# TUSB546 USB Type-C™ Enabler EVM

The TUSB546 USB Type-C™ Alternate Mode re-driving switch supports data rates up to 10 Gbps for a downstream facing port (host). This guide describes how to bring up the EVM and includes schematics that can be used as a reference design for the alternate mode implementations of the host system with the TUSB546 device.

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# 1 TUSB546EVM-SRC

Figure 1 illustrates the EVM board.

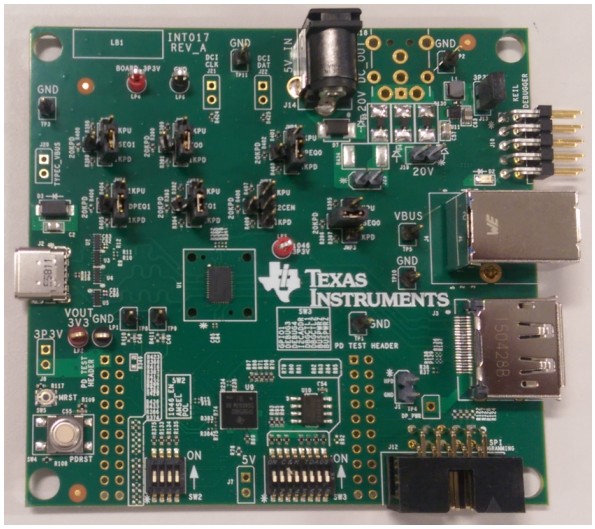


**Figure 1. TUSB546 EVM**

The TUSB546EVM-SRC can be used with a legacy DP Source or USB Host system to evaluate the USB Type-C implementation. Figure 2 is a typical test setup.

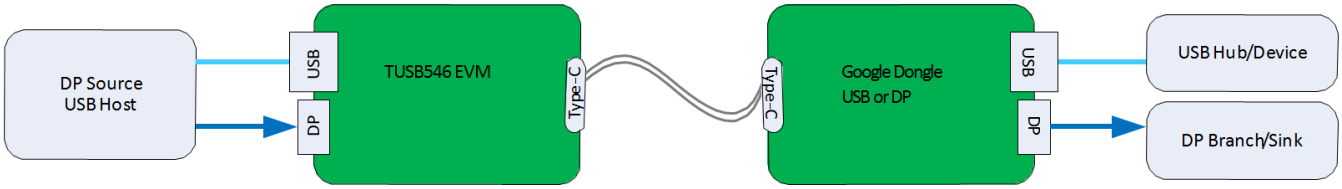



**Figure 2. Test Board Setup**

The EVM comes with a legacy Type B USB receptacle to connect to USB host systems and a DisplayPort receptacle to connect to DisplayPort-capable source. The TUSB546 EVM uses the Texas Instruments TPS65982 (http://www.ti.com/product/TPS65982) controller for power delivery and CC pin control.

# 2 TUSB546EVM Configuration

This section provides the configuration options available in the TUSB546EVM.

## *2.1 TUSB546 EVM Default EQ Configuration*

The headers in Table 1 are provided for TUSB546 EQ configuration by default, configuration settings may need to be optimized depending on the amount of loss of each channel in the system.

**Table 1. TUSB546 Configuration Pins**

| Reference Designator | JMP Control | Configuration |
|---|---|---|
| JMP1 | Downstream EQ0 | No Connect |
| JMP2 | Downstream EQ1 | SHUNT on pin 2–4 (20-kΩ pulldown) |
| JMP3 | Upstream SSEQ0 | SHUNT on pin 2–1 (1-kΩ pullup) |
| JMP4 | Upstream SSEQ1 | SHUNT on pin 2–4 (20-kΩ pulldown) |
| JMP5 | DP EQ0 | SHUNT on pin 2–4 (20-kΩ pulldown) |
| JMP6 | DP EQ1 | SHUNT on pin 2–4 (20-kΩ pulldown) |


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## 2.2 TUSB546 EQ Control

Each of the TUSB546 receiver lanes has individual controls for receiver equalization. Table 2, Table 3, and Table 4 detail the gain values for each available combination for downstream, upstream, and all DisplayPort configurations.

**Table 2. Configuration Pin-Level Definitions**

| Level | Settings |
|---|---|
| 0 | Option 1: Tie 1 kΩ 5% to GND<br>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<br>Option 2: Tie directly to VCC |

**Table 3. USB 3.1 EQ Settings**

| USB3.1 Downstream Facing Ports | | | USB3.1 Upstream Facing Port | | |
|---|---|---|---|---|---|
| EQ1 Pin Level | EQ0 Pin Level | EQ Gain @ 5 GHz (dB) | SSEQ1 Pin Level | SSEQ0 Pin Level | EQ Gain @ 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 4. DisplayPort EQ Settings**

| All DisplayPort Lanes | | |
|---|---|---|
| **DPEQ1 Pin Level** | **DPEQ0 Pin Level** | **EQ Gain @ 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 via USB Type B J4. No external power is to be applied via J14 unless standalone operation is desired.

If testing the DisplayPort only, or if bypassing VBUS power, the EVM must be powered via J14 (5-V, 1-A input).


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## 3 TUSB546EVM Schematics

Figure 3 displays the block diagram of the EVM.

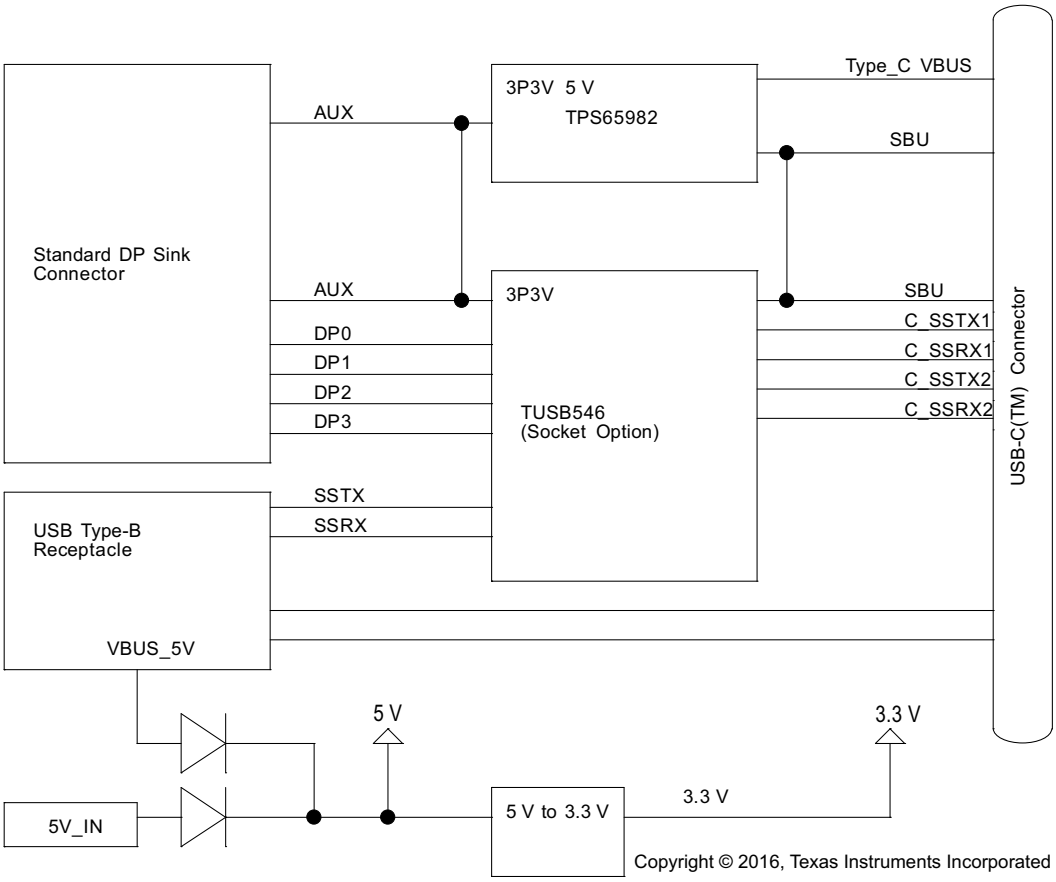
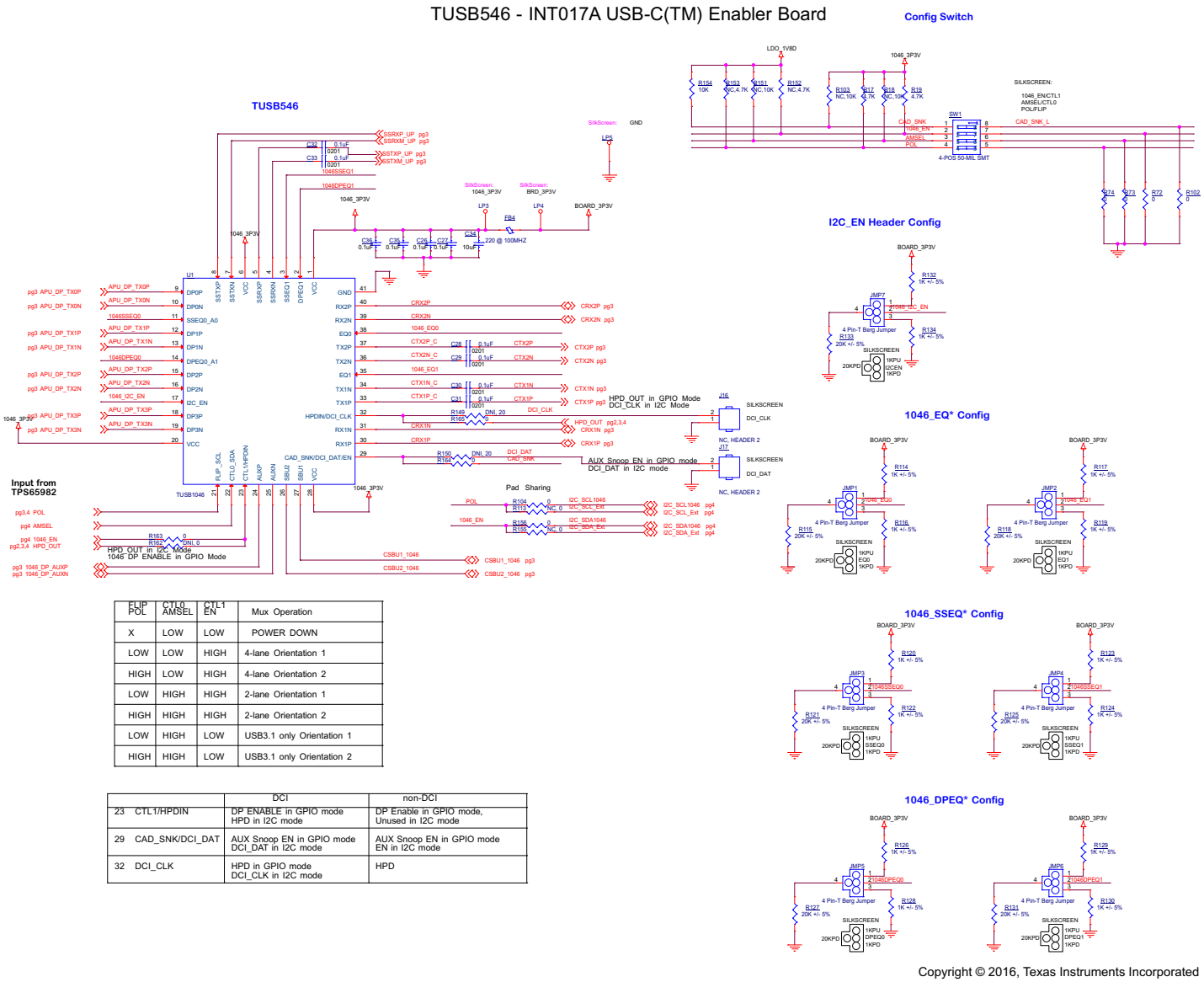



**Figure 3. TUSB546EVM Block Diagram**


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Figure 4 through Figure 7 show the EVM schematics.




| FLIP POL | CTL0 AMSEL | CTL1 EN | Mux Operation |
|---|---|---|---|
| X | LOW | LOW | POWER DOWN |
| LOW | LOW | HIGH | 4-lane Orientation 1 |
| HIGH | LOW | HIGH | 4-lane Orientation 2 |
| LOW | HIGH | HIGH | 2-lane Orientation 1 |
| HIGH | HIGH | HIGH | 2-lane Orientation 2 |
| LOW | HIGH | LOW | USB3.1 only Orientation 1 |
| HIGH | HIGH | LOW | USB3.1 only Orientation 2 |

| | DCI | non-DCI |
|---|---|---|
| 23 CTL1/HPDIN | DP ENABLE in GPIO mode<br>HPD in I2C mode | DP Enable in GPIO mode,<br>Unused in I2C mode |
| 29 CAD_SNK/DCI_DAT | AUX Snoop EN in GPIO mode<br>DCI_DAT in I2C mode | AUX Snoop EN in GPIO mode<br>EN in I2C mode |
| 32 DCI_CLK | HPD in GPIO mode<br>DCI_CLK in I2C mode | HPD |

**Figure 4. TUSB546EVM Schematics (1 of 4)**



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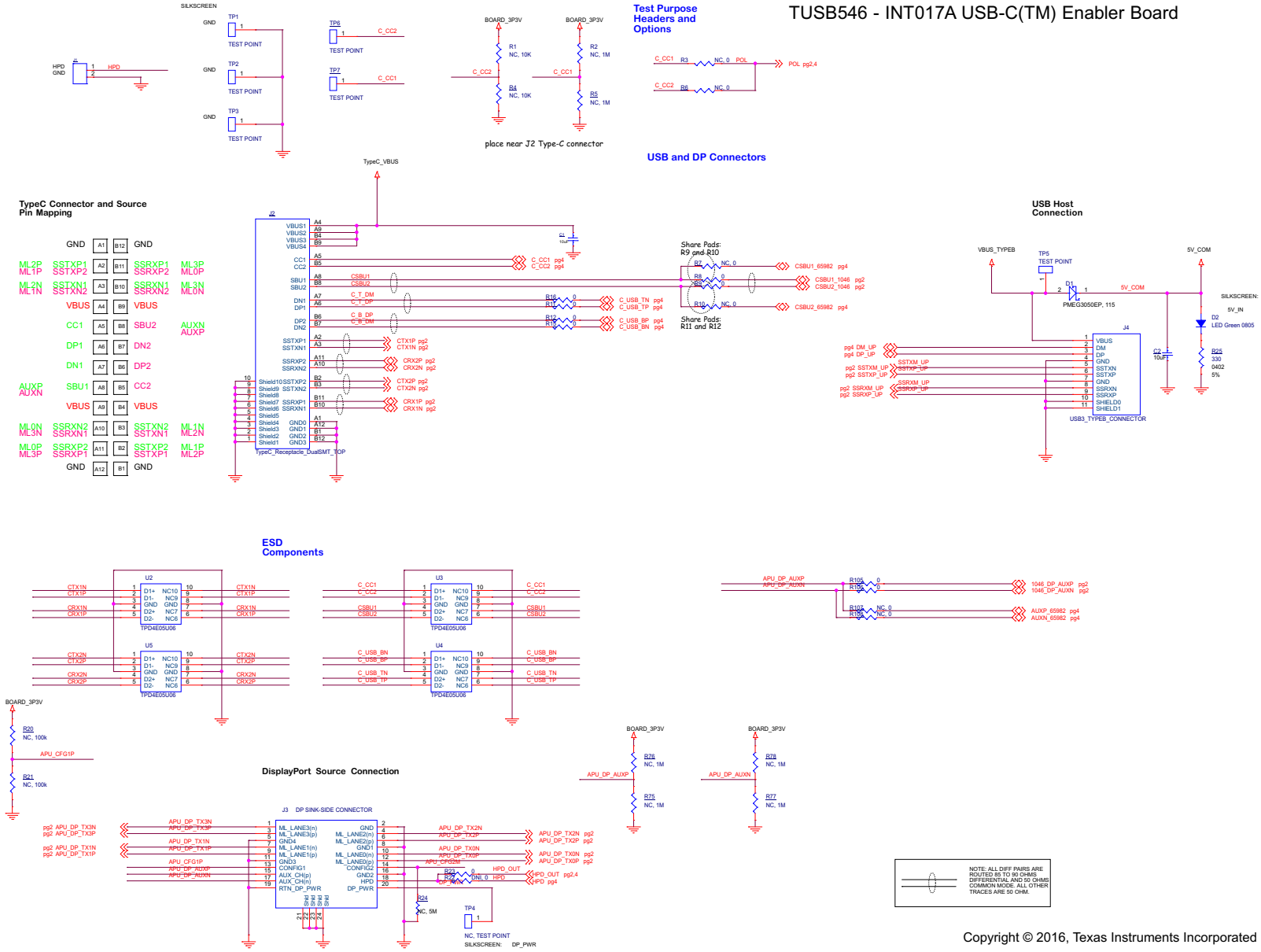
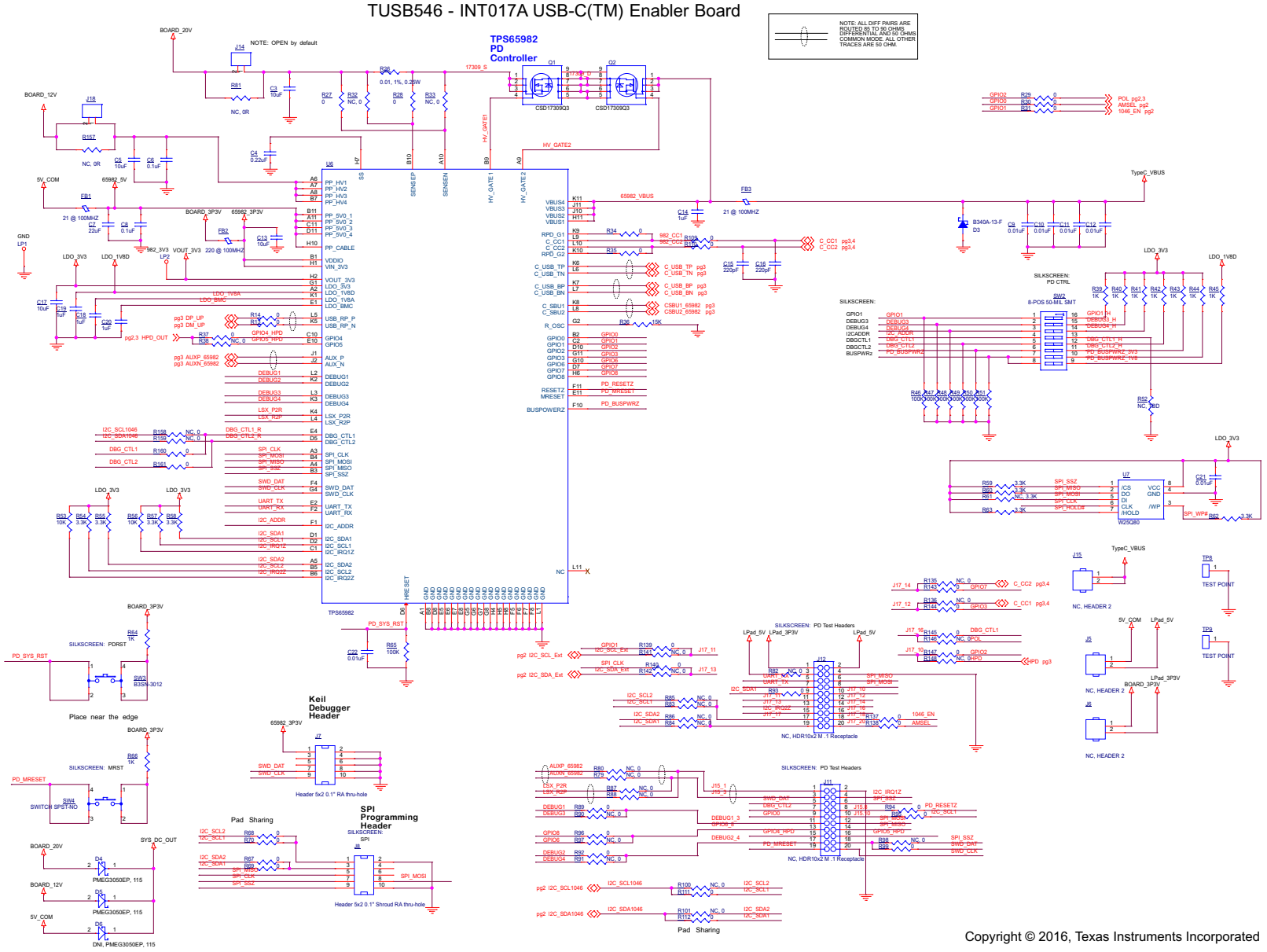



**Figure 5. TUSB546EVM Schematics (2 of 4)**



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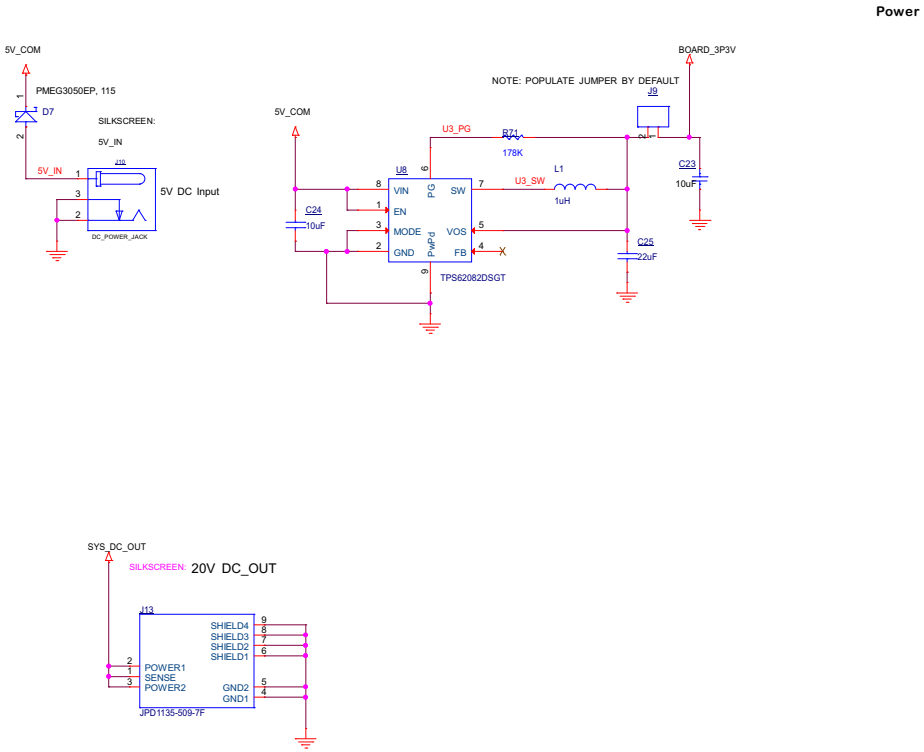

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**Figure 6. TUSB546EVM Schematics (3 of 4)**



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TUSB546 - INT017A USB-C(TM) Enabler Board




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**Figure 7. TUSB546EVM Schematics (4 of 4)**



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# 4 Bill of Materials

Table 5 lists the TUSB546EVM bill of materials (BOM).

**Table 5. TUSB546 EVM Bill of Materials**

| Item | Qty | Reference | Part | Manufacturer | Manufacturer Part Number | PCB Footprint |
|---|---|---|---|---|---|---|
| 1 | 9 | C1,C2,C3,C5,C13,C17,C23,C24,C34 | 10uF | Murata | GRM188R61C106MA73D | 603 |
| 2 | 1 | C4 | 0.22uF | Murata | GRM152R61A224KE19D | 402 |
| 3 | 12 | C6,C8,C26,C27,C28,C29,C30,C31,C32,C33,C35,C36 | 0.1uF | Murata | GRM155R61A104KA01D | 402 |
| 4 | 2 | C7,C25 | 22uF | Murata | GRM188R60J226MEA0D | 603 |
| 5 | 6 | C9,C10,C11,C12,C21,C22 | 0.01uF | Murata | GRM155R71C103KA01D | 402 |
| 6 | 4 | C14,C18,C19,C20 | 1uF | Murata | GRM155R60J105ME19D | 402 |
| 7 | 2 | C15,C16 | 220pF | Murata | GRM1555C1H221JA01D | 402 |
| 8 | 5 | D1,D4,D5,D6,D7 | SCHOTTKY | NXP | PMEG3050EP,115 | SOD-128 |
| 9 | 1 | D2 | LED Green 0805 | Lumex | SML-LX0805GC-TR | 805 |
| 10 | 1 | D3 | B340A-13-F | Diodes Inc | B340A-13-F | |
| 11 | 2 | FB1,FB3 | 21 @ 100MHZ | Taiyo Yuden | FBMJ2125HM210NT | |
| 12 | 2 | FB2,FB4 | 220 @ 100MHZ | MuRata | BLM18EG221SN1D | |
| 13 | 7 | JMP1,JMP2,JMP3,JMP4,JMP5,JMP6,JMP7 | 4 Pin-T Berg Jumper | | | berg2x3tee |
| 14 | 4 | J1,J9,J14,J18 | CON02 | FCI | 68001-402HLF | HDR_THVT_1X2_100_M |
| 15 | 1 | J2 | TypeC_Receptacle_DualSMT_TOP | Foxconn | UT12113-11601-7H | USB_TYPEC_UT1211 |
| 16 | 1 | J3 | DP SINK-SIDE CONNECTOR | Molex Inc | 472720001 | con_DP_SD-47272-001 |
| 17 | 1 | J4 | USB3_TYPEB_CONNECTOR | Amphenol Commercial Products | GSB4211311WEU | usb3_typeb_ak4aa009 |
| 18 | 5 | J5,J6,J15,J16,J17 | NC, HEADER 2 | Omron Electronics Inc-EMC Div | XG8T-0231 | berg1x2 |
| 19 | 1 | J7 | Header 5x2 0.1" RA thru-hole | FCI | 68021-210HLF | HDR_THRT_68020 |
| 20 | 1 | J8 | Header 5x2 0.1" Shroud RA thru-hole | 3M | 20210-5002HB | HDR_THRT_2X5_100 |
| 21 | 1 | J10 | DC_PWR_JACK | CUI Inc. | PJ-202AH | pj-202ah |
| 22 | 2 | J11,J12 | NC, HDR10x2 M .1 Receptacle | Sullins | PPPC102LFBN-RC | HDR_THVT_2x10_100_F |
| 23 | 1 | J13 | JPD1135-509-7F | Foxconn | JPD1135-509-7F | Jack_THRT_JPD1135 |
| 24 | 2 | LP1,LP5 | LP | Keystone Electronics | 5011 | THM Test Point |
| 25 | 3 | LP2,LP3,LP4, | | Keystone Electronics | 5010 | THM Test Point |
| 26 | 1 | L1 | 1uH | Taiyo Yuden | NR3015T1R0N | IND_NR3015 |
| 27 | 2 | Q1,Q2 | MOS_P_4D_3S | Texas Instruments | CSD17309Q3 | Q3_SON-8 |



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**Table 5. TUSB546 EVM Bill of Materials (continued)**

| Item | Qty | Reference | Part | Manufacturer | Manufacturer Part Number | PCB Footprint |
|---|---|---|---|---|---|---|
| 28 | 2 | R1,R4 | NC, 10K | Panasonic Electronic Components | ERJ-2GEJ103X | 402 |
| 29 | 6 | R2,R5,R75,R76,R77,R78 | NC, 1M | Panasonic Electronic Components | ERJ-2GEJ105X | 402 |
| 30 | 34 | R3,R6,R7,R10,R32,R33,R38,R79,R80,R82,R83,R84,R85,R86,R87,R88,R90,R91,R97,R98,R100,R101,R107,R108,R113,R135,R136,R141,R142,R146,R148,R155,R158,R159 | NC, 0 | Panasonic Electronic Components | ERJ-2GE0R00X | 402 |
| 31 | 53 | R8,R9,R11,R12,R13,R14,R15,R16,R23,R27,R28,R29,R30,R31,R34,R35,R37,R67,R68,R69,R70,R72,R73,R74,R89,R92,R93,R94,R95,R96,R99,R102,R104,R105,R106,R109,R110,R111,R112,R137,R138,R139,R140,R143,R144,R145,R147,R156,R160,R161,R163,R164,R165 | 0 | Panasonic Electronic Components | ERJ-2GE0R00X | 402 |
| 32 | 2 | R17,R19 | 4.7K | Panasonic Electronic Components | ERJ-2GEJ472X | 402 |
| 33 | 3 | R18,R103,R151 | NC,10K | Panasonic Electronic Components | ERJ-2GEJ103X | 402 |
| 34 | 2 | R20,R21 | NC, 100k | Panasonic Electronic Components | ERJ-2GEJ104X | 402 |
| 35 | 2 | R22,R162 | DNI, 0 | Panasonic Electronic Components | ERJ-1GN0R00C | 201 |
| 36 | 1 | R24 | NC, 1M | Panasonic Electronic Components | ERJ-1GEF1004C | 201 |
| 37 | 1 | R25 | 330 | Panasonic Electronic Components | ERJ-2GEJ331X | 402 |
| 38 | 1 | R26 | 0.01, 1%, 0.25W | Panasonic Electronic Components | ERJ-6BWFR010V | 805 |
| 39 | 1 | R36 | 15K | Panasonic Electronic Components | ERJ-2RKF1502X | 402 |
| 40 | 9 | R39,R40,R41,R42,R43,R44,R45,R64,R66 | 1K | Panasonic Electronic Components | ERJ-2GEJ102X | 402 |
| 41 | 7 | R46,R47,R48,R49,R50,R51,R65 | 100K | Panasonic Electronic Components | ERJ-2GEJ104X | 402 |
| 42 | 1 | R52 | NC, 100 | Panasonic Electronic Components | ERJ-2GEJ101X | 402 |
| 43 | 3 | R53,R56,R154 | 10K | Panasonic Electronic Components | ERJ-2GEJ103X | 402 |
| 44 | 8 | R54,R55,R57,R58,R59,R60,R62,R63 | 3.3K | Panasonic Electronic Components | ERJ-2GEJ332X | 402 |
| 45 | 1 | R61 | NC, 3.3K | Panasonic Electronic Components | ERJ-2GEJ332X | 402 |
| 46 | 1 | R71 | 178K | Panasonic Electronic Components | ERJ-3EKF1783V | 603 |
| 47 | 2 | R81,R157 | NC, 0R | Vishay Dale | RCL12250000Z0EG | 2512 |
| 48 | 14 | R114,R116,R117,R119,R120,R122,R123,R124,R126,R128,R129,R130,R132,R134 | 1K +/- 5% | Panasonic Electronic Components | ERJ-2GEJ102X | 402 |


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**Table 5. TUSB546 EVM Bill of Materials (continued)**

| Item | Qty | Reference | Part | Manufacturer | Manufacturer Part Number | PCB Footprint |
|---|---|---|---|---|---|---|
| 49 | 7 | R115,R118,R121,R125,R127,R131,R133 | 20K +/- 5% | Panasonic Electronic Components | ERJ-2GEJ203X | 402 |
| 50 | 2 | R149,R150 | DNI, 20 | Panasonic Electronic Components | ERJ-2GEJ200X | 402 |
| 51 | 2 | R152,R153 | NC,4.7K | Panasonic Electronic Components | ERJ-2GEJ472X | 402 |
| 52 | 1 | SW1 | 4-POS 50-MIL SMT | CampersandK(ITT-CANNON) | TDA04H0SB1R | sw_smvt_dip_4pos_8 |
| 53 | 1 | SW2 | 8-POS 50-MIL SMT | CampersandK(ITT-CANNON) | TDA08H0SB1R | SW_SMVT_SPST_TDA08 |
| 54 | 1 | SW3 | Pushbutton Switch | Omron Electronics Inc-EMC Div | B3SN-3012P | switch_b3sn |
| 55 | 1 | SW4 | SWITCH SPST-NO | CampersandK Components | KMT221G HF LFS | kmt2_switch |
| 56 | 8 | TP1,TP2,TP3,TP5,TP6,TP7,TP8,TP9 | TEST POINT | Samtec | HTSW-101-07-G-S | berg1x1 |
| 57 | 1 | TP4 | NC, TEST POINT | Keystone Electronics | 1035 | berg1x1 |
| 58 | 1 | U1 | TUSB546 | Texas Instruments | TUSB546 | |
| 59 | 4 | U2,U3,U4,U5 | TPD4E05U06 | Texas Instruments | TPD4E05U06 | DQA |
| 60 | 1 | U6 | TPS65982 | Texas Instruments | TPS65982 | ZQZ_BGA_96 |
| 61 | 1 | U7 | W25Q80 | WINBOND | W25Q80DVSNIG | SOIC_8_197x157_50 |
| 62 | 1 | U8 | TPS62082DSGT | Texas Instruments | TPS62082DSGT | dsg |



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# 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/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 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.

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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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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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