bq27320EVM-766 Evaluation Module

This evaluation module (EVM) is a complete evaluation system for the bq27320. This EVM includes one bq27320 circuit module, an external current sense resistor. A separate orderable EV2300 or EV2400 PC interface board for gas gauge along with a PC USB cable, and Microsoft® Windows® based PC software is needed when using this EVM. The circuit module includes one bq27320 integrated circuit and all other onboard components necessary to monitor and predict capacity for a system-side or removable battery pack fuel-gauge solution. With the EV2300 or EV2400, users can:

- Read the bq27320 data registers
- Program the chipset for different configurations
- Log cycling data for further evaluation
- Evaluate the overall functionality under different charge and discharge conditions

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1 Features

This EVM has the following features:

- Complete evaluation system for the bq27320 CEDV gas gauge
- Populated circuit module for quick setup
- Personal computer (PC) software and interface board for easy evaluation
- Software allows data logging for system analysis

1.1 Kit Contents

This EVM kit contains the following:

- bq27320 circuit module (PWR766)

This EVM is used for the evaluation of the bq27320 device. Visit the product web folder at www.ti.com to properly configure the bq27320.

1.2 Ordering Information

Table 1 lists the EVM ordering information.

Table 1. Ordering Information

Part Number	EVM Part Number	Configuration	Chemistry
bq27320	bq27320EVM-766	1-series cell	Li-ion

1.3 bq27320 Circuits Module Performance Specification Summary

Table 2 summarizes the performance specifications of the bq27320 circuit module.

Table 2. Performance Specification Summary

Specification	Min	Typ	Max	Units
Input Voltage Pack+ to Pack–	2.8	3.6	4.5	V

2 bq27320EVM Quick Start Guide

This section provides the step-by-step procedures required to take 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 required for setup and evaluation of the EVM:

- bq27320 circuit module
- EV2300 or EV2400 communications interface adapter
- USB cable to the communications interface adapter to the computer
- Computer setup with Windows XP or higher operating system
- Access to the internet to download bqStudio software setup program
- DC power supply capable of supplying 4.5 V and 2 A. (Constant current and constant voltage capability is desirable.)

2.2 System Requirements

The bqStudio software requires Windows XP or later. Using later versions of the Windows operating system can cause issues with the 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.

2.3 Software Installation

Find the latest software version of bqStudio on http://www.ti.com/tool/bqstudio. Search by part number for bq27320 to access the tool folder for the device. Use the following steps to install the bq27320 bqStudio software:

1. Ensure that the EV2300 or EV2400 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 bqStudio installer file that was downloaded from the TI Web site.
4. Follow the on-screen instructions until completing the software installation.
5. Before starting the evaluation software, connect the EV2300 or EV2400 to the computer using the USB cable.
6. If EV2300 is connected, wait until the system prompt *New Hardware Found* appears. Choose *Select Location Manually*, and use the **Browse** button to point to the TIUSBWin2K-XP-1 subdirectory.
7. Answer **Continue** to the warning that drivers are not certified with Microsoft.
8. If the EV2300 is connected, after the previous 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.
10. For the EV2400, the driver should be installed along with software installation.

2.4 Troubleshooting Unexpected Dialog Boxes

Log in as administrator before downloading the files. The driver is not signed, so the administrator must allow installation of unsigned drivers in the operating system. If using Windows 7, install the software with administrator privileges.

2.5 EVM Connections

The bq27320 evaluation system comprises three hardware components: the bq27320 circuit module, the EV2300 or EV2400 PC interface board, and the PC.

2.5.1 Connecting the bq27320 Circuit Module to a Battery Pack

Figure 1 illustrates the device connection to a battery and system load and charger.
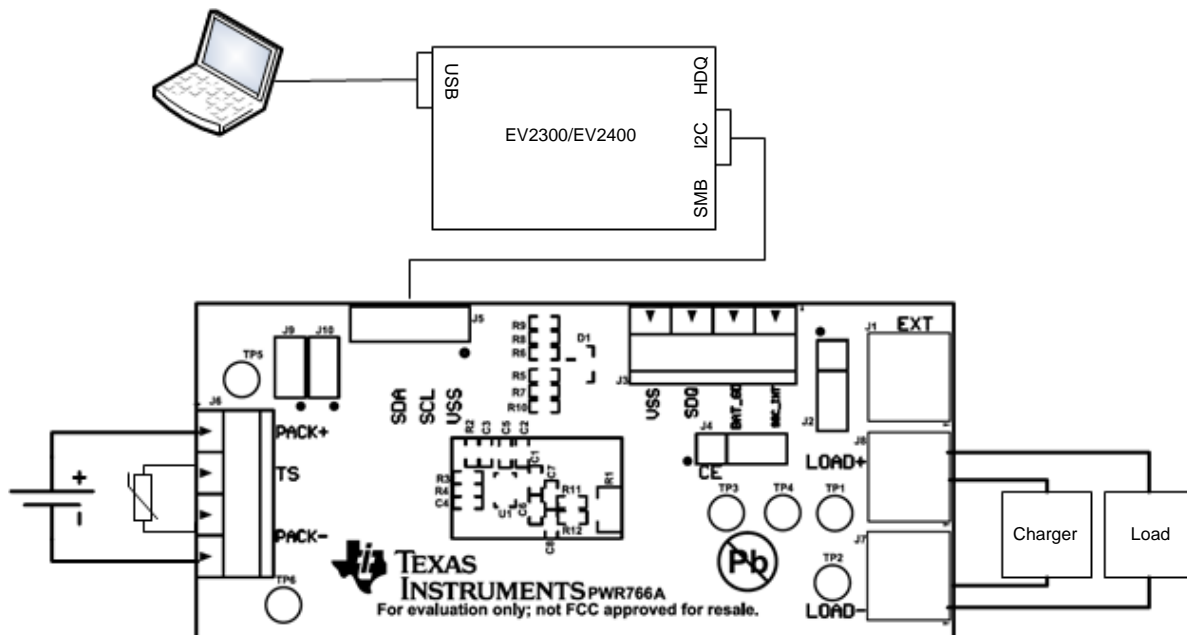

Figure 1. bq27320 Circuit Module Connection to Pack and System Load/Charger

2.5.2 Circuit Module Connections

Contacts on the circuit module provide the following connections:
- Direct connection to the battery pack (J6): PACK+/PACK–
- Charger and load connection (J7 and J8): LOAD+ and LOAD–
- I2C communication port (J5): SDA, SCL, and VSS
- Signal outputs (J3): SOC_INT, SDQ and BAT_GD
- External power connection (J1): EXT

2.5.3 Pin Description

Table 3 lists the EVM pins and their descriptions.

Table 3. EVM Pins Descriptions

Pin Name	Description
PACK+	Pack positive terminal
PACK–	Pack negative terminal
TS	Pack thermistor connection
SDA	I2C communication data line
SCL	I2C communication clock line
BAT_GD	Battery Good push-pull indicator output
SOC_INT	SOC state interrupts output
SDQ	Communication interface to authentication ID IC using SDQ protocol
CE	Chip enable
EXT	External supply connection
LOAD+	High potential of load or charger connection
LOAD–	Low potential of load or charger connection

2.6 PC Interface Connection

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

1. Connect the bq27320-based EVM to the EV2300 or EV2400 using wire leads as shown in Table 4.
2. Connect the PC USB cable to the EV2300 or EV2400 and the PC USB port.

Table 4. Circuit Module to EV2300 or EV2400 Connections

bq27320EVM	EV2300	EV2400
SDA	SDA	SDA
SCL	SCL	SCL
VSS	GND	GND
J9	Short	Open
J10	Short	Open

The bq27320EVM-766 is now set up for operation.

3 Operation

This section details the operation of the bq27320 bqStudio software.

3.1 Starting the Program

With the EV2300 or EV2400 and the bq27320EVM connected to the computer, run bqStudio from the Desktop or installation directory. The window consists of a tools panel at the top and other child windows that can be hidden, docked in various positions, or allowed to float as separate windows. When bqStudio first starts up, the *DashBoard*, the *Registers*, and *Commands* windows should be open (Figure 2). Additional windows can be added by clicking the corresponding icons in the tools panel at the top of the main window.

Clicking the **Scan** (continuous scan) or **Refresh** (single time scan) buttons updates the data in the *Registers* and *Data Memory* windows.

The logging function in bqStudio logs selected Data Registers last received from the bq27320. Enable this function by clicking the **Start Log** button. The default elapsed interval is 4000 milliseconds, to change this interval, go to *Windows*, select *Preferences*, choose *Registers*, and change the Scan/Log Interval from 4000 to 1000 milliseconds. There is no need to log faster than 1 second as the gauge will not update the registers faster than 1 second.
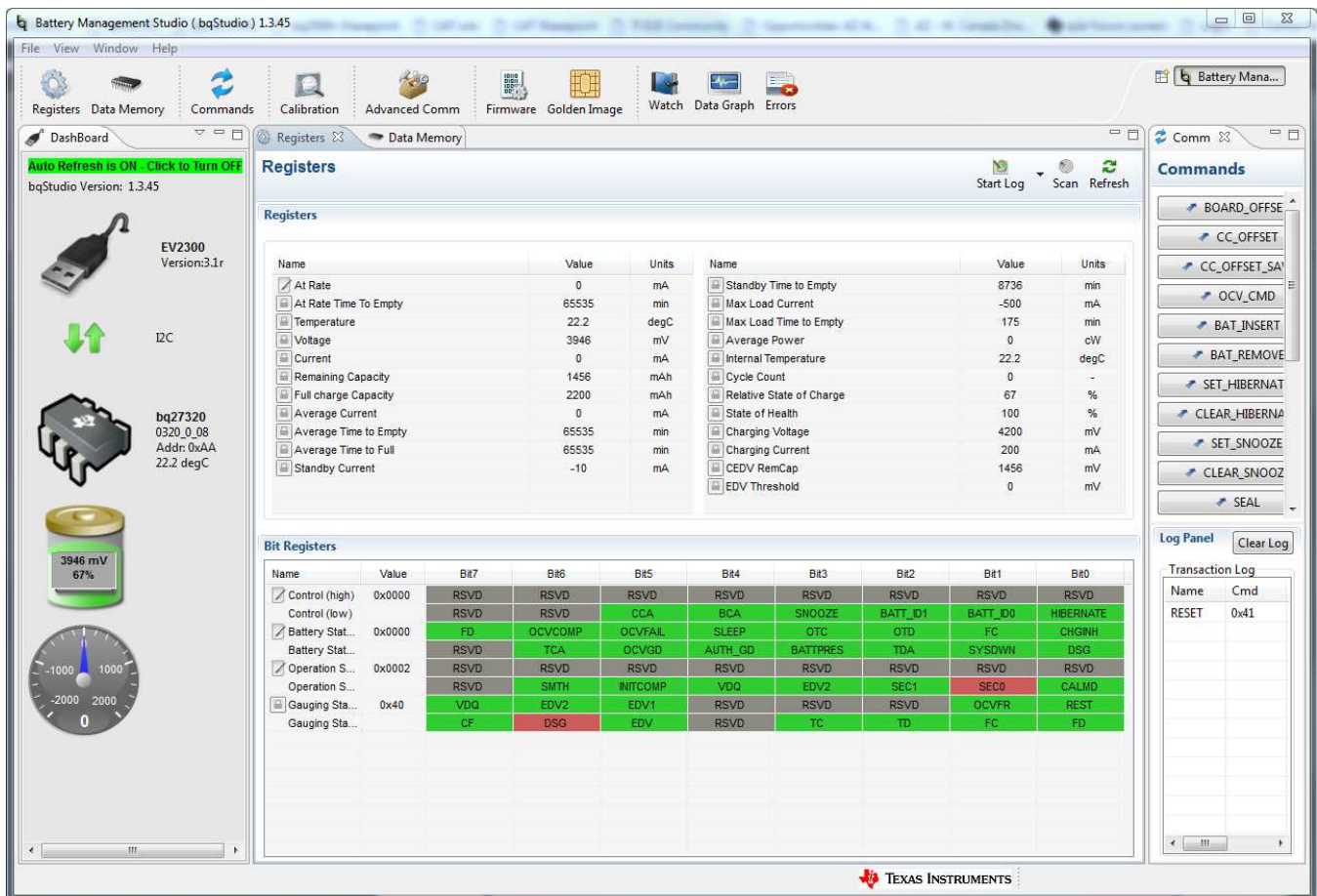

Figure 2. Registers Screen

3.2 Setting Programmable bq27320 Options

The bq27320 comes configured per the default settings detailed in the bq27320 technical reference manual (TRM) (SLUUBE6). Ensure that the settings are correctly changed to match pack and application for the bq27320 solution being evaluated.

IMPORTANT: The correct setting of these options is essential for the best performance. Configure the settings using the *Data Memory* window (Figure 3).
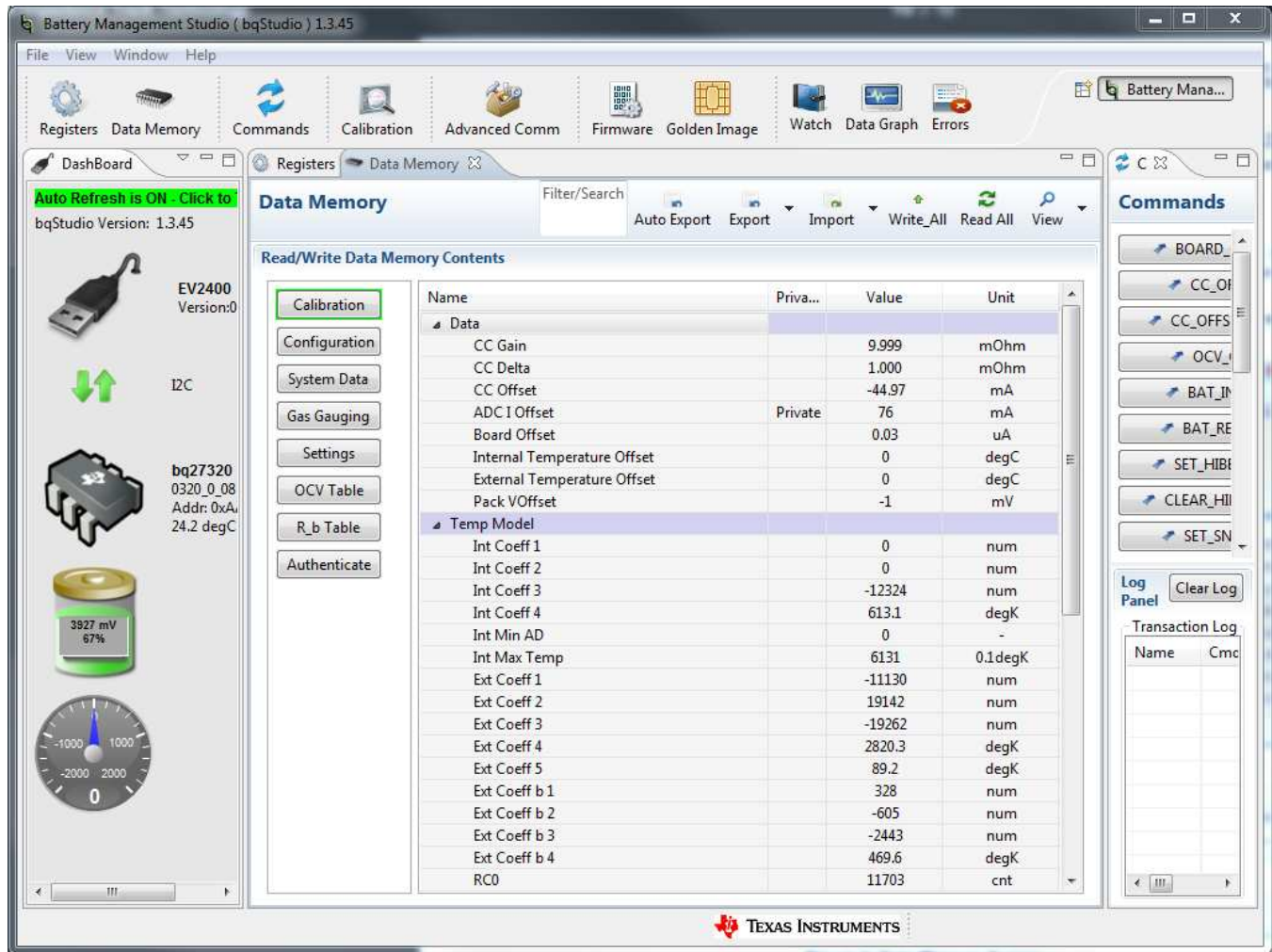

Figure 3. Data Memory Screen

To read all the data from the bq27320 non-volatile flash memory, click on the *Read All* button on the *Data Memory* window. Make sure the device is not sealed and in full access to read and write to the data memory. Clicking on a parameter is the first step for parameter updates and a window pops up providing details on the selected parameter. Next, enter the value in the value textbox and press **Enter**. After pressing **Enter**, bqStudio updates the selected parameter. Click the *Import* button in the *Data Memory* window to import an entire configuration from a specified *.gg.csv file.

Save the configuration to a file by clicking the **Export** button in the *Data Memory* window and entering a file name. The configuration is saved to a *.gg.csv file. The module calibration data is also held in the bq27320 data memory. If the *Gauge Dashboard* is not displaying any information, then the bq27320 may not be supported by the bqStudio version being used: a bqStudio upgrade may be required.

3.3 Calibration

The bq27320EVM must be calibrated to ensure accurate value reporting. Calibrate the EVM in the *Calibration* window in bqStudio (Figure 4).
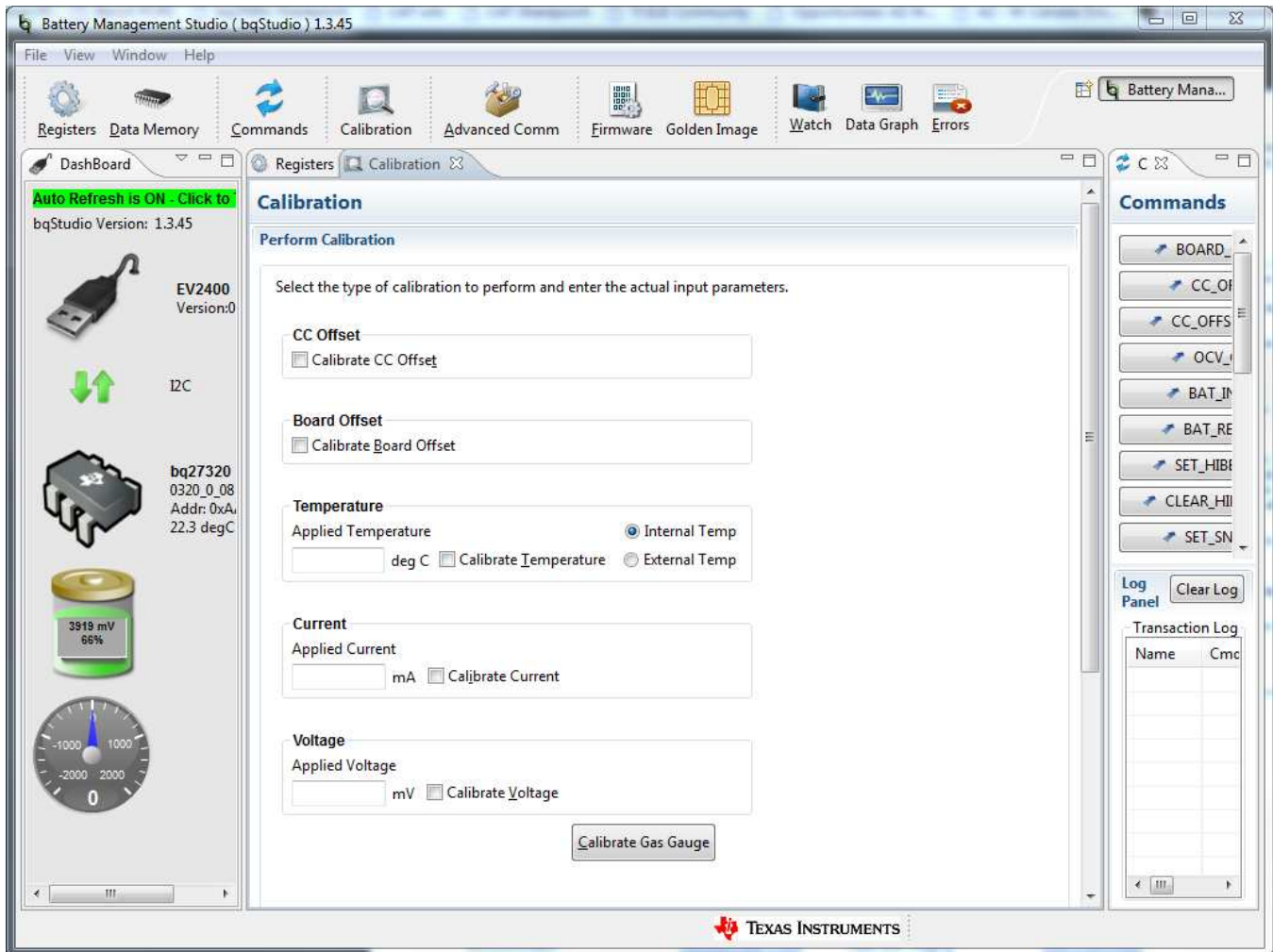

Figure 4. Calibration Screen

Calibration consists of the following:

- CC Offset/Board Offset: Check **Calibrate CC Offset** and **Calibrate Board Offset**, then click the **Calibrate Gas Gauge** button to calibrate the Coulomb counter and board offsets. Ensure no current is flowing through the sense resistor during these steps. After a successful calibration, a green check mark shows next to the **Calibrate Gas Gauge** button.
- Current: Connect a 2-A load to LOAD+/LOAD– or a current source to LOAD–/PACK–. Ensure the measured current reported is negative, or else reverse the connections. Check **Calibrate Current** and enter the current into the textbox then click the **Calibrate Gas Gauge** button.
- Voltage: Apply a known DC voltage to PACK+/PACK– with no current flowing through the sense resistor. Check **Calibrate Voltage** and enter the voltage into the textbox then click the **Calibrate Gas Gauge** button.

3.4   Setting the CEDV Parameters

TI provides an online gauging parameter calculator (GPC) for CEDV gauges tool (www.ti.com/tool/GPCCEDV) to evaluate the bq27320. After programming the design parameters to the gauge, use the EVM to obtain the experimental data needed to calculate the CEDV coefficients.
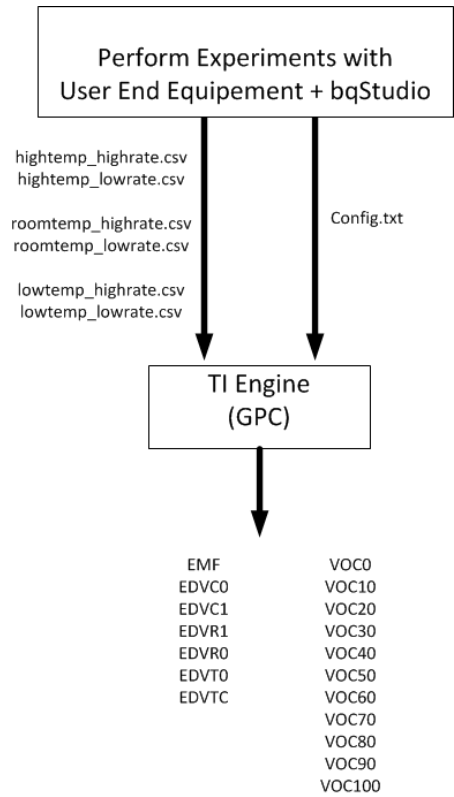
Figure 5. CEDV Coefficients Calculation Flow

The folllowing items are required:

- bqStudio software
- bq27320EVM-766
- Power supply able to source/sink current. For example, a gauge development kit (GDK) or a Keithley sourcemeter. Alternatively, use a regular DC power supply and electronic load.

Refer to *Simple Guide to CEDV Data Collection for Gauging Parameter Calculator (GPC)* (SLUUB45) for a detailed explanation of the CEDV coefficients data collection process and GPC tool configuration.

4   Circuit Module Physical Layout, Bill of Materials and Schematic

This section contains the board layout, bill of materials, and schematic for the bq27320 circuit module.

4.1   Board Layout

This section shows the printed circuit board (PCB) layers (Figure 7 through Figure 10), and assembly drawing (Figure 6) for the bq27320 module.
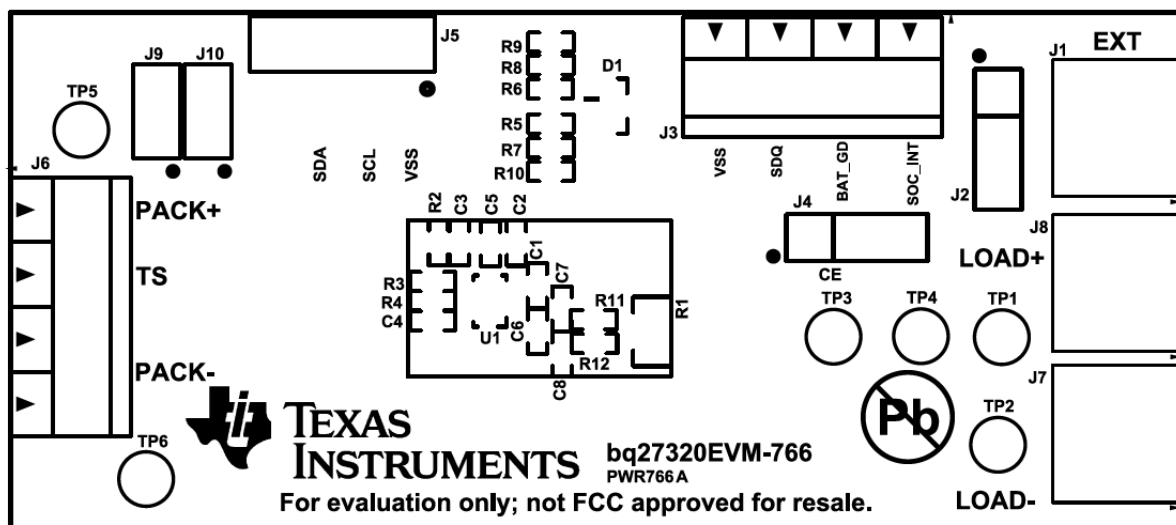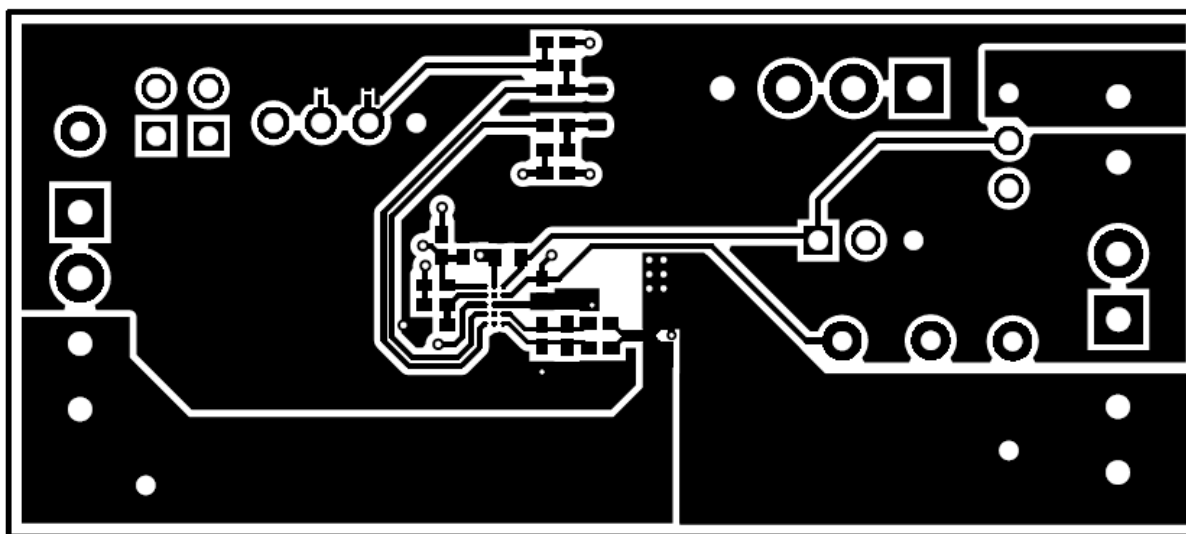

Figure 6. Top Silkscreen
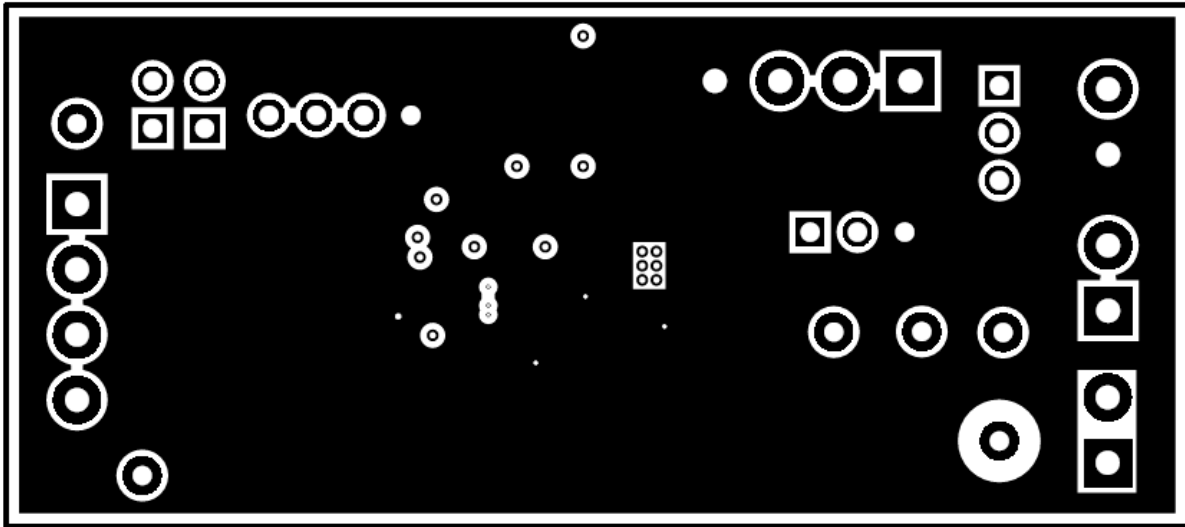

Figure 7. Top Layer
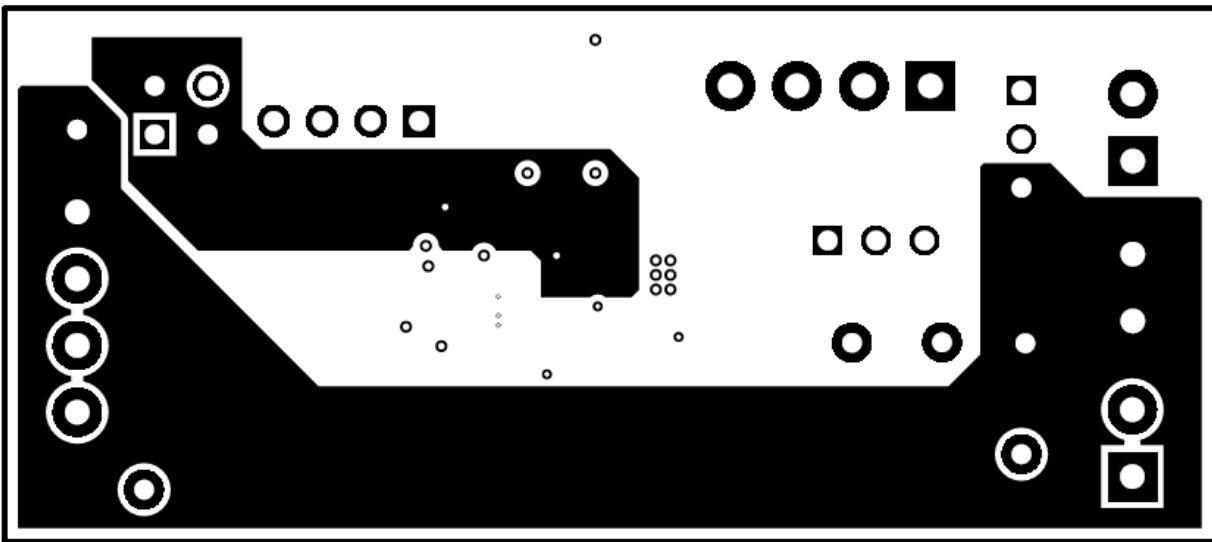
Figure 8. Inner Layer 1
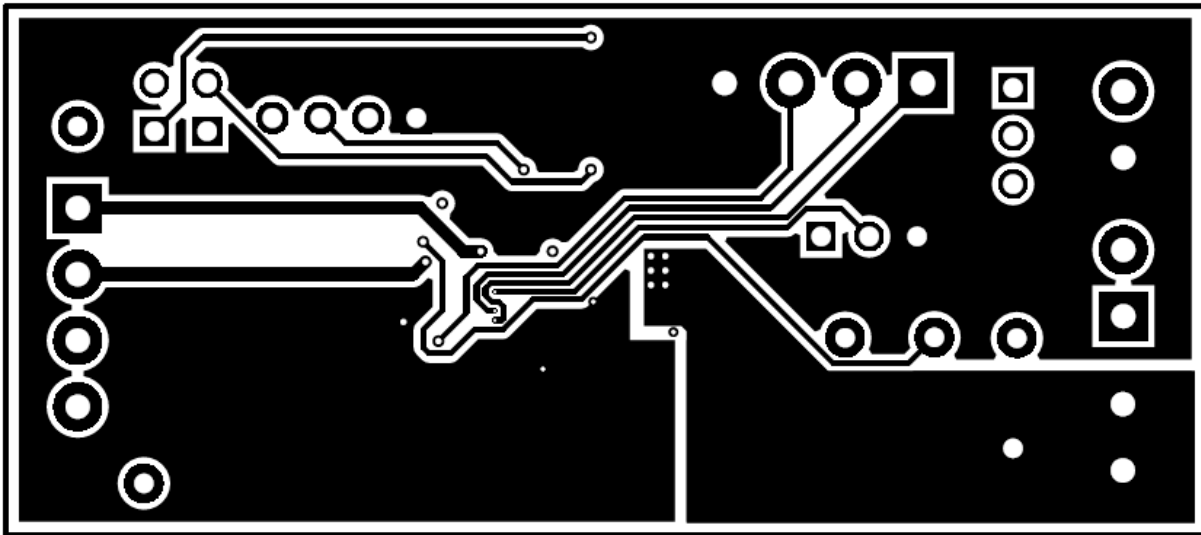

Figure 9. Inner Layer 2

Figure 10. Bottom Layer

4.2   Bill of Materials

Table 5 lists the BOM for this EVM.

Table 5. bq27320EVM-766 Bill of Materials

Designator	Qty	Value	Description	Footprint	PartNumber	Manufacturer
PCB	1		Printed Circuit Board		PWR766	Any
C1	1	1uF	CAP, CERM, 1 μF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM152R60J105ME15D	Murata
C2, C4, C5, C6, C7, C8	6	0.1uF	CAP, CERM, 0.1 μF, 10 V, +/- 10%, X5R, 0402	0402	GRM155R61A104KA01D	Murata
C3	1	0.033uF	CAP, CERM, 0.033 μF, 10 V, +/- 10%, X7R, 0402	0402	GRM155R71A333KA01D	Murata
D1	1	5.6V	Diode, Zener, 5.6 V, 300 mW, SOT-23	SOT-23	AZ23C5V6-TP	Micro Commercial Components
J1	1		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	TERM_BLK_ED555-2DS	ED555/2DS	On-Shore Technology
J2, J4	2		Header, 100mil, 3x1, Tin, TH	CONN_PEC03SAAN	PEC03SAAN	Sullins Connector Solutions
J3, J6	2		Terminal Block, 6A, 3.5mm Pitch, 4-Pos, TH	TERM_BLK_ED555-4DS	ED555/4DS	On-Shore Technology
J5	1		Header (friction lock), 100mil, 4x1, R/A, TH	CONN_22-05-3041	22-05-3041	Molex
J7	1		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	TERM_BLK_ED555-2DS	ED555/2DS	On-Shore Technology
J8	1		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	TERM_BLK_ED555-2DS	ED555/2DS	On-Shore Technology
J9, J10	2		Header, 100mil, 2x1, Tin, TH	CONN_PEC02SAAN	PEC02SAAN	Sullins Connector Solutions
R1	1	0.01	RES, 0.01, 1%, 0.25 W, 0805	0805_HV	WSL0805R0100FEA18	Vishay-Dale
R2	1	1.8Meg	RES, 1.8 M, 5%, 0.063 W, 0402	0402	CRCW04021M80JNED	Vishay-Dale
R3	1	18.2k	RES, 18.2 k, 1%, 0.063 W, 0402	0402	CRCW040218K2FKED	Vishay-Dale
R4	1	1.00k	RES, 1.00 k, 1%, 0.063 W, 0402	0402	CRCW04021K00FKED	Vishay-Dale
R5, R6, R7, R8, R11, R12	6	100	RES, 100, 1%, 0.063 W, 0402	0402	CRCW0402100RFKED	Vishay-Dale
R9, R10	2	10k	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale
TP1, TP5	2	Red	Test Point, Miniature, Red, TH	Keystone5000	5000	Keystone
TP2, TP3, TP4, TP6	4	Black	Test Point, Miniature, Black, TH	Keystone5001	5001	Keystone
U1	1		System-Side Fuel Gauge with Integrated LDO, YZF0015ANAN	YZF0015ANAN	BQ27320YZFR	Texas Instruments

4.3 Schematic

Figure 11 illustrates the schematic for the EVM.
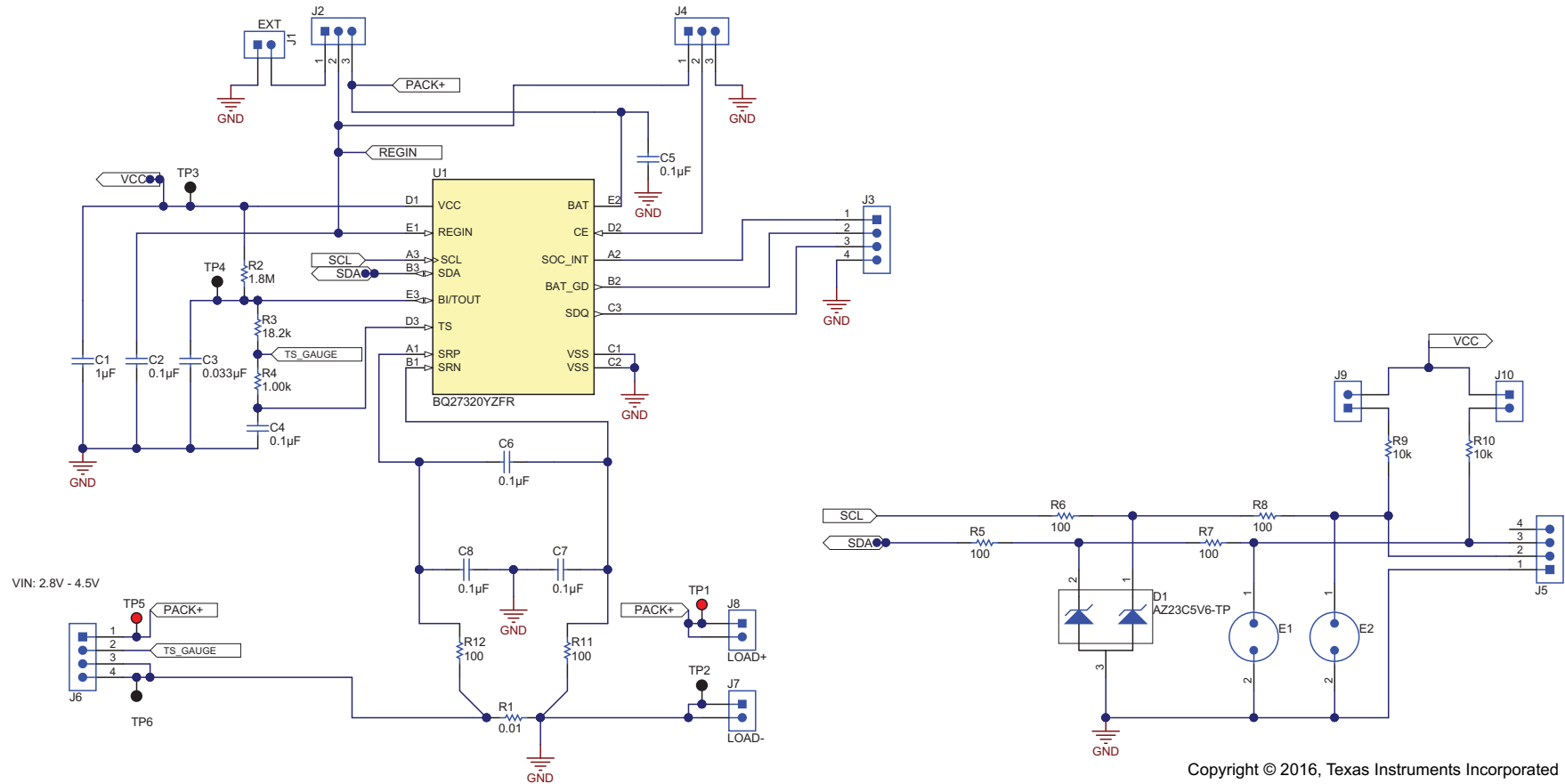
Figure 11. bq27320EVM Schematic

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