TEXAS INSTRUMENTS

bq26500 Single Cell Battery Fuel Gauge Evaluation Module

User's Guide

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It is important to operate this EVM within the maximum input voltage ranges specified in Table 4.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 50°C. The EVM is designed to operate properly with certain components above 50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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bq26500 Single Cell Battery Fuel Gauge Evaluation Module

Portable Power Products

ABSTRACT

The bq26500EVM is a complete evaluation system for the bq26500 single cell Li-Ion and Li-Polymer battery gas gauge device. The EVM includes one bq26500 circuit module, an EV2300 PC interface board for gas gauge evaluation, a USB cable, CD ROM including windows-based PC software and support documentation.

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1 Introduction

The bq26500EVM is a complete evaluation system for the bq26500 single cell Li-Ion and Li-Polymer battery gas gauge device. The EVM includes one bq26500 circuit module, an EV2300 PC interface board for gas gauge evaluation, a USB cable, CD ROM including windows-based PC software and support documentation. The circuit module includes one bq26500, a current sense resistor and all other components on-board necessary to calculate remaining battery capacity and predict at rate time to empty. The circuit module connects directly across the cell in a battery. With the PC interface board and software, the user can read the bq26500 data registers, program the on-chip configuration EEPROM, and evaluate the functions of the bq26500 under different charge and discharge conditions.

1.1 Features

- Complete evaluation system for the bq26500 battery gas gauge
- Populated circuit module for quick setup
- PC software and interface board for easy evaluation
- Software allows EEPROM programming and data logging for system analysis

1.2 Kit Contents

1. bq26500 circuit module with sense resistor
2. PC interface board (EV2300 for USB interface)
3. CD ROM including windows-based PC software and support documentation
4. USB cable
5. Set of support documentation

1.3 Ordering Information

Table 1. Ordering Information

EVM PART NUMBER	PC INTERFACE BOARD	CHEMISTRY	PACK VOLTAGE	CAPACITY
bq26500EVM−001	USB	Li-Ion	2.6 V to 4.5 V	100 to 2000 mah

2 bq26500EVM Based Circuit Module

The bq26500EVM based circuit module is an example circuit for battery fuel gauging of a single cell Li-Ion/Li-Polymer battery pack. There are two separate circuits on the EVM module. One is the active bq26500 fuel gauging circuitry; the other is the logic and power control to program the on-chip configuration EEPROM of the bq26500. In a typical application, only the active fuel gauging circuitry is required. The EEPROM programming circuitry would be required in a test setup to configure the bq26500 for the application by programming the EEPROM.

Contacts on the circuit module provide direct connection to the cell (J1−1, J2−2), the serial communications port (J1−3). The system load and charger connect across J1−1 and J2−1.

2.1 Test Points

Table 2. Test Points

TEST POINT	SIGNAL NAME	DESCRIPTION
J1−1	PACK+	Cell positive/pack positive
J1−2	GPIO	GPIO pin of the bq26500
J1−3	HDQ	Serial communications port
J2−1	PACK−	Pack negative
J2−2	BAT−	Cell negative
J3−1	21V	High voltage for EEPROM programming
J3−2	PROG	Input for timing of EEPROM programming pulse
J3−3	VSS	Programming ground
J4	1−2 jumper position for programming EEPROM 2−3 jumper position for normal bq26500 operation (fuel gauging)	

3 bq26500EVM Circuit Module Schematic

The schematic shows the circuit for the bq26500EVM implementation.

3.1 Schematic

Figure 1 shows the bq26500EVM circuit module schematic diagram.

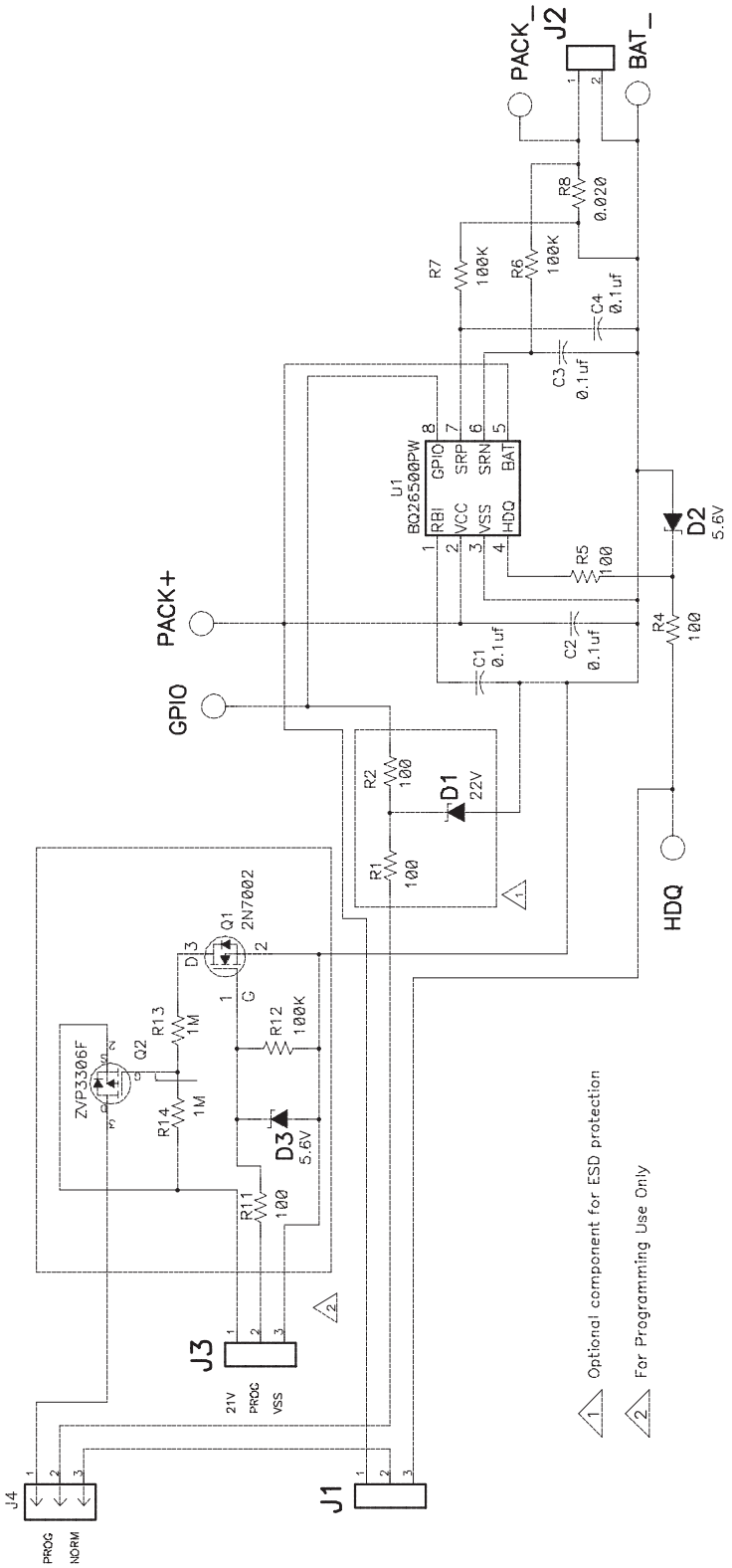

Figure 1. bq26500EVM Schematic

4 Circuit Module Physical Layouts

This chapter contains the board layout and assembly drawings for the bq26500EVM circuit module.

4.1 Board Layout

Figure 2, 3, 4 and 5 shows the PCB layers and assembly drawing for the bq26500EVM circuit module.

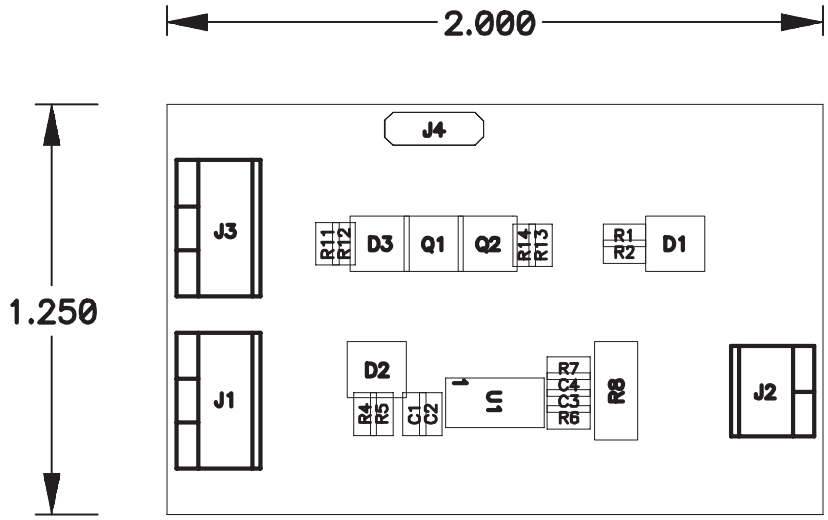

Figure 2. bq26500EVM Topside Assembly

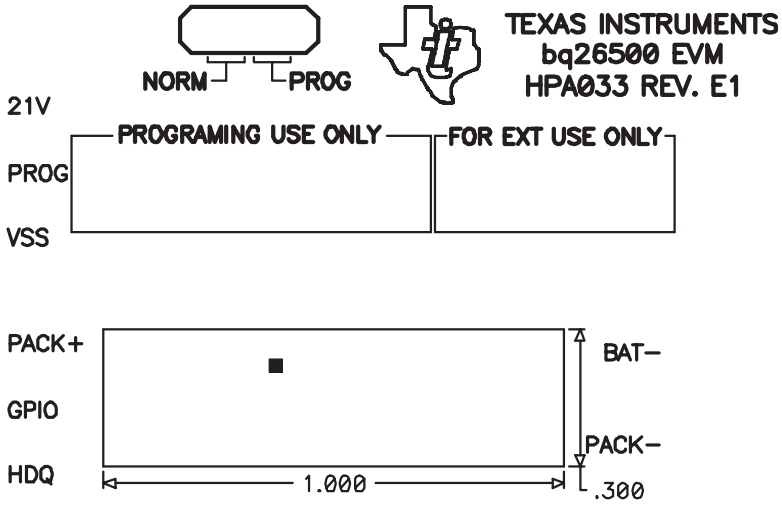

Figure 3. bq26500EVM Silkscreen

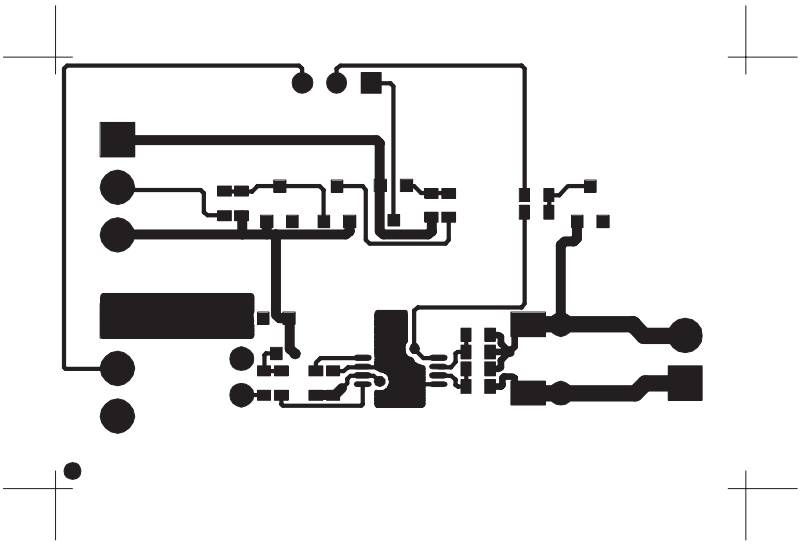

Figure 4. bq26500EVM Layer 1 Layout

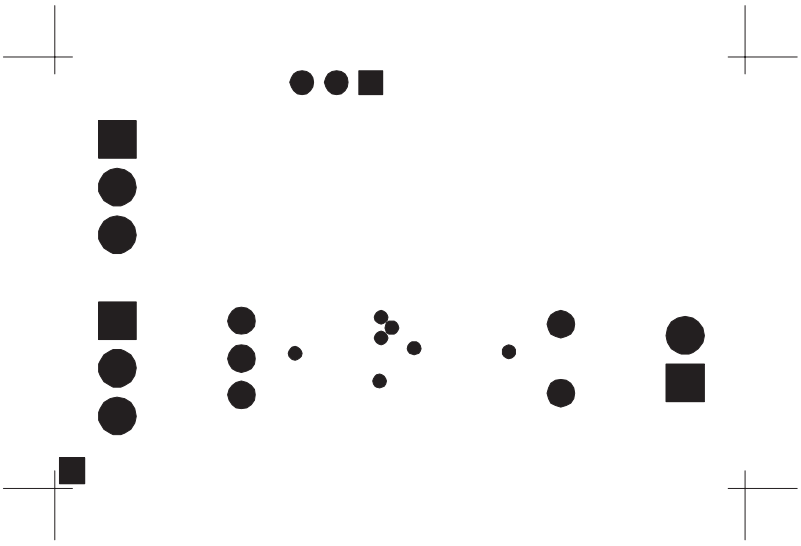

Figure 5. bq26500EVM Layer 2 Layout

5 bq26500EVM Circuit Module List of Materials

List of materials required for the bq26500EVM circuit module.

Table 3. List of Materials

REFDES	QTY	DESCRIPTION	MFR	PART NUMBER
C1, C2, C3, C4	4	Capacitor, ceramic, 0.1 µF, 16 V, X7R, 603	muRata	GRM39X7R104K16
D1	1	Diode, Zener, 22 V, 350 mW, SOT23	Diodes, Inc.	BZX84C22
D2, D3	2	Diode, Zener, 5.6 V, 350 mW, SOT23	Diodes, Inc.	BZX84C5V6T
Q1	1	MOSFET, N-channel, 2N7002, 60 V, 115 mA, 1.2 Ω, SOT23	Vishay−Liteon	2N7002DICT
Q2	1	MOSFET, P-channel, ZVP3306F, −60 V, 0.09 A, 14 Ω, SOT23	Zetex	ZVP3306F
R1, R2, R4, R5, R11	5	Resistor, chip, 100 Ω, 1/16 W, 5%, 603	Std	Std
R13, R14	2	Resistor, Chip, 1 M, 1/16 W, 5%, 603	Std	Std
R6, R7, R12	3	Resistor, Chip, 100 kΩ, 1/16 W, 5%, 603	Std	Std
R8	1	Resistor, Chip, 0.020 Ω, 1/2 W, 2%, 2010	Dale	WSL2010−R020
U1	1	Single cell Li-Ion/Polymer gas gauge device, TSSOP−08	Texas Instruments	bq26500PW
J1, J3	2	Terminal blocks, 3 position	OST	ED1515
J2	1	Terminal blocks, 2 position	OST	ED1514
J4	1	Header, 3-pin, 100-mil spacing, (36-pin strip)	Sullins	PTC36SAAN
N/A	1	Shunt	Any	HPA033
N/A	1	PCB	Any	HPA033

6 bq26500EVM Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq26500EVM circuit module. Table 4 gives the performance specifications of the circuit.

Table 4. Performance Specification Summary

SPECIFICATION	MIN	TYP	MAX	UNITS
Input Voltage PACK+/BAT−	2.6		4.5	V
Charge and Discharge Current			3	A

NOTES: 1. Charge and discharge max. is limited by the PCB design and power dissipation of the 20-mΩ 1/2-W sense resistor included in the kit.

7 EVM Hardware and Software Setup

This section describes how to install the bq26500EVM PC software and how to connect the different components of the EVM.

7.1 Software Installation

The following steps install the bq26500 evaluation software:

1. Insert CD ROM into a CD ROM drive.
2. Select the CD ROM drive using **My Computer** or **File Manager**.
3. Select the ReadMeFirst.txt file.
4. Follow the instructions to install USB drivers for EV2300.
5. After installing the USB drivers for EV2300, double-click on the Setup.exe icon.
6. The setup program installs a windows application group.

7.2 Hardware Connection

There are three hardware components to the bq26500EVM:

- The bq26500EVM circuit module,
- The PC interface board,
- And the PC.

7.2.1 Connecting the bq26500EVM circuit module to a battery pack

Figure 6. shows how to connect the bq26500EVM circuit module to a Li-Ion cell and the system load/charger.

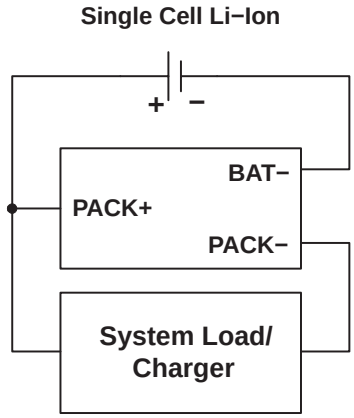

Figure 6. bq26500EVM Circuit Module Connection to Cells and System Load/Charger

7.2.2 PC Interface Connection

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

1. Connect colored wires that are included with EV2300 to BQ26500EVM using Table 5 as a guide.
2. Connect the connector with colored wires to the HDQ connector that is on EV2300. HDQ connection is located on the top right of EV2300.
3. Connect the PC USB cable to the EV2300 and the PC USB port.

The bq26500EVM is now set up for operation.

Table 5. Circuit Module-to-EV2300 Connection

BQ26500EVM	COLOR
HDQ	BROWN
PACK−	BLACK
PROG	WHITE
PACK+(1)	RED

NOTES: (1) This connection is not useful when using a system load, charger or a power source (battery or external power supply).

8 Operation

This section details the operation of the bq26500EVM software.

8.1 Starting the Program

Run the program from the **Start|Programs|Texas Instruments|bq26500 Battery Monitor** menu sequence. The software defaults to PC USB port for communication. If the EV2300 is connected to USB port, the program should load and display the initial data screen.

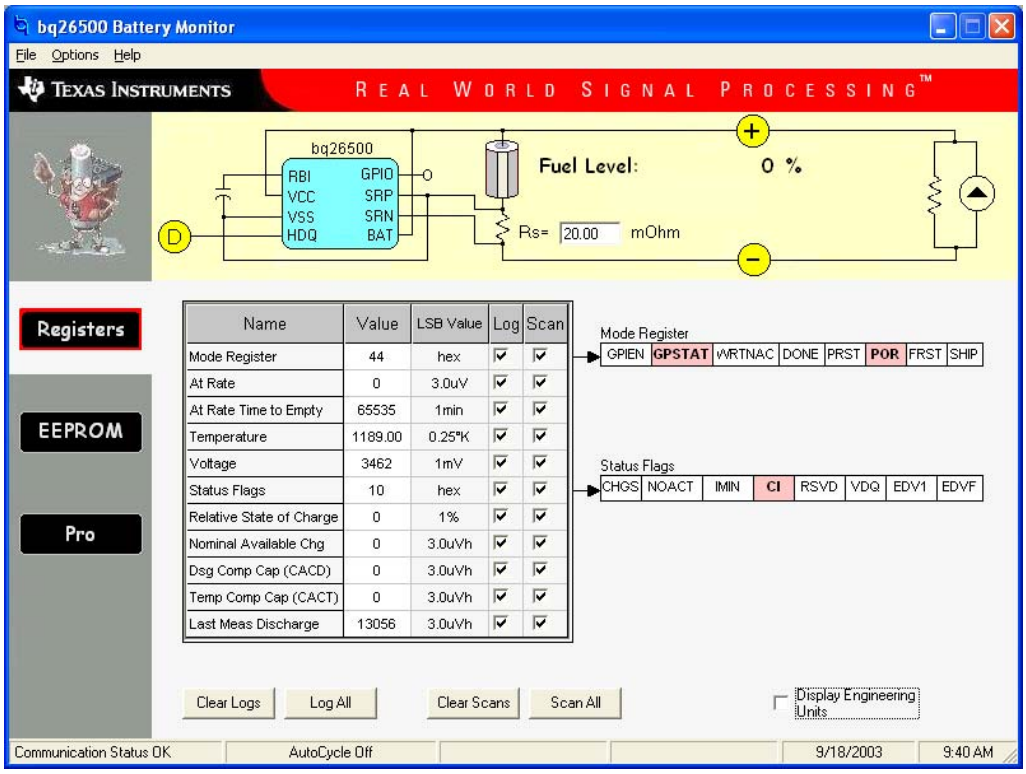

Figure 7. Initial Register Screen

If the EV2300 is not connected to a USB port, the program will display a USB error message and then display the initial data screen with no data in the register locations.

The com port can be changed by selecting the port under the options menu.

8.2 Initialization

This section describes the settings that must be made before the bq26500 is evaluated.

8.2.1 Loading the sense resistor value

The bq26500EVM comes with a 20-mΩ sense resistor on the circuit board. Make sure the sense resistor value is entered in the R_S box at the top of the initial register screen. This value is used by the PC program to convert the bq26500 data set to engineering units. Checking the display engineering units box displays the data set in engineering units. No check mark displays the data set just as the bq26500 calculates them, ie, in units of 3.0-uVh counts.

8.2.2 Programming the bq26500 EEPROM

Each bq26500 is programmed at the factory with default values in the EEPROM. The values in EEPROM should be changed to match specific applications. The EEPROM values can be read by using the EEPROM screen.

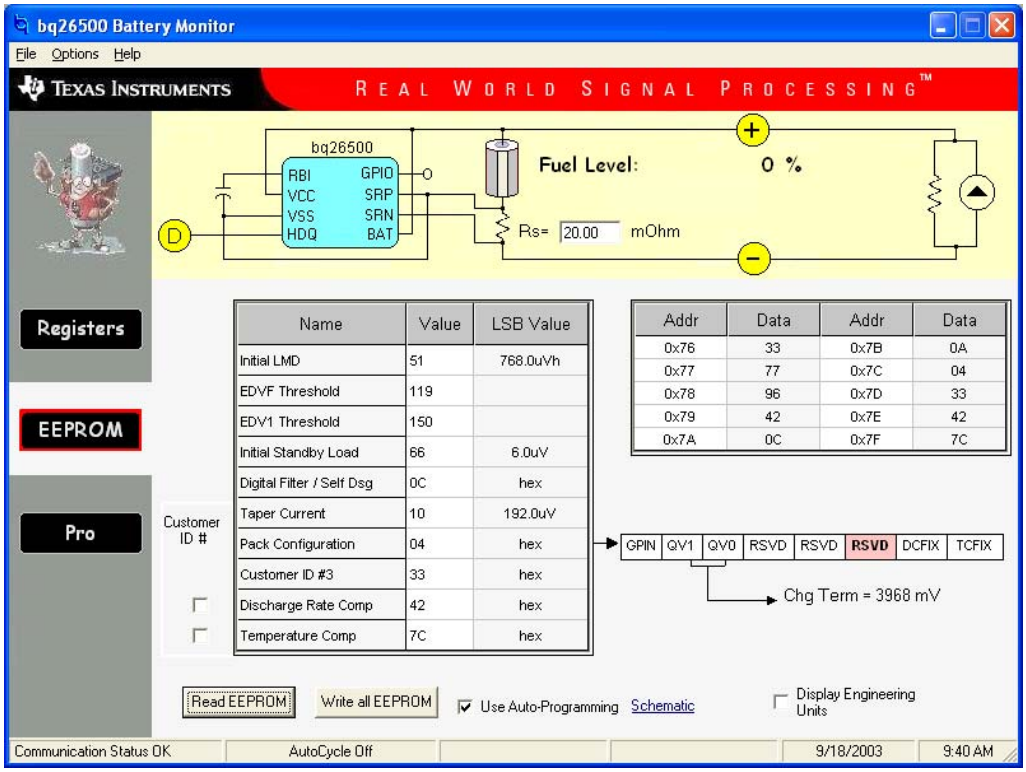

Figure 8. EEPROM Screen

The values in the EEPROM can be easily changed using the EVM's auto programming feature. To use the auto program feature:

1. Make sure VOUT of the EV2300 is connected to PROG of the EVM
2. Connect a 21-V supply across 21 V (J3−1) and VSS (J3−3)
3. Click on the **use auto-programming** box to enable auto EEPROM programming

To change the EEPROM values simply click on the value to be changed, enter the new value, and press enter.

The EEPROM values can be stored in a file on the PC by using the File|Save Gas Gauge Flash Constants command from the pull down menu. Similarly, a saved file can be load by using the File|Open Gas Gauge Flash Constants command. Once the file is called up, the Write all EEPROM button can be used to write all the EEPROM values at once.

> **NOTE:** Changing EEPROM data affects critical aspects of the bq26500 operation. Please review the bq26500 data sheet to determine how to develop new data for the EEPROM based on your application. It is recommend to first save the default EEPROM data as a file first before changing the data. In this way, the default data programming can easily be restored.

The bq26500 automatically uses the new EEPROM in its calculations once programmed.

8.2.3 Resetting the bq26500

The bq26500 can be reset at anytime by using the Options|Special Options|Reset bq26500 from the pulldown menu. When reset, the bq26500 loads the configuration values from EEPROM and set the remaining capacity registers to zero.

8.3 Configuring the Register Screen

The register screen has options for setting which data set values are to be scanned by the program. Scanning can be turned on or off using the Options|Scan pull down command. The items to be scanned are set by clicking on the corresponding Scan box in each row of data. A check mark in the box indicates that that data item will be scanned and updated on the PC display.

8.4 The Pro Screen

The pro screens allows the data location in the bq26500 to be addressed individually by entering the address to be read or the address and data to be written.

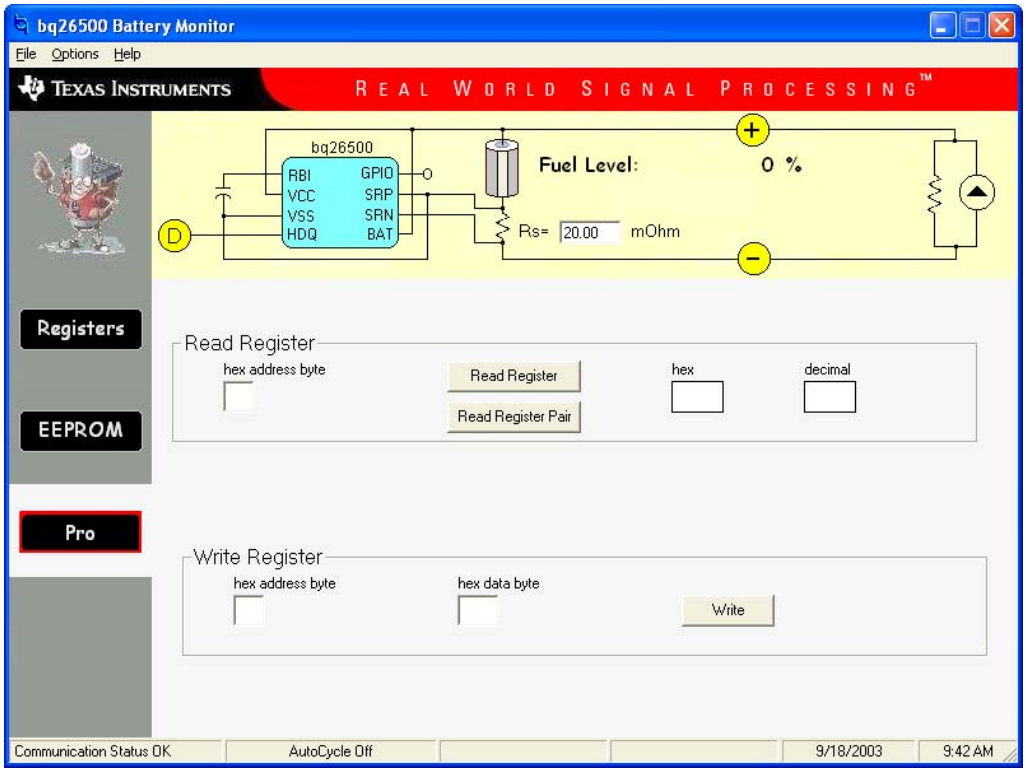

Figure 9. Pro Screen

8.5 Data Logging

The bq26500 registers can be logged by using the data log function. To log the data and create a log file:

1. Select the registers to log by clicking on the corresponding **Log** box in each row of data.
2. **File|Start Data Log** from the pull-down menu.
3. Enter the name of the data log file in the **Name Datalog File** box
4. Click on the **Open** button
5. To stop the data logging select **File|Close Data Log** from the pull-down menu

The file can be imported into a text editor, spreadsheet, or word processor program.

Table 6. Example Data Log

SAMPLE	STAMP	ELAPSED (s)	VOLTAGE	NAC	TEMP COMP
1	3:31:30	10	3829	1084.58	1084.58
2	3:31:40	20	3829	1086.26	1086.26
3	3:31:50	30	3832	1087.48	1087.48
4	3:32:00	40	3800	1087.48	1087.48
5	3:32:10	50	3786	1087.48	1087.48
6	3:32:20	60	3786	1087.48	1087.48
7	3:32:30	70	3630	1087.78	1087.78
8	3:32:40	80	3622	1084.12	1064.91
9	3:32:50	90	3614	1081.68	1062.47
10	3:33:00	100	3609	1078.02	1060.03
11	3:33:10	110	3603	1075.74	1033.34
12	3:33:20	120	3754	1075.74	1033.34
13	3:33:30	130	3762	1075.74	1033.34
14	3:33:40	140	3765	1075.74	1033.34
15	3:33:50	150	3767	1075.74	1033.34
16	3:34:00	160	3622	1073.91	1032.73
17	3:34:10	170	3609	1072.69	1032.73
18	3:34:20	180	3598	1070.25	1032.73
19	3:34:30	190	3593	1065.52	1032.73
20	3:34:40	200	3695	1065.52	1032.73
21	3:34:50	210	3810	1065.52	1032.73
22	3:35:00	220	3810	1065.52	1032.73
23	3:35:10	230	3813	1065.52	1032.73
24	3:35:20	240	3767	1065.52	1032.73

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