User's Guide
SLLU279A–March 2018–Revised June 2018

TUSB564RNQEVM User's Guide

The TUSB564 device is a USB Type-C / VESA DisplayPort™, Alternate Mode, redriving switch which supports data rates up to 10 Gbps for an Upstream facing port (device). This guide describes how to bring up the EVM, and includes schematics that can be used as a reference design for Alternate Mode implementations of the system with the TUSB564 device.

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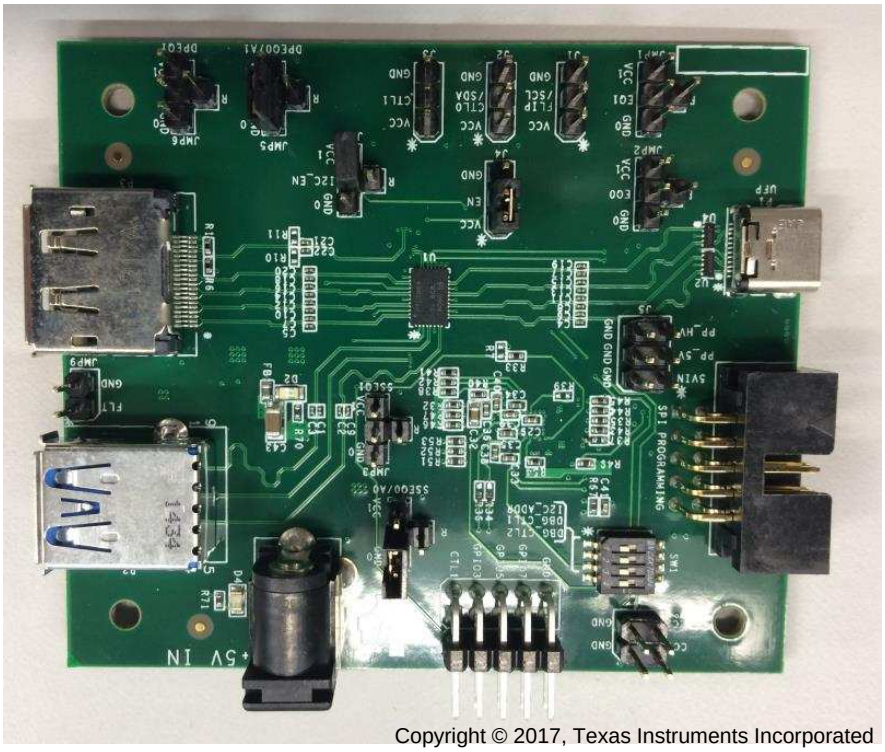
Trademarks

DisplayPort is a trademark of VESA.

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1 TUSB564RNQEVM

The TUSB564RNQEVM (see Figure 1) can be used with an Alternate Mode, Type-C Source such as the TUSB546 EVM and/or USB, or the DisplayPort, Type-C Host system to evaluate the Type-C implementation.



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Figure 1. TUSB564RNQEVM Board

Figure 2 shows a typical test setup. The EVM comes with a legacy Type-A USB receptacle to connect to a USB hub/device, and a DisplayPort receptacle to connect to the DisplayPort Sink. The TUSB564RNQEVM uses the TPS65983 device, from TI, for CC pin control and I2C or pin-strap mode, to configure the device.

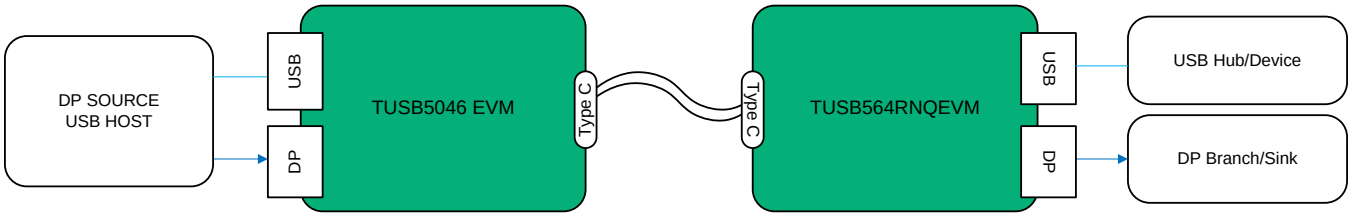


Figure 2. Test Board Setup

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2 TUSB564RNQEVM Configuration

This section provides the configuration options available in the TUSB564EVM.

2.1 TUSB564RNQEVM Default Configuration

Table 1 lists the headers provided for the configuration of the TUSB564 by default. The configuration settings may need to be optimized depending on the amount of loss of each channel in the system. The EVM is configured to I2C mode by default. If GPIO configuration is desired, then the JMP7 (I2C_EN) shunt must be changed to shunt pins 2 – 3 (GND).

Table 1. TUSB564 Configuration Pins

Reference Designator	Jumper Control	Configuration
JMP1	Downstream EQ1	Shunt on pin 1 – 2 (GND)
JMP2	Downstream EQ0	Shunt on pin 2 – 3 (PU)
JMP3	Upstream SSEQ1	Shunt on pin 1 – 2 (GND)
JMP4	Upstream SSEQ0	Shunt on pin 2 – 3 (PU)
JMP5	DP EQ1	Shunt on pin 1 – 2 (GND)
JMP6	DP EQ0	Shunt on pin 2 – 3 (PU)
JMP7	I2C_EN	Shunt on pin 1 – 2 (PU)
J1	FLIP	Shunt on pin 2 – 3 (GND)
J2	CTL0	Shunt on pin 1 – 2 (PU)
J3	CTL1	Shunt on pin 1 – 2 (PU)
J4	EN	Shunt on pin 1 – 2 (PU)

2.2 TUSB564 Equalization Control

Equalization (EQ) can be controlled using I2C or pin-strapping. Each of the TUSB564 receiver lanes has individual controls for receiver equalization (see Table 2). Table 3 and Table 4 list the gain values of each available combination of Downstream, Upstream, and DisplayPort configurations.

Table 2. Configuration Pin Level Definitions

Level	Settings
0	Option 1: Tie 1-KΩ 5% to GND
	Option 2: Tie directly to GND
R	Tie 20-KΩ 5% to GND
F	Float (leave pin open)
1	Option 1: Tie 1-KΩ 5% to VCC
	Option 2: Tie directly to VCC

Table 3. USB 3.1 EQ Settings

USB 3.1 Downstream Facing Ports			USB 3.1 Upstream Facing Port		
EQ1 Pin Level	EQ0 Pin Level	EQ Gain at 5 GHz (dB)	SSEQ1 Pin Level	SSEQ0 Pin Level	EQ Gain at 5 GHz (dB)
0	0	0	0	0	0
0	R	1	0	R	1
0	F	2	0	F	2
0	1	3	0	1	3
R	0	4	R	0	4
R	R	5	R	R	5
R	F	6	R	F	6
R	1	7	R	1	7

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Table 3. USB 3.1 EQ Settings (continued)

USB 3.1 Downstream Facing Ports			USB 3.1 Upstream Facing Port		
EQ1 Pin Level	EQ0 Pin Level	EQ Gain at 5 GHz (dB)	SSEQ1 Pin Level	SSEQ0 Pin Level	EQ Gain at 5 GHz (dB)
F	0	8	F	0	8
F	R	9	F	R	9
F	F	10	F	F	10
F	1	11	F	1	11
1	0	12	1	0	12
1	R	13	1	R	13
1	F	14	1	F	14
1	1	15	1	1	15

Table 4. DisplayPort EQ Settings

All DisplayPort Lanes		
DPEQ1 Pin Level	DPEQ0 Pin Level	EQ Gain at 5 GHz (dB)
0	0	0
0	R	1
0	F	2
0	1	3
R	0	4
R	R	5
R	F	6
R	1	7
F	0	8
F	R	9
F	F	10
F	1	11
1	0	12
1	R	13
1	F	14
1	1	15

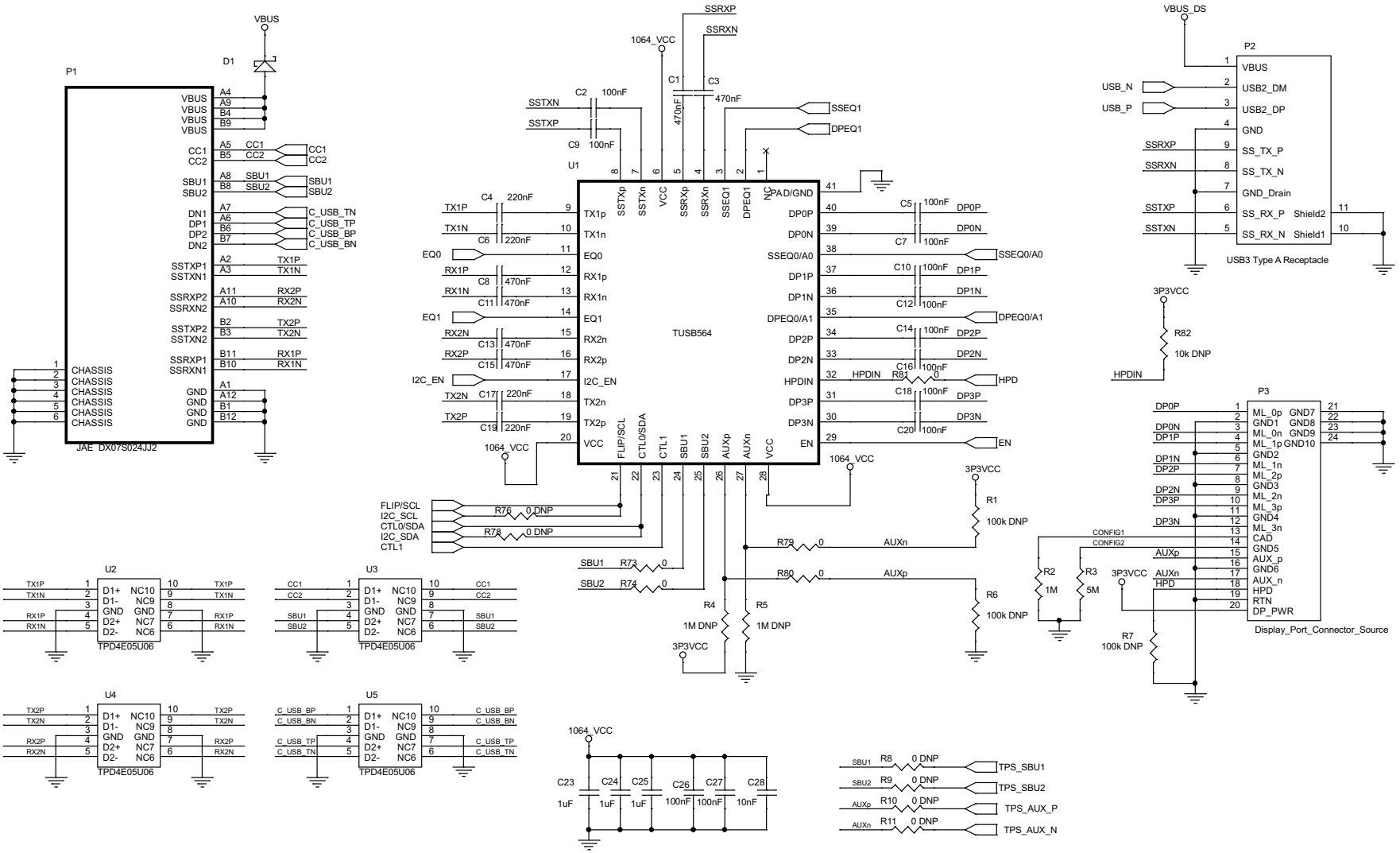
2.3 Power

The EVM is designed to operate off of the VBUS, from a USB host connected through a USB Type-C (P2). 5-V external power does not need to be applied through J8, unless standalone operation is desired. If testing the DisplayPort only, or if bypassing VBUS power, the EVM must be powered through J8 (5-V, 1-A input).

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3 TUSB564RNQEVM Schematics

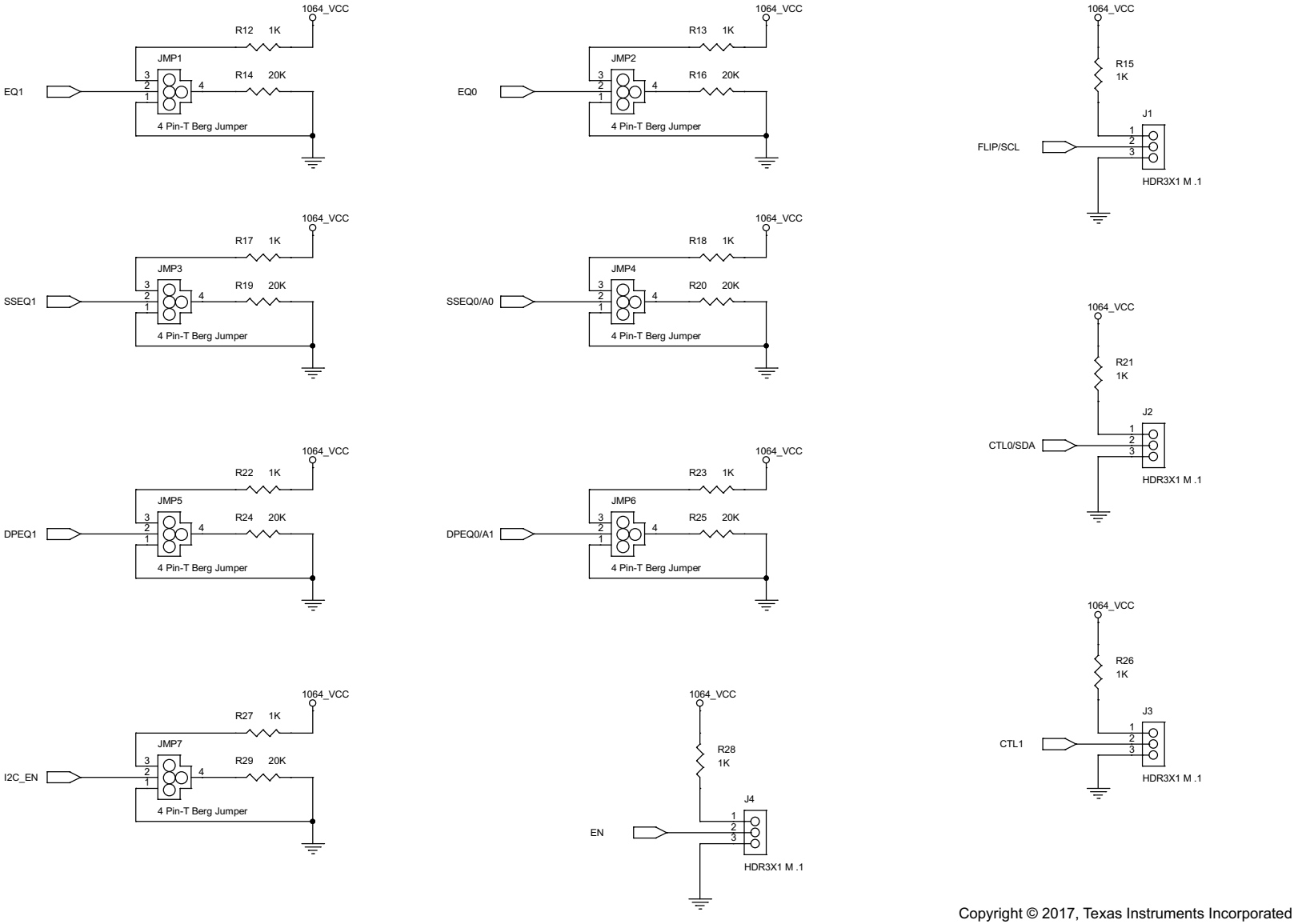
Figure 3, Figure 4, Figure 5, and Figure 6 show the TUSB564RNQEVM schematics.



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Figure 3. TUSB564RNQEVM Schematic (1/4)

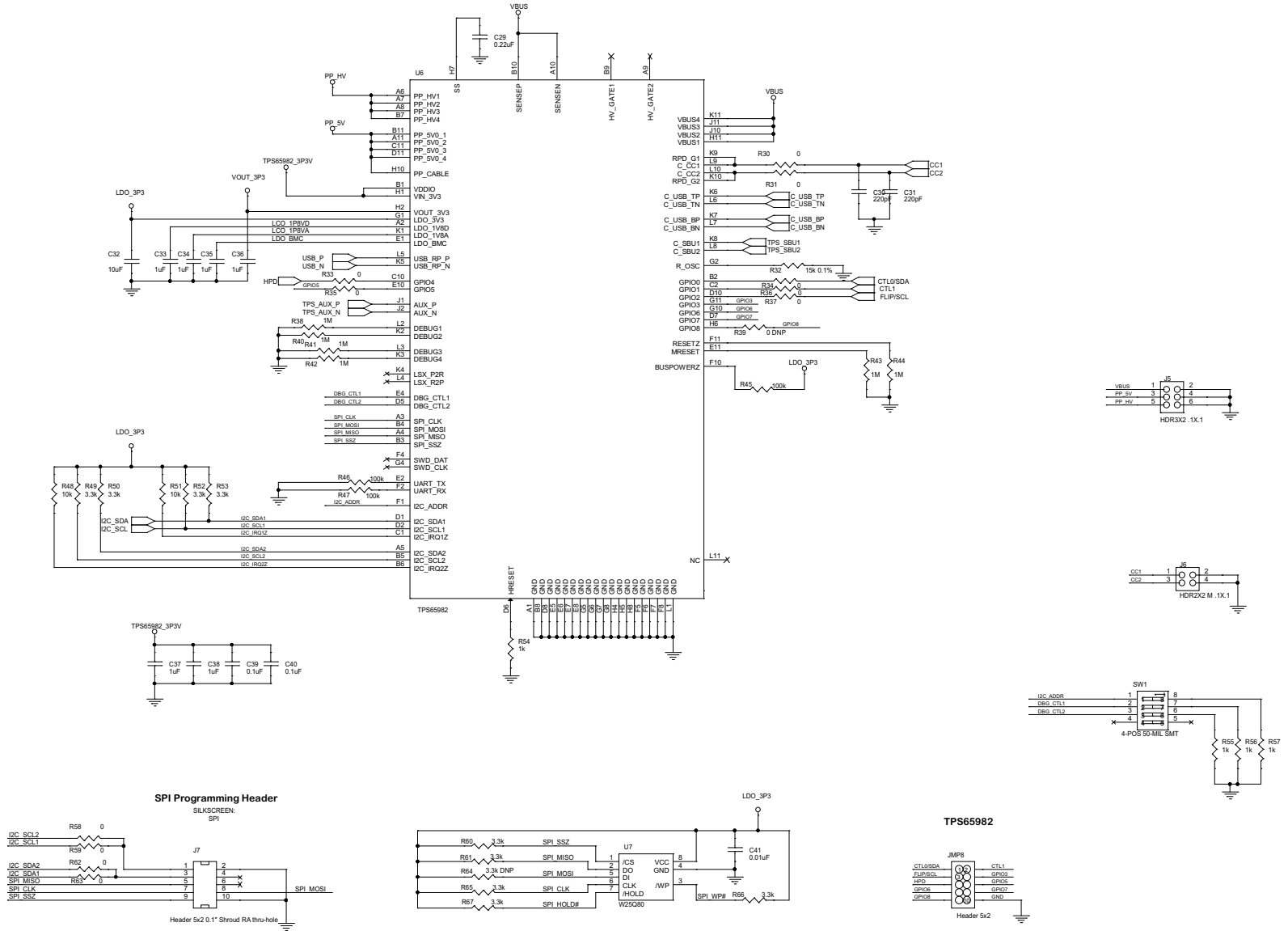
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Figure 4. TUSB564RNQEVM Schematic (2/4)

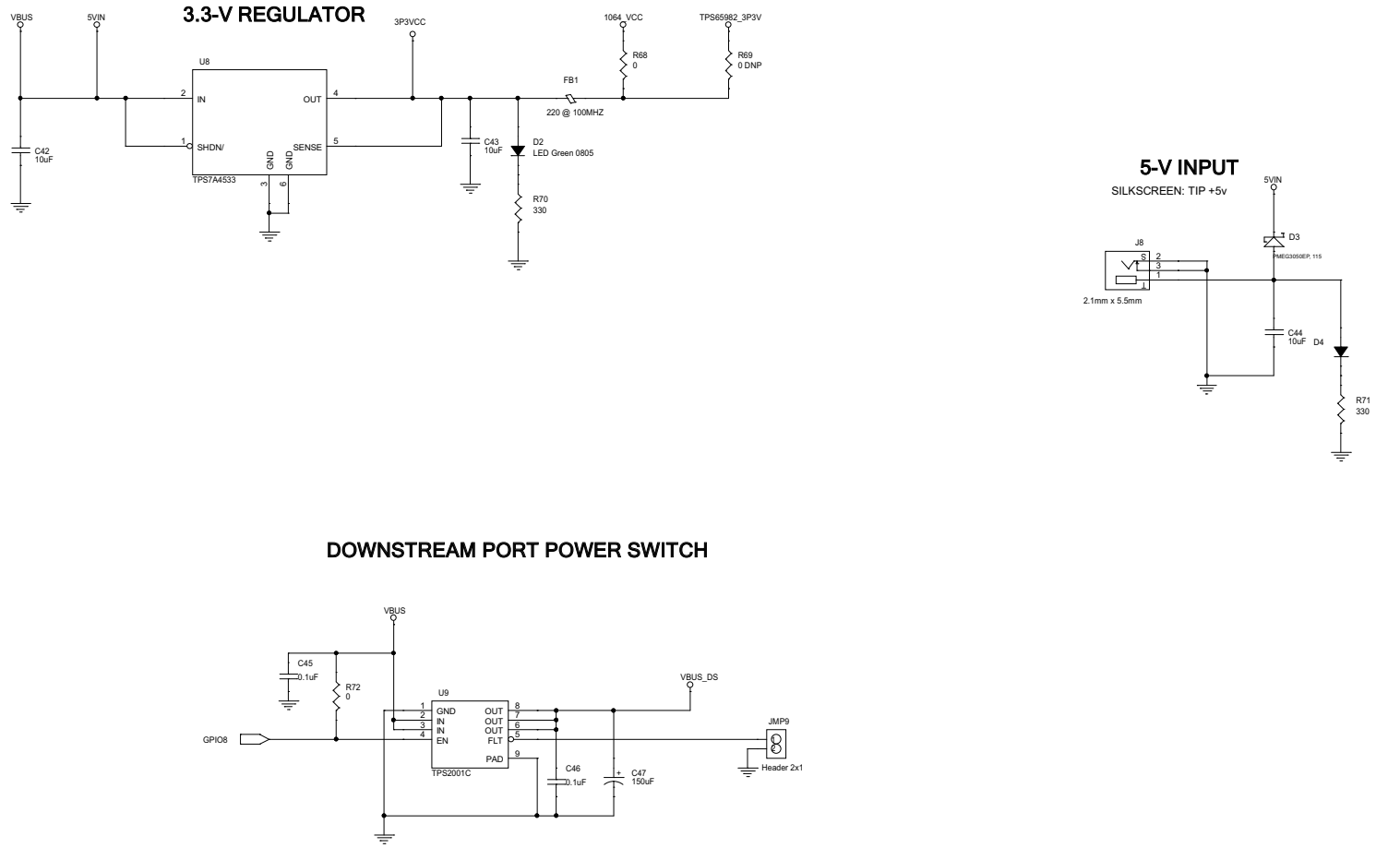
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Figure 5. TUSB564RNQEVM Schematic (3/4)

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Figure 6. TUSB564RNQEVM Schematic (4/4)

4 Bill of Materials

Table 5 lists the TUSB564RNQEVM bill of materials.

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Table 5. BOM

Item	Quantity	Reference	Part	Footprint	Manufacturer	Part Number	Description
1	6	C1, C3, C8, C11, C13, C15	470 nF	c0201	Murata	GRM033R60J474KE90D	Capacitor, ceramic, 0.47 µF, 6.3 V, X5R, 0201
2	10	C2, C5, C7, C9, C10,C12, C14, C16, C18, C20	100 nF	c0201	Murata	GRM033R61A104KE15D	Capacitor, ceramic, 0.1 µF, 10 V, X5R, 0201
3	4	C4, C6, C17, C19	220 nF	c0201	Murata	GRM033R60G224ME15D	Capacitor, ceramic, 0.22µF, 4 V, X5R, 0201
4	9	C23, C24, C25, C33, C34, C35, C36, C37, C38	1 µF	c0402	Murata	GRM155R60J105ME19D	Capacitor, ceramic, 1 µF, 6.3 V, X5R, 0402
5	2	C26, C27	100 nF	c0402	Murata	GRM155R61A104KA01D	Capacitor, ceramic, 0.1 µF, 10 V, X5R, 0402
6	1	C28	10 nF	c0402	Murata	GRM155R71C103KA01D	Capacitor, ceramic, 10000 pF, 16 V, X7R, 0402
7	1	C29	0.22 µF	c0402	Murata	GRM152R61A224KE19D	Capacitor, ceramic, 0.22 µF, 10 V, X5R, 0402
8	2	C30, C31	220 pF	c0402	Murata	GRM1555C1H221JA01D	Capacitor, ceramic, 220 pF, 50 V, C0G/NP0, 0402
9	1	C32	10 µF	c0603	Murata	GRM188R61C106MA73D	GRM188R61C106MA73D
10	4	C39, C40, C45, C46	0.1 µF	c0402	Murata	GRM155R61A104KA01D	Capacitor, ceramic, 0.1 µF, 10 V, X5R, 0402
11	1	C41	0.01 µF	c0402	Murata	GRM155R71C103KA01D	GRM155R71C103KA01D
12	3	C42, C43, C44	10 µF	c1206	Murata	GRM319R61E106KA12D	Capacitor, ceramic, 10 µF, 25 V, X5R, 1206
13	1	C47	150 µF, DNI	7343	Murata	GRM31CR60J157ME11L	Capacitor, ceramic, 150 µF, 6.3 V, X5R, 1206
14	1	D1	SCHOTTKY	diode_smb	NXP	PMEG3050EP,115	Diode SCHOTTKY, 30 V, 5 A, SOD128
15	2	D2, D4	LED green 0805	805	Lumex	LTST-C170KGKT	LED green clear, 0805, SMD
16	1	D3	SCHOTTKY	DO-214AA	Nexperia	PMEG3050EP,115	Diode SCHOTTKY, 30 V, 5 A, SOD128
17	1	FB1	220 at 100 MHz	fb_0603	MuRata	BLM18EG221SN1D	Ferrite bead, 220 Ω, 0603, 1LN
18	7	JMP1, JMP2, JMP3, JMP4, JMP5, JMP6, JMP7	4-pin T Berg jumper	berg2x3tee	AMP	68000-103HLF	BERGSTIK II .100" SR STRAIGHT
	7	JMP1, JMP2, JMP3, JMP4, JMP5, JMP6, JMP7	4-pin T Berg jumper	berg2x3tee	AMP	68000-101HLF	BERGSTIK II .100" SR STRAIGHT
19	1	JMP8	Header 5 × 2	HDR_THVT_2x5_100	FCI	68021-210HLF	Connector header, 10 POS .,100 R/A, 15 AU

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Table 5. BOM (continued)

Item	Quantity	Reference	Part	Footprint	Manufacturer	Part Number	Description
20	1	JMP9	Header 2 × 1	HDR_THVT_1x2_100	Amphenol FCI	77311-118-02LF	Connector header, 2 POS, VERT, T/H
21	4	J1, J2, J3, J4	Header 3 × 1, M, .1	HDR_THVT_1x3_100_M	3M	961103-6404-AR	Connector header, VERT, SGL, 3 POS, GOLD
22	1	J5	Header 3 × 2, .1 × .1	HDR_THVT_2x3_100_M	Harwin	M20-9980345	DIL, Vertical, PC, TAIL-PIN HEADER
23	1	J6	Header 2 × 2, M, .1 × .1	HDR_THVT_2x2_100	Amphenol FCI	67997-404HLF	Connector header, 4 POS., 100 STR TIN
24	1	J7	Header 5 × 2 0.1" Shroud RA thru-hole	HDR_THRT_2X5_100	Amphenol FCI	67997-410HLF	Connector header, 10 POS., 100 STR TIN
25	1	J8	2.1 mm × 5.5 mm	PJ-202AH	CUI Inc.	PJ-202AH	Connector power, 2 × 5.5 mm, KINKED PIN
26	1	P1	JAE DX07B024JJ2	USB-C_SMRT_DX07B024JJ2	JAE	DX07B024JJ2	Connector receptacle, USB 3.1, Type-C, BRD EDGE
27	1	P2	USB3 Type A Receptacle	USB3_TYPEA	TE Connectivity	1932258-1	Connector receptacle, USB 3.0, STD A, BLUE
28	1	P3	Display_Port_Connector_Source	CON_DP_SD-47272-001	Molex Inc	472720001	Connector receptacle, 20 POS., UDI, R/A, SMD
29	3	R1, R6, R7	100-k DNP	r0402	Panasonic Electronic Components	ERJ-2GEJ104X	ERJ-2GEJ104X
30	7	R2, R38, R40, R41, R42, R43, R44	1 M	r0402	Panasonic Electronic Components	ERJ-2GEJ105X	Resistor, SMD, 1-MΩ, 5%, 1/10W, 0402
31	1	R3	5 M	r0402	Ohmite	HVC0402T5004JET	Resistor, SMD, 5-M Ω, 5%, 1/20W, 0402
32	2	R4, R5	1-M DNP	r0402	Panasonic Electronic Components	ERJ-2GEJ105X	Resistor, SMD, 1-M Ω, 5%, 1/10W, 0402
33	7	R8, R9, R10, R11, R39, R76, R78	0 DNP	r0402	Panasonic Electronic Components	ERJ-2GE0R00X	Resistor, SMD, 0 Ω, jumper, 1/10W, 0402
34	15	R12, R13, R15, R17, R18, R21, R22, R23, R26, R27, R28, R54, R55, R56, R57	1 k	r0402	Panasonic Electronic Components	ERJ-2GEJ102X	Resistor, SMD, 1K Ω, 5%, 1/10W, 0402
35	7	R14, R16, R19, R20, R24, R25, R29	20 K	r0402	Panasonic Electronic Components	ERJ-2GEJ203X	Resistor, SMD, 20K Ω, 5%, 1/10W, 0402
36	2	R30, R31	0	r0201	Panasonic Electronic Components	ERJ-1GN0R00C	Resistor, SMD, 0 Ω, jumper, 1/20W 0201
37	1	R32	15-k 0.1%	r0402	Panasonic Electronic Components	ERA-2AEB153X	Resistor, SMD, 15-kΩ, 0.1%, 1/16W, 0402
38	7	R33, R35, R73, R74, R79, R80, R81	0	r0402	Panasonic Electronic Components	ERJ-2GE0R00X	Resistor, SMD, 0 Ω, jumper, 1/10W, 0402

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Table 5. BOM (continued)

Item	Quantity	Reference	Part	Footprint	Manufacturer	Part Number	Description
39	8	R34, R36, R37, R58, R59, R62, R63, R72	0	r0402	Panasonic Electronic Components	ERJ-2GE0R00X	Resistor, SMD, 0 Ω, jumper, 1/10W 0402
40	3	R45, R46, R47	100 k	r0402	Panasonic Electronic Components	ERJ-2GEJ104X	Resistor, SMD, 100-kΩ, 5%, 1/10W, 0402
41	2	R48, R51	10 k	r0402	Panasonic Electronic Components	ERJ-2GEJ103X	Resistor, SMD, 10-kΩ, 5%, 1/10W, 0402
42	9	R49, R50, R52, R53, R60, R61, R65, R66, R67	3.3 k	r0402	Panasonic Electronic Components	ERJ-2GEJ332X	Resistor, SMD, 3.3-kΩ, 5%, 1/10W, 0402
43	1	R64	3.3-k DNP	r0402	Panasonic Electronic Components	ERJ-2GEJ332X	Resistor, SMD, 3.3-kΩ, 5%, 1/10W, 0402
44	1	R68	0	r1206	Panasonic Electronic Components	ERJ-8GEY0R00V	Resistor, SMD, 0 Ω, JUMPER 1/4W, 1206
45	1	R69	0 DNP	r1206	Panasonic Electronic Components	ERJ-8GEY0R00V	Resistor, SMD, 0 Ω, JUMPER 1/4W, 1206
46	2	R70, R71	330	r0402	Panasonic Electronic Components	ERJ-2GEJ331X	Resistor, SMD, 330 Ω, 5%, 1/10W, 0402
49	1	R82	10-k DNP	r0402	Panasonic Electronic Components	ERJ-2GEJ103X	Resistor, SMD, 10-kΩ 5%, 1/10W, 0402
50	1	SW1	4-POS., 50-MIL SMT	sw_smvt_dip_4pos_8	C&K (ITT-CANNON)	TDA04H0SB1R	Switch slide dip, SPST, 25 MA, 24 V
51	1	U1	TUSB564RNQ	RNQ0040A	Texas Instruments	TUSB564	Provided by TI
52	4	U2, U3, U4, U5	TPD4E05U06	DQA	Texas Instruments	TPD4E05U06DQAR	TVS DIODE, 5.5 VWM, 14VC, 10SON
53	1	U6	TPS65983	ZQZ_BGA_96	Texas Instruments	TPS65983ACZQZR	IC, PD, CTLR, USB Type-C, 96BGA
54	1	U7	W25Q80	SOIC_8_197x157_50	WINBOND	W25Q80DVSNIG	IC, flash, 8 mbit, 104 MHz, 8 SOIC
55	1	U8	TPS7A4533	DCQ_PDSO_6	Texas Instruments	TPS7A4533DCQR	IC, regulator, linear, 3.3 V, 1.5 A, SOT223-6
56	1	U9	TPS2001C	DGN_PDSO_8	Texas Instruments	TPS2001CDGN	IC, power, SW, USB, 2.87 A, 1 CH, 8MSOP
57	1	Label	"HSDC025-001"			Any	Sticket Text: HSDC025-001 Rev A

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (March 2018) to A Revision	Page
• Changed Pin 4 From: SSRXp To: SSRXn; Pin 5 From: SSRXn To: SSRXp; Pin 7 From: SSTXp To: SSTXn; and Pin 8 From: SSTXn To: SSTXp in Figure 3	5

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2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

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   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, 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:*

      FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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/lsds/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/lsds/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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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.

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

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

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