

BQ25601 and BQ25601D (PWR877) Evaluation Module

This user's guide provides detailed testing instructions for the BQ25601 and BQ25601D evaluation modules (EVMs). Also included are descriptions of the necessary equipment, equipment setup, procedures, the printed-circuit board layouts, schematics, and the bill of materials (BOM) .

Throughout this user's guide, the abbreviations *EVM*, *BQ25601EVM*, *BQ25601DEVM*, *PWR877*, and the term *evaluation module* are synonymous with the PWR877 evaluation module, unless otherwise noted.

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1 Introduction

1.1 EVM Features

For detailed features and operation, refer to [Table 1](#) for a list of devices and their data sheets.

Table 1. Device Data Sheets

Device	Data Sheet	EVM Label	Variant
BQ25601	SLUSCK5	BQ25601EVM-877	001
BQ25601D	SLUSDA2	BQ25601DEVM-877	002

The PWR877 evaluation module (EVM) is a complete charger module for evaluating an I²C-controlled, single-cell NVDC charge using either the BQ25601 or BQ25601D device.

This EVM does not include EV2300/EV2400 interface board. To evaluate the EVM, a EV2300/EV2400 interface board must be ordered separately.

1.2 I/O Descriptions

[Table 2](#) lists the jumper connections available on this EVM.

Table 2. EVM Connections

Jack	Description	BQ25601 (variant 001)	BQ25601D (variant 002)
J1-VA C/VBU S	VAC for BQ25601: positive charger input voltage sense, VBUS for BQ25601D: positive charger input voltage	Installed	Installed
J1-GN D	Ground	Installed	Installed
J2-PM ID	PMID pin connection	Installed	Installed
J2-GN D	Ground	Installed	Installed
J3-SY S	Connected to system	Installed	Installed
J3-GN D	Ground	Installed	Installed
J4-BA T	Connected to battery pack positive node	Installed	Installed
J4-GN D	Ground	Installed	Installed
J5	Input mini-USB port	Not Installed	Installed
J6	Output mini-USB port	Not Installed	Not Installed
J7	USB-TO-GPIO connector	Not Installed	Not Installed
J8	I ² C 4-pin connector	Installed	Installed

[Table 3](#) lists the EVM jumper connections.

Table 3. EVM Jumper Connections and Shunt Installation

Jack	Description	BQ25601 Setting	BQ25601D Setting
JP1	D+ and PSEL pin selection	Short PSEL to Low	Not Installed
JP2	D- and \overline{PG} pin selection	Short to \overline{PG}	Short to D-
JP3	VBUS and DSEL pin selection	Short to VBUS (pin 24)	Short to VBUS
JP4	STAT, \overline{PG} , \overline{CE} , INT, and OTG pins internal pullup source (SYS or BAT)	Short to SYS	Short to SYS
JP5	D+ and D- connections for input current limit setting	Not Installed	Installed

Table 3. EVM Jumper Connections and Shunt Installation (continued)

Jack	Description	BQ25601 Setting	BQ25601D Setting
JP6	OTG pin to GND	Not Installed	Not Installed
JP7	\overline{CE} pin setting: pull low to enable the charge	Installed	Installed
JP8	TS pin to GND	Not Installed	Not Installed
JP9	TS resistor divider pullup source (REGN) connection	Installed	Installed
JP10	Internal 10 k Ω to GND to TS pin	Installed	Installed
JP11	STAT pin LED indication	Installed	Installed
S1	\overline{QON} control	Default Off	Default Off
S2	Switch to short indicator LEDs	Default Off	Default On

Table 4 lists the recommended operating conditions for this EVM.

Table 4. Recommended Operating Conditions

Symbol	Description	MIN	TYP	MAX	Unit
Supply voltage, $V_{VAC/VBUS}$	Input voltage from AC adapter	3.9	5	13.5	V
Battery voltage, V_{BAT}	Voltage applied at V_{BAT} terminal	0	4.208	4.624	V
IBAT	Fast charging current	0		3.0	A
	Discharging current through internal MOSFET	6			A
Supply current, I_{IN}	Maximum input current from AC adapter input	0		3.0	A

2 Test Summary

2.1 Equipment

This section includes a list of supplies required to perform tests on this EVM.

- Power Supplies:** Power supply #1 (PS#1): a power supply capable of supplying 5 V at 3 A is required. While this part can handle larger voltage and current, it is not necessary for this procedure.
- Load #1:** (4-quadrant supply, constant voltage < 4.5 V) A 0–20 V, 0–5 A, > 30-W system, DC electronic load and setting as constant voltage load mode.
or:
Kepco load: BOP 20–5M, DC 0 to ± 20 V, 0 to ± 5 A (or higher).
- Load #2:** Use with Boost Mode
VBUS to GND load, 10 Ω , 5 W or greater.
- Meters:** Six Fluke 75 multimeters, (equivalent or better).
or:
Four equivalent voltage meters and two equivalent current meters. The current meters must be capable of measuring 5-A+ current.
- Computer:** A computer with at least one USB port and a USB cable. The BQ25601EVM or BQ25601DEV evaluation software must be properly installed.
- USB-TO-GPIO Communication Kit:** EV2300/EV2400 USB-based PC interface board.
- Software:** Download [bqStudio](http://www.ti.com/bqStudio) from www.ti.com.
Double click the *Battery Management Studio* installation file, follow the installation steps. The software supports the Microsoft® Windows® XP and Windows 7 operating systems.

2.2 Equipment Setup

Use the following list to set up the equipment:

- Set PS#1 for 5-V DC, 1-A current limit and then turn off the supply.
- Connect the output of PS#1 in series with a current meter (multimeter) to J1 (VAC/VBUS and GND).
- Connect a voltage meter across TP3 (VAC/VBUS) and TP6 (GND).

- Turn on Load #1, set to constant voltage mode, and output to 2.5 V. Turn off (disable) the load. Apply the load in series with a current meter (multimeter), ground side to J4 (BAT and GND) as shown in Figure 1.

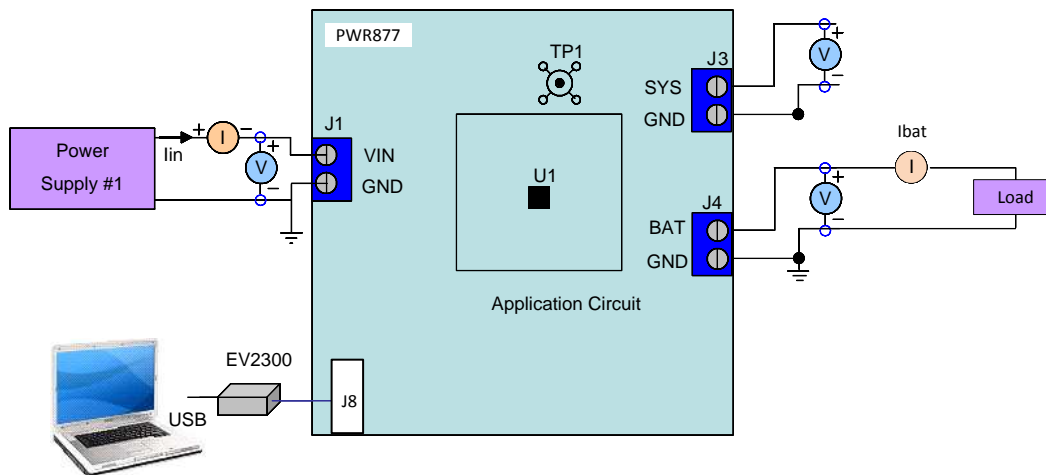


Figure 1. Original Test Setup for BQ25601EVM and BQ25601DEVM

- Connect one voltage meter across TP5 (BAT) and TP7 (GND) to measure the battery voltage.
- Connect the EV2300/2400 USB interface board to the computer with a USB cable and from the I²C port to J8 with the 4-pin cable. The connections are shown in Figure 2.

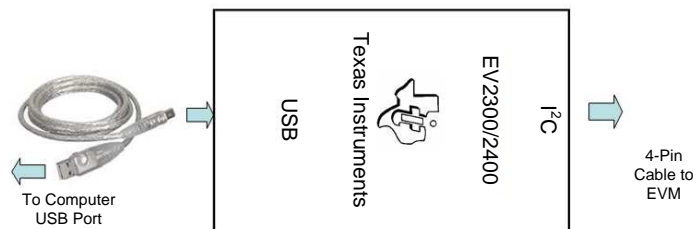


Figure 2. Connections of EV2300/2400

- Install shunts as shown in Table 3.
- Turn on the computer. Launch *Battery Management Studio* (bqStudio). Select *Charger* and either *Charger_1_00-bq25601.bqz* or the *Charger_1_00-bq25601D.bqz* evaluation software. The main window of the software is shown in Figure 3.

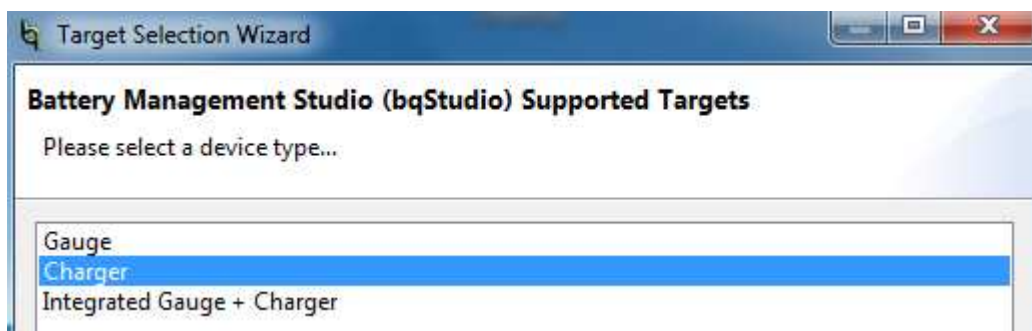


Figure 3. Selection Window of the bqStudio Evaluation Software

2.3 Test Procedure

2.3.1 Current Settings

Use the following list when setting the current:

1. Make sure the [Equipment Setup](#) steps are followed.
2. Launch the **BQ25601** or **BQ25601D** EVM GUI software, if not already done.
3. Turn on PS#1:
 - **Measure** → V_{sys} (TP4 (SYS), TP8 (GND)) = 4.20 ±0.3 V

NOTE: Completely disconnect Load #1 from the BAT pin, if a different voltage value is seen.

2.3.2 Communication Verification

Use the following steps for communication verification:

1. In the EVM software, specify device “I2C Address” as **D6** for BQ25601 or BQ25601D.



2. Click the **Read** button.
3. In the EVM GUI software *Field View* (see the following example screen shot), make the following changes as necessary:
 - Select “Disabled” for the *Watchdog Timer*
 - Set *Input Voltage Limit* to "4.2V"
 - Set *Input Current Limit* to "0.5A"
 - Set *Charge Voltage Limit* to "4.208V" for the BQ2601EVM or "4.199V" for the BQ25601DEVM
 - Set *Fast Charge Current Limit* to "0.48A"
 - Set *Pre-charge Current Limit* to "0.24A"
 - Set *Minimum System Voltage* to "3.5V"
 - Select *Enable Charge*
 - Deselect *Enable Termination*

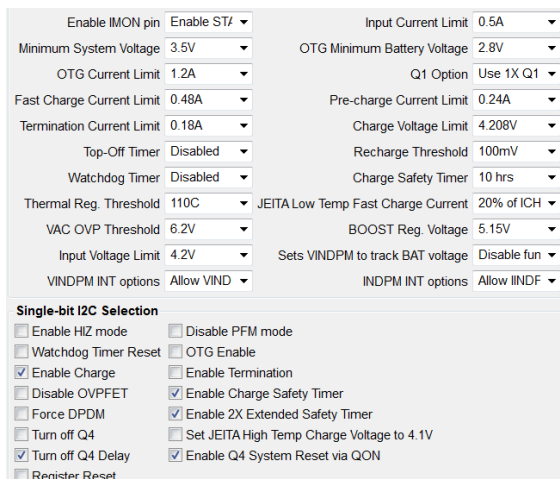


Figure 4. BQ25601 EVM GUI

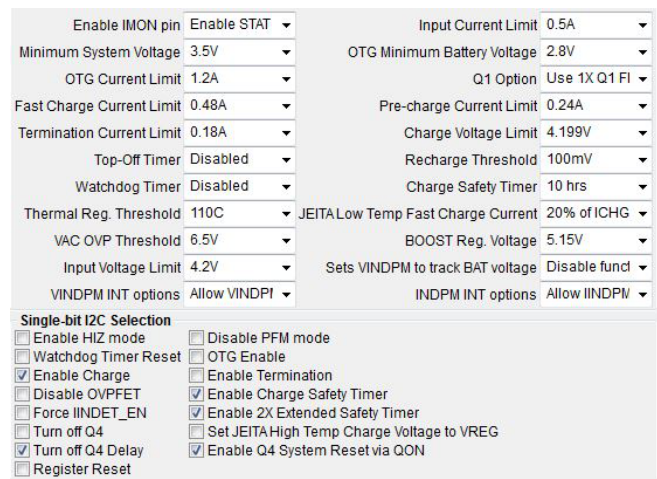


Figure 5. BQ25601D EVM GUI

2.3.3 Charger Mode Verification

Use the following steps for charger mode verification:

1. Turn on PS#1, click the **Read** button twice
 - **Observe** → everything "Normal" at the *Fault* box

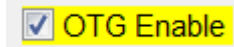
Fault	
Watchdog Fault	Normal
Charge Fault	Normal
Battery Temperature Fault	Normal
Boost Fault	Normal
Battery Fault	Normal

- **Observe** → D3 (STAT) is on
 - **Observe** → D4 (PG) is on
2. Enable Load #1 from [Equipment Setup](#), step 4. Measure the voltage across J3 and J4 as follows:
 - **Measure** → V(TP4 (SYS), TP7 (GND)) = 3.65 V ±0.3 V
 - **Measure** → V(TP5 (BAT), TP7 (GND)) = 2.5 V ±0.2 V
 3. Change the load to 3.7 V
 - **Measure** → V(TP4 (SYS), TP7 (GND)) = 3.8 V ±0.3 V
 - **Measure** → V(TP5 (BAT), TP7 (GND)) = 3.7 V ±0.1 V
 - **Measure** → IBAT = 480 mA ±200 mA (= fast charge current)
 4. In the software, set *Fast Charge Current Limit* to "1.02A"
 - **Measure** → I_{IN} = 500 mA ±200 mA (= input current limit)

2.3.4 Boost Mode Verification

Use the following steps for boost mode verification:

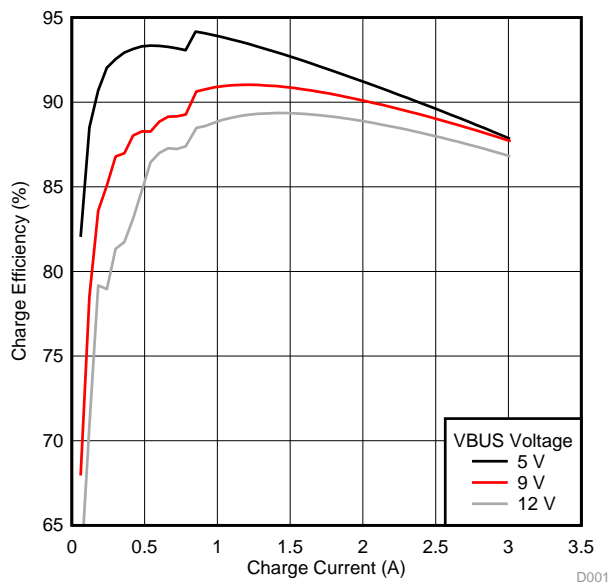
1. Turn off and disconnect PS#1
2. If the constant voltage load connected from BAT to GND is not a four-quadrant supply (sources current) remove the load and use the power source disconnected in step one, set to 3.7 V and 2-A current limit and connect between BAT and GND
3. Check the Enable OTG option in the GUI



4. Apply 10 Ω (5 W or greater) across J1 VAC/VBUS(+) to GND(-)
 - **Measure** \rightarrow VAC/VBUS = 5.15 V \pm 0.2 V
5. Turn off and disconnect power supply
6. Remove 10- Ω resistor at VAC/VBUS

2.3.5 Evaluation Results

This section contains [Charge Efficiency vs Charge Current](#) and [IINDPM Accuracy vs IINDPM Setting](#) graphs.



$f_{SW} = 1.5$ MHz, $V_{BAT} = 3.8$ V, Inductor DCR = 28 m Ω

Figure 6. Charge Efficiency vs Charge Current

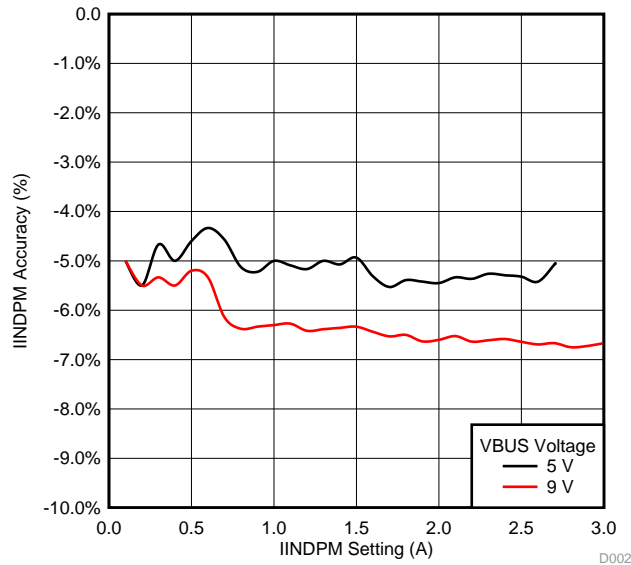


Figure 7. IINDPM Accuracy vs IINDPM Setting

The following pertains to both [Figure 6](#) and [Figure 7](#) in relation to only the BQ25601EVM of PWR877 (Variant 001):

1. VBUS test point is not optimally placed for the current revision of the BQ25601EVM variant of the PWR877 board.
2. VBUS capacitor is not optimally placed for the BQ25601EVM.
3. To measure the efficiency on the BQ25601EVM accurately, solder a wire at pin 24 of the integrated circuit (IC) and use this point voltage reading as the actual VBUS voltage for the efficiency calculations.
4. To have tight IINDPM regulation, a > 1- μ F capacitor must be placed close to pin 24.

2.3.6 Helpful Tips

1. The leads and cables to the various power supplies, batteries and loads have resistance. The current meters also have series resistance. The charger dynamically reduces charge current depending on the voltage sensed at its VAC/VBUS pin (using the VINDPM feature), BAT pin (as part of normal termination), and TS pin (through its battery temperature monitoring feature via battery thermistor). Therefore, voltmeters must be used to measure the voltage as close to the IC pins as possible instead of relying on the digital readouts of the power supply. If a battery thermistor is not available, make sure shunts JP9 and JP10 are in place.
When measuring the efficiency of the BQ25601EVM variant, please solder a wire at pin 24 of the IC and use this point voltage reading as the actual VBUS voltage for the efficiency calculations.
2. When using a source meter that can source and sink current as your battery simulator, TI highly recommends adding a large (1000+ μ F) capacitor at the EVM BAT and GND connectors in order to prevent oscillations at the BAT pin due to mismatched impedances of the charger output and source meter input within their respective regulation loop bandwidths. Configuring the source meter for 4-wire sensing eliminates the need for a separate voltmeter to measure the voltage at the BAT pin. When using 4-wire sensing, always ensure that the sensing leads are connected in order to prevent accidental overvoltage by the power leads.
3. For precise measurements of charge current and battery regulation near termination, the current meter in series with the battery or battery simulator should not be set to auto-range and may need be removed entirely. An alternate method for measuring charge current is to either use an oscilloscope with hall effect current probe or place a 1% or better, thermally-capable (for example, 0.010 Ω in a 1210 or larger footprint) resistor in series between the BAT pin and battery and measure the voltage across that resistor.

3 PCB Layout Guideline

Minimize the switching node rise and fall times for minimum switching loss. Proper layout of the components minimizing high-frequency current path loop is important to prevent electrical and magnetic field radiation and high-frequency resonant problems. This PCB layout priority list must be followed in the order presented for proper layout:

1. Place the input capacitor as close as possible to the PMID pin and GND pin connections and use the shortest copper trace connection or GND plane.
2. Place the inductor input terminal as close to the SW pin as possible. Minimize the copper area of this trace to lower electrical and magnetic field radiation but make the trace wide enough to carry the charging current. Do not use multiple layers in parallel for this connection. Minimize parasitic capacitance from this area to any other trace or plane.
3. Put an output capacitor near to the inductor and the IC. Tie ground connections to the IC ground with a short copper trace connection or GND plane.
4. Route analog ground separately from power ground. Connect analog ground and connect power ground separately. Connect analog ground and power ground together using power pad as the single ground connection point or use a 0- Ω resistor to tie analog ground to power ground.
5. Use a single ground connection to tie the charger power ground to the charger analog ground just beneath the IC. Use ground copper pour but avoid power pins to reduce inductive and capacitive noise coupling.
6. Place decoupling capacitors next to the IC pins and make the trace connection as short as possible.
7. It is critical that the exposed power pad on the backside of the IC package be soldered to the PCB ground. Ensure that there are sufficient thermal vias directly under the IC connecting to the ground plane on the other layers.
8. The via size and number should be enough for a given current path.

See the EVM design for the recommended component placement with trace and via locations. For the QFN information, refer to *Quad Flatpack No-Lead Logic Packages* ([SCBA017](#)) and *QFN/SON PCB Attachment* ([SLUA271](#)).

4 Board Layout, Schematic, and Bill of Materials

4.1 Board Layout

Figure 8 through Figure 15 illustrate the PCB board layouts.

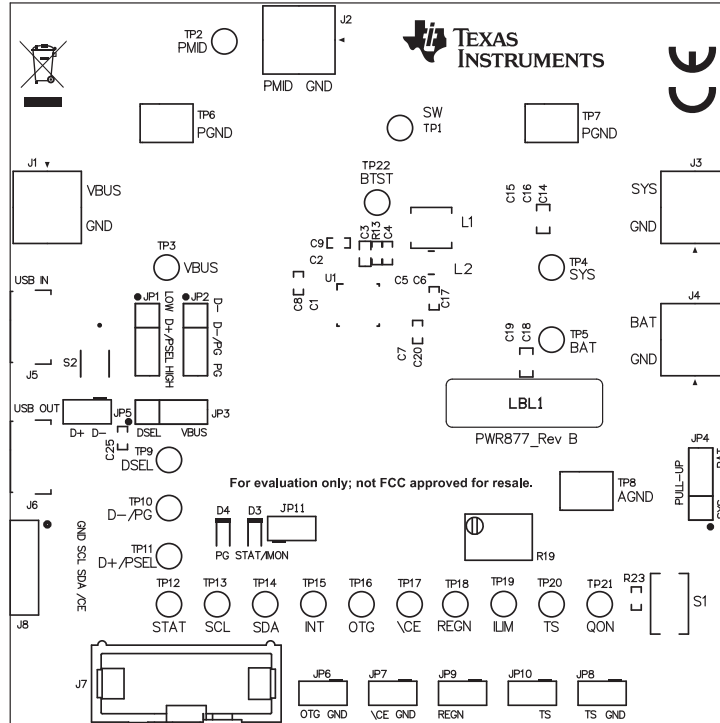


Figure 8. PWR877 Rev. B Top Overlay

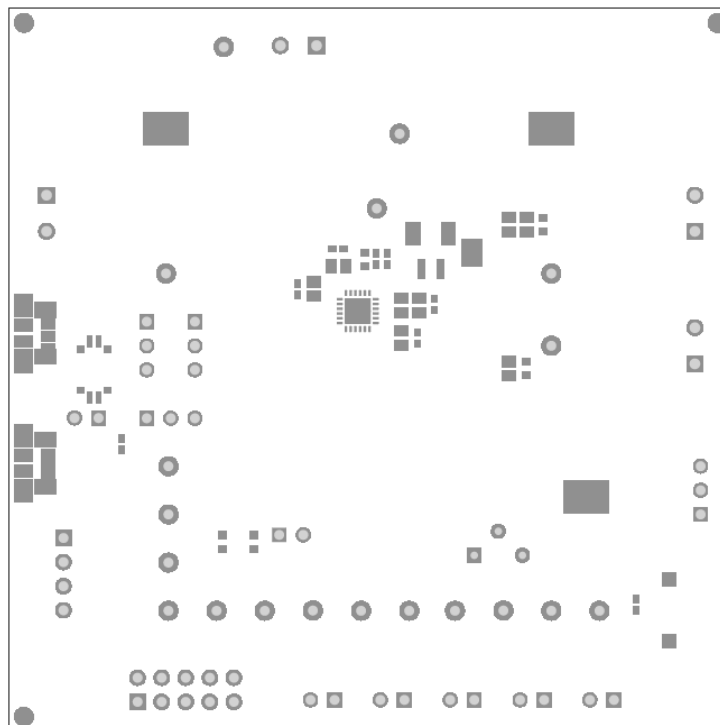


Figure 9. PWR877 Rev. B Top Solder Mask

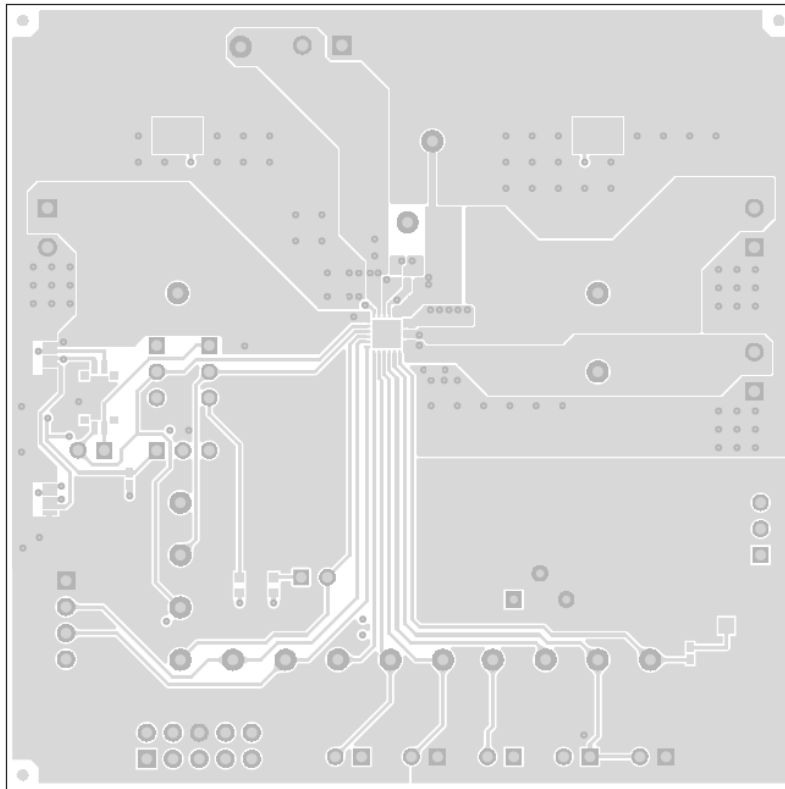


Figure 10. PWR877 Rev. B Top Layer

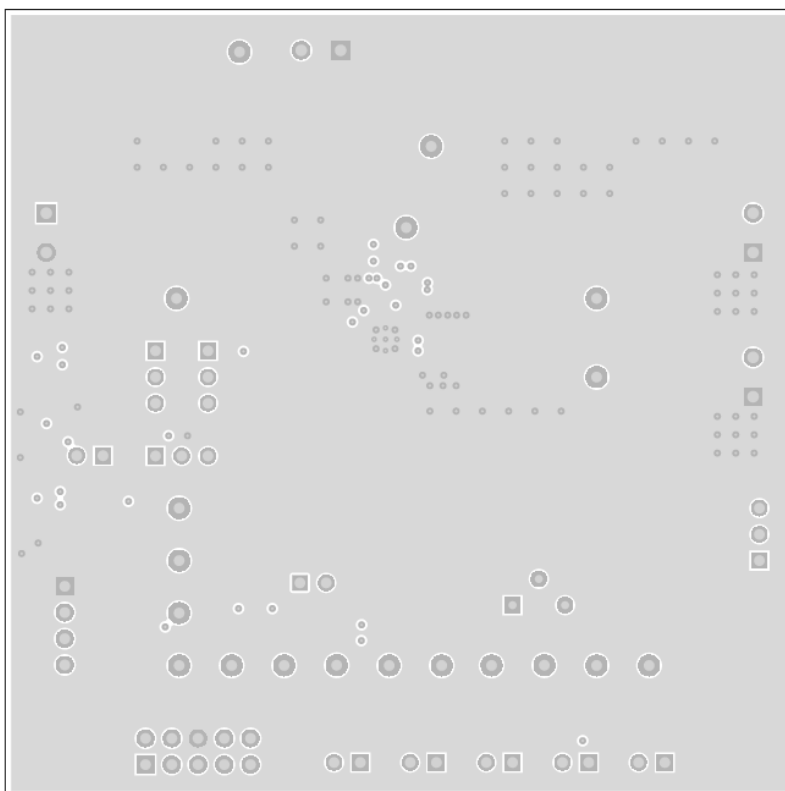


Figure 11. PWR877 Rev. B Layer 1

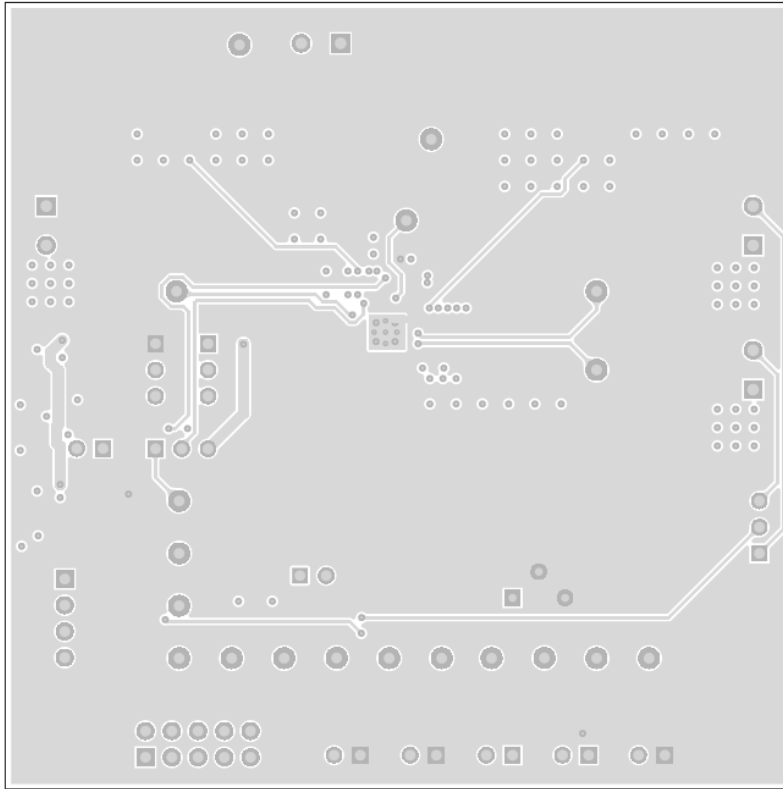


Figure 12. PWR877 Rev. B Layer 2

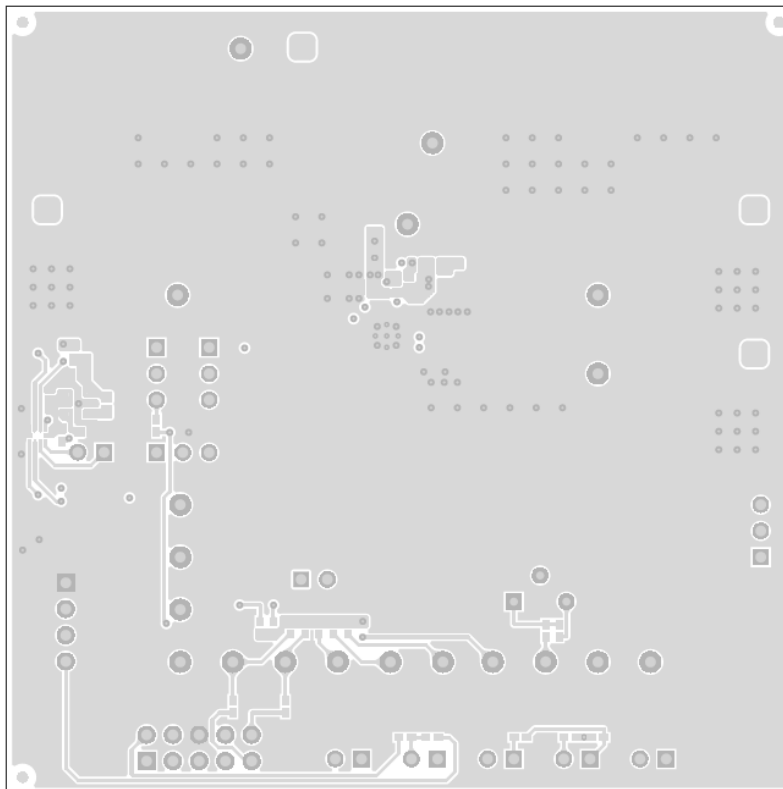


Figure 13. PWR877 Rev. B Bottom Layer

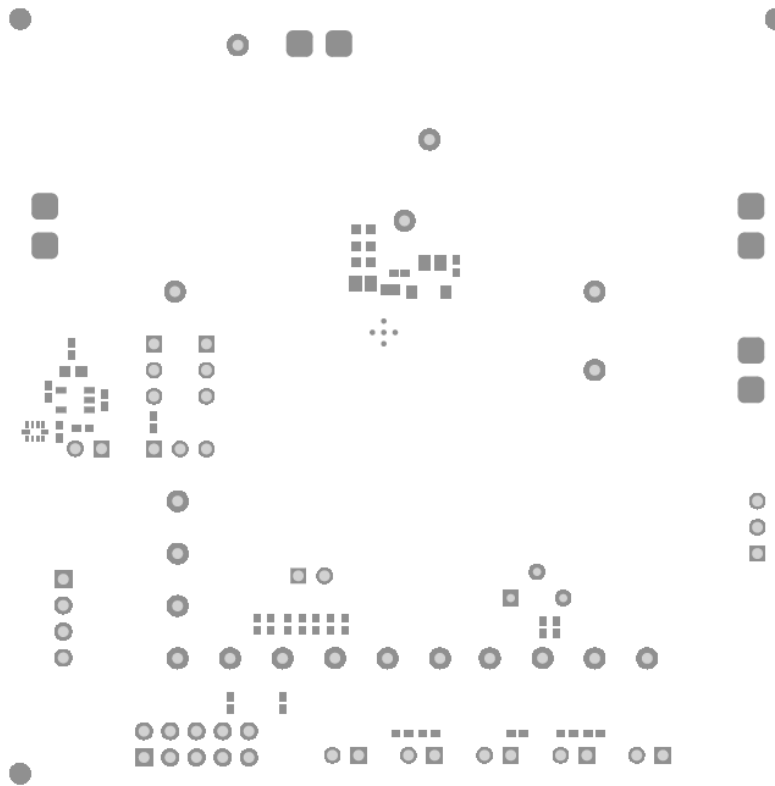


Figure 14. PWR877 Rev. B Bottom Solder Mask

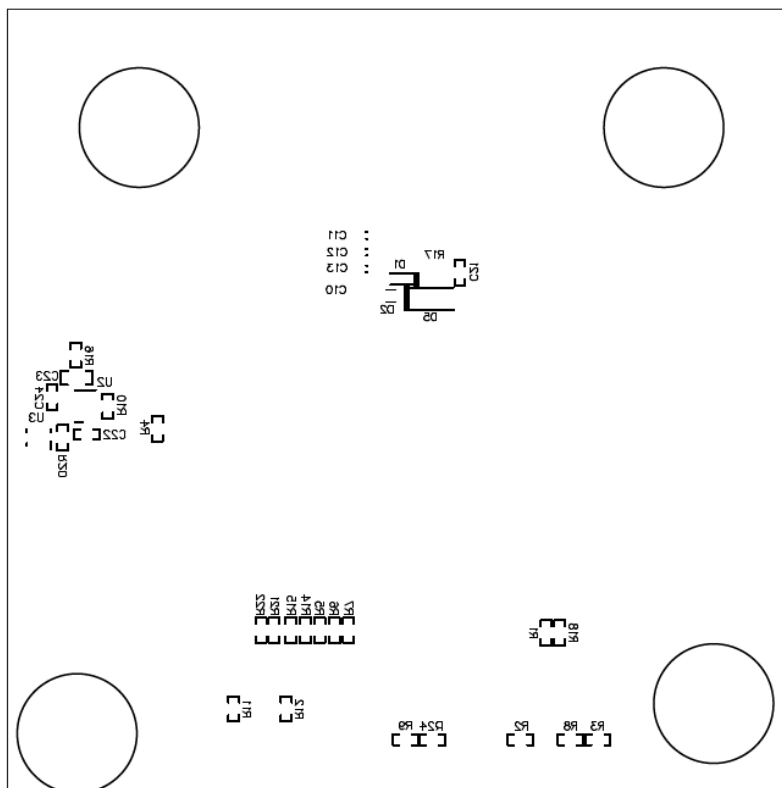


Figure 15. PWR877 Rev. B Bottom Overlay

4.2 Schematics

Figure 16 illustrates the schematic for this BQ25601 EVM.

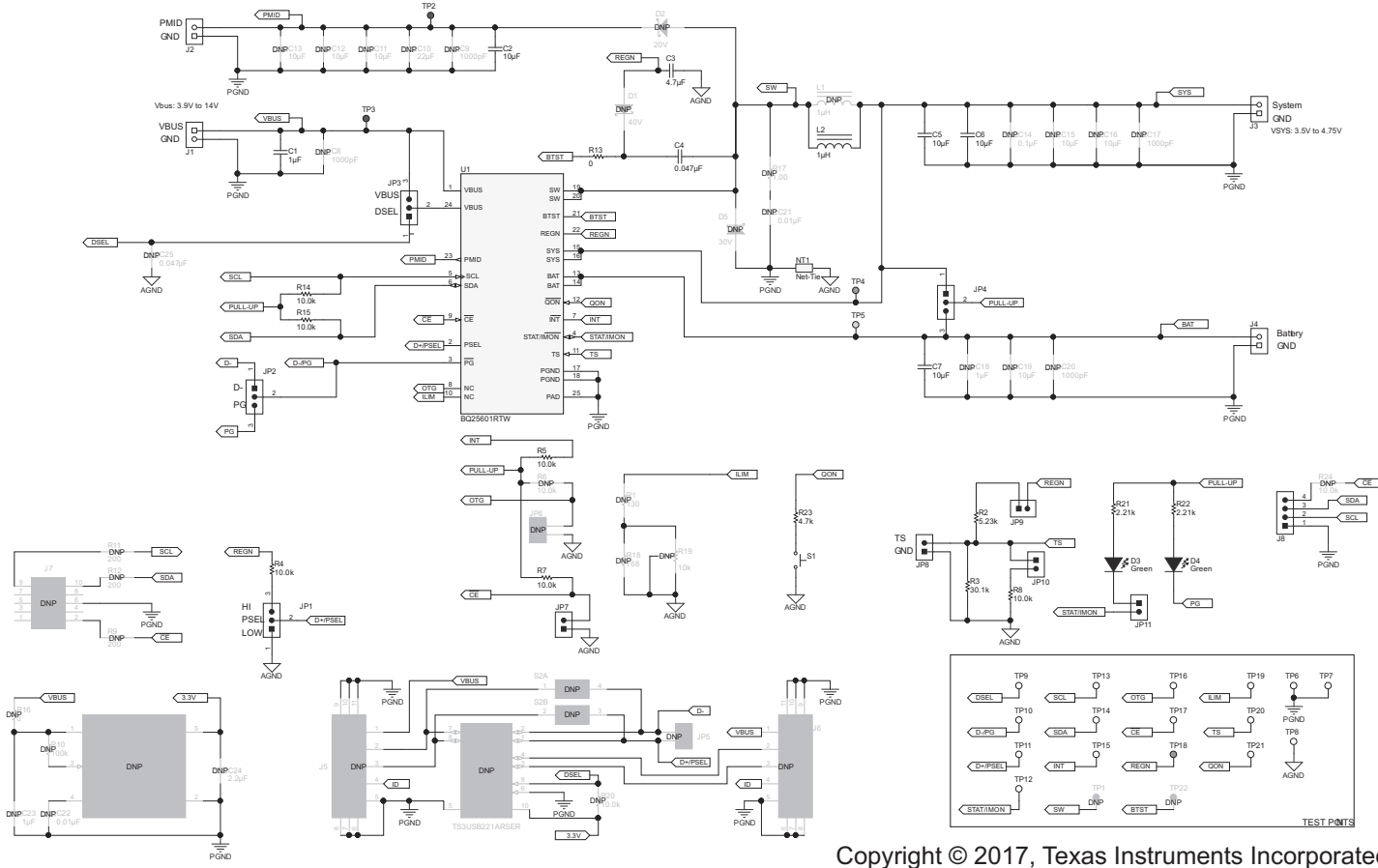


Figure 16. BQ25601EVM-877 Schematic

NOTE: This board is a dual-layout board. For BQ25601, pin 1 is the VAC pin, which is the charger input voltage sense. This pin must be connected to pin 24 (VBUS).

Figure 17 illustrates the schematic for this BQ25601D EVM.

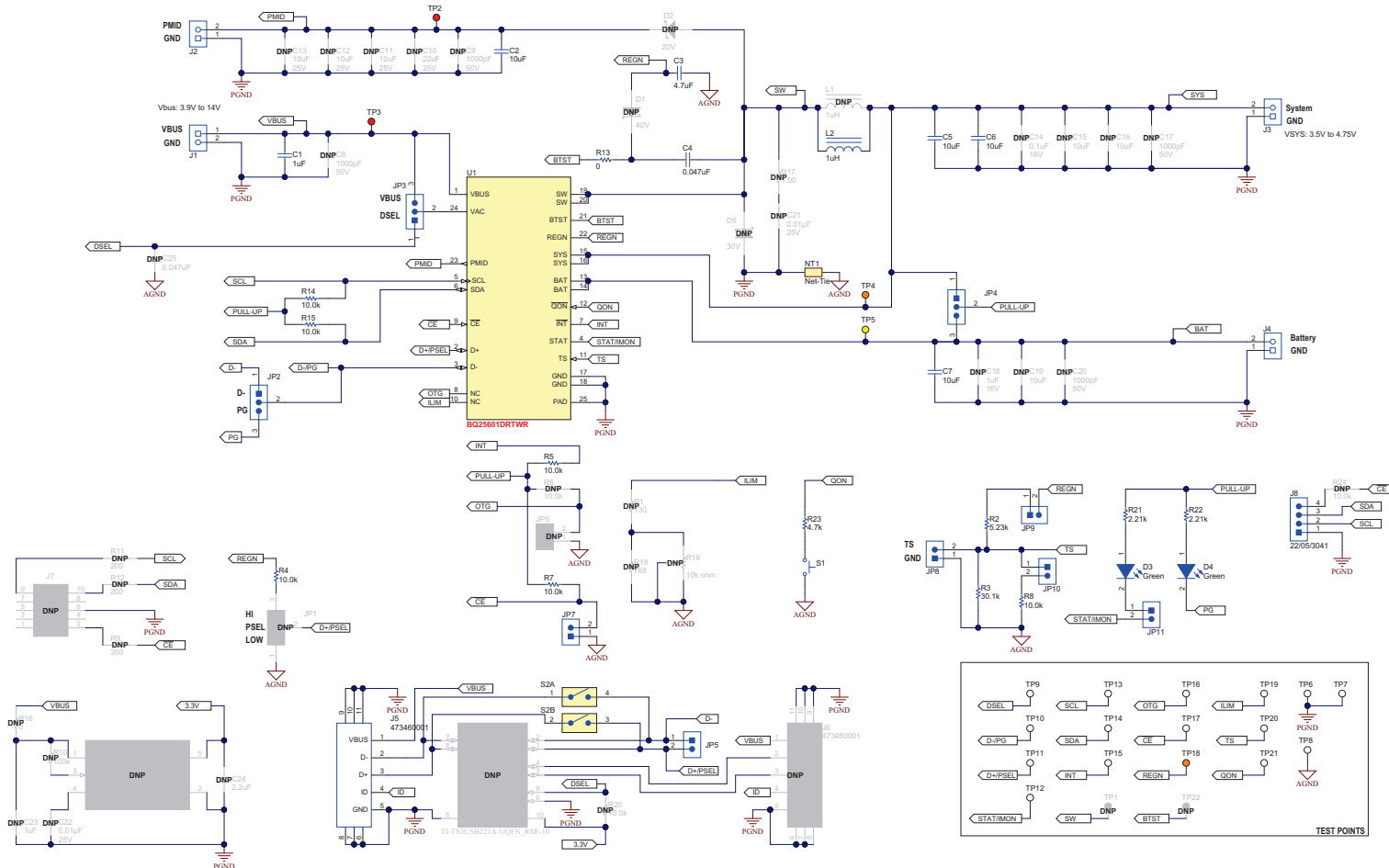


Figure 17. BQ25601DEVM-877 Schematic

4.3 Bill of Materials

Table 5 lists the BQ25601EVM-877 BOM.

Table 5. BQ25601EVM-877 Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
IPCB	1		Printed Circuit Board		BQ25601EVM-877	Any	-	-
C1	1	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0805	0805	GRM219R71E105KA88D	Murata		
C2	1	10uF	CAP, CERM, 10uF, 25V, +/-10%, X5R, 0805	0805	C2012X5R1E106K125AB	TDK		
C3	1	4.7uF	CAP, CERM, 4.7uF, 16V, +/-10%, X5R, 0603	0603	GRM188R61C475KAAJ	Murata		
C4	1	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0402	0402	GRM155R71E473KA88D	Murata		
C5, C6, C7	3	10uF	CAP, CERM, 10 µF, 10 V, +/- 10%, X7R, 0805	0805	GRM21BR71A106KE51L	Murata		
D3, D4	2	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On		
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M		
J1, J2, J3, J4	4	2x1	Conn Term Block, 2POS, 3.81mm, TH	2POS Terminal Block	1727010	Phoenix Contact		
J8	1		Header, 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex		
JP1, JP2, JP3, JP4	4		Header, 100mil, 3x1, Tin plated, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
JP7, JP8, JP9, JP10, JP11	5		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
L2	1	1uH	Inductor, 1 µH, 3.2 A, 0.028 ohm, SMD	2.5x2mm	MPIM252010F1R0M-LF	Microgate		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady	-	-
R2	1	5.23k	RES, 5.23k ohm, 1%, 0.063W, 0402	0402	CRCW04025K23FKED	Vishay-Dale		
R3	1	30.1k	RES, 30.1k ohm, 1%, 0.063W, 0402	0402	CRCW040230K1FKED	Vishay-Dale		
R4, R5, R7, R8, R14, R15	6	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R13	1	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R21, R22	2	2.21k	RES, 2.21k ohm, 1%, 0.063W, 0402	0402	CRCW04022K21FKED	Vishay-Dale		
R23	1	4.7k	RES, 4.7k ohm, 5%, 0.063W, 0402	0402	CRCW04024K70JNED	Vishay-Dale		
S1	1		Switch, Normally open, 2.3N force, 200k operations, SMD	KSR	KSR221GLFS	C and K Components		
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP7, SH-JP9, SH-JP10, SH-JP11	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP2, TP3	2	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone		
TP4, TP18	2	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
TP5	1	Yellow	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone		
TP6, TP7, TP8	3	SMT	Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP19, TP20, TP21	12	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		
U1	1		RTW0024H (WQFN-24)	RTW0024H	BQ25601RTW	Texas Instruments	bq25601RTW	Texas Instruments
C8, C9, C17, C20	0	1000pF	CAP, CERM, 1000pF, 25V, +/-5%, C0G/NP0, 0402	0402	C1005C0G1E102J	TDK		
C10	0	22uF	CAP, CERM, 22 µF, 25 V, +/- 20%, X5R, 0805	0805	GRM21BR61E226ME44	Murata		
C11, C12, C13	0	10uF	CAP, CERM, 10uF, 25V, +/-20%, X5R, 0603	0603	GRM188R61E106MA73	Murata		

Table 5. BQ25601EVM-877 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
C14	0	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X7R, 0603	0603	C1608X7R1C104K	TDK		
C15, C16, C19	0	10uF	CAP, CERM, 10 uF, 10 V, +/- 10%, X7R, 0805	0805	GRM21BR71A106KE51L	Murata		
C18	0	1uF	CAP, CERM, 1uF, 16V, +/-10%, X7R, 0603	0603	C1608X7R1C105K	TDK		
C21, C22	0	0.01uF	CAP, CERM, 0.01uF, 25V, +/-10%, X7R, 0402	0402	C1005X7R1E103K	TDK		
C23	0	1uF	CAP, CERM, 1uF, 25V, +/-10%, X7R, 0603	0603	C1608X7R1E105K080AB	TDK		
C24	0	2.2uF	CAP, CERM, 2.2uF, 10V, +/-10%, X5R, 0402	0402	C1005X5R1A225K050BC	TDK		
C25	0	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0402	0402	GRM155R71E473KA88D	Murata		
D1	0	40V	Diode, Schottky, 40V, 0.38A, SOD-523	SOD-523	ZLLS350TA	Diodes Inc.		
D2	0	20V	Diode, Schottky, 20 V, 1 A, 1.4x0.6x0.31mm	1.4x0.6x0.31mm	NSR10F20NXT5G	ON Semiconductor		
D5	0	30V	Diode, Schottky, 30 V, 1 A, SOD-123	SOD-123	B130LAW-7-F	Diodes Inc.		
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
J5, J6	0		Connector, Receptacle, Micro-USB Type B, R/A, Bottom Mount SMT	7.5x2.45x5mm	0473460001	Molex		
J7	0		Header (shrouded), 100mil, 5x2, High-Temperature, Gold, TH	5x2 Shrouded header	N2510-6002-RB	3M		
JP5, JP6	0		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
L1	0	1uH	Inductor, Wirewound, 1 uH, 4 A, 0.041 ohm, SMD	4.06x4.06mm	74437321010	Würth Elektronik		
R1	0	130	RES, 130 ohm, 1%, 0.063W, 0402	0402	CRCW0402130RFKED	Vishay-Dale		
R6, R20, R24	0	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R9, R11, R12	0	200	RES, 200 ohm, 1%, 0.063W, 0402	0402	CRCW0402200RFKED	Vishay-Dale		
R10	0	100k	RES, 100k ohm, 1%, 0.063W, 0402	0402	CRCW0402100KFKED	Vishay-Dale		
R16	0	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R17	0	1.00	RES, 1.00 ohm, 1%, 0.125W, 0805	0805	CRCW08051R00FKEA	Vishay-Dale		
R18	0	768	RES, 768 ohm, 1%, 0.063W, 0402	0402	CRCW0402768RFKED	Vishay-Dale		
R19	0	10k	Trimmer, 10k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-103LF	Bourns		
S2	0		DIP Switch, SPST, 2Pos, Slide, SMT	SW, 4.7x1.45x3mm	CVS-02TB	Copal Electronics		
SH-JP5, SH-JP6, SH-JP8	0	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP22	0	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
U2	0		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator in SOT-23 Package, DBV0005A	DBV0005A	LP2985AIM5-3.3/NOPB	Texas Instruments		None
U3	0		ESD Protected, High-Speed USB 2.0 (480-Mbps) 1:2 Multiplexer / Demultiplexer Switch, 1:2 Mux / Demux, 6 ohm RON, 2.5 to 3.3V, -40 to 85 degC, 10-Pin UQFN (RSE), Green (RoHS & no Sb/Br)	RSE0010A	TS3USB221ARSER	Texas Instruments	Equivalent	None
Notes:			Unless otherwise noted in the Alternate Part Number or Alternate Manufacturer columns, all parts may be substituted with equivalents.					

Table 6 lists the BQ25601DEVM-877 BOM.

Table 6. BQ25601DEVM-877 Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		BQ25601DEVM-877	Any	-	-
C1	1	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0805	0805	GRM219R71E105KA88D	MuRata		
C2	1	10uF	CAP, CERM, 10uF, 25V, +/-10%, X5R, 0805	0805	C2012X5R1E106K125AB	TDK		
C3	1	4.7uF	CAP, CERM, 4.7uF, 16V, +/-10%, X5R, 0603	0603	GRM188R61C475KAAJ	MuRata		
C4	1	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0402	0402	GRM155R71E473KA88D	MuRata		
C5, C6, C7	3	10uF	CAP, CERM, 10 µF, 10 V, +/- 10%, X7R, 0805	0805	GRM21BR71A106KE51L	MuRata		
D3, D4	2	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On		
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M		
J1, J2, J3, J4	4	2x1	Conn Term Block, 2POS, 3.81mm, TH	2POS Terminal Block	1727010	Phoenix Contact		
J5	1		Connector, Receptacle, Micro-USB Type B, R/A, Bottom Mount SMT	7.5x2.45x5mm	0473460001	Molex		
J8	1		Header, 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex		
JP1, JP2, JP3, JP4	4		Header, 100mil, 3x1, Tin plated, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
JP5, JP7, JP8, JP9, JP10, JP11	6		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
L2	1	1uH	Inductor, 1 µH, 3.2 A, 0.028 ohm, SMD	2.5x2mm	MPIM252010F1R0M-LF	Microgate		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650" x 0.200"W	THT-14-423-10	Brady	-	-
R2	1	5.23k	RES, 5.23k ohm, 1%, 0.063W, 0402	0402	CRCW04025K23FKED	Vishay-Dale		
R3	1	30.1k	RES, 30.1k ohm, 1%, 0.063W, 0402	0402	CRCW040230K1FKED	Vishay-Dale		
R4, R5, R7, R8, R14, R15	6	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R13	1	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale		
R21, R22	2	2.21k	RES, 2.21k ohm, 1%, 0.063W, 0402	0402	CRCW04022K21FKED	Vishay-Dale		
R23	1	4.7k	RES, 4.7k ohm, 5%, 0.063W, 0402	0402	CRCW04024K70JNED	Vishay-Dale		
S1	1		Switch, Normally open, 2.3N force, 200k operations, SMD	KSR	KSR221GLFS	C and K Components		
S2	1		DIP Switch, SPST, 2Pos, Slide, SMT	SW, 4.7x1.45x3mm	CVS-02TB	Copal Electronics		
SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP7, SH-JP9, SH-JP10, SH-JP11	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP2, TP3	2	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone		
TP4, TP18	2	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
TP5	1	Yellow	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone		
TP6, TP7, TP8	3	SMT	Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP19, TP20, TP21	12	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		
C8, C9, C17, C20	0	1000pF	CAP, CERM, 1000pF, 25V, +/-5%, C0G/NP0, 0402	0402	C1005C0G1E102J	TDK		
C10	0	22uF	CAP, CERM, 22 µF, 25 V, +/- 20%, X5R, 0805	0805	GRM21BR61E226ME44	MuRata		

Table 6. BQ25601DEVM-877 Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
C11, C12, C13	0	10uF	CAP, CERM, 10uF, 25V, +/-20%, X5R, 0603	0603	GRM188R61E106MA73	MuRata		
C14	0	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X7R, 0603	0603	C1608X7R1C104K	TDK		
C15, C16, C19	0	10uF	CAP, CERM, 10 uF, 10 V, +/- 10%, X7R, 0805	0805	GRM21BR71A106KE51L	MuRata		
C18	0	1uF	CAP, CERM, 1uF, 16V, +/-10%, X7R, 0603	0603	C1608X7R1C105K	TDK		
C21, C22	0	0.01uF	CAP, CERM, 0.01uF, 25V, +/-10%, X7R, 0402	0402	C1005X7R1E103K	TDK		
C23	0	1uF	CAP, CERM, 1uF, 25V, +/-10%, X7R, 0603	0603	C1608X7R1E105K080AB	TDK		
C24	0	2.2uF	CAP, CERM, 2.2uF, 10V, +/-10%, X5R, 0402	0402	C1005X5R1A225K050BC	TDK		
C25	0	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0402	0402	GRM155R71E473KA88D	MuRata		
D1	0	40V	Diode, Schottky, 40V, 0.38A, SOD-523	SOD-523	ZLLS350TA	Diodes Inc.		
D2	0	20V	Diode, Schottky, 20 V, 1 A, 1.4x0.6x0.31mm	1.4x0.6x0.31mm	NSR10F20NXT5G	ON Semiconductor		
D5	0	30V	Diode, Schottky, 30 V, 1 A, SOD-123	SOD-123	B130LAW-7-F	Diodes Inc.		
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
J6	0		Connector, Receptacle, Micro-USB Type B, R/A, Bottom Mount SMT	7.5x2.45x5mm	0473460001	Molex		
J7	0		Header (shrouded), 100mil, 5x2, High-Temperature, Gold, TH	5x2 Shrouded header	N2510-6002-RB	3M		
JP6	0		Header, 100mil, 2x1, Tin plated, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
L1	0	1uH	Inductor, Wirewound, 1 uH, 4 A, 0.041 ohm, SMD	4.06x4.06mm	74437321010	Würth Elektronik		
R1	0	130	RES, 130 ohm, 1%, 0.063W, 0402	0402	CRCW0402130RFKED	Vishay-Dale		
R6, R20, R24	0	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale		
R9, R11, R12	0	200	RES, 200 ohm, 1%, 0.063W, 0402	0402	CRCW0402200RFKED	Vishay-Dale		
R10	0	100k	RES, 100k ohm, 1%, 0.063W, 0402	0402	CRCW0402100KFKED	Vishay-Dale		
R16	0	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW0402000Z0ED	Vishay-Dale		
R17	0	1.00	RES, 1.00 ohm, 1%, 0.125W, 0805	0805	CRCW08051R00FKEA	Vishay-Dale		
R18	0	768	RES, 768 ohm, 1%, 0.063W, 0402	0402	CRCW0402768RFKED	Vishay-Dale		
R19	0	10k	Trimmer, 10k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-103LF	Bourns		
SH-JP1, SH-JP6, SH-JP8	0	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP22	0	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
U1	0		I2C Controlled 3-A, Single-Cell Battery Charger for High Input Voltage and NVDC Power Path Management, RTW0024H (WQFN-24)	RTW0024H	BQ25601RTWR	Texas Instruments	BQ25601RTWT	Texas Instruments
U2	0		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator in SOT-23 Package, DBV0005A	DBV0005A	LP2985AIM5-3.3/NOPB	Texas Instruments		None
U3	0		ESD Protected, High-Speed USB 2.0 (480-Mbps) 1:2 Multiplexer / Demultiplexer Switch, 1:2 Mux / Demux, 6 ohm RON, 2.5 to 3.3V, -40 to 85 degC, 10-Pin UQFN (RSE), Green (RoHS and no Sb/Br)	RSE0010A	TS3USB221ARSER	Texas Instruments	Equivalent	None
Notes:			Unless otherwise noted in the Alternate PartNumber and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.					

Revision History

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

Changes from Original (April 2017) to A Revision	Page
• Changed Figure 8	11
• Added Figure 17	16
• Added Table 6	19

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.
 - 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 semiconductor 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 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 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/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 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.

【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/lstds/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/lstds/ti_ja/general/eStore/notice_02.page

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:*

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