TUSB1044 Active Cable EVM

The TUSB1044 device is a *Video Electronics Standards Association* (VESA®) USB Type-C™ *Alternate Mode* (Alt Mode) re-driving switch supporting data rates up to 10Gbps for a downstream facing port (Host) or upstream facing port (Device). This guide describes how to bring up the EVM and includes schematics that can be used as reference for the cable implementations with the TUSB1044 device. This EVM is intended to demonstrate the SuperSpeed and SuperSpeed+ functionality of the TUSB1044.

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1 TUSB1044EVM

Figure 1 illustrates the *TUSB1044 Active Cable* EVM.

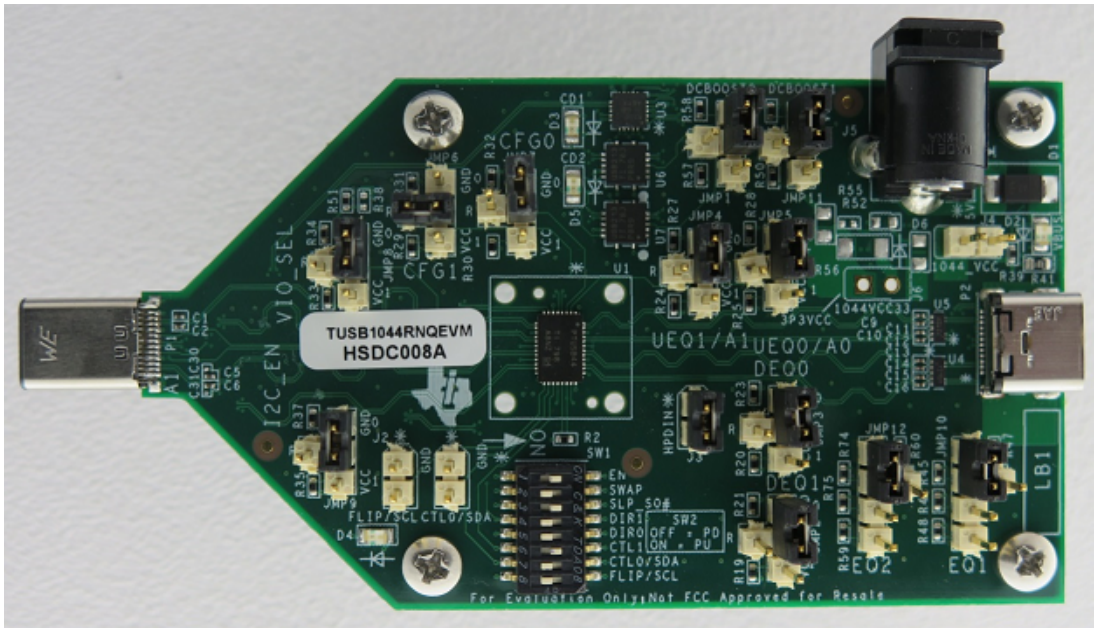


Figure 1. TUSB1044 EVM

The TUSB1044EVM can be used with a DFP or UFP USB Type-C source or device to evaluate the USB Type-C implementation. Figure 2 is a typical test set-up.

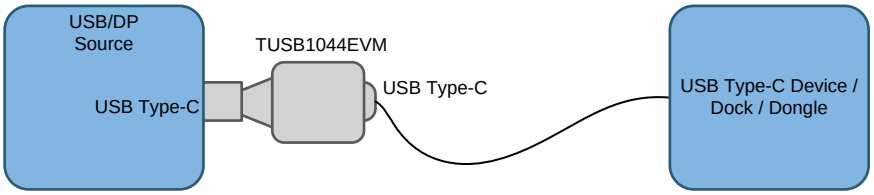


Figure 2. TUSB1044 System Example

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2 TUSB1044EVM Configuration

This section provides the configuration options available in the TUSB1044EVM.

2.1 TUSB1044 EVM Default Jumper and Switch Configuration

The following headers are provided for TUSB1044 configuration by default, configuration settings may need to be optimized depending on the amount of loss of each channel in the system.

Table 1. TUSB1044 Configuration Pins

Reference Designator	JMP Control	Configuration
J1	CTL0/SDA	No Connect
J2	FLIP/SCL	No Connect
J3	HPDIN	No Connect
J4	VCC Isolate	No Connect
JMP2	DEQ1	SHUNT on pin 1-2 (GND)
JMP3	DEQ0	SHUNT on pin 1-2 (GND)
JMP4	UEQ1/A1	SHUNT on pin 1-2 (GND)
JMP5	UEQ0/A0	SHUNT on pin 1-2 (GND)
JMP6	CFG1	SHUNT on pin 2–4 (20K PD)
JMP7	CFG0	SHUNT on pin 1-2 (GND)
JMP8	VIO_SEL	SHUNT on pin 1-2 (GND)
JMP9	I2C_EN	SHUNT on pin 1-2 (GND)
JMP10	EQ1	SHUNT on pin 1-2 (200 Ω to GND)
JMP11	DC_BOOST1	SHUNT on pin 1-2 (20 kΩ to 3.3 V)
JMP12	EQ2	SHUNT on pin 1-2 (200 Ω to GND)
JMP13	DC_BOOST2	SHUNT on pin 1-2 (20 kΩ to 3.3 V)

NOTE: Figure 3 and Figure 4 show how some early boards were built with a different configuration of JMP10 and JMP12. For these boards, connect a jumper wire from pin 1 to pins 3–5.

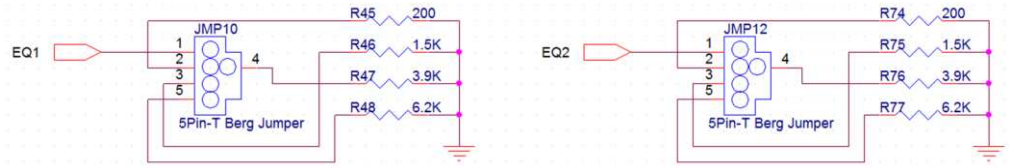


Figure 3. Early Board JMP10 and JMP12 Schematic

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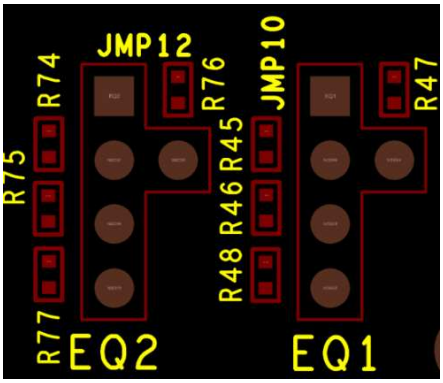


Figure 4. Early Board JMP10 and JMP12 Layout

Table 2. Switch Configuration

SW1 Position	Control Signal	Configuration
1	EN	ON
2	SWAP	OFF
3	SLP_S0#	ON
4	DIR1	OFF
5	DIR0	OFF
6	CTL1	ON
7	CTL0/SDA	ON
8	FLIP/SCL	OFF

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2.2 TUSB1044 EQ Control

Each of the TUSB1044 receiver lanes has individual controls for receiver equalization. Table 3 through Table 5 detail the gain values for each available combination for downstream, upstream, and all DisplayPort™ configurations.

Table 3. Config 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 4. USB 3.1 EQ Settings

USB 3.1 Downstream Facing Ports				USB 3.1 Upstream Facing Ports		
DEQ1 Pin Level	DEQ0 Pin Level	EQ Gain at 5 GHz (dB)		UEQ1 Pin Level	UEQ0 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
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

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Table 5. VOD Linear Range and DC Gain

VOD Linear Range and DC Gain						
Setting	**CFG1 Pin Level**	**CFG0 Pin Level**	**DS DC Gain (dB)**	**US DC Gain (dB)**	**DS VOD (mVpp)**	**US VOD (mVpp)**
1	0	0	+1	0	900	900
2	0	R	0	+1	900	900
3	0	F	0	0	900	900
4	0	1	+1	+1	900	900
5	R	0	0	0	1100	1100
6	R	R	+1	0	1100	1100
7	R	F	0	+1	1100	1100
8	R	1	+2	+2	1100	1100
9	F	0	–1	–1	1300	1300
10	F	R	+2.5	+2.5	1300	1300
11	F	F	0	0	1300	1300
12	F	1	+1	+1	1300	1300
13	1	0	–1	0	1300	1300
14	1	R	0	–1	1300	1300
15	1	F	0	+1	1300	1300
16	1	1	+1	0	1300	1300

2.3 Power

The EVM is designed to operate off of the VBUS from a USB host connected via the USB Type-C plug connector. Apply no external power via J4, unless standalone operation is desired.

If testing DisplayPort only, or if bypassing VBUS power, the EVM must be powered via J4 (5 V, 1-A input).

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3 TUSB1044EVM Schematics

Figure 5 through Figure 8 illustrate the EVM schematics.

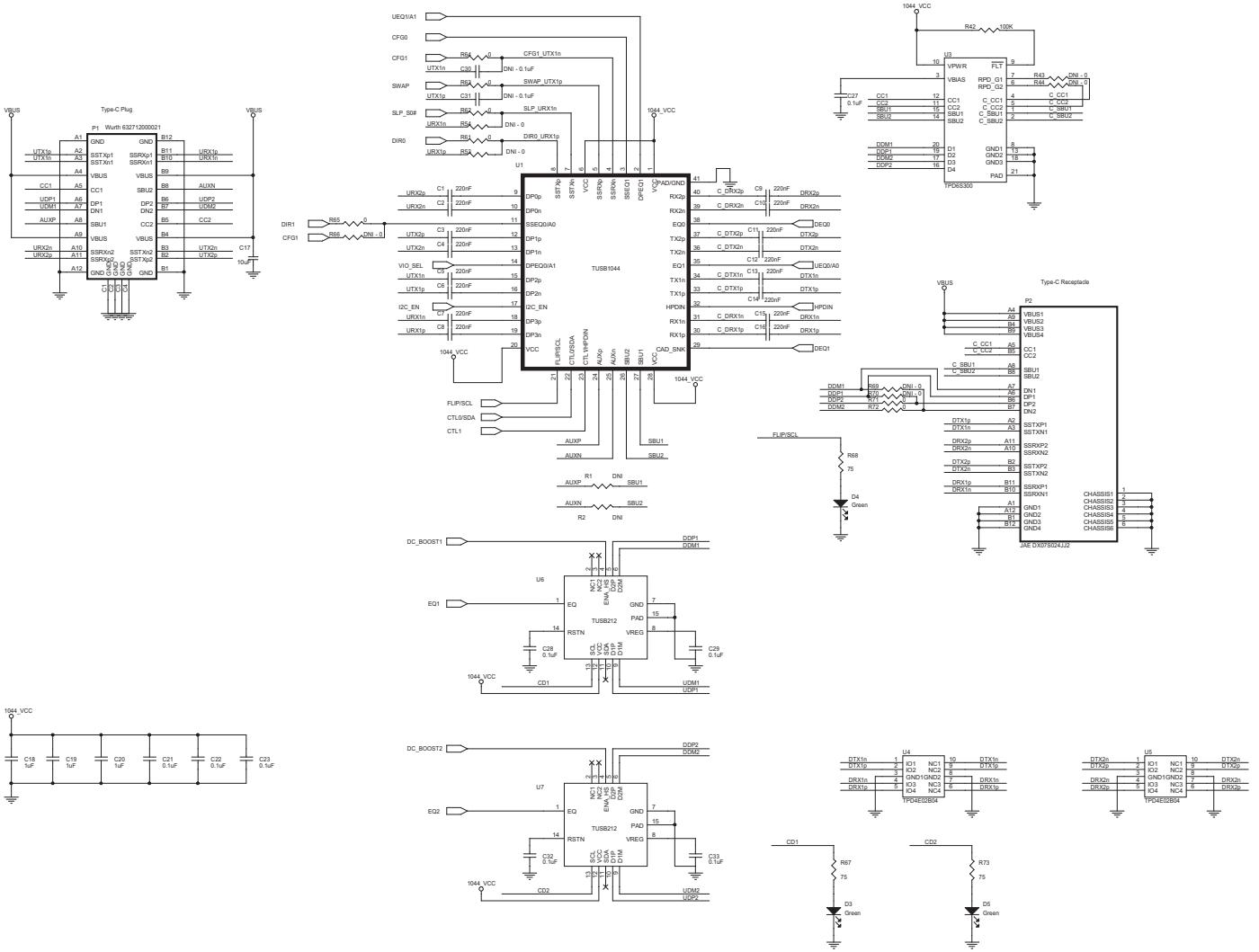


Figure 5. TUSB1044EVM Schematic (Page 1)

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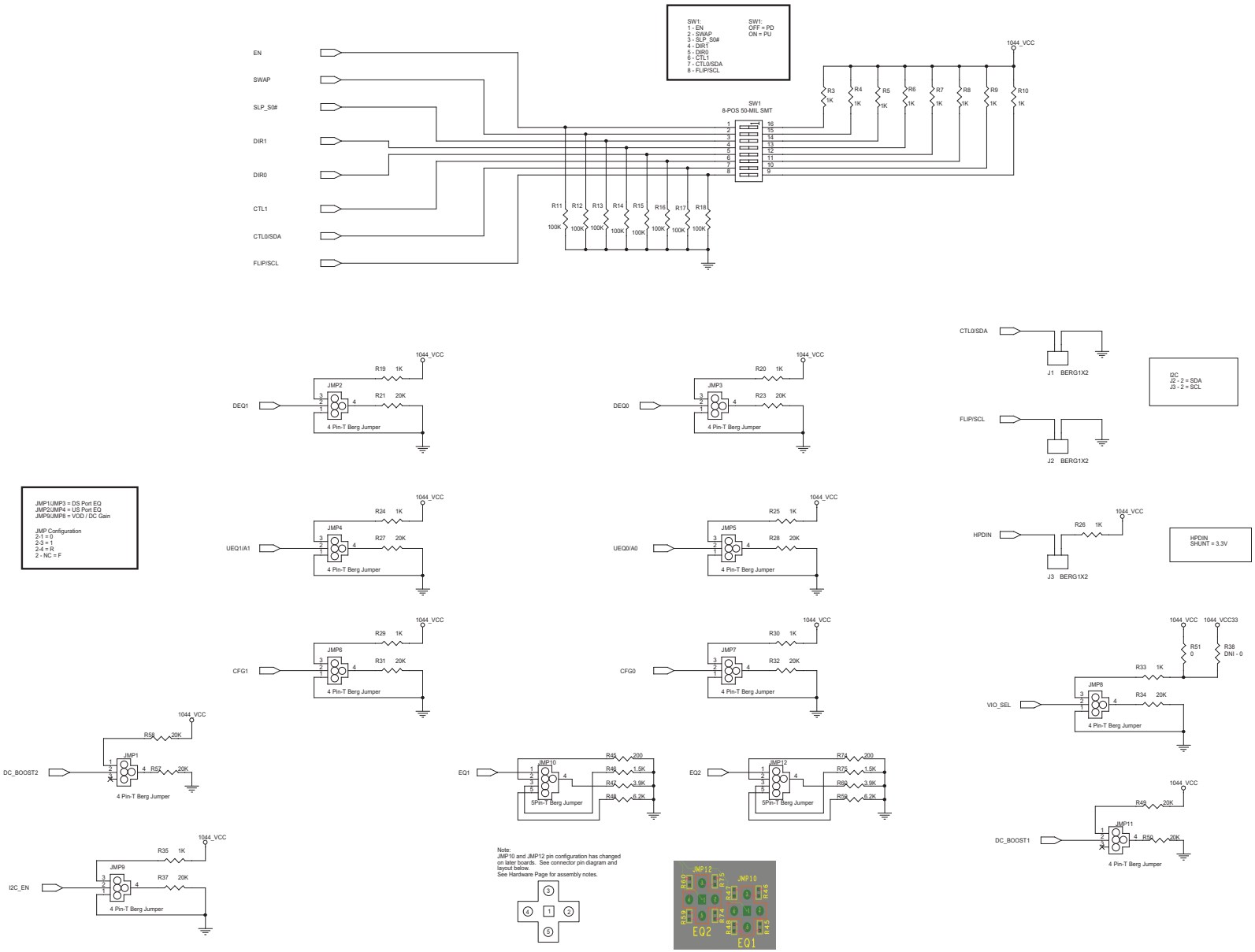


Figure 6. TUSB1044EVM Schematic (Page 2)

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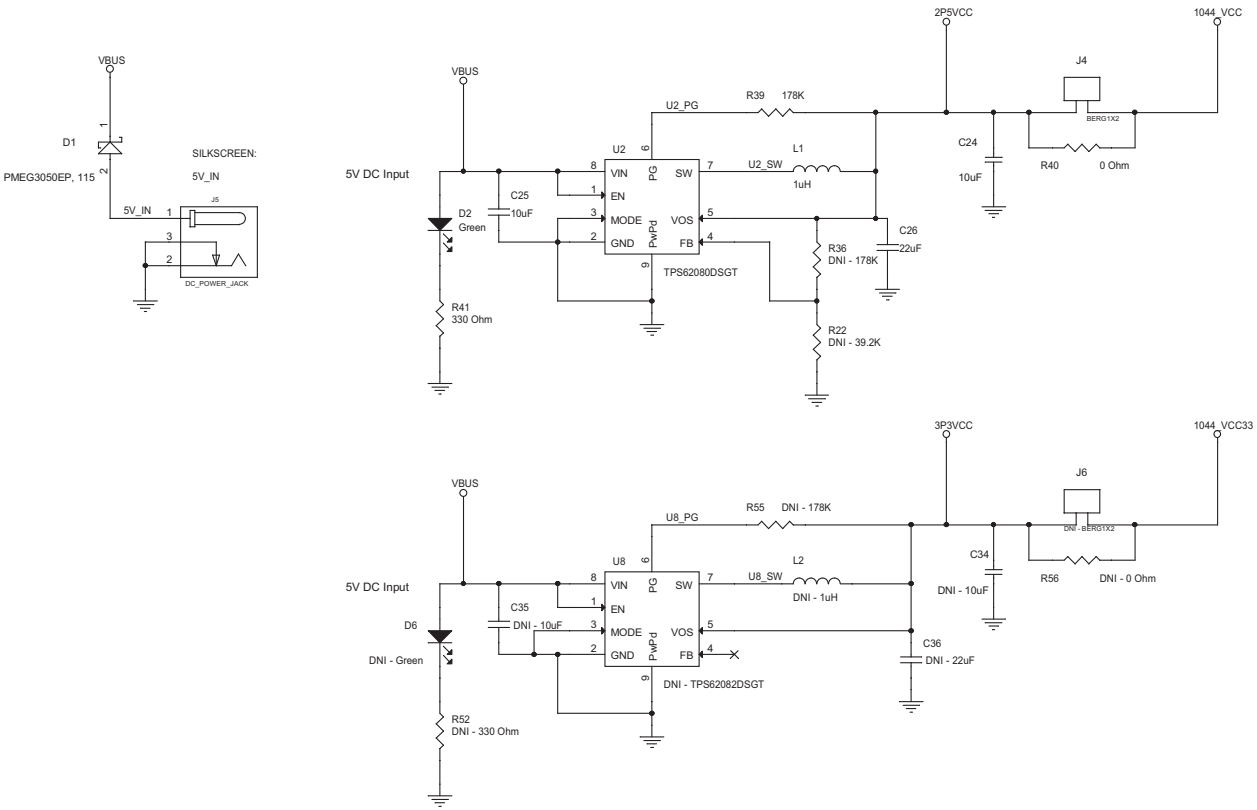


Figure 7. TUSB1044EVM Schematic (Page 3)

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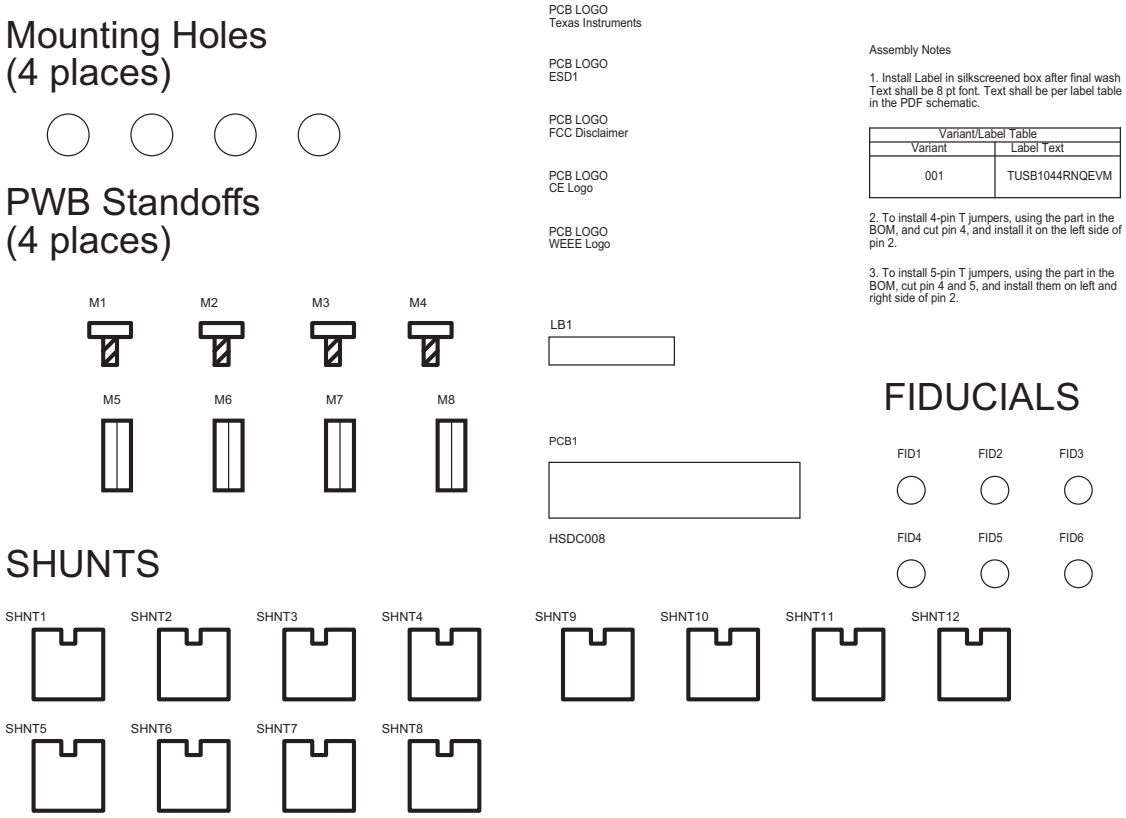


Figure 8. TUSB1044EVM Schematic (Page 4)

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4 Bill of Materials

Table 6 lists the TUSB1044EVM bill of materials (BOM).

Table 6. TUSB1044 Bill of Materials

Item	QTY	Reference	Part	Footprints	Manufacturer	Manufacturer Part No	Description
1	16	C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15,C16	220nF	c0201	TDK Corporation	C0603X5R1A224K	CAP CER 0.22UF 10V X5R 0201
2	3	C17,C24,C25	10uF	805	Samsung	CL21B106KOQNNNE	CAP CER 10UF 16V X7R 0805
3	0	C34,C35	DNI - 10uF	805	Samsung	CL21B106KOQNNNE	CAP CER 10UF 16V X7R 0805
4	3	C18,C19,C20	1uF	c0201	Murata Electronics North America	GRM033R60J105MEA2D	CAP CER 1UF 6.3V X5R 0201
5	8	C21,C22,C23,C27,C28,C29,C32,C33	0.1uF	c0201	Murata Electronics North America	GRM033R61A104ME15D	CAP CER 0.1UF 10V X5R 0201
6	0	C30,C31	DNI - 0.1uF	c0201	Murata Electronics North America	GRM155R71C104KA88D	CAP CER 0.1UF 10V X5R 0201
7	1	C26	22uF	805	Taiyo Yuden	JMK212BJ226KG-T	CAP CER 22UF 6.3V X5R 0805
8	0	C36	DNI - 22uF	805	Taiyo Yuden	JMK212BJ226KG-T	CAP CER 22UF 6.3V X5R 0805
9	1	D1	SCHOTTKY	diode_smb	NXP Semiconductors	PMEG3050EP,115	DIODE SCHOTTKY 30V 5A SOD128
10	5	D2,D3,D4,D5	Green	led0805	Lite-On Inc	LTST-C170KGKT	LED GREEN CLEAR 0805 SMD
11	0	D6	DNI - Green	led0805	Lite-On Inc	LTST-C170KGKT	LED GREEN CLEAR 0805 SMD
12	10	JMP1,JMP2,JMP3,JMP4,JMP5,JMP6,JMP7,JMP8,JMP9,JMP11	4 Pin-T Berg Jumper	berg2x3tee	Samtec Inc	HTSW-104-07-G-S	4 Positions Header Connector Through Hole
13	2	JMP10,JMP12	5Pin-T Berg Jumper	berg2x5tee	Samtec Inc	HTSW-105-07-G-S	5 Positions Header Connector Through Hole
14	5	J1,J2,J3,J4	CON02	HDR_THVT_1x2_100_M	Samtec Inc	HTSW-102-07-G-S	2 Positions Header Connector Through Hole
15	0	J6	DNI - CON02	HDR_THVT_1x2_100_M	Samtec Inc	HTSW-102-07-G-S	2 Positions Header Connector Through Hole
16	1	J5	DC_PWR_JACK	pj-202ah	CUI	PJ-202AH	CONN PWR JACK 2X5.5MM KINKED PIN
17	1	L1	1uH	IND_NR3015	Taiyo Yuden	NR3015T1R0N	FIXED IND 1UH 2.1A 36 MOHM SMD
18	0	L2	DNI - 1uH	IND_NR3015	Taiyo Yuden	NR3015T1R0N	FIXED IND 1UH 2.1A 36 MOHM SMD
19	1	LB1	Label		3M	THT-14-423-10	PCB Label 0.650"H x 0.200"W
20	4	M1,M2,M3,M4	NY PMS 440 005 PH	Screw	B&F Fastener	NY PMS 440 0050 PH	40x.5 inch nylon
21	4	M5,M6,M7,M8	1902E	Standoff	Keystone	1902E	Standoff
22	1	P1	Wurth 632712000021	usb-c_smrt_632_712_000_b6_b7	Wurth Electronics Inc	632712000021	CONN PLUG USB TYPE C SMD
23	1	P2	JAE DX07S024JJ2	USB-C_SMRT_DX07S024JJ2	JAE Electronics	DX07S024JJ2R1300	CONN RCPT USB3.1 TYPEC SMD R/A
24	1	PCB1	HSDC008	n/a	Any	HSDC008	PCB
25	0	R1,R2	DNI - 0 Ohm	r0402	Yageo	RC0402JR-070RL	RES SMD 0.0OHM JUMPER 1/16W 0402
26	17	R3,R4,R5,R6,R7,R8,R9,R10,R19,R20,R24,R25,R26,R29,R30,R33,R35	1K	r0402	Vishay Dale	CRCW04021K00FKED	RES SMD 1K OHM 1% 1/16W 0402
27	9	R11,R12,R13,R14,R15,R16,R17,R18,R42	100K	r0402	Yageo	RC0402FR-07100KL	RES SMD 100K OHM 1% 1/16W 0402
28	12	R21,R23,R27,R28,R31,R32,R34,R37,R49,R50,R58,R57	20K	r0402	Vishay Dale	CRCW040220K0FKED	RES SMD 20K OHM 1% 1/5W 0402
29	1	R39	178K	r0402	Panasonic Electronic Components	ERJ-2RKF1783X	RES SMD 178K OHM 1% 1/10W 0402
30	0	R36,R55	DNI - 178K	r0402	Panasonic Electronic Components	ERJ-2RKF1783X	RES SMD 178K OHM 1% 1/10W 0402

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Table 6. TUSB1044 Bill of Materials (continued)

Item	QTY	Reference	Part	Footprints	Manufacturer	Manufacturer Part No	Description
31	1	R40	0 Ohm	r1206	Vishay Dale	CRCW12060000Z0EA	RES SMD 0.0 OHM JUMPER 1/4W 1206
32	0	R56	DNI - 0 Ohm	r1206	Vishay Dale	CRCW12060000Z0EA	RES SMD 0.0 OHM JUMPER 1/4W 1206
33	2	R41	330 Ohm	r0603	Yageo	RC0603FR-07330RL	RES SMD 330 OHM 1% 1/10W 0603
34	0	R52	DNI - 330 Ohm	r0603	Yageo	RC0603FR-07330RL	RES SMD 330 OHM 1% 1/10W 0603
35	1	R51	0	r0402	Panasonic Electronic Components	ERJ-2GE0R00X	RES SMD 0.0OHM JUMPER 1/10W 0402
36	0	R38,R43,R44,	DNI - 0	r0402	Panasonic Electronic Components	ERJ-2GE0R00X	RES SMD 0.0OHM JUMPER 1/10W 0402
37	2	R45,R74	200	r0402	Panasonic Electronic Components	ERJ-2RKF2000X	RES SMD 200 OHM 1% 1/10W 0402
38	2	R46,R75	1.5K	r0402	Panasonic Electronic Components	ERJ-2RKF1501X	RES SMD 1.5K OHM 1% 1/10W 0402
39	2	R47,R60	3.9K	r0402	Panasonic Electronic Components	ERJ-2RKF3901X	RES SMD 3.9K OHM 1% 1/10W 0402
40	2	R48,R59	6.2K	r0402	Panasonic Electronic Components	ERJ-2GEJ622X	RES SMD 6.2K OHM 5% 1/10W 0402
41	7	R61,R62,R63,R64,R65,R71,R72	0	r0201	Panasonic Electronic Components	ERJ-1GN0R00C	RES SMD 0.0OHM JUMPER 1/20W 0201
42	0	R53,R54, R66,R69,R70	DNI - 0	r0201	Panasonic Electronic Components	ERJ-1GN0R00C	RES SMD 0.0OHM JUMPER 1/20W 0201
43	3	R67,R68,R73	75	r0603	Yageo	RC0603JR-0775RL	RES SMD 75 OHM 5% 1/10W 0603
44	0	R22	DNI - 39.2K	r0402	Yageo	RC0402FR-0739K2L	RES SMD 39.2K OHM 1% 1/16W 0402
45	12	SHNT1,SHNT2,SHNT3,SHNT4,SHNT5,SHNT6,SHNT7,SHNT8,SHNT9,SHNT10,SHNT11,SHNT12	QPC02SXGN-RC	0.1	Sullins Connector Solutions	QPC02SXGN-RC	CONN JUMPER SHORTING .100" GOLD
46	1	SW1	8-POS 50-MIL SMT	SW_SMVT_SPST_TDA08	C&K Components	TDA08H0SB1	SWITCH SLIDE DIP SPST 25MA 24V
47	1	U1	TUSB1044	40 pin QFN	Texas Instruments	TUSB1044RNQ	USB Type-C DP ALT Mode, 10 Gbps Linear Redriver Crosspoint Switch
48	1	U2	TPS62080DSGT	dsg	Texas Instruments	TPS62082DSGT	1.2A High Efficient Step Down Converter in 2x2mm SON Package. 3.3 Vout (Min)
49	1	U3	TPD6S300	ruk0020b	Texas Instruments	TPD6S300RUKR	USB Type-C™ Port Protector: Short-to-VBUS Overvoltage and IEC ESD Protection
50	2	U4,U5	TPD4E02B04	dqa0010a	Texas Instruments	TPD4E02B04DQAR	4-Channel ESD Protection Diode for USB Type-C and HDMI 2.0
51	0	U8	DNI - TPS62082	dsg	Texas Instruments	TPS62082DSGT	1.2A High Efficient Step Down Converter in 2x2mm SON Package. 3.3 Vout (Min)

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Revision History

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

Changes from A Revision (April 2018) to B Revision	Page
• Deleted TUSB212 support throughout the document.	1

Revision History

Changes from Original (March 2018) to A Revision	Page
• Added TUSB212 support throughout the document.	1
• Changed *Figure 1*.	2
• Added **NOTE:** and *Figure 3* and *Figure 4*.	3
• Changed schematic images: *Figure 5* through *Figure 8*.	7
• Changed *Table 6*.	11

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

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   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 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 a nonconforming EVM if (a) the nonconformity was 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, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   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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