bq27426EVM-738 EVM: Single-Cell Impedance Track Technology

This evaluation module (EVM) is a complete evaluation system for the bq27426. The EVM includes one bq27426 circuit module with an integrated current-sense resistor. A separated orderable EV2300 or EV2400 PC interface board for gas gauge interface along with a PC USB cable, and Windows®-based PC software is needed when using this EVM. The circuit module includes one bq27426 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 or EV2400 interface board and software, the user can:

- Read the bq27426 data registers
- Update the RAM for different configurations
- Log cycling data for further evaluation
- Evaluate the overall functionality of the bq27426 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 bq27426 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

1.1 Kit Contents

- bq27426 circuit module (PWR214)

This EVM is used for the evaluation of bq27426. Visit the product Web folder at www.ti.com to properly configure the bq27426.

1.2 Ordering Information

Table 1. Ordering Information

Part Number	EVM Part Number	Firmware Version	Chemistry
bq27426-G1	bq27426EVM-738	v2.02	4.2 V (1202) 4.35 V (3230) 4.4 V (3142)

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2 bq27426-Based Circuit Module

The bq27426 based circuit module is a complete and compact example solution of a bq27426 circuit for battery management. The circuit module incorporates a bq27426 battery gas gauge integrated circuit (IC) with external sense resistor to accurately predict the capacity of a 1-series Li-ion cell.

2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the battery pack (J5): PACK+, PACK–
- To the I^2C communications port (J1): 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 (J2 and J5-2): GPOUT and BIN
- External connect to power the IC (TP4): EXT VCC

2.2 Pin Description

Pin Name	Description
PACK+	Pack positive terminal
PACK–	Pack negative terminal
SDA	I^2C™ communication data line
EXT VDD	External supply connection
SCL	I^2C communication clock line
VSS	Signal return for communication line, shared with charger and ground
CHARGER+/LOAD+	High potential of load or charger connection
CHARGER–/LOAD–	Low potential of load or charger connection (system VSS)
BIN	Battery insertion detection input
GPOUT	General purpose output

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3 Circuit Module Physical Layout, Bill of Materials and Schematic

This section contains the board layout, bill of materials, and schematic for the bq27426 circuit module.

3.1 Board Layout

This section shows the printed-circuit board (PCB) layers (Figure 1 through Figure 3), and assembly drawing for the bq27426 module.

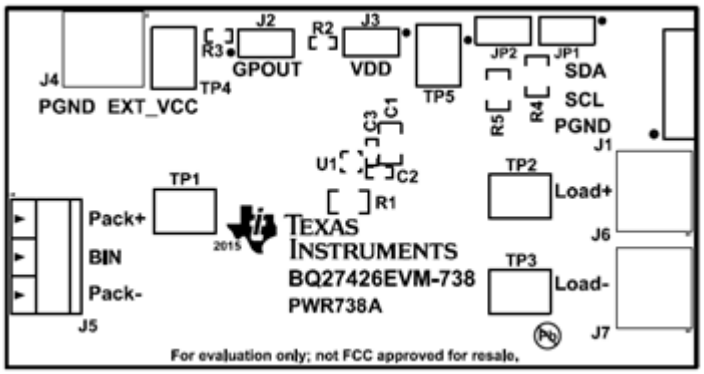


Figure 1. bq27426EVM Layout – Top Silk

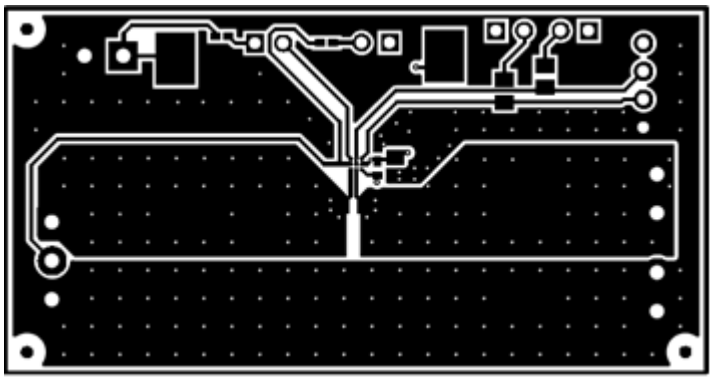


Figure 2. bq27426EVM Layout - Top Layer

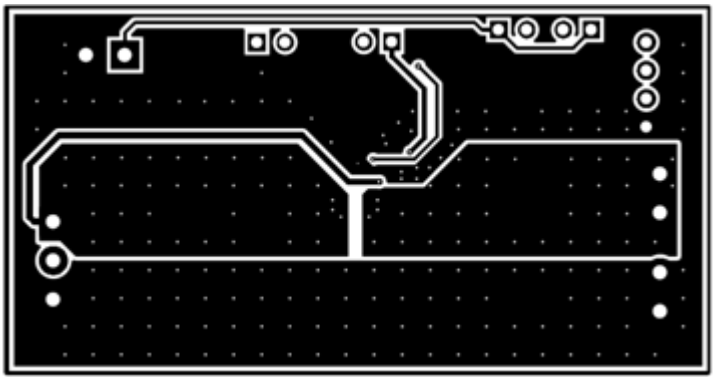


Figure 3. bq27426EVM Layout – Bottom Layer

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3.2 Bill of Material

Table 2. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
PCB	1		Printed Circuit Board		PWR738	Any
C1	1	2.2uF	CAP, CERM, 2.2 µF, 16 V, +/- 10%, X5R, 0805	0805	0805YD225KAT2A	AVX
C2	1	1uF	CAP, CERM, 1 µF, 16 V, +/- 10%, X5R, 0402	0402	C1005X5R1C105K050BC	TDK
C3	1	0.47uF	CAP, CERM, 0.47 µF, 6.3 V, +/- 10%, X5R, 0402	0402	GRM155R60J474KE19D	MuRata
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.25 X 0.075, Clear	75x250 mil	SJ5382	3M
J1	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex
J2, J3, JP1, JP2	4		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
J4, J6, J7	3		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J5	1		Terminal Block, 6A, 3.5mm Pitch, 3-Pos, TH	10.5x8.2x6.5mm	ED555/3DS	On-Shore Technology
R1	1	0.01	RES, 0.01, 1%, 0.25 W, 0805	0805	WSL0805R0100FEA18	Vishay-Dale
R2	1	1.8Meg	RES, 1.8Meg ohm, 5%, 0.063W, 0402	0402	CRCW04021M80JNED	Vishay-Dale
R3	1	5.1k	RES, 5.1k ohm, 5%, 0.063W, 0402	0402	CRCW04025K10JNED	Vishay-Dale
R4, R5	2	10.0k	RES, 10.0 k, 1%, 0.125 W, 0805	0805	CRCW080510K0FKEA	Vishay-Dale
SH-JP1, SH-JP2	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
TP1, TP2, TP3, TP4, TP5	5	SMT	Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone
U1	1		System-Side Impedance Track Fuel Gauge, YZF0009AKAL	YZF0009AKAL	BQ27426YZFR	Texas Instruments

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3.3 Schematic

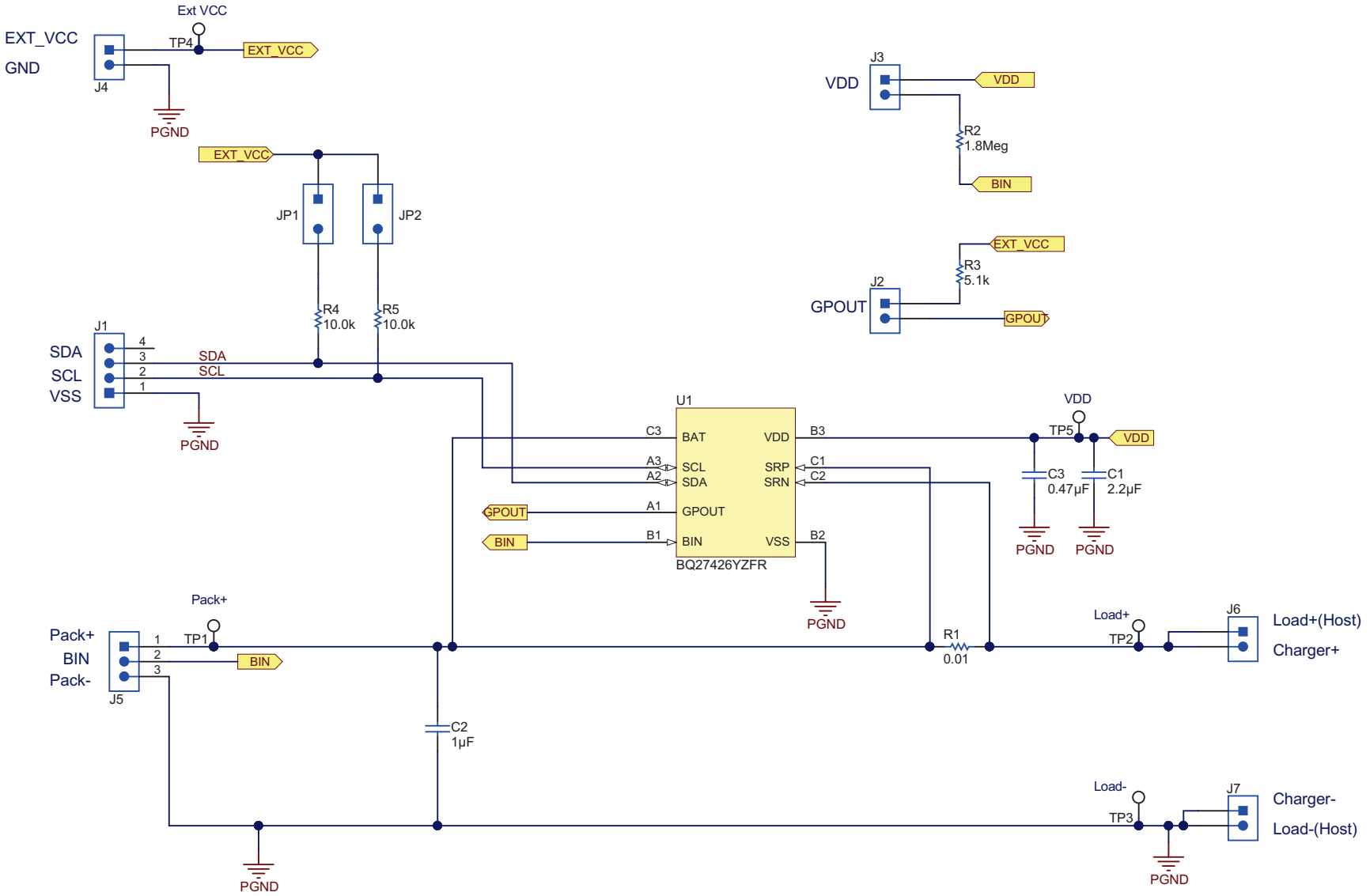


Figure 4. bq27426EVM Schematic

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3.4 bq27426 Circuits Module Performance Specification Summary

This section summarizes the performance specifications of the bq27426 circuit module.

Table 3. Performance Specification Summary

Specification	Min	Typ	Max	Units
Input voltage Pack+ to Pack–	2.5	3.6	4.5	V

4 EVM Hardware and Software Setup

This section describes how to install the bq27426EVM PC software and how to connect the different components of the EVM.

4.1 System Requirements

The bqStudio software requires Windows XP or later. Using later versions of Windows operating system can have 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.

4.2 Software Installation

Find the latest software version of bqStudio on http://www.ti.com/tool/bqstudio. Search by part number for bq27426 to access the tool folder for the device. Use the following steps to install bq27426 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 instructions on screen 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 system prompt *New Hardware Found* appears. Choose *Select Location Manually*, and use the **Browse** button to point to subdirectory TIUSBWin2K-XP-1.
7. Answer **Continue** to the warning that drivers are not certified with Microsoft®.
8. 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.

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. If using Windows 7, install the software with administrator privileges.

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6 Hardware Connection

The bq27426 evaluation system comprises three hardware components: the bq27426 circuit module, the EV2300 or EV2400 PC interface board, and the PC.

6.1 Connecting the bq27426 Circuit Module to a Battery Pack

Figure 5 shows how to connect the bq27426 circuit module to the cells and system load/charger.

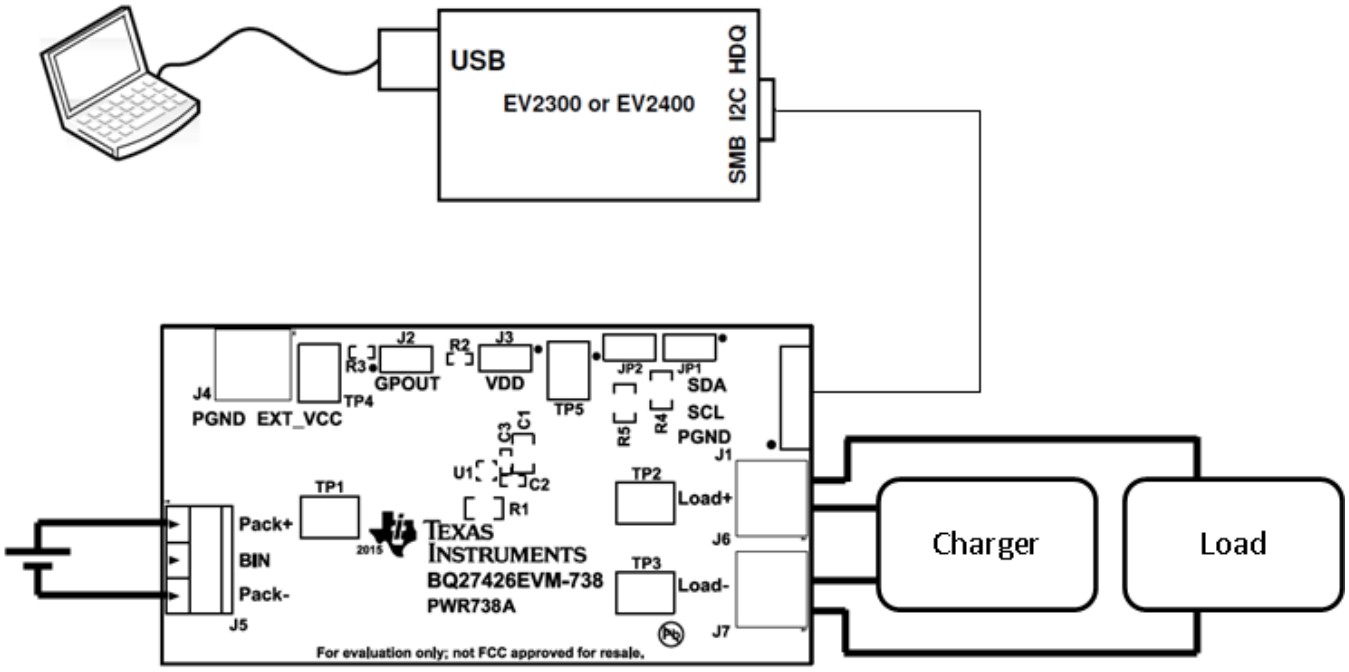


Figure 5. bq27426 Circuit Module Connection to Pack and System Load/Charger

6.2 PC Interface Connection

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

1. Connect the bq27426-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

bq27426EVM	EV2300	EV2400
SDA	SDA	SDA
SCL	SCL	SCL
VSS	VSS	VSS
JP1	Short	Open
JP2	Short	Open
EXT_VCC (J4 or TP4)	External supply > 1.8 V	N/A

The bq27426EVM is now set up for operation.

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7 Operation

This section details the operation of the bq27426 bqStudio software.

7.1 Starting the Program

Run bqStudio from the desktop. 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 *Gauge Dashboard* window, the Registers window and *Data Memory* window should be seen in the main window. *Registers, Data Memory, Commands*, and other windows can be added to the main window by clicking on the corresponding icon in the tools panel at the top of the main window. Data should appear initially in the *Gauge Dashboard, Registers* and *Data Memory* sections. The **Refresh** (single time scan) or the **Scan** (continuous scan) buttons can be clicked in order to update the data in the *Registers* and *Data Memory* windows. The continuous scan is enabled when the *Scan* checkbox is highlighted green and disabled when the *Scan* checkbox is not highlighted. The continuous scanning interval can be set with the *stopwatch* icon next to the **Scan** button. When the *stopwatch* icon is clicked, a drop-down menu will appear and the desired scanning interval can be selected. The scan interval value will show up next to the *stopwatch* icon.

bqStudio provides a logging function which logs selected Data Registers last received from the bq27426. To enable this function, click the **Start Log**. The default elapsed interval is 4000 milliseconds, to change this interval, go to Window, select Preferences, choose Registers, and change Scan/Log Interval from 4000 to 1000 milliseconds. There is no need to log faster than 1 second as the gas gauge will not update the registers faster than 1 second.

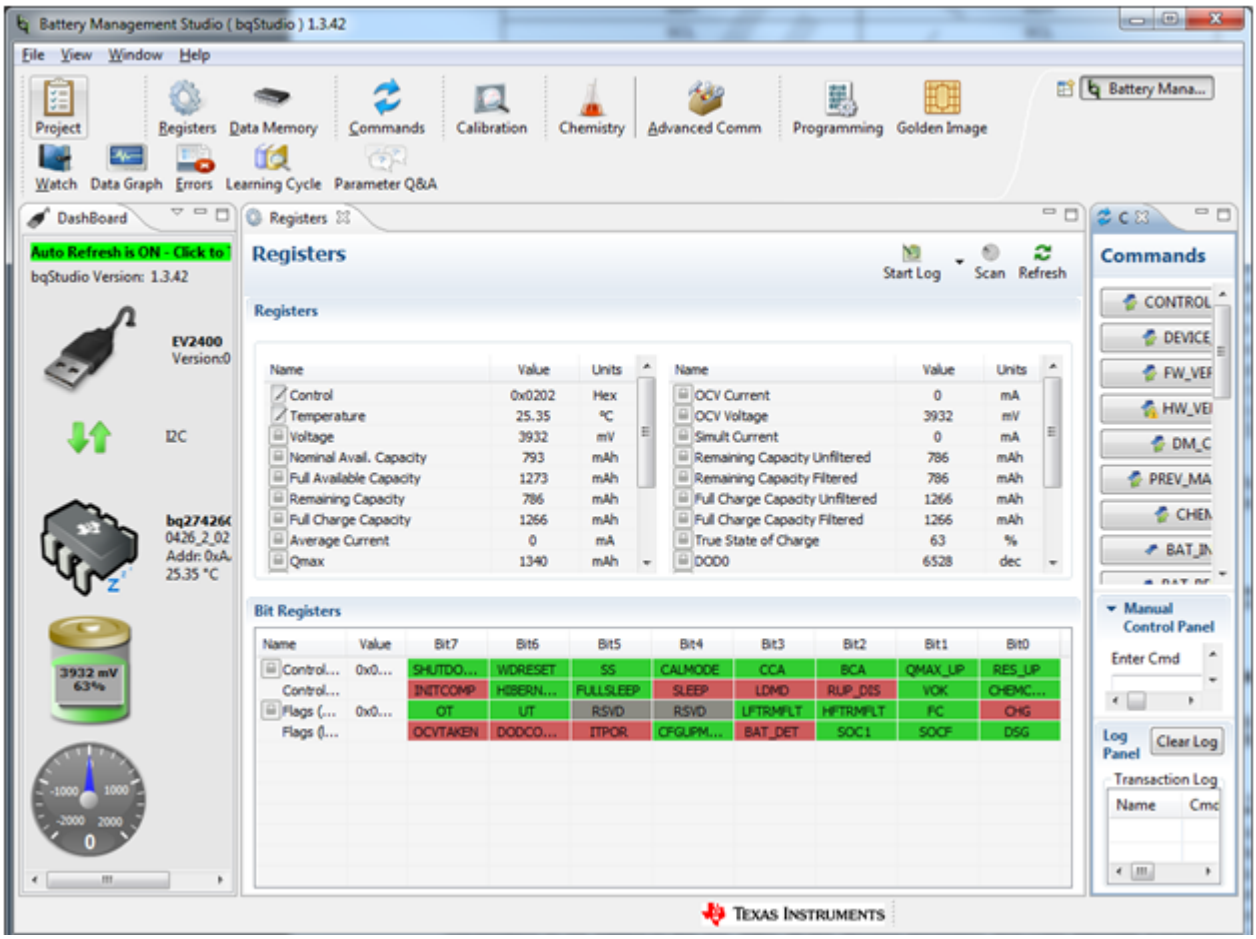


Figure 6. Registers Screen

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Figure 6 shows the main bqStudio window. Additional Flag and Control Status data can be viewed at the bottom of the registers window.

7.2 Setting Programmable bq27426 Options

The bq27426 OTP comes configured per the default settings detailed in the bq27426 data sheet. Ensure that the settings are correctly changed to match the pack and application for the bq27426 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 Memory* window seen in the main *bqStudio* window (Figure 7).

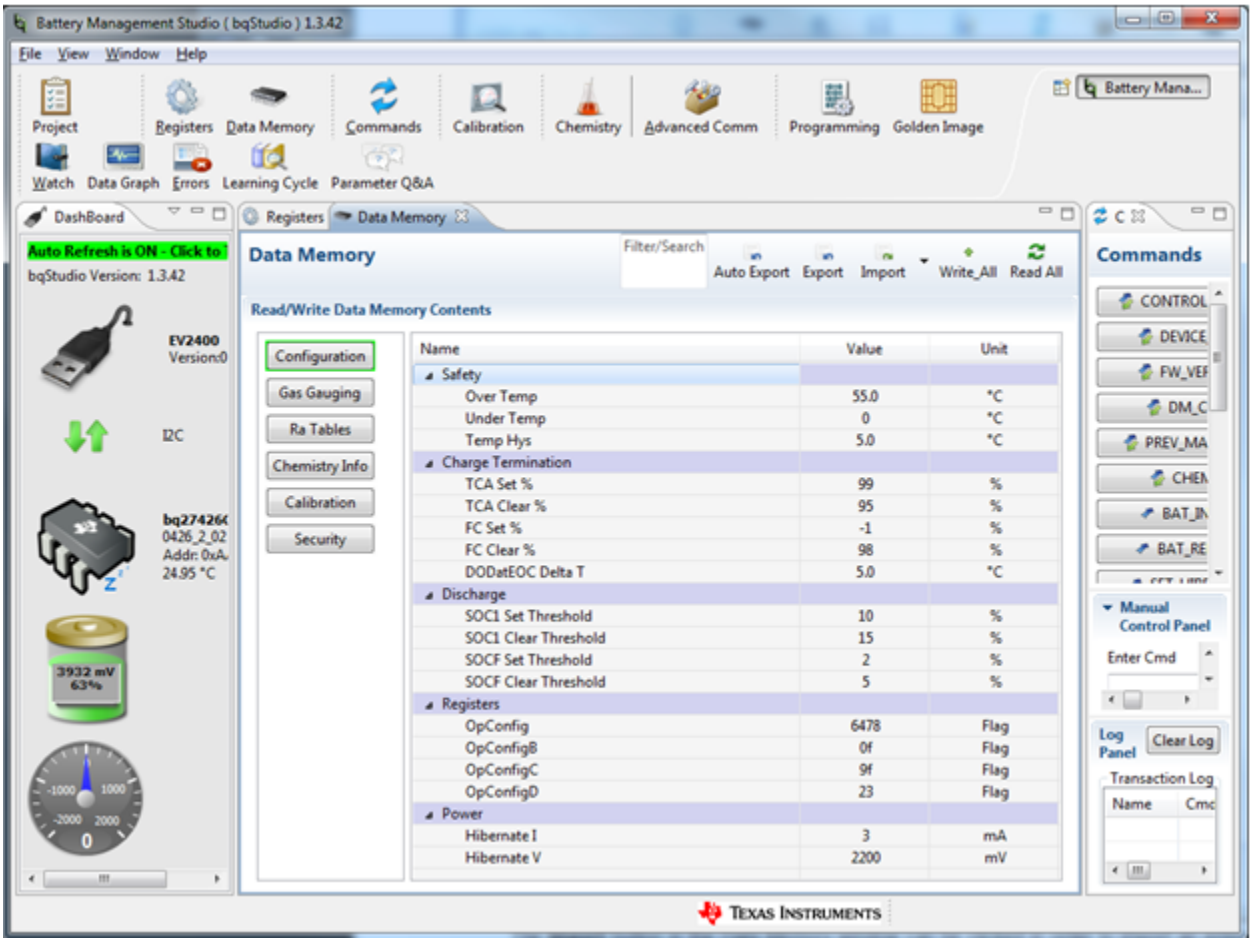


Figure 7. Data Memory Screen

To read all the data from the bq27426 OTP, click on the **Refresh** button in the *Data Memory* window.

To make a RAM update and write to an OTP location, make sure that the [CFGUPMODE] bit in the Flags register is set by sending the SET_CFGUPDATE subcommand (0x0013). The SET_CFGUPDATE subcommand can be sent to the bq27426 in bqStudio by clicking the **SET_CFGUPDATE** button in the Commands window. However, bqStudio will handle the update of the OTP parameter(s) automatically so the user will not have to worry about entering and exiting CONFIG UPDATE mode. To update an OTP parameter, click on the desired parameter and a window will pop-up that provides details on the selected OTP parameter. Next, enter the value in the value textbox and press **Enter**. After **Enter** has been pressed, bqStudio will update the selected parameter. Note that the OTP updates are stored in RAM and a POR or full RESET subcommand (0x0041) will change the OTP back to the default value. The **Import** button in the *Data Memory* window can be clicked in order to import an entire OTP configuration from a specified *.gg.csv file.

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The OTP configuration can be saved to a file by clicking the **Export** button in the Data Memory window and entering a file name. The OTP configuration will be saved to a *.gg.csv file. The module calibration data is also held in the bq27426 data Memory. If the Gauge Dashboard is not displaying any information, then the bq27426 may not be supported by the bqStudio version that is being used, a bqStudio upgrade may be required.

7.3 Setting the Chemistry

The bq27426 comes pre-programmed with three chemistry IDs. The default setting is using ID 3230 which supports 4.35 volt batteries. In order to support 4.2-4.3 volt batteries, select Chemistry #1 (1202). 4.4 volt batteries, select Chemistry #2 (3142).

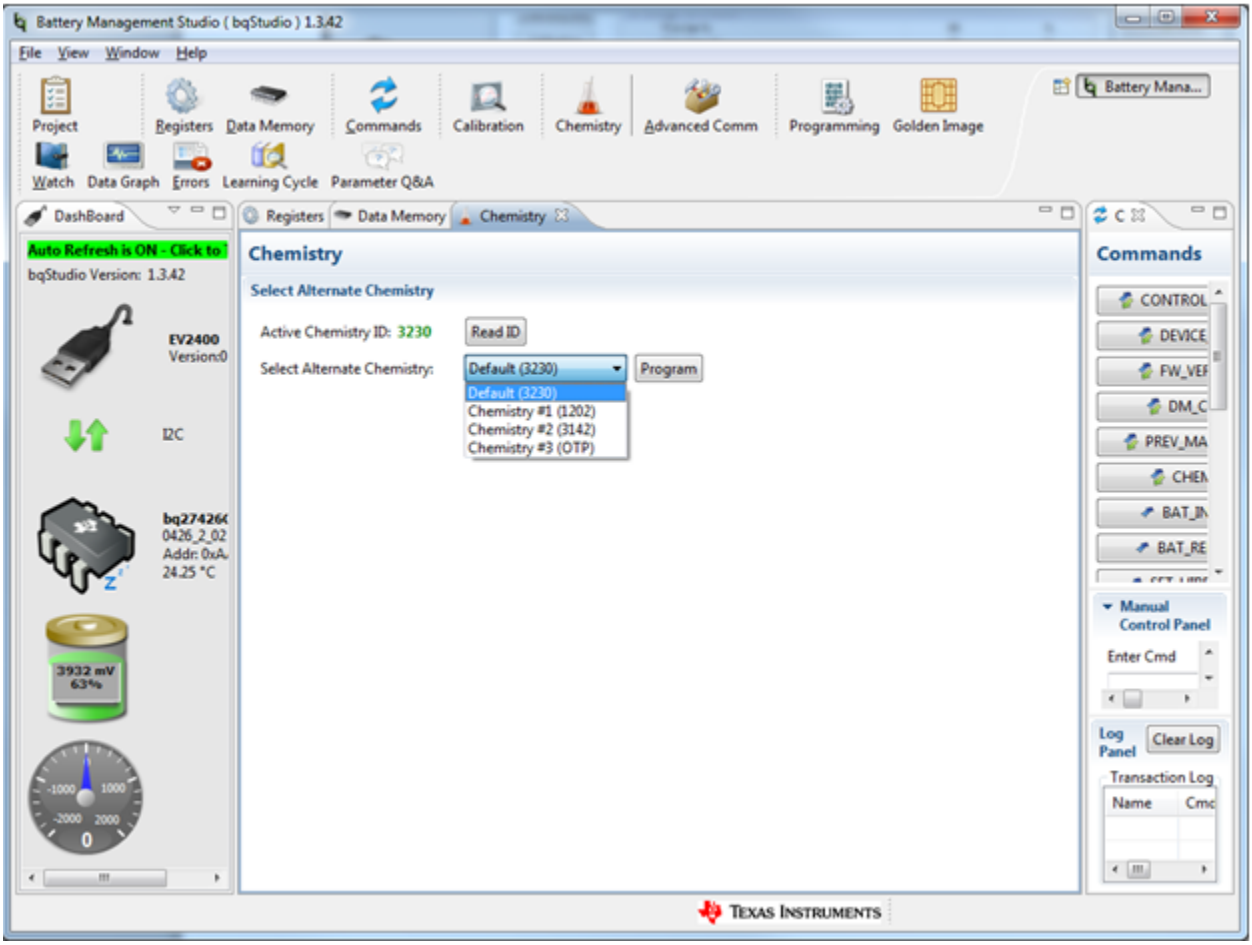


Figure 8. Chemistry Screen

8 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 .

1. *bq27426 System-Side Impedance Track™ Fuel Gauge with Integrated Sense Resistor* data sheet (SLUSC91)

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