bq27545EVM Single-Cell Impedance Track™ Technology Evaluation Module

This evaluation module (EVM) is a complete evaluation system for the bq27545. The EVM includes one bq27545 circuit module, with a current sense resistor, and thermistor. The circuit module includes one bq27545 integrated circuit (IC), and all other onboard components necessary to monitor and predict capacity. The circuit module connects directly across the cell in a battery. With the EV2300/EV2400 interface board and software, the user can read the bq27545 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the bq27545 solution under different charge and discharge conditions.

Contents

List of Figures

List of Tables

1 Features

- Complete evaluation system for the bq27545 gas gauge with Impedance Track™ Technology
- Populated circuit module for quick setup
- PC software (available at power.ti.com) and interface board for easy evaluation
- Software that allows data logging for system analysis

1.1 Kit Contents

- bq27545 circuit module

1.2 Ordering Information

Table 1. Ordering Information

EVM PART NUMBER	CHEMISTRY	CONFIGURATION	CAPACITY
bq27545EVM	Li-ion	1 cell	Any

2 bq27545-Based Circuit Module

The bq27545-based circuit module is a complete and compact example solution of a bq27545 circuit for battery management. The circuit module incorporates a bq27545 battery gas gauge IC, and all other components necessary to accurately predict the capacity of a 1-series Li-Ion cell.

2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the cells: CELL+ and CELL-
- To the serial communications ports (SDA, SCL) or HDQ
- The system load and charger connect across PACK+ and PACK-

2.2   Pin Descriptions

PIN NAME	DESCRIPTION
PACK+	Pack positive terminal
PACK-	Pack negative terminal
CELL+	Cell positive terminal
CELL-	Cell negative terminal
SDA	I^2C™ communication data line
SCL	I^2C communication clock line
HDQ	Single wire communication line

3   bq27545 Circuit Module Schematic

This section contains schematic information.

3.1   Schematic

The schematic follows the bill of materials in this user's guide.

4   Circuit Module Physical Layouts and Bill of Materials

This section contains the printed-circuit board (PCB) layout, bill of materials, and assembly drawings for the bq27545 circuit module.

4.1   Board Layout

This section shows the PCB layers (Figure 1 through Figure 6), and assembly drawing for the bq27545 module.
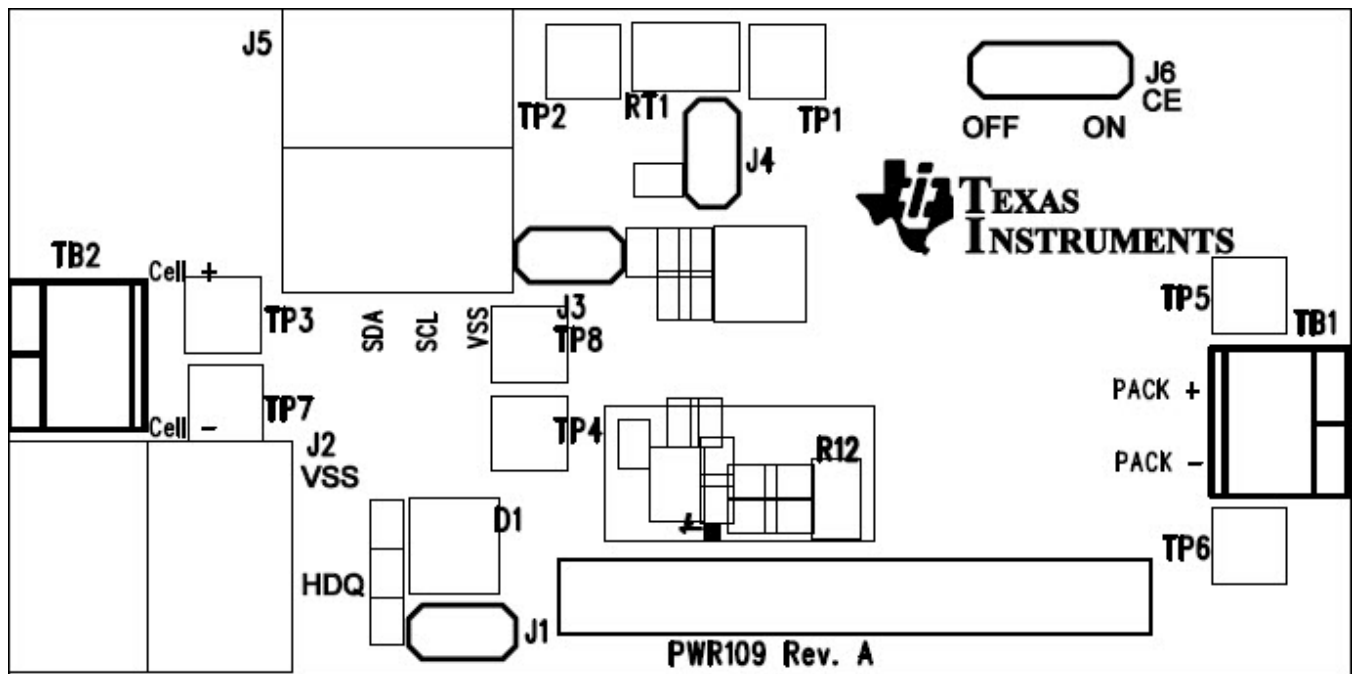

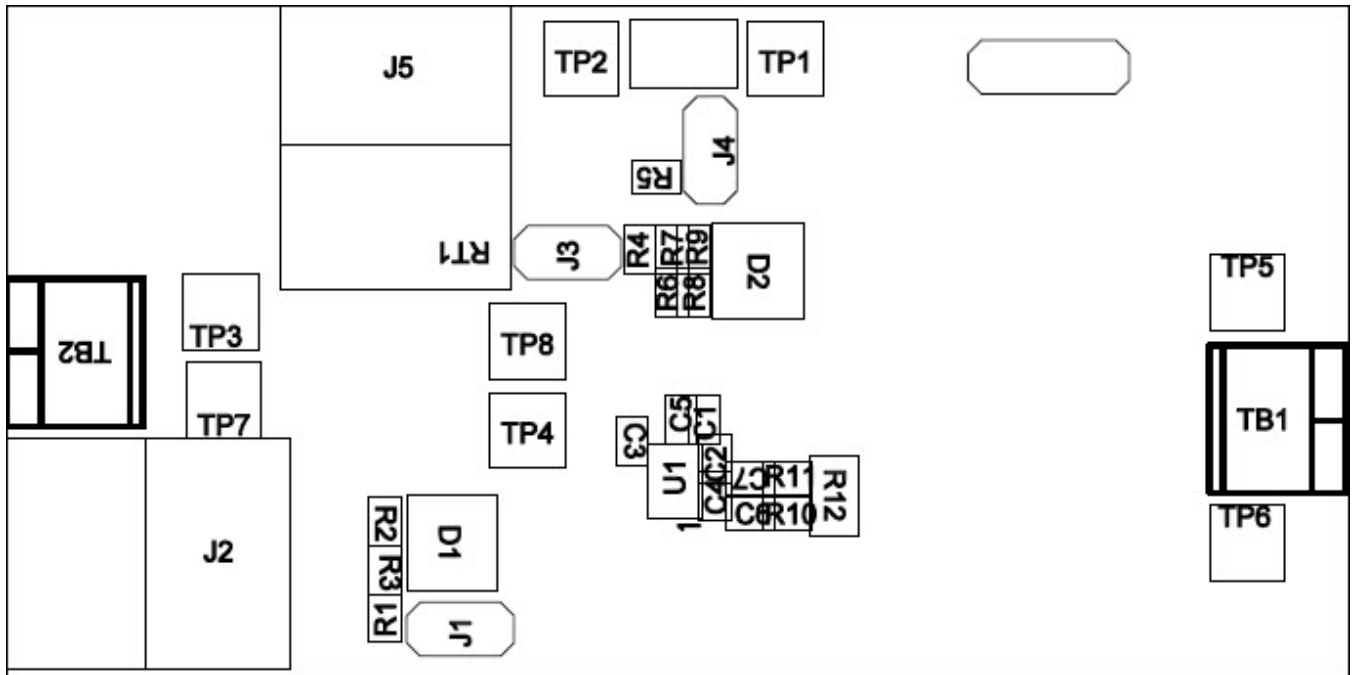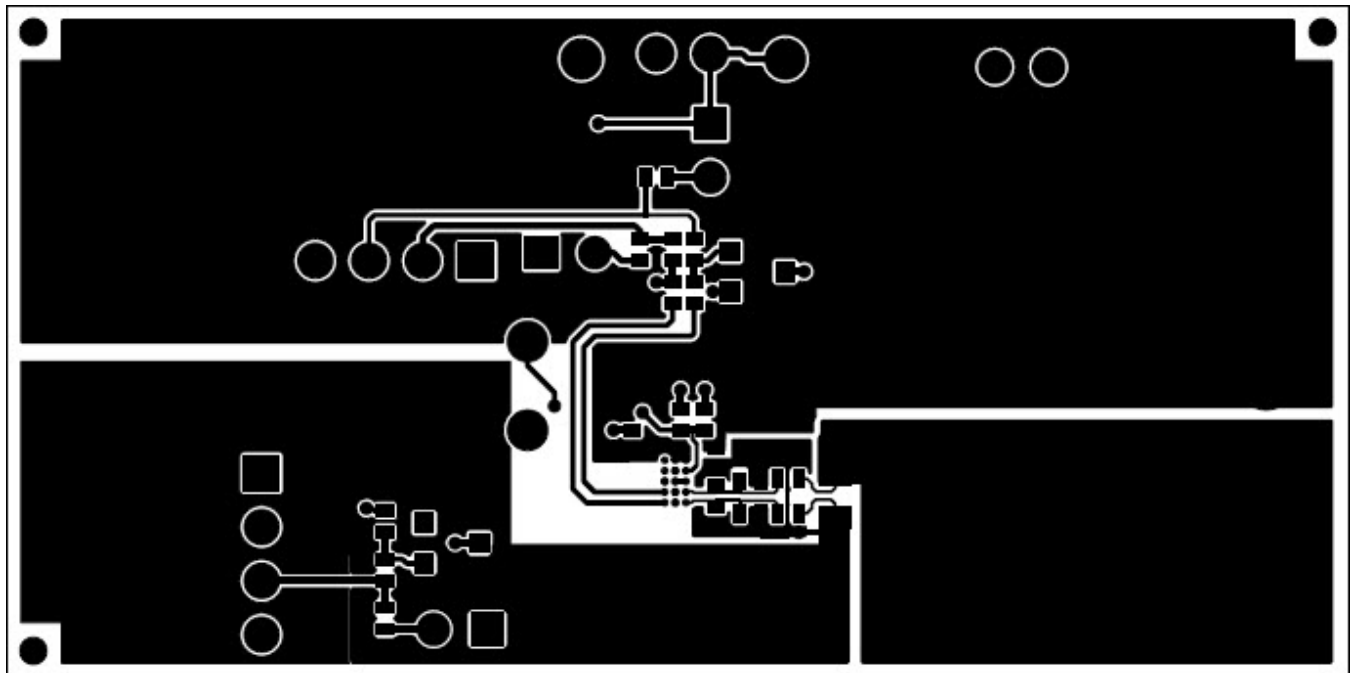**Figure 1. bq27545EVM Layout, Silkscreen**

Figure 2. Top Assembly

Figure 3. Top Layer
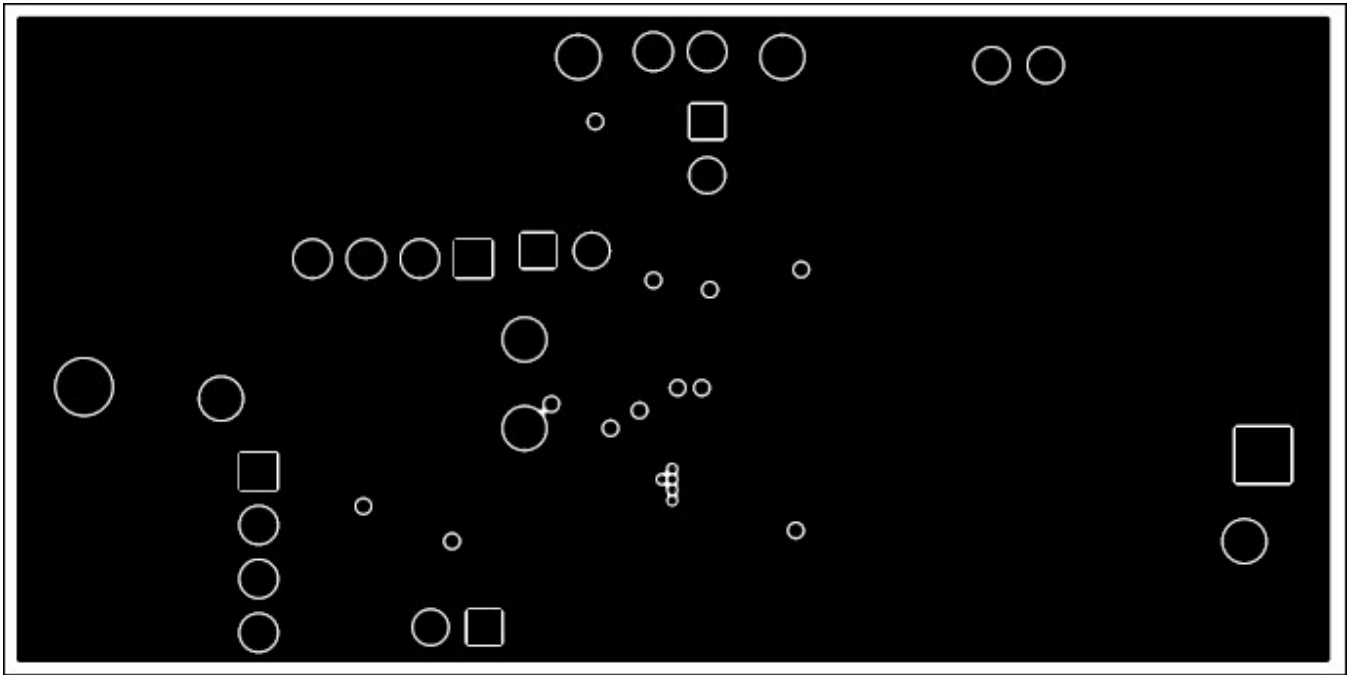
Figure 4. Layer 2

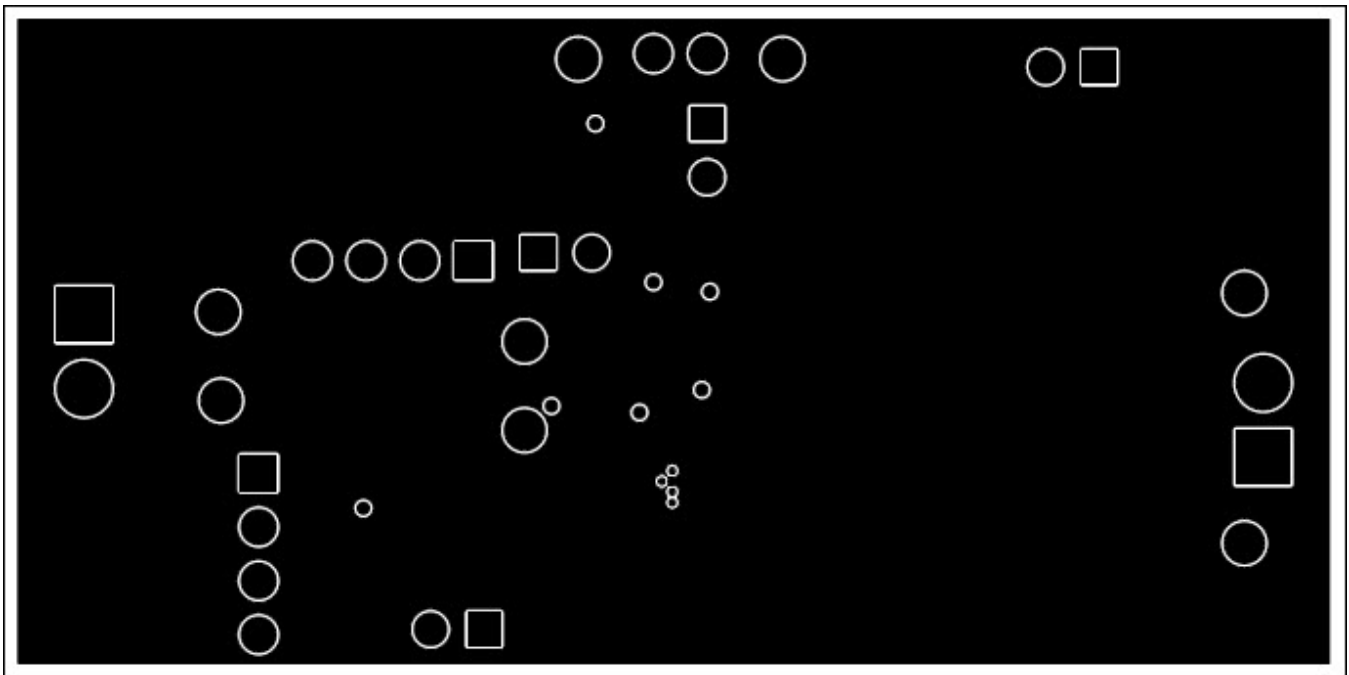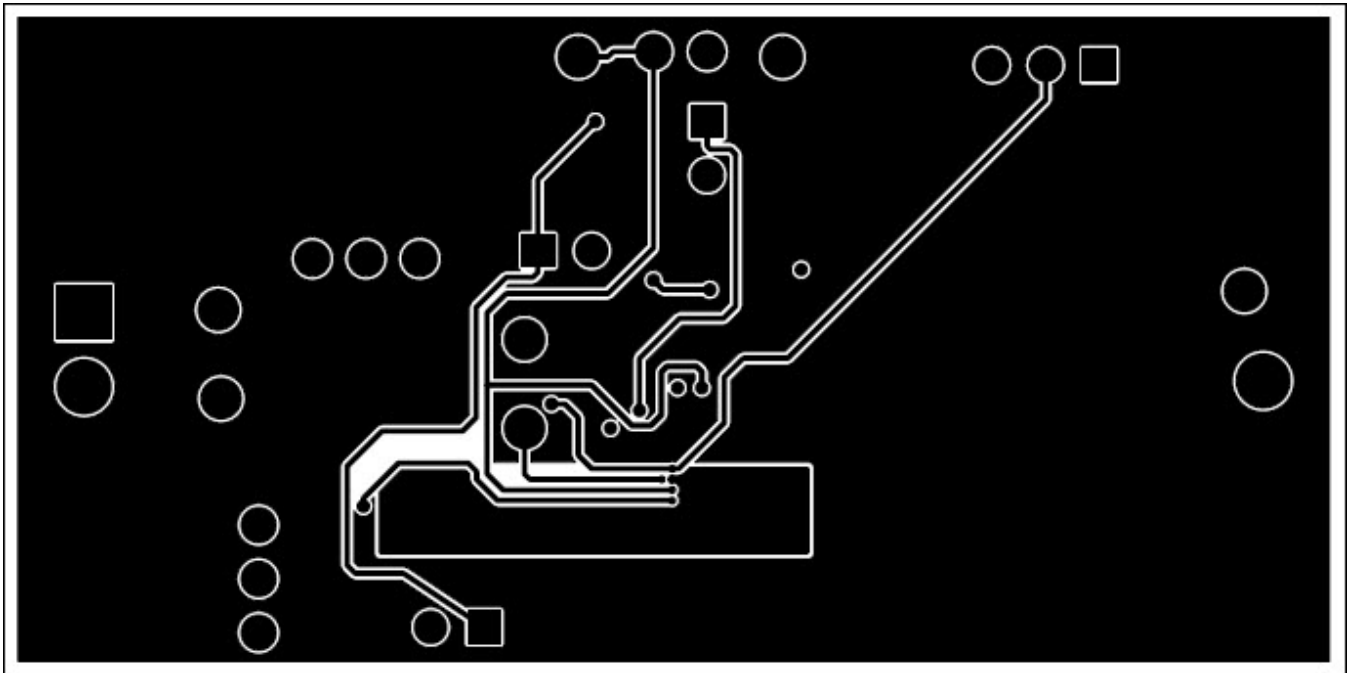**Figure 5. Layer 3**

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Figure 6. Bottom Layer

4.2 Bill of Materials and Schematic

Table 2. Bill of Materials

Count	Ref Des	Description	Size	MFG	Part No.
4	C2, C3, C4, C6, C7	Capacitor, Ceramic, 0.1uF, 10V, X5R, 10%	402	Murata	GRM155R61A104KA01D
1	C5	Capacitor, Ceramic, 6.3V, 1uF, X5R, 10%	402	Murata	GRM155R60J105KE19D
1	C1	Capacitor, Ceramic, 6.3V, 0.47uF, X5R, 10%	402	Murata	GRM155R60J474KE19D
2	D1, D2	Diode, Dual, Zener, 5.6 V, 300mW	SOT23	Diodes	AZ23C5V6-7-F
1	J6	Header, Male 3-pin, 100mil spacing	0.100 inch x 3	Sullins	PEC03SAAN
3	J1, J3, J4	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	Sullins	PEC02SAAN
2	J2, J5	Header, Friction Lock Ass'y, 4-pin Right Angle	0.400 x 0.500	Molex	22-05-3041
8	R2, R3, R6, R7, R8, R9, R10, R11	Resistor, Chip, 100Ω, 1/16-W, 5%	402	Std	Std
1	R1	Resistor, Chip, 4.7kΩ, 1/16-W, 5%	402	Std	Std
2	R4, R5	Resistor, Chip, 10kΩ, 1/16-W, 5%	402	Std	Std
1	R12	Resistor, Chip, 0.01Ω, 1/4W, 1%, 75ppm	402	Std	Std
1	RT1	Thermistor, 10K ohms	0.095 X 0.150 inch	Semitec	103AT-2
2	TB1, TB2	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	OST	ED555/2DS
6	TP1, TP2, TP4, TP6, TP7, TP8	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	Keystone	5001
2	TP3, TP5	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	Keystone	5000
4	--	Shunt, 100mil, Black	0.100	3M	929950-00
1	U1	IC, Impedance-Track Fuel Gauge for Battery Pack Integration	BGA-15	TI	BQ27545YZFR-G1

Figure 7. Schematic

4.3   bq27545 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq27545 circuit module.

Table 3. Performance Specification Summary

Specification	Min	Typ	Max	Units
Input voltage Pack+ to Pack–	2.7	3.6	4.4	V
Input voltage CELL+ to CELL-	2.7	3.6	4.4	V
Charge and discharge current	0	1	2	A

5   EVM Hardware and Software Setup

This section describes how to install the bq27545EVM PC software, and how to connect the different components of the EVM.

5.1   System Requirements

The bq27545EVSW software requires Windows® XP if using EV2300 and Windows XP or newer if using EV2400. Drivers for Windows 98SE are provided, but Microsoft no longer supports Windows 98; Windows 98 may 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.

5.2   Software Installation

Find the latest software version in the bq27545 tool folder on power.ti.com. Make a search by part number for bq27545 to access the tool folder.

5.2.1   Using EV2300

Use the following steps to install the bq27545EVSW 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 bq27545 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.

5.2.2   Using EV2400

Use the following steps to install the bq27545EVSW software when 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 bq27545 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. Before starting the EVSW, connect the EV2400 to the computer using the USB cable.

6. Wait for 20 seconds or until windows installs the driver.

6 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.

7 Hardware Connection

The bq27545EVM comprises three hardware components: the bq27545 circuit module, the EV2300/EV2400 PC interface board, and the PC.

7.1 Connecting the bq27545 Circuit Module to a Battery Cell

Figure 8 shows how to connect the bq27545 circuit module to the cell and system load or charger.
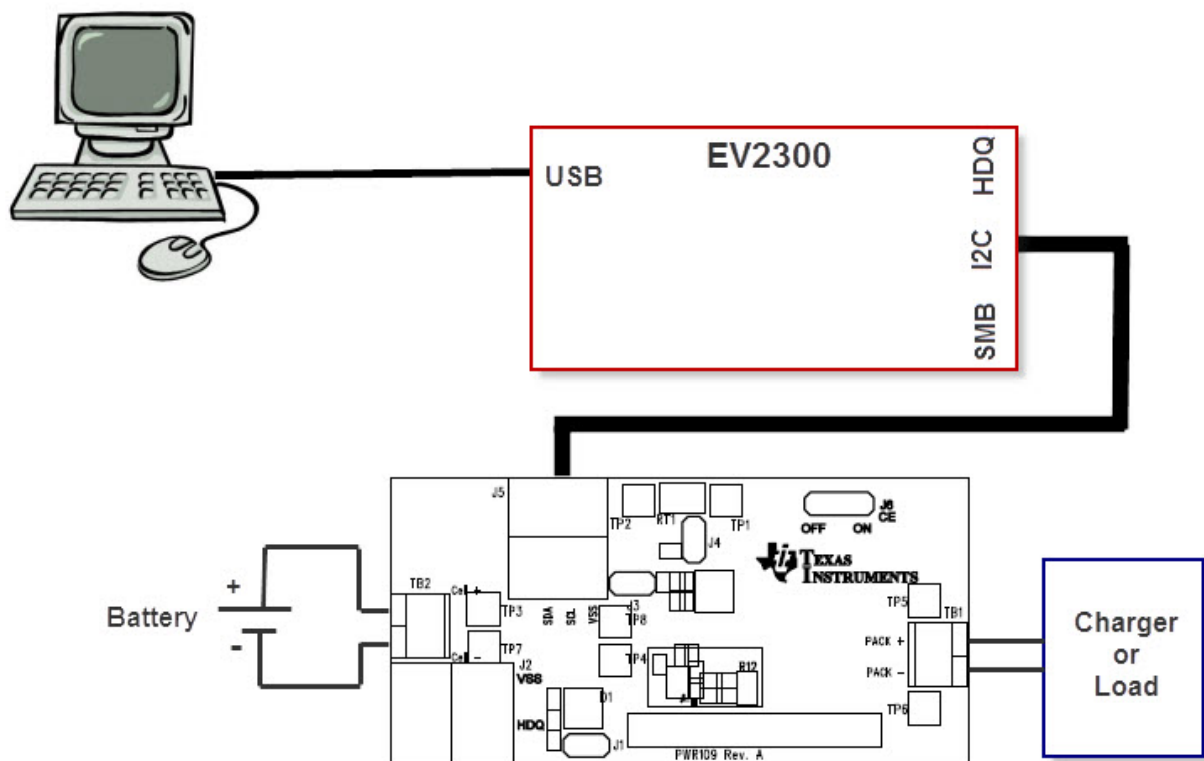

Figure 8. bq27545 Circuit Module Connection to Cell and System Load or Charger

7.2 PC Interface Connection

The bq27545 can be configured as an HDQ communication device or left in default as an I^2C device. Once the bq27545 is configured for HDQ communication, it cannot be reverted to I^2C mode. Refer to chapter 12 of this document for information on configuring the bq27545 to HDQ mode.

The following steps configure the hardware for interfacing to the PC:

1. Connect the bq27545-based pack to the EV2300/EV2400 using wire leads as shown in Table 4.

Table 4. Circuit Module to EV2300/EV2400 Connections – I^{2}C

bq27545-Based Battery (I^{2}C mode)	EV2300 (I^{2}C port)	EV2400 (Port 2, I^{2}C)
SDA	SDA 3	SDA 2.3
SCL	SCL 2	SCL 2.2
VSS	GND 1	VSS 2.1

Table 5. Circuit Module to EV2300/EV2400 Connections – HDQ

bq27545-Based Battery (HDQ mode)	EV2300 (HDQ port)	EV2400 (Port 3, HDQ)
HDQ	HDQ 3	SDA 3.3
VSS	GND 1	VSS 3.1

2. Connect the PC USB cable to the EV2300/EV2400 and the PC USB port.

The bq27545EVM is now set up for operation.

8   Operation

This section details the operation of the bq27545 EVSW software.

8.1   Starting the Program

Run bq27545 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 via 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 bq27545 EVSW provides a logging function which logs the values that were last scanned by the EVSW. To enable this function, select the *Start Logging* button, which 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 scan interval because this results in the same value being logged at least twice.
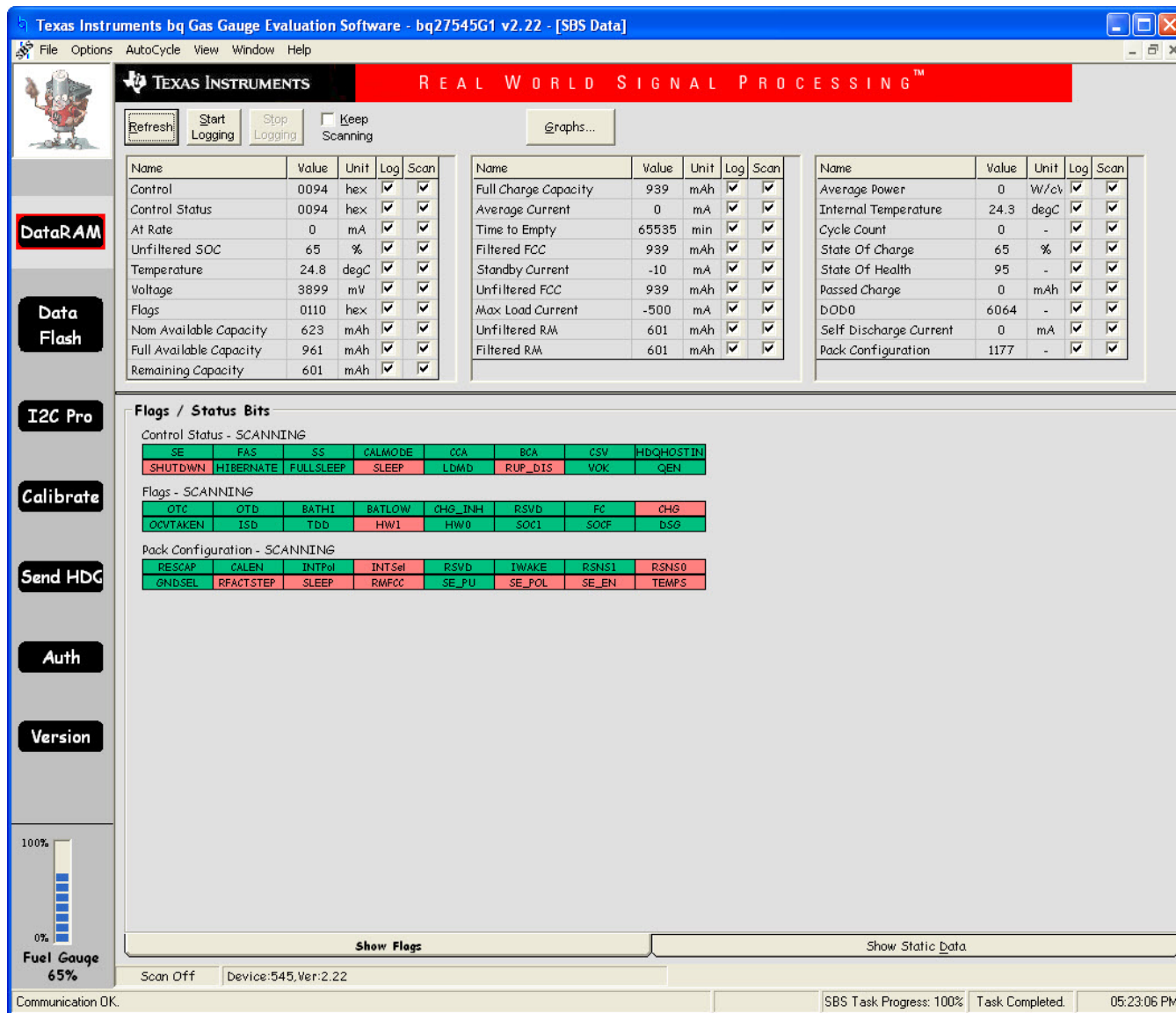
Figure 9. DataRAM Screen

This screen (Figure 9) shows the DataRAM data set. Additional Flags/Status Bits data can be viewed at the bottom of the DataRAM screen.

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

8.2   Setting Programmable bq27545 Options

The bq27545 data flash comes configured per the default settings detailed in the bq27545 data sheet (SLUSAT0). Ensure that the settings are correctly changed to match the pack and application for the bq27545 solution being evaluated.

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

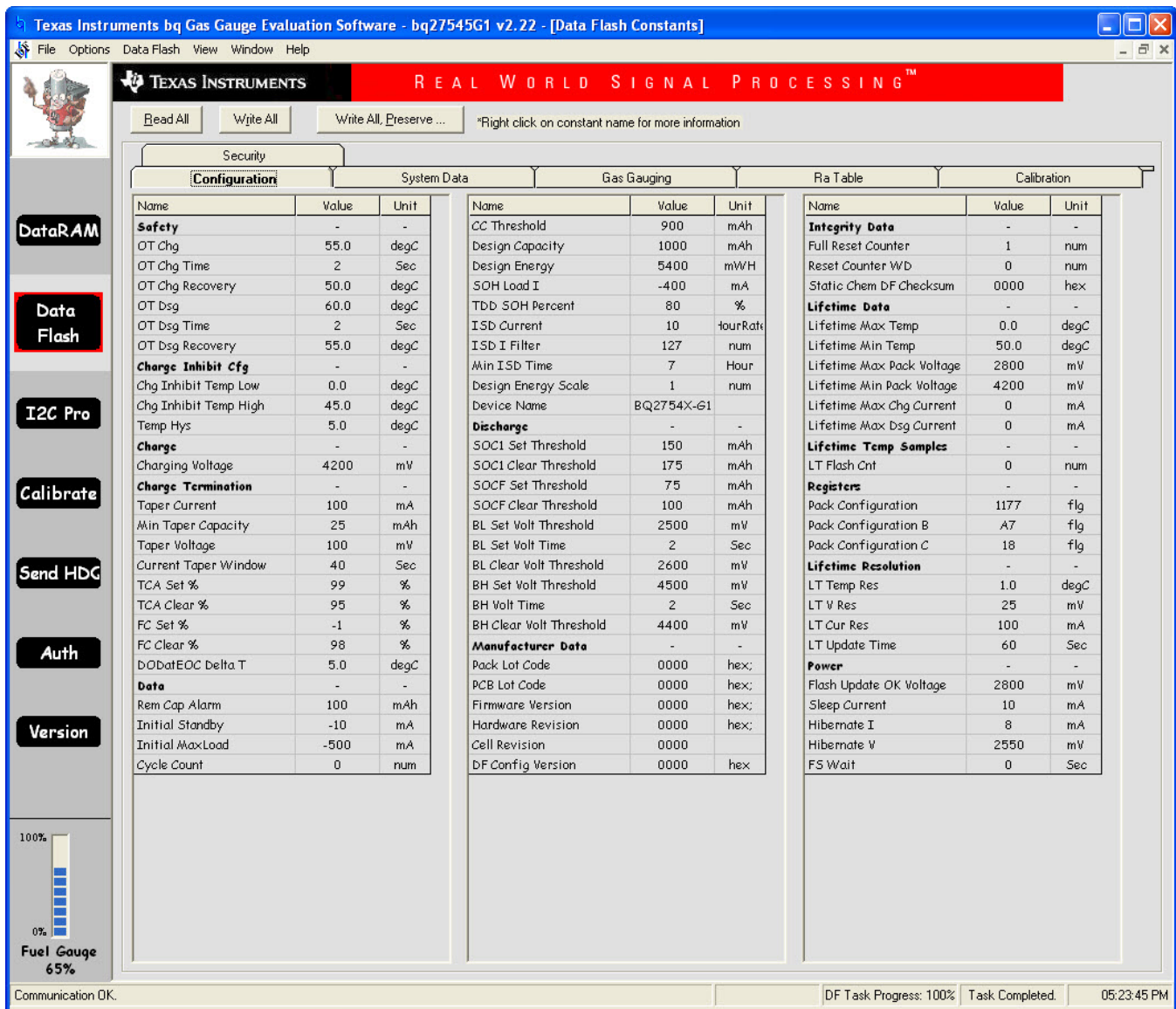The settings can be configured using the Data Flash screen (Figure 10).

Figure 10. Data Flash Screen

To read all the data from the bq27545 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 can also be retrieved in this way, imported, and written to the bq27545 using the | Write All | button.

The module calibration data is also held in the bq27545 data flash.

The bq27545 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 is also set under the | Options menu |.

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

If the data flash screen is blank, then the bq27545 that is being used may not be supported by the bqEVSW version that is being used. An upgrade may be required.

9 Calibrate Screen

To ensure proper calibration, proceed in the order that follows. These steps may or may not be required, depending on the type of calibration being performed.

9.1 Calibrate the bq27545

The bq27545 EVSW allows the user to calibrate for voltage, current and temperature measurements (see Figure 11). Select the types of calibration to be performed .

Enter the measured values for the types selected.

9.2 CC Offset Calibration

This performs the internal calibration of the coulomb counter input offset.

9.3 Voltage Calibration

Remove the load applied between Pack+ and Pack-.

Ensure that voltage is stable before performing voltage calibration. Measure the voltage across Pack+ and Pack-. Type the voltage value in mV into Enter Actual Voltage .

Ensure that Voltage Cal checkbox is selected. Press the *Calibrate Voltage and Temperature as indicated below* button to calibrate.

9.4 Temperature Calibration

Measure the temperature for PACK. Type the temperature value into Enter Actual Temperature.

Ensure that Temperature checkbox is selected. Press the *Calibrate Voltage and Temperature as indicated below* button.

9.5 Board Offset Calibration

This performs the offset calibration for the current offset of the board.

It is expected that no current is flowing through the sense resistor while performing this calibration step. Remove load or external voltage and short Pack- to Batt-.

Press the *Calculate Board Offset* button.

9.6 Pack Current Calibration

Connect a load to LOAD– and LOAD+ that draws approximately 1 A, or connect a current source to LOAD– and Pack-. Measure the current and type value into Enter Actual Current using (-) for current in discharge direction.

Press the *Calculate Pack Current* button.

Figure 11. Calibration Screen

10 I2C Pro Screen

10.1 I²C Communication

The set of read or write operations over I²C are not specific to any gas gauge. These are provided as general-purpose communication tools (Figure 12).
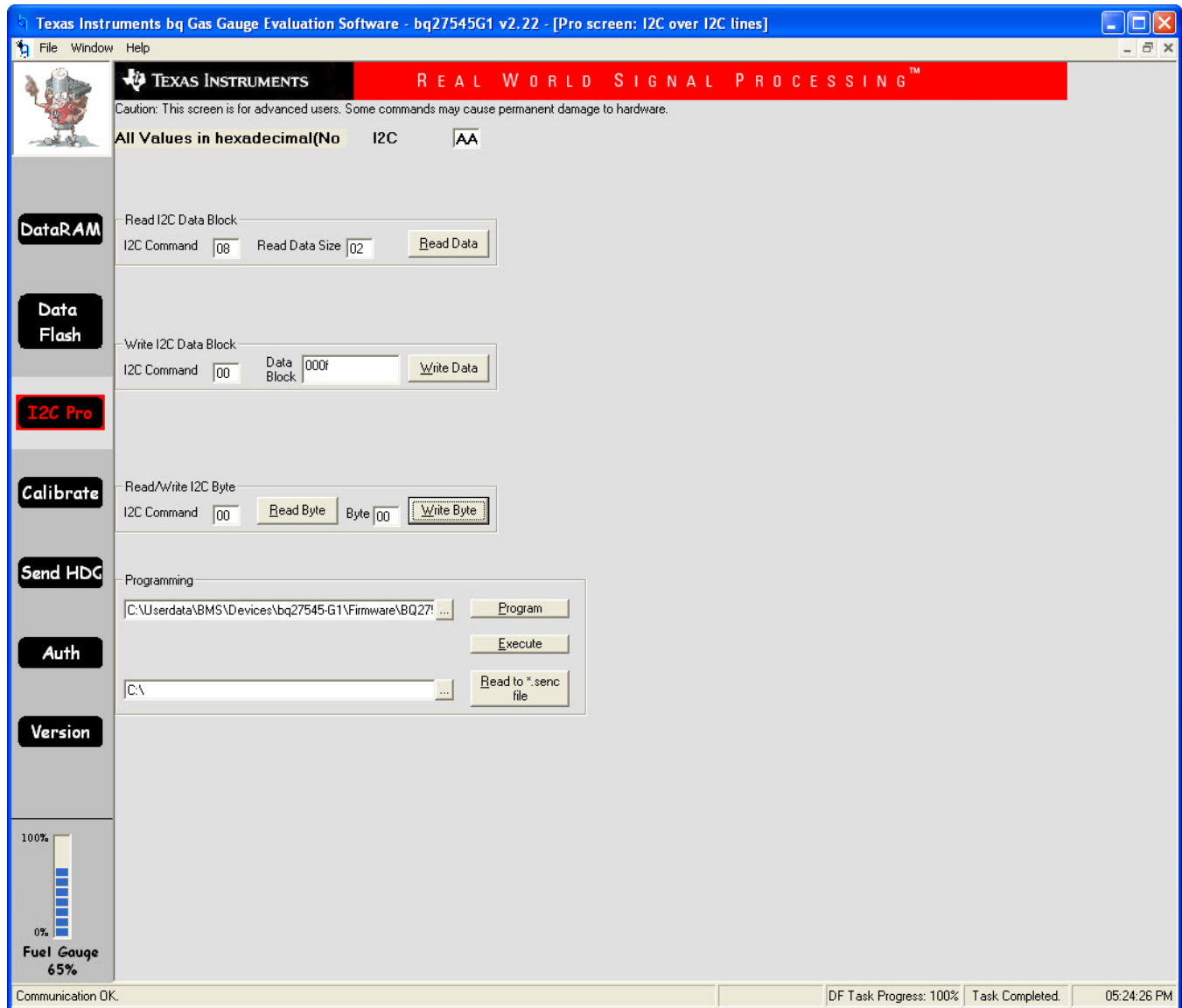

Figure 12. I2C Pro Screen

11   bqConfig

11.1   Configuration Tool

For research, development, and testing purposes the bq27545 EVSW can be used to view and log RAM registers as well as to view and modify certain DATAFLASH settings. However, TI also provides another standalone software tool called bqConfig which can be used to program the most common DATAFLASH registers, to perform calibration, and to generate a final image file that can be used in mass production. The wizard in bqConfig guides the user through the process to create a .dmi file, which contains all the DATAFLASH data of bq27545. Furthermore, bqConfig can also generate the .dffs file that is typically used to program the bq27545 in mass production.

The bqConfig tool can be downloaded from the bq27545 product page at power.ti.com.

12   Send HDQ Screen

To configure a bq27545 into HDQ mode, navigate to the *Send HDQ* screen. It is possible that all the screen options on the left are not visible depending on screen resolution. If needed, scroll within the left menu to access the *Send HDQ* link. Click on the "Change comm to HDQ8" button while having the bq27545 connected to the EV2300/EV2400 via I^{2}C. Clicking on the button causes a message to appear indicating that the process is not reversible and to confirm if the actions are desired. Also, it explains what to do once the HDQ mode has been activated.

Once converting the bq27545 into HDQ mode, it is required that you connect the HDQ terminal of the EV2300/EV2400 with the HDQ connector (J4) of the bq27545 EVM, then restart the EVSW, and select the "bq27545HDQR1" with the proper firmware version from the list of supported devices within the EVSW.
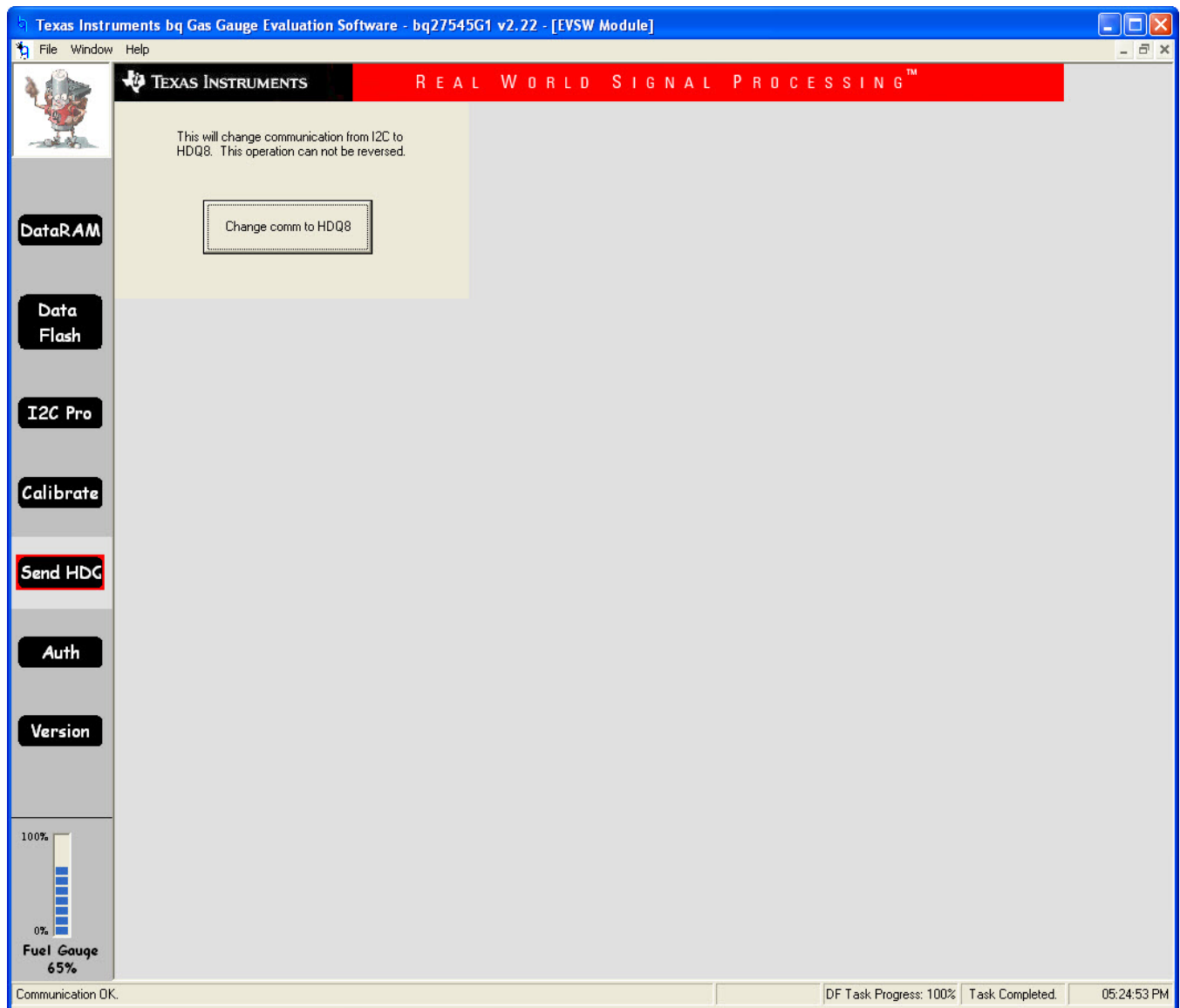
Figure 13. Send HDQ Screen

13   Related Documentation From Texas Instruments

- *bq27545, Single Cell Li-Ion Battery Fuel Gauge for Battery Pack Integration* data sheet ([SLUSAT0](#))

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

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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.

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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
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http://www.tij.co.jp

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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.

IMPORTANT NOTICE

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