

# **TUSB8040A Evaluation Module**

## **User's Guide**



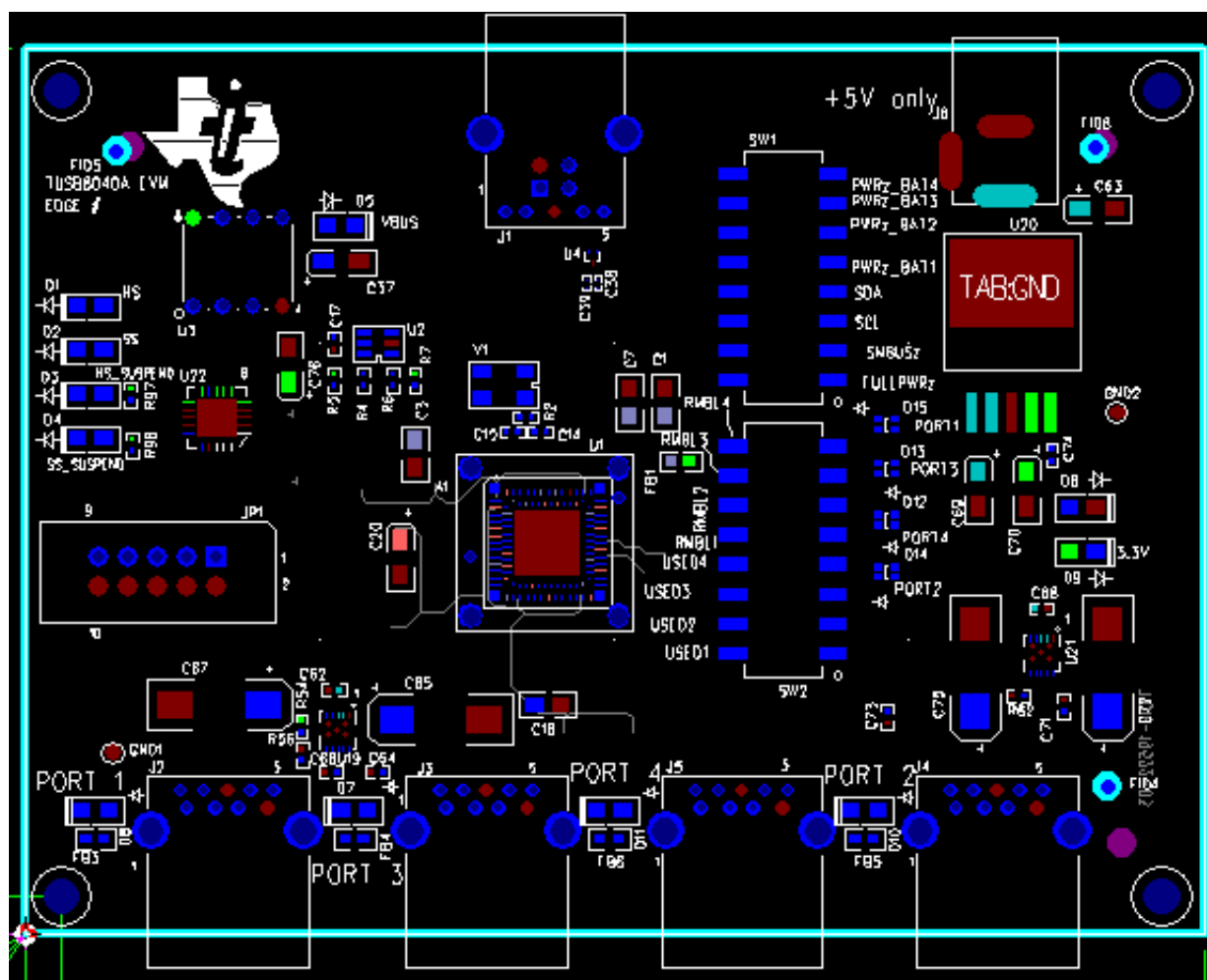
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<b>1</b>	<b>Introduction .....</b>	<b>3</b>
<b>2</b>	<b>Hardware Overview .....</b>	<b>4</b>
<b>1</b>	<b>TUSB8040A .....</b>	<b>4</b>
<b>2</b>	<b>USB Port Connectors .....</b>	<b>4</b>
2.1	USB Port Connector - Power .....	4
2.2	USB Port Connector – Noise Filtering .....	5
<b>3</b>	<b>Hub Configuration .....</b>	<b>5</b>
<b>4</b>	<b>Optional Serial EEPROM .....</b>	<b>5</b>
<b>5</b>	<b>Power/Reset .....</b>	<b>5</b>
<b>6</b>	<b>Optional Circuitry .....</b>	<b>6</b>
<b>3</b>	<b>Hardware Set Up .....</b>	<b>7</b>
<b>1</b>	<b>Configuration Switches .....</b>	<b>7</b>
<b>2</b>	<b>Hardwired Configurations .....</b>	<b>9</b>
<b>3</b>	<b>SMBUS Support .....</b>	<b>9</b>
<b>4</b>	<b>EVM Installation .....</b>	<b>9</b>
<b>5</b>	<b>Troubleshooting .....</b>	<b>10</b>
<b>Appendix A Schematics .....</b>		<b>11</b>
<b>Appendix B TUSB8040AEVM Bill of Materials .....</b>		<b>15</b>

## Introduction

The TI TUSB8040A evaluation module is a functional board design of a single device that implements both a USB 3.0 hub and a USB 2.0 hub. The EVM can support both SuperSpeed (SS) and USB 2.0 (HS, FS, and LS) operation on its USB ports. This EVM is intended for use in evaluating system compatibility, developing optional EEPROM firmware, and validating interoperability. This EVM also acts as a hardware reference design for any implementation of the TUSB8040A.

Upon request, layout files for the EVM can be provided to illustrate techniques used to route the differential pairs, use of split power planes, placement of filters and other critical components, and methods used to achieve length matching of critical signals.



- A Note the EVM dimensions of 3" x 4" accommodates various lab test components, actual production implementations can be much smaller. Also, the TUSB8040AEVM is laid out to accept either a TUSB8040A unit or a socket. This socket functionality would not need to be duplicated on a production implementation.

**Figure 1. TUSB8040AEVM Top Layer Layout**

## Hardware Overview

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The TUSB8040AEVM board hardware can be divided into five functional areas:

### 1 TUSB8040A

The TUSB8040A on the TUSB8040AEVM (U1 on the schematic) operates as a functional interconnect between an upstream connection to a USB host or hub and up to four directly connected downstream devices or hubs. More devices and hubs can be supported if arranged in tiers. The TUSB8040A is capable of supporting operation at USB SuperSpeed (SS), High-Speed (HS), Full Speed (FS) or Low Speed (LS). In general, the speed of the upstream connection of the TUSB8040AEVM limits the downstream connections to that speed (SS, HS, and FS) or lower.

The TUSB8040A requires a 24-MHz low ESR crystal, Y1 with a 1-M $\Omega$  feedback resistor. The crystal should be fundamental mode with a load capacitance of 12 pF – 24 pF and a frequency stability rating of  $\pm 100$  PPM or better. To ensure a proper startup oscillation condition, a maximum crystal equivalent series resistance (ESR) of 50  $\Omega$  is recommended.

The TUSB8040A can also use an oscillator or other clock source. When using an external clock source such as an oscillator, the reference clock should have  $\pm 100$  PPM (or better) frequency stability and have less than 50-ps absolute peak to peak jitter (or less) than 25-ps peak to peak jitter after applying the USB 3.0 jitter transfer function.

### 2 USB Port Connectors

The TUSB8040AEVM is equipped with 5 standard nine pin USB 3.0 port connectors. One of these five connectors, J1, is a Type B connector designed to interface with an upstream USB host or hub. The remaining connectors, J2-J5, are Type A connectors for connection to downstream devices or hubs. Standard size connectors were used on the EVM design, but USB micro connectors can be used if desired. It is also possible to implement a legacy USB connector on one or more of the downstream ports if SuperSpeed operation is not desired.

The USB ports can be attached via a standard USB cable to any USB 3.0 or legacy USB host, hub or device. The TUSB8040A will automatically connect to any upstream USB 3.0 host or hub at both SuperSpeed and High-Speed. Using a legacy USB cable between the TUSB8040AEVM and a USB 3.0 host or hub will force it to High-Speed operation. The same is true if a legacy USB cable is used between the TUSB8040A EVM and a downstream SuperSpeed capable device in that operation will be limited to USB High-Speed.

#### 2.1 USB Port Connector - Power

VBUS is received from the upstream host or hub on J1. The TUSB8040A is configured as a self-powered hub, so there should not be any significant current draw by the EVM from VBUS. The TUSB8040A does monitor the VBUS input after filtering through a resistor divider network of a 90.9-k $\Omega$ , 1% resistor, R1, and a 10-k $\Omega$ , 1% resistor, R3. VBUS cannot be directly connected to the TUSB8040A device.

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**NOTE:** The VBUS LED implemented on the EVM will cause a USB 2.0 compliance issue because it draws greater than 2-mA of current while the USB connection is suspended. It is included for lab evaluation purposes only.

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A bulk capacitor of at least 1  $\mu$ F is required on the upstream port VBUS input to comply with the USB specification. The TUSB8040AEVM uses a 10- $\mu$ F capacitor, C37.

VBUS, sourced by the 5-V wall power input, J6, is provided to the downstream port connectors so that bus powered devices may be attached to the downstream ports. The USB 3.0 specification limits the current consumption of a USB 3.0 device to 900 mA at 5 V. The current limiting parameter of the TPS2560 devices, U19 and U21, is configured to 1.5 A to avoid any spurious over-current events due to bus-powered HDD spin-up power fluctuations ([SLVS930](#)). A production implementation could place stricter limits on this power consumption. An over-current event on any of the downstream port connectors will be reported to the TUSB8040A via the OVERCURxZ inputs.

## 2.2 USB Port Connector – Noise Filtering

Each downstream VBUS output has a 150-μF bulk capacitor (C65, C67, C72, C75) as recommended by the TPS2560 data manual to prevent in-rush current events on the downstream devices. In addition, there are ferrite beads and small capacitors on the VBUS lines to reduce noise and address ESD/EMI concerns.

The TUSB8040AEVM also implements optional isolation using two small noise filtering capacitors and a 1-MΩ resistor between the earth ground of each connector and the digital ground of the EVM, this is not a requirement but should be used if ground isolation is desired.

Please note that the series capacitors implemented on the SS TX pairs are incorporated to satisfy the USB 3.0 requirement that differential links be AC coupled on the transmit pair.

## 3 Hub Configuration

The TUSB8040AEVM can be configured by setting several inputs to the TUSB8040A that are sampled at power-on reset or using an optional serial EEPROM. See section 3.1 for a full description of these inputs and how to configure them. A production implementation would either rely on the default internal pull-up or pull-down resistor for each configuration input or over-ride it with an external pull-up or pull-down resistor.

## 4 Optional Serial EEPROM

Each TUSB8040AEVM is equipped with an onboard EEPROM/socket placeholder. A small I<sup>2</sup>C EEPROM can be installed to set the configuration registers as defined in the TUSB8040A data manual ([SLLSE47](#)). In its default setting, the EVM does not have an EEPROM installed and instead uses the configuration inputs to determine any optional settings of the TUSB8040A.

The EEPROM interface defaults to programmable (not write-protected) so that any installed EEPROM's contents may be modified to test various settings. If an EEPROM data change is required, the values may be changed using the register access methods outlined in the TUSB8040A data sheet ([SLLSE97](#)). In addition, a Windows® based EEPROM utility is available upon request.

## 5 Power/Reset

The TUSB8040AEVM operates from the power provided by a 5-V wall power adapter, not bus power supplied by a USB host. It is recommended to use a wall power adapter that is capable of sourcing 4 A to 5 A because the hub must be able to source significant power on its downstream ports (900 mA per port).

The TUSB8040AEVM uses a single channel LDO voltage regulator to drop 5 V to 3.3 V. The TPS7A4533, U20, is a 1.5-A output linear regulator ([SLVS720](#)). The 1.1-V core voltage required by the TUSB8040A is sourced by the 3.3-V rail to reduce unnecessary heat dissipation. The TPS74801, U22, is a 1.5-A output single channel LDO linear regulator ([SBVS074](#)). Both regulators require few external passive components and are appropriately rated for heat dissipation.

While there are two power-on reset sources on the TUSB8040AEVM, only one is required. Implemented on the EVM is a supervisory circuit, TPS3808G33, U2 ([SBVS050](#)). This device has two input sources: the BOARD\_3P3V power rail and the 1.1-V regulator power good output. The other reset source is the RC circuit created by the internal pull-up resistor of GRSTz and the 1-μF capacitor, C18. If R4-R7, C16 and C17 are installed, the reset supervisor circuit is enabled. If those passive components are not populated, the RC circuit is enabled.

The TUSB8040A requires a power on reset of 3 ms, the value of the capacitor used in the RC circuit would vary based on the voltage ramp characteristics of the implementation.

## 6 Optional Circuitry

The TUSB8040AEVM design implements a variety of LEDs, none of which are required by the USB specification. They are provided to make testing and debug easier.

- D1 – Indicates that the upstream USB port is connected at High-Speed.
- D2 – Indicates that the upstream USB port is connected at SuperSpeed.
- D3 – Indicates that the upstream USB port has entered a High-Speed suspend state.
- D4 – Indicates that the upstream USB port has entered a SuperSpeed suspend state.
- D5 – Indicates when VBUS is provided to the upstream USB port.
- D6 – Indicates that 5 V is being applied to the TUSB8040AEVM.
- D7, D8, D10, D11 – Indicate when VBUS is applied to the downstream USB ports. The TUSB8040AEVM enables or disables power to all downstream USB ports simultaneously.
- D9 – Indicates BOARD\_3P3V is active
- D12 – D15 (dual LEDs) – Implement the USB 2.0 specification for port indicator LEDs. These LEDs indicate if the downstream ports are connected at USB 2.0 speeds (green) or if there is an over current event on a downstream port (amber).

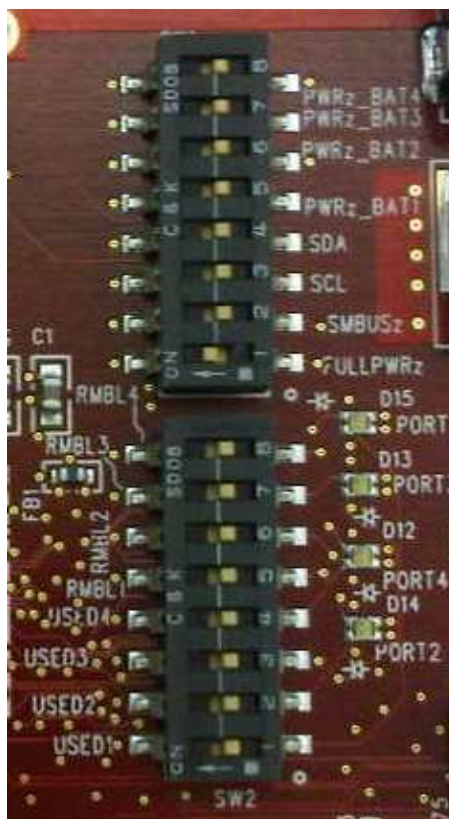
The TUSB8040AEVM incorporates ESD protection circuitry for the differential pairs of all five ports. The TPD2EUSB30 devices are not required or populated on the EVMs, but are recommended for any system where ESD events are a concern, especially if the end equipment requirements exceed the device specifications (i.e. HBM 2000 kV, CDM 500 V) ([SLVSAC2](#)).

The switches present on the TUSB8040AEVM are intended for TI lab evaluation only and are not required for production designs.

## Hardware Set Up

### 1 Configuration Switches

The TI TUSB8040AEM has two sets of switches to facilitate configuration changes. Changing these switch settings without a complete understanding of the result is not recommended. Configuration inputs are only read by the TUSB8040A during power on reset, changing the switch settings while the EVM is powered on will have no effect. Please refer to the EVM schematic for additional information (included in the appendix).



**Figure 2. Configuration Switches**

The switch definitions are as follows, with the standard setting in parenthesis:

**SW1\_1 (on):** FULLPWRz Switch. The TUSB8040A has an internal pull up on this terminal, so the TUSB8040A defaults to a non full power management mode. If the switch is set to the ON position, the terminal is pulled low and full power management mode is enabled. This means that the TUSB8040A reports that it supports downstream port power switching in the USB descriptors it sends to the USB host. Since the TUSB8040AEM does implement downstream port power switching, full power management mode should be enabled.

**SW1\_2 (off):** SMBUSz Switch. The TUSB8040A has an internal pull up on this terminal, so I<sup>2</sup>C interface mode is enabled by default. If the switch is set to the ON position, the terminal is pulled low and SMBUS mode is enabled.



**SW1\_3 (off):** SCL (Serial Clock) Switch. The TUSB8040A has an internal pull down on this terminal, so the serial EEPROM/SMBUS interface is disabled. If the switch is set to the ON position, a pull up resistor is connected to the serial clock terminal to indicate that an I<sup>2</sup>C EEPROM may be attached (along with a pull up resistor on SDA).

The SCL\_SMBCLK terminal is also sampled at the deassertion of reset to determine if USB 3.0 SuperSpeed low power states U1 and U2 initiation is disabled. If SCL\_SMBCLK is high, U1 and U2 low power state initiation is disabled. If SCL\_SMBCLK is low, U1 and U2 low power states are completely enabled. If the optional EEPROM or SMBUS is implemented, the value of the u1u2TimerOvr bit of the Device Configuration Register determines if the low power state initiation is enabled.

**SW1\_4 (off):** SDA (Serial Data) Switch. The TUSB8040A has an internal pull down on this terminal, so the serial EEPROM/SMBUS interface is disabled. If the switch is set to the ON position, a pull up resistor is connected to the serial clock terminal to indicate that an I<sup>2</sup>C EEPROM may be attached (along with a pull up resistor on SCL).

The SDA\_SMBDAT terminal is also sampled at the deassertion of reset to determine if the USB 3.0 SuperSpeed low power states U1 and U2 are disabled. If SDA\_SMBDAT is high, U1 and U2 low power states are completely disabled. If SDA\_SMBDAT is low, U1 and U2 low power states are enabled. If the optional EEPROM or SMBUS is implemented, the value of the u1u2Disable bit of the Device Configuration Register determines if the low power state U1 and U2 are enabled. Note that disabling U1 and U2 via the SDA\_SMBDAT terminal, overrides the U1 and U2 initiation disable of the SCL\_SMBCLK terminal.

**SW1\_5 (off):** PWRz\_BAT1 Switch. The TUSB8040A has an internal pull down on this terminal, so USB Battery Charging mode on Port 1 is disabled by default. If the switch is set to the ON position, the terminal is pulled high and battery charging is enabled on downstream port 1.

**SW1\_6 (off):** PWRz\_BAT2 Switch. The TUSB8040A has an internal pull down on this terminal, so USB Battery Charging mode on Port 2 is disabled by default. If the switch is set to the ON position, the terminal is pulled high and battery charging is enabled on downstream port 2.

**SW1\_7 (off):** PWRz\_BAT3 Switch. The TUSB8040A has an internal pull down on this terminal, so USB Battery Charging mode on Port 3 is disabled by default. If the switch is set to the ON position, the terminal is pulled high and battery charging is enabled on downstream port 3.

**SW1\_8 (off):** PWRz\_BAT4 Switch. The TUSB8040A has an internal pull down on this terminal, so USB Battery Charging mode on Port 4 is disabled by default. If the switch is set to the ON position, the terminal is pulled high and battery charging is enabled on downstream port 4.

**SW2\_1 (off):** USED1 Switch. The TUSB8040A has an internal pull up on this terminal, so Port 1 is enabled by default. If the switch is set to the ON position, the terminal is pulled low, Port 1 is disabled and the TUSB8040A will report as 3 port hub (or less if other USEDx terminals are set low).

**SW2\_2 (off):** USED2 Switch. The TUSB8040A has an internal pull up on this terminal, so Port 2 is enabled by default. If the switch is set to the ON position, the terminal is pulled low, Port 2 is disabled and the TUSB8040A will report as 3 port hub (or less if other USEDx terminals are set low).

**SW2\_3 (off):** USED3 Switch. The TUSB8040A has an internal pull up on this terminal, so Port 3 is enabled by default. If the switch is set to the ON position, the terminal is pulled low, Port 3 is disabled and the TUSB8040A will report as 3 port hub (or less if other USEDx terminals are set low).

**SW2\_4 (off):** USED4 Switch. The TUSB8040A has an internal pull up on this terminal, so Port 4 is enabled by default. If the switch is set to the ON position, the terminal is pulled low, Port 4 is disabled and the TUSB8040A will report as 3 port hub (or less if other USEDx terminals are set low).

**SW2\_5 (off):** RMBL1 Switch. The TUSB8040A has an internal pull up on this terminal, so any devices connected to Port 1 are reported as removable by default. If the switch is set to the ON position, the terminal is pulled low and the TUSB8040A will report a device connected to Port 1 as non-removable.

**SW2\_6 (off):** RMBL2 Switch. The TUSB8040A has an internal pull up on this terminal, so any devices connected to Port 2 are reported as removable by default. If the switch is set to the ON position, the terminal is pulled low and the TUSB8040A will report a device connected to Port 2 as non-removable.

**SW2\_7 (off):** RMBL3 Switch. The TUSB8040A has an internal pull up on this terminal, so any devices connected to Port 3 are reported as removable by default. If the switch is set to the ON position, the terminal is pulled low and the TUSB8040A will report a device connected to Port 3 as non-removable.



**SW2\_8 (off):** RMBL4 Switch. The TUSB8040A has an internal pull up on this terminal, so any devices connected to Port 4 are reported as removable by default. If the switch is set to the ON position, the terminal is pulled low and the TUSB8040A will report a device connected to Port 4 as non-removable.

## 2 Hardwired Configurations

**PORTINDz** - The TUSB8040A has an internal pull up on this terminal, so port indicator LED support is not reported to the USB host by default. Since the TUSB8040AEVM has port indicator LEDs, this terminal has been pulled low.

**GANGED** - The TUSB8040A has an internal pull up on this terminal, so ganged downstream power switch support is reported to the USB host by default. Since the TUSB8040AEVM has individual downstream port power switches, this terminal has been pulled low.

**HS\_SUSPEND\_POLARITY** - The TUSB8040A samples HS\_SUSPEND\_POLARITY at the deassertion of reset to determine the polarity of the downstream port power switch enables. The TUSB8040A has an internal pull down on this terminal to set the power enables to active low. Since the TUSB8040AEVM implements power switches with active low enables, R97 is not populated.

**SS\_SUSPEND\_SSC** - The TUSB8040A samples SS\_SUSPEND\_SSC at the deassertion of reset to determine if SSC is enabled. The TUSB8040A has an internal pull down on this terminal to enable SSC. Since several devices and hosts in the USB 3.0 community have SSC locking issues, SSC is disabled on the TUSB8040AEVM and R98 is populated.

## 3 SMBUS Support

The TUSB8040AEVM must be modified to support the SMBUS option:

SMBUSz (switch 1\_2) must be set to the ON position.

SCL\_SMBCLK (switch 1\_3) must be set to the ON position to enable the pull-up.

SDS\_SMBDAT (switch 1\_4) must be set to the ON position to enable the pull-up.

SMBUS Address: 0x40:

FULLPWRMGMENTz\_SMBA1— low on TUSB8040AEVM

GANGED\_SMBA2 — low on TUSB8040AEVM

PORTINDz\_SMBA3— low on TUSB8040AEVM

SMBUS Address: 0x41:

FULLPWRMGMENTz\_SMBA1 (switch 1\_1)— high on TUSB8040AEVM

GANGED\_SMBA2 — low on TUSB8040AEVM

PORTINDz\_SMBA3— low on TUSB8040AEVM

External connections to SDA\_SMBDAT and SCL\_SMBCLK can be made at the I<sup>2</sup>C EEPROM footprint.

## 4 EVM Installation

To install the EVM, perform the following steps:

1. Attach a 5-V wall power source to J6. LEDs D6 and D9 should be lit.
2. Attach a USB cable between J1 and a USB host. LEDs D5, D7, D8, D10 and D11 should be lit.
  - (a) If the TUSB8040AEVM is attached to a USB 3.0 host, D1 and D2 should be lit.
  - (b) If the TUSB8040AEVM is attached to a USB 2.0 host, D1 should be lit.

## 5 Troubleshooting

**Case 1:** Device function(s) are “banged out” in Device Manager.

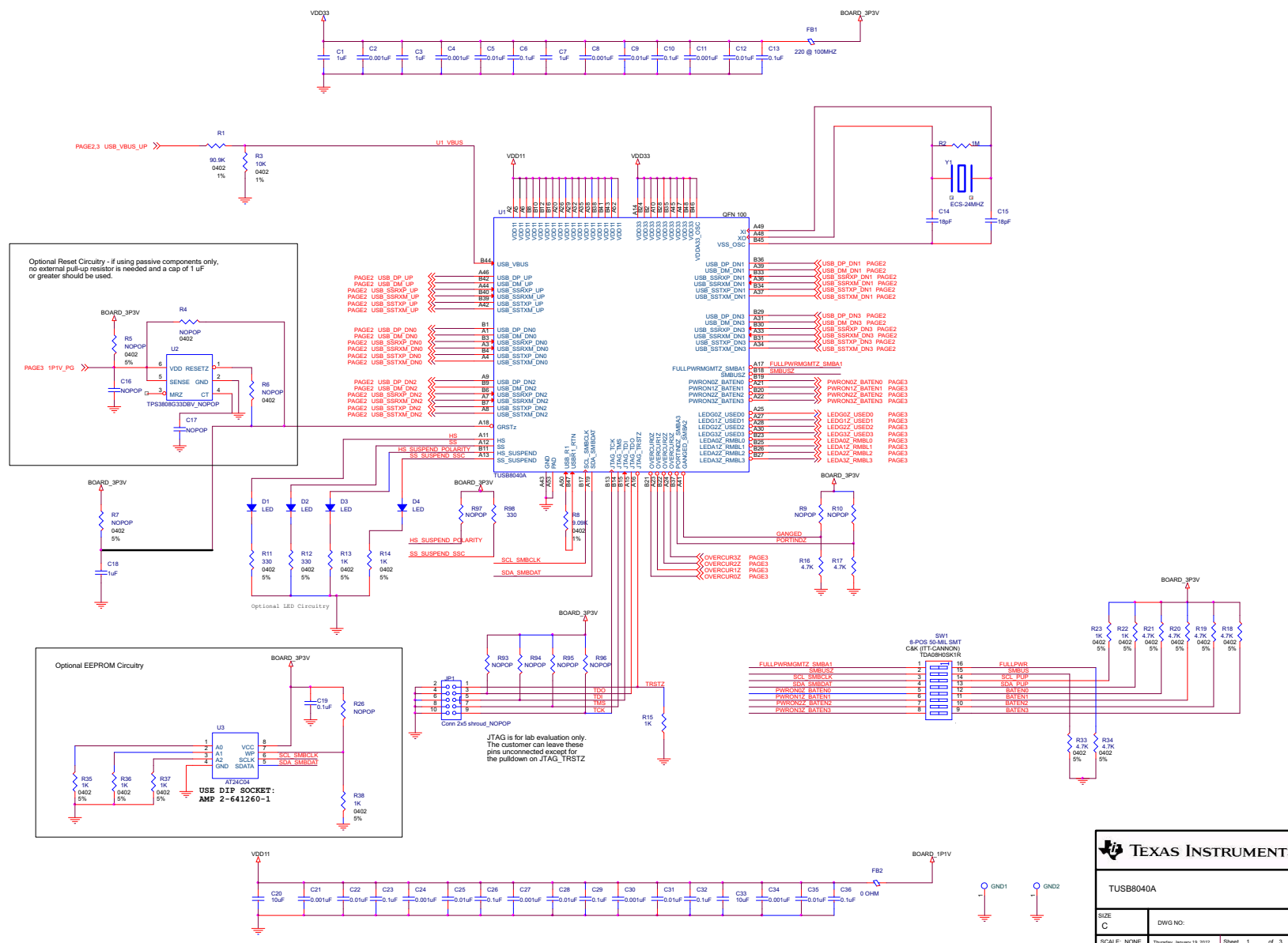
- Make sure that the latest updates are installed for the operating system.
- Make sure that the latest drivers are installed for the host controller.

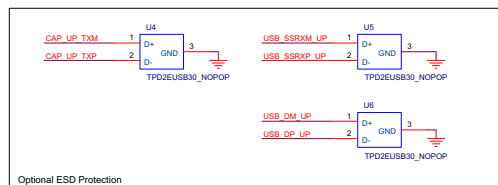
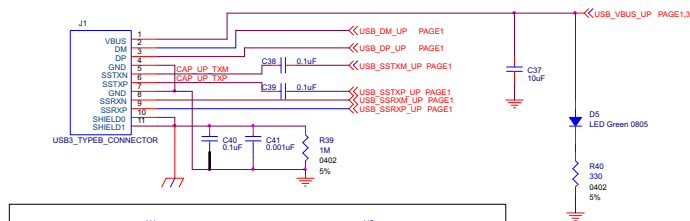
**Case 2:** The EVM does not work at all.

- Verify that all switches are in their default state and the EVM is powered on with a 5-V source with adequate current.
- If installed, remove the serial EEPROM from the EEPROM socket. The EVM does not require an EEPROM to operate.
- In the case where a 12-V power supply has been attached to the EVM, the fault is non-recoverable.

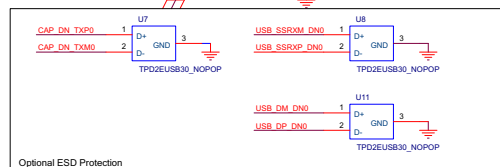
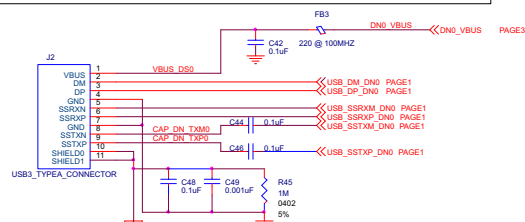
## Appendix A Schematics

The following pages contain schematics for the TUSB8040A.

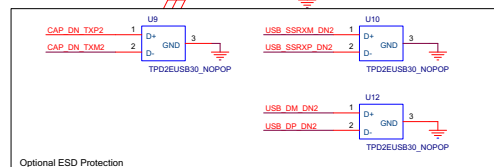
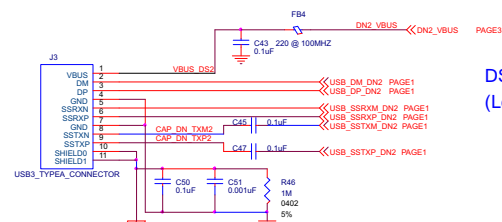
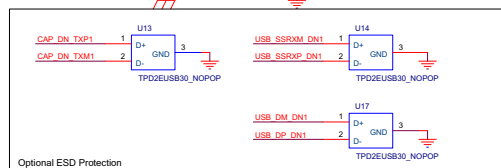
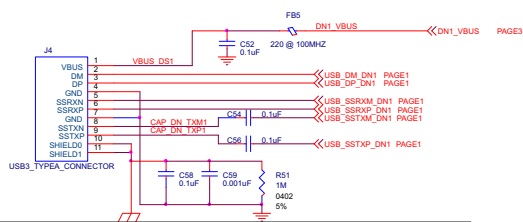




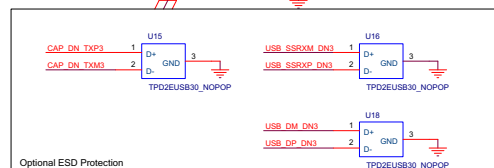
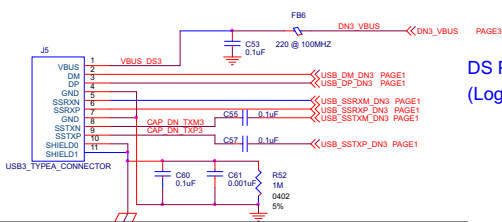
DS PORT 1  
(Logical DS Port 0)



DS PORT 2  
(Logical DS Port 1)

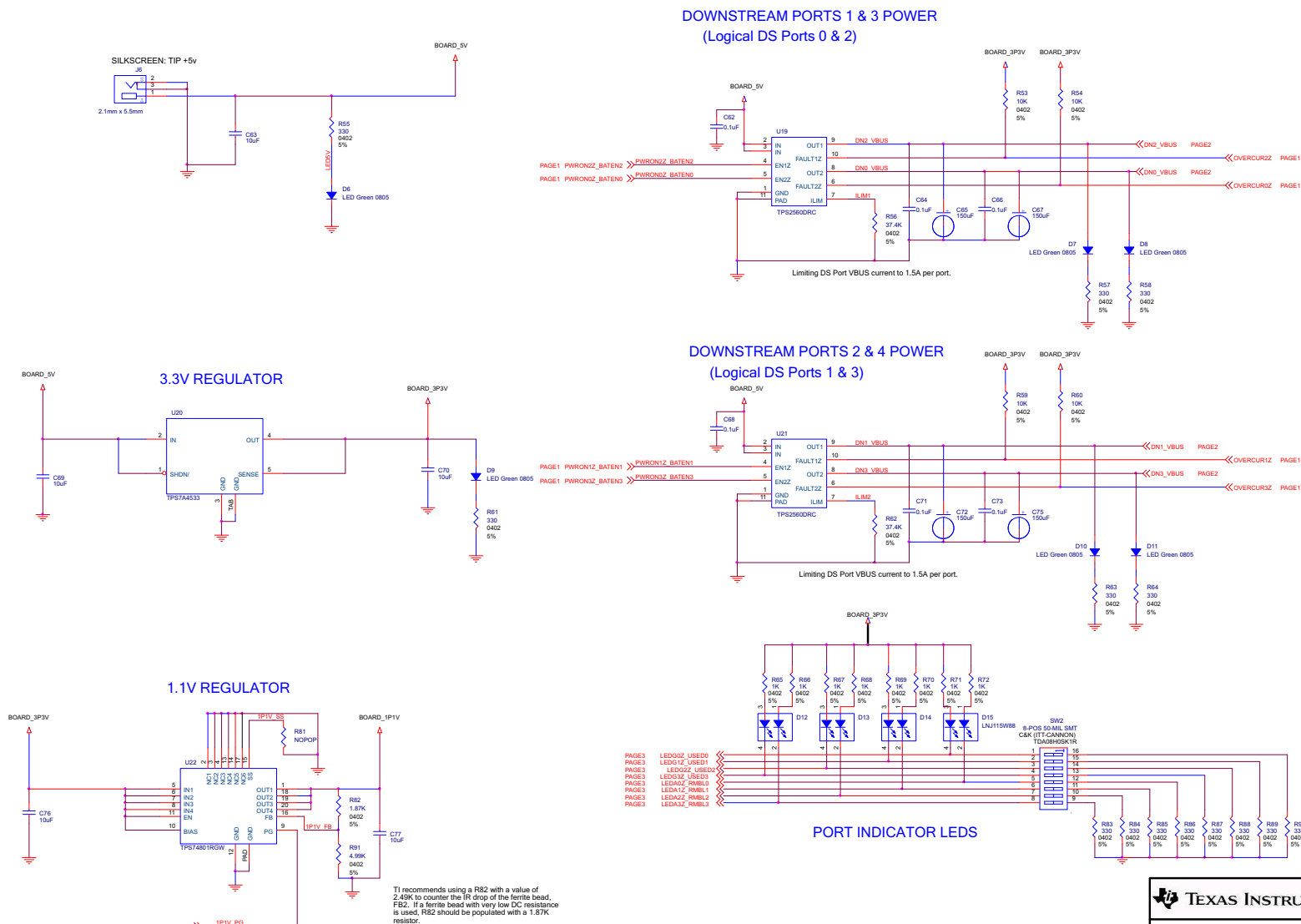


DS PORT 3  
(Logical DS Port 2)



DS PORT 4  
(Logical DS Port 3)

<b>TEXAS INSTRUMENTS</b>	
USB3 CONNECTORS	
SIZE C	DWG NO.:
SCALE: NONE	Thursday, January 19, 2012 Sheet 2 of 3



## **Appendix B TUSB8040AEVM Bill of Materials**

The following pages contain the BOM for TUSB8040AEVM.



Table 1. TUSB8040AEVM BOM

Item	Quantity	Reference	Part	Manufacturer	Part Number	Package
1	4	C1,C3,C7,C18	1uF	TDK	C2012X7R1A105K	805
2	14	C2, C4, C8, C11, C21, C24, C27, C30, C34,C41, C49, C51, C59, C61	0.001uF	TDK	C1005X7R1H102K	402
3	8	C5, C9, C12, C22, C25, C28, C31, C35	0.01uF	AVX	0402YC103KAT2A	402
4	24	C6, C10, C13, C19, C23, C26, C29, C32, C36, C40, C42, C43, C48, C50, C52, C53, C58, C60, C62, C64, C66, C68, C71, C73	0.1uF	Yageo	CC0402KRX5R6BB104	402
5	10	C38, C39, C44, C45, C46, C47, C54, C55, C56, C57	0.1uF	TDK	CC0402KRX5R6BB104	201
6	2	C14, C15	18pF	AVX	04025A180JAT2A	402
7	8	C20, C33, C37, C63, C69, C70, C76, C77	10uF	Murata Electronics	GRM31CR61C106KC31L	1206
8	4	C65, C67, C72, C75	150uF	Kemet	B45197A2157K409 (Tantalum)	7343
9	14	R4, R5, R6, R9, R10, C16, C17, R26, R81, R93, R94, R95, R96, R97	NO POP			402
10	11	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11	LED Green 0805	Lite On	LTST-C171GKT	805
11	5	FB1, FB3, FB4, FB5, FB6	220 @ 100MHZ Ferrite Bead	Murata Electronics	BLM18PG221SN1D	603
12	2	SW1, SW2	8-POS 50-MIL SMT	C&K Components	SD08H0SBR	
13	1	J1	USB3_ TYPEB_CONNECTOR	FoxConn	UEB1112C-2AK1-4H	9_RA_TH_B
14	4	J2, J3, J4, J5	USB3_ TYPEA_CONNECTOR	FoxConn	UEA1112C-4HK1-4H	9_RA_TH_A
15	1	J6	2.1mm x 5.5mm DC Power Jack	CUI Inc.	PJ-202AH (PJ-002AH)	2.1mm x 5.5mm
16	6	R2, R39, R45, R46, R51, R52	1M	Rohm Semiconductor	MCR01MZPJ105	402
17	1	R1	90.9K 1%	Rohm Semiconductor	MCR01MZPF9092	402
18	5	R7, R53, R54, R59, R60	10K	Rohm Semiconductor	MCR01MZPJ103	402
19	1	R3	10K 1%	Rohm Semiconductor	MCR01MZPF1002	402
20	8	R16, R17, R18, R19, R20, R21, R33, R34	4.7K	Rohm Semiconductor	MCR01MZPJ472	402
21	17	R15, R22, R23, R35, R36, R37, R38, R65, R66, R67, R68, R69, R70, R71, R72, R13, R14	4.7K	Rohm Semiconductor	MCR01MZPJ102	402
22	1	R6	0	Rohm Semiconductor	MCR01MZPJ000	402
23	18	R11, R12, R40, R55, R98, R57, R58, R61, R63, R64, R83, R84, R85, R86, R87, R88, R89, R90	330	Rohm Semiconductor	MCR01MZPJ331	402
24	2	R56, R62	37.4K	Vishay / Dale	CRCW040237K4FKED	402
25	1	R82	1.87K	Vishay / Dale	CRCW04021K87FKED	402
26	1	R91	1.87K	Vishay / Dale	CRCW04024K99FKED	402
27	1	U1	TUSB8040A - USB 3.0 Hub	Texas Instruments	TUSB8040A	100QFN

**Table 1. TUSB8040AEVM BOM (continued)**

Item	Quantity	Reference	Part	Manufacturer	Part Number	Package
28	1	U2	TPS3808G33DBV - Voltage Supervisor	Texas Instruments	TPS3808G33DBV	6DBV
29	1	U3	AT24C04 / SOCKET - I2C EEPROM	Atmel / Tyco	AT24C04A-10PU-1.8 / 2-641260-1	8DIP / 8SOIC SOCKET
30	15	U4, U5, U6, U7, U8, U9, U10, U11, U12, U13, U14, U15, U16, U17, U18	TPD2EUSB30 - USB ESD Protection	Texas Instruments	TPD2EUSB30	3DRT
31	2	U19, U21	TPS2560DRC - USB Power Switch	Texas Instruments	TPS2560DRC	10SON
32	1	U20	TPS7A4533 - 3.3V Voltage Regulator	Texas Instruments	TPS7A4533KTT	DDPAK-5
33	1	U22	TPS74801RGW - 1.1V Voltage Regulator	Texas Instruments	TPS74801RGW	20VQFN
34	1	Y1	ECS-24MHZ Crystal	ECS	ECX-53B (ECS-240-20-30B-TR)	5.0mm x 3.2mm
35	4	D12, D13, D14, D15	Green Amber LED	Panasonic	LNJ115W88	603
36	1	JP1	Conn 2x5 shroud	3M	LNJ115W88	HDR5X2 M 0.1" TH
37	1	R8	9.09K 1%	Panasonic - ECG	ERJ-2RKF9091X	402
38	1	FB2	0 ohm			603
39	1	NO POP	NO POP AC Power Adapter	CUI Inc	ETSA050360UDC-P5P-SZ	2.1mm I.D. x 5.5mm
40	4		PCB Feet	Richco Plastic Co	RBS-12 or RBS-32	



## EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit [www.ti.com/esh](http://www.ti.com/esh) or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

## REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

### General Statement for EVMs including a radio

*User Power/Frequency Use Obligations:* This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

### For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

#### Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### **FCC Interference Statement for Class B EVM devices**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### **For EVMs annotated as IC – INDUSTRY CANADA Compliant**

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### **Concerning EVMs including radio transmitters**

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

### **Concerning EVMs including detachable antennas**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

### **Concernant les EVMs avec appareils radio**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### **Concernant les EVMs avec antennes détachables**

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

## **【Important Notice for Users of this Product in Japan】**

**This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan**

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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## EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

**For Feasibility Evaluation Only, in Laboratory/Development Environments.** Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

**Certain Instructions.** It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

**Agreement to Defend, Indemnify and Hold Harmless.** You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

**Safety-Critical or Life-Critical Applications.** If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit [www.ti.com/esh](http://www.ti.com/esh) or contact TI.

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## REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

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### General Statement for EVMs including a radio

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### For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

#### Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**FCC Interference Statement for Class B EVM devices**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**For EVMs annotated as IC – INDUSTRY CANADA Compliant**

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**Concerning EVMs including radio transmitters**

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

**Concerning EVMs including detachable antennas**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

**Concernant les EVMs avec appareils radio**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**Concernant les EVMs avec antennes détachables**

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

**Certain Instructions.** It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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**Safety-Critical or Life-Critical Applications.** If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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