User's Guide

SLUUAO5B–August 2013–Revised April 2014

bq24295EVM-549 (PWR549) User's Guide

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1 Introduction

1.1 EVM Features

Refer to the data sheet (SLUSBC1) for detailed features and operation.

1.2 Design Considerations

1. Install the JP1 shunt for proper operation.
2. Disable the watchdog timer if not using the **WDG Timer Reset** button (illustrated in Figure 4), so the programmed setting does not reset.
3. The GUI STATUS and FAULT block are helpful in troubleshooting, if the design is having issues.
4. In Boost mode, if not using a battery or power supply with short leads, extra capacitance at J5 (BAT/GND) may be needed.
5. The *OTG Low* box has to be unchecked and the *Enable OTG* box must be checked to get into Boost mode.
6. PWB thickness affects the “On-the-GO” (OTG) Boost Output regulation at load currents over 0.75 A. An evaluation was performed using different thicknesses of PCBs with the Load Regulation results shown in Figure 1.
   TI recommends using a 4-layer PCB constructed with two 15-mil, 2-oz Cu/layer boards fixed together, for a total thickness of 31 mils. The 4-layer PCB, has a stack up of a component/routing layer, GND layer, routing layer and a GND layer. A second choice is a 2-layer, 24-mil PCB, or thinner, with a component/routing layer and a GND plane layer. The bq24295EVM-549 REV B EVM is built on a 24-mil thick PCB.

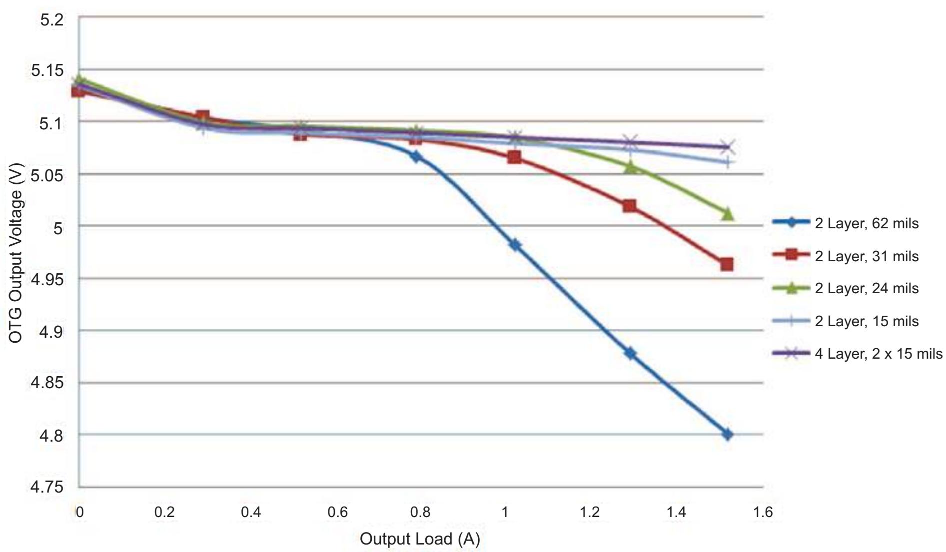

Figure 1. OTG Boost Mode 5-V Output Load Regulation Versus PCB Layer Thickness - Default Setting

1.3 General Descriptions

The bq24295 evaluation module is a complete charger module for evaluating an I^{2}C Controlled single NVDC-1 charge using the bq2419x devices. For details, see bq24295 data sheet (SLUSBC1).

The bq24295 EVM doesn’t include the USB-to-GPIO interface board. To evaluate the bq24295 EVM, the USB-to-GPIO interface board must be ordered separately. Search ti.com for "USB-to-GPIO".

1.4 I/O Description

Table 1 contains the EVM connections.

Table 1. EVM Connections

Jack	Description
J1-PMID	PMID pin connection or power bank output
J1-GND	Ground
J2-V_{BUS}	Input: positive terminal
J2-GND	Input: negative terminal (ground terminal)
J3-SYS	Connected to system
J3-GND	Ground
J4	USB-to-GPIO connector (USB Interface Adapter Connector - HPA172)
J5-BAT+	Connected to battery pack
J5-GND	Ground
J6	Mini_USB connector
J7-INT	INT pin connection
J7-OTG	OTG pin connection
J7-$\overline{CE}$	$\overline{CE}$ pin connection
J7-GND	Ground

Table 2 lists the jumper connections for this EVM.

Table 2. Jumper Connections

Jack	Description	Factory Setting
JP1	VSYS pull-up for STAT, PG, INT, CE, SCL, SDA	Shunt installed
JP2	200-Ω short between D+ and D–	Shunt not installed
JP3	TS1 to GND fault	Shunt not installed

Table 3 lists the switch settings for the EVM.

Table 3. Switch Settings

Switch	Description	Procedure Setting
S2-1	OTG switched to GND: ON	OFF
S2-2	CE switched to GND: ON	OFF
S2-3	TS 10 kΩ switched to GND: ON	ON
S2-4	REGN switched to TS divider: ON	ON
S3	PSEL/PG (left) or D+/D– (Right) Connection	Right

Table 4 gives the recommended operating conditions for this EVM.

Table 4. Recommended Operating Conditions

Symbol	Description	MIN	TYP	MAX	Unit
Supply voltage, V_{IN}	Input voltage from AC adapter input	3.9	5	6	V
Battery voltage, V_{BAT}	Voltage applied at V_{BAT} terminal		3.7	4.25	V
Supply current, I_{AC}	Maximum input current from AC adapter input			3	A
Output current, I_{OUT}	Output current			4	A
Operating junction temperature range, T_J		0		125	°C

2 Test Summary

Section 2.1 – Section 2.3 explains the equipment, the equipment setup, and the test procedures.

2.1 Equipment

2.1.1 Power Supplies

Power supply #1 (PS#1): a power supply capable of supplying 5 V at 1 A is required. While this part can handle a larger voltage and/or current, it is not necessary for this procedure.

2.1.2 Load #1 (Electronic Load, Constant Voltage < 4.5 V) - Battery Connection

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)

Or:

Real single-cell battery

2.1.3 Load #2 – Use with Boost Mode

PMID-to-GND load, 10 Ω, 5 W or greater

2.1.4 Meters

Five Fluke 75 multimeters, (equivalent or better)

Or:

Three equivalent voltage meters and two equivalent current meters.

The current meters must be capable of measuring 2 A of current.

2.1.5 Computer

A computer with at least one USB port and a USB cable. The bq2429xEVM evaluation software must be properly installed.

2.1.6 USB-to-GPIO Communication Kit (HPA172-USB Interface Adapter)

2.1.7 Software

Unzip the bq2429xEVM_GUI.zip and double-click on the *SETUP.EXE* file. Follow the installation steps. The software supports the Microsoft® Windows® XP and Windows 7 operating systems.

2.2 Equipment Setup

(A) Set PS#1 for 5-V DC, 1-A current limit and then turn off the supply.

(B) Connect the output of PS#1 in series with a current meter (multimeter) to J2 (VBUS and GND), as shown in Figure 3.

(C) Connect a voltage meter across J2 (VBUS) and J2 (GND).

(D) Turn on the electron Load, set to constant voltage mode and output to 2.5 V. Turn off (disable) Load. Connect Load to J5 (BAT+ and GND) as shown in Figure 3, via a current meter in the return line of the load. Connect a voltage meter across J5 (BAT+ and GND).

(E) Connect a voltage meter across J3 (SYS and GND).

(F) Connect HPA172 USB interface adapter to the computer with a USB mini-cable and to J4 with the 10-pin ribbon cable. The connections are shown in Figure 2.

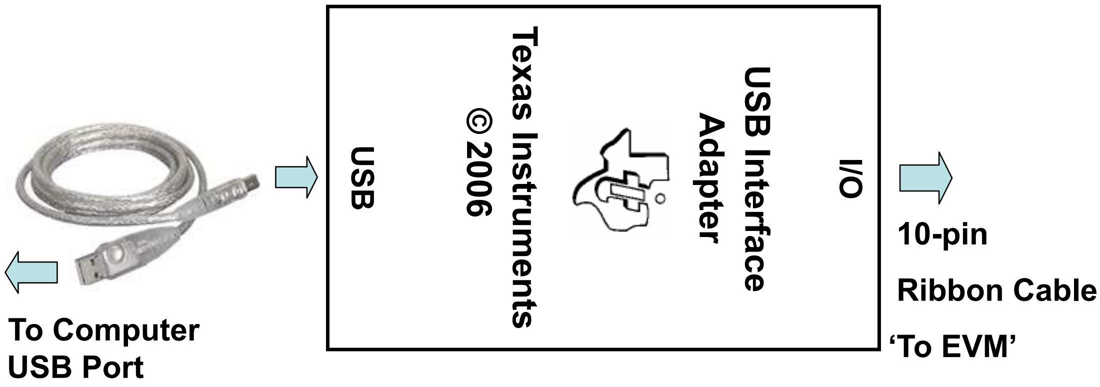

Figure 2. Connections of the HPA172 Kit

(G) Install jumpers as per Table 2.

(H) Set S2 toggle bits as per Table 3, procedure setting column.

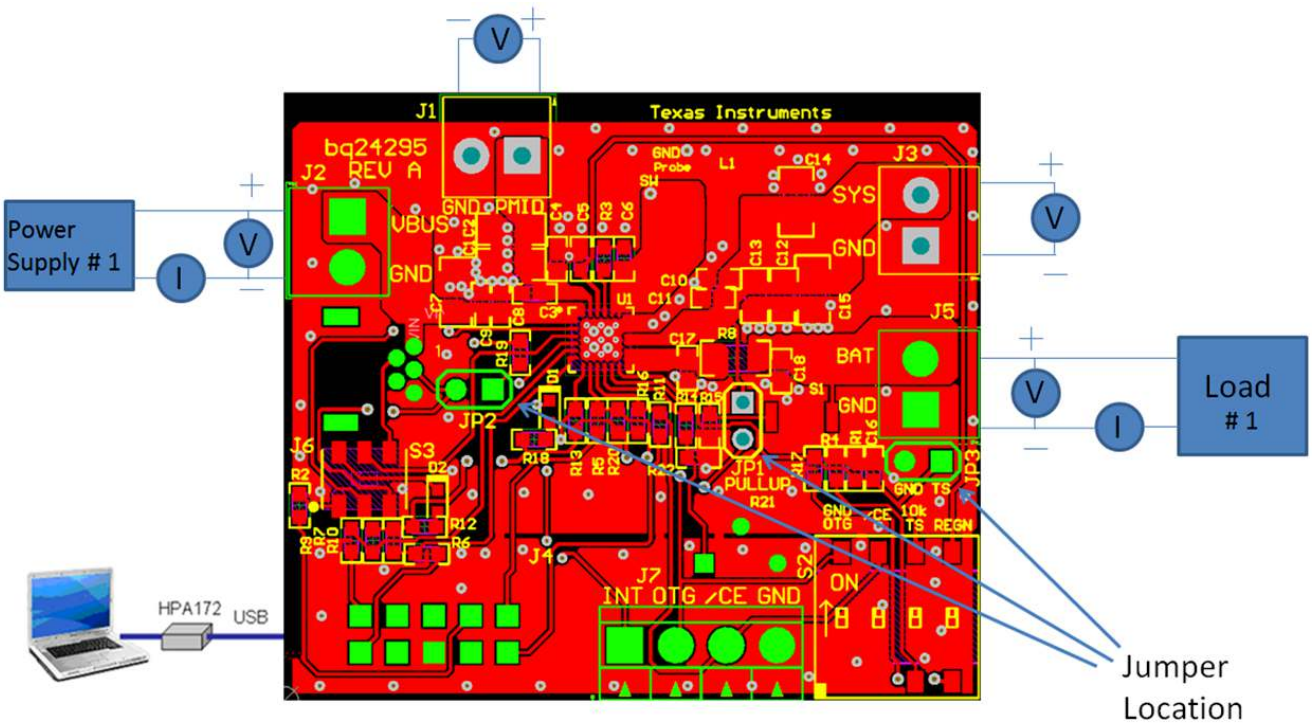

Figure 3. Original Test Setup for PWR549 (bq24295 EVM)

(I) Turn on the computer. Launch the bq2429x evaluation software. The main window of the software is shown in Figure 4.

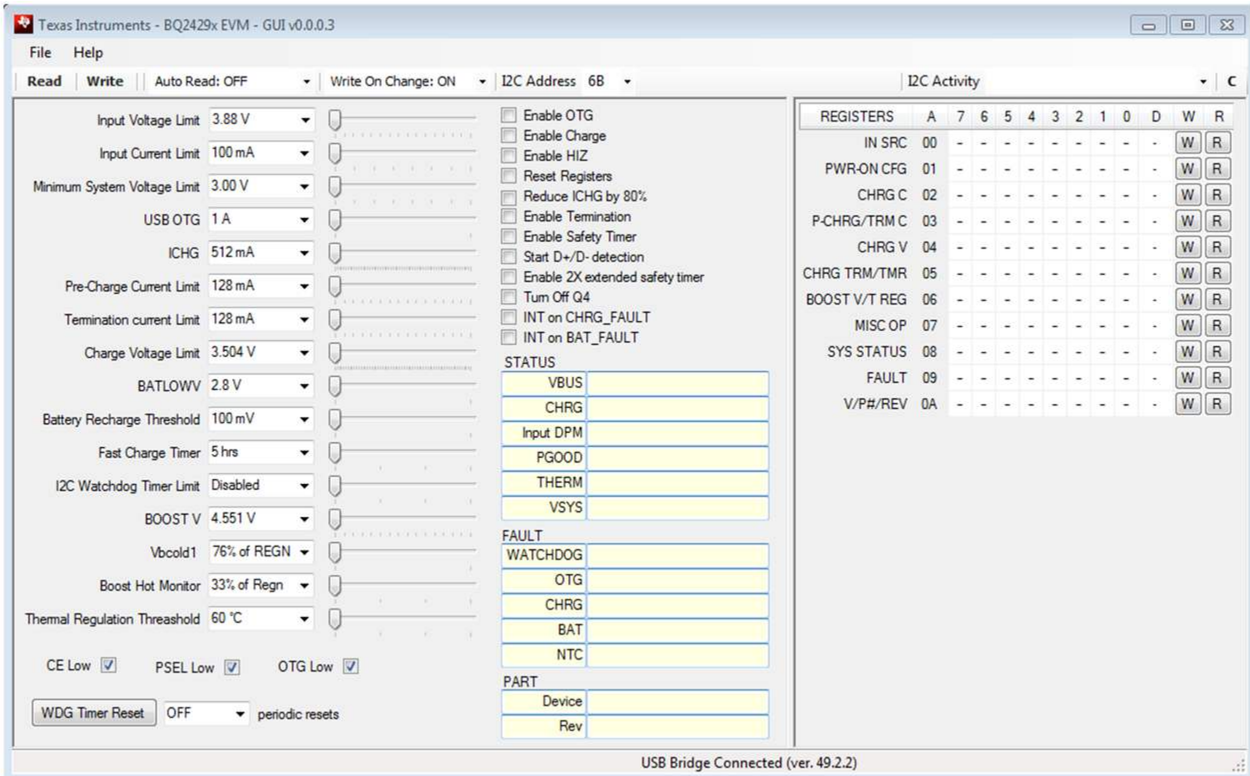

Figure 4. Main Window of the bq2429x Evaluation Software

2.3 Procedure

2.3.1 Current Settings

Make sure EQUIPMENT SETUP steps are followed.

1. **ILIM** Setting: Set the potentiometer to its lowest value for max input current. Turn the screw on the potentiometer counterclockwise (Pot should make click sound when fully CCW).
2. Launch BQ2429x EVM GUI application on computer, if not already done.
3. Turn on PS#1
   Measure → V (J3(SYS), J3(GND)) = 4.10 ±300 mV

2.4 Charge Voltage and Current Regulation of VIN and Device ID Verification

2.4.1 Software setup (all of these steps are done in the GUI):

- Device address: 6B

- Click the **Read** button two times, one second apart
- Select *Disabled* for *I2C Watchdog Timer Limit*
- Set *Input Voltage Limit* to 4.2 V
- Set *Input Current Limit* to 500 mA
- Set *Charge Voltage Limit* to 4.208 V
- Set Fast Charge Current, *ICHG* to 512 mA

- Set *Pre-Charge Current Limit* to 256 mA
- Un-Check *Enable Termination* (see Figure 5)

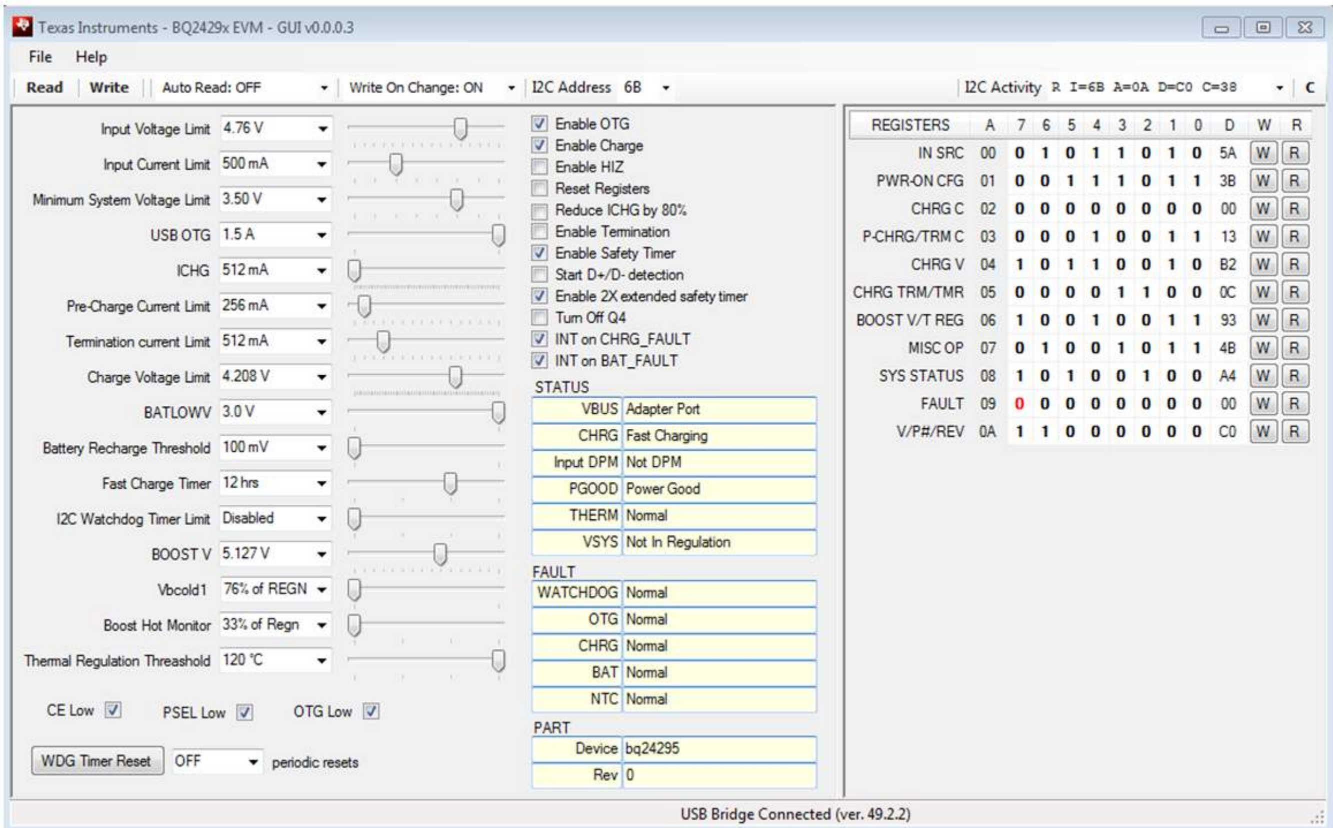

Figure 5. Main Window with Enable Termination Unchecked

- Click the **Read** button three times, one second apart
  Observe → Everything normal at *FAULT* box
  Observe → D1 (STAT) is on

Enable Load #1 from Section 2.1.2. Measure the system and battery voltage.

Measure → V(J3(SYS), J3(GND)) = 3.5 V ±300 mV

Measure → V(J5(BAT), J5(GND)) = 2.5 V ±200 mV

Increase the Load #1 voltage to 3.7 V.

Measure → V(J3(SYS), J3(GND)) = 3.75 V ±200 mV

Measure → IBAT = 500 mA ±200 mA

Measure → V(J5(BAT), J5(GND)) = 3.75 V ±200 mV

In the Software, Select Fast Charge Current, "ICHG" to 1024 mA.

Measure → Iin = 500 mA ±200 mA

2.4.2 Verify the device ID and JEITA shown in the software matches the following table:

Assy Number	EVM Part Number	Device ID	JEITA
PWR549-001	bq24295EVM-549	bq24295	Disabled

2.4.3 Verify Scope Measurements (see Figure 6 through Figure 8 – 500 ns/div):

Connect scope probe ground lead to Ground J1-GND (make sure lead is short), probe and verify the following waveforms, as shown in Figure 6 through Figure 8.

Figure 6) Buck Mode Switch Node Waveform - (2 VDC/div): TP left of inductor L1

Figure 7) Buck Mode Input PMID Ripple - (AC coupled 20 mV/div): Right side of C2 Cap

Figure 8) Buck Mode Output System Ripple – (AC coupled 50 mV/div): top side of C12 cap

Measure → Figure 6 – SW node Frequency between 1.25 MHz and 1.6 MHz,

Measure → Figure 6 – SW node Duty cycle between 71 and 81%.

Measure → Figure 7 - PMID AC Ripple < 15 mV excluding high frequency spikes

Measure → Figure 8 - SYS AC Ripple < 10 mV excluding high frequency spikes

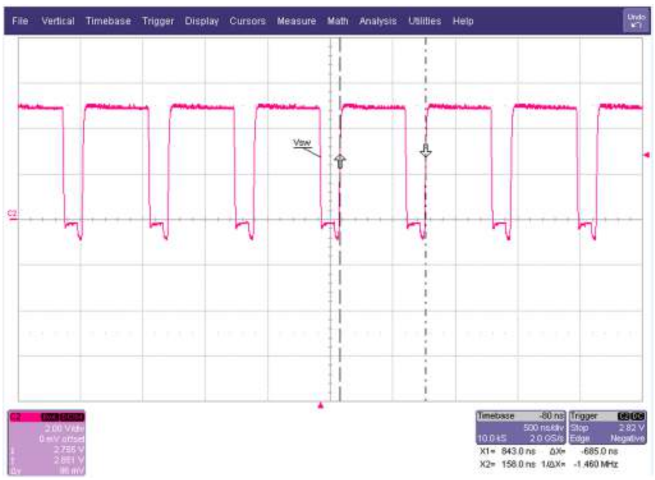

Figure 6. Buck Mode Switch Node Waveform, VBUS = 5 V, VBAT = 3.7 V

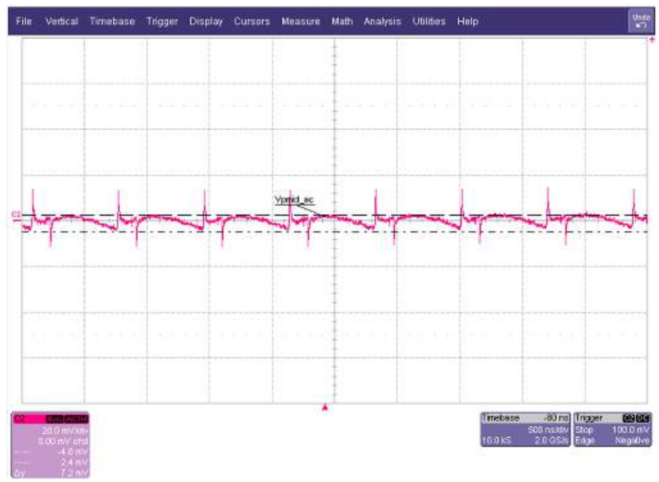

Figure 7. Buck Mode Input PMID Ripple, VBUS = 5 V, VBAT = 3.7 V

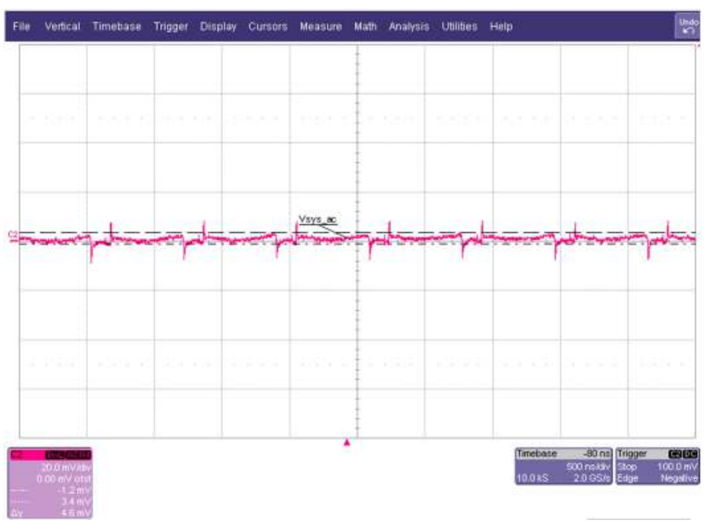

Figure 8. Buck Mode Output Ripple, VBUS = 5 V, VBAT = 3.7 V

2.4.4 Verify Device ID Using GUI Software and Table 5.

Table 5. Device ID

Assembly Number	EVM Part Number	Device ID
PWR549-001	bq24295EVM-549	bq24295

2.4.5 Switch to Boost Mode

1. Turn off and disconnect PS#1. May be used in step 2, if needed.
2. Move the voltmeter from J2 (VBUS/GND) to J1 (PMID/GND).
3. If the constant voltage supply connected between BAT+ and GND, from above, is not a 4 quadrant supply (can source current) then this needs to be replaced with a power source set to 3.7 VDC that can source current. Connect new power source, if necessary, that is set to 3.7 V and turn on.
4. Apply 10 ohms (5 W or greater) across J1 (PMID(+) to GND(–))
5. Click the GUI read button two times to make sure the latest data is read.
6. Disable the “I2C watchdog timer Limit” if set to a time.
7. Uncheck the “Enable Charge” Box if checked.
8. Uncheck the “OTG Low” box in the GUI.
9. Check the “Enable OTG” if un-checked.
10. Verify switch node waveform
11. Verify PMID to GND on J1 is between 4.9 V and 5.3 V (See Figure 9).

CH2 (5 V/div): SW Node – (Left Side of inductor to GND)

Measure → SW Frequency (TP2) - Frequency between 1.1 MHz and 1.5 MHz, (Period = 1 / f_{sw})

Measure → SW Duty cycle (TP2) - Duty cycle between 26 and 33%. (tV_{SW_LOW} / period)

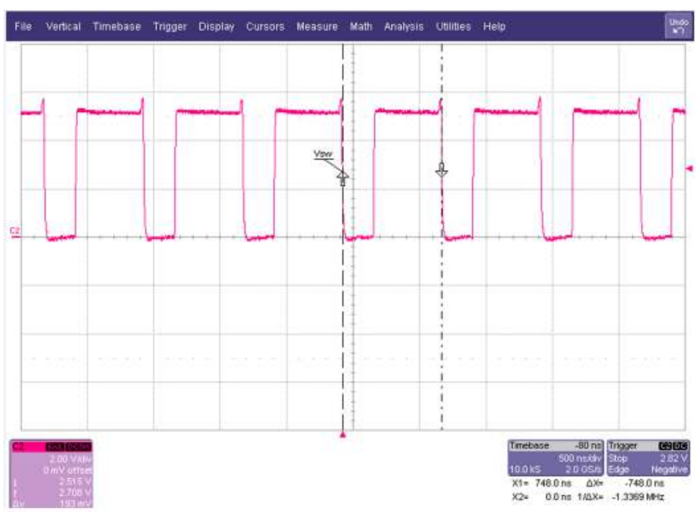

Figure 9. Boost Mode Ripple and Duty Cycle; VBAT = 3.7 V

2.4.6 Turn off Power Source connected to BAT+ and GND.

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 and GND pin connections and use the shortest possible 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 SCBA017 and SLUA271.

4 PCB Thermal Design

The IC is one of the major heat dissipation components on the EVM, and is cooled with thermal PowerPAD vias connected to the bottom layer. The copper pour on the bottom layer is 1 in x 2 in representing a thermal design of this size. Note how there are very few routing etches in the bottom layer and that they are positioned to maximize (not impede) the flow of heat away from the IC. All good thermal designs have at least one layer of 2-oz copper (without cuts) to spread the heat (conduction) across the PCB so it can be dissipated into the air (convection) with minimal heat rise.

5 Board Layout, Schematic, and Bill of Materials

5.1 Board Layout

Figure 10 through Figure 12 illustrate the board layouts for this EVM.

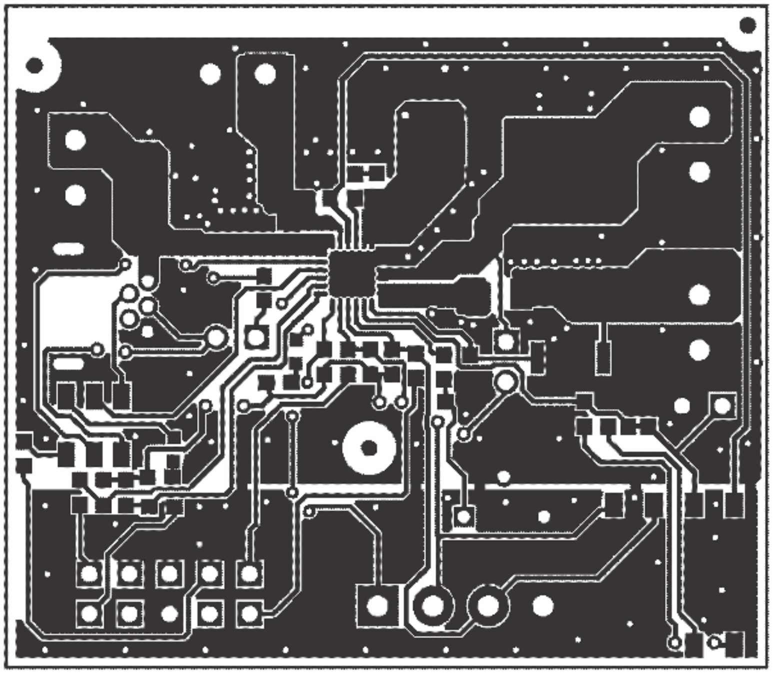

Figure 10. bq24295 EVM Top Layer

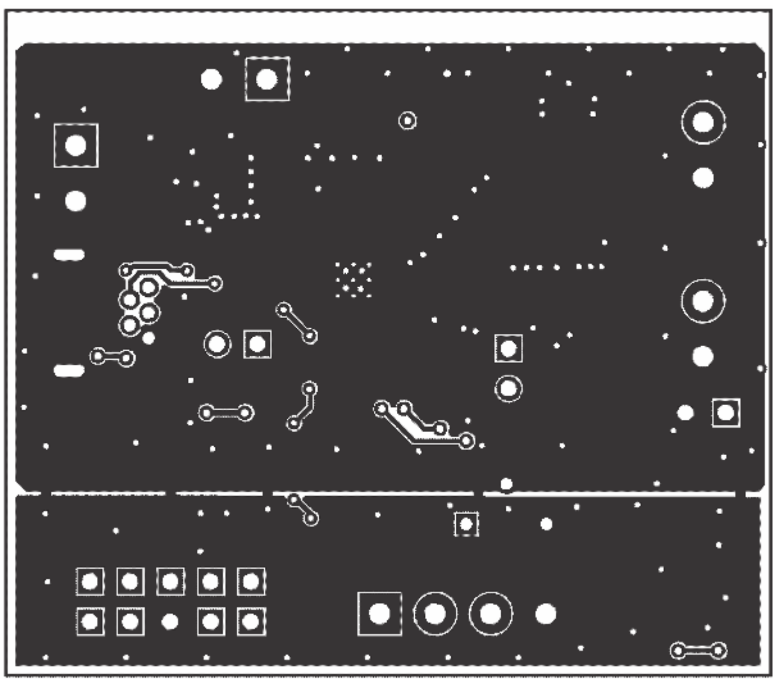

Figure 11. bq24295 EVM Bottom Layer

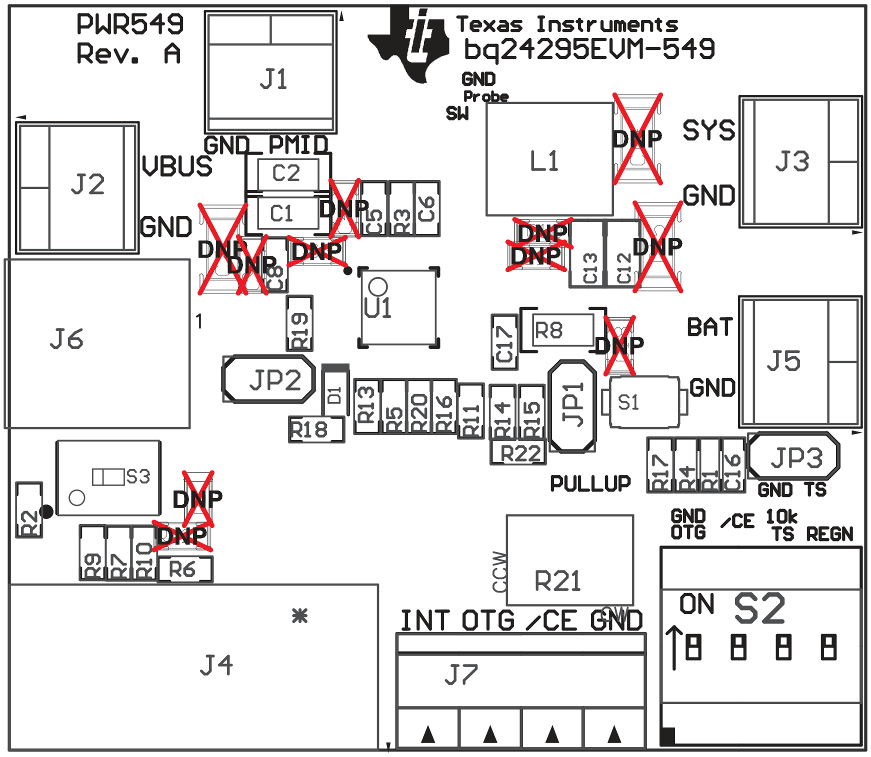

Figure 12. bq24295 EVM Top Assembly

5.2 Schematic

Figure 13 illustrates the schematic for this EVM.

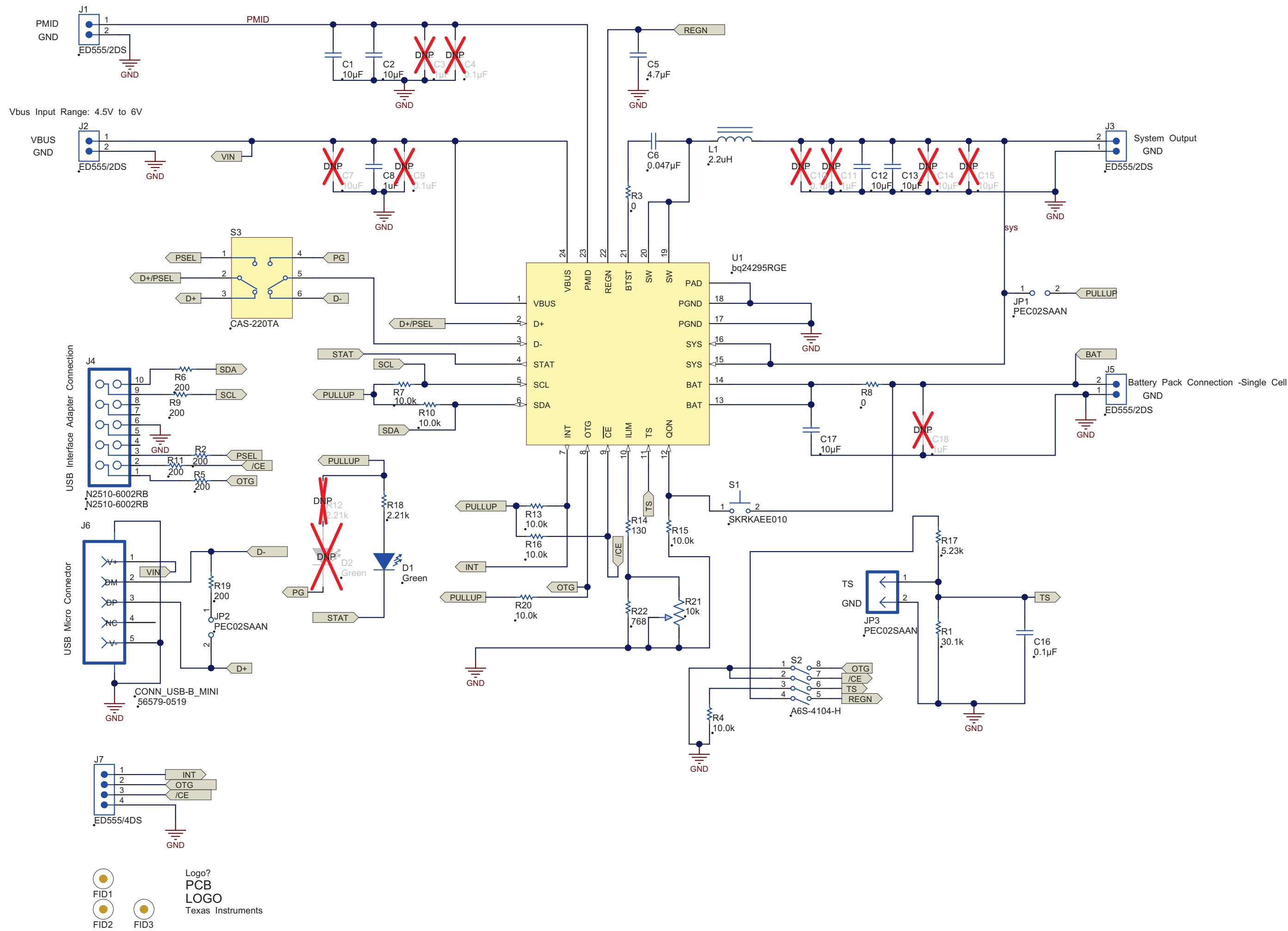

Figure 13. bq24295 EVM Schematic

Bill of Materials

Table 6 contains the bill of materials.

Table 6. Bill of Materials

Designator	Qty	Value	Description	PackageReference	PartNumber	Manufacturer
C1, C2	2	10uF	CAP, CERM, 10uF, 25V, +/-10%, X5R, 1206	1206	GRM31CR61E106KA12L	MuRata
C5	1	4.7uF	CAP, CERM, 4.7uF, 16V, +/-10%, X5R, 0603	0603	GRM188R61C475KAAJ	MuRata
C6	1	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E473KA01D	MuRata
C8	1	1uF	CAP, CERM, 1uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E105KA12D	MuRata
C12, C13	2	10uF	CAP, CERM, 10uF, 16V, +/-10%, X5R, 0805	0805	GRM21BR61C106KE15L	MuRata
C16	1	0.1uF	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E104KA01D	MuRata
C17	1	10uF	CAP, CERM, 10uF, 10V, +/-10%, X5R, 0603	0603	C1608X5R1A106M	TDK
D1	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
J1, J2, J3, J5	4		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology, Inc.
J4	1	N2510-6002RB	Connector, Male Straight 2x5 pin, 100mil spacing, 4 Wall	0.338 x 0.788 inch	N2510-6002RB	3M
J6	1	56579-0519	Connector, USB-B, Mini, 5-pins	0.354 X 0.307 Inches	56579-0519	Molex
J7	1		Terminal Block, 6A, 3.5mm Pitch, 4-Pos, TH	14x8.2x6.5mm	ED555/4DS	On-Shore Technology, Inc.
JP1, JP2, JP3	3	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN	Sullins
L1	1	2.2uH	Inductor, SMT, 5A,	0.204 x 0.216 inch	IHLP2020BZER2R2M11	Vishay
R1	1	30.1k	RES, 30.1k ohm, 1%, 0.1W, 0603	0603	CRCW060330K1FKEA	Vishay-Dale
R2, R5, R6, R9, R11, R19	6	200	RES, 200 ohm, 1%, 0.1W, 0603	0603	CRCW0603200RFKEA	Vishay-Dale
R3	1	0	RES, 0 ohm, 5%, 0.1W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R4, R7, R10, R13, R15, R16, R20	7	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R8	1	0	RES, 0 ohm, 5%, 0.25W, 1206	1206	CRCW12060000Z0EA	Vishay-Dale
R14	1	130	RES, 130 ohm, 1%, 0.1W, 0603	0603	CRCW0603130RFKEA	Vishay-Dale
R17	1	5.23k	RES, 5.23k ohm, 1%, 0.1W, 0603	0603	CRCW06035K23FKEA	Vishay-Dale
R18	1	2.21k	RES, 2.21k ohm, 1%, 0.1W, 0603	0603	CRCW06032K21FKEA	Vishay-Dale
R21	1	10k	Potentiometer, 3/8 Cermet, Single-Turn	0.25x0.17 inch	3266W-1-103LF	Bourns
R22	1	768	RES, 768 ohm, 1%, 0.1W, 0603	0603	CRCW0603768RFKEA	Vishay-Dale
S1	1		Switch, Push Button, SMD	2.9x2x3.9mm SMD	SKRKAEE010	Alps
S2	1		DIP Switch, 4 position slide actuator, SPST, SMD	SMT DIP switch	A6S-4104-H	Omron Electronic Components
S3	1		SLIDE SWITCH DPDT .1A, SMT	SWITCH, 5.4x2.5x3.9mm	CAS-220TA	Copal Electronics
U1	1		I2C Controlled 4A Single Cell Charger with Adjustable Voltage & 1.5A Synchronous Boost Operation, RGE0024H	RGE0024H	bq24295RGE	Texas Instruments
-	1	929950-00	Shunt, 100-mil, Black	0.100	929950-00	3M
-	1	PWR549	1.7x2 inch 2 layer 2oz. PCB	2.5x2.5inch	PCB	Any
C3, C11, C18	0	1uF	CAP, CERM, 1uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E105KA12D	MuRata
C4, C9, C10	0	0.1uF	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E104KA01D	MuRata
C7, C14, C15	0	10uF	CAP, CERM, 10uF, 25V, +/-10%, X5R, 1206	1206	GRM31CR61E106KA12L	MuRata
D2	0	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On

Table 6. Bill of Materials (continued)

Designator	Qty	Value	Description	PackageReference	PartNumber	Manufacturer
R12	0	2.21k	RES, 2.21k ohm, 1%, 0.1W, 0603	0603	CRCW06032K21FKEA	Vishay-Dale
	Notes:	Unless otherwise noted in the Alternate PartNumber and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.				

Revision History

Changes from A Revision (September 2014) to B Revision	Page
• Added step 6 to design configurations section	2

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

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10. User has sole responsibility to ensure the safety of any activities to be conducted by it and its employees, affiliates, contractors or designees, with respect to handling and using EVMs. Further, user is responsible to ensure that any interfaces (electronic and/or mechanical) between EVMs 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.
11. User shall employ reasonable safeguards to ensure that user’s use of EVMs will not result in any property damage, injury or death, even if EVMs should fail to perform as described or expected.
12. User shall be solely responsible for proper disposal and recycling of EVMs consistent with all applicable federal, state, and local requirements.

Certain Instructions. User shall operate EVMs within TI’s recommended specifications and environmental considerations per the user’s guide, accompanying documentation, and any other applicable requirements. Exceeding the specified ratings (including but not limited to input and output voltage, current, power, and environmental ranges) for EVMs may cause property damage, personal injury or death. If there are questions concerning these ratings, 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the applicable EVM user's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using EVMs’ schematics located in the applicable EVM user's guide. When placing measurement probes near EVMs during normal operation, please be aware that EVMs may become very warm. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use EVMs.

Agreement to Defend, Indemnify and Hold Harmless. User agrees to defend, indemnify, and hold TI, its directors, officers, employees, agents, representatives, affiliates, licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of, or in connection with, any handling and/or use of EVMs. User’s indemnity shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if EVMs fail to perform as described or expected.

Safety-Critical or Life-Critical Applications. If user intends to use EVMs in evaluations of safety critical applications (such as life support), and a failure of a TI product considered for purchase by user for use in user’s product would reasonably be expected to cause severe personal injury or death such as devices which are classified as FDA Class III or similar classification, then user must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

RADIO FREQUENCY REGULATORY COMPLIANCE INFORMATION FOR EVALUATION MODULES

Texas Instruments Incorporated (TI) evaluation boards, kits, and/or modules (EVMs) and/or accompanying hardware that is marketed, sold, or loaned to users may or may not be subject to radio frequency regulations in specific countries.

General Statement for EVMs Not Including a Radio

For EVMs not including a radio and not subject to the U.S. Federal Communications Commission (FCC) or Industry Canada (IC) regulations, TI intends EVMs to be used only for engineering development, demonstration, or evaluation purposes. EVMs are not finished products typically fit for general consumer use. EVMs may nonetheless generate, use, or radiate radio frequency energy, but have not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or the ICES-003 rules. Operation of such EVMs may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: For EVMs including a radio, the radio included in such EVMs is intended for development and/or professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability in such EVMs and their development application(s) must comply with local laws governing radio spectrum allocation and power limits for such EVMs. It is the user’s sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by TI unless user has obtained appropriate experimental and/or development licenses from local regulatory authorities, which is the sole responsibility of the user, including its acceptable authorization.

U.S. Federal Communications Commission Compliance

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 could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

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 its own expense.

FCC Interference Statement for Class B EVM devices

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.

Industry Canada Compliance (English)

For EVMs Annotated as IC – INDUSTRY CANADA Compliant:

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

Concerning EVMs Including Radio Transmitters

This device complies with Industry Canada licence-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.

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.

Canada Industry Canada Compliance (French)

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

Important Notice for Users of EVMs Considered “Radio Frequency Products” in Japan

EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If user uses EVMs in 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.

http://www.tij.co.jp

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