bq27531EVM With bq27531 Battery Management Unit Impedance Track™ Fuel Gauge and bq24192 4.5-A, Switch-Mode Battery Charger for Single-Cell Applications

This evaluation module (EVM) is a complete evaluation system for the Battery Management Unit (BMU) chipset consisting of the bq27531-G1 fuel gauge and bq24192 battery charger. The EVM includes one bq27531 circuit, including a current sense resistor and one thermistor. In addition, the fuel gauge controls the bq24192 battery charger's settings and monitors its status via I²C communication lines. Together, the chipset provides all necessary components to monitor and predict capacity for a system-side fuel gauge solution as well as to charge the battery from either an adapter or USB input with up to 4.5-A of charge current. The circuit module connects directly across the battery pack. With the EV2300 interface board and software, the user can read the bq27531-G1 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the battery management unit solution under different charge and discharge conditions. The latest Microsoft® Windows® based PC software can be downloaded from the product folder on the Texas Instruments Web site.

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1 Features

- Complete evaluation system for the Battery Management Unit chipset consisting of the bq27531-G1 Impedance Track fuel gauge and bq24192 4.5-A Battery Charger.
- Populated circuit module for quick setup
- Personal computer (PC) software and interface board (orderable on TI website) for easy evaluation
- Software that allows data logging for system analysis (available in product folder on TI website)
- Ability to upgrade to the latest firmware version by flash reprogramming

1.1 Kit Contents

- bq27531-G1 and bq24192 chipset circuit module (PWR216)
- NTC103AT thermistor

This EVM is used for the evaluation of the bq27531-G1 and bq24192 BMU chipset. Ensure that you visit the product Web folder at www.ti.com to download the latest firmware version, evaluation software, and documentation for the associated product to be evaluated.

1.2 Ordering Information

Table 1. Ordering Information

EVM PART NUMBER	CHEMISTRY	CONFIGURATION	CAPACITY
bq27531EVM	Li-ion	1 cell	Any

2 bq27531-Based Circuit Module

The bq27531-based circuit module is a complete and compact example solution of a bq27531 circuit for battery management. The circuit module incorporates a bq27531 battery gas gauge integrated circuit (IC) and all other components necessary to accurately predict the capacity of 1-series Li-ion cell.

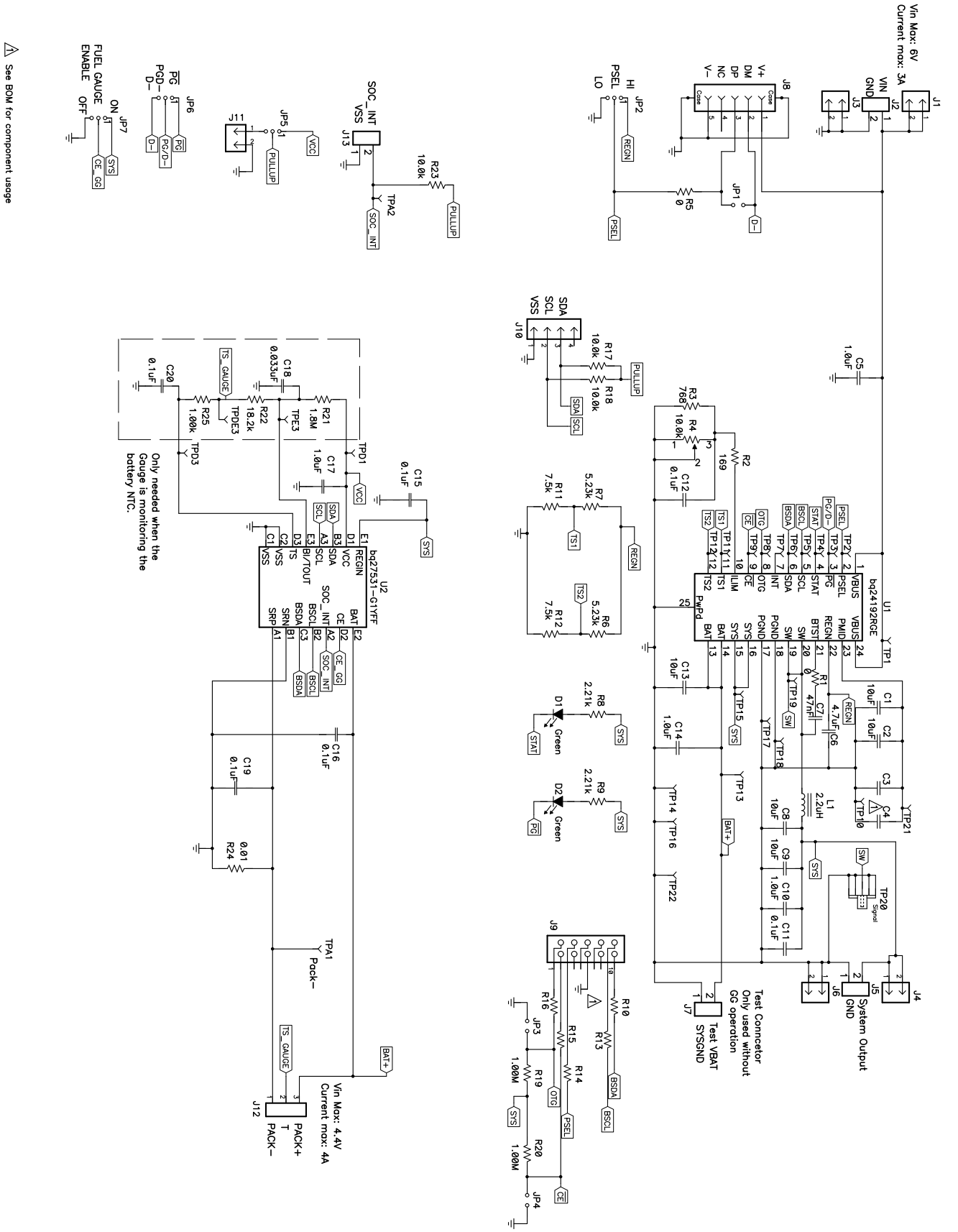

Figure 1. Schematic

2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the battery pack (J12): PACK+, PACK–, and TS
- To the serial communications port (J10): SDA, SCL, and VSS
- Connection to system load (J5)
- Connection to charger (J2)
- Access to signal output (J13): SOC_INT

2.2 I/O Description

Header/Terminal Block	Description
J1–VIN	Adapter positive terminal
J2–VIN	Adapter positive terminal
J2–GND	Adapter negative terminal
J3-GND	Adapter negative terminal
J4-SYS	System positive terminal
J5-SYS	System positive terminal
J5-GND	System negative terminal
J6-GND	System negative terminal
J7-TEST	Test terminal
J8	USB Miniconnector
J9	USBTOGPIO 10-pin connector (not installed)
J10	EV2300 connector for using bq27531 software to communicate with bq27531 IC
J11	Allows SOC_INT to be tied to external pullup rather than VCC
J12-PACK+	Battery positive terminal
J12-T	Pack thermistor input that leads to IC TS pin
J12-PACK-	Battery negative terminal
J12-SOC_INT	SOC_INT output from gauge

2.3 Test Points

Test Point	Description
TP1	bq24192 IN voltage
TP2	bq24192 PSEL pin
TP3	bq24192 PG/D- pin
TP4	bq24192 STAT pin
TP5	bq24192 SCL = bq27531 BSCL - I2C communication clock line
TP6	bq24192 SDA = bq27531 BSDA - I2C communication data line
TP7	bq24192 INT pin
TP8	bq24192 OTG pin
TP9	bq24192 CE pin
TP10	PGND
TP11	bq24192 TS1 pin
TP12	bq24192 TS2 pin
TP13	bq24192 BAT pin
TP14	PGND
TP15	bq24192 SYS pin
TP16	PGND
TP17	PGND

Test Point	Description
TP18	PGND
TP19	bq24192 SW pin
TP20	bq24192 SW signal
TP21	bq24192 PMID pin
TP22	PGND
TPA1	PACK-
TPA2	bq27531 SOC_INT pin
TPD1	bq27531 VCC pin
TPD3	bq27531 TS pin
TDPE3	External thermistor output
TPE3	bq27531 BI/TOUT pin

2.4 Control and Key Parameters Setting

Jumper	Description	Default Factory Setting
JP1 USB D+/D-	Shorting jumper for USB data lines DM (D-) and DP (D+). When shorted, USB input current limit defaults to 1.5 A. Otherwise, USB100 mode is selected.	INSTALLED
JP2 PSEL	2-3 (PSEL = LO): Indicates that an ac adapter is connected to the USB input and sets the USB input current limit to 1.5 A. 1-2 (PSEL = HI): Indicates that a USB source is connected to the USB input and sets the input current limit to 500 mA. (DEFAULT)	1-2 (PSEL = HI)
JP3 OTG	When installed, OTG feature will be disabled.	NOT INSTALLED
JP4 CHARGE ENABLE	When installed, charging is enabled.	INSTALLED
JP5 SOC_INT	2-3: SOC_INT is tied to external pull-up 1-2: SOC_INT is tied to onboard VCC through pull-up (DEFAULT)	1-2 VCC
JP6 D-/PG	2-3: Connect D-/PG to D- 1-2: Connect D-/PG to PG (DEFAULT)	1-2 PG
JP7 FUEL GAUGE ENABLE	1-2 ON: Fuel gauge enable (CE) pin high for normal operation (DEFAULT) 2-3 OFF: Fuel gauge enable (CE) pin low to disable gauging	1-2 ON

3 Circuit Module Physical Layouts, Bill of Materials, and Schematic

This section contains the board layout, bill of materials, assembly drawings, and schematic for the bq27531 circuit module.

3.1 Board Layout

This section shows the printed-circuit board (PCB) layers (Figure 2 through Figure 5), assembly drawing, and schematic for the bq27531 module.

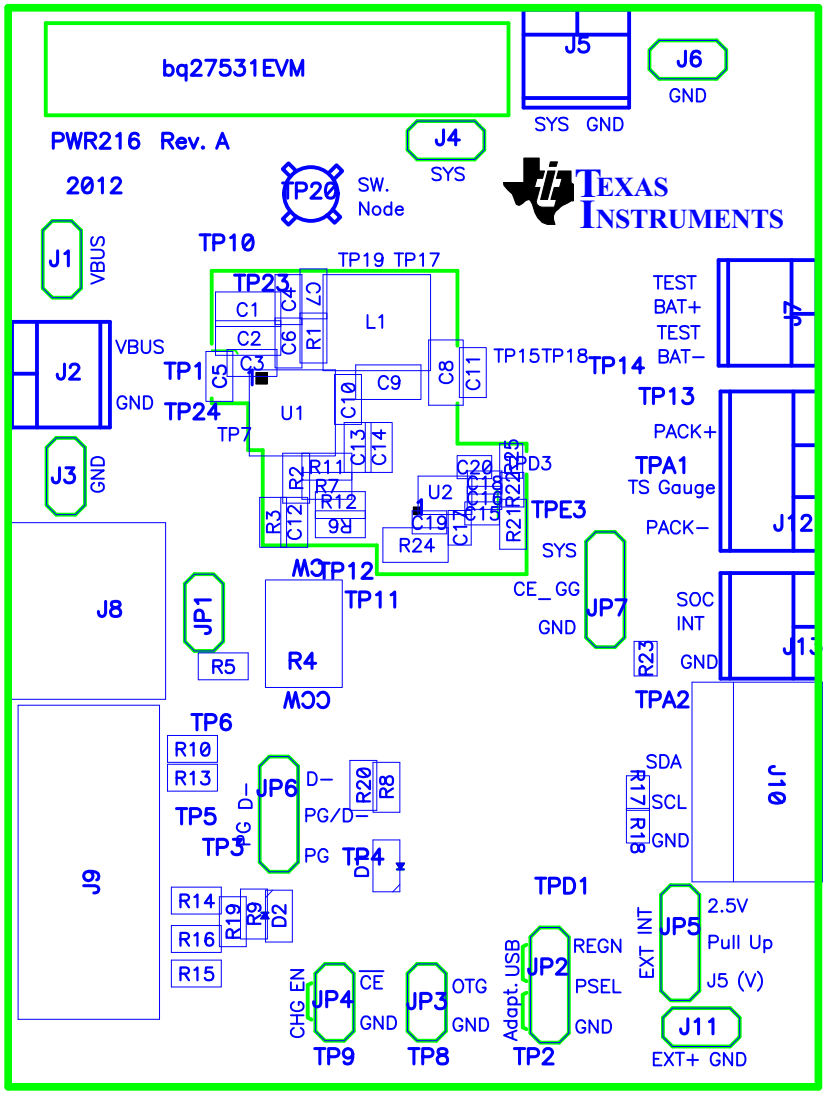

Figure 2. bq27531EVM-001 Layout – Silk Screen

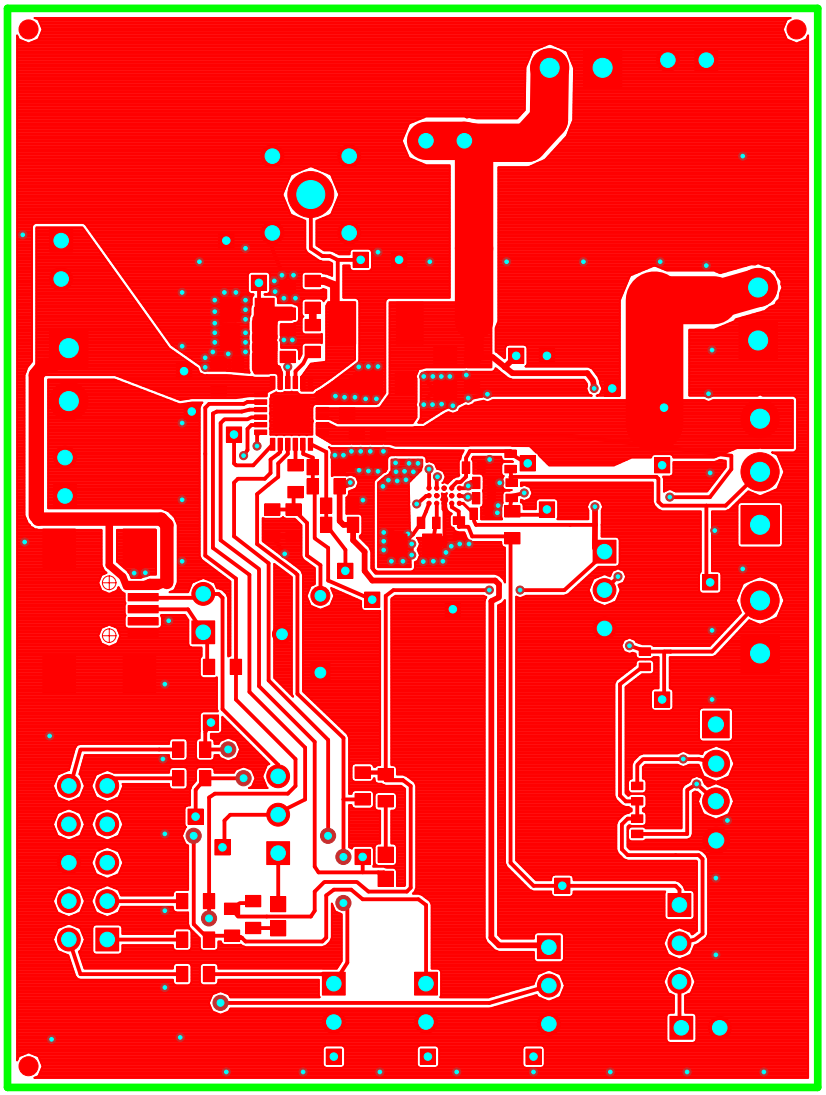

Figure 3. Layer 1

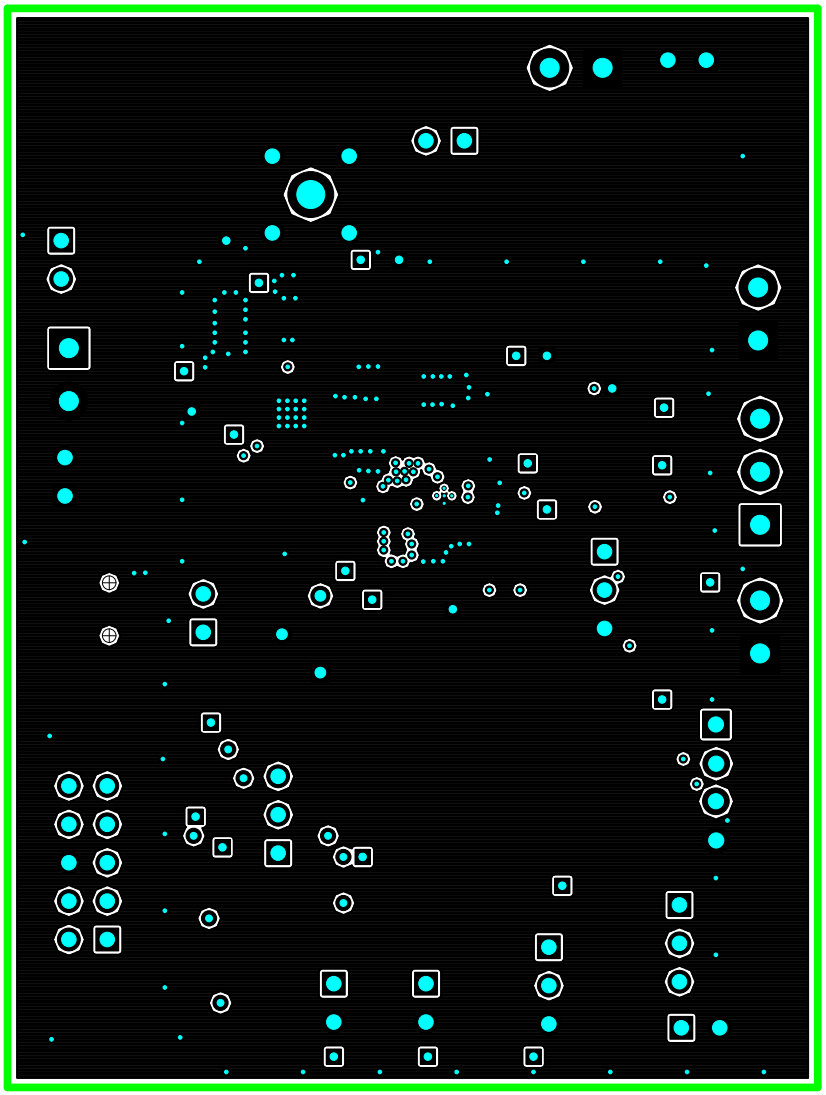

Figure 4. Layer 2

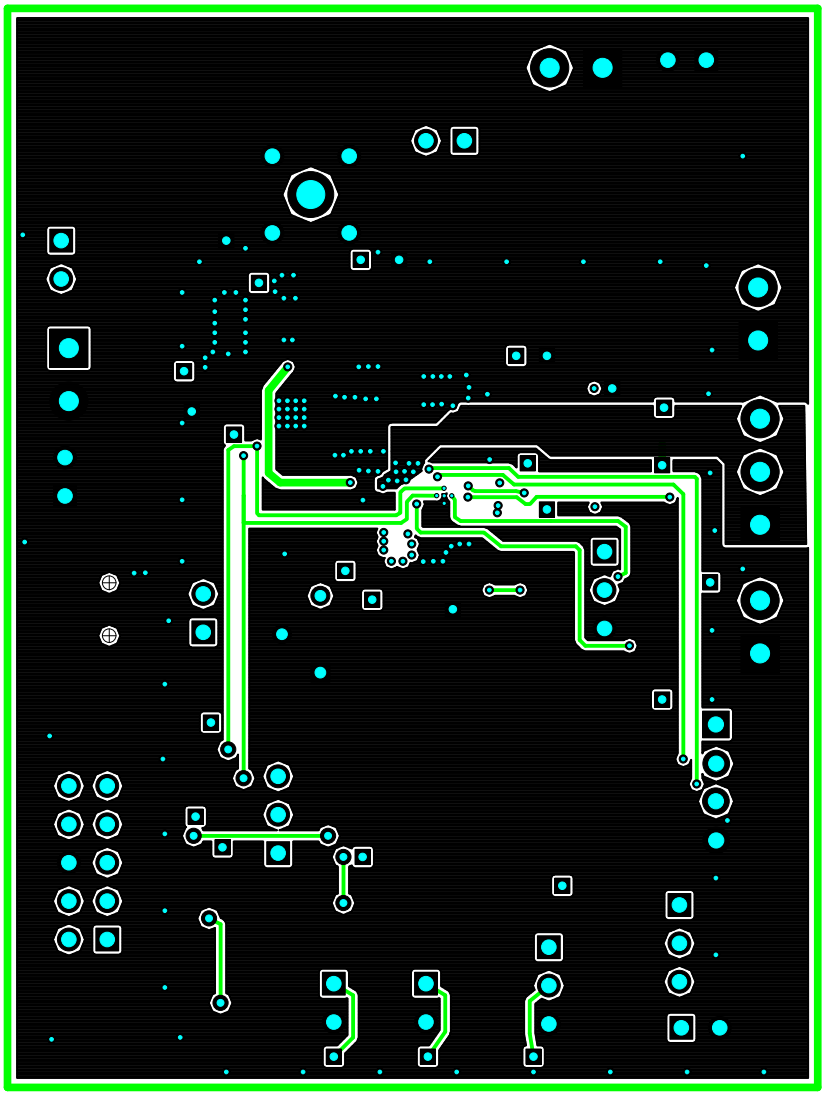

Figure 5. Layer 3

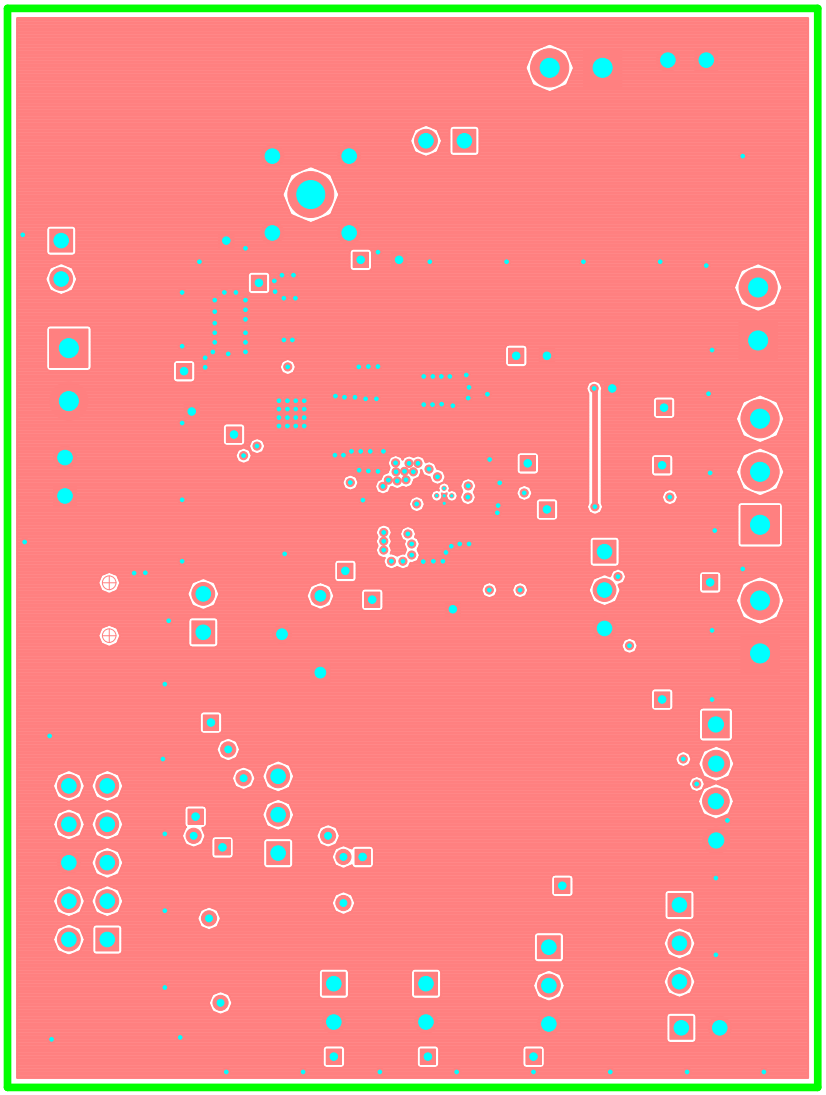

Figure 6. Layer 4

3.2 Bill of Materials and Schematic

Table 2. Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
1	C18	0.033uF	Capacitor, Ceramic, 16V, X7R, 10%	402	C1005X7R1C333K	TDK
4	C15, C16, C19, C20	0.1uF	Capacitor, Ceramic, 6.3V, X5R, 10%	402	C1005X5R0J104K050BA	TDK
1	C17	1.0uF	Capacitor, Ceramic, 6.3V, X5R, 10%	402	C1005X5R0J105K050BB	TDK
2	C11, C12	0.1uF	Capacitor, Ceramic, 25V, X5R, 10%	603	C1608X5R1E104K	TDK
2	C10, C14	1.0uF	Capacitor, Ceramic, 10V, X5R, 10%	603	C1608X5R1A105K080AC	TDK
1	C5	1.0uF	Capacitor, Ceramic, 25V, X5R, 10%	603	C1608X5R1E105K080AC	TDK
1	C6	4.7uF	Capacitor, Ceramic, 10V, X5R, 10%	603	CGB3B1X5R1A475K055AC	TDK
1	C13	10uF	Capacitor, Ceramic, 10V, X5R, 10%	603	C1608X5R1A106K080AC	TDK
1	C7	47nF	Capacitor, Ceramic, 10V, X5R, 10%	603	06033D473KAT2A	AVX
0	C3, C4	DNP	Capacitor, Ceramic, 10V, X5R, 10%	603		
4	C1, C2, C8, C9	10uF	Capacitor, Ceramic, 25V, X5R, 10%	805	C2012X5R1E106K125AB	TDK
0	J9	DNP	Connector, Male Straight 2x5 pin, 100mil spacing, 4 Wall	0.338 x 0.788 inch	N2510-6002-RB	3M
1	J8	UX60-MB-5ST	Connector, Recpt, USB-B, Mini, 5-pins, SMT	0.354 X 0.303 Inches	UX60-MB-5ST	Hirose Electric Co
2	D1, D2	Green	Diode, LED, Green, 2.1-V, 10-mA, 6-mcd	603	LTST-C190GKT	Liteon
5	J1, J3, J4, J6, J11	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	J10	22-05-3041	Header, Friction Lock Ass'y, 4-pin Right Angle	0.400 x 0.500	22-05-3041	Molex
1	L1	2.2uH	Inductor, SMT, 4.2A, 50.1milliohm	0.204 x 0.216 inch	IHLP2020BZER2R2M01	Vishay
3	JP1, JP3, JP4	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
4	JP2, JP5, JP6, JP7	PEC03SAAN	Header, Male 3-pin, 100mil spacing	0.100 inch x 3	PEC03SAAN	Sullins
1	R4	10.0k	Potentiometer, 3/8 Cermet, Single-Turn	0.25x0.17 inch	3266W-1-103LF	Bourns
1	R25	1.00k	Resistor, Chip, 1/16W, 1%	402	CRCW04021K00FKED	Vishay
3	R17, R18, R23	10.0k	Resistor, Chip, 1/16W, 1%	402	CRCW040210K0FKED	Vishay
1	R22	18.2k	Resistor, Chip, 1/16W, 1%	402	CRCW040218K2FKED	Vishay
2	R1, R5	0	Resistor, Chip, 1/10W	603	CRCW06030000Z0EA	Vishay
2	R6, R7	5.23k	Resistor, Chip, 1/10W, 1%	603	CRCW06035K23FKEA	Vishay
2	R19, R20	1.00M	Resistor, Chip, 1/10W, 1%	603	ERJ-3EKF1004V	Panasonic
2	R11, R12	7.5k	Resistor, Chip, 1/10W, 1%	603	CRCW06037K50FKEA	Vishay
1	R2	169	Resistor, Chip, 1/10W, 1%	603	ERJ-3EKF1690V	Panasonic
0	R10, R13, R14, R15, R16	DNP	Resistor, Chip, 1/10W, 1%	603		
1	R3	768	Resistor, Chip, 1/10W, 1%	603	ERJ-3EKF7680V	Panasonic

Table 2. Bill of Materials (continued)

1	R21	1.8M	Resistor, Chip, 1/10W, 1%	603	ERJ-3EKF1804V	Panasonic
2	R8, R9	2.21k	Resistor, Chip, 1/10W, 1%	603	ERJ-3EKF2211V	Panasonic
1	R24	0.01	Resistor, Chip, 1/4W, 1%	805	WSL0805R0100FEA18	Vishay
4	J2, J5, J7, J13	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25	ED555/2DS	OST
1	J12	ED555/3DS	Terminal Block, 3-pin, 6-A, 3.5mm	0.41 x 0.25 inch	ED555/3DS	OST
0	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TPA1, TPA2, TPD1, TPD3, TPDE3, TPE3	DNP	Test Point, 0.020 Hole	0.100 x 0.100 inch		
1	TP20	131-4244-00	Adaptor, 3.5-mm probe clip (or 131-5031-00)	0.200 inch	131-4244-00	Tektronix
1	U1	bq24192RGET	IC, I2C Controlled 4.5A Single Cell USB/Adapter Charger	QFN-24	bq24192RGET	TI
1	U2	bq27531-G1YZFT	IC, Battery Management Unit Impedance Track Fuel Gauge With bq24192 Charger Controller	BGA	bq27531-G1YZFT	TI
1	RT1	10K	Thermistor, NTC, 3-A	0.095 X 0.150 inch	103AT-2	Semitec
5			Shunt, 100-mil, Black	0.100	929950-00	3M
1			PCB		PWR216	Any

3.3 bq27531 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq27531 circuit module.

3.4 Recommended Operating Conditions

		Min	Typ	Max	Unit
Supply voltage, V_{IN}	Input voltage from ac adapter	4.2		6	V
System voltage, V_{SYS}	Voltage output at SYS terminal (depends on VBAT voltage and status of V_{INDPM} and input current limit circuits)	3.3		VBATREG+4.17 %	V
Battery voltage, V_{BAT}	Voltage output at VBAT terminal (registers set via bq27531 software)	3	4.2	4.44	V
Supply current, $I_{IN(MAX)}$	Maximum input current from ac adapter input (registers set via bq27531 software)	1.5		3	A
Fast charge current, $I_{CHRG(MAX)}$	Battery charge current (registers set via bq27531 software)	0.550		3	A
Operating junction temperature range, T_J		-40		125	°C

4 EVM Hardware and Software Setup

This section describes how to connect the different components of the EVM how to install the bq27531EVM PC software and.

4.1 Recommended Test Equipment

4.1.1 Power Supplies

1. Power Supply #1 (PS #1) capable of supplying 6 V at 3 A is required.
2. If not using a battery as the load, then power supply #2 (PS #2) capable of supplying up to 5 V at 5 A is required to power the circuit shown in Figure 7.

4.1.2 Load #1 Between BAT and GND

Testing with an actual battery is the best way to verify operation in the system. If a battery is not available, then a circuit similar to the one shown in Figure 7 can simulate a battery when connected to a power supply.

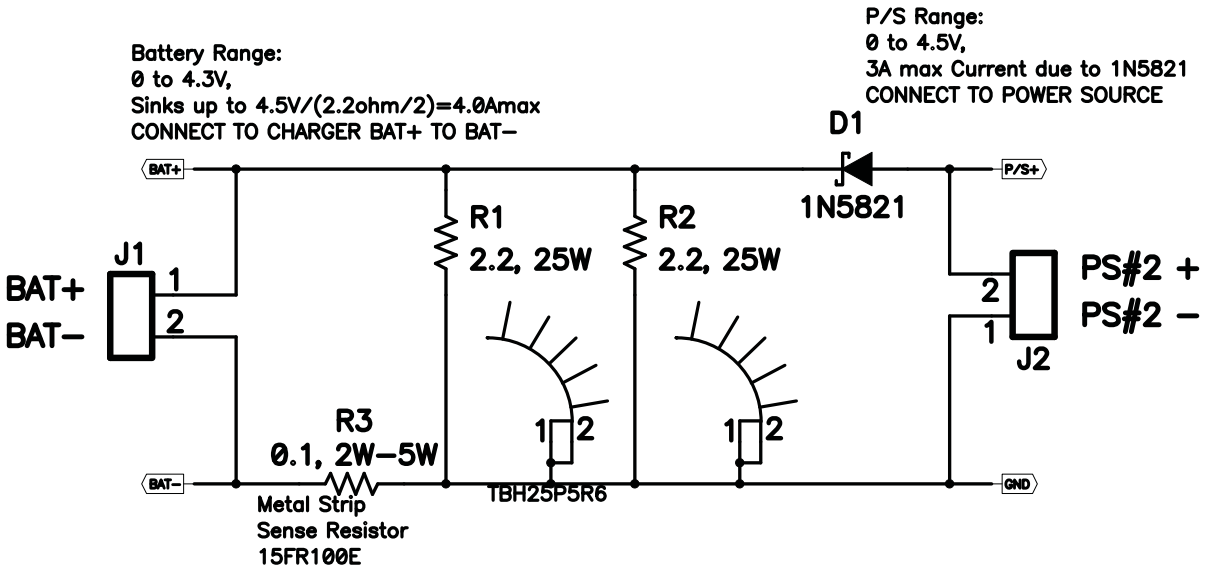

Figure 7. BAT_Load (PR1010) Schematic

4.1.3 Load #2 Between SYS and GND

Although not required, a resistive load capable of sinking up to 3 A can be used.

4.1.4 Meters

Three equivalent voltage meters (VM #) and two equivalent current meters (CM #) are required. The current meters must be able to measure 3-A current.

4.1.5 Test Equipment Setup

1. For all power connections, use short, twisted-pair wires of appropriate gauge wire for the amount of the current.
2. Set Power Supply #1 (PS #1) for 6-V, 3-A current limit and then turn off supply.
3. If BAT_Load as shown in Figure 8 is used, connect Power Supply #2 (PS #2) set to approximately 3.6 V to the input side (PS #2+/-) of BAT_Load, then turn off PS #2.
4. Connect the output side of the battery or BAT_Load in series with current meter to J12 (PACK+, PACK-). Ensure that a voltage meter is connected across J12 (PACK+,PACK-).
5. Connect VM #3 across J5 (SYS, GND).
6. Ensure jumpers are at the default factory settings per Section 2.4
7. Connect I2C port of EV2300 with J10 board using the assembled 4 colored-wire connector included with EV2300 kit (GND / BLACK at the bottom).
8. After the preceding steps have been performed, the test setup for PWR216 is configured as is shown in Figure 8

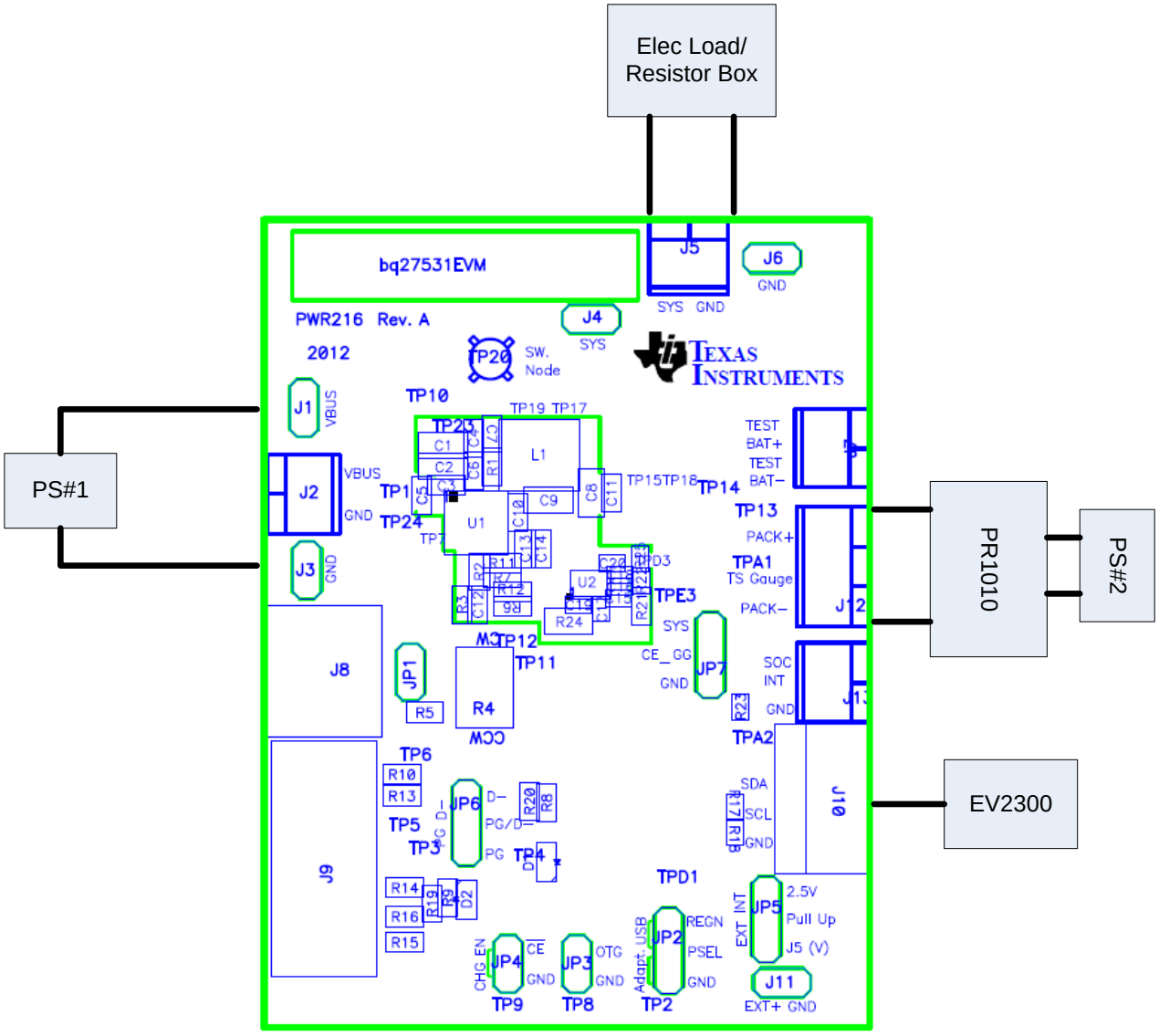

Figure 8. Test Setup for bq27531EVM (PWR216)

9. Turn on the computer. Open the bq27531 evaluation software. The main window of the software is shown in Figure 9 (DataRAM Screen).

4.2 Software Installation

Find the latest software version at http://www.ti.com/tool/bqStudio. Use the following steps to install Battery Management Studio:

4.2.1 Using EV2300

1. Ensure that the EV2300 is not connected to the PC through a USB cable before starting this procedure.
2. Select the *Tool and Software* tab in the product folder.
3. Under the *Software* section, click on *Battery Management Studio (bqStudio) Software Suite*.
4. Click the **Download** button to download the software.
5. Download software to hard drive.
6. Double-click the software executable and follow all instructions and prompts.

4.2.2 Using EV2400:

1. Ensure that the EV2400 is not connected to the PC through a USB cable before starting this procedure.
2. Browse for the supported software link within the bq27531 TI web site product folder to find the downloadable EVSW installation files.
3. Open the software file that was downloaded from the TI web site.
4. Follow the instructions on screen until the software installation is completed.

5 Troubleshooting Unexpected Dialog Boxes

The user that is downloading the files must be logged in as the administrator.

The driver is not signed, so the administrator must allow installation of unsigned drivers in the operating system policy.

6 Operation

This section details the operation of the bqStudio software.

6.1 Starting the Program

Run bqStudio from the Start | All Programs | Texas Instruments | Battery Management Studio. The main screen (Figure 9) appears. If instead of Figure 9 appearing, Figure 10 appears, it may mean that the EVM is not connected to the computer correctly. Make sure that the USB interface (EV2300 or EV2400 or GDK) and the bq27531 are connected and restart bqStudio. If this still does not resolve the issue, check if the I2C pullup resistors are connected. Data begins to appear once the <Refresh> (single-time scan) button is clicked, or when the Scan button is clicked. To disable the scan feature, simply click the **Scan** button again.

The continuous scanning period can be set by opening Window | Preferences → Registers section. The range for this interval is 0 ms to 65,535 ms. Only items that are selected for scanning are scanned within this period.

Battery Management Studio provides a logging function which logs the values that were last scanned. To enable this function, select the Start Log button; this causes the Scan button to be pressed. When logging is Stopped, the Scan button will still be selected and has to be manually clicked again.

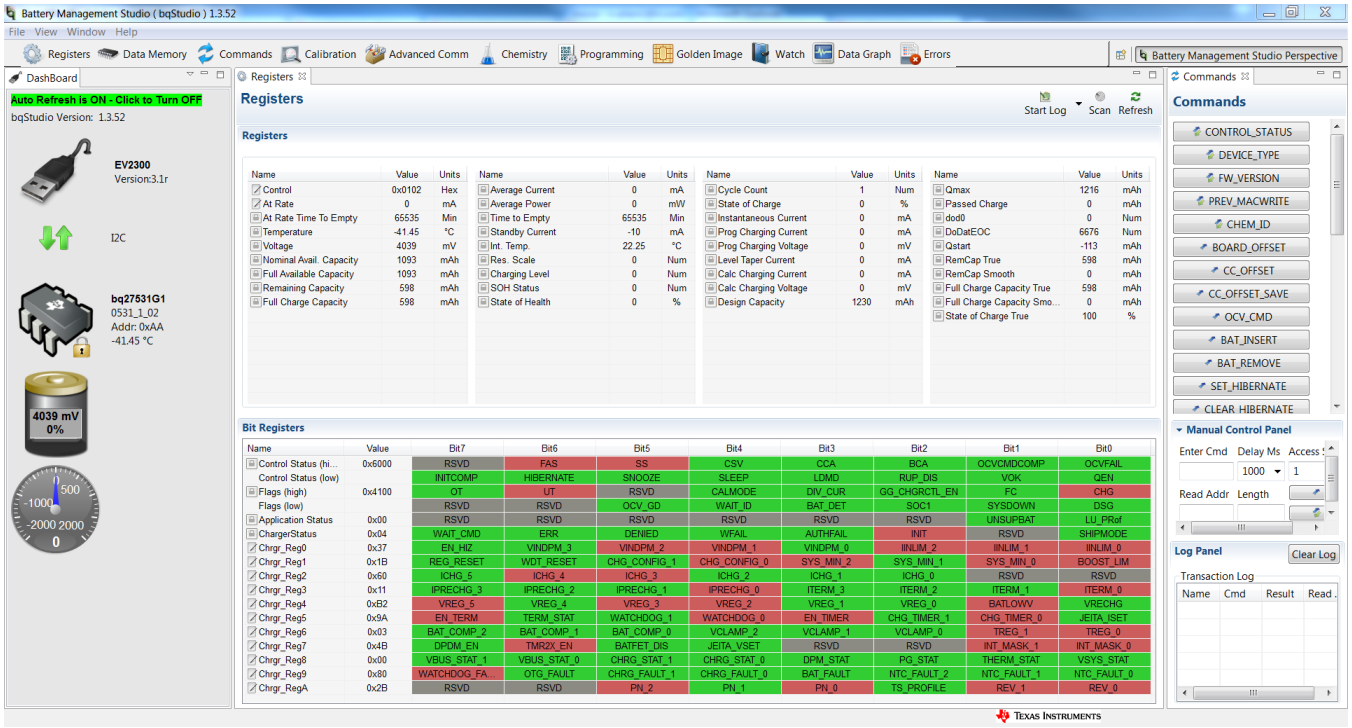

Figure 9. Registers Screen

This screen (Figure 9) shows the RAM data in the bq27531 device. Additional Flags and Status data can be viewed at the bottom of the *Registers* screen.

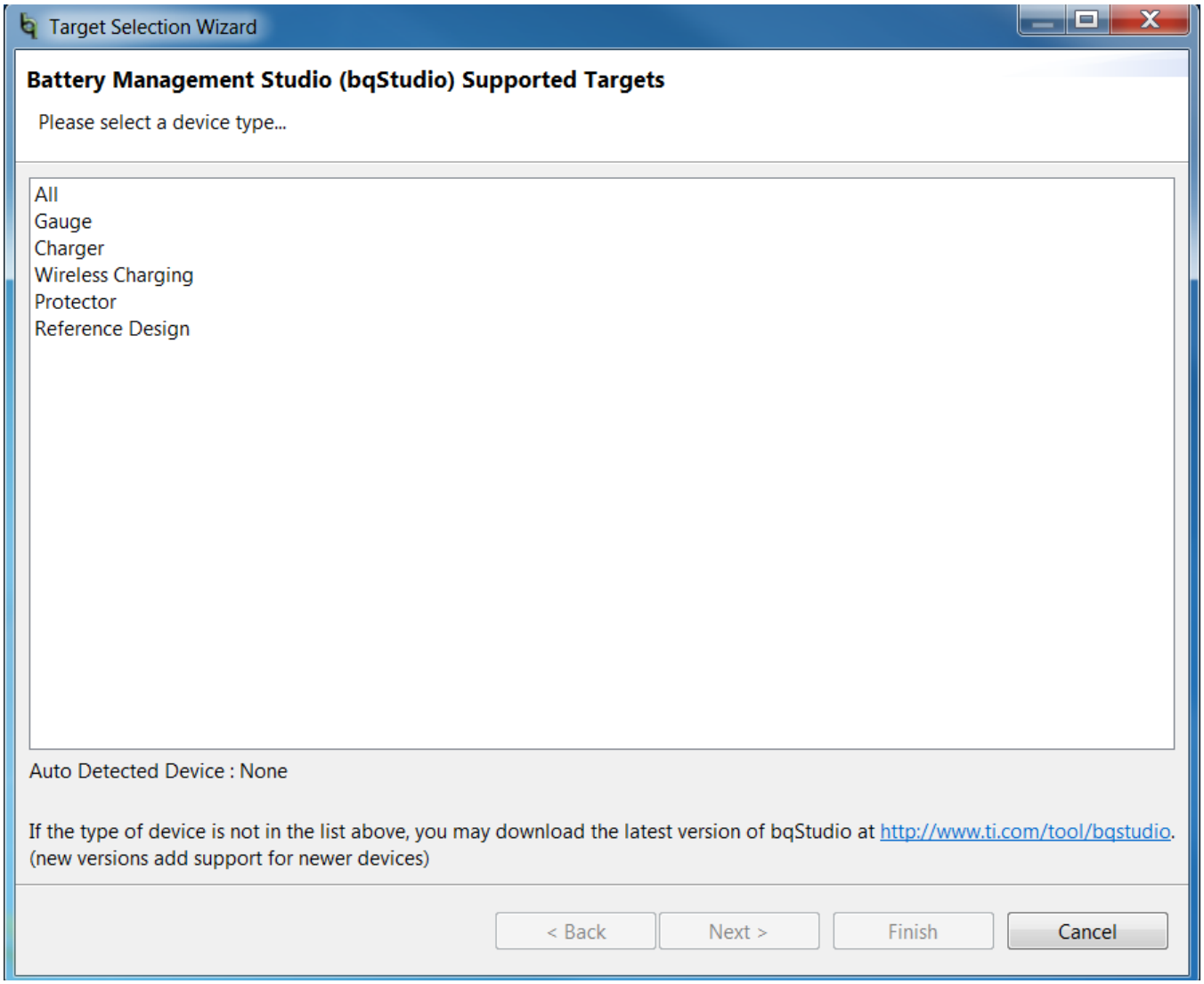

Figure 10. bqStudio Default Page

6.2 Setting Programmable bq27531 Options

The bq27531 data memory comes configured per the default settings detailed in the bq27531 technical reference manual (SLUUA96). Ensure that the settings are correctly changed to match the pack and application for the bq27531 solution being evaluated.

IMPORTANT: The correct setting of these options is essential to get the best performance.

The settings can be configured using the Data Memory screen (Figure 11).

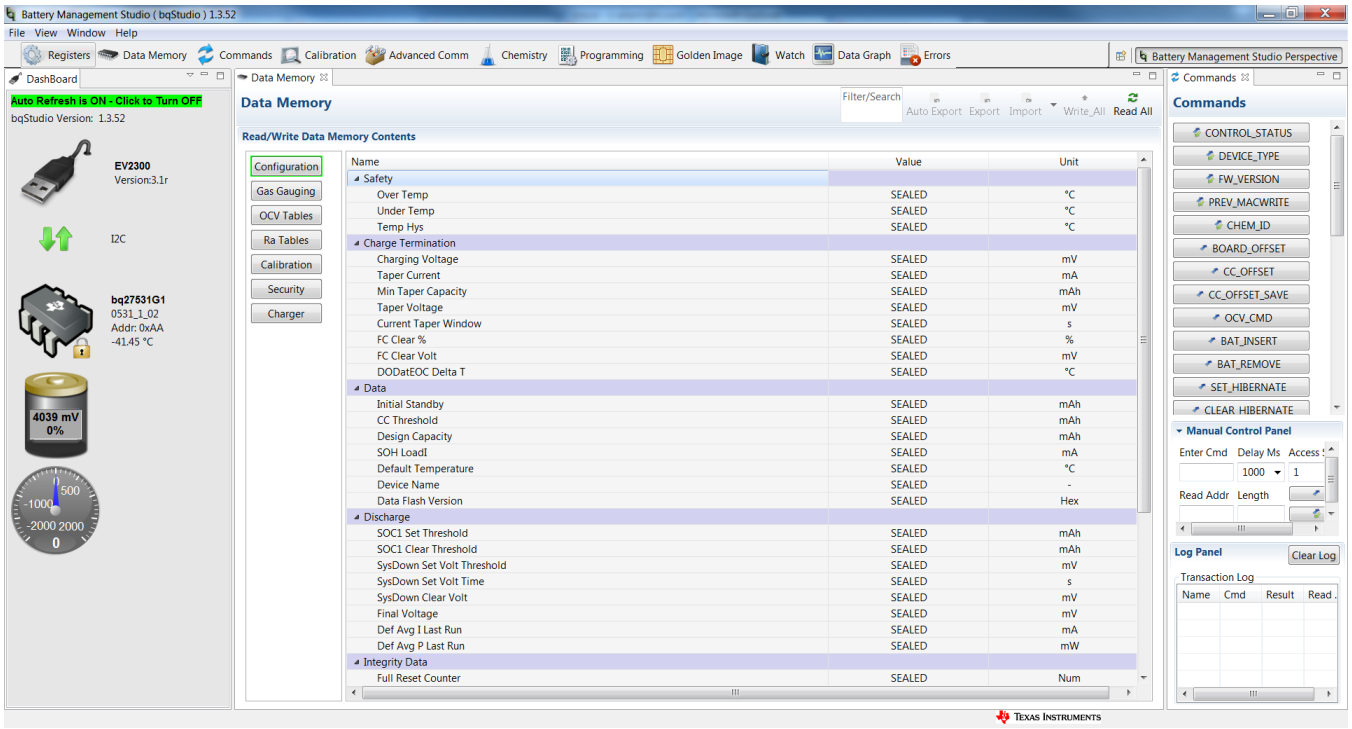

Figure 11. Data Memory Screen

To read all the data from the bq27531 non-volatile flash memory, click on the **Read All** button on the *Data Memory* window. Make sure the device is not sealed and in full access to read or write to the data memory. To update a parameter, click on the desired parameter and a window pops-up that provides details on the selected parameter. Next, enter the value in the value textbox and press **Enter**. After pressing **Enter**, bqStudio updates the selected parameter. The **Import** button in the *Data Memory* window can be clicked in order to import an entire configuration from a specified *.gg.csv file.

Save the configuration to a file by clicking the **Export** button in the *Data Memory* window and entering a file name. The configuration is saved to a *.gg.csv file. The module calibration data is also held in the bq27531 data memory. If the Gauge Dashboard is not displaying any information, then the bq27531 may not be supported by the bqStudio version being used, a bqStudio upgrade may be required.

7 Calibration

The bq27530EVM must be calibrated to ensure accurate value reporting. This can be done by going to the *Calibration* window in bqStudio (Figure 12).

7.1 Calibrating the bq27531

Calibrate each item one at a time in the order presented in this document. Select the types of calibration to be performed by selecting the corresponding checkbox (see Figure 12).

Enter the measured values for the types selected, if necessary.

Then press the *Calibrate Part as indicated below* button. After all calibration is complete, close the Calibrate subwindow. While the Calibrate subwindow is open, even in the background, the calibration routines are running in firmware. Close the subwindow to ensure that they are stopped before proceeding with configuration or testing.

7.2 CC Offset Calibration

This performs the internal calibration of the coulomb counter input offset. Press the *Calibrate Coulomb Counter* button.

7.3 Voltage Calibration

- Measure the voltage across Pack+ and Pack- with a calibrated meter.
- Type the voltage value in mV into *Enter Actual Voltage* .
- Measure the temperature for PACK.
- Type the temperature value into Enter Actual Temperature.
- Press the *Calibrate Voltage and Temperature* as indicated below button.

7.4 Board Offset Calibration

This performs the offset calibration for the current offset of the board. It takes approximately 35 seconds to complete.

It is expected that no current is flowing through the sense resistor while performing this calibration step. Remove load and short PACK– to GND.

Press the *Calibration Board Offset* button.

7.5 Pack Current Calibration

- Connect a load to GND and SYS that draws approximately 1 A, or connect a current source to GND and Pack–. Ensure that the Measured Current reported is negative, or else reverse the connections.
- Measure the current with a calibrated meter, and type the value into Enter Actual Current using (-) for current in discharge direction.
- Press the *Calibrate Gas Gauge* button.

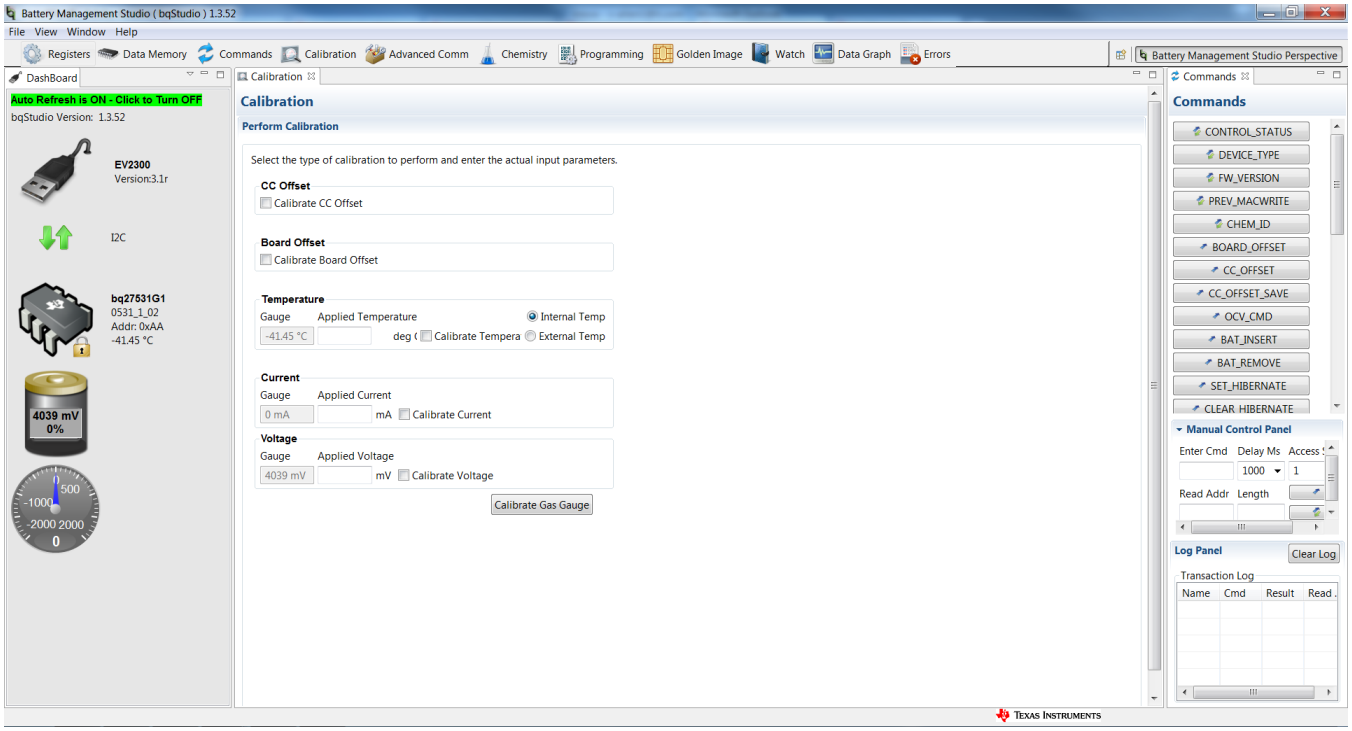

Figure 12. Calibration Screen

8 Advanced Communication I²C

8.1 I²C Communication

I²C read/write operations are not specific to any gas gauge. These operations serve as general-purpose communication tools (Figure 13).

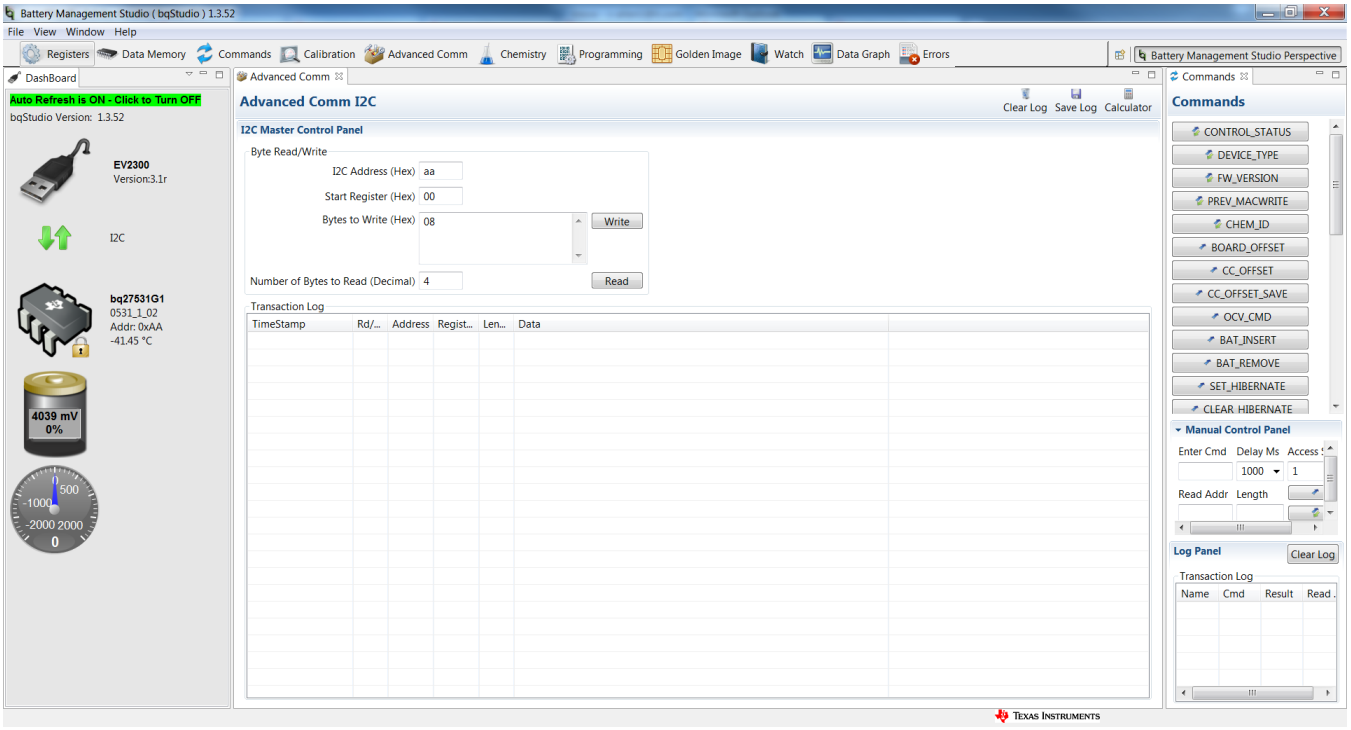

Figure 13. Advanced Communication I²C

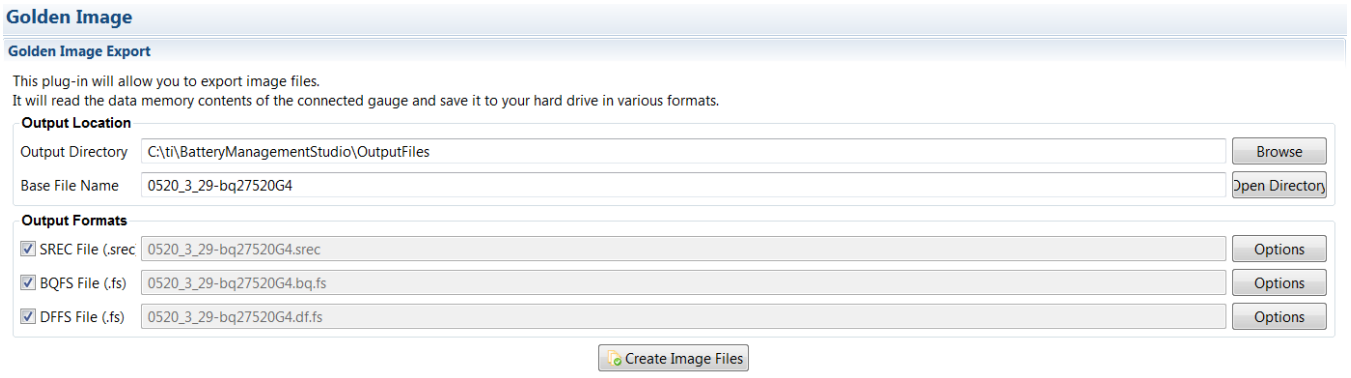

Figure 14. Golden Image Output Screen

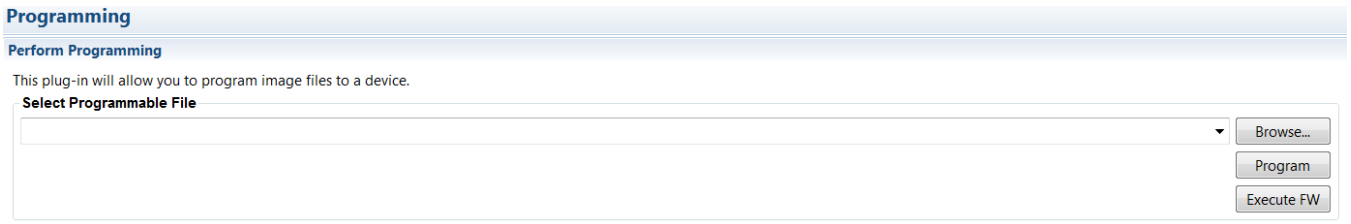

Figure 15. Perform Programming Screen

9 Related Documentation From Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, identify this document by its title and literature number. Updated documents also can be obtained through the TI Web site at www.ti.com.

- *bq27531, System-Side Impedance Track™ Fuel Gauge With Integrated LDO* data sheet (SLUSBE7)

Revision History

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

Changes from Original (April 2013) to A Revision	Page
• Deleted *System Requirements* and reworded *Software Installation* sections in *EVM Hardware and Software Setup*.	15
• Changed the entire *Operation* section, text and images.	17
• Changed *Calibrate Screen* section to *Calibration* section, and changed much of the text in the section.	19
• Changed *I2C Pro Screen* section to *Advanced Communication I2C*, changed some text and the images in this section.	21

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   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*

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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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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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