetDeviceDescriptor,
kUSB_DeviceEventGetConfigurationDescriptor,
kUSB_DeviceEventGetStringDescriptor,
kUSB_DeviceEventGetHidDescriptor,
kUSB_DeviceEventGetHidReportDescriptor,
kUSB_DeviceEventGetHidPhysicalDescriptor,
kUSB_DeviceEventGetBOSDescriptor,
kUSB_DeviceEventGetDeviceQualifierDescriptor,
kUSB_DeviceEventVendorRequest,
kUSB_DeviceEventSetRemoteWakeup,
kUSB_DeviceEventGetConfiguration,
kUSB_DeviceEventGetInterface }

```

*Available common EVENT types in device callback.*

## USB device APIs

- `usb_status_t USB_DeviceInit` (`uint8_t` controllerId, `usb_device_callback_t` deviceCallback, `usb_device_handle` \*handle)
  - Initializes the USB device stack.*
- `usb_status_t USB_DeviceRun` (`usb_device_handle` handle)
  - Enables the device functionality.*
- `usb_status_t USB_DeviceStop` (`usb_device_handle` handle)
  - Disables the device functionality.*
- `usb_status_t USB_DeviceDeinit` (`usb_device_handle` handle)
  - De-initializes the device controller.*
- `usb_status_t USB_DeviceSendRequest` (`usb_device_handle` handle, `uint8_t` endpointAddress, `uint8_t` \*buffer, `uint32_t` length)
  - Sends data through a specified endpoint.*
- `usb_status_t USB_DeviceRecvRequest` (`usb_device_handle` handle, `uint8_t` endpointAddress, `uint8_t` \*buffer, `uint32_t` length)
  - Receives data through a specified endpoint.*
- `usb_status_t USB_DeviceCancel` (`usb_device_handle` handle, `uint8_t` endpointAddress)
  - Cancels the pending transfer in a specified endpoint.*
- `usb_status_t USB_DeviceInitEndpoint` (`usb_device_handle` handle, `usb_device_endpoint_init_struct_t` \*epInit, `usb_device_endpoint_callback_struct_t` \*endpointCallback)
  - Initializes a specified endpoint.*
- `usb_status_t USB_DeviceDeinitEndpoint` (`usb_device_handle` handle, `uint8_t` endpointAddress)

## Data Structure Documentation

- Deinitializes a specified endpoint.*
- `usb_status_t USB_DeviceStallEndpoint` (`usb_device_handle` handle, `uint8_t` endpointAddress)  
*Stalls a specified endpoint.*
- `usb_status_t USB_DeviceUnstallEndpoint` (`usb_device_handle` handle, `uint8_t` endpointAddress)  
*Unstalls a specified endpoint.*
- `usb_status_t USB_DeviceGetStatus` (`usb_device_handle` handle, `usb_device_status_t` type, void \*param)  
*Gets the status of the selected item.*
- `usb_status_t USB_DeviceSetStatus` (`usb_device_handle` handle, `usb_device_status_t` type, void \*param)  
*Sets the status of the selected item.*
- void `USB_DeviceTaskFunction` (void \*deviceHandle)  
*Device task function.*
- void `USB_DeviceKhciIsrFunction` (void \*deviceHandle)  
*Device KHCI ISR function.*
- void `USB_DeviceEhciIsrFunction` (void \*deviceHandle)  
*Device EHCI ISR function.*
- void `USB_DeviceLpcIp3511IsrFunction` (void \*deviceHandle)  
*Device LPC USB ISR function.*
- void `USB_DeviceGetVersion` (`uint32_t` \*version)  
*Gets the device stack version function.*
- `usb_status_t USB_DeviceUpdateHwTick` (`usb_device_handle` handle, `uint64_t` tick)  
*Update the hardware tick.*
- `#define USB_DeviceKhciTaskFunction(deviceHandle) USB_DeviceTaskFunction(deviceHandle)`  
*Device KHCI task function.*
- `#define USB_DeviceEhciTaskFunction(deviceHandle) USB_DeviceTaskFunction(deviceHandle)`  
*Device EHCI task function.*
- `#define USB_DeviceLpcIp3511TaskFunction(deviceHandle) USB_DeviceTaskFunction(deviceHandle)`  
*Device LPC ip3511 controller task function.*

## 4.2 Data Structure Documentation

### 4.2.1 struct usb\_device\_endpoint\_callback\_message\_struct\_t

#### Data Fields

- `uint8_t * buffer`  
*Transferred buffer.*
- `uint32_t length`  
*Transferred data length.*
- `uint8_t isSetup`  
*Is in a setup phase.*

## 4.2.2 struct usb\_device\_endpoint\_callback\_struct\_t

### Data Fields

- [usb\\_device\\_endpoint\\_callback\\_t callbackFn](#)  
*Endpoint callback function.*
- void \* [callbackParam](#)  
*Parameter for callback function.*

## 4.2.3 struct usb\_device\_endpoint\_init\_struct\_t

### Data Fields

- uint16\_t [maxPacketSize](#)  
*Endpoint maximum packet size.*
- uint8\_t [endpointAddress](#)  
*Endpoint address.*
- uint8\_t [transferType](#)  
*Endpoint transfer type.*
- uint8\_t [zlt](#)  
*ZLT flag.*

## 4.2.4 struct usb\_device\_endpoint\_status\_struct\_t

### Data Fields

- uint8\_t [endpointAddress](#)  
*Endpoint address.*
- uint16\_t [endpointStatus](#)  
*Endpoint status : idle or stalled.*

## 4.3 Macro Definition Documentation

### 4.3.1 #define USB\_SETUP\_PACKET\_SIZE (8U)

### 4.3.2 #define USB\_DeviceKhciTaskFunction( *deviceHandle* ) USB\_DeviceTaskFunction(deviceHandle)

The function is used to handle the KHCI controller message. In the bare metal environment, this function should be called periodically in the main function. In the RTOS environment, this function should be used as a function entry to create a task.

## Typedef Documentation

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.3.3 #define USB\_DeviceEhciTaskFunction( *deviceHandle* ) USB\_DeviceTaskFunction(*deviceHandle*)

The function is used to handle the EHCI controller message. In the bare metal environment, this function should be called periodically in the main function. In the RTOS environment, this function should be used as a function entry to create a task.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.3.4 #define USB\_DeviceLpctlp3511TaskFunction( *deviceHandle* ) USB\_DeviceTaskFunction(*deviceHandle*)

The function is used to handle the LPC ip3511 controller message. In the bare metal environment, this function should be called periodically in the main function. In the RTOS environment, this function should be used as a function entry to create a task.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

## 4.4 Typedef Documentation

### 4.4.1 typedef usb\_status\_t(\*usb\_device\_endpoint\_callback\_t)(usb\_device\_handle handle, usb\_device\_endpoint\_callback\_message\_struct\_t \*message, void \*callbackParam)

This callback function is used to notify the upper layer what the transfer result is. This callback pointer is passed when a specified endpoint is initialized by calling API [USB\\_DeviceInitEndpoint](#).

Parameters

---



|                      |   |
|----------------------|---|
| <i>handle</i>        | The device handle. It equals to the value returned from <a href="#">USB_DeviceInit</a> .  |
| <i>message</i>       | The result of a transfer, which includes transfer buffer, transfer length, and whether is in a setup phase. phase for control pipe. |
| <i>callbackParam</i> | The parameter for this callback. It is same with <a href="#">usb_device_endpoint_callback_struct_t::callbackParam</a> .             |

Returns

A USB error code or `kStatus_USB_Success`.

### 4.4.2 `typedef usb_status_t(* usb_device_callback_t)(usb_device_handle handle, uint32_t callbackEvent, void *eventParam)`

This callback function is used to notify the upper layer that the device status has changed. This callback pointer is passed by calling API [USB\\_DeviceInit](#).

Parameters

|                      |  |
|----------------------|--|
| <i>handle</i>        | The device handle. It equals the value returned from <a href="#">USB_DeviceInit</a> .          |
| <i>callbackEvent</i> | The callback event type. See enumeration <a href="#">usb_device_event_t</a> .                  |
| <i>eventParam</i>    | The event parameter for this callback. The parameter type is determined by the callback event. |

Returns

A USB error code or `kStatus_USB_Success`.

## 4.5 Enumeration Type Documentation

### 4.5.1 `enum usb_device_status_t`

Enumerator

*kUSB\_DeviceStatusTestMode* Test mode.  
*kUSB\_DeviceStatusSpeed* Current speed.  
*kUSB\_DeviceStatusOtg* OTG status.  
*kUSB\_DeviceStatusDevice* Device status.  
*kUSB\_DeviceStatusEndpoint* Endpoint state [usb\\_device\\_endpoint\\_status\\_t](#).  
*kUSB\_DeviceStatusDeviceState* Device state.  
*kUSB\_DeviceStatusAddress* Device address.  
*kUSB\_DeviceStatusSynchFrame* Current frame.  
*kUSB\_DeviceStatusBus* Bus status.  
*kUSB\_DeviceStatusBusSuspend* Bus suspend.

## Enumeration Type Documentation

*kUSB\_DeviceStatusBusSleep* Bus suspend.  
*kUSB\_DeviceStatusBusResume* Bus resume.  
*kUSB\_DeviceStatusRemoteWakeup* Remote wakeup state.  
*kUSB\_DeviceStatusBusSleepResume* Bus resume.

### 4.5.2 enum usb\_device\_state\_t

Enumerator

*kUSB\_DeviceStateConfigured* Device state, Configured.  
*kUSB\_DeviceStateAddress* Device state, Address.  
*kUSB\_DeviceStateDefault* Device state, Default.  
*kUSB\_DeviceStateAddressing* Device state, Address setting.  
*kUSB\_DeviceStateTestMode* Device state, Test mode.

### 4.5.3 enum usb\_device\_endpoint\_status\_t

Enumerator

*kUSB\_DeviceEndpointStateIdle* Endpoint state, idle.  
*kUSB\_DeviceEndpointStateStalled* Endpoint state, stalled.

### 4.5.4 enum usb\_device\_event\_t

Enumerator

*kUSB\_DeviceEventBusReset* USB bus reset signal detected.  
*kUSB\_DeviceEventSuspend* USB bus suspend signal detected.  
*kUSB\_DeviceEventResume* USB bus resume signal detected. The resume signal is driven by itself or a host  
*kUSB\_DeviceEventSleep* USB bus LPM suspend signal detected.  
*kUSB\_DeviceEventLPMResume* USB bus LPM resume signal detected. The resume signal is driven by itself or a host  
*kUSB\_DeviceEventError* An error is happened in the bus.  
*kUSB\_DeviceEventDetach* USB device is disconnected from a host.  
*kUSB\_DeviceEventAttach* USB device is connected to a host.  
*kUSB\_DeviceEventSetConfiguration* Set configuration.  
*kUSB\_DeviceEventSetInterface* Set interface.  
*kUSB\_DeviceEventGetDeviceDescriptor* Get device descriptor.  
*kUSB\_DeviceEventGetConfigurationDescriptor* Get configuration descriptor.  
*kUSB\_DeviceEventGetStringDescriptor* Get string descriptor.

*kUSB\_DeviceEventGetHidDescriptor* Get HID descriptor.  
*kUSB\_DeviceEventGetHidReportDescriptor* Get HID report descriptor.  
*kUSB\_DeviceEventGetHidPhysicalDescriptor* Get HID physical descriptor.  
*kUSB\_DeviceEventGetBOSDescriptor* Get configuration descriptor.  
*kUSB\_DeviceEventGetDeviceQualifierDescriptor* Get device qualifier descriptor.  
*kUSB\_DeviceEventVendorRequest* Vendor request.  
*kUSB\_DeviceEventSetRemoteWakeup* Enable or disable remote wakeup function.  
*kUSB\_DeviceEventGetConfiguration* Get current configuration index.  
*kUSB\_DeviceEventGetInterface* Get current interface alternate setting value.

## 4.6 Function Documentation

### 4.6.1 `usb_status_t USB_DeviceInit ( uint8_t controllerId, usb_device_callback_t deviceCallback, usb_device_handle * handle )`

This function initializes the USB device module specified by the controllerId.

Parameters

|     |                       |   |
|-----|-----------------------|---|
| in  | <i>controllerId</i>   | The controller ID of the USB IP. See the enumeration <a href="#">usb_controller_index_t</a> . |
| in  | <i>deviceCallback</i> | Function pointer of the device callback.  |
| out | <i>handle</i>         | It is an out parameter used to return the pointer of the device handle to the caller.         |

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>                     | The device is initialized successfully.  |
| <i>kStatus_USB_Invalid-Handle</i>              | The handle is a NULL pointer.  |
| <i>kStatus_USB_Busy</i>                        | Cannot allocate a device handle.   |
| <i>kStatus_USB_Controller-NotFound</i>         | Cannot find the controller according to the controller id.   |
| <i>kStatus_USB_Invalid-ControllerInterface</i> | The controller driver interfaces is invalid. There is an empty interface entity.   |
| <i>kStatus_USB_Error</i>                       | The macro <code>USB_DEVICE_CONFIG_ENDPOINTS</code> is more than the IP's endpoint number. Or, the device has been initialized. Or, the mutex or message queue is created failed. |

---

## Function Documentation

### 4.6.2 `usb_status_t USB_DeviceRun ( usb_device_handle handle )`

The function enables the device functionality, so that the device can be recognized by the host when the device detects that it has been connected to a host.

Parameters

|           |               |   |
|-----------|---------------|---|
| <i>in</i> | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|-----------|---------------|---|

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | The device is run successfully.   |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.   |
| <i>kStatus_USB_Invalid-Handle</i>      | The device handle is a NULL pointer. Or the controller handle is invalid. |

### 4.6.3 `usb_status_t USB_DeviceStop ( usb_device_handle handle )`

The function disables the device functionality. After this function called, even if the device is detached to the host, it can't work.

Parameters

|           |               |  |
|-----------|---------------|--|
| <i>in</i> | <i>handle</i> | The device handle received from <a href="#">USB_DeviceInit</a> . |
|-----------|---------------|--|

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | The device is stopped successfully.                                      |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |
| <i>kStatus_USB_Invalid-Handle</i>      | The device handle is a NULL pointer or the controller handle is invalid. |

### 4.6.4 `usb_status_t USB_DeviceDeinit ( usb_device_handle handle )`

The function de-initializes the device controller specified by the handle.

Parameters

|           |               |   |
|-----------|---------------|---|
| <i>in</i> | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|-----------|---------------|---|

## Function Documentation

Return values

|                                   |  |
|-----------------------------------|--|
| <i>kStatus_USB_Success</i>        | The device is stopped successfully.                                      |
| <i>kStatus_USB_Invalid-Handle</i> | The device handle is a NULL pointer or the controller handle is invalid. |

### 4.6.5 `usb_status_t USB_DeviceSendRequest ( usb_device_handle handle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

The function is used to send data through a specified endpoint.

Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>handle</i>           | The device handle got from <a href="#">USB_DeviceInit</a> .                         |
| in | <i>endpoint-Address</i> | Endpoint index.   |
| in | <i>buffer</i>           | The memory address to hold the data need to be sent. The function is not reentrant. |
| in | <i>length</i>           | The data length need to be sent.  |

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | The send request is sent successfully.                             |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Busy</i>                | Cannot allocate DTDS for current transfer in EHCI driver.          |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |
| <i>kStatus_USB_Error</i>               | The device is doing reset.   |

Note

The return value indicates whether the sending request is successful or not. The transfer done is notified by the corresponding callback function. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for one specific endpoint, the application should implement a queue on the application level. The subsequent transfer can begin only when the previous transfer is done (get notification through the endpoint callback).

**4.6.6** `usb_status_t USB_DeviceRecvRequest ( usb_device_handle handle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

The function is used to receive data through a specified endpoint. The function is not reentrant.

## Function Documentation

### Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>handle</i>           | The device handle got from <a href="#">USB_DeviceInit</a> . |
| in | <i>endpoint-Address</i> | Endpoint index.   |
| in | <i>buffer</i>           | The memory address to save the received data.               |
| in | <i>length</i>           | The data length want to be received.                        |

### Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | The receive request is sent successfully.                          |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Busy</i>                | Cannot allocate DTDS for current transfer in EHCI driver.          |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |
| <i>kStatus_USB_Error</i>               | The device is doing reset.   |

### Note

The return value indicates whether the receiving request is successful or not. The transfer done is notified by the corresponding callback function. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for one specific endpoint, the application should implement a queue on the application level. The subsequent transfer can begin only when the previous transfer is done (get notification through the endpoint callback).

### 4.6.7 `usb_status_t USB_DeviceCancel ( usb_device_handle handle, uint8_t endpointAddress )`

The function is used to cancel the pending transfer in a specified endpoint.

### Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------|---|



|    |                         |   |
|----|-------------------------|---|
| in | <i>endpoint-Address</i> | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |
|----|-------------------------|---|

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | The transfer is cancelled.  |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer or the controller handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.                                       |

**4.6.8 usb\_status\_t USB\_DeviceInitEndpoint ( usb\_device\_handle *handle*, usb\_device\_endpoint\_init\_struct\_t \* *epInit*, usb\_device\_endpoint\_callback\_struct\_t \* *endpointCallback* )**

The function is used to initialize a specified endpoint. The corresponding endpoint callback is also initialized.

Parameters

|    |                          |  |
|----|--------------------------|--|
| in | <i>handle</i>            | The device handle received from <a href="#">USB_DeviceInit</a> .   |
| in | <i>epInit</i>            | Endpoint initialization structure. See the structure <a href="#">usb_device_endpoint_init_struct_t</a> . |
| in | <i>endpoint-Callback</i> | Endpoint callback structure. See the structure <a href="#">usb_device_endpoint_callback_struct_t</a> .   |

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | The endpoint is initialized successfully.  |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid.   |
| <i>kStatus_USB_Invalid-Parameter</i>   | The epInit or endpointCallback is NULL pointer. Or the endpoint number is more than USB_DEVICE_CONFIG_ENDPOINTS. |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in EHCI driver.   |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |

---

## Function Documentation

### 4.6.9 `usb_status_t USB_DeviceDeinitEndpoint ( usb_device_handle handle, uint8_t endpointAddress )`

The function is used to deinitializes a specified endpoint.

## Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>handle</i>           | The device handle got from <a href="#">USB_DeviceInit</a> .                 |
| in | <i>endpoint-Address</i> | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |

## Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | The endpoint is de-initialized successfully.                       |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i>   | The endpoint number is more than USB_DEVICE_CONFIG_ENDPOINTS.      |
| <i>kStatus_USB_Busy</i>                | The endpoint is busy in EHCI driver.                               |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |

#### 4.6.10 `usb_status_t USB_DeviceStallEndpoint ( usb_device_handle handle, uint8_t endpointAddress )`

The function is used to stall a specified endpoint.

## Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>handle</i>           | The device handle received from <a href="#">USB_DeviceInit</a> .            |
| in | <i>endpoint-Address</i> | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |

## Return values

|                                      |  |
|--------------------------------------|--|
| <i>kStatus_USB_Success</i>           | The endpoint is stalled successfully.                              |
| <i>kStatus_USB_Invalid-Handle</i>    | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i> | The endpoint number is more than USB_DEVICE_CONFIG_ENDPOINTS.      |

## Function Documentation

|  |                             |
|--|-----------------------------|
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller. |
|--|-----------------------------|

### 4.6.11 `usb_status_t USB_DeviceUninstallEndpoint ( usb_device_handle handle, uint8_t endpointAddress )`

The function is used to uninstall a specified endpoint.

Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>handle</i>           | The device handle received from <a href="#">USB_DeviceInit</a> .            |
| in | <i>endpoint-Address</i> | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |

Return values

|  |   |
|--|---|
| <i>kStatus_USB_Success</i>             | The endpoint is uninstalled successfully.                                   |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid.          |
| <i>kStatus_USB_Invalid-Parameter</i>   | The endpoint number is more than <code>USB_DEVICE_CONFIG_ENDPOINTS</code> . |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.   |

### 4.6.12 `usb_status_t USB_DeviceGetStatus ( usb_device_handle handle, usb_device_status_t type, void * param )`

The function is used to get the status of the selected item.

Parameters

|     |               |  |
|-----|---------------|--|
| in  | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> .                |
| in  | <i>type</i>   | The selected item. See the structure <a href="#">usb_device_status_t</a> . |
| out | <i>param</i>  | The parameter type is determined by the selected item.                     |

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | Get status successfully.   |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Invalid-Parameter</i>   | The parameter is NULL pointer.                                     |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |
| <i>kStatus_USB_Error</i>               | Unsupported type.  |

#### 4.6.13 **usb\_status\_t USB\_DeviceSetStatus ( usb\_device\_handle handle, usb\_device\_status\_t type, void \* param )**

The function is used to set the status of the selected item.

Parameters

|    |               |  |
|----|---------------|--|
| in | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> .                |
| in | <i>type</i>   | The selected item. See the structure <a href="#">usb_device_status_t</a> . |
| in | <i>param</i>  | The parameter type is determined by the selected item.                     |

Return values

|  |  |
|--|--|
| <i>kStatus_USB_Success</i>             | Set status successfully.   |
| <i>kStatus_USB_Invalid-Handle</i>      | The handle is a NULL pointer. Or the controller handle is invalid. |
| <i>kStatus_USB_Controller-NotFound</i> | Cannot find the controller.  |
| <i>kStatus_USB_Error</i>               | Unsupported type or the parameter is NULL pointer.                 |

#### 4.6.14 **void USB\_DeviceTaskFunction ( void \* deviceHandle )**

The function is used to handle the controller message. This function should not be called in the application directly.

## Function Documentation

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.6.15 void USB\_DeviceKhcilsrFunction ( void \* *deviceHandle* )

The function is the KHCI interrupt service routine.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.6.16 void USB\_DeviceEhcilsrFunction ( void \* *deviceHandle* )

The function is the EHCI interrupt service routine.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.6.17 void USB\_DeviceLpclp3511IsrFunction ( void \* *deviceHandle* )

The function is the LPC USB interrupt service routine.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>deviceHandle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
|----|---------------------|---|

### 4.6.18 void USB\_DeviceGetVersion ( uint32\_t \* *version* )

The function is used to get the device stack version.

Parameters

|     |                |   |
|-----|----------------|---|
| out | <i>version</i> | The version structure pointer to keep the device stack version. |
|-----|----------------|---|

**4.6.19** `usb_status_t` **USB\_DeviceUpdateHwTick** ( `usb_device_handle` *handle*,  
`uint64_t` *tick* )

The function is used to update the hardware tick.

## Function Documentation

### Parameters

|    |               |   |
|----|---------------|---|
| in | <i>handle</i> | The device handle got from <a href="#">USB_DeviceInit</a> . |
| in | <i>tick</i>   | Current hardware tick(uint is ms).                          |



## 4.7 USB Device Controller driver

### 4.7.1 Overview

The interface between KHCI/EHCI etc controller Driver and Common Controller driver.

#### Modules

- [USB Device Controller EHCI driver](#)
- [USB Device Controller KHCI driver](#)
- [USB Device Controller LPC IP3511 driver](#)

#### Data Structures

- struct [usb\\_device\\_callback\\_message\\_struct\\_t](#)  
*Device notification message structure. [More...](#)*
- struct [usb\\_device\\_controller\\_interface\\_struct\\_t](#)  
*USB device controller interface structure. [More...](#)*
- struct [usb\\_device\\_struct\\_t](#)  
*USB device status structure. [More...](#)*

#### Macros

- #define [usb\\_device\\_controller\\_handle](#) [usb\\_device\\_handle](#)  
*Macro to define controller handle.*

#### Typedefs

- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_init\\_t](#))(uint8\_t controllerId, [usb\\_device\\_handle](#) handle, [usb\\_device\\_controller\\_handle](#) \*controllerHandle)  
*USB device controller initialization function typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_deinit\\_t](#))([usb\\_device\\_controller\\_handle](#) controllerHandle)  
*USB device controller de-initialization function typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_send\\_t](#))([usb\\_device\\_controller\\_handle](#) controllerHandle, uint8\_t endpointAddress, uint8\_t \*buffer, uint32\_t length)  
*USB device controller send data function typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_recv\\_t](#))([usb\\_device\\_controller\\_handle](#) controllerHandle, uint8\_t endpointAddress, uint8\_t \*buffer, uint32\_t length)  
*USB device controller receive data function typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_cancel\\_t](#))([usb\\_device\\_controller\\_handle](#) controllerHandle, uint8\_t endpointAddress)  
*USB device controller cancel transfer function in a specified endpoint typedef.*
- typedef [usb\\_status\\_t](#)(\* [usb\\_device\\_controller\\_control\\_t](#))([usb\\_device\\_controller\\_handle](#) controllerHandle, [usb\\_device\\_control\\_type\\_t](#) command, void \*param)

## USB Device Controller driver

*USB device controller control function typedef.*

### Enumerations

- enum `usb_device_notification_t` {  
    `kUSB_DeviceNotifyBusReset` = 0x10U,  
    `kUSB_DeviceNotifySuspend`,  
    `kUSB_DeviceNotifyResume`,  
    `kUSB_DeviceNotifyLPMSleep`,  
    `kUSB_DeviceNotifyLPMResume`,  
    `kUSB_DeviceNotifyError`,  
    `kUSB_DeviceNotifyDetach`,  
    `kUSB_DeviceNotifyAttach` }  
    *Available notify types for device notification.*
- enum `usb_device_control_type_t` {  
    `kUSB_DeviceControlRun` = 0U,  
    `kUSB_DeviceControlStop`,  
    `kUSB_DeviceControlEndpointInit`,  
    `kUSB_DeviceControlEndpointDeinit`,  
    `kUSB_DeviceControlEndpointStall`,  
    `kUSB_DeviceControlEndpointUnstall`,  
    `kUSB_DeviceControlGetDeviceStatus`,  
    `kUSB_DeviceControlGetEndpointStatus`,  
    `kUSB_DeviceControlSetDeviceAddress`,  
    `kUSB_DeviceControlGetSynchFrame`,  
    `kUSB_DeviceControlResume`,  
    `kUSB_DeviceControlSleepResume`,  
    `kUSB_DeviceControlSuspend`,  
    `kUSB_DeviceControlSleep`,  
    `kUSB_DeviceControlSetDefaultStatus`,  
    `kUSB_DeviceControlGetSpeed`,  
    `kUSB_DeviceControlGetOtgStatus`,  
    `kUSB_DeviceControlSetOtgStatus`,  
    `kUSB_DeviceControlSetTestMode`,  
    `kUSB_DeviceControlGetRemoteWakeUp` }  
    *Control type for controller.*

## 4.7.2 Data Structure Documentation

### 4.7.2.1 struct `usb_device_callback_message_struct_t`

#### Data Fields

- `uint8_t * buffer`

- *Transferred buffer.*  
uint32\_t [length](#)
- *Transferred data length.*  
uint8\_t [code](#)
- *Notification code.*  
uint8\_t [isSetup](#)
- *Is in a setup phase.*

#### 4.7.2.2 struct usb\_device\_controller\_interface\_struct\_t

##### Data Fields

- [usb\\_device\\_controller\\_init\\_t deviceInit](#)  
*Controller initialization.*
- [usb\\_device\\_controller\\_deinit\\_t deviceDeinit](#)  
*Controller de-initialization.*
- [usb\\_device\\_controller\\_send\\_t deviceSend](#)  
*Controller send data.*
- [usb\\_device\\_controller\\_rcv\\_t deviceRecv](#)  
*Controller receive data.*
- [usb\\_device\\_controller\\_cancel\\_t deviceCancel](#)  
*Controller cancel transfer.*
- [usb\\_device\\_controller\\_control\\_t deviceControl](#)  
*Controller control.*

#### 4.7.2.3 struct usb\_device\_struct\_t

##### Data Fields

- volatile uint64\_t [hwTick](#)  
*Current hw tick(ms)*
- [usb\\_device\\_controller\\_handle controllerHandle](#)  
*Controller handle.*
- const  
[usb\\_device\\_controller\\_interface\\_struct\\_t \\* controllerInterface](#)  
*Controller interface handle.*
- [usb\\_device\\_callback\\_t deviceCallback](#)  
*Device callback function pointer.*
- [usb\\_device\\_endpoint\\_callback\\_struct\\_t endpointCallback](#) [USB\_DEVICE\_CONFIG\_ENDPOINTS<< 1U]  
*Endpoint callback function structure.*
- uint8\_t [deviceAddress](#)  
*Current device address.*
- uint8\_t [controllerId](#)  
*Controller ID.*
- uint8\_t [state](#)  
*Current device state.*
- uint8\_t [remotewakeup](#)  
*Remote wakeup is enabled or not.*

## USB Device Controller driver

- `uint8_t isResetting`  
*Is doing device reset or not.*

### 4.7.3 Enumeration Type Documentation

#### 4.7.3.1 `enum usb_device_notification_t`

Enumerator

*kUSB\_DeviceNotifyBusReset* Reset signal detected.  
*kUSB\_DeviceNotifySuspend* Suspend signal detected.  
*kUSB\_DeviceNotifyResume* Resume signal detected.  
*kUSB\_DeviceNotifyLPMSleep* LPM signal detected.  
*kUSB\_DeviceNotifyLPMResume* Resume signal detected.  
*kUSB\_DeviceNotifyError* Errors happened in bus.  
*kUSB\_DeviceNotifyDetach* Device disconnected from a host.  
*kUSB\_DeviceNotifyAttach* Device connected to a host.

#### 4.7.3.2 `enum usb_device_control_type_t`

Enumerator

*kUSB\_DeviceControlRun* Enable the device functionality.  
*kUSB\_DeviceControlStop* Disable the device functionality.  
*kUSB\_DeviceControlEndpointInit* Initialize a specified endpoint.  
*kUSB\_DeviceControlEndpointDeinit* De-initialize a specified endpoint.  
*kUSB\_DeviceControlEndpointStall* Stall a specified endpoint.  
*kUSB\_DeviceControlEndpointUnstall* Unstall a specified endpoint.  
*kUSB\_DeviceControlGetDeviceStatus* Get device status.  
*kUSB\_DeviceControlGetEndpointStatus* Get endpoint status.  
*kUSB\_DeviceControlSetDeviceAddress* Set device address.  
*kUSB\_DeviceControlGetSynchFrame* Get current frame.  
*kUSB\_DeviceControlResume* Drive controller to generate a resume signal in USB bus.  
*kUSB\_DeviceControlSleepResume* Drive controller to generate a LPM resume signal in USB bus.  
*kUSB\_DeviceControlSuspend* Drive controller to enetr into suspend mode.  
*kUSB\_DeviceControlSleep* Drive controller to enetr into sleep mode.  
*kUSB\_DeviceControlSetDefaultStatus* Set controller to default status.  
*kUSB\_DeviceControlGetSpeed* Get current speed.  
*kUSB\_DeviceControlGetOtgStatus* Get OTG status.  
*kUSB\_DeviceControlSetOtgStatus* Set OTG status.  
*kUSB\_DeviceControlSetTestMode* Drive xCHI into test mode.  
*kUSB\_DeviceControlGetRemoteWakeUp* Get flag of LPM Remote Wake-up Enabled by USB host.

## 4.7.4 USB Device Controller KHCI driver

### 4.7.4.1 Overview

#### Data Structures

- struct `usb_device_khci_endpoint_state_struct_t`  
*Endpoint state structure. [More...](#)*
- struct `usb_device_khci_state_struct_t`  
*KHCI state structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_MAX_FS_ISO_MAX_PACKET_SIZE` (1023U)  
*The maximum value of ISO maximum packet size for FS in USB specification 2.0.*
- #define `USB_DEVICE_MAX_FS_NONE_ISO_MAX_PACKET_SIZE` (64U)  
*The maximum value of non-ISO maximum packet size for FS in USB specification 2.0.*
- #define `USB_KHCI_BDT_SET_ADDRESS`(bdt\_base, ep, direction, odd, address)  
*Set BDT buffer address.*
- #define `USB_KHCI_BDT_SET_CONTROL`(bdt\_base, ep, direction, odd, control)  
*Set BDT control fields.*
- #define `USB_KHCI_BDT_GET_ADDRESS`(bdt\_base, ep, direction, odd)  
*Get BDT buffer address.*
- #define `USB_KHCI_BDT_GET_CONTROL`(bdt\_base, ep, direction, odd)  
*Get BDT control fields.*

#### USB device KHCI functions

- `usb_status_t USB_DeviceKhciInit` (uint8\_t controllerId, `usb_device_handle` handle, `usb_device_controller_handle` \*khciHandle)  
*Initializes the USB device KHCI instance.*
- `usb_status_t USB_DeviceKhciDeinit` (`usb_device_controller_handle` khciHandle)  
*Deinitializes the USB device KHCI instance.*
- `usb_status_t USB_DeviceKhciSend` (`usb_device_controller_handle` khciHandle, uint8\_t endpoint-Address, uint8\_t \*buffer, uint32\_t length)  
*Sends data through a specified endpoint.*
- `usb_status_t USB_DeviceKhciRecv` (`usb_device_controller_handle` khciHandle, uint8\_t endpoint-Address, uint8\_t \*buffer, uint32\_t length)  
*Receives data through a specified endpoint.*
- `usb_status_t USB_DeviceKhciCancel` (`usb_device_controller_handle` khciHandle, uint8\_t ep)  
 *Cancels the pending transfer in a specified endpoint.*
- `usb_status_t USB_DeviceKhciControl` (`usb_device_controller_handle` khciHandle, `usb_device_control_type_t` type, void \*param)  
*Controls the status of the selected item.*

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### 4.7.4.2 Data Structure Documentation

#### 4.7.4.2.1 struct usb\_device\_khci\_endpoint\_state\_struct\_t

##### Data Fields

- `uint8_t * transferBuffer`  
*Address of buffer containing the data to be transmitted.*
- `uint32_t transferLength`  
*Length of data to transmit.*
- `uint32_t transferDone`  
*The data length has been transferred.*
- `uint32_t state`  
*The state of the endpoint.*
- `uint32_t maxPacketSize: 10U`  
*The maximum packet size of the endpoint.*
- `uint32_t stalled: 1U`  
*The endpoint is stalled or not.*
- `uint32_t data0: 1U`  
*The data toggle of the transaction.*
- `uint32_t bdtOdd: 1U`  
*The BDT toggle of the endpoint.*
- `uint32_t dmaAlign: 1U`  
*Whether the transferBuffer is DMA aligned or not.*
- `uint32_t transferring: 1U`  
*The endpoint is transferring.*
- `uint32_t zlt: 1U`  
*zlt flag*

##### 4.7.4.2.1.1 Field Documentation

###### 4.7.4.2.1.1.1 uint32\_t usb\_device\_khci\_endpoint\_state\_struct\_t::transferLength

#### 4.7.4.2.2 struct usb\_device\_khci\_state\_struct\_t

##### Data Fields

- `usb_device_struct_t * deviceHandle`  
*Device handle used to identify the device object belongs to.*
- `uint8_t * bdt`  
*BDT buffer address.*
- `USB_Type * registerBase`  
*The base address of the register.*
- `uint8_t setupPacketBuffer [USB_SETUP_PACKET_SIZE *2]`  
*The setup request buffer.*
- `uint8_t * dmaAlignBuffer`  
*This buffer is used to fix the transferBuffer or transferLength does not align to 4-bytes when the function USB\_DeviceKhciRecv is called.*
- `usb_device_khci_endpoint_state_struct_t endpointState [USB_DEVICE_CONFIG_ENDPOINTS *2]`  
*Endpoint state structures.*

- `uint8_t isDmaAlignBufferInusing`  
The `dmaAlignBuffer` is used or not.
- `uint8_t isResetting`  
Is doing device reset or not.
- `uint8_t controllerId`  
Controller ID.
- `uint8_t setupBufferIndex`  
A valid setup buffer flag.

#### 4.7.4.2.2.1 Field Documentation

##### 4.7.4.2.2.1.1 `uint8_t* usb_device_khci_state_struct_t::dmaAlignBuffer`

The macro `USB_DEVICE_CONFIG_KHCI_DMA_ALIGN` is used to enable or disable this feature. If the feature is enabled, when the `transferBuffer` or `transferLength` does not align to 4-bytes, the `transferLength` is not more than `USB_DEVICE_CONFIG_KHCI_DMA_ALIGN_BUFFER_LENGTH`, and the flag `isDmaAlignBufferInusing` is zero, the `dmaAlignBuffer` is used to receive data and the flag `isDmaAlignBufferInusing` is set to 1. When the transfer is done, the received data, kept in `dmaAlignBuffer`, is copied to the `transferBuffer`, and the flag `isDmaAlignBufferInusing` is cleared.

#### 4.7.4.3 Function Documentation

##### 4.7.4.3.1 `usb_status_t USB_DeviceKhciInit ( uint8_t controllerId, usb_device_handle handle, usb_device_controller_handle * khciHandle )`

This function initializes the USB device KHCI module specified by the `controllerId`.

Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration type <code>usb_controller_index_t</code> . |
| in  | <i>handle</i>       | Pointer of the device handle used to identify the device object belongs to.                     |
| out | <i>khciHandle</i>   | An out parameter used to return the pointer of the device KHCI handle to the caller.            |

Returns

A USB error code or `kStatus_USB_Success`.

##### 4.7.4.3.2 `usb_status_t USB_DeviceKhciDeinit ( usb_device_controller_handle khciHandle )`

This function deinitializes the USB device KHCI module.

## USB Device Controller driver

### Parameters

|    |                   |                                    |
|----|-------------------|------------------------------------|
| in | <i>khciHandle</i> | Pointer of the device KHCI handle. |
|----|-------------------|------------------------------------|

### Returns

A USB error code or `kStatus_USB_Success`.

#### 4.7.4.3.3 `usb_status_t USB_DeviceKhciSend ( usb_device_controller_handle khciHandle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

This function sends data through a specified endpoint.

### Parameters

|    |                         |  |
|----|-------------------------|--|
| in | <i>khciHandle</i>       | Pointer of the device KHCI handle.                   |
| in | <i>endpoint-Address</i> | Endpoint index.                                      |
| in | <i>buffer</i>           | The memory address to hold the data need to be sent. |
| in | <i>length</i>           | The data length need to be sent.                     |

### Returns

A USB error code or `kStatus_USB_Success`.

### Note

The return value indicates whether the sending request is successful or not. The transfer completion is notified by the corresponding callback function. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is obtained through the endpoint callback).

#### 4.7.4.3.4 `usb_status_t USB_DeviceKhciRecv ( usb_device_controller_handle khciHandle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

This function receives data through a specified endpoint.



Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>khciHandle</i>       | Pointer of the device KHCI handle.            |
| in | <i>endpoint-Address</i> | Endpoint index.                               |
| in | <i>buffer</i>           | The memory address to save the received data. |
| in | <i>length</i>           | The data length to be received.               |

Returns

A USB error code or `kStatus_USB_Success`.

Note

The return value indicates whether the receiving request is successful or not. The transfer completion is notified by the corresponding callback function. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is obtained through the endpoint callback).

**4.7.4.3.5 `usb_status_t USB_DeviceKhciCancel ( usb_device_controller_handle khciHandle, uint8_t ep )`**

The function is used to cancel the pending transfer in a specified endpoint.

Parameters

|    |                   |   |
|----|-------------------|---|
| in | <i>khciHandle</i> | Pointer of the device KHCI handle.  |
| in | <i>ep</i>         | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |

Returns

A USB error code or `kStatus_USB_Success`.

**4.7.4.3.6 `usb_status_t USB_DeviceKhciControl ( usb_device_controller_handle khciHandle, usb_device_control_type_t type, void * param )`**

The function is used to control the status of the selected item.

## USB Device Controller driver

### Parameters

|         |                   |  |
|---------|-------------------|--|
| in      | <i>khciHandle</i> | Pointer of the device KHCI handle.   |
| in      | <i>type</i>       | The selected item. See enumeration type <code>usb_device_control_type_t</code> . |
| in, out | <i>param</i>      | The parameter type is determined by the selected item.                           |

### Returns

A USB error code or `kStatus_USB_Success`.

## 4.7.5 USB Device Controller EHCI driver

### 4.7.5.1 Overview

#### Data Structures

- struct `usb_device_ehci_state_struct_t`  
*EHCI state structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_MAX_HS_ISO_MAX_PACKET_SIZE` (1024U)  
*The maximum value of ISO type maximum packet size for HS in USB specification 2.0.*
- #define `USB_DEVICE_MAX_HS_INTERRUPT_MAX_PACKET_SIZE` (1024U)  
*The maximum value of interrupt type maximum packet size for HS in USB specification 2.0.*
- #define `USB_DEVICE_MAX_HS_BULK_MAX_PACKET_SIZE` (512U)  
*The maximum value of bulk type maximum packet size for HS in USB specification 2.0.*
- #define `USB_DEVICE_MAX_HS_CONTROL_MAX_PACKET_SIZE` (64U)  
*The maximum value of control type maximum packet size for HS in USB specification 2.0.*

#### USB device EHCI functions

- `usb_status_t USB_DeviceEhciInit` (`uint8_t controllerId`, `usb_device_handle handle`, `usb_device_controller_handle *ehciHandle`)  
*Initializes the USB device EHCI instance.*
- `usb_status_t USB_DeviceEhciDeinit` (`usb_device_controller_handle ehciHandle`)  
*Deinitializes the USB device EHCI instance.*
- `usb_status_t USB_DeviceEhciSend` (`usb_device_controller_handle ehciHandle`, `uint8_t endpointAddress`, `uint8_t *buffer`, `uint32_t length`)  
*Sends data through a specified endpoint.*
- `usb_status_t USB_DeviceEhciRecv` (`usb_device_controller_handle ehciHandle`, `uint8_t endpointAddress`, `uint8_t *buffer`, `uint32_t length`)  
*Receive data through a specified endpoint.*
- `usb_status_t USB_DeviceEhciCancel` (`usb_device_controller_handle ehciHandle`, `uint8_t ep`)  
*Cancel the pending transfer in a specified endpoint.*
- `usb_status_t USB_DeviceEhciControl` (`usb_device_controller_handle ehciHandle`, `usb_device_control_type_t type`, `void *param`)  
*Controls the status of the selected item.*

### 4.7.5.2 Data Structure Documentation

#### 4.7.5.2.1 struct `usb_device_ehci_state_struct_t`

##### Data Fields

- `usb_device_struct_t * deviceHandle`  
*Device handle used to identify the device object is belonged to.*

## USB Device Controller driver

- USBHS\_Type \* [registerBase](#)  
*The base address of the register.*
- USBPHY\_Type \* [registerPhyBase](#)  
*The base address of the PHY register.*
- usb\_device\_ehci\_qh\_struct\_t \* [qh](#)  
*The QH structure base address.*
- usb\_device\_ehci\_dtd\_struct\_t \* [dtd](#)  
*The DTD structure base address.*
- usb\_device\_ehci\_dtd\_struct\_t \* [dtdFree](#)  
*The idle DTD list head.*
- usb\_device\_ehci\_dtd\_struct\_t \* [dtdHard](#) [USB\_DEVICE\_CONFIG\_ENDPOINTS \*2]  
*The transferring DTD list head for each endpoint.*
- usb\_device\_ehci\_dtd\_struct\_t \* [dtdTail](#) [USB\_DEVICE\_CONFIG\_ENDPOINTS \*2]  
*The transferring DTD list tail for each endpoint.*
- int8\_t [dtdCount](#)  
*The idle DTD node count.*
- uint8\_t [endpointCount](#)  
*The endpoint number of EHCI.*
- uint8\_t [isResetting](#)  
*Whether a PORT reset is occurring or not.*
- uint8\_t [controllerId](#)  
*Controller ID.*
- uint8\_t [speed](#)  
*Current speed of EHCI.*
- uint8\_t [isSuspending](#)  
*Is suspending of the PORT.*

### 4.7.5.3 Function Documentation

#### 4.7.5.3.1 `usb_status_t USB_DeviceEhciInit ( uint8_t controllerId, usb_device_handle handle, usb_device_controller_handle * ehciHandle )`

This function initializes the USB device EHCI module specified by the controllerId.

#### Parameters

|     |                     |   |
|-----|---------------------|---|
| in  | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration type <code>usb_controller_index_t</code> . |
| in  | <i>handle</i>       | Pointer of the device handle used to identify the device object is belonged to.                 |
| out | <i>ehciHandle</i>   | An out parameter used to return the pointer of the device EHCI handle to the caller.            |

#### Returns

A USB error code or `kStatus_USB_Success`.

**4.7.5.3.2** `usb_status_t USB_DeviceEhciDeinit ( usb_device_controller_handle ehciHandle )`

This function deinitializes the USB device EHCI module.

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### Parameters

|    |                   |                                    |
|----|-------------------|------------------------------------|
| in | <i>ehciHandle</i> | Pointer of the device EHCI handle. |
|----|-------------------|------------------------------------|

### Returns

A USB error code or `kStatus_USB_Success`.

#### 4.7.5.3.3 `usb_status_t USB_DeviceEhciSend ( usb_device_controller_handle ehciHandle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

This function sends data through a specified endpoint.

### Parameters

|    |                         |  |
|----|-------------------------|--|
| in | <i>ehciHandle</i>       | Pointer of the device EHCI handle.                   |
| in | <i>endpoint-Address</i> | Endpoint index.                                      |
| in | <i>buffer</i>           | The memory address to hold the data need to be sent. |
| in | <i>length</i>           | The data length to be sent.                          |

### Returns

A USB error code or `kStatus_USB_Success`.

### Note

The return value means whether the sending request is successful or not. The transfer completion is indicated by the corresponding callback function. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is received through the endpoint callback).

#### 4.7.5.3.4 `usb_status_t USB_DeviceEhciRecv ( usb_device_controller_handle ehciHandle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

This function Receives data through a specified endpoint.

Parameters

|    |                         |   |
|----|-------------------------|---|
| in | <i>ehciHandle</i>       | Pointer of the device EHCI handle.            |
| in | <i>endpoint-Address</i> | Endpoint index.                               |
| in | <i>buffer</i>           | The memory address to save the received data. |
| in | <i>length</i>           | The data length want to be received.          |

Returns

A USB error code or kStatus\_USB\_Success.

Note

The return value just means if the receiving request is successful or not; the transfer done is notified by the corresponding callback function. Currently, only one transfer request can be supported for one specific endpoint. If there is a specific requirement to support multiple transfer requests for one specific endpoint, the application should implement a queue in the application level. The subsequent transfer could begin only when the previous transfer is done (get notification through the endpoint callback).

**4.7.5.3.5 usb\_status\_t USB\_DeviceEhciCancel ( usb\_device\_controller\_handle *ehciHandle*, uint8\_t *ep* )**

The function is used to cancel the pending transfer in a specified endpoint.

Parameters

|    |                   |   |
|----|-------------------|---|
| in | <i>ehciHandle</i> | Pointer of the device EHCI handle.                                      |
| in | <i>ep</i>         | Endpoint address, bit7 is the direction of endpoint, 1U - IN, 0U - OUT. |

Returns

A USB error code or kStatus\_USB\_Success.

**4.7.5.3.6 usb\_status\_t USB\_DeviceEhciControl ( usb\_device\_controller\_handle *ehciHandle*, usb\_device\_control\_type\_t *type*, void \* *param* )**

The function is used to control the status of the selected item.

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### Parameters

|         |                   |  |
|---------|-------------------|--|
| in      | <i>ehciHandle</i> | Pointer of the device EHCI handle.   |
| in      | <i>type</i>       | The selected item. See enumeration type <code>usb_device_control_type_t</code> . |
| in, out | <i>param</i>      | The parameter type is determined by the selected item.                           |

### Returns

A USB error code or `kStatus_USB_Success`.



## 4.7.6 USB Device Controller LPC IP3511 driver

### 4.7.6.1 Overview

#### Data Structures

- struct `usb_device_lpc3511ip_endpoint_state_struct_t`  
*Endpoint state structure. [More...](#)*
- struct `usb_device_lpc3511ip_state_struct_t`  
*LPC USB controller (IP3511) state structure. [More...](#)*

#### Macros

- #define `USB_DEVICE_IP3511_ENDPOINT_RESERVED_BUFFER_SIZE` (5 \* 1024)  
*The reserved buffer size, the buffer is for the memory copy if the application transfer buffer is ((not 64 bytes alignment) || (not in the same 64K ram) || (HS && OUT && not multiple of 4))*
- #define `USB_DEVICE_IP3511_BITS_FOR_RESERVED_BUFFER` ((`USB_DEVICE_IP3511_ENDPOINT_RESERVED_BUFFER_SIZE` + 63) / 64)  
*Use one bit to represent one reserved 64 bytes to allocate the buffer by uint of 64 bytes.*
- #define `USB_DEVICE_IP3511_RESERVED_BUFFER_FOR_COPY` (`USB_DEVICE_CONFIG_LPCIP3511FS` + `USB_DEVICE_CONFIG_LPCIP3511HS`)  
*How many IPs support the reserved buffer.*
- #define `USB_DEVICE_IP3511_DOUBLE_BUFFER_ENABLE` (1u)  
*Prime all the double endpoint buffer at the same time, if the transfer length is larger than max packet size.*

#### USB device controller (IP3511) functions

- `usb_status_t USB_DeviceLpc3511IpInit` (`uint8_t controllerId`, `usb_device_handle handle`, `usb_device_controller_handle *controllerHandle`)  
*Initializes the USB device controller instance.*
- `usb_status_t USB_DeviceLpc3511IpDeinit` (`usb_device_controller_handle controllerHandle`)  
*Deinitializes the USB device controller instance.*
- `usb_status_t USB_DeviceLpc3511IpSend` (`usb_device_controller_handle controllerHandle`, `uint8_t endpointAddress`, `uint8_t *buffer`, `uint32_t length`)  
*Sends data through a specified endpoint.*
- `usb_status_t USB_DeviceLpc3511IpRecv` (`usb_device_controller_handle controllerHandle`, `uint8_t endpointAddress`, `uint8_t *buffer`, `uint32_t length`)  
*Receives data through a specified endpoint.*
- `usb_status_t USB_DeviceLpc3511IpCancel` (`usb_device_controller_handle controllerHandle`, `uint8_t ep`)  
*Cancel the pending transfer in a specified endpoint.*
- `usb_status_t USB_DeviceLpc3511IpControl` (`usb_device_controller_handle controllerHandle`, `usb_device_control_type_t type`, `void *param`)  
*Controls the status of the selected item.*

## USB Device Controller driver

### 4.7.6.2 Data Structure Documentation

#### 4.7.6.2.1 struct usb\_device\_lpc3511ip\_endpoint\_state\_struct\_t

##### Data Fields

- uint8\_t \* [transferBuffer](#)  
*Address of buffer containing the data to be transmitted.*
- uint32\_t [transferLength](#)  
*Length of data to transmit.*
- uint32\_t [transferDone](#)  
*The data length has been transferred.*
- uint32\_t [transferPrimedLength](#)  
*it may larger than transferLength, because the primed length may larger than the transaction length.*
- uint8\_t \* [epPacketBuffer](#)  
*The max packet buffer for copying.*
- uint32\_t [state](#)  
*The state of the endpoint.*
- uint32\_t [maxPacketSize](#): 11U  
*The maximum packet size of the endpoint.*
- uint32\_t [stalled](#): 1U  
*The endpoint is stalled or not.*
- uint32\_t [transferring](#): 1U  
*The endpoint is transferring.*
- uint32\_t [zlt](#): 1U  
*zlt flag*
- uint32\_t [epPacketCopyed](#): 1U  
*whether use the copy buffer*
- uint32\_t [epControlDefault](#): 5u  
*The EP command/status 26~30 bits.*
- uint32\_t [doubleBufferBusy](#): 2U  
*How many buffers are primed, for control endpoint it is not used.*
- uint32\_t [producerOdd](#): 1U  
*When priming one transaction, prime to this endpoint buffer.*
- uint32\_t [consumerOdd](#): 1U  
*When transaction is done, read result from this endpoint buffer.*

##### 4.7.6.2.1.1 Field Documentation

###### 4.7.6.2.1.1.1 uint32\_t usb\_device\_lpc3511ip\_endpoint\_state\_struct\_t::transferLength

###### 4.7.6.2.1.1.2 uint32\_t usb\_device\_lpc3511ip\_endpoint\_state\_struct\_t::transferPrimedLength

#### 4.7.6.2.2 struct usb\_device\_lpc3511ip\_state\_struct\_t

##### Data Fields

- uint8\_t [controlData](#) [64U]  
*< control data buffer, must align with 64*
- [usb\\_device\\_lpc3511ip\\_endpoint\\_state\\_struct\\_t endpointState1](#) [2]  
*< (28 \* 2 bytes)Endpoint state structures*

- `usb_device_handle deviceHandle`  
(4 bytes) Device handle used to identify the device object belongs to
- `USB_Type * registerBase`  
(4 bytes) ip base address
- `uint8_t controllerId`  
Controller ID.
- `uint8_t isResetting`  
Is doing device reset or not.
- `uint8_t deviceSpeed`  
some controller support the HS

#### 4.7.6.2.2.1 Field Documentation

##### 4.7.6.2.2.1.1 `uint8_t usb_device_lpc3511ip_state_struct_t::controlData[64U]`

8 bytes' setup data, must align with 64

##### 4.7.6.2.2.1.2 `usb_device_lpc3511ip_endpoint_state_struct_t usb_device_lpc3511ip_state_struct_t::endpointState1[2]`

4 bytes for zero length transaction, must align with 64

#### 4.7.6.3 Macro Definition Documentation

##### 4.7.6.3.1 `#define USB_DEVICE_IP3511_BITS_FOR_RESERVED_BUFFER ((USB_DEVICE_IP3511_ENDPOINT_RESERVED_BUFFER_SIZE + 63) / 64)`

#### 4.7.6.4 Function Documentation

##### 4.7.6.4.1 `usb_status_t USB_DeviceLpc3511Iplnit ( uint8_t controllerId, usb_device_handle handle, usb_device_controller_handle * controllerHandle )`

This function initializes the USB device controller module specified by the controllerId.

Parameters

|    |                     |   |
|----|---------------------|---|
| in | <i>controllerId</i> | The controller ID of the USB IP. See the enumeration type <code>usb_controller_index_t</code> . |
| in | <i>handle</i>       | Pointer of the device handle used to identify the device object belongs to.                     |

## USB Device Controller driver

|     |                          |  |
|-----|--------------------------|--|
| out | <i>controller-Handle</i> | An out parameter used to return the pointer of the device controller handle to the caller. |
|-----|--------------------------|--|

Returns

A USB error code or `kStatus_USB_Success`.

### 4.7.6.4.2 `usb_status_t USB_DeviceLpc3511pDeinit ( usb_device_controller_handle controllerHandle )`

This function deinitializes the USB device controller module.

Parameters

|    |                          |  |
|----|--------------------------|--|
| in | <i>controller-Handle</i> | Pointer of the device controller handle. |
|----|--------------------------|--|

Returns

A USB error code or `kStatus_USB_Success`.

### 4.7.6.4.3 `usb_status_t USB_DeviceLpc3511pSend ( usb_device_controller_handle controllerHandle, uint8_t endpointAddress, uint8_t * buffer, uint32_t length )`

This function sends data through a specified endpoint.

Parameters

|    |                          |  |
|----|--------------------------|--|
| in | <i>controller-Handle</i> | Pointer of the device controller handle.             |
| in | <i>endpoint-Address</i>  | Endpoint index.                                      |
| in | <i>buffer</i>            | The memory address to hold the data need to be sent. |
| in | <i>length</i>            | The data length need to be sent.                     |

Returns

A USB error code or `kStatus_USB_Success`.

Note

The return value indicates whether the sending request is successful or not. The transfer completion is notified by the corresponding callback function. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is obtained through the endpoint callback).

**4.7.6.4.4 usb\_status\_t USB\_DeviceLpc3511pRecv ( usb\_device\_controller\_handle controllerHandle, uint8\_t endpointAddress, uint8\_t \* buffer, uint32\_t length )**

This function receives data through a specified endpoint.

Parameters

|    |                          |   |
|----|--------------------------|---|
| in | <i>controller-Handle</i> | Pointer of the device controller handle.      |
| in | <i>endpoint-Address</i>  | Endpoint index.                               |
| in | <i>buffer</i>            | The memory address to save the received data. |
| in | <i>length</i>            | The data length to be received.               |

Returns

A USB error code or kStatus\_USB\_Success.

Note

The return value indicates whether the receiving request is successful or not. The transfer completion is notified by the corresponding callback function. Currently, only one transfer request can be supported for a specific endpoint. If there is a specific requirement to support multiple transfer requests for a specific endpoint, the application should implement a queue in the application level. The subsequent transfer can begin only when the previous transfer is done (a notification is obtained through the endpoint callback).

**4.7.6.4.5 usb\_status\_t USB\_DeviceLpc3511pCancel ( usb\_device\_controller\_handle controllerHandle, uint8\_t ep )**

The function is used to cancel the pending transfer in a specified endpoint.

## USB Device Controller driver

### Parameters

|    |                          |   |
|----|--------------------------|---|
| in | <i>controller-Handle</i> | Pointer of the device controller handle.                                    |
| in | <i>ep</i>                | Endpoint address, bit7 is the direction of endpoint, 1U - IN, and 0U - OUT. |

### Returns

A USB error code or kStatus\_USB\_Success.

#### 4.7.6.4.6 `usb_status_t USB_DeviceLpc3511lpControl ( usb_device_controller_handle controllerHandle, usb_device_control_type_t type, void * param )`

The function is used to control the status of the selected item.

### Parameters

|         |                          |  |
|---------|--------------------------|--|
| in      | <i>controller-Handle</i> | Pointer of the device controller handle.   |
| in      | <i>type</i>              | The selected item. Please refer to enumeration type <code>usb_device_control_type_t</code> . |
| in, out | <i>param</i>             | The parameter type is determined by the selected item.                                       |

### Returns

A USB error code or kStatus\_USB\_Success.

## 4.8 USB Device Spec Chapter 9 driver

### 4.8.1 Overview

#### Macros

- #define **USB\_DEVICE\_STATUS\_SIZE** (0x02U)  
*Defines USB device status size when the host request to get device status.*
- #define **USB\_INTERFACE\_STATUS\_SIZE** (0x02U)  
*Defines USB device interface status size when the host request to get interface status.*
- #define **USB\_ENDPOINT\_STATUS\_SIZE** (0x02U)  
*Defines USB device endpoint status size when the host request to get endpoint status.*
- #define **USB\_CONFIGURE\_SIZE** (0X01U)  
*Defines USB device configuration size when the host request to get current configuration.*
- #define **USB\_INTERFACE\_SIZE** (0X01U)  
*Defines USB device interface alternate setting size when the host request to get interface alternate setting.*
- #define **USB\_GET\_STATUS\_DEVICE\_MASK** (0x03U)  
*Defines USB device status mask.*
- #define **USB\_GET\_STATUS\_INTERFACE\_MASK** (0x03U)  
*Defines USB device interface status mask.*
- #define **USB\_GET\_STATUS\_ENDPOINT\_MASK** (0x03U)  
*Defines USB device endpoint status mask.*

#### Enumerations

- enum **usb\_device\_control\_read\_write\_sequence\_t** {  
  **kUSB\_DeviceControlPipeSetupStage** = 0U,  
  **kUSB\_DeviceControlPipeDataStage**,  
  **kUSB\_DeviceControlPipeStatusStage** }  
*Control read and write sequence.*

#### Functions

- **usb\_status\_t USB\_DeviceControlPipeInit** (**usb\_device\_handle** handle, void \*param)  
*Initializes the control pipes.*

### 4.8.2 Enumeration Type Documentation

#### 4.8.2.1 enum usb\_device\_control\_read\_write\_sequence\_t

Enumerator

- kUSB\_DeviceControlPipeSetupStage** Setup stage.
- kUSB\_DeviceControlPipeDataStage** Data stage.
- kUSB\_DeviceControlPipeStatusStage** status stage

### 4.8.3 Function Documentation

#### 4.8.3.1 `usb_status_t USB_DeviceControlPipeInit ( usb_device_handle handle, void * param )`

The function is used to initialize the control pipes. This function should be called when event `kUSB_DeviceEventBusReset` is received.



## Parameters

|    |               |                      |
|----|---------------|----------------------|
| in | <i>handle</i> | The device handle.   |
| in | <i>param</i>  | The event parameter. |

## Returns

A USB error code or `kStatus_USB_Success`.

## **4.9 USB Device Configuration**

# Chapter 5

## USB OS Adapter

### 5.1 Overview

The OS adapter (OSA) is used to hide the differences between RTOSes and enable a USB stack with the same code base and behavior.

Note

OSA should not be used in the USB application. Therefore, from the USB application viewpoint, OSA is invisible.

### Macros

- #define **USB\_BIG\_ENDIAN** (0U)  
*Define big endian.*
- #define **USB\_LITTLE\_ENDIAN** (1U)  
*Define little endian.*
- #define **ENDIANNESS USB\_LITTLE\_ENDIAN**  
*Define current endian.*

### Typedefs

- typedef void \* **usb\_osa\_event\_handle**  
*Define USB OSA event handle.*
- typedef void \* **usb\_osa\_sem\_handle**  
*Define USB OSA semaphore handle.*
- typedef void \* **usb\_osa\_mutex\_handle**  
*Define USB OSA mutex handle.*
- typedef void \* **usb\_osa\_msgq\_handle**  
*Define USB OSA message queue handle.*

### Enumerations

- enum **usb\_osa\_status\_t** {  
    **kStatus\_USB\_OSA\_Success** = 0x00U,  
    **kStatus\_USB\_OSA\_Error**,  
    **kStatus\_USB\_OSA\_TimeOut** }  
*USB OSA error code.*
- enum **usb\_osa\_event\_mode\_t** {  
    **kUSB\_OsaEventManualClear** = 0U,  
    **kUSB\_OsaEventAutoClear** = 1U }  
*The event flags are cleared automatically or manually.*

## Overview

### USB OSA Memory Management

- void \* **USB\_OsaMemoryAllocate** (uint32\_t length)  
*Reserves the requested amount of memory in bytes.*
- void **USB\_OsaMemoryFree** (void \*p)  
*Frees the memory previously reserved.*

### USB OSA Event

- **usb\_osa\_status\_t USB\_OsaEventCreate** (usb\_osa\_event\_handle \*handle, uint32\_t flag)  
*Creates an event object with all flags cleared.*
- **usb\_osa\_status\_t USB\_OsaEventDestroy** (usb\_osa\_event\_handle handle)  
*Destroys a created event object.*
- **usb\_osa\_status\_t USB\_OsaEventSet** (usb\_osa\_event\_handle handle, uint32\_t bitMask)  
*Sets an event flag.*
- **usb\_osa\_status\_t USB\_OsaEventWait** (usb\_osa\_event\_handle handle, uint32\_t bitMask, uint32\_t flag, uint32\_t timeout, uint32\_t \*bitSet)  
*Waits for an event flag.*
- **usb\_osa\_status\_t USB\_OsaEventCheck** (usb\_osa\_event\_handle handle, uint32\_t bitMask, uint32\_t \*bitSet)  
*Checks an event flag.*
- **usb\_osa\_status\_t USB\_OsaEventClear** (usb\_osa\_event\_handle handle, uint32\_t bitMask)  
*Clears an event flag.*

### USB OSA Semaphore

- **usb\_osa\_status\_t USB\_OsaSemCreate** (usb\_osa\_sem\_handle \*handle, uint32\_t count)  
*Creates a semaphore with a given value.*
- **usb\_osa\_status\_t USB\_OsaSemDestroy** (usb\_osa\_sem\_handle handle)  
*Destroys a semaphore object.*
- **usb\_osa\_status\_t USB\_OsaSemPost** (usb\_osa\_sem\_handle handle)  
*Posts a semaphore.*
- **usb\_osa\_status\_t USB\_OsaSemWait** (usb\_osa\_sem\_handle handle, uint32\_t timeout)  
*Waits on a semaphore.*

### USB OSA Mutex

- **usb\_osa\_status\_t USB\_OsaMutexCreate** (usb\_osa\_mutex\_handle \*handle)  
*Creates a mutex.*
- **usb\_osa\_status\_t USB\_OsaMutexDestroy** (usb\_osa\_mutex\_handle handle)  
*Destroys a mutex.*
- **usb\_osa\_status\_t USB\_OsaMutexLock** (usb\_osa\_mutex\_handle handle)  
*Waits for a mutex and locks it.*
- **usb\_osa\_status\_t USB\_OsaMutexUnlock** (usb\_osa\_mutex\_handle handle)  
*Unlocks a mutex.*

### USB OSA Message Queue

- **usb\_osa\_status\_t USB\_OsaMsgqCreate** (usb\_osa\_msgq\_handle \*handle, uint32\_t count, uint32\_t size)

- *Creates a message queue.*  
**usb\_osa\_status\_t USB\_OsaMsgqDestroy** (**usb\_osa\_msgq\_handle** handle)
- *Destroys a message queue.*  
**usb\_osa\_status\_t USB\_OsaMsgqSend** (**usb\_osa\_msgq\_handle** handle, void \*msg)
- *Sends a message.*  
**usb\_osa\_status\_t USB\_OsaMsgqRecv** (**usb\_osa\_msgq\_handle** handle, void \*msg, uint32\_t timeout)
- *Receives a message.*  
**usb\_osa\_status\_t USB\_OsaMsgqCheck** (**usb\_osa\_msgq\_handle** handle, void \*msg)
- *Checks a message queue and receives a message if the queue is not empty.*

## 5.2 Enumeration Type Documentation

### 5.2.1 enum usb\_osa\_status\_t

Enumerator

- kStatus\_USB\_OSA\_Success* Success.
- kStatus\_USB\_OSA\_Error* Failed.
- kStatus\_USB\_OSA\_TimeOut* Timeout occurs while waiting.

### 5.2.2 enum usb\_osa\_event\_mode\_t

Enumerator

- kUSB\_OsaEventManualClear* The flags of the event is cleared manually.
- kUSB\_OsaEventAutoClear* The flags of the event is cleared automatically.

## 5.3 Function Documentation

### 5.3.1 void\* USB\_OsaMemoryAllocate ( uint32\_t length )

The function is used to reserve the requested amount of memory in bytes and initializes it to 0.

Parameters

|               |                             |
|---------------|-----------------------------|
| <i>length</i> | Amount of bytes to reserve. |
|---------------|-----------------------------|

Returns

Pointer to the reserved memory. NULL if memory can't be allocated.

### 5.3.2 void USB\_OsaMemoryFree ( void \* p )

The function is used to free the memory block previously reserved.

## Function Documentation

### Parameters

|          |   |
|----------|---|
| <i>p</i> | Pointer to the start of the memory block previously reserved. |
|----------|---|

### 5.3.3 `usb_osa_status_t USB_OsaEventCreate ( usb_osa_event_handle * handle, uint32_t flag )`

This function creates an event object and sets its clear mode. If the clear mode is `kUSB_OsaEventAutoClear`, when a task gets the event flags, these flags are cleared automatically. If the clear mode is `kUSB_OsaEventManualClear`, the flags must be cleared manually.

### Parameters

|               |   |
|---------------|---|
| <i>handle</i> | It is an out parameter, which is used to return the pointer of the event object.                    |
| <i>flag</i>   | The event is auto-clear or manual-clear. See the enumeration <a href="#">usb_osa_event_mode_t</a> . |

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_event_handle eventHandle;  
usb_osa_status_t      usbOsaStatus;  
usbOsaStatus = USB_OsaEventCreate(&eventHandle,  
    kUSB_OsaEventManualClear);
```

### 5.3.4 `usb_osa_status_t USB_OsaEventDestroy ( usb_osa_event_handle handle )`

### Parameters

|               |                              |
|---------------|------------------------------|
| <i>handle</i> | Pointer to the event object. |
|---------------|------------------------------|

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_status_t      usbOsaStatus;  
...  
usbOsaStatus = USB_OsaEventDestroy(eventHandle);
```

### 5.3.5 `usb_osa_status_t` `USB_OsaEventSet ( usb_osa_event_handle handle, uint32_t bitMask )`

Sets specified flags for an event object.

## Function Documentation

### Parameters

|                |                              |
|----------------|------------------------------|
| <i>handle</i>  | Pointer to the event object. |
| <i>bitMask</i> | Event flags to be set.       |

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_status_t    usbOsaStatus;  
...  
usbOsaStatus = USB_OsaEventSet(eventHandle, 0x01U);
```

### 5.3.6 `usb_osa_status_t USB_OsaEventWait ( usb_osa_event_handle handle, uint32_t bitMask, uint32_t flag, uint32_t timeout, uint32_t * bitSet )`

This function waits for a combination of flags to be set in an event object. An applications can wait for any/all bits to be set. This function can get the flags that wake up the waiting task.

### Parameters

|                |  |
|----------------|--|
| <i>handle</i>  | Pointer to the event object.   |
| <i>bitMask</i> | Event flags to wait.   |
| <i>flag</i>    | Wait all flags or any flag to be set. 0U - wait any flag, others, wait all flags.  |
| <i>timeout</i> | The maximum number of milliseconds to wait for the event. If the wait condition is not met, passing 0U waits indefinitely when the environment is an RTOS and returns the <code>kStatus_OSA_Timeout</code> immediately. Pass any value for the bare metal. |
| <i>bitSet</i>  | Flags that wake up the waiting task are obtained by this parameter.  |

### Returns

An USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_status_t    usbOsaStatus;  
uint32_t            bitSet;  
...  
usbOsaStatus = USB_OsaEventWait(eventHandle, 0x01U, 0U, 0U, &bitSet);
```



**5.3.7** `usb_osa_status_t` **USB\_OsaEventCheck** ( `usb_osa_event_handle` *handle*,  
`uint32_t` *bitMask*, `uint32_t` \* *bitSet* )

This function checks for a combination of flags to be set in an event object.

## Function Documentation

### Parameters

|                |                              |
|----------------|------------------------------|
| <i>handle</i>  | Pointer to the event object. |
| <i>bitMask</i> | Event flags to check.        |
| <i>bitSet</i>  | Flags have been set.         |

### Returns

An USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_status_t    usbOsaStatus;  
uint32_t           bitSet;  
...  
usbOsaStatus = USB_OsaEventCheck(eventHandle, 0x01U, &bitSet);
```

### 5.3.8 `usb_osa_status_t` `USB_OsaEventClear` ( `usb_osa_event_handle` *handle*, `uint32_t` *bitMask* )

This function clears flags of an event object.

### Parameters

|                |                             |
|----------------|-----------------------------|
| <i>handle</i>  | Pointer to the event object |
| <i>bitMask</i> | Event flags to be cleared.  |

### Returns

An USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_status_t    usbOsaStatus;  
...  
usbOsaStatus = USB_OsaEventClear(eventHandle, 0x01U);
```

### 5.3.9 `usb_osa_status_t` `USB_OsaSemCreate` ( `usb_osa_sem_handle *` *handle*, `uint32_t` *count* )

This function creates a semaphore and sets the default count.

## Parameters

|               |  |
|---------------|--|
| <i>handle</i> | It is an out parameter, which is used to return pointer of the semaphore object. |
| <i>count</i>  | Initializes a value of the semaphore.  |

## Returns

An USB OSA error code or `kStatus_OSA_Success`.

## Example:

```
usb_osa_sem_handle    semHandle;
usb_osa_status_t     usbOsaStatus;
usbOsaStatus = USB_OsaSemCreate(&semHandle, 1U);
```

### 5.3.10 `usb_osa_status_t USB_OsaSemDestroy ( usb_osa_sem_handle handle )`

This function destroys a semaphore object.

## Parameters

|               |                           |
|---------------|---------------------------|
| <i>handle</i> | Pointer to the semaphore. |
|---------------|---------------------------|

## Returns

An USB OSA error code or `kStatus_OSA_Success`.

## Example:

```
usb_osa_sem_handle    semHandle;
usb_osa_status_t     usbOsaStatus;
...
usbOsaStatus = USB_OsaSemDestroy(semHandle);
```

### 5.3.11 `usb_osa_status_t USB_OsaSemPost ( usb_osa_sem_handle handle )`

This function wakes up a task waiting on the semaphore. If a task is not pending, increases the semaphore's value.

## Function Documentation

### Parameters

|               |                           |
|---------------|---------------------------|
| <i>handle</i> | Pointer to the semaphore. |
|---------------|---------------------------|

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_sem_handle    semHandle;  
usb_osa_status_t     usbOsaStatus;  
...  
usbOsaStatus = USB_OsaSemPost(semHandle);
```

### 5.3.12 `usb_osa_status_t USB_OsaSemWait ( usb_osa_sem_handle handle, uint32_t timeout )`

This function checks the semaphore's value. If it is positive, it decreases the semaphore's value and return `kStatus_OSA_Success`.

### Parameters

|                |  |
|----------------|--|
| <i>handle</i>  | Pointer to the semaphore.  |
| <i>timeout</i> | The maximum number of milliseconds to wait for the semaphore. If the wait condition is not met, passing 0U waits indefinitely when environment is RTOS. And return <code>kStatus_OSA_Timeout</code> immediately for bare metal no matter what value has been passed. |

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_sem_handle    semHandle;  
usb_osa_status_t     usbOsaStatus;  
...  
usbOsaStatus = USB_OsaSemWait(semHandle, 0U);
```

### 5.3.13 `usb_osa_status_t USB_OsaMutexCreate ( usb_osa_mutex_handle * handle )`

This function creates a mutex and sets it to an unlocked status.

## Parameters

|               |   |
|---------------|---|
| <i>handle</i> | It is out parameter, which is used to return the pointer of the mutex object. |
|---------------|---|

## Returns

A USB OSA error code or `kStatus_OSA_Success`.

## Example:

```
usb_osa_mutex_handle mutexHandle;
usb_osa_status_t      usbOsaStatus;
usbOsaStatus = USB_OsaMutexCreate(&mutexHandle);
```

### 5.3.14 `usb_osa_status_t` **USB\_OsaMutexDestroy** ( `usb_osa_mutex_handle` *handle* )

This function destroys a mutex and sets it to an unlocked status.

## Parameters

|               |                       |
|---------------|-----------------------|
| <i>handle</i> | Pointer to the mutex. |
|---------------|-----------------------|

## Returns

A USB OSA error code or `kStatus_OSA_Success`.

## Example:

```
usb_osa_mutex_handle mutexHandle;
usb_osa_status_t      usbOsaStatus;
...
usbOsaStatus = USB_OsaMutexDestroy(mutexHandle);
```

### 5.3.15 `usb_osa_status_t` **USB\_OsaMutexLock** ( `usb_osa_mutex_handle` *handle* )

This function checks the mutex status. If it is unlocked, it locks it and returns the `kStatus_OSA_Success`. Otherwise, it waits forever to lock in RTOS and returns the `kStatus_OSA_Success` immediately for bare metal.

## Function Documentation

Parameters

|               |                       |
|---------------|-----------------------|
| <i>handle</i> | Pointer to the mutex. |
|---------------|-----------------------|

Returns

A USB OSA error code or `kStatus_OSA_Success`.

Example:

```
usb_osa_mutex_handle mutexHandle;  
usb_osa_status_t      usbOsaStatus;  
...  
usbOsaStatus = USB_OsaMutexLock(mutexHandle);
```

### 5.3.16 `usb_osa_status_t` **USB\_OsaMutexUnlock** ( `usb_osa_mutex_handle` *handle* )

This function unlocks a mutex.

Parameters

|               |                       |
|---------------|-----------------------|
| <i>handle</i> | Pointer to the mutex. |
|---------------|-----------------------|

Returns

A USB OSA error code or `kStatus_OSA_Success`.

Example:

```
usb_osa_mutex_handle mutexHandle;  
usb_osa_status_t      usbOsaStatus;  
...  
usbOsaStatus = USB_OsaMutexUnlock(mutexHandle);
```

### 5.3.17 `usb_osa_status_t` **USB\_OsaMsgqCreate** ( `usb_osa_msgq_handle` \* *handle*, `uint32_t` *count*, `uint32_t` *size* )

This function creates a message queue.

## Parameters

|               |  |
|---------------|--|
| <i>handle</i> | It is an out parameter, which is used to return a pointer of the message queue object. |
| <i>count</i>  | The count of elements in the queue.  |
| <i>size</i>   | Size of every elements in words.   |

## Returns

A USB OSA error code or kStatus\_OSA\_Success.

## Example:

```
usb_osa_msgq_handle msgqHandle;
usb_osa_status_t usbOsaStatus;
usbOsaStatus = USB_OsaMsgqCreate(msgqHandle, 8U, 4U);
```

### 5.3.18 usb\_osa\_status\_t USB\_OsaMsgqDestroy ( usb\_osa\_msgq\_handle *handle* )

This function destroys a message queue.

## Parameters

|               |                             |
|---------------|-----------------------------|
| <i>handle</i> | Pointer to a message queue. |
|---------------|-----------------------------|

## Returns

A USB OSA error code or kStatus\_OSA\_Success.

## Example:

```
usb_osa_msgq_handle msgqHandle;
usb_osa_status_t usbOsaStatus;
...
usbOsaStatus = USB_OsaMsgqDestroy(msgqHandle);
```

### 5.3.19 usb\_osa\_status\_t USB\_OsaMsgqSend ( usb\_osa\_msgq\_handle *handle*, void \* *msg* )

This function sends a message to the tail of the message queue.

## Function Documentation

### Parameters

|               |  |
|---------------|--|
| <i>handle</i> | Pointer to a message queue.                        |
| <i>msg</i>    | The pointer to a message to be put into the queue. |

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_msgq_handle    msgqHandle;
message_struct_t       message;
usb_osa_status_t       usbOsaStatus;
...
usbOsaStatus = USB_OsaMsgqSend(msgqHandle, &message);
```

### 5.3.20 `usb_osa_status_t USB_OsaMsgqRecv ( usb_osa_msgq_handle handle, void * msg, uint32_t timeout )`

This function receives a message from the head of the message queue.

### Parameters

|                |  |
|----------------|--|
| <i>handle</i>  | Pointer to a message queue.  |
| <i>msg</i>     | The pointer to save a received message.  |
| <i>timeout</i> | The maximum number of milliseconds to wait for a message. If the wait condition is not met, passing 0U waits indefinitely when an environment is RTOS and returns the <code>kStatus_OSA_Timeout</code> immediately for bare metal. |

### Returns

A USB OSA error code or `kStatus_OSA_Success`.

### Example:

```
usb_osa_msgq_handle    msgqHandle;
message_struct_t       message;
usb_osa_status_t       usbOsaStatus;
...
usbOsaStatus = USB_OsaMsgqRecv(msgqHandle, &message, 0U);
```

### 5.3.21 `usb_osa_status_t USB_OsaMsgqCheck ( usb_osa_msgq_handle handle, void * msg )`

This function checks a message queue and receives a message if the queue is not empty.



Parameters

|               |   |
|---------------|---|
| <i>handle</i> | Pointer to a message queue.             |
| <i>msg</i>    | The pointer to save a received message. |

Returns

A USB OSA error code or `kStatus_OSA_Success`.

Example:

```
usb_osa_msgq_handle    msgqHandle;
message_struct_t       message;
usb_osa_status_t       usbOsaStatus;
...
usbOsaStatus = USB_OsaMsgqCheck(msgqHandle, &message);
```



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