

Transition from USB 3.1 Hub to USB 3.2 Hub



ABSTRACT

This application report provides instructions on how to transition an application that is currently using a USB 3.1 TUSB8041A, TUSB8042, TUSB8043, and TUSB8044 RGC hub to the TUSB8042A, TUSB8043A, and TUSB8044A RGC family of USB 3.2 generation 1 hubs. It also explains the improvements included in the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs.

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1 Introduction

The following are the high-level functional differences between the various hubs:

- TUSB8041A: USB 2.1 and USB 3.0/3.1 generation 1 compliant, 4-port hub
- TUSB8042: USB 2.1 and USB 3.1 generation 1 compliant, 4-port hub
- TUSB8043: USB 2.1 and USB 3.1 generation 1 compliant, 4-port hub, with a HID programming interface
- TUSB8044: USB 2.1 and USB 3.1 generation 1 compliant, 4-port hub, with a HID programming interface, USB 2.0 Billboard support
- TUSB8042A: USB 2.1 and USB 3.2 generation 1 compliant, 4-port hub
- TUSB8043A: USB 2.1 and USB 3.2 generation 1 compliant, 4-port hub, with a HID programming interface
- TUSB8044A: USB 2.1 and USB 3.2 generation 1 compliant, 4-port hub, with a HID programming interface, USB 2.0 Billboard support

[Table 1-1](#) lists the USB product IDs.

Table 1-1. USB Product IDs

| PRODUCT ID | TUSB8041 AND TUSB8041A | TUSB8042 AND TUSB8042A | TUSB8043 AND TUSB8043A | TUSB8044 AND TUSB8044A |
|------------|------------------------|------------------------|------------------------|------------------------|
| USB 3.x | 0x8140 | 0x8240 | 0x8340 | 0x8440 |
| USB 2.x | 0x8142 | 0x8242 | 0x8342 | 0x8442 |

2 Changes to Support USB Specification Compliance

2.1 USB 3.2 Specification Updates / ECNs

The TUSB8042A, TUSB8043A, and TUSB8044A family of hubs include several design updates necessary to accommodate the latest USB 3.2 specification and various ECNs. Functionally, customers see little to no impact from these changes, but they are required to pass the updated USB compliance test suites.

The Pending HP Timer ECN to the USB 3.1 specification mandated the relaxing of the Pending_HP_timer from 3 μ s to 10 μ s to allow for the extended propagation delay when retimers and long cables are used. The TUSB8041A, TUSB8042, TUSB8043, and TUSB8044 family of hubs used the 3 μ s Pending_HP_timer value, which cause compliance test fails in the following USB compliance tests. The TUSB8042A, TUSB8043A, and TUSB8044A family of hubs uses the new 10 μ s value.

- The legacy value of PENDING_HP_TIMER could cause FAILs in: TD 7.1, TD 7.9, TD 7.11, TD 7.26, TD 7.27, TD 7.28, and TD 7.29

The Pending HP Timer ECN also added a new timing requirement of tDHPResponse to constrain HP and LC processing time for better legacy compatibility. It is recommended that a design respond with LGOOD or LBAD within 400-ns in SuperSpeed operation. This capability was also added to the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs. The following compliance tests can fail without the change:

- tLinkTurnAround can cause FAILs in TD 7.1, TD 7.9, TD 7.13, and TD 7.14

There was also a Ux LFPS Exit ECN to the Ux_EXIT_TIMERS that was added in the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs to accommodate propagated cable delays in applications with retimers and long cables. Without the change the following compliance tests can fail:

- Ux_EXIT_TIMER can cause FAILs in TD 7.18 and TD 7.23

In addition to functional specification changes, there are some minor descriptor changes that are required to pass compliance testing:

- TUSB8042, TUSB8043, and TUSB8044: Device Descriptor bcdUSB field = 0310h
- TUSB8042A, TUSB8043A, and TUSB8044A: Device Descriptor bcdUSB field = 0320h
- TUSB8044 Billboard Capability Descriptor: bcdVersion = 1.10
- TUSB8044 Billboard Capability Descriptor: bcdVersion = 1.21

2.2 Alternate Mode Capability Descriptor

In addition to the USB 3.2 specification changes and ECNs incorporated by the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs, the TUSB8044A also implements the new Alternate Mode Capability Descriptor required by the USB Device Class Definition for Billboard Devices Release 1.21. This descriptor is used in addition to the regular Billboard capability descriptor to further describe the alternate mode. The AlternateModeVdo field, which describes the contents of the Mode VDO for the alternate mode, can be customized in the TUSB8044A using SMBUS, EEPROM or OTP. Table 5 in the [TUSB8044A Four-post USB 3.1 Gen1 Hub with USB Billboard Data Sheet](#) provides more information on how to customize this field.

Table 2-1. Billboard Alternate Mode Capability Descriptor

| OFFSET | FIELD | BYTES | DESCRIPTION |
|--------|--------------------|-------|--|
| 0 | bLength | 1 | Size in bytes |
| 1 | bDescriptorType | 1 | DEVICE CAPABILITY Type |
| 2 | bDevCapabilityType | 1 | BILLBOARD ALTERNATE MODE CAPABILITY |
| 3 | bIndex | 1 | Index of the Alternate Mode |
| 4 | dwAlternateModeVdo | 4 | See Table 5 in the TUSB8044A Datasheet |

2.3 Register Changes

Table 2-2 lists the register changes in the new family of hubs.

Table 2-2. Register Changes

| ADDRESS | TUSB8041A, TUSB8042, TUSB8043, AND TUSB8044 | TUSB8042A AND TUSB8043A | TUSB8044A |
|---------------|---|-------------------------|------------------------------|
| 0x0Ch - 0x0Fh | Reserved | Reserved | Billboard Alternate Mode VDO |

3 Erratum Fixes

There are several minor design updates to the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs to address erratum from the previous hub generations:

- The TUSB8041A, TUSB8042, TUSB8043, and TUSB8044 hub family did not support applications that disabled (marked as unused) ports 1 and 3. This has been corrected in the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs.
- The TUSB8041A, TUSB8042, TUSB8043, and TUSB8044 hub family did not support implementations that used custom string descriptors, but left the language ID as 0x0000h. This has been corrected in the TUSB8042A, TUSB8043A, and TUSB8044A family of hubs.
- The TUSB8043 and TUSB8044 devices were not able to support applications that disabled the serial number string descriptor by setting the serial number string length to zero. The TUSB8043A and TUSB8044A can support the disabling of the serial number string descriptor by setting the string descriptor length to zero. The serial number reporting capability has been removed from the HID and Billboard functions.
- The TUSB8043 and TUSB8044 devices hold the SCL/SMBCLK signal low while there was no upstream host connection if an EEPROM was installed. The TUSB8043A and TUSB8044A devices do not hold SCL/SMBCLK low when an EEPROM is installed and there is no upstream connection.

4 Battery Charging

The TUSB8042A, TUSB8043A, and TUSB8044A include some battery charging mode improvements from the previous hub family.

Table 4-1. Battery Charging Changes

| CHARGING MODE | TUSB8042A, TUSB8043A, AND TUSB8044A |
|-------------------------|---|
| CDP | CDP mode is now restarted based on certain line state conditions. This improves charging performance when a charging device is connected to a suspended but powered port or if there is a noise event that looks like a failed USB connection |
| DCP | No change from previous hub generation |
| ACP modes / Galaxy mode | Several new shorter charging mode sequences are now supported. See Table 1 and Table 2 in the TUSB8044A Four-post USB 3.1 Gen1 Hub with USB Billboard Data Sheet |

5 Layout Changes

Table 5-1 lists the layout changes between the various variants of each hub family.

Note

The only layout change from the TUSB8041A, TUSB8042, TUSB8043, and TUSB8044 families to the TUSB8042A, TUSB8043A, and TUSB8044A is that the pulldown resistor on the TEST pin (49) is now required, not just recommended.

Table 5-1. Layout Changes

| TUSB8041, TUSB8041A, TUSB8042, AND TUSB8042A | TUSB8043 AND TUSB8043A | TUSB8044 AND TUSB8044A |
|---|--|--|
| Set pins 40, 42, 45 as needed | Set pins 40, 42, 45 as needed | Set pins 40, 42, 45 as needed – may need to be routed to PD controller for Billboard support. |
| SCL/SMBCLK and SDA/SMBDAT unconnected, routed to I ² C EEPROM or SMBUS host. | SCL/SMBCLK and SDA/SMBDAT unconnected, routed to I ² C EEPROM or SMBUS host or routed to any I ² C EEPROM to be addressed by HID interface | SCL/SMBCLK and SDA/SMBDAT unconnected, routed to I ² C EEPROM or SMBUS host or routed to any I ² C EEPROM to be addressed by HID interface |

6 HID Improvements

The TUSB8043A and TUSB8044A devices incorporate several changes to the HID endpoint implementation to improve interoperability and ease customer use.

- The TUSB8043A and TUSB8044A device added the ability to vary the I2C clock speed from 400 kHz to 100 KHz using an opcode bit.
- The ability to enable/disable endpoint 1 via an opcode bit has also been added. If EP1 is disabled, EP1 always sends NAK and EP0 must be used for GET REPORT.
- The TUSB8043A and TUSB8044A have improved support for I2C clock stretching.
- The I2C timing at 400 KHz was adjusted to better align with the scalar requirements (SCL timing was adjusted).
- Interrupt endpoint polling rate was increased to 125 μ s from 1 ms to improve programming time.
- I2C hold time was increased (approximately doubled) to improve interoperability with various devices.

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