

TUSB4020BPHP Evaluation Module

This document describes how to use and configure the TUSB4020BPHP evaluation module (EVM). Also included in this user's guide are set up and installation instructions, a troubleshooting section, the bill of materials (BOM), and the EVM schematics.

Contents

1	Introduction	2
2	Hardware Overview.....	3
	2.1 TUSB4020BPHP.....	3
	2.2 USB Port Connectors	3
	2.3 Optional Serial EEPROM	3
	2.4 Power.....	4
	2.5 Hub Configuration	4
	2.6 Optional Circuitry.....	4
3	Hardware Set Up	5
	3.1 Configuration Switch	5
4	EVM Installation.....	6
5	Troubleshooting	6
Appendix A	TUSB4020BPHP EVM Bill of Materials.....	7
Appendix B	TUSB4020BPHP EVM Schematics	9

List of Figures

1	TUSB4020B EVM Top Layer Layout.....	2
2	TUSB4020B PHP EVM Schematic.....	9
3	EVM Power Schematic	10

List of Tables

1	EVM Bill of Materials	7
---	-----------------------------	---

1 Introduction

The Texas Instruments TUSB4020B evaluation module is a functional board design of a single device that implements a USB 2.0 hub. The EVM can support 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 TUSB4020B.

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.

NOTE: The EVM accommodates various lab test components, actual production implementations can be much smaller.

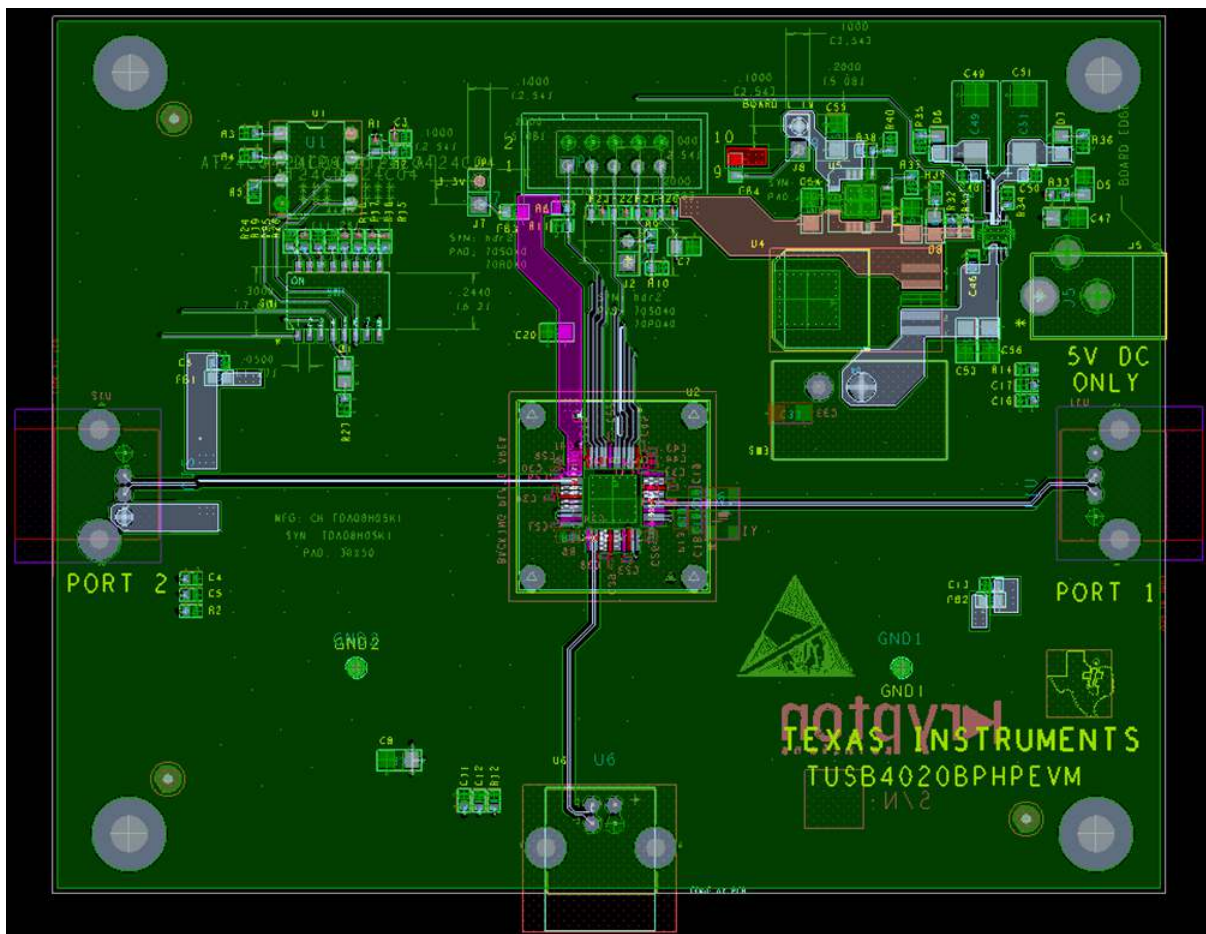


Figure 1. TUSB4020B EVM Top Layer Layout

2 Hardware Overview

The TUSB4020B EVM board hardware can be divided into six functional areas:

2.1 TUSB4020BPHP

The TUSB4020B EVM (U2 on the [schematic](#)) operates as a functional interconnect between an upstream connection to a USB host or hub and up to two directly connected downstream devices or hubs. More devices and hubs can be supported if arranged in tiers. The TUSB4020B is capable of supporting operation at High-Speed (HS), Full Speed (FS) or Low Speed (LS). In general, the speed of the upstream connection of the TUSB4020B EVM limits the downstream connections to that speed (HS and FS) or lower.

The TUSB4020B requires a 24-MHz low ESR crystal, Y1 with a 1-M Ω feedback resistor. The crystal should be fundamental mode with a load capacitance of 12 pF – 24 pF and a frequency stability rating of ± 100 PPM or better. To ensure a proper startup oscillation condition, a maximum crystal equivalent series resistance (ESR) of 50 Ω is recommended.

The TUSB4020B can also use an oscillator or other clock source. When using an external clock source such as an oscillator, the reference clock should have ± 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.

2.2 USB Port Connectors

VBUS is received from the upstream host or hub on J3. The TUSB4020B is configured as a self-powered hub, so there is not any significant current draw by the EVM from VBUS. The TUSB4020B does monitor the VBUS input after filtering through a resistor divider network of a 90.9-k Ω , 1% resistor, R9, and a 10-k Ω , 1% resistor, R10. VBUS cannot be directly connected to the TUSB4020B device. A bulk capacitor of at least 1 μ F is required on the upstream port VBUS input to comply with the USB specification. The TUSB4020BEVM uses a 10- μ F capacitor, C8.

VBUS, sourced by the 5-V wall power input, J5, is provided to the downstream port connectors. The USB 2.0 specification limits the current consumption of a USB 2.0 device to 500 mA at 5 V. The current limiting parameter of the TPS2561 device, U3, is configured to 2.2 A to avoid any spurious overcurrent events due to bus-powered HDD spin-up power fluctuations or unnecessary limiting during USB charging. A production implementation could place stricter limits on this power consumption. An overcurrent event on any of the downstream port connectors will be reported to the TUSB4020B via the OVERCURxZ inputs.

2.2.1 USB Port Connector – Noise Filtering

Each downstream VBUS output has a 150- μ F bulk capacitor (C49, C51) as recommended by the TPS2561 data manual ([SLVS930](#)) 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 TUSB4020BEVM also implements optional isolation using two small noise filtering capacitors and a 1-M Ω 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.

2.3 Optional Serial EEPROM

Each TUSB4020BEVM is equipped with an onboard EEPROM/socket placeholder, U1. A small I2C EEPROM can be installed to set the configuration registers as defined in the TUSB4020B data manual. 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 TUSB4020B.

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 TUSB4020B data sheet (#NUM#). In addition, a Microsoft® Windows® based EEPROM utility is available upon request.

2.4 Power

The TUSB4020B EVM operates from the power provided by a 5-V wall power adapter, J5, 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 (500 mA per port).

The TUSB4020B EVM uses a single channel LDO voltage regulator to drop 5 V to 3.3 V. The TPS7A4533, U4, is a 1.5-A output linear regulator ([SLVS720](#)). The 1.1-V core voltage required by the TUSB4020B is sourced by the 3.3-V rail to reduce unnecessary heat dissipation. The TPS74801, U5, 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.

2.5 Hub Configuration

The TUSB4020BEVM can be configured by setting several inputs to the TUSB4020B that are sampled at power-on reset or using an optional serial EEPROM or SMBUS host. A production implementation without EEPROM or SMBUS could either rely on the default internal pull-up or pull-down resistor for each configuration input or override it with an external pull-up or pull-down resistor. The settings can be modified using SW1 on the EVM. Descriptions of the possible configuration changes are included in the [Configuration Switch](#) section.

2.6 Optional Circuitry

The TUSB4020B EVM design implements a variety of LEDs, none of which are required by the USB specification. The LEDs are provided for easier testing and debug.

- D1 – Indicates that the upstream USB port is connected at High-Speed
- D5 – Indicates that 5 V is being applied to the TUSB4020B EVM
- D6 – Indicates downstream USB port 1 power is on
- D7 – Indicates downstream USB port 2 power is on
- D8 – Indicates BOARD_3P3V is active

3 Hardware Set Up

3.1 Configuration Switch

The TI TUSB4020BEVM has a set 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 TUSB4020B during power on reset, changing the switch settings while the EVM is powered on will have no effect. Please refer to the [EVM schematic](#) in [Appendix B](#) for additional information.

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

- SW1_1 (on):** FULLPWRMGMTZ_SMBA1_SS Switch. The TUSB4020B has an internal pull up on this terminal, so the TUSB4020B 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 TUSB4020B reports that it supports downstream port power switching in the USB descriptors it sends to the USB host. Since the TUSB4020B EVM does implement downstream port power switching, full power management mode should be enabled.
- SW1_2 (off):** PWRCTL_POL_SS_DN1 Switch. The TUSB4020B has an internal pull down on this terminal, so port power control polarity defaults to active high. If the switch is set to the ON position, the terminal is pulled high and the port power control polarity changes to active low.
- SW1_3 (off):** SMBUSz_SS_DN2 Switch. The TUSB4020B has an internal pull up on this terminal, so I2C 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_4 (on):** GANGED_SMBA2_HS Switch. The TUSB4020B has an internal pull up on this terminal, so ganged mode is enabled by default. If the switch is set to the ON position, the terminal is pulled low and individual port power control mode is enabled. Since the TUSB4020B EVM does implement individual port power controls, this terminal should be set high.
- SW1_5 (off):** SCL_SMBCLK_SSCDIS Switch. The TUSB4020B 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 I2C EEPROM may be attached (along with a pull-up resistor on SDA).
- SW1_6 (off):** SDA_SMBDAT_U1U2DIS Switch. The TUSB4020B 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 I2C EEPROM may be attached (along with a pull-up resistor on SCL).
- SW1_7 (off):** PWRCTL1_BATEN1 Switch. The TUSB4020B 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_8(off):** PWRCTL2_BATEN2 Switch. The TUSB4020B has an internal pull down on this terminal, so the 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.

4 EVM Installation

Install the EVM with the following steps:

1. Attach a 5-V, 3-A wall power source to J5. LEDs D8 and D5 should be lit.
2. Attach a USB cable between J3 and a USB host. LEDs D1, D6, and D7 should be lit.

5 Troubleshooting

Use the following to troubleshoot issues:

Case 1: One or more device functions 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 to support any bus-powered devices (3A+)
- 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

TUSB4020BPHP EVM Bill of Materials

This appendix contains the TUSB4020BPHP EVM BOM.

Table 1. EVM Bill of Materials

Item	QTY	Reference	Part	Manufacturer	Part Number	Pkg	Description
1	2	C7,C20	1uF	TDK	C2012X7R1A105K	805	CAP CER 1.0UF 10V X7R 10% 0805
2	3	C4,C12,C16,	0.001uF	TDK	C1005X7R1H102K	402	CAP CER 1000PF 50V X7R 10% 0402
3	8	C21,C26,C27,C30,C34, C37,C40,C43	0.001uF	TDK	C0603X7R1E102K	201	CAP CER 1000PF 25V 10% X7R 0201
4	8	C22,C24,C28,C31,C35, C38,C41,C44	0.01uF	TDK	C0603X5R1A103K	201	CAP CER 10000PF 10V 10% X5R 0201
5	9	C3,C5,O6,C11,C13,C17 , C46,C48,C50	0.1uF	Yageo	CC0402KRX5R6BB104	402	CAP CERAMIC .1UF 10V X5R 0402
6	8	C23,C25,C29,C32,C36, C39,C42,C45	0.1uF	TDK	C0603X5R0J104M	201	CAP CER .10UF 6.3V X5R 0201
7	2	C18,C19	18pF	AVX	04025A180JAT2A	402	CAP CERM 18PF 5% 50V NP0 0402
8	8	C8,C33,C47,C52,C53,C 54,C55, C56	10uF	Murata Electronics	GRM31CR61C106KC31L	1206	CAPACITOR CERM 10UF 16V 10% SMD
9	2	C49,C51	150uF	Kemet	B45197A2157K409 (Tantalum)	7343	CAP TANT 150UF 10V 10% LOESR SMD
10	8	R1,R8,R20,R21,R22,R2 3, R37,	NOPOP			402	NOPOP
11	5	D1,D5,D6,D7,D8	LED Green 0805	Lite On	LTST-C171GKT	805	LED GREEN CLEAR THIN 0805 SMD
12	4	FB1,FB2,FB3,FB4	220 @ 100MHZ Ferrite Bead	Murata	BLM18PG221SN1D	603	FERRITE CHIP 220 OHM 1400MA 0603
13	1	SW1	8-POS 50-MIL SMT	C&K Components	SD08H0SBR		SWITCH DIP SPST SEALED 8POS SMD
14	1	U6	USB 2.0 Type B USB- Shield	Amphenol	UE27BC54130		USB RCPT GOLD TYPE B R/A
15	2	U11,U12	USB 2.0 Type A USB- Shield	Amphenol	UE27AC54100		USB RCPT GOLD TYPE B R/A
16	1	J5	2.1mm x 5.5mm DC Power Jack	CUI Inc.	PJ-202AH (PJ-002AH)	2.1mm x 5.5mm	CONN PWR JACK 2.1X5.5MM HIGH CUR
17	4	R2,R12,R13,R14	1M	Rohm Semiconductor	MCR01MZPJ105	402	RES 1.0M OHM 1/16W 5% 0402 SMD
18	1	R9	90.9K 1%	Rohm Semiconductor	MCR01MZPF9092	402	RES 90.9K OHM 1/16W 1% 0402 SMD
19	2	R31,R32	10K	Rohm Semiconductor	MCR01MZPJ103	402	RES 10K OHM 1/16W 5% 0402 SMD
20	1	R10	10K 1%	Rohm Semiconductor	MCR01MZPF1002	402	RES 10K OHM 1/16W 1% 0402 SMD
21	9	R15,R16,R17,R18,R19, R24, R25,R26,R27	4.7K	Vishay / Dale	CRCW04024K70FKED	402	RES 4.70K OHM 1/16W 1% 0402 SMD
22	5	R3,R4,R5,R7,R11	1K	Rohm Semiconductor	MCR01MZPJ102	402	RES 1.0K OHM 1/16W 5% 0402 SMD
23	4	R33,R35,R36,R39	330	Rohm Semiconductor	MCR01MZPJ331	402	RES 330 OHM 1/16W 5% 0402 SMD
24	1	R34	25.5K	Panasonic - ECG	ERJ-2RKF2552X	402	RES 25.5K OHM 1/10W 1% 0402 SMD
25	1	R38	1.87K	Vishay / Dale	CRCW04021K87FKED	402	RES 1.87K OHM 1/16W 1% 0402 SMD
26	1	R40	4.99K	Vishay / Dale	CRCW04024K99FKED	402	RES 4.99K OHM 1/16W 1% 0402 SMD
27	1	U2	TUSB4020B	Texas Instruments	TUSB4020B	48QFP	

Table 1. EVM Bill of Materials (continued)

Item	QTY	Reference	Part	Manufacturer	Part Number	Pkg	Description
28	1	U1	AT24C04 Socket	TE Connectivity	AT24C04A-10PU-1.8 / 2-641260-1	8DIP / 8SOIC SOCKET	CONN IC SOCKET 8POS DIP TIN
29	1	U3	TPS2561DRC-USB Power Switch	Texas Instruments	TPS2561DRC	10SON	
30	1	U4	TPS7A4533 - 3.3V Voltage Regulator	Texas Instruments	TPS7A4533KTT	DDPAK-5	
31	1	U5	TPS74801RGW - 1.1V Voltage Regulator	Texas Instruments	TPS74801RGW	20VQFN	
32	1	Y1	ECS-24MHZ Crystal	ECS	ECX-53B (ECS-240-20-30B-TR)	5.0mm x 3.2mm	CRYSTAL 24.000 MHZ 20PF SMD
33	1	JP1	Conn 2x5 shroud - NOPOP				
34	1	R6	9.53K 1%	Rohm Semiconductor	MCR01MRTF9531	402	RES 9.53K OHM 1/16W 1% 0402 SMD
35	2	GND1,GND2	TEST POINT - NOPOP				NOPOP
36	1	J2,J7,J8	Header 1x2	3M	961102-6404-AR		CONN HEADER VERT SGL 2POS GOLD
37	1	SW3	L101_switch	C&K Components	L101011MS02Q		SLIDE SWITCH SPST

TUSB4020BPHP EVM Schematics

This appendix contains the TUSB4020BPHP schematic.

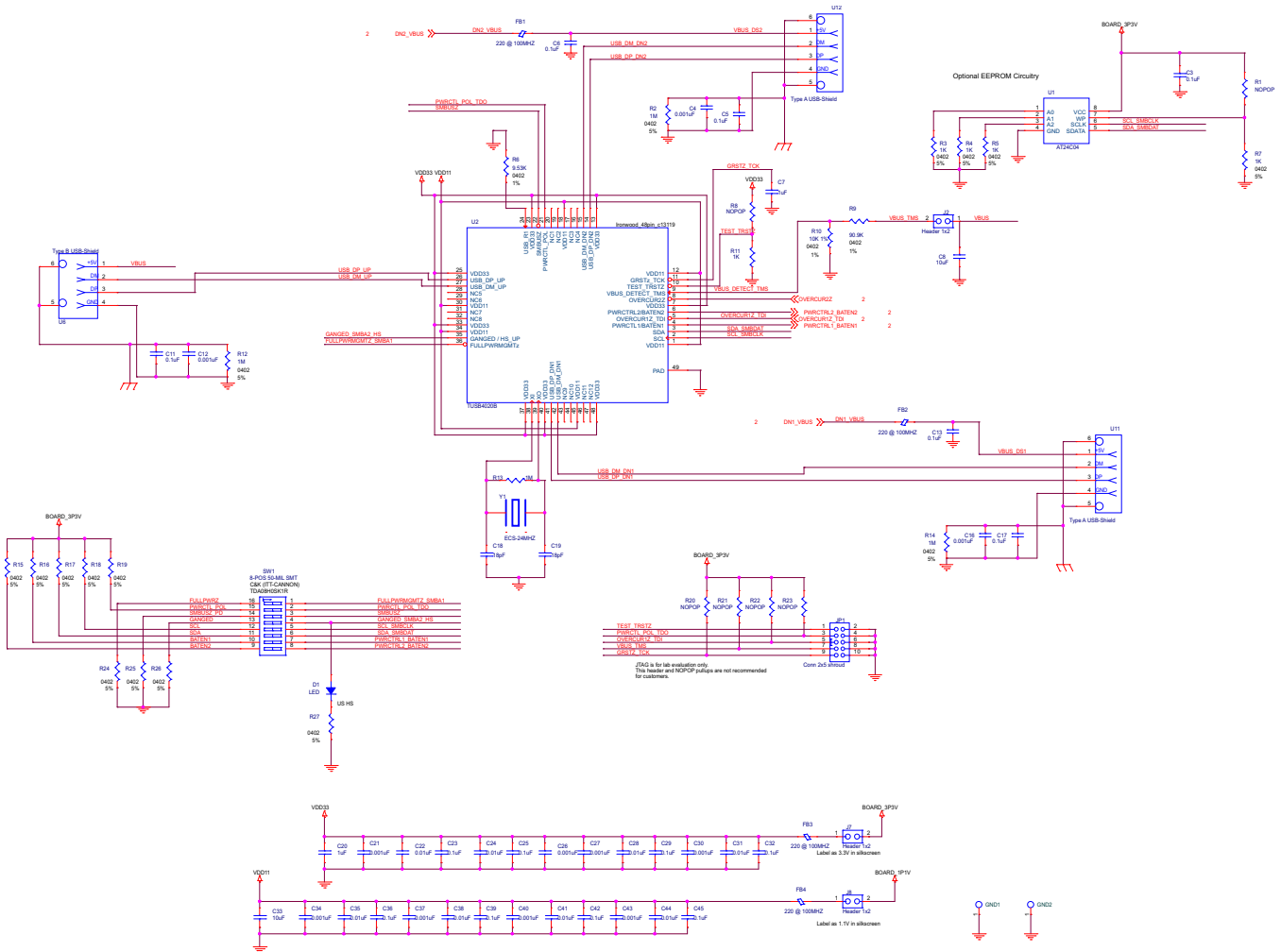


Figure 2. TUSB4020B PHP EVM Schematic

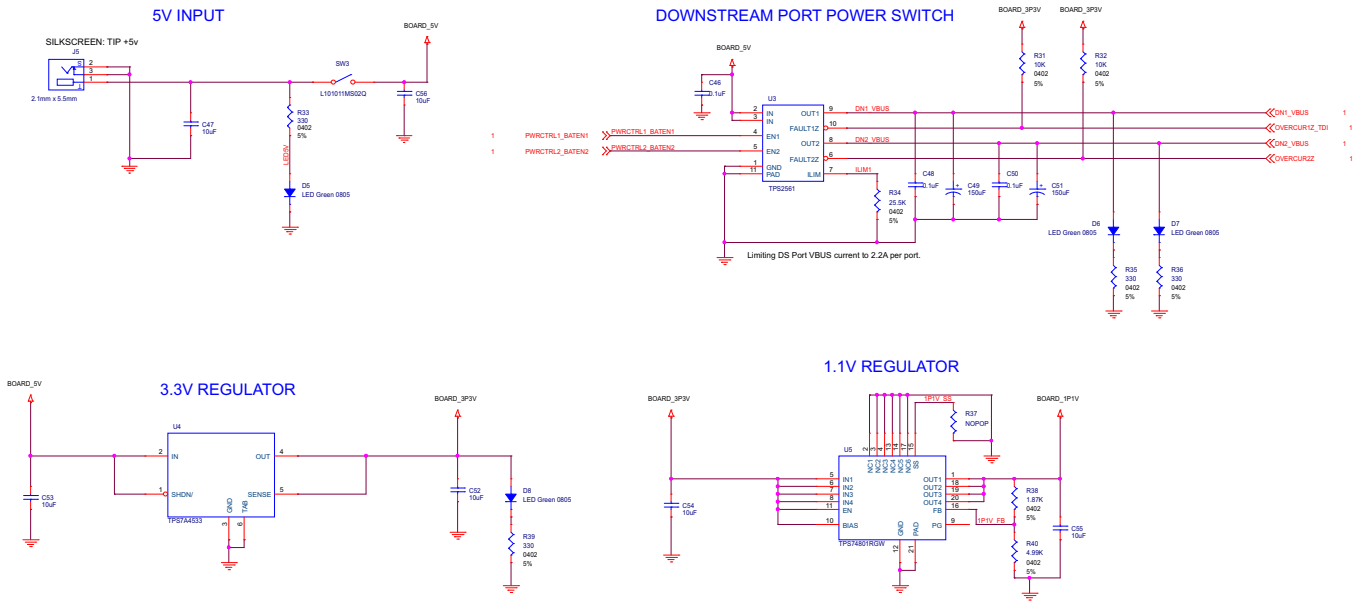


Figure 3. EVM Power Schematic

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
 - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
 - 3.1 *United States*
 - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
 - 3.1.2 *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

NOTE: 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

NOTE: 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.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

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.

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.

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.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.
7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL 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 HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
8. *Limitations on Damages and Liability:*
- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2015, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com