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 I^2C 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 Windows™-based PC software can be downloaded from the product folder on the Texas Instruments Web site.

Contents

1 Features 2
2 bq27531-Based Circuit Module 2
3 Circuit Module Physical Layouts, Bill of Materials, and Schematic 5
4 EVM Hardware and Software Setup 13
5 Troubleshooting Unexpected Dialog Boxes 16
6 Operation 17
7 Calibrate Screen 19
8 I2C Pro Screen 21
9 Related Documentation From Texas Instruments 21

List of Figures

1 Schematic 3
2 bq27531EVM-001 Layout – Silk Screen 6
3 Layer 1 7
4 Layer 2 8
5 Layer 3 9
6 Layer 4 10
7 BAT_Load (PR1010) Schematic 13
8 Test Setup for bq27531EVM (PWR216) 15
9 DataRAM Screen 17
10 Data Flash Screen 18
11 Calibration Screen 20
12 I2C Pro Screen 21

List of Tables

1 Ordering Information 2
2 Bill of Materials 11

Impedance Track is a trademark of Texas Instruments.
Windows, Microsoft are trademarks of Microsoft Corporation.
All other trademarks are the property of their respective owners.

Copyright © 2013, Texas Instruments Incorporated

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.

Copyright © 2013, Texas Instruments Incorporated

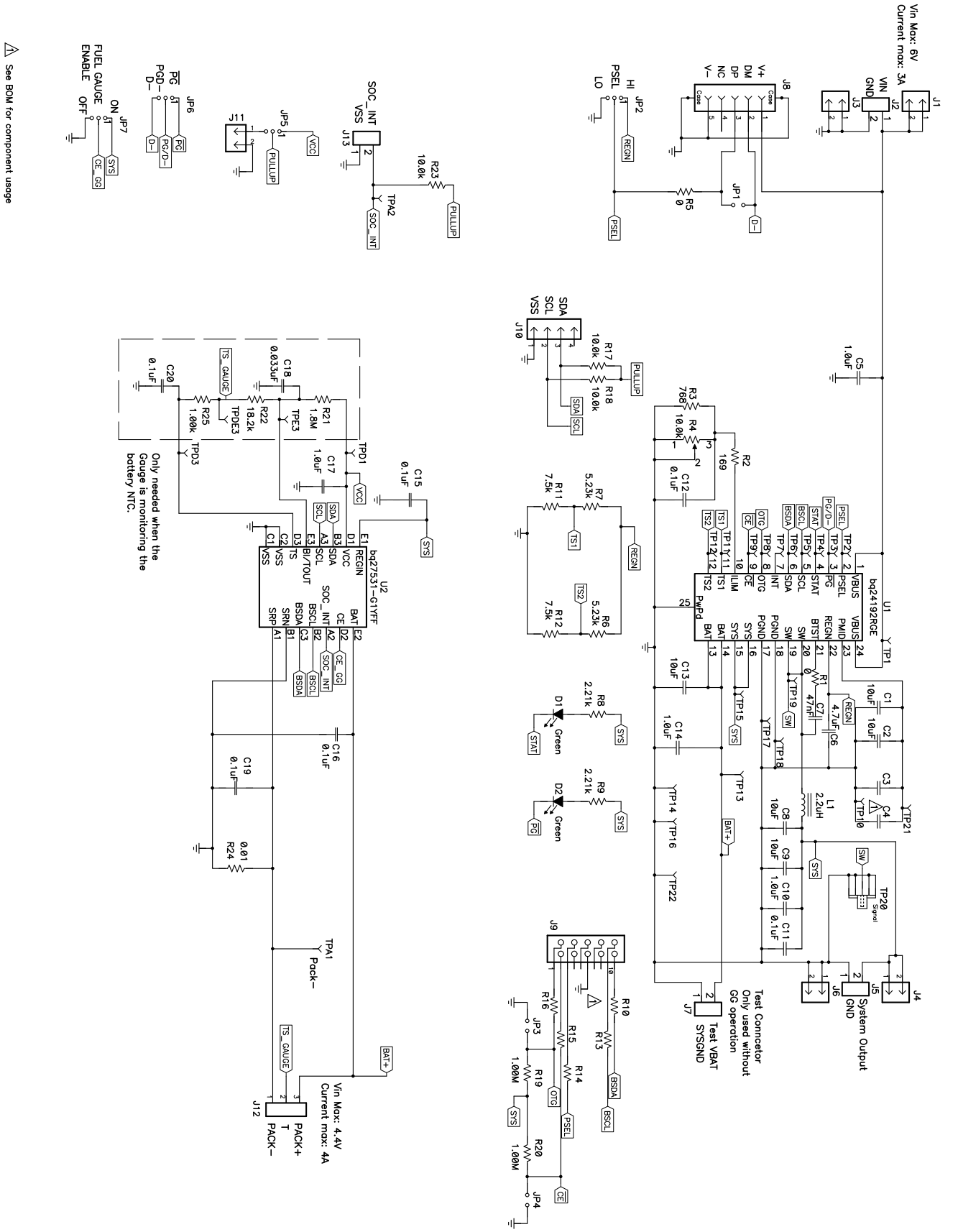

Figure 1. Schematic

Copyright © 2013, Texas Instruments Incorporated

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

Copyright © 2013, Texas Instruments Incorporated

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.

Copyright © 2013, Texas Instruments Incorporated

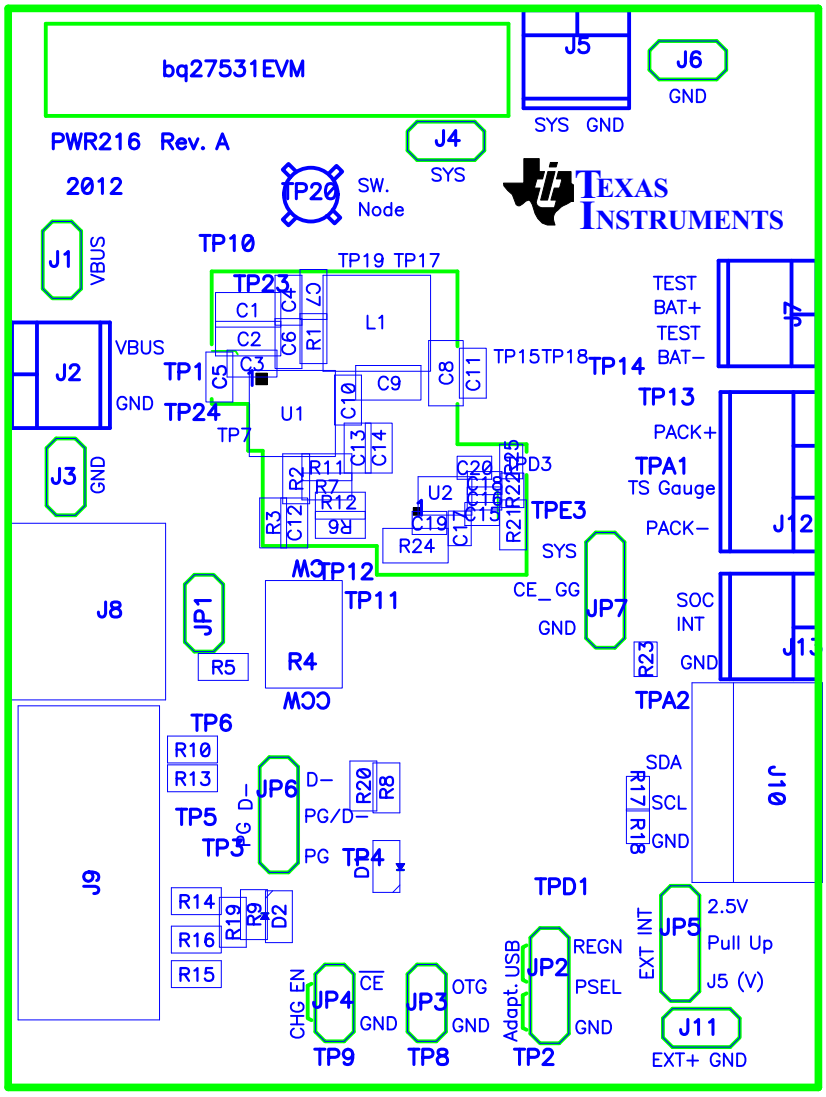

Figure 2. bq27531EVM-001 Layout – Silk Screen

Copyright © 2013, Texas Instruments Incorporated

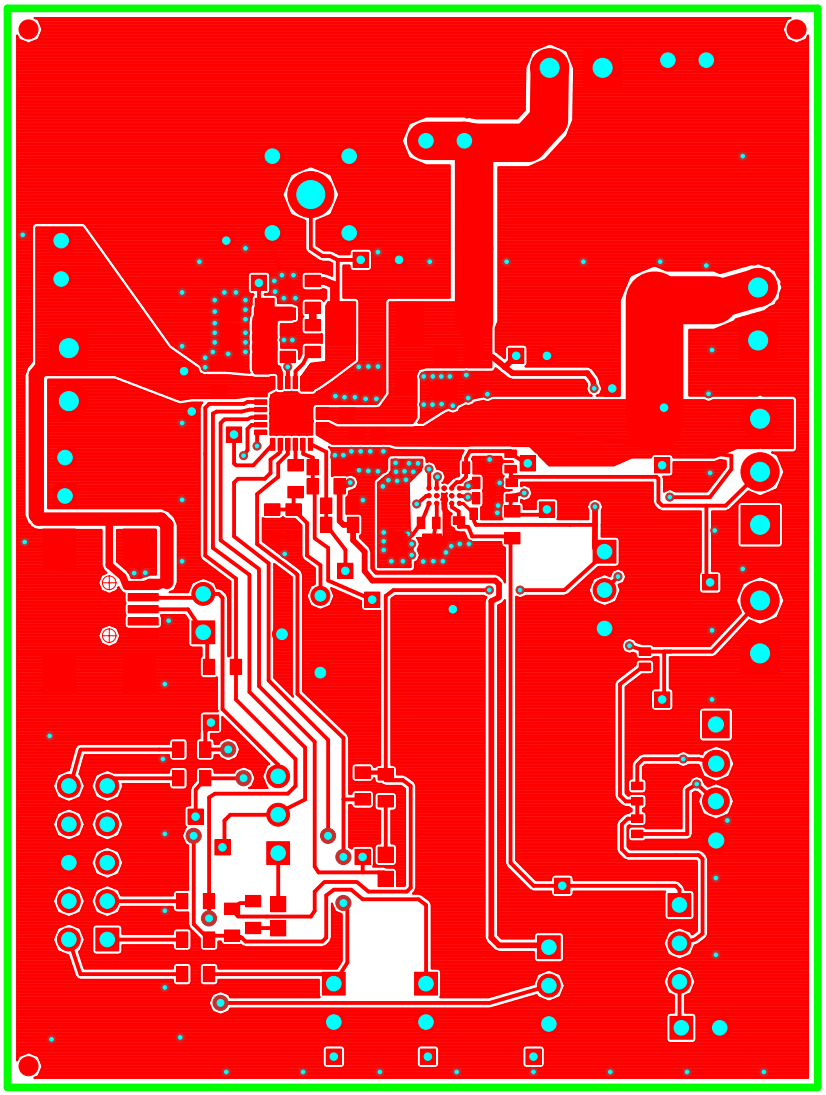

Figure 3. Layer 1

Copyright © 2013, Texas Instruments Incorporated

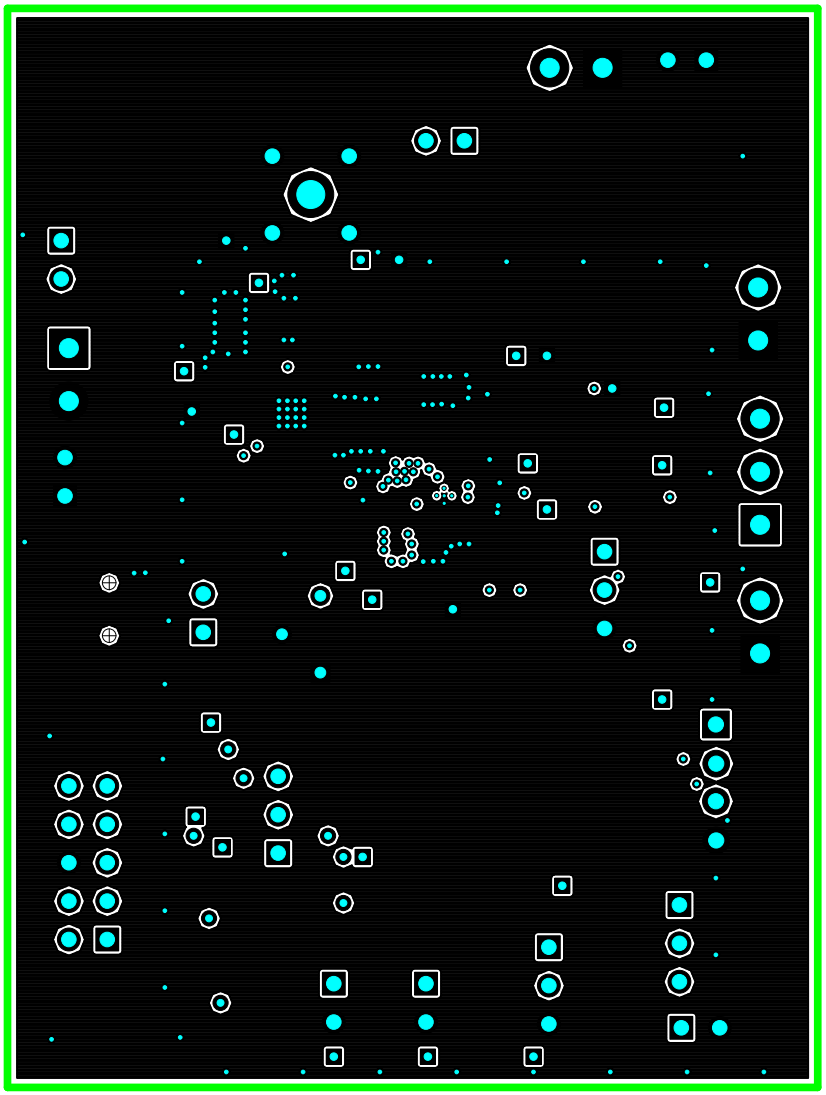

Figure 4. Layer 2

Copyright © 2013, Texas Instruments Incorporated

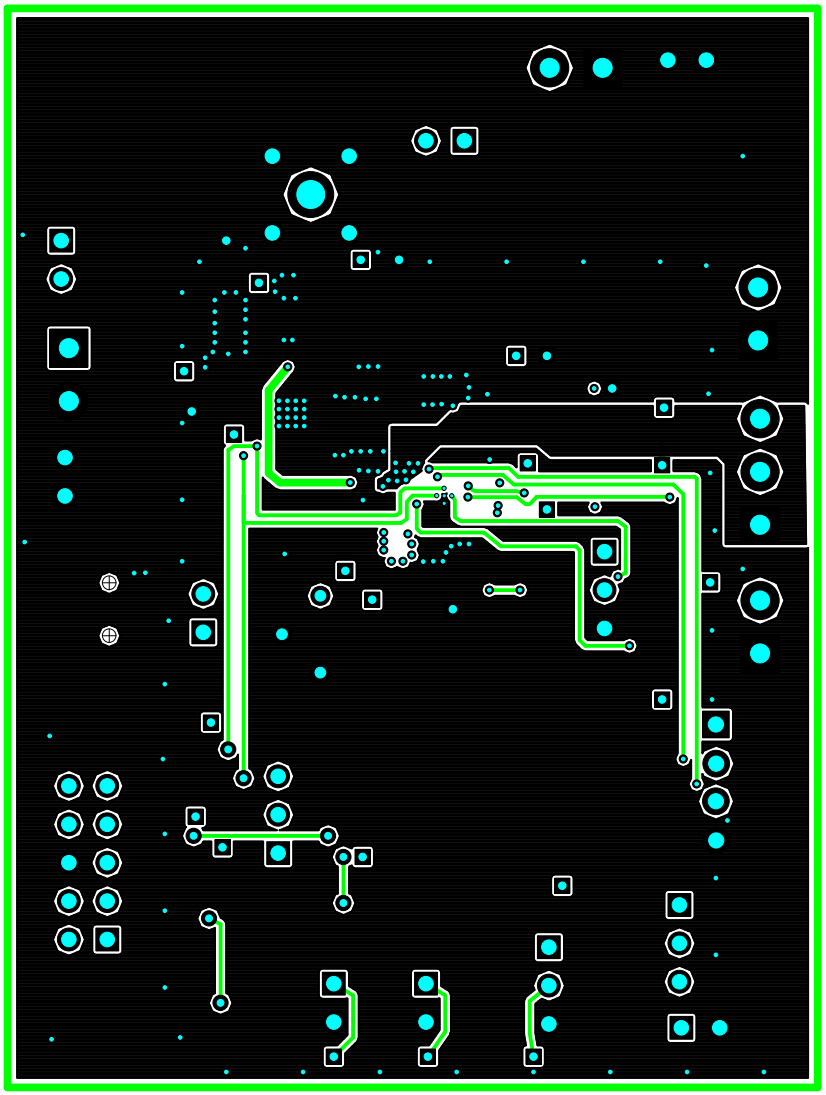

Figure 5. Layer 3

Copyright © 2013, Texas Instruments Incorporated

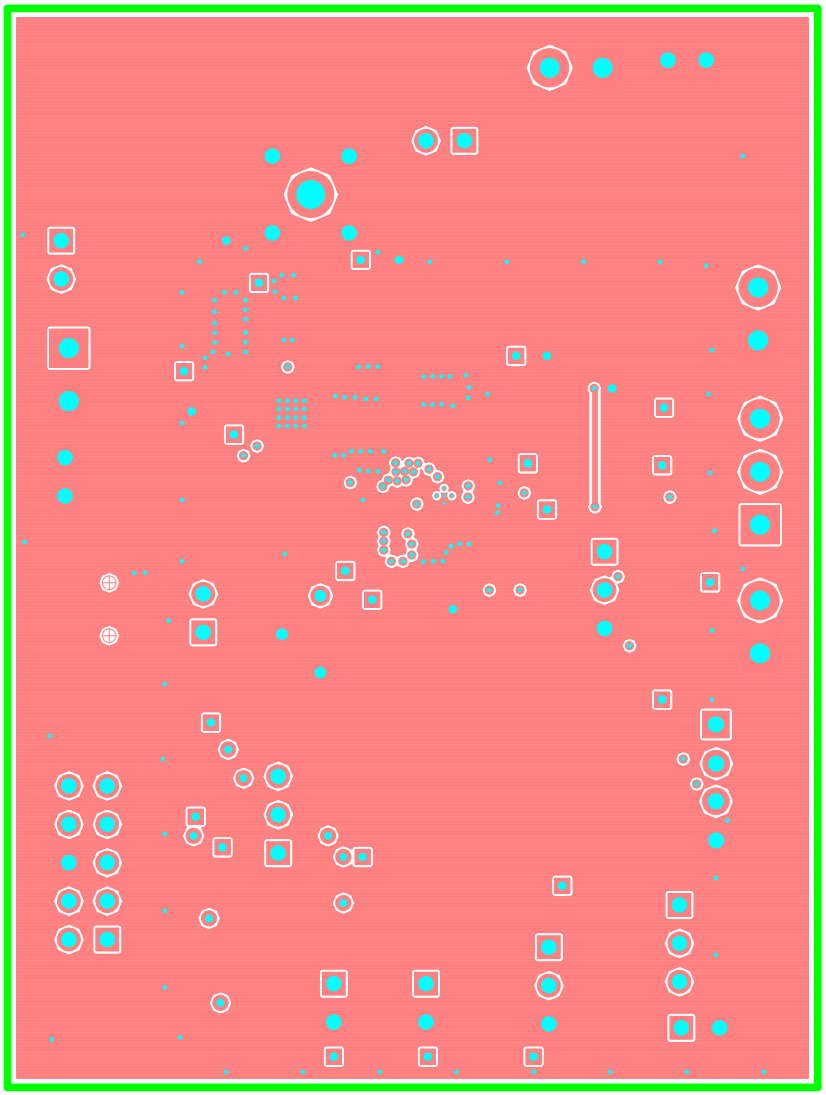

Figure 6. Layer 4

Copyright © 2013, Texas Instruments Incorporated

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

Copyright © 2013, Texas Instruments Incorporated

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

Copyright © 2013, Texas Instruments Incorporated

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.

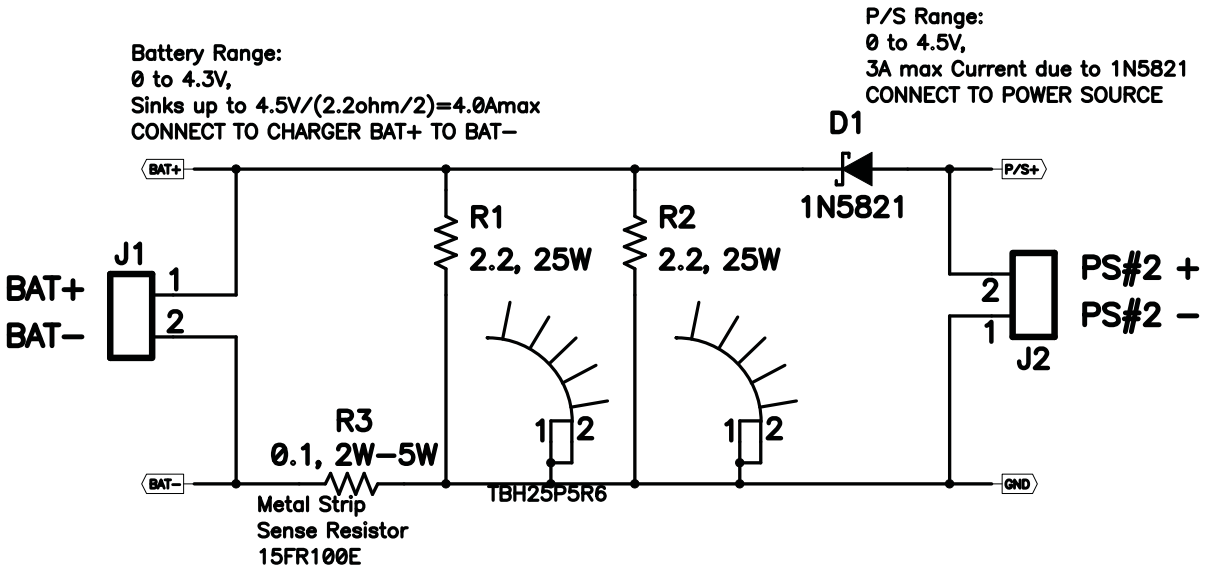

Figure 7. BAT_Load (PR1010) Schematic

Copyright © 2013, Texas Instruments Incorporated

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

Copyright © 2013, Texas Instruments Incorporated

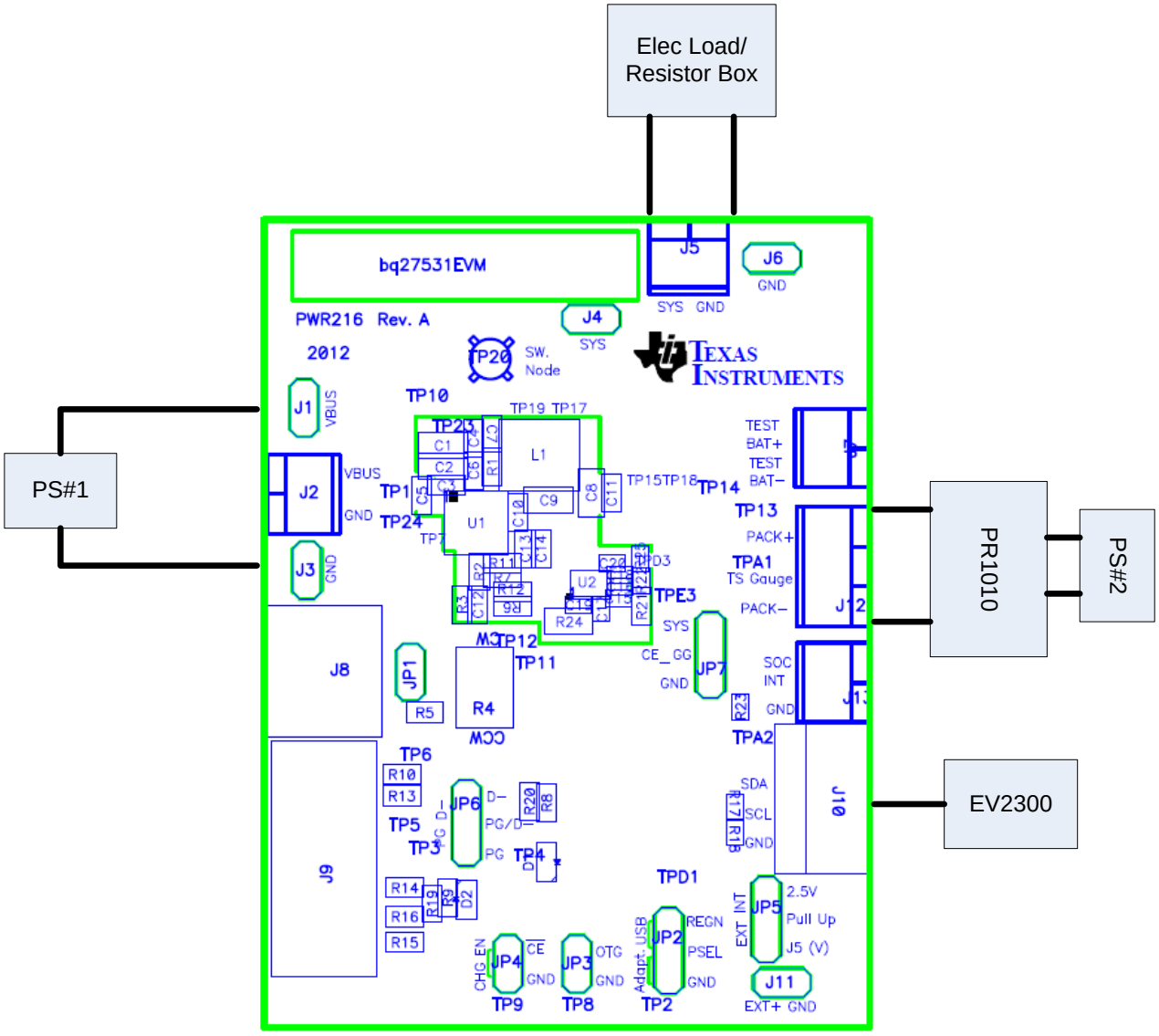

Figure 8. Test Setup for bq27531EVM (PWR216)

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

Copyright © 2013, Texas Instruments Incorporated

4.2 Software System Requirements

The bq27531EVSW software requires 32-bit versions of Windows 2000 or Windows XP. Drivers for Windows 98SE are provided, but Microsoft™ no longer supports Windows 98; therefore, Windows 98 can have issues with USB driver support. The EV2300 USB drivers have been tested for Windows 98SE, but no assurance is made for problem-free operation with specific system configurations.

4.3 Software Installation

Find the latest software version in the bq27531 tool folder on power.ti.com. Make a search by part number for bq27531 to access the tool folder.

4.3.1 Using EV2300

Use the following steps to install the bq27531EVSW software when using EV2300:

1. Ensure that the EV2300 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 evaluation software (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. Before starting the EVSW, connect the EV2300 to the computer using the USB cable.
6. Wait until the system prompt “new hardware found” appears. Choose “select location manually”, and use the “browse” button to point to subdirectory TIUSBWin2K-XP-1.
7. Answer “continue” to the warning that drivers are not certified with Microsoft™.
8. After installation finishes, another system prompt "new hardware found" appears. Repeat steps 6 and 7, but specify the directory as TIUSBWin2K-XP-2.
9. Answer "continue" to the warning that drivers are not certified with Microsoft. Driver installation is now finished.

4.3.2 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.

Copyright © 2013, Texas Instruments Incorporated

6 Operation

This section details the operation of the bq27531 EVSW software.

6.1 Starting the Program

Run bq27531 EVSW from the Start | Programs | Texas Instruments | bq Evaluation Software menu sequence. The DataRAM screen (Figure 9) appears. Data begins to appear once the <Refresh> (single time scan) button is clicked, or when the <Keep Scanning> check box is checked. To disable the scan feature, deselect <Keep Scanning>.

The continuous scanning period can be set with the | Options | and | Set Scan Interval | menu selections. The range for this interval is 0 ms to 65,535 ms. Only items that are selected for scanning are scanned within this period.

The bq27531 EVSW provides a logging function which logs the values that were last scanned by EVSW. To enable this function, select the *Start Logging* button; this causes the *Keep Scanning* button to be selected. When logging is *Stopped*, the Keep Scanning button is still selected and has to be manually unchecked.

The logging intervals are specified under the | Options | menu with the maximum value of 65,535 ms. The *Log* interval cannot be smaller than the scan interval because this results in the same value being logged at least twice.

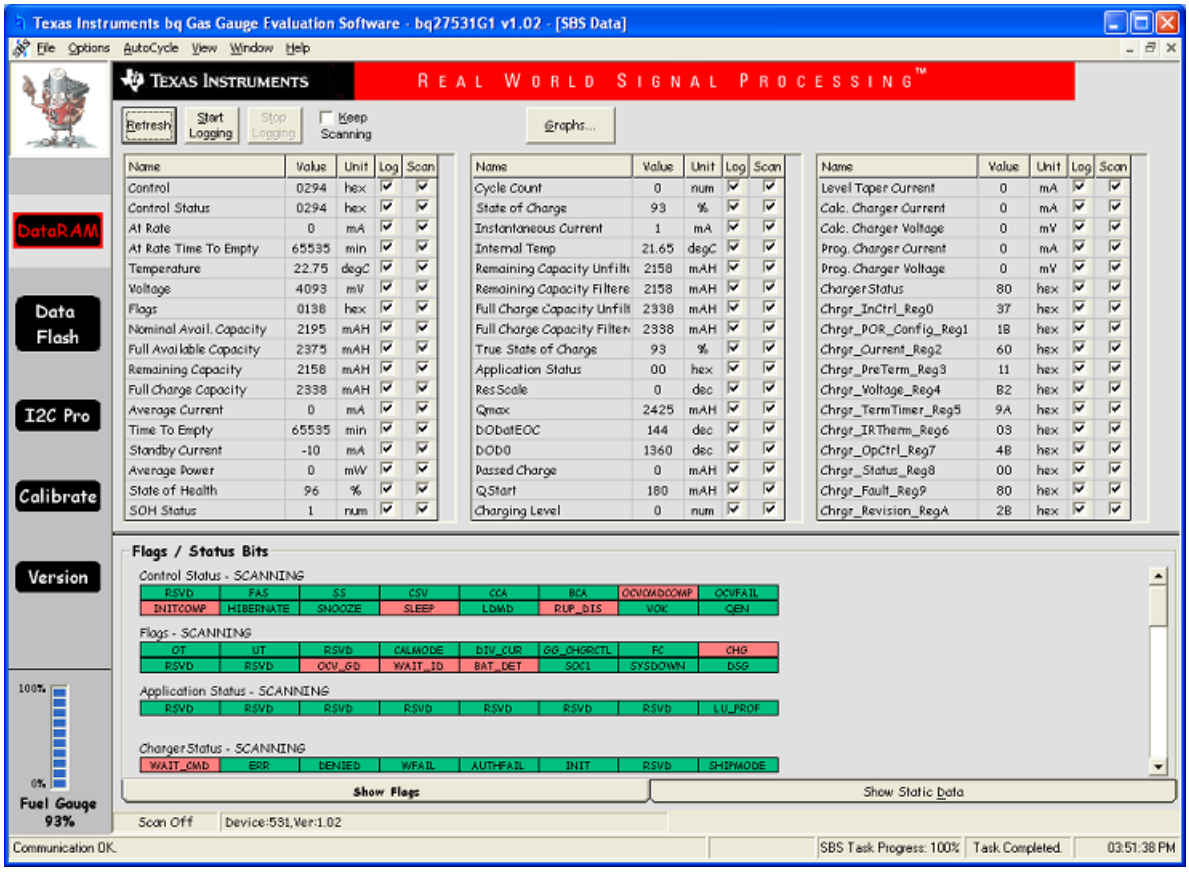

Figure 9. DataRAM Screen

This screen (Figure 9) shows the RAM data set. Additional Flag and Status data can be viewed at the bottom of the DataRAM screen.

Dragging the splitter bar (line that separates the Flags/Status data from Data Ram register values) changes the height of the Flags/Status Data display. Selecting | View |, then | Auto Arrange | returns the splitter bar to its original location.

Copyright © 2013, Texas Instruments Incorporated

6.2 Setting Programmable bq27531 Options

The bq27531 data flash comes configured per the default settings detailed in the bq27531 data sheet. 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 Flash screen (Figure 10).

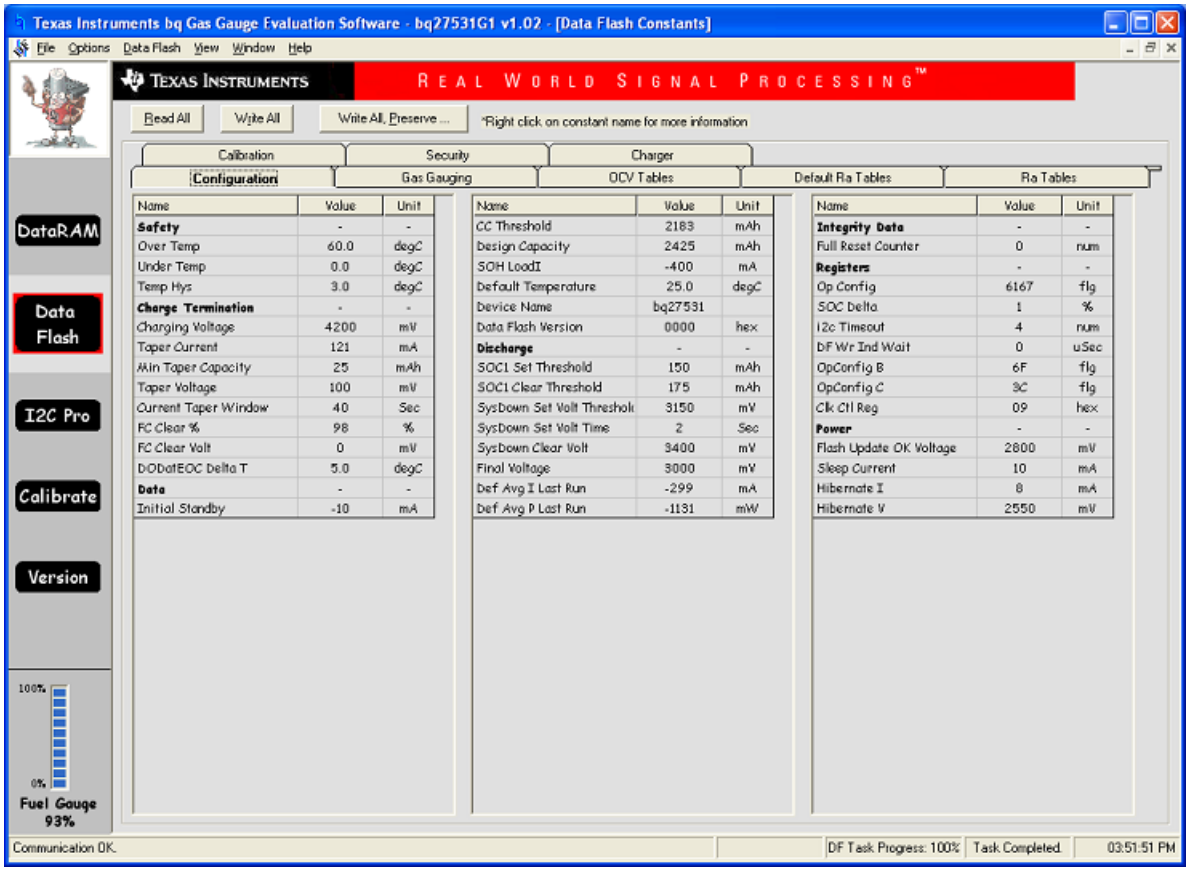

Figure 10. Data Flash Screen

To read all the data from the bq27531 data flash, click on menu option | Data Flash | Read All |.

To write to a data flash location, click on the desired location, enter the data and press <Enter>, which writes the entire tab of flash data, or select menu option | Data Flash | Write All |. The data flash must be read before any writes are performed to avoid any incorrect data being written to the device.

The | File | Special Export | menu options allows the data flash to be exported, but it configures the exported data flash to a learned state ready for mass production use.

The data-flash configuration can be saved to a file by selecting | File | Export | and entering a file name. A data-flash file also can be retrieved in this way, imported, and written to the bq27531 using the | Write All | button.

The module calibration data is also held in the bq27531 data flash.

The bq27531 allows for an automatic data-flash export function, similar to the DataRAM logging function. This feature, when selected via | Options | Auto Export |, exports Data Flash to a sequential series of files named as *FilenameNNNNN.gg* where N = a decimal number from 0 to 9.

The AutoExport interval is set under the | Options menu | with a minimum value of 15 s. The AutoExport filename also is set under the | Options menu |.

Copyright © 2013, Texas Instruments Incorporated

When a check is next to | AutoExport |, the AutoExport is in progress. The same menu selection is used to turn on/off AutoExport.

If the Data Flash screen is blank, then the bq27531 that is being used may not be supported by the bqEVSW version that is being used. An upgrade may be required. Most of the Data Flash also cannot be read if the bq27531 is in Sealed mode.

7 Calibrate Screen

To ensure proper calibration, perform the following steps. These steps may or may not be required, depending on the type of calibration being performed. Only one calibration item can be selected and calibrated at a time.

7.1 To Calibrate 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 11).

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 Pack Current* button.

Copyright © 2013, Texas Instruments Incorporated

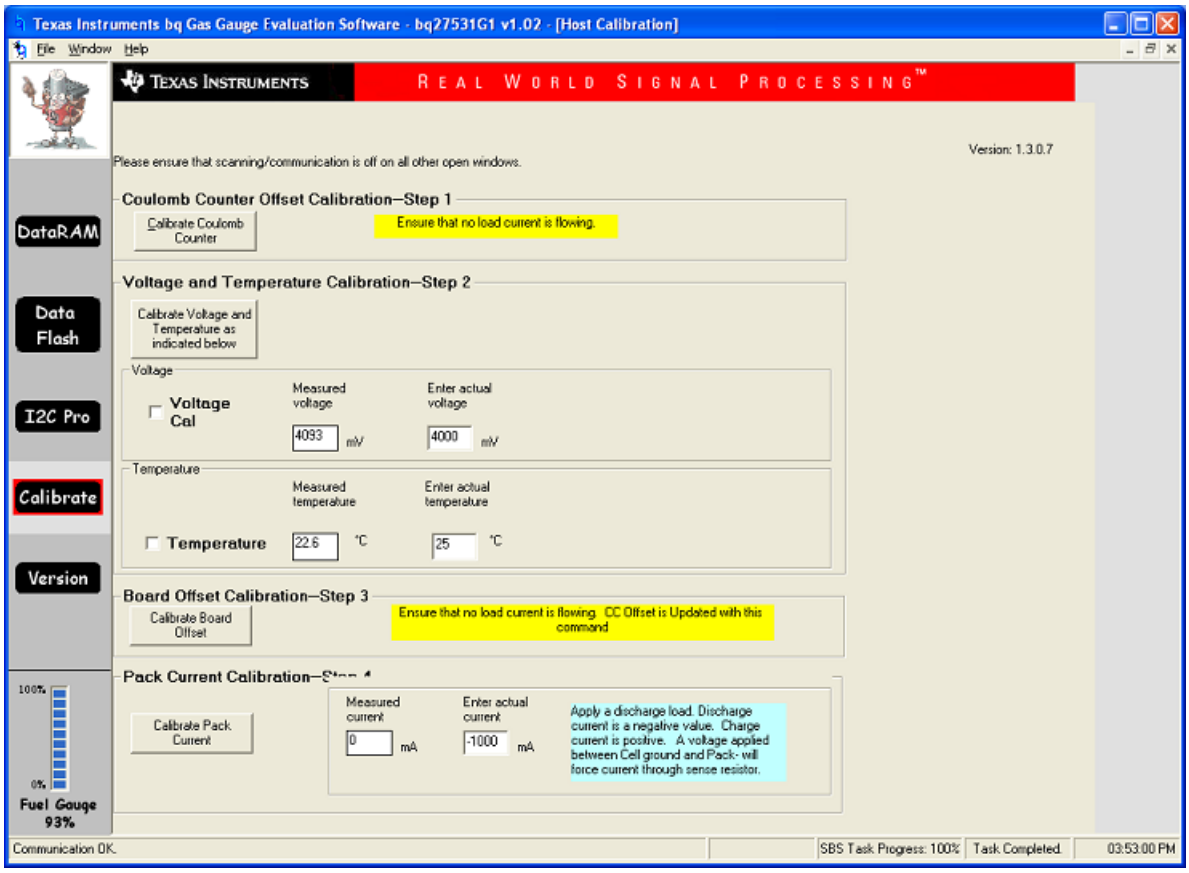

Figure 11. Calibration Screen

Copyright © 2013, Texas Instruments Incorporated

8 I2C Pro Screen

8.1 I²C Communication

The read/write operations of the I2C Pro function is not specific to any gas gauge. These operations serve as general-purpose communication tools (Figure 12).

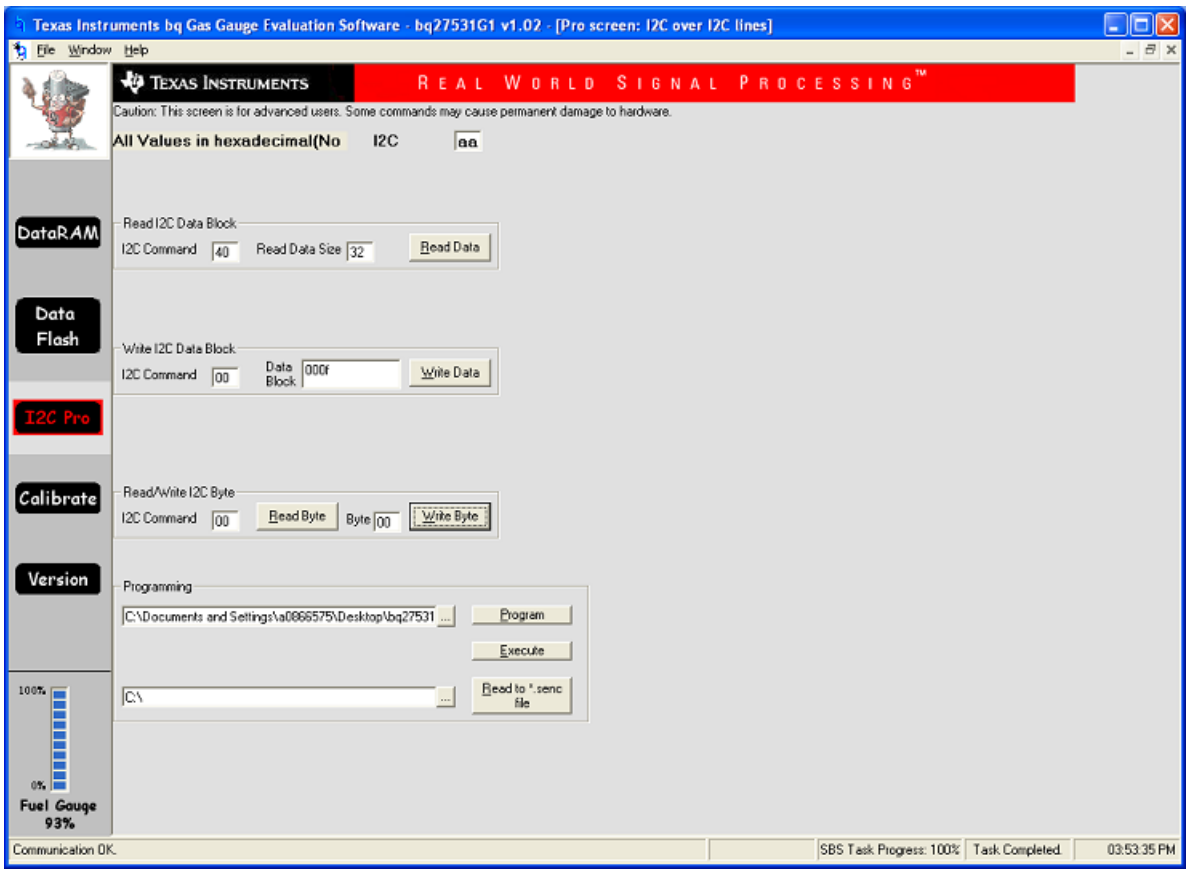

Figure 12. I2C Pro Screen

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)

Copyright © 2013, Texas Instruments Incorporated

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. 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 Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品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２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 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 the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI 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 you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated