

bq27520EVM With System-Side, Single-Cell Impedance Track™ Technology

This evaluation module (EVM) is a complete evaluation system for the bq27520. The EVM includes one bq27520 circuit module, a current sense resistor, and one thermistor. An EV2300 board is required to interface this EVM with the PC and can be purchased separately. The circuit module includes one bq27520 integrated circuit and all other onboard components necessary to monitor and predict capacity for a system-side fuel gauge solution. The circuit module connects directly across the battery pack. With the EV2300 interface board and software, the user can read the bq27520 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the bq27520 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.

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1 Features

- Complete evaluation system for the bq27520 gas gauge with Impedance Track technology
- Populated circuit module for quick setup
- Personal computer (PC) software and interface board for easy evaluation
- Software that allows data logging for system analysis
- Ability to upgrade to the latest firmware version by flash reprogramming

1.1 Kit Contents

- bq27520 circuit module (HPA568)
- NTC103AT thermistor

This EVM is used for the evaluation of different bq27520-based products. 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
bq27520EVM	Li-ion	1 cell	Any

2 bq27520-Based Circuit Module

The bq27520-based circuit module is a complete and compact example solution of a bq27520 circuit for battery management. The circuit module incorporates a bq27520 battery gas gauge integrated circuit (IC) and all other components necessary to accurately predict the capacity of 1-series Li-ion cell.

2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the battery pack (J2 or J3): PACK+, PACK–, and TS
- To the serial communications port (J8): SDA, SCL, and VSS
- The system load and charger connect across charger and load (J6 and J7): CHARGER–/LOAD– and CHARGER+/LOAD+.
- Access to signal outputs (J5): SOC_INT, BAT_GD, and BAT_LOW

2.2 Pin Descriptions

PIN NAME	DESCRIPTION
PACK+	Pack positive terminal
PACK–	Pack negative terminal
TS	Pack thermistor input that leads to IC TS pin
SDA	I ² C communication data line
SCL	I ² C communication clock line
VSS	Signal return for communication line, shared with charger and ground
CHG+/LOAD+	High potential of load or charger connection
CHG–/LOAD–	Low potential of load or charger connection (system VSS)
BAT_GD	Access to push-pull output that indicates that pack is ready to be connected to system

PIN NAME	DESCRIPTION
BAT_LOW	Access to push-pull output that signals low State-of-Charge (SOC)
SOC_INT	Access to open-drain output that signals interrupt for changes in SOC

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 bq27520 circuit module.

3.1 Board Layout

This section shows the printed-circuit board (PCB) layers (Figure 1 through Figure 4), assembly drawing, and schematic for the bq27520 module.

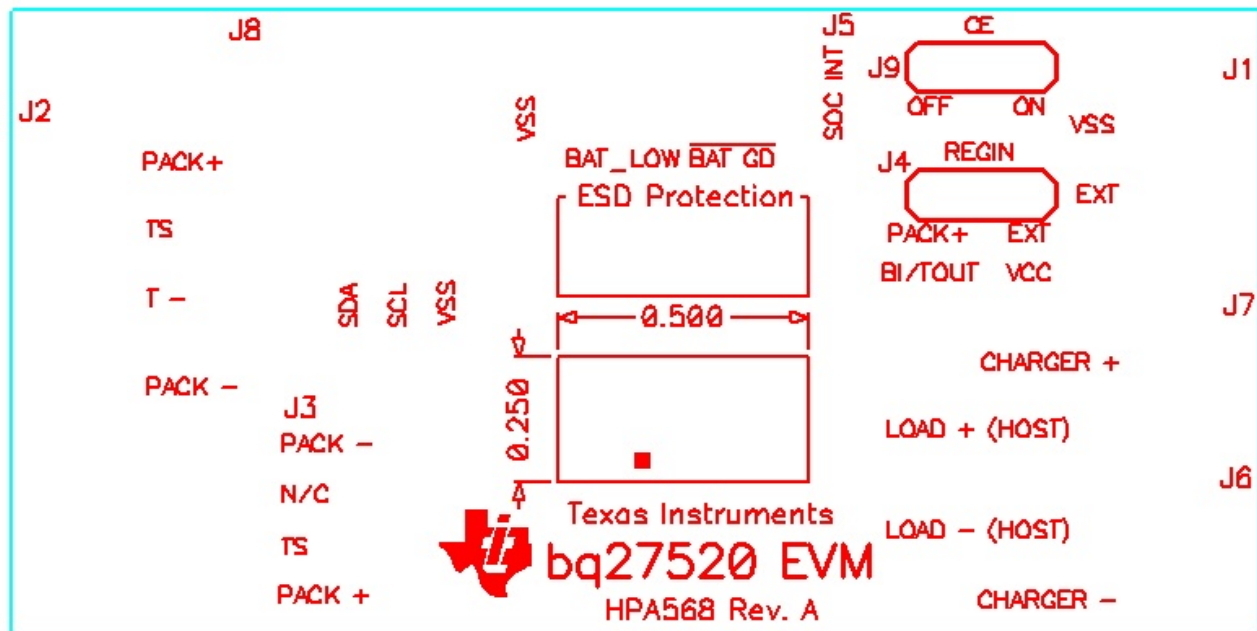


Figure 1. bq27520EVM-001 Layout – Silk Screen

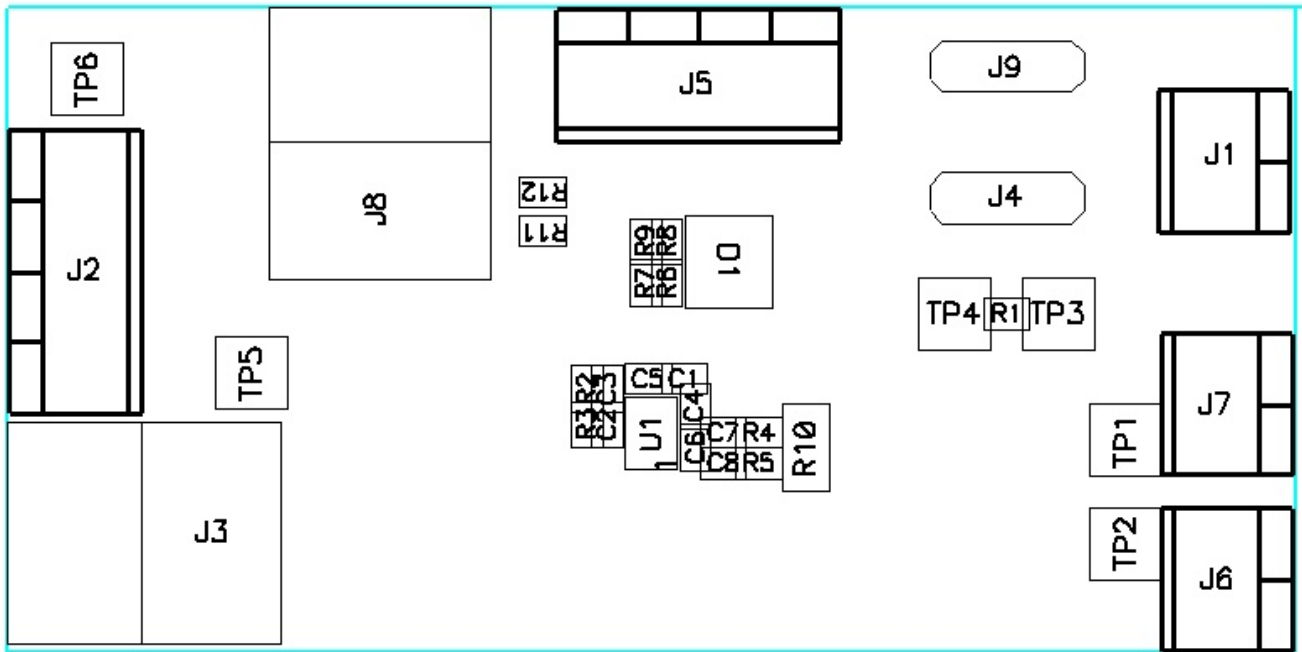


Figure 2. Top Assembly

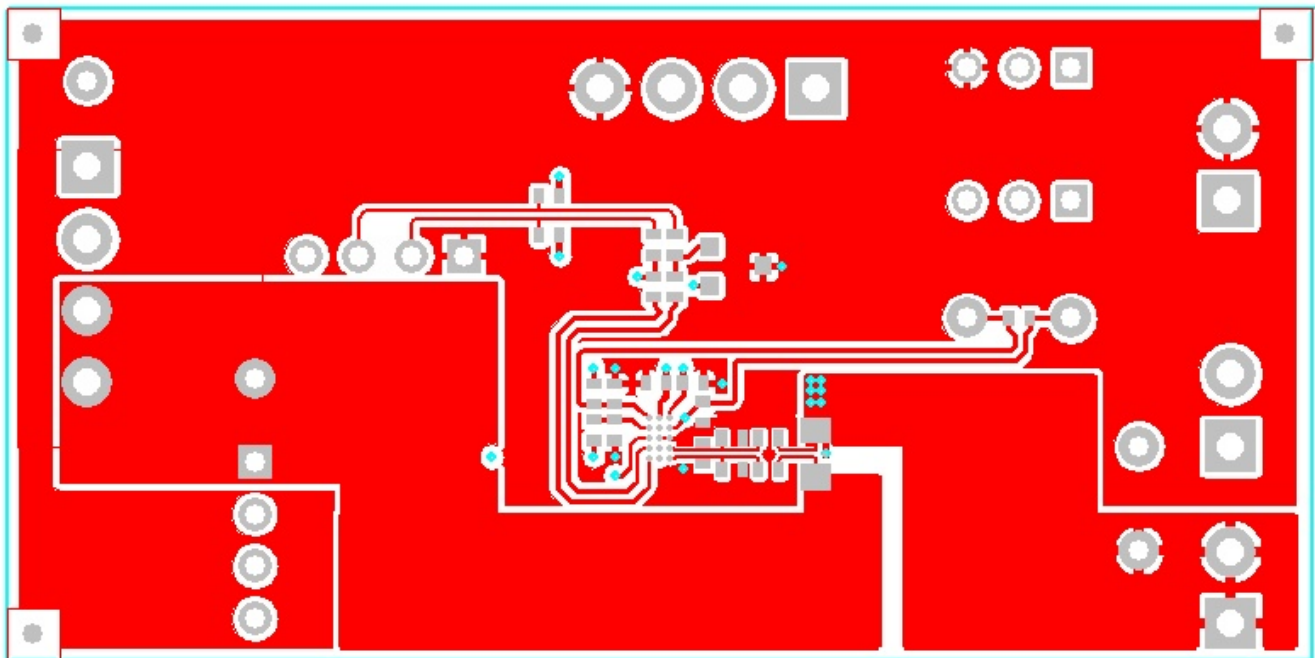
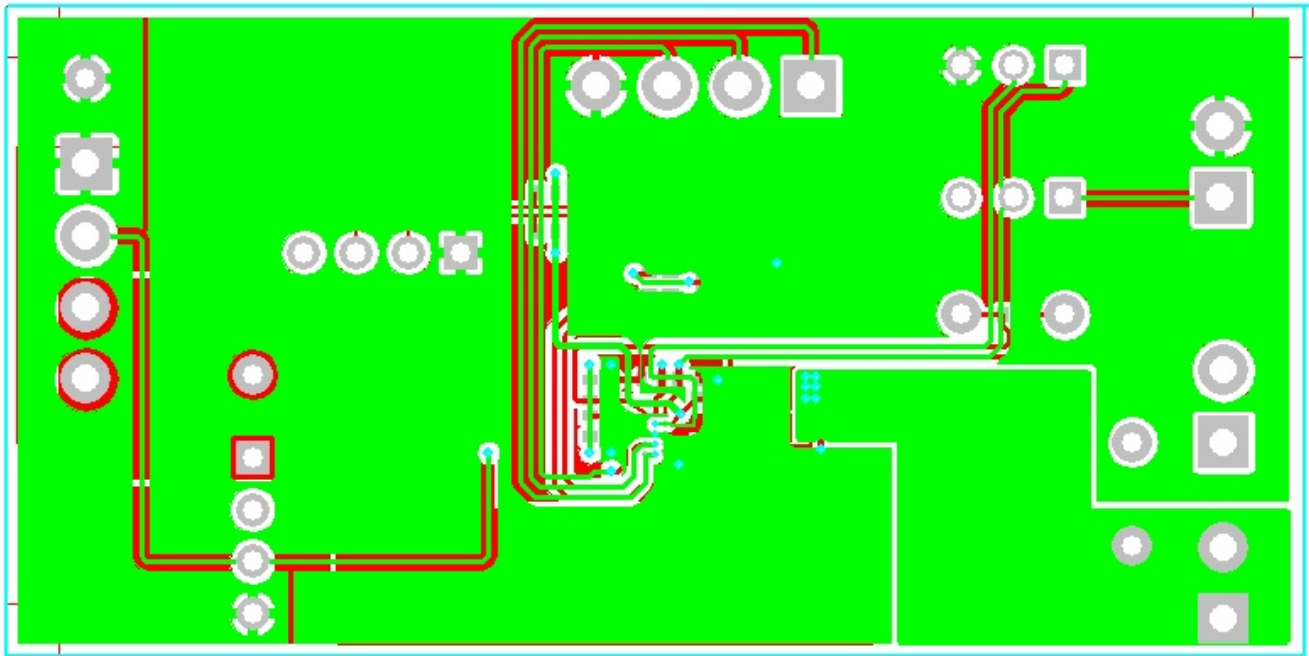


Figure 3. Top Layer


Figure 4. Bottom Layer

3.2 Bill of Materials and Schematic

Table 2. Bill of Materials

Count	Ref Des	Description	Size	MFG	Part Number
6	C1, C2, C5–C8	Capacitor, Ceramic, 0.1 μ F, 10 V, X5R	0402	Murata	GRM155R61A104KA01D
1	C3	Capacitor, Ceramic, 33 nF, 10 V, X7R, +/-10%	0402	Murata	GRM155R71A333KA01D
1	C4	Capacitor, Ceramic, 1 μ F, 6.3V, X5R	0402	Murata	GRM155R60J105KE19D
1	D1	Diode, Dual, Zener, 5.6 V, 300 mW	SOT23	Diodes	AZ23C5V6-7
3	J1, J6, J7	Terminal Block, 2-pin, 6 A, 3.5 mm	0.27 x 0.25 inch	OST	ED555/2DS
2	J2, J5	Terminal Block, 4-pin, 6 A, 3.5 mm	0.55 x 0.25 inch	OST	ED555/4DS
2	J3, J8	Header, Friction Lock Assy, 4-pin Right Angle,	0.400 x 0.500	Molex	22-05-3041
2	J4, J9	Header, Male 3-pin, 100-mil spacing, (36-pin strip)	0.100 inch x 3	Sullins	PEC36SAAN
1	R1	Resistor, Chip, 1.80 M Ω , 1/16 W, 5%	0402	Std	Std
1	R10	Resistor, Chip, 0.01 Ω , 1/4 W, 1%	0805	Vishay	WSL0805R0100FEA18
2	R11, R12	Resistor, Chip, 10 k Ω , 1/16 W, 5%	0402	Std	Std
1	R2	Resistor, Chip, 18.2 k Ω , 1/16 W, 5%	0402	Std	Std
1	R3	Resistor, Chip, 1 k Ω , 1/16 W, 5%	0402	Std	Std
6	R4–R9	Resistor, Chip, 100 Ω , 1/16 W, 5%	0402	Std	Std
3	TP1, TP3, TP6	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	Keystone	5000
2	TP2, TP5	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	Keystone	5001
1	TP4	Test Point, White, Thru Hole Color Keyed	0.100 x 0.100 inch	Keystone	5002
1	U1	IC, System-Side Impedance-Track Fuel Gauge	BGA	Texas Instruments	BQ27520YZF

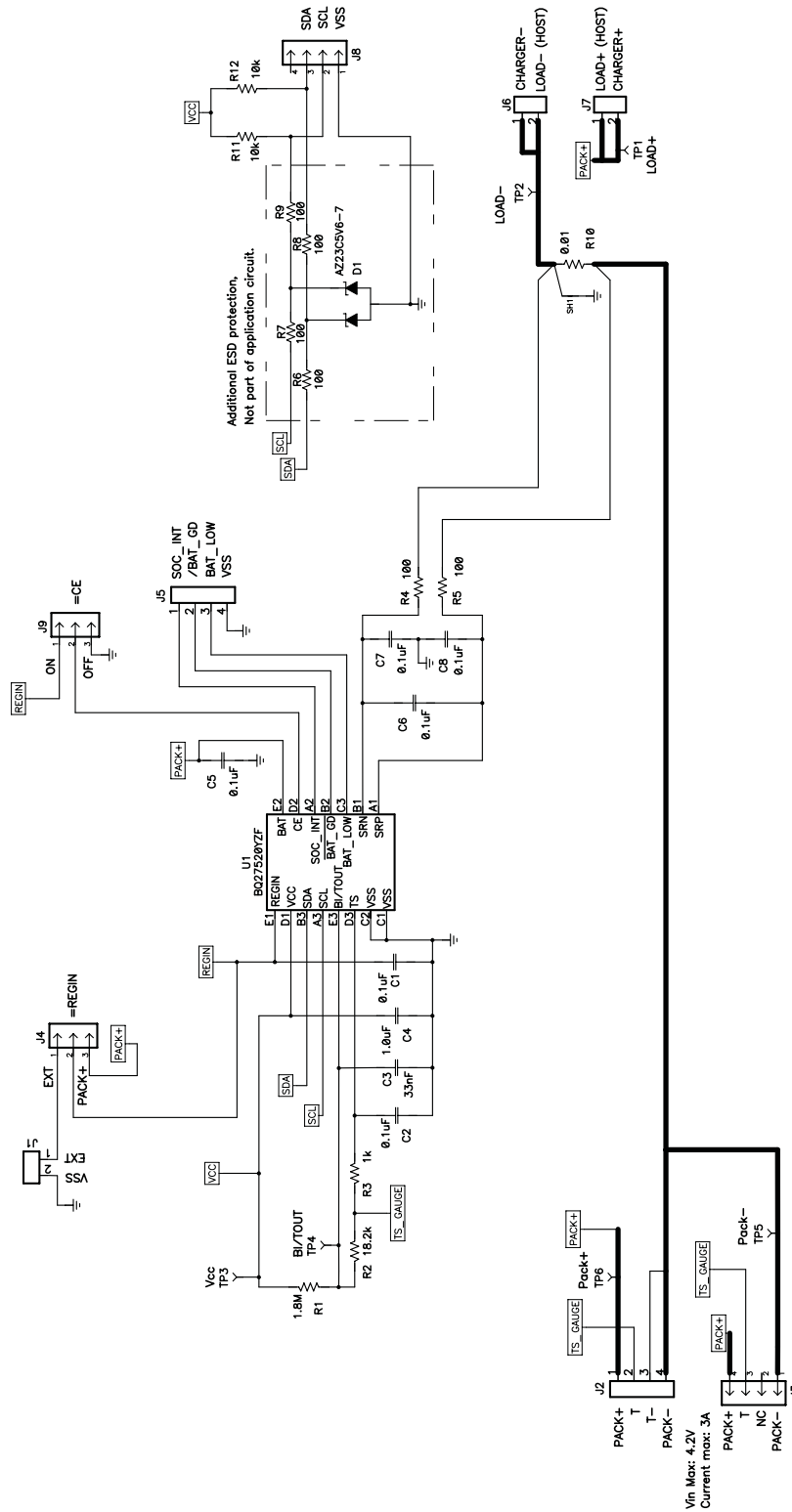


Figure 5. Schematic

3.3 bq27520 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq27520 circuit module.

Table 3. Performance Specification Summary

Specification	Min	Typ	Max	Units
Input voltage Pack+ to Pack-	2.7	3.6	4.3	V
Charge and discharge current	0	1	2	A

4 EVM Hardware and Software Setup

This section describes how to install the bq27520EVM PC software and how to connect the different components of the EVM.

4.1 System Requirements

The bq27520EVSW 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.

4.2 Software Installation

Find the latest software version in the bq27520 tool folder on power.ti.com. Make a search by Part Number for bq27520 to access the tool folder. Use the following steps to install the bq27520EVSW software:

1. Ensure that the EV2300 is not connected to the personal computer (PC) through the USB cable before starting this procedure.
2. Open the archive containing the installation package, and copy its contents into a temporary directory.
3. Open the software file that was downloaded from the TI Web site.
4. Follow the instructions on screen until completing the software installation.
5. Before starting the evaluation software, connect the EV2300 to the computer using the USB cable.
6. Wait until system prompt "new hardware found" appears. If Windows cannot find the drivers automatically, 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 1 through 5, 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 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 Hardware Connection

The bq27520EVM-001 comprises three hardware components: the bq27520 circuit module, the EV2300 PC interface board, and the PC.

6.1 Connecting the bq27520 Circuit Module to a Battery Pack

Figure 6 shows how to connect the bq27520 circuit module to the cells and system load/charger.

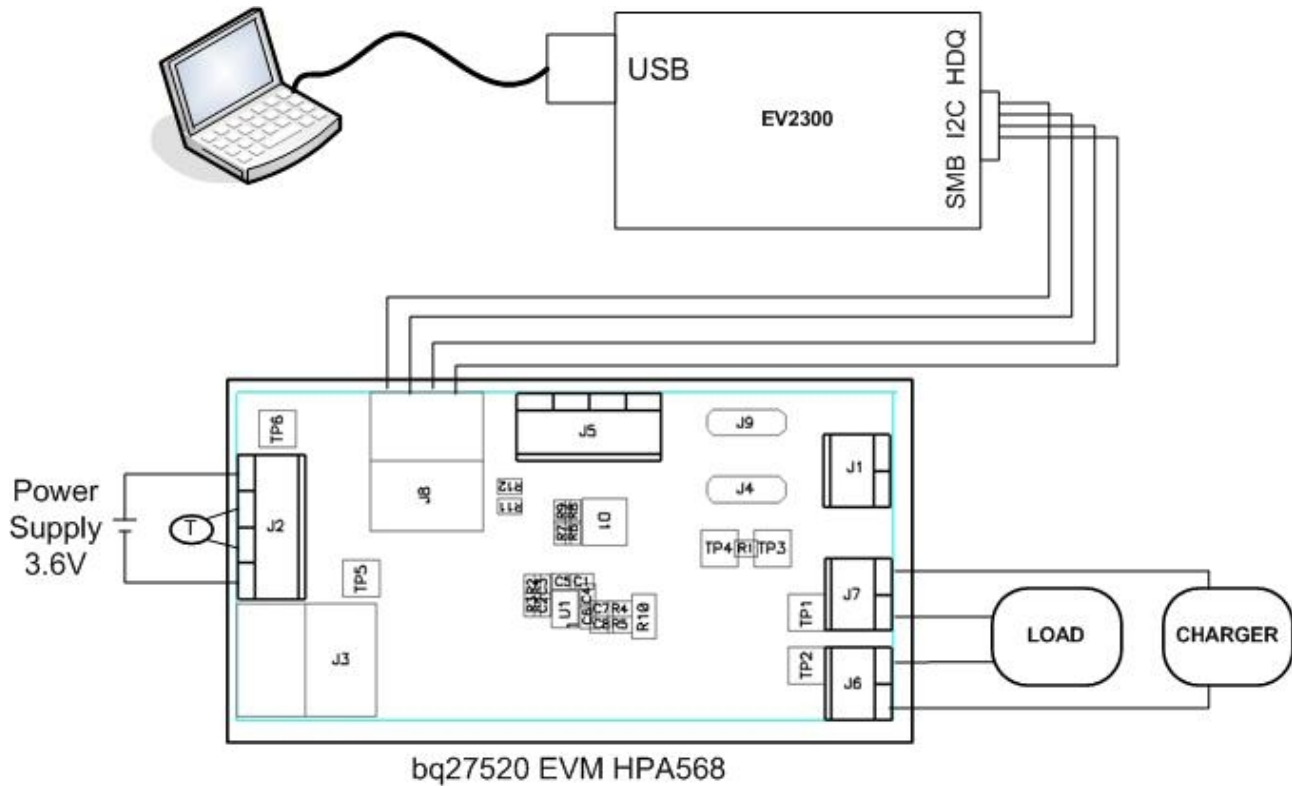


Figure 6. bq27520 Circuit Module Connection to Cell and System Load/Charger

6.2 PC Interface Connection

The following steps configure the hardware for interface to the PC.

1. Connect the bq27520-based EVM to the EV2300 using wire leads as shown in Table 4.

Table 4. Circuit Module to EV2300 Connections

bq27520-Based Battery	EV2300
SDA	SDA
SCL	SCL
VSS	GND

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

The bq27520EVM-001 is now set up for operation.

7 Operation

This section details the operation of the bq27520 EVSW software.

7.1 Starting the Program

Run bq27520 EVSW from the Start | Programs | Texas Instruments | bq Evaluation Software menu sequence. The DataRAM screen (Figure 7) 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 bq27520 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.

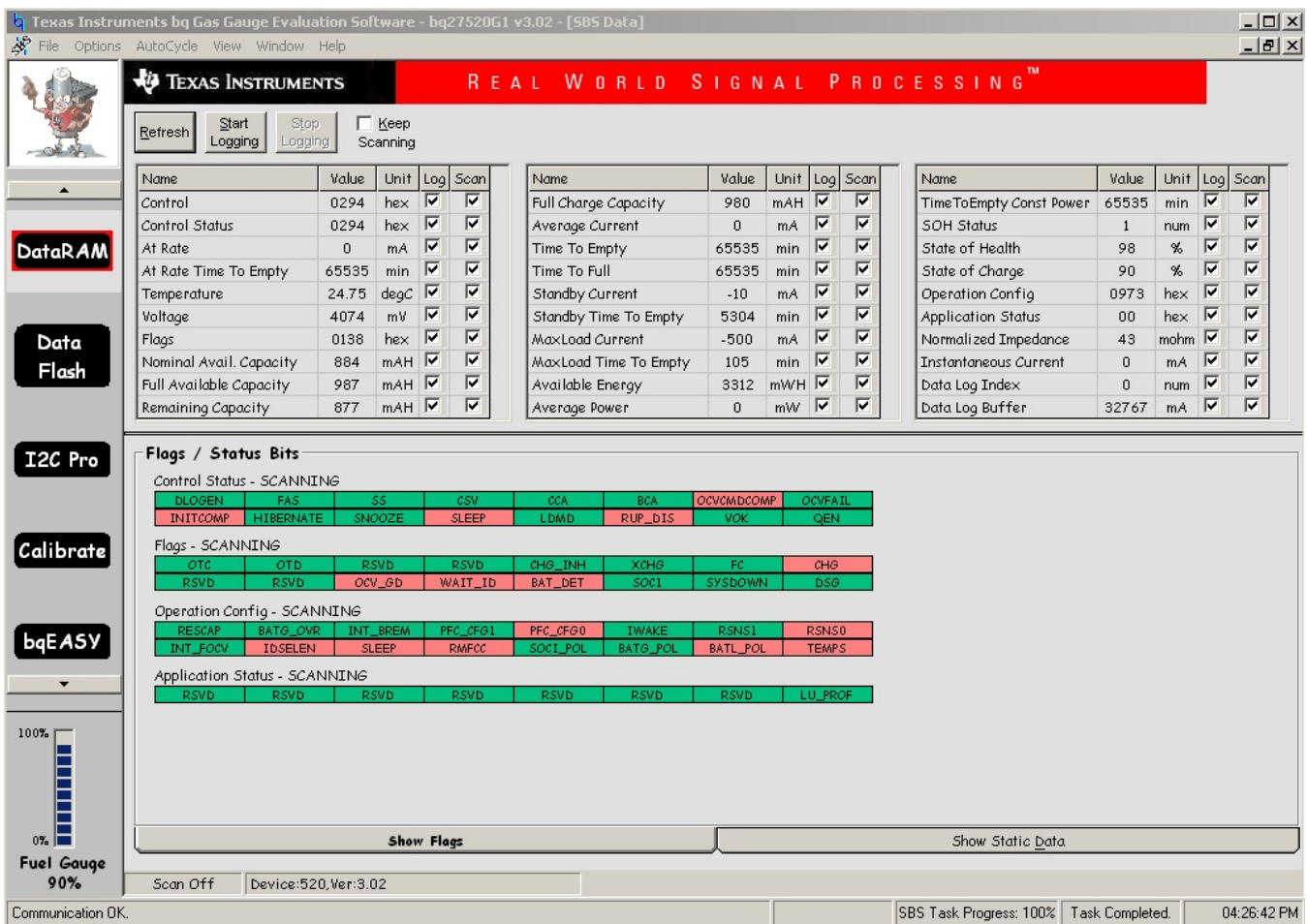


Figure 7. DataRAM Screen

This screen (Figure 7) 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.

7.2 Setting Programmable bq27520 Options

The bq27520 data flash comes configured per the default settings detailed in the bq27520 data sheet. Ensure that the settings are correctly changed to match the pack and application for the bq27520 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 8).

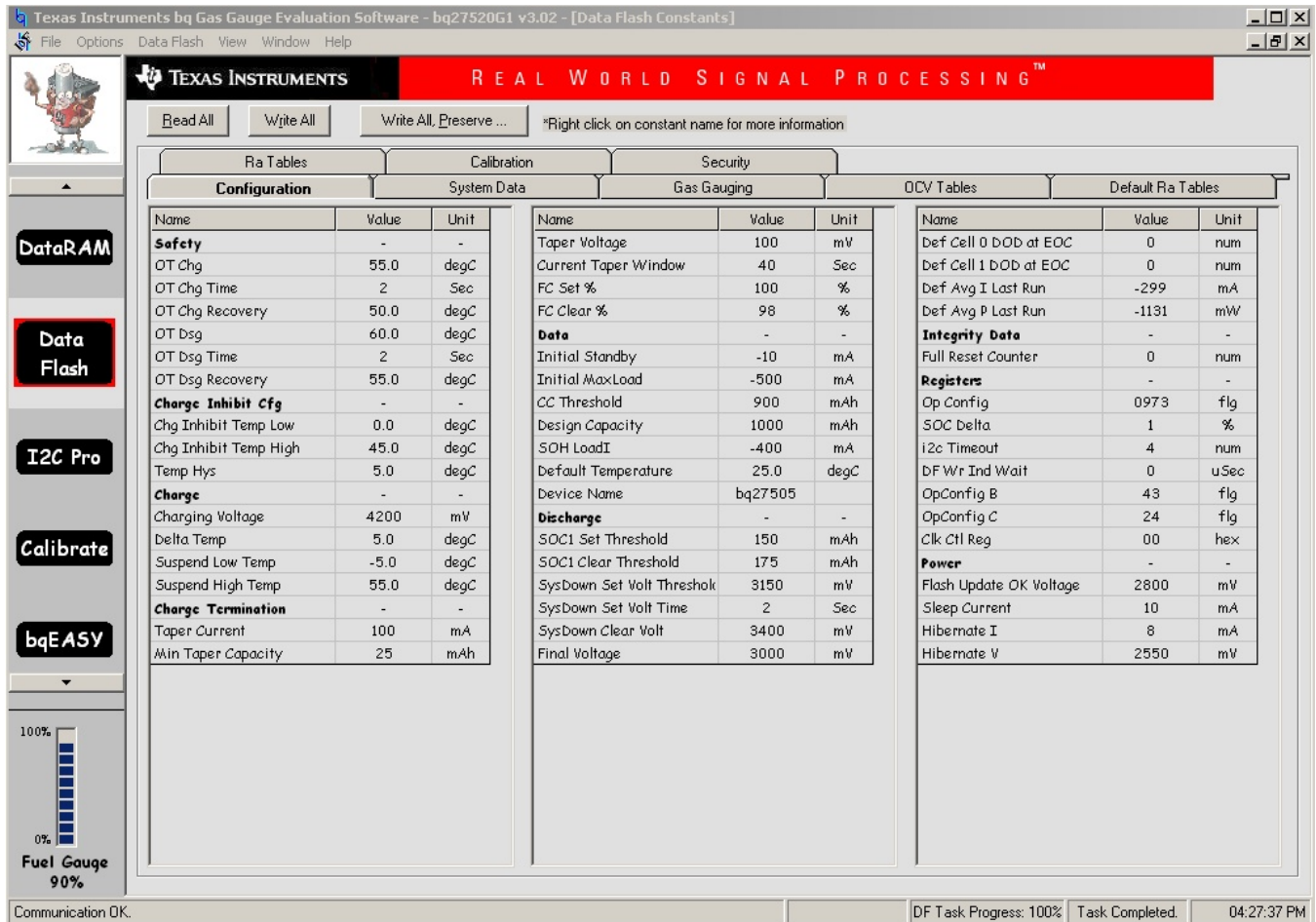


Figure 8. Data Flash Screen

To read all the data from the bq27520 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 bq27520 using the | Write All | button.

The module calibration data is also held in the bq27520 data flash.

The bq27520 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 |.

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 bq27520 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 bq27520 is in Sealed mode.

8 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.

8.1 To Calibrate the bq27520

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 9](#)).

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 you proceed with configuration or testing.

8.2 CC Offset Calibration

This performs the internal calibration of the coulomb counter input offset. Press the *Calibrate Part as indicated below* button.

8.3 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 LOAD–.

Press the *CC Board Offset Calibration* button.

8.4 Voltage Calibration

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

8.5 Temperature Calibration

- Measure the temperature for PACK.
- Type the temperature value into *Enter Actual Temperature*.
- Select if the temperature sensor to calibrate is the internal or external.
- Press the *Calibrate Part as indicated below* button.

8.6 Pack Current Calibration

- Connect a load to LOAD– and LOAD+ that draws approximately 1 A, or connect a current source to LOAD– and Pack–. 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 Part as indicated below* button.

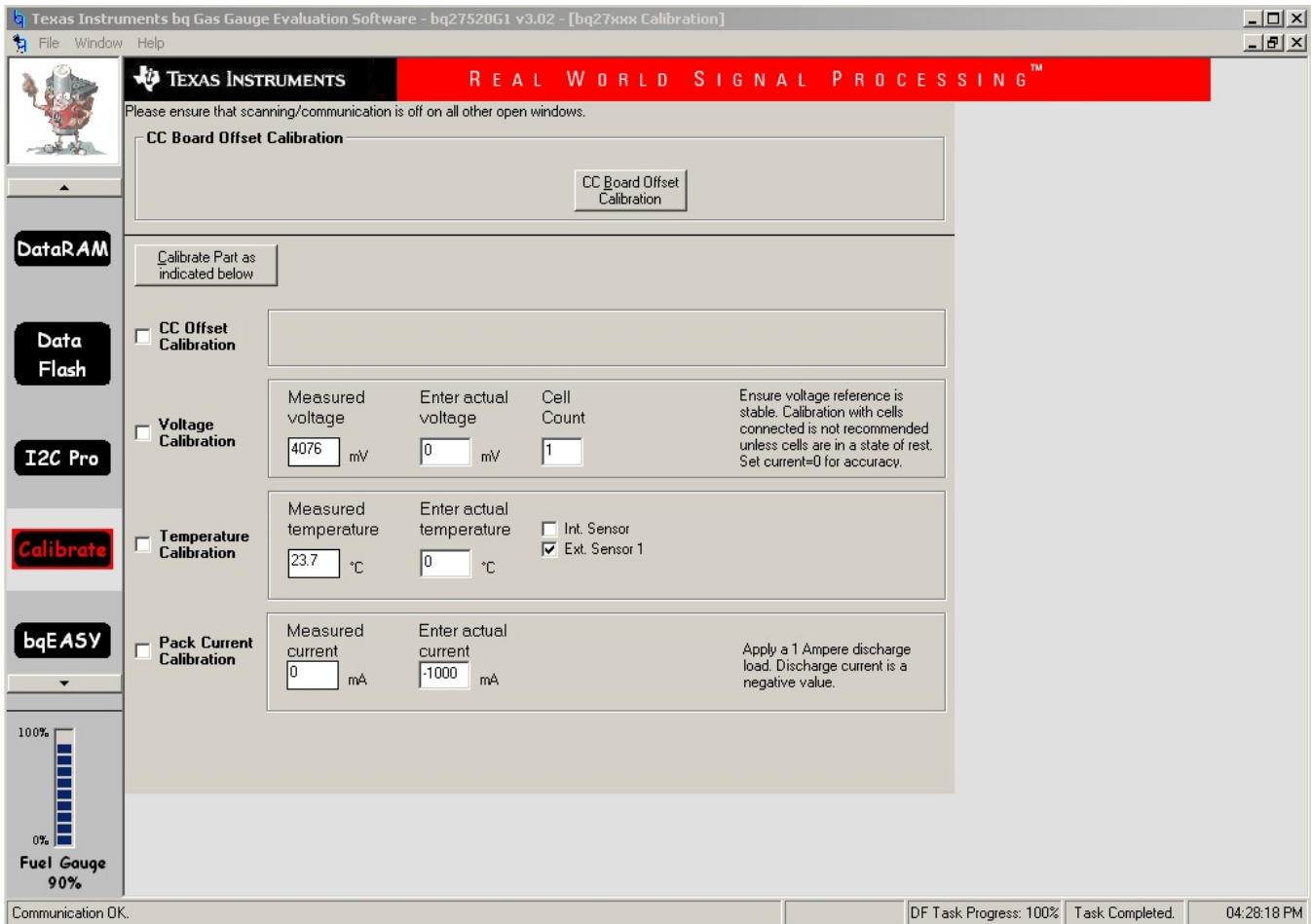


Figure 9. Calibration Screen

9 I2C Pro Screen

9.1 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 10).

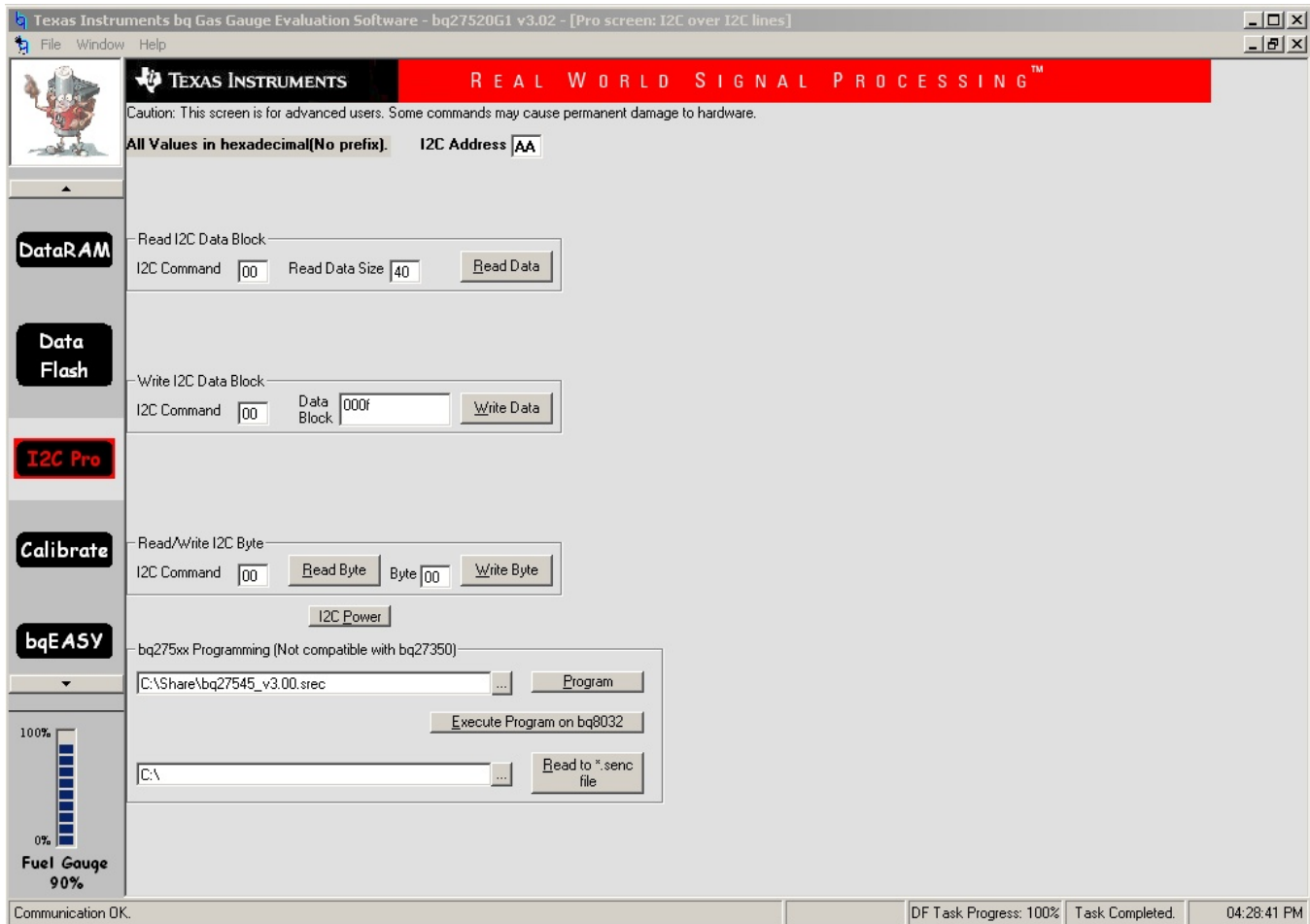


Figure 10. I2C Pro Screen

10 bqEASY™ Software

10.1 Introduction

Texas Instruments fuel gauges, employing the Impedance Track algorithm, offer an unmatched array of features and benefits. Sometimes, however, the wide range of configuration settings can seem challenging to get started with the evaluation process. In addition, determining the correct chemistry model and producing the 'golden image' file can be time consuming. The bqEASY program is designed to greatly simplify the process of configuring, calibrating, selecting chemistry, and performing learning cycles through the step-by-step use of a wizard program.

The bqEASY software runs inside the current EV software when it is executed by clicking the bqEASY button in the left column of buttons below the Calibrate button in the EV software.



Figure 11. bqEASY Welcome Screen

10.2 Program Navigation and Flowchart

The sequence of operation of the bqEASY program can be understood by reviewing the basic flowchart in [Figure 12](#). Using the program is simple – just start a new project and follow the steps sequentially from 1A to 5C. You can use the Next button, or click on the top tabs and left subsection labels to move to any desired page. Some operations must be completed in sequence due to data dependencies, or to implement the proper flow. Therefore, it is recommended that the prescribed sequence be followed, at least at first.

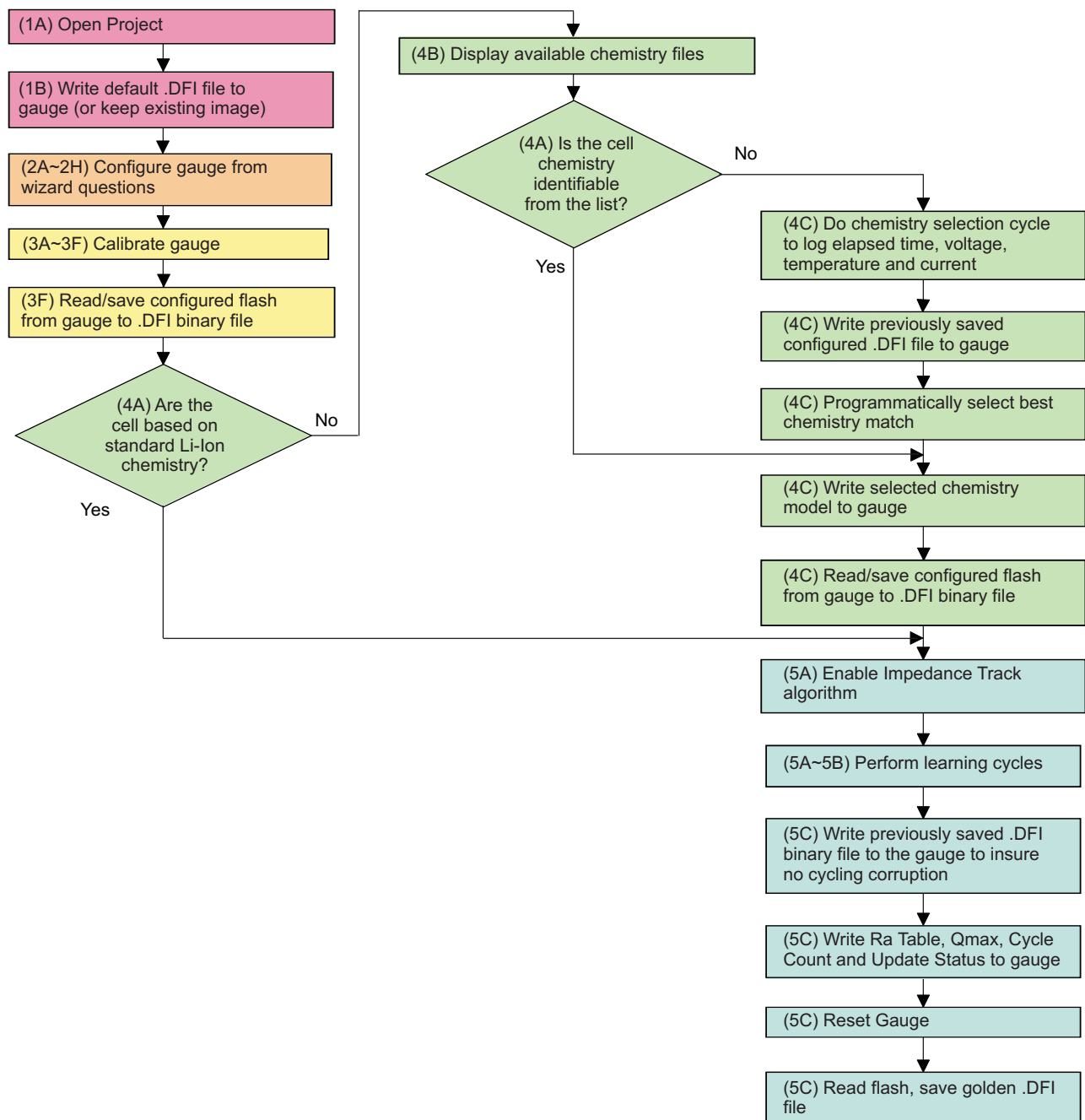


Figure 12. bqEASY Flowchart

10.3 Simplified Configuration Procedures

These simplified configuration procedures can be used to quickly set up the parameters without navigating through the entire user interface.

1. Simple configuration of the gas gauge with default or custom data:
 - (a) Open the current EV software, and click the bqEASY button in the left column of buttons below the "Calibrate" button in the EV software.
 - (b) Click the "2. Configure" tab at the top row of bqEASY tabs. (Note: You can skip the first tab.)
 - (c) Answer all questions, or leave defaults for all of tab "2", but be sure to click the "OK" button at the

bottom of each tab "2" page to ensure that a Completion Checkmark appears for each page.

- (d) On page 2H, when you click the "OK" button, the software asks you to write to the data-flash memory. Click "Yes" for OK to write to the data flash.

Your Gas Gauge Module now has the data flash configured as you declared with all the information entered in tab "2. Configure".

2. Simply install the Chemistry data using the bqEASY software, if the chemistry is a known chemistry available in the bqEASY software:
 - (a) Open the current EV software, and click the bqEASY button in the left column of buttons below the "Calibrate" button in the EV software.
 - (b) Click the "4. Chemistry" tab at the top row of bqEASY tabs. (Note: You can skip all tabs prior to this.)
 - (c) Either select "Use Default Chemistry", or click "Enable Chemistry Selection," and select the correct chemistry from the list.
 - (d) If you cannot find the proper chemistry, check the device EVM tool folder on the TI Web site for any new bqChemistry file updates. These are updated more frequently than the EV software., Between EV software updates, TI creates a self-extracting installer and posts it in the EVM tool folder for the part being used. Install these updates if they are in the folder.

The software now configures all data-flash locations on Your Gas Gauge Module that deal with chemistry functions. No other data-flash locations are modified.

10.4 Files

The bqEASY software uses four types of files to configure a fuel gauge.

1. **.ENCR** – These are default data-flash definition files found in the \bq_Evaluation_Software folder. The .ENCR file is basically a copy of the entire data flash from a fresh gas gauge prior to any data-flash updates either by the user or the gas gauge. They are unique for each version of each TI fuel gauge product. If you are working with a new version fuel gauge and an older version of bqEASY software, the correct file may not be present. This requires a new version of the EV software with bqEASY software. Navigate to the TI Web site in the EVM tool folder for the device being used, and download the latest version, or contact TI. For the bqEASY program, the .ENCR files act mainly as a dictionary to look up the address for a given data-flash location. For bqEVSW, they define screen parameters including address, display formulas, and data type. An error message appears if the correct .ENCR file cannot be found.
2. **.CHEM (Chemistry Files)** – These are read-only files found in the ..\bq_Evaluation_Software\Plugins\Chemistry folder of the application. When a new Li-Ion battery chemistry is developed, a new Impedance Track model is required to define the chemical model. During automated chemistry selection, each of these files is scanned in order to select the best match with the recorded data. If you are working with a newly developed chemistry, it is possible that an acceptable match may not be found. If this is the case, check for updated bqEASY software or bqChemistry files on the TI Web site in the EVM tool folder for the part being used.
3. **.DFI (Data-Flash Image Files)** – These are binary images of the fuel gauge data flash with modified values based on the application. Because of the binary format, it is quick and easy to transfer them to and from a gauge. Each fuel gauge model and firmware version has a unique read-only .DFI which is found in the ..\bq_Evaluation_Software\Plugins\Device_Defaults folder of the application. During the bqEASY process, intermediate versions of .DFI files are recorded with current updated data in order to prevent the possibility of corruption. Then, the final output of the bqEASY software is also a .DFI file which is the 'golden image' that is programmed into each production unit. This output file is placed in the ..\bq_Evaluation_Software\Plugins\Projects folder.
4. **.EZY (bqEASY Project Files)**– These are read-write text files which record header information regarding a project, answers to the wizard questions, and status regarding the stage of completion (the red check marks). They are kept in the ..\bq_Evaluation_Software\Plugins\Projects folder.

10.5 Completion Checkmarks

As the wizard questions and tasks are completed, completion checkmarks appear in two places – along the task list on the left and on the category tabs on top. A checkmark on a top tab only appears after all tasks in the category have been completed. For example, in [Figure 8](#) all of the Setup tasks and all of the Configure tasks have been completed. Completion marks are saved in the .EZY project text file. When a completed or partially completed project file is opened, the user is given the chance to erase the checkmarks.

10.6 Device Detection

The bqEASY program is designed to work with a fuel gauge present and already communicating with the bqEVSU evaluation software through the EV2300 USB interface. When the evaluation software is started, it reads the device type and displays it on the upper title block. This information is used by the bqEASY program to select the correct default data-flash image (.DFI) and data-flash configuration file (.ENCR) for this particular device. To ensure that the device has not changed, the bqEASY software also checks the device type when the bqEASY button is pressed. If the correct files are not found, first check the TI Web site in the EVM tool folder for the part being used, and download the latest version of EV software with bqEASY support. If that fails to help, contact TI.

1. Setup

As the wizard questions and tasks are completed, completion checkmarks appear in two places – along the task list on the left and on the category tabs on top. A checkmark on a top tab only appears after all tasks in the category have been completed. Completion marks are saved in the .EZY project text file. When a completed or partially completed project file is opened, the user is given the chance to erase the checkmarks.

2. Configure

A series of eight screens is used to collect information about the battery pack application to enable automatic configuration of the most critical data-flash parameters.

3. Calibrate

If you wish to proceed with either automatic chemistry selection or *golden* unit learning cycles, the Impedance Track fuel gauge must be accurately calibrated. The bqEASY screens simply ask the user to use the calibration screen of the bqEVSU for this purpose.

4. Chemistry

The chemistry choices presented in section 4B ([Figure 12](#)) are based on files in the \Chemistry folder of the bqEASY application. The latest files are available for downloading from the ti.com Web site. Automation of the chemistry-selection cycle is made possible using a simple load and switch as depicted in [Figure 13](#). The VOUT pin of the EV2300 may require a 1-M Ω pulldown resistor to ensure that the switch is turned off when signaled to do so. The switch can be implemented with either a low VGS-threshold FET or a small relay such as the OMICRON G6RN-1 with a 5-Vdc coil. Multiple 2N7000 FETs can be paralleled if nothing else is available. The load can be either a power resistor or an electronic load set to a discharge rate of C/5. Hint: Follow the instructions exactly, or errors can result.

5. Cycle

When preparing for mass production, cell learning is required, but only on one *golden pack*. The chemical information learned from one pack is quickly transferred to all production units prior to calibration. Doing this correctly requires a series of charge and discharge cycles. The discharge part can be automated with the bqEASY program if the simple load circuit for the chemistry selection is available. Follow the screen instructions.

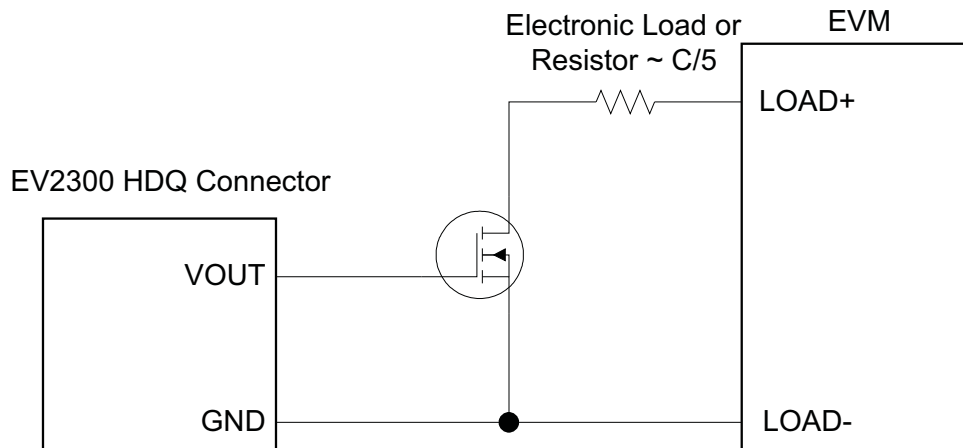


Figure 13. Load and Switch

11 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.

- *bq27520, System-Side Impedance Track Fuel Gauge With Integrated LDO* data sheet ([SLUS955](#))

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

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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.

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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 EVMs for RF Products 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.

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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. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. 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.

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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.

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