bq27750EVM 1-Series Li-Ion Battery Pack Manager Evaluation Module

This evaluation module (EVM) is a complete evaluation system for the bq27750 battery management system. The EVM includes one bq27750 circuit module and a link to the Microsoft® Windows® based PC software. The circuit module includes one bq27750 integrated circuit (IC) and all other onboard components necessary to monitor and predict capacity, monitor critical parameters, protect the battery from overcharge, over-discharge, short-circuit, and overcurrent in 1-series cell Li-Ion or Li-Polymer battery packs. The circuit module connects directly across the battery. With the EV2300 or EV2400 interface board and software, the user can read the bq27750 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the solution under different charge and discharge conditions using I^{2}C communication protocol.

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1 Features

The EVM supports the following features:

- Complete evaluation system for the bq27750EVM 1-series battery pack manager evaluation module
- Populated circuit module for quick setup
- Software that allows data logging for system analysis

1.1 Kit Contents

The following items are supplied with the EVM kit:

- bq27750 circuit module
- Cable to connect the EVM to an EV2300 or EV2400 Communications Interface adapter

1.2 Ordering Information

For complete ordering information, see the product page at www.ti.com.

Table 1. Ordering Information

EVM Part Number	Chemistry	Configuration	Capacity
bq27750EVM	Li-Ion	1-cell	Any

1.3 Documentation

For information on the bq27750 and bq294502 device firmware and hardware, see the following documentation:

- bq27750 data sheet (SLUSCM7)
- *bq27750 Technical Reference Manual* (TRM) (SLUUBI6)

1.4   bq27750 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq27750 EVM.

Table 2. Performance Specification Summary

Specification	MIN	TYP	MAX	Units
Input voltage 1P+ to 1N–	2.5	3.5	25	V
Charge and discharge current	0	2	7	A

2   bq27750EVM Quick Start Guide

This section provides the step-by-step procedures required to use a new EVM and configure it for operation in a laboratory environment.

2.1   Items Needed for EVM Setup and Evaluation

The following items are needed for EVM setup and evaluation:

- bq27750 circuit module
- EV2300 or EV2400 communications interface adapter
- Cable to connect the EVM to an EV2300 or EV2400 communications interface adapter
- USB cable to connect the communications interface adapter to the computer
- Computer setup with Microsoft Windows XP, or higher, operating system
- Access to the Internet to download the *Battery Management Studio* software setup program
- One battery cell
- A DC power supply that can supply 5 V

2.2   Software Installation

Find the latest software version in the bq27750 tool folder on www.ti.com. Use the following steps to install the bq27750 Battery Management Studio software:

1. Download and run the *Battery Management Studio* setup program from the *Development Tools* section of the bq27750EVM product folder on www.ti.com. See Section 3 for detailed information on using the tools in the *Battery Management Studio*.

2. If the *Communications Interface Adapter* was not previously installed, after the bqStudio installation, a TI USB DRIVER INSTALLER pops up. Click **Yes** for the agreement message and follow its instructions. Two drivers are associated with the EV2300 and an additional file may be required for the EV2400. Follow the instructions to install both. Do not reboot the computer, even if asked to do so.

3. Plug the communications interface adapter into a USB port using the USB cable. The Windows system may show a prompt that new hardware has been found. When asked, "Can Windows connect to Windows Update to search for software?", select "No, not this time", and click **Next**. In the next dialog window, it indicates "This wizard helps you install software for: TI USB Firmware Updater". Select "Install the software automatically (Recommended)" and click **Next**. It is common for the next screen to be the *Confirm File Replace* screen. Click **No** to continue. If this screen does not appear, then go to the next step. After Windows indicates that the installation was finished, a similar dialog window pops up to install the second driver. Proceed with the same installation preference as the first one. The second driver is TI USB bq80xx Driver.

2.3 EVM Connections Module Connections

This section covers the hardware connections for the EVM. See Figure 1.
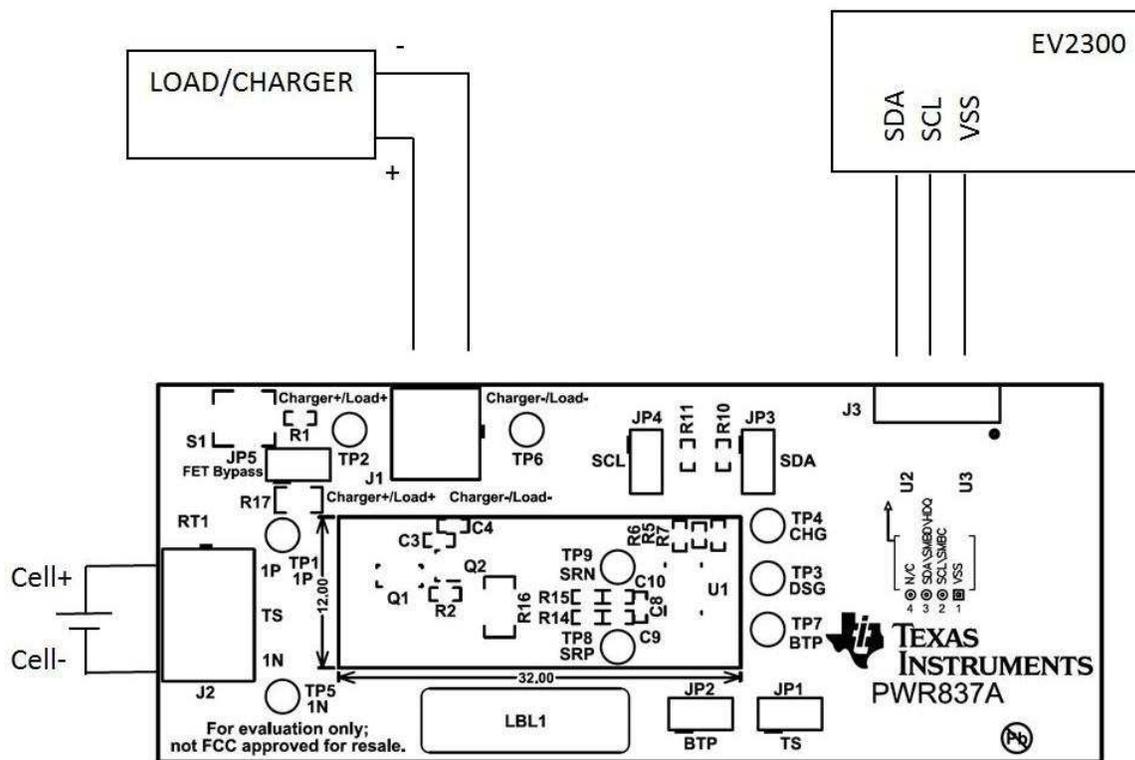
Figure 1. bq27750 Circuit Module Connection to Cells and System Load or Charger

- Direct connection to the cells: 1N (BAT–), 1P (BAT+)

  Attach the cells to the J2 terminal block. A specific connection sequence is not required, but it is a good practice to start with the BAT– of the battery before the BAT+. A power supply set at 4 V can be used instead of a battery for evaluation purposes.

- I²C™ (SDA, SCL)

  Attach the communications interface adapter cable to J3 and to the I²C port on the EV2300.

  > **NOTE:** If the EVM board is an E1 revision, it will only work with an EV2400. If it is an A revision, the EV2300 can be used. Ensure that shunts are placed on P2 and P3 jumpers to enable the onboard pullup resistors. If the EV2400 is used, there will be no need for shunts on P2 and P3 because it has internal pullup resistors.

- System load and charger connections across Charger+/Load+ and Charger-/Load-

  Attach the load to the J1 terminal block. The positive terminal of the load should be connected to the terminal block position labeled PACK+. The ground wire for the load should be connected to the other terminal block position labeled Charger-/Load-.

- Wake-up the device up from SHUTDOWN (WAKE)

  Press the **Wake** pushbutton switch S1 to temporarily connect 1P to Charger+/Load+. This applies voltage to the PACK pin on the bq27750 to power-up the regulators and start the initialization sequence.

- Parameter setup

  Data flash parameters should be updated to fine tune the gauge to the pack. See the *bq27750 Technical Reference Manual* (SLUUBI6) for help with setting the parameters.

3   Battery Management Studio

3.1   *Starting the Program*

Run *Battery Management Studio* from the Start | Programs | Texas Instruments | Battery Management Studio sequence or the *Battery Management Studio* shortcut. As long as the device has been woken up from shutdown mode by momentarily pressing button **S1** or applying a charger voltage, the gauge will be automatically detected and the register screen will appear as seen in Figure 2. If your device contains an earlier firmware version, then auto detection of the device may not occur. If that happens, on the window that pops up as shown in Figure 3, select any bq27750.bqz file. This action will enable the program to get started and the user can update the firmware using the latest .srec file for the device downloadable from the product folder of the gauge at www.ti.com.
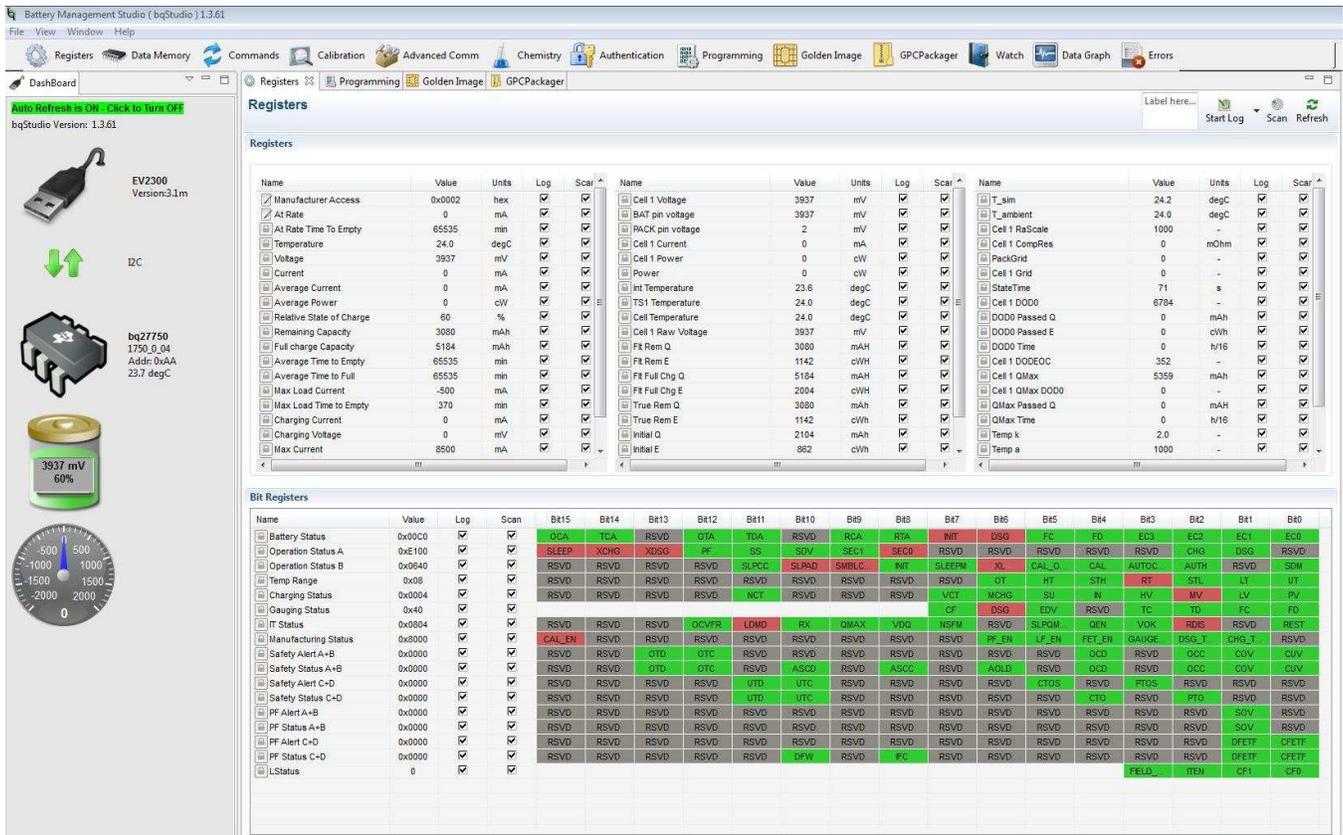
Figure 2. Registers Screen

Copyright © 2017, Texas Instruments Incorporated
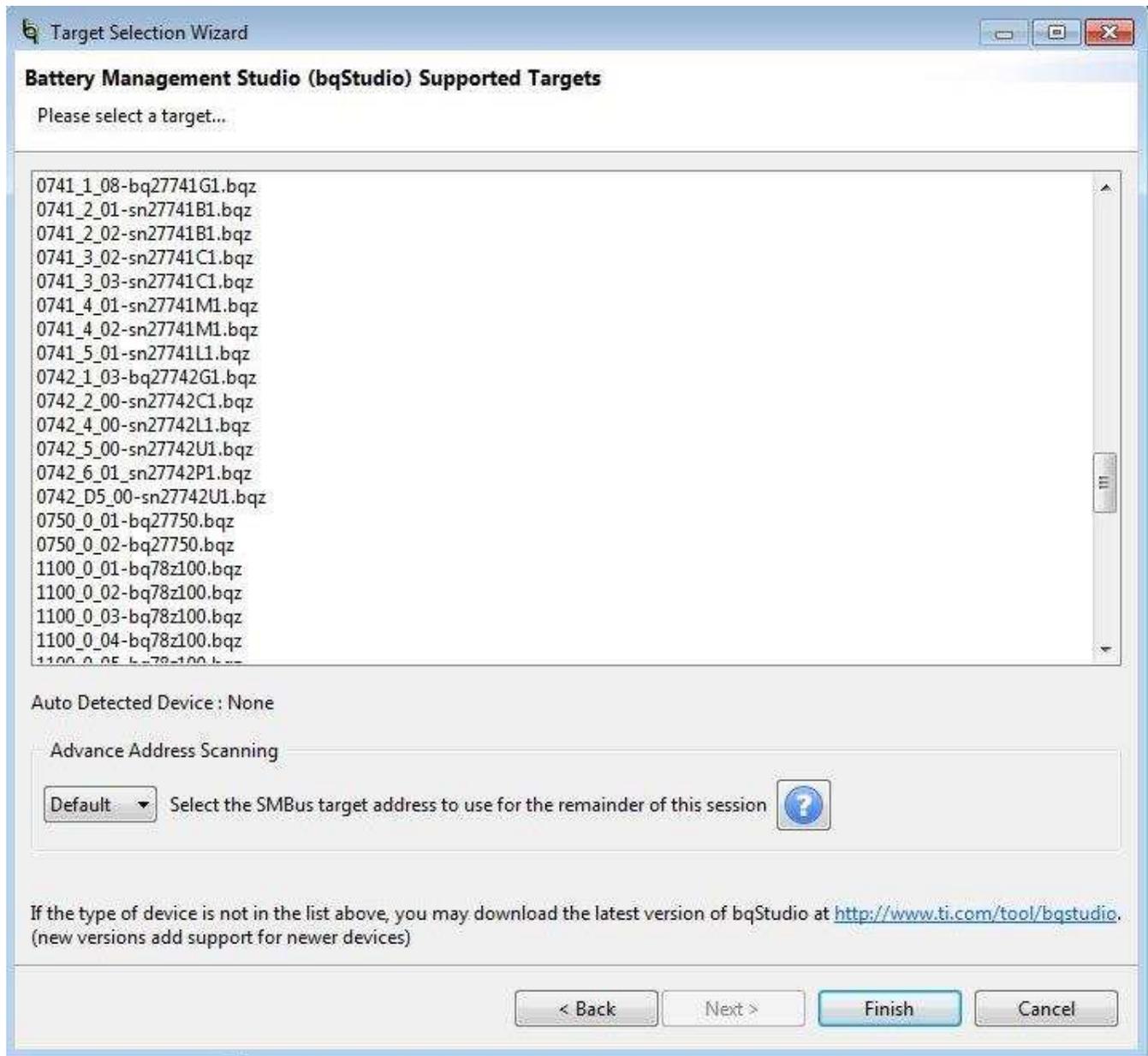
Figure 3. Battery Management Studio Supported Targets

3.2   Registers Screen

The *Registers* section contains parameters used to monitor gauging. The *Bit Registers* section provides bit-level picture of status and fault registers. A green flag indicates that the bit is 0 (low state) and a red flag indicates that the bit is 1 (high state). A greyed-out bit indicates that the bit is reserved. Data begins to appear once the **Refresh** (single-time scan) button is selected, or it scans continuously if the **Scan** button is selected. The continuous scanning period can be set via the | Windows | Preferences | Register selections.

The *Battery Management Studio* program provides a logging function which logs all the values of the parameters in the *Register* section if running the program in "Show basic view mode". To selectively choose the parameters of the *Register* section that are scanned and logged, set *Battery Management Studio* to "Show Advanced view mode". This mode can be set via | Windows | Preferences | All Global Settings| Show Advanced Views. Uncheck the fields that are not needed to be scanned or logged. To enable logging, select the **Log** button; this causes the **Scan** button to be selected. When logging is stopped, the **Scan** button is still selected and has to be manually deselected.

3.3 Data Memory Screen

The bq27750 data flash comes configured per the default settings detailed in the bq27750 TRM. Ensure that the settings are correctly changed to match the pack and application for the solution being evaluated. For ease of configuration, a text file with a gg.csv extension can be extracted, modified, and imported back on the device. Use the export and import buttons as seen in Figure 4 to export and import gg.csv files. The auto export button enables gg files to be exported periodically at intervals. This is useful when debugging issues with the gauge. A *Write All* command is necessary if a gg.csv file is imported to ensure that all the changes made on the gg.csv file are effected on the gauge. The *Read All* command is used to read back all of the data written to the gauge so that the changes made can be verified. The *Filter/Search* field enables the user to search for a particular parameter in the data memory content.

> **NOTE:** Do not make modifications to the gg.csv file using Microsoft Excel® as it makes changes to file, which bqStudio rejects. Make sure to use a text editor like Notepad or similar to edit a gg.csv file.
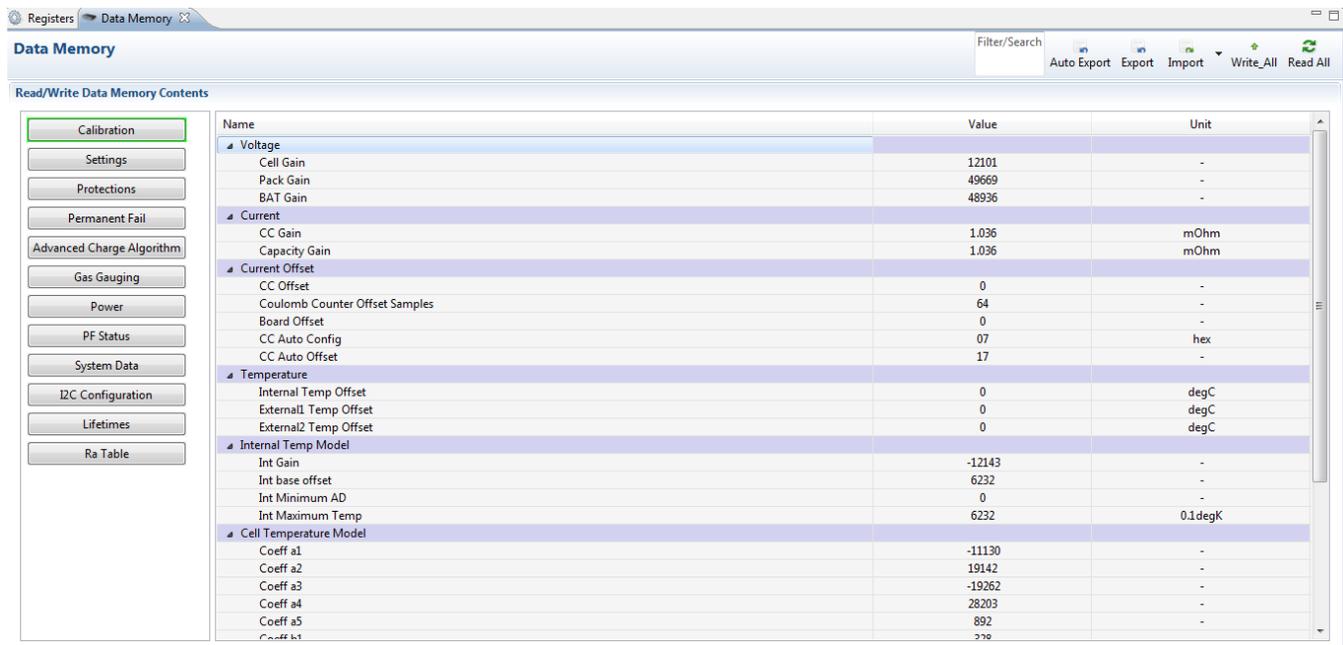
Figure 4. Data Memory Screen

3.4 Calibration Screen

The voltages, temperatures, and currents should be calibrated to provide good gauging performance. Press the **Calibration** button while in the "Show Advanced view mode" to select the **Advanced Calibration** window, see Figure 5. If in the "Show basic view mode", the basic calibration window shows when the **Calibration** button is clicked. The **Advanced Calibration** window enables the internal temperature sensor as well as the external thermistor to be calibrated.
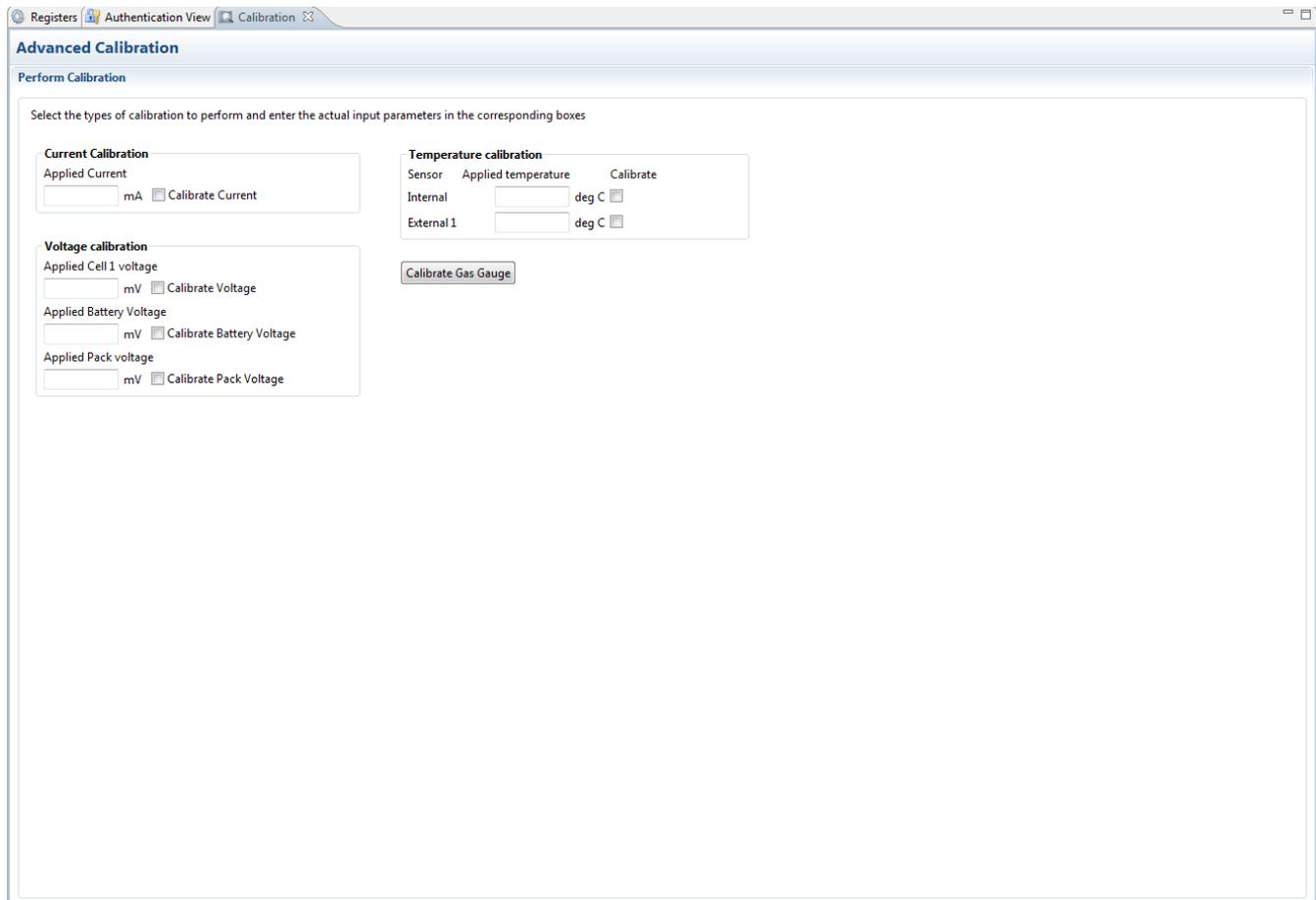
Figure 5. Calibration Screen

3.4.1 Voltage Calibration

- Measure the voltage from 1N to 1P and enter this value in the *Applied Cell 1 Voltage* field and *Applied Battery Voltage*, then select the **Calibrate Voltage** and calibrate battery voltage checkboxes.
- Measure the voltage from Charger+/Load+ to Charger-/Load- and enter this value in the *Applied Pack Voltage* field and select the **Calibrate Pack Voltage** box. If the voltage is not present, then turn the charge and discharge FETs on by entering a 0x22 command in the *Manufacturer Access* register on the **Register** screen.
- Press the **Calibrate Gas Gauge** button to calibrate the voltage measurement system.
- Deselect the **Calibrate Voltage** boxes after voltage calibration has completed.

3.4.2 Temperature Calibration

- Enter the room temperature in each of the *Applied Temperature* fields and select the **Calibrate** box for each thermistor to be calibrated. The temperature values must be entered in degrees Celsius.
- Press the **Calibrate Gas Gauge** button to calibrate the temperature measurement system.
- Deselect the **Calibrate** boxes after temperature calibration has completed.

3.4.3   Current Calibration

The *Board Offset Calibration* option is not offered in *Battery Management Studio*, because it is not required when using the bq27750EVM. The *Board Offset Calibration* option is available in bqProduction.

- Connect and measure a 2-A current source from 1N (–) and Charger-/Load- to calibrate without using the FETs. (TI does not recommend calibration using the FETs.)
- Enter "–2000" in the *Applied Current* field and select the *Calibrate Current* box.
- Press the **Calibrate Gas Gauge** button to calibrate.
- Deselect the *Calibrate Current* box after current calibration has completed.

3.5 Authentication Screen

The bq27750 supports SHA-1 HMAC authentication with the host system. The authentication screen of bqStudio allows for the SHA-1 calculator to be tested, perform gauge authentication by the host and change the gauge authentication key.
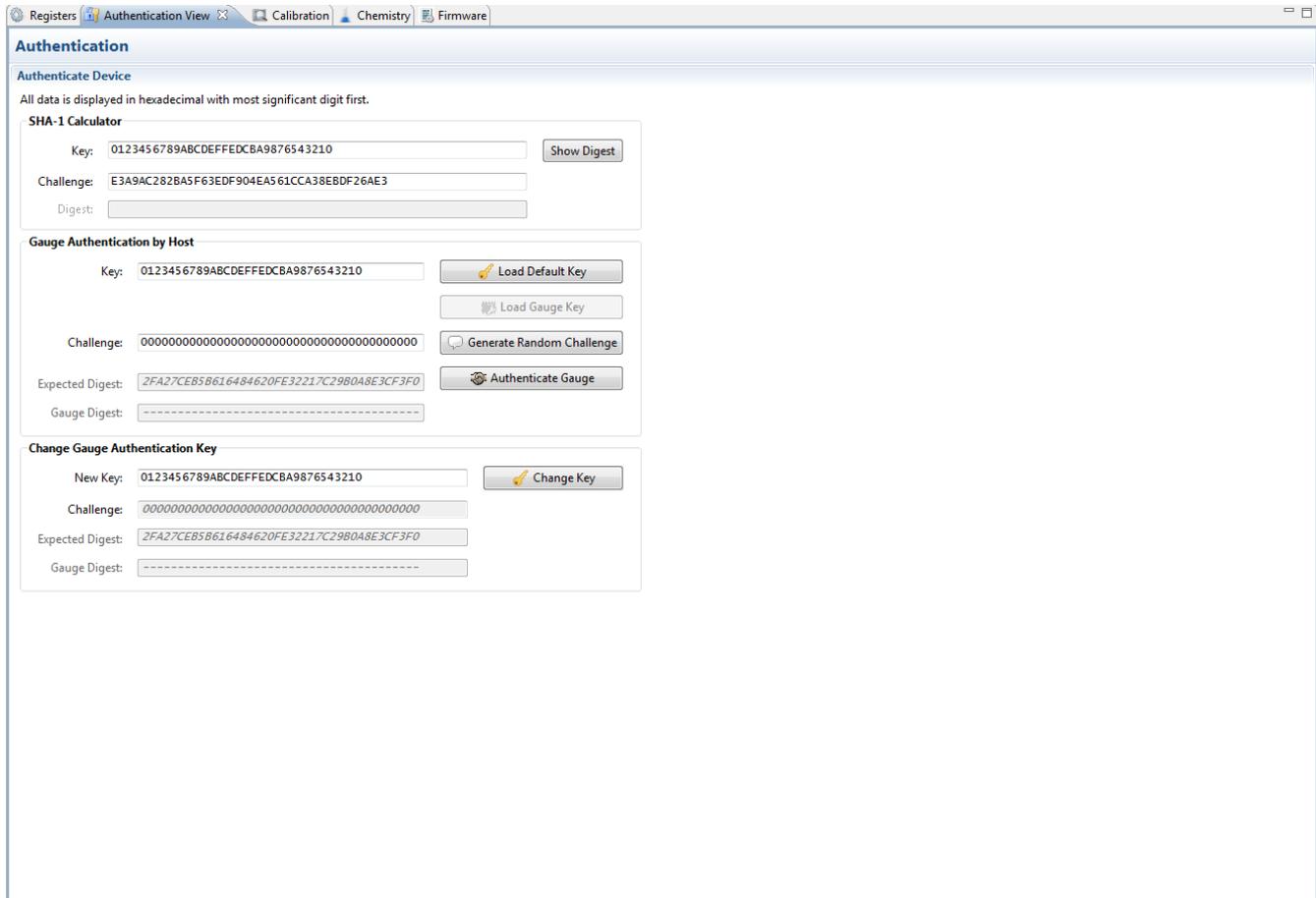
Figure 6. Authentication Screen

3.6 Chemistry Selection

The chemistry file contains parameters that the simulations use to model the cell and its operating profile. It is critical to program a *Chemistry ID* that matches the cell into the device. Some of these parameters can be viewed in the Data Flash section of the *Battery Management Studio*.

Press the **Chemistry** button to select the *Chemistry* window.

*   The table can be sorted by clicking the desired column. For example: Click the *Chemistry ID* column header.
*   Select the *Chemistry ID* that matches your cell from the table (see Figure 7).
*   Press **Update Chemistry from Database** to update the chemistry in the device.

Figure 7. Chemistry Screen

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3.7 *Programming Screen*

Press the **Programming** button to select the **Programming** window. This window allows the user to program the device firmware. Use the following procedures to program the device:

- Search for the .srec file using the **Browse** button.
- Press the **Program** button and wait for the download to complete.
- Click the Execute FW to return the device to NORMAL mode after programming has completed, see Figure 8.
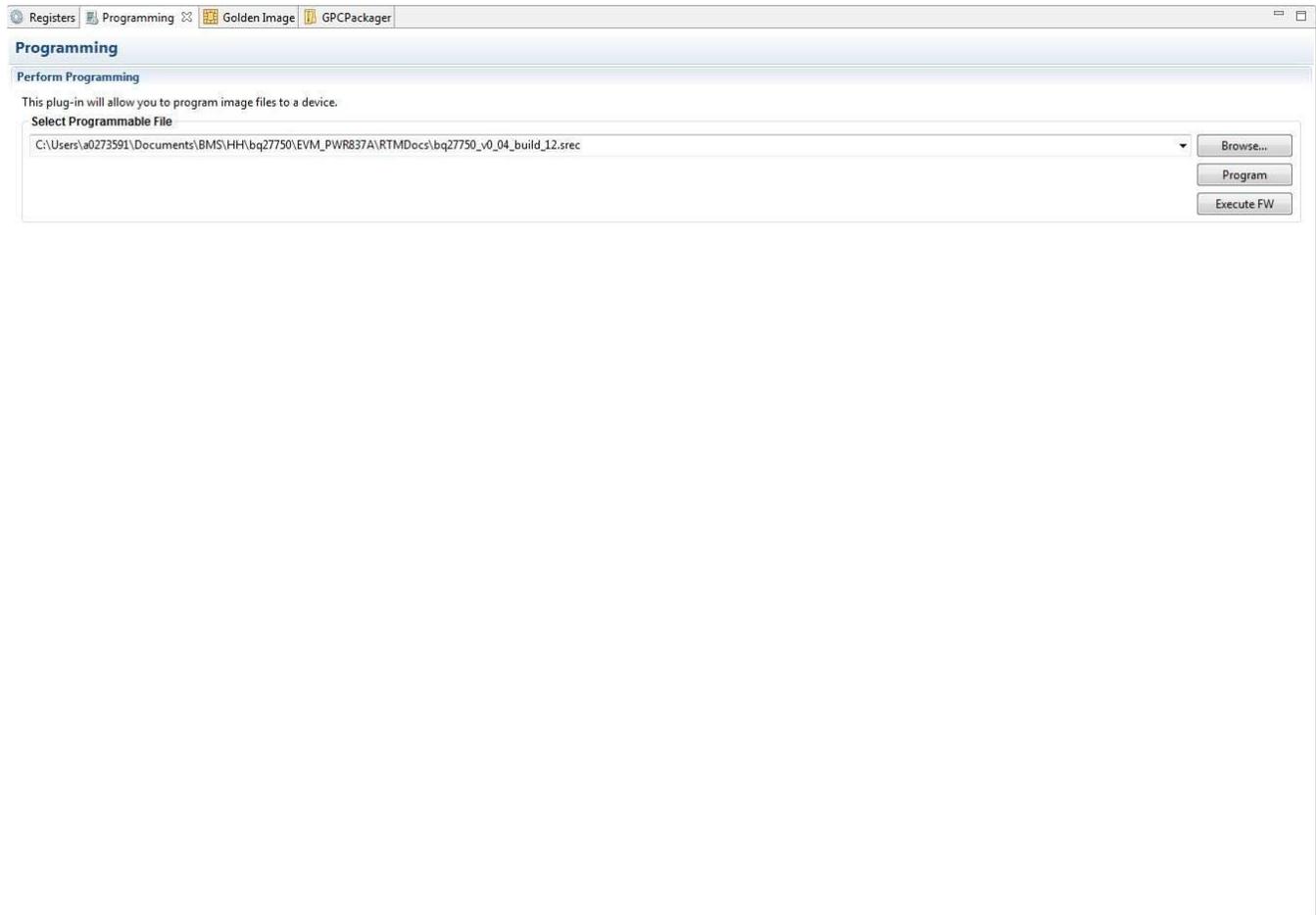
Figure 8. Programming Screen

3.8 Advanced Comm Screen

Press the **Advanced Comm** button to select the **Advanced Comm** window. This tool provides access to parameters using I^{2}C and Manufacturing Access commands, see Figure 9. The transaction log screen shows the history of sent commands.

NOTE: I^{2}C commands are sent in Little-Endian format.
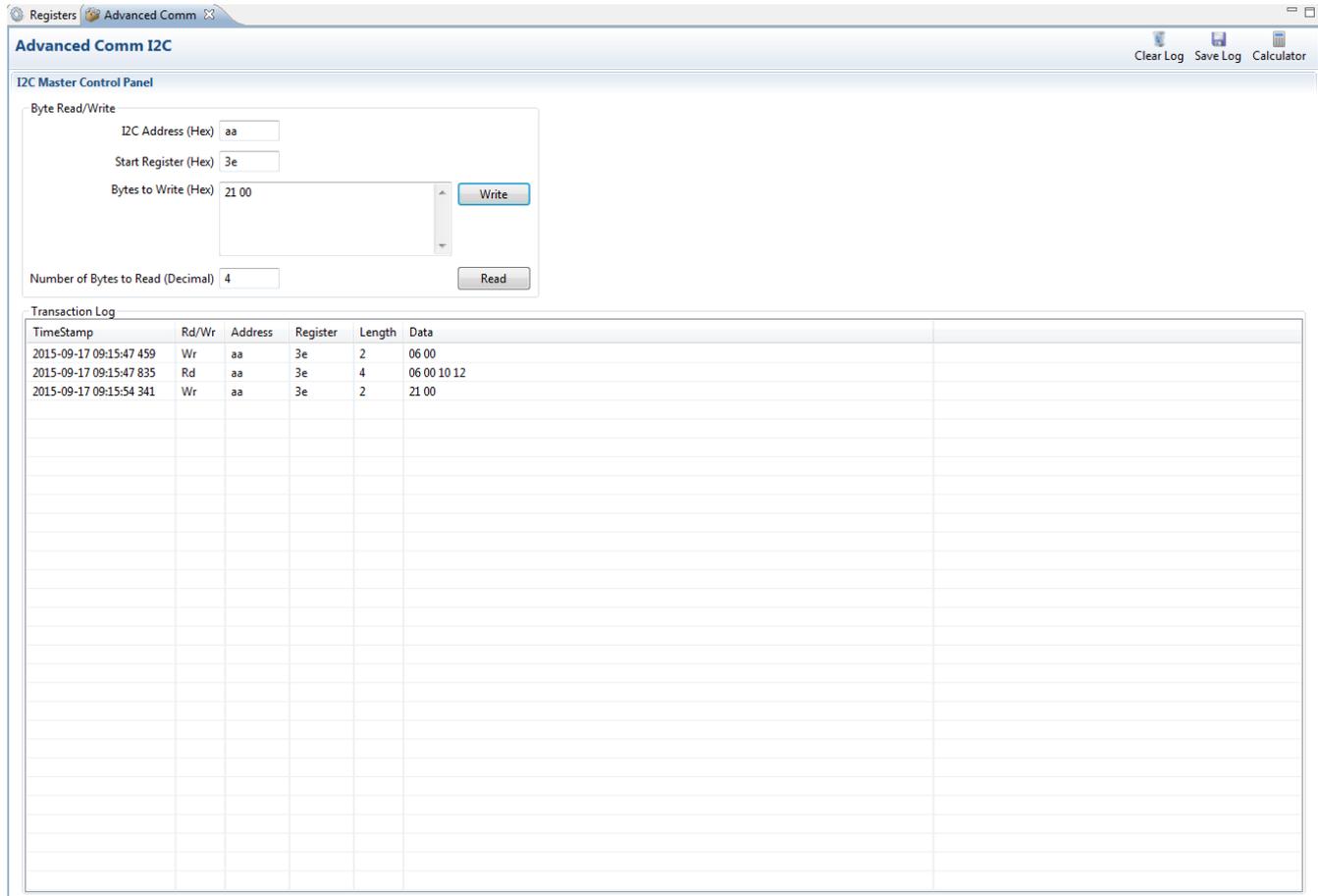
Figure 9. Advanced Comm Screen

Examples:

Reading an I^{2}C Command.

- Read chemical ID (0x 0006).
  - Write to mac address 3e Command 06 00 (see Figure 9)
  - Read 4 bytes.
  - The result returned is 10 12, which is little endian for chem id 1210.

Sending a MAC *Gauging()* to enable IT via *ManufacturerAccess()*.

- With Impedance Track™ disabled, send *Gauging()* (0x0021) to *ManufacturerAccess()*.
  - Write to mac address 3e command 21 00 (see Figure 9).

3.9 Golden Image

The golden image screen allows for the creation of a golden file to be used to program multiple devices. A flash stream file (.bqfs, .dffs or .gmfs) can be extracted by:

- Browsing to the desired location
- Creating a file name in the *Base File Name* field
- Checking the corresponding checkbox for the file that needs to be created
- Clicking the options button next to the fields, additional checkboxes pop up that allow additions such as the unseal codes, ROM command, and so forth, to the golden files, as needed
- Clicking the **Create Image Files** button, seeFigure 10
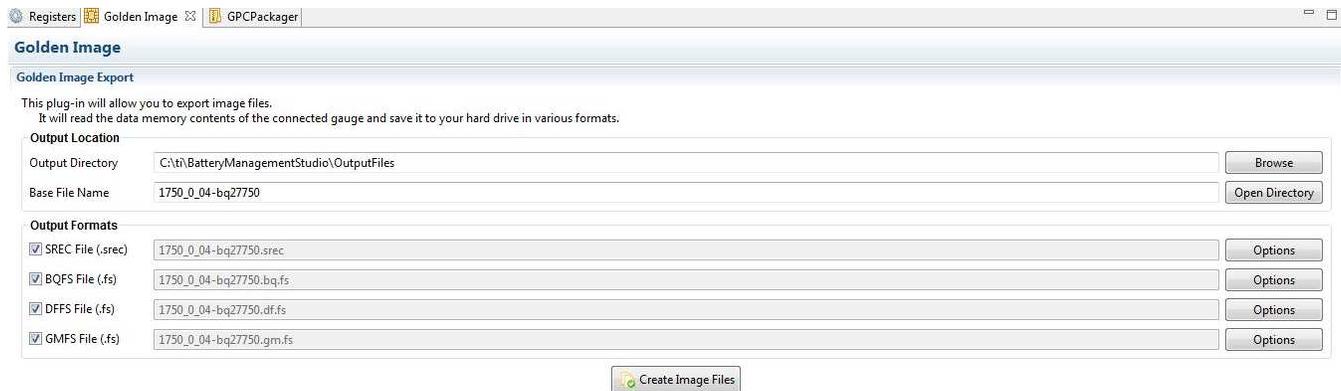
Figure 10. Golden Image Screen

3.10 GPC Packager

This allows the creation of a file package to be uploaded to the *Gauge Parameter Calculator Packager* (gpc) tool on www.ti.com. Click on the gpc packager help for guidance on usage, see Figure 11
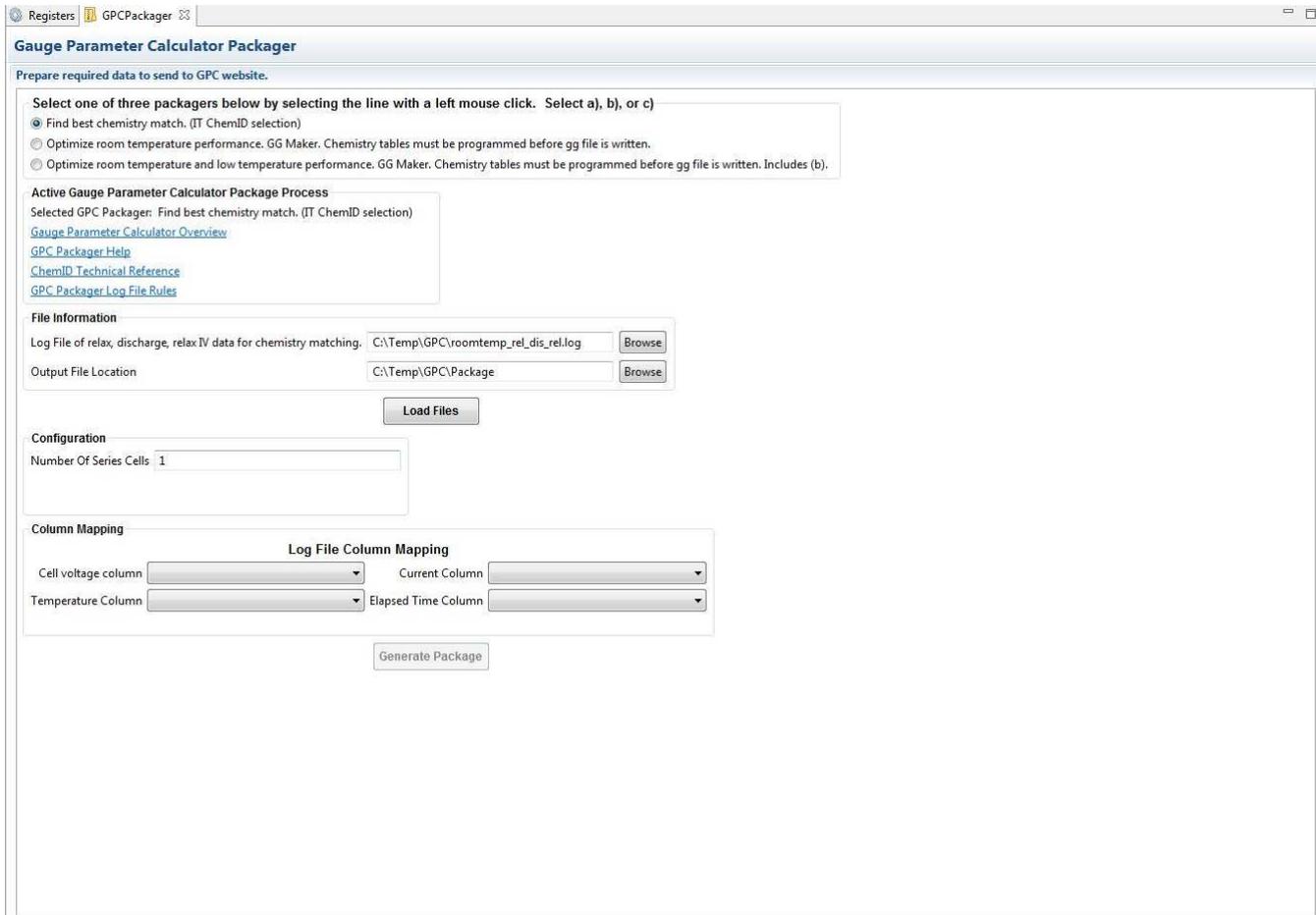
Figure 11. GPC Packager Screen

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3.11 Watch Screen

This enables monitoring of specific registers and data memory items at user-specified time intervals. By clicking the *Add Register* or *Add Data Memory Item*, these will be added to the table of values to be tracked.

Figure 12. Watch Screen

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3.12 Data Graph Screen

This enables specified registers and data memory items to be plotted in a graph in real time based on a specific time interval chosen as shown in Figure 13.

Figure 13. Data Graph Screen

3.13 Error Screen

This keeps track of any error that may occur with bqStudio during usage.
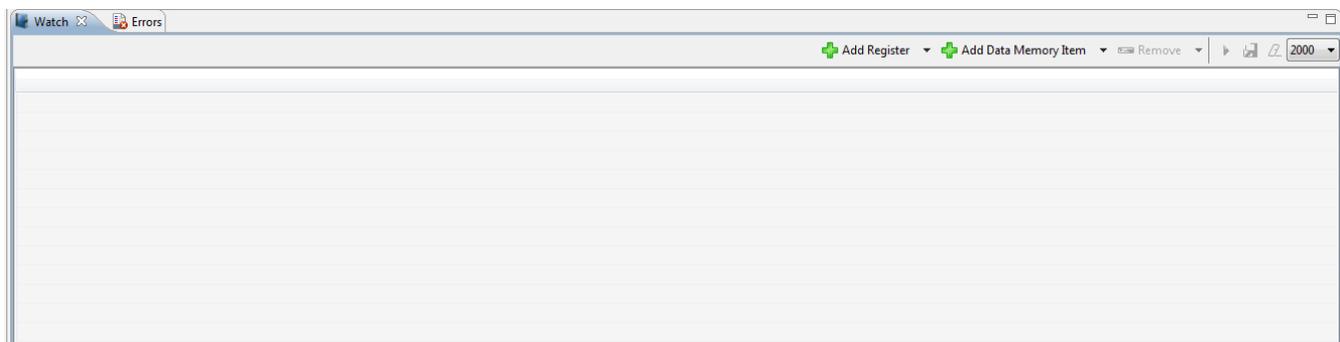
Figure 14. Error Screen

4   Circuit Module Physical Layouts and Bill of Materials

This section contains the printed-circuit board (PCB) layout, assembly drawings, bill of materials (BOM), and schematic for the bq27750 circuit module.

4.1   Board Layout

Figure 15 through Figure 20 illustrate the PCB layers and assembly drawings for the bq27750 module.
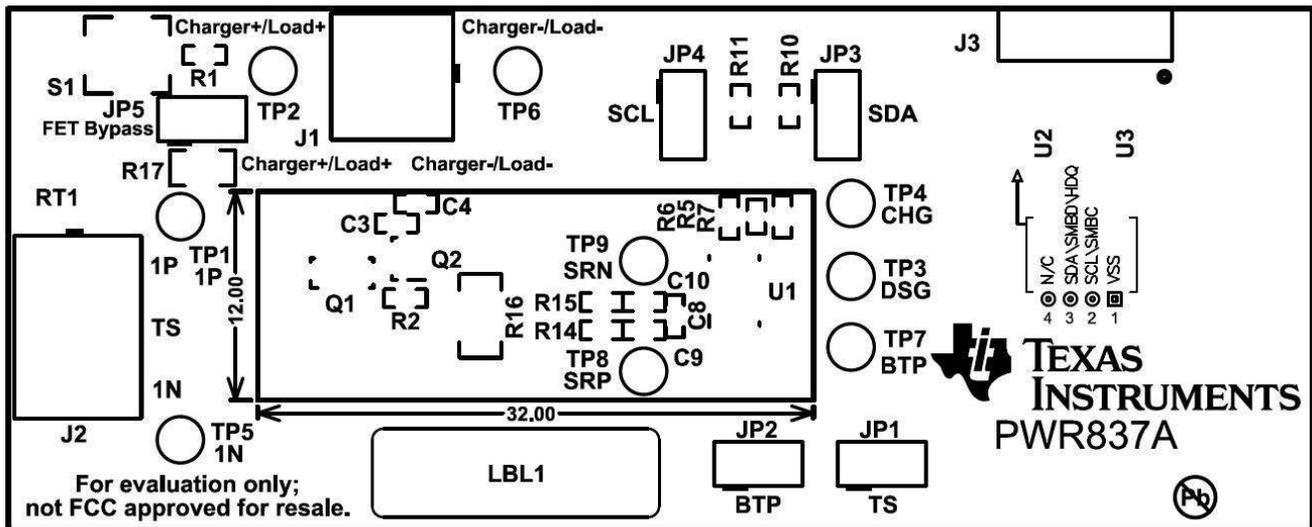
Figure 15. Top Silk Screen
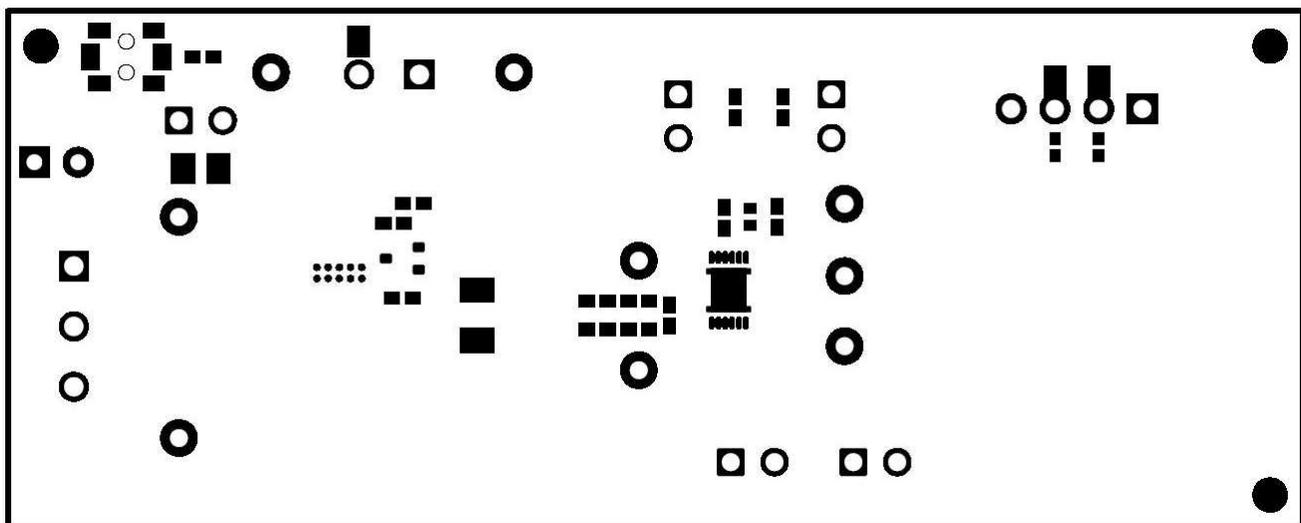
Figure 16. Bottom Silk Screen

Figure 17. Top Assembly

Figure 18. Bottom Assembly
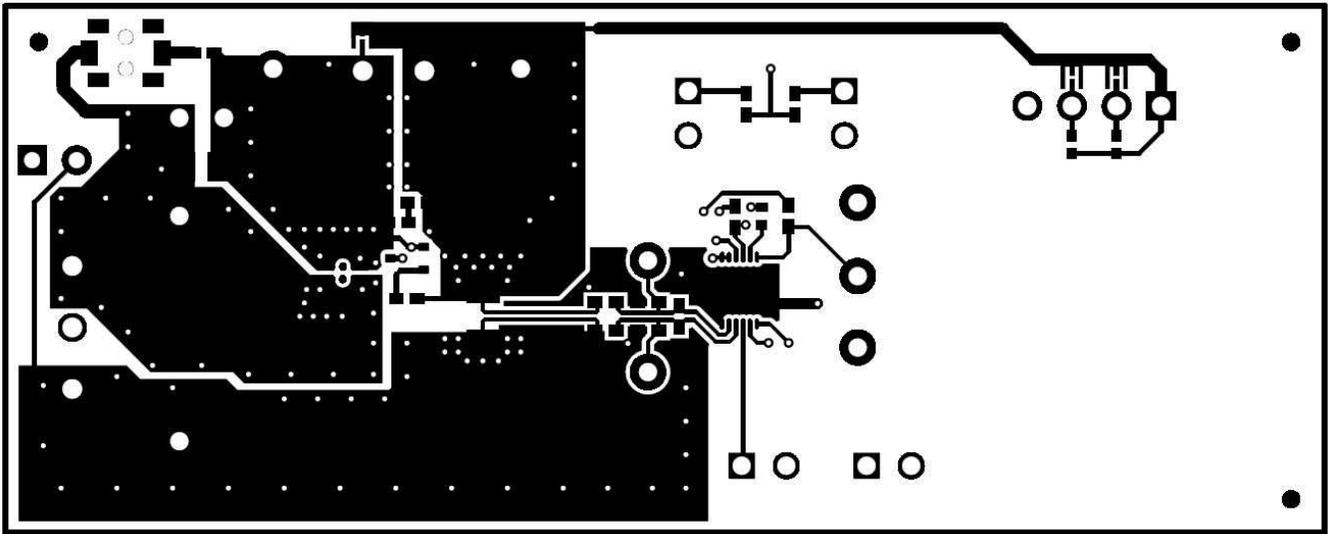
Figure 19. Top Layer
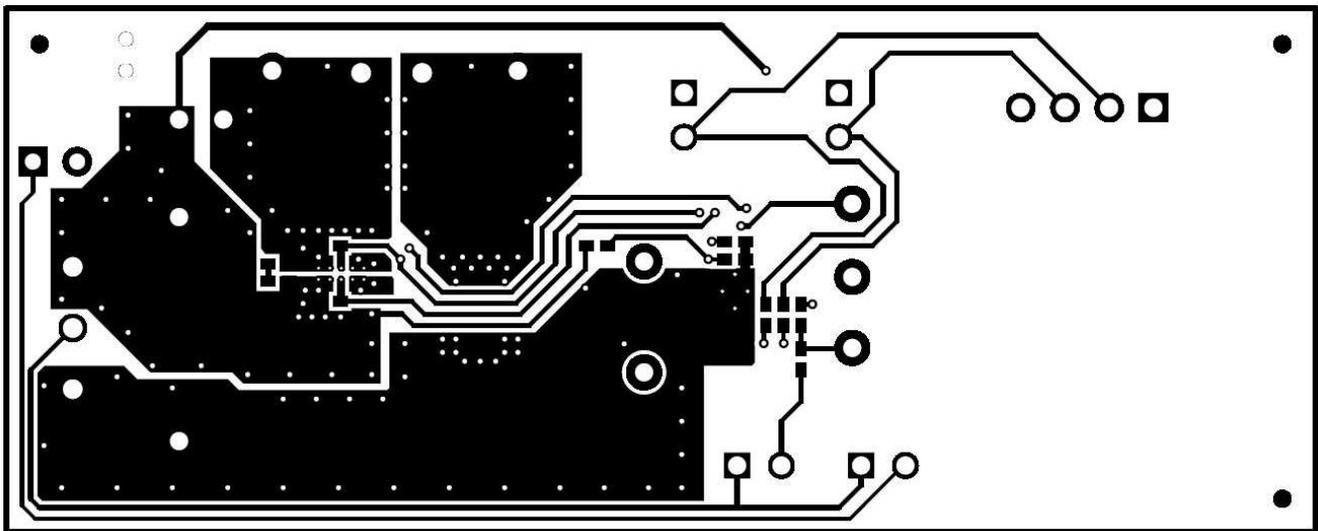
Figure 20. Bottom Layer

4.2   Bill of Materials and Schematic

Table 3 lists the EVM BOM.

Table 3. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		PWR837	Any
C1, C2, C3, C4, C5, C8	6	0.1uF	CAP, CERM, 0.1 µF, 6.3 V, +/- 10%, X5R, 0402	0402	GRM155R60J104KA01D	Murata
C6	1	2.2uF	CAP, CERM, 2.2 µF, 6.3 V, +/- 10%, X5R, 0402	0402	GRM155R60J225KE95D	Murata
J1	1		Terminal Block, 3.5 mm, 2x1, Tin, TH	Terminal Block, 3.5 mm, 2x1, TH	39357-0002	Molex
J2	1		Terminal Block, 3.5 mm, 3x1, Tin, TH	Terminal Block, 3.5 mm, 3x1, TH	39357-0003	Molex
J3	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex
JP1, JP3, JP4, JP5	4		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady
Q1	1	30V	MOSFET, 2-CH, N-CH, 30 V, A, YJG0010A (PICOSTAR-10)	YJG0010A	CSD87501L	Texas Instruments
Q2	1	60V	MOSFET, N-CH, 60 V, 0.31 A, SOT-323	SOT-323	2N7002KW	Fairchild Semiconductor
R1	1	1.0k	RES, 1.0 k, 5%, 0.063 W, 0402	0402	CRCW04021K00JNED	Vishay-Dale
R2	1	10k	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale
R3, R4	2	10Meg	RES, 10 M, 5%, 0.063 W, 0402	0402	CRCW040210M0JNED	Vishay-Dale
R5	1	10.0	RES, 10.0, 0.1%, 0.063 W, 0402	0402	CPF0402B10RE1	TE Connectivity
R6, R7, R10, R11	4	5.1k	RES, 5.1 k, 5%, 0.063 W, 0402	0402	CRCW04025K10JNED	Vishay-Dale
R8	1	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R12, R13, R14, R15	4	100	RES, 100, 1%, 0.063 W, 0402	0402	CRCW0402100RFKED	Vishay-Dale
R16	1	0.001	RES, 0.001, 1%, 1 W, AEC-Q200 Grade 0, 1206	1206	CSNL1206FT1L00	Stackpole Electronics Inc
RT1	1	10.0k ohm	Thermistor NTC, 10.0k ohm, 1%, Disc, 5x8.4 mm	Disc, 5x8.4 mm	103AT-2	SEMITEC Corporation
S1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	3.9x2.9mm	PTS820 J20M SMTR LFS	C&K Components
SH-JP1, SH-JP3, SH-JP4	3	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
TP1, TP2	2		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP3, TP4, TP5, TP6, TP8, TP9	6		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
U1	1		1-Cell to 2-Series Cell Programmable Battery Manager, DRZ0012A (VSON-12)	DRZ0012A	BQ27750DRZR	Texas Instruments
U2, U3	2		ESD in 0402 Package with 10 pF Capacitance and 6 V Breakdown, 1 Channel, -40 to +125 degC, 2-pin X2SON (DPY), Green (RoHS & no Sb/Br)	DPY0002A	TPD1E10B06DPYR	Texas Instruments
W1	1		Cable assembly, 4 pin Edge # 6575051	N/A	SMBUS CBL002	Any
C7	0	1uF	CAP, CERM, 1 µF, 35 V, +/- 10%, X5R, 0402	0402	GRM155R6YA105KE11D	Murata
C9, C10	0	0.1uF	CAP, CERM, 0.1 µF, 6.3 V, +/- 10%, X5R, 0402	0402	GRM155R60J104KA01D	Murata

Table 3. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
JP2	0		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
R9	0	330k	RES, 330 k, 5%, 0.063 W, 0402	0402	CRCW0402330KJNED	Vishay-Dale
R17	0	0	RES, 0, 5%, 0.125 W, 0805	0805	CRCW08050000Z0EA	Vishay-Dale
SH-JP2, SH-JP5	0	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
TP7	0		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone

illustrates the EVM schematic.
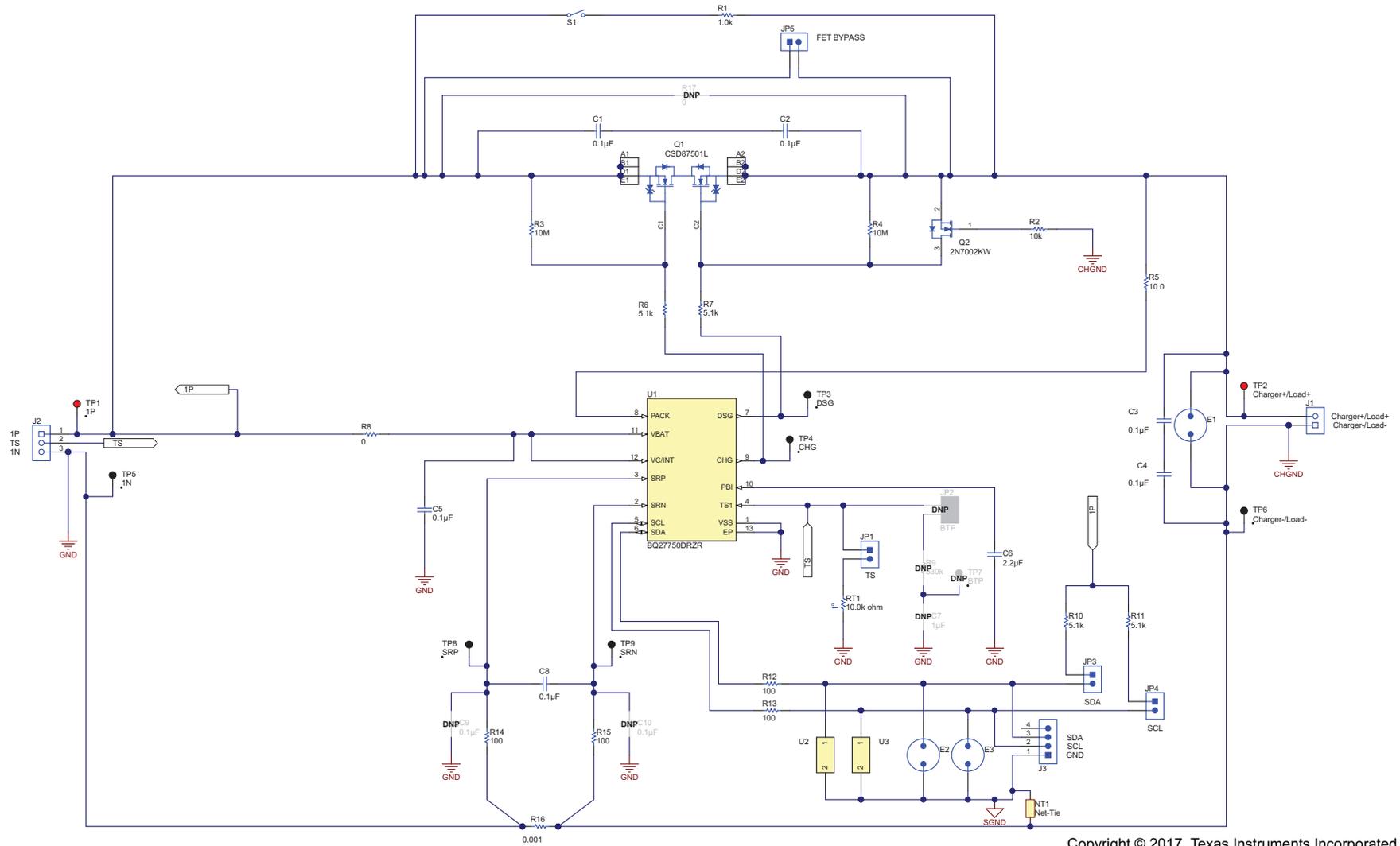
Figure 21. Schematic

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STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

    1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

    1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

    3.1 *United States*

        3.1.1 *Notice applicable to EVMs not FCC-Approved:*

        FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

        3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

        CAUTION

        This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

        FCC Interference Statement for Class A EVM devices

        NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

  3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

  3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

  3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,

2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or

3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもの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

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL 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 HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.