bq26500EVM Single-Cell Battery Fuel Gauge Evaluation Module

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, CD ROM including Windows®-based PC software and support documentation. An EV2300 board for gas gauge evaluation is required to interface this EVM with the PC and can be purchased separately.

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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, CD ROM including Windows-based PC software and support documentation. An EV2300 board for gas gauge evaluation is required to interface this EVM with the PC and can be purchased separately. 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. CD ROM including Windows-based PC software and support documentation
3. Set of support documentation

1.3   Ordering Information

Table 1 contains the ordering information for the EVM

Table 1. bq26500EVM 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 describes the EVM test points and lists their signal names.

Table 2. bq26500EVM 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)	

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3   bq26500EVM Circuit Module Schematic

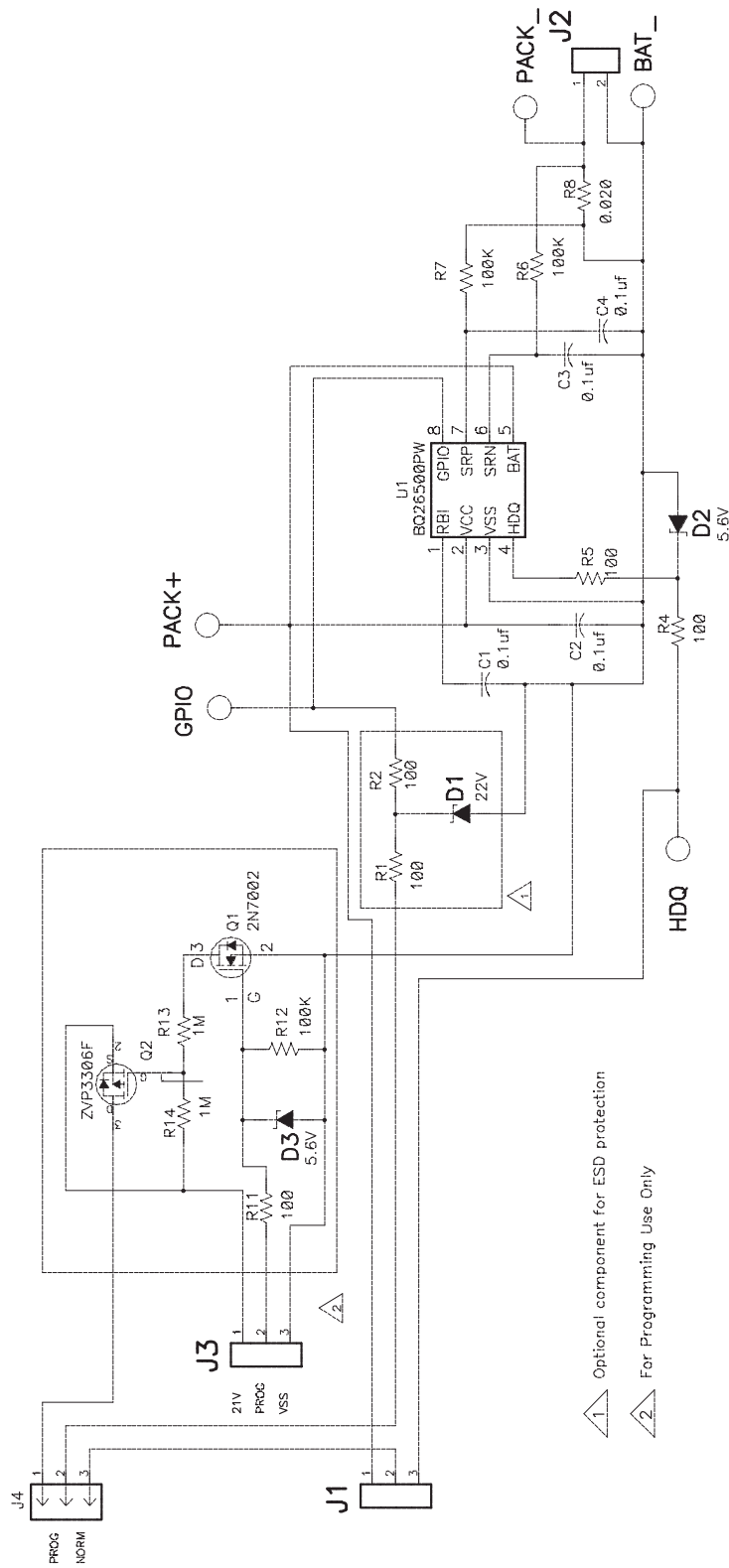Figure 1 shows the circuit module schematic diagram.

Figure 1. bq26500EVM Circuit Module Schematic

4   Circuit Module Physical Layouts

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

4.1   Board Layout

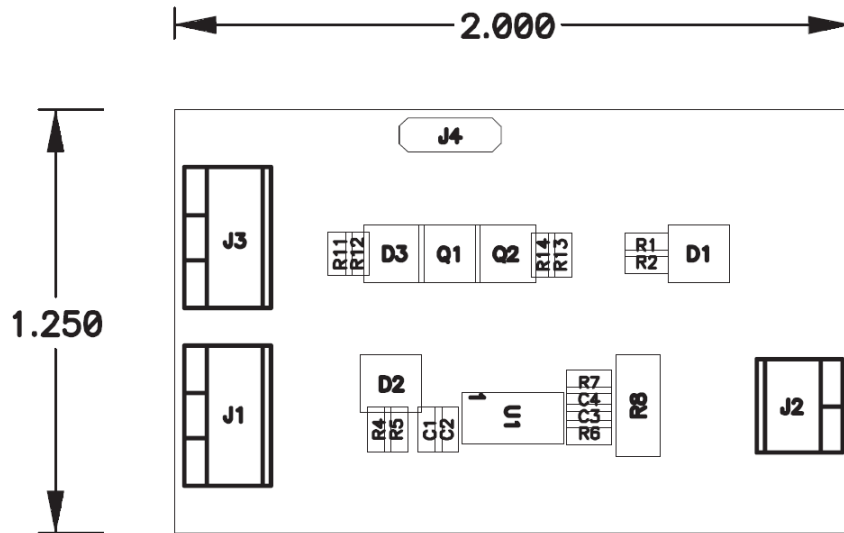Figure 2 through Figure 5 show the PCB layers and assembly drawing for the bq26500EVM circuit module.
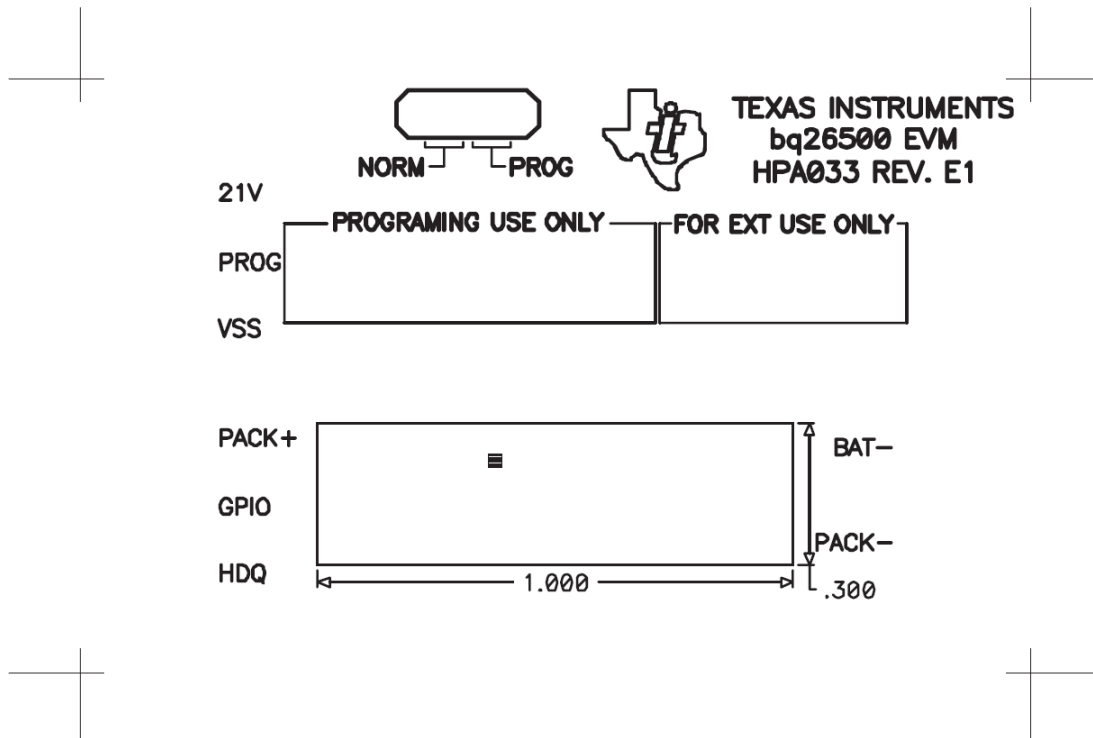

Figure 2. bq26500EVM Topside Assembly
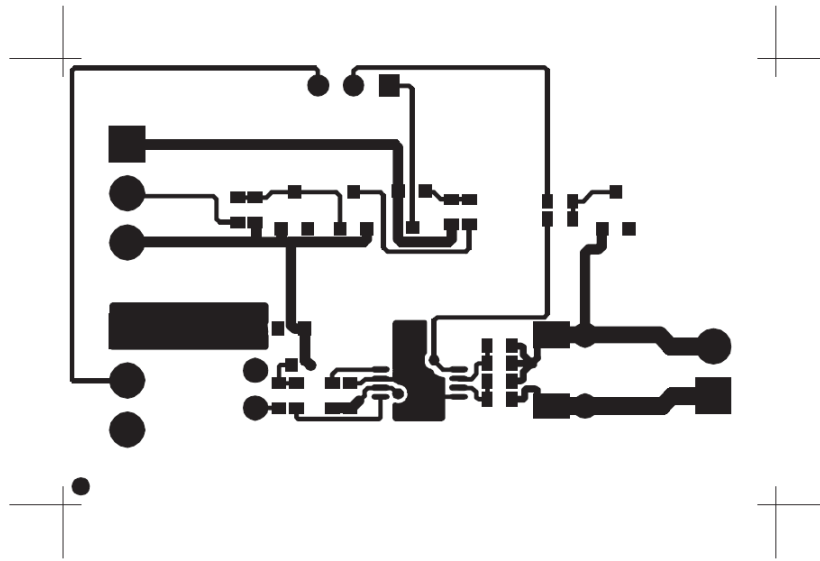

Figure 3. bq26500EVM Silkscreen

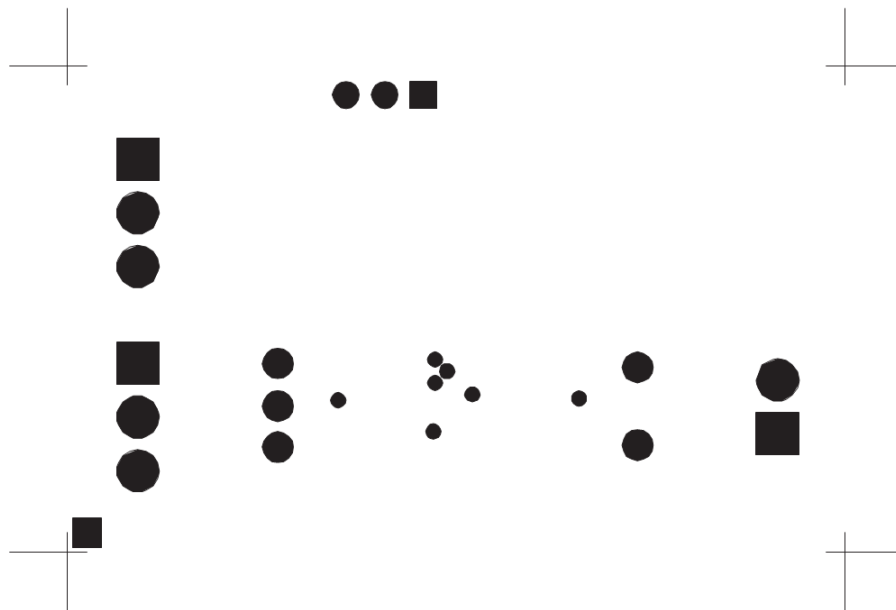**Figure 4. bq26500EVM Layer 1 Layout**

Figure 5. bq26500EVM Layer 2 Layout

5   bq26500EVM Circuit Module List of Materials

Table 3 displays the EVM bill of materials.

Table 3. bq26500EVM Bill of Materials

Ref Designators	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[1]	A

[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

Install the bq26500 evaluation software with steps through through :
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

The three hardware components to the bq26500EVM are:

- 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.
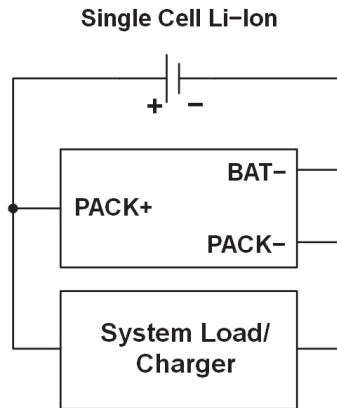

Figure 6. bq26500EVM Circuit Module Connection to Cells and System Load/Charger

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 lists the circuit module-to-EV2300 connections.

Table 5. Circuit Module-to-EV2300 Connection

bq26500EVM	Color
HDQ	BROWN
PACK−	BLACK
PROG	WHITE
PACK+[1]	RED

[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 as shown in Figure 7.
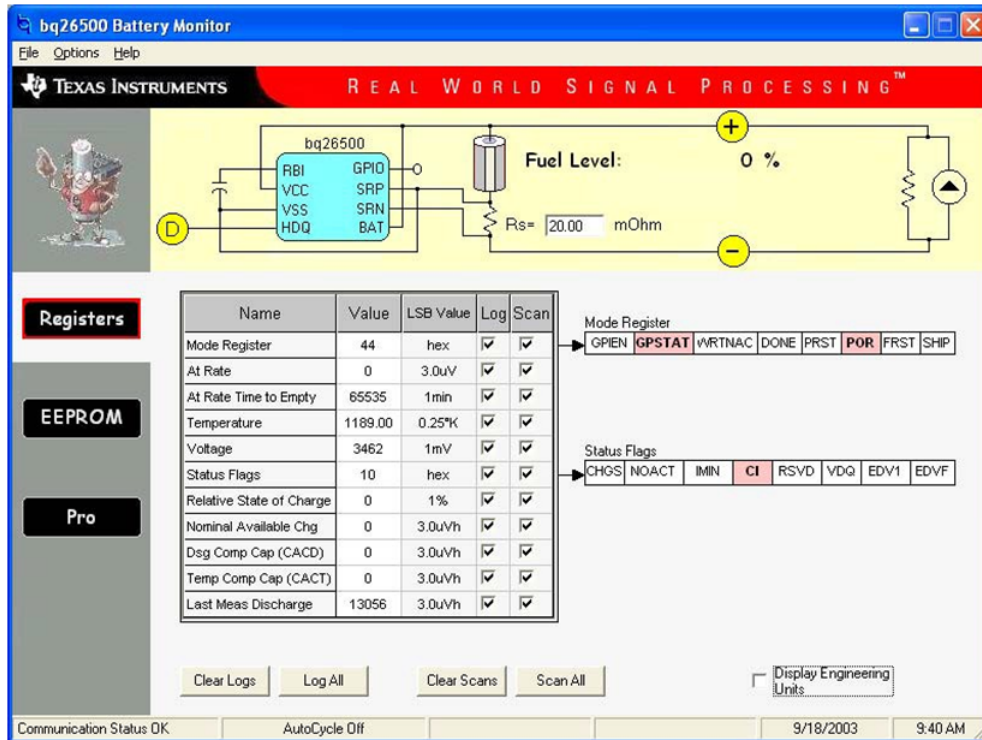

Figure 7. Initial Register Screen

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 RS 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-µVh 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).
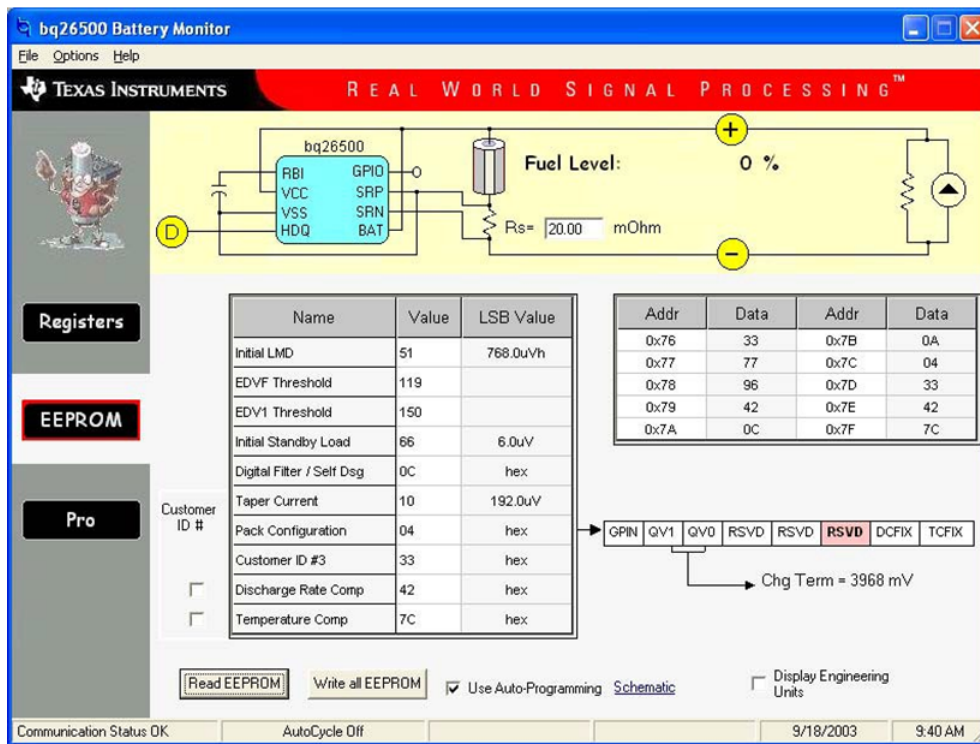
Figure 8. EEPROM Screen

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.
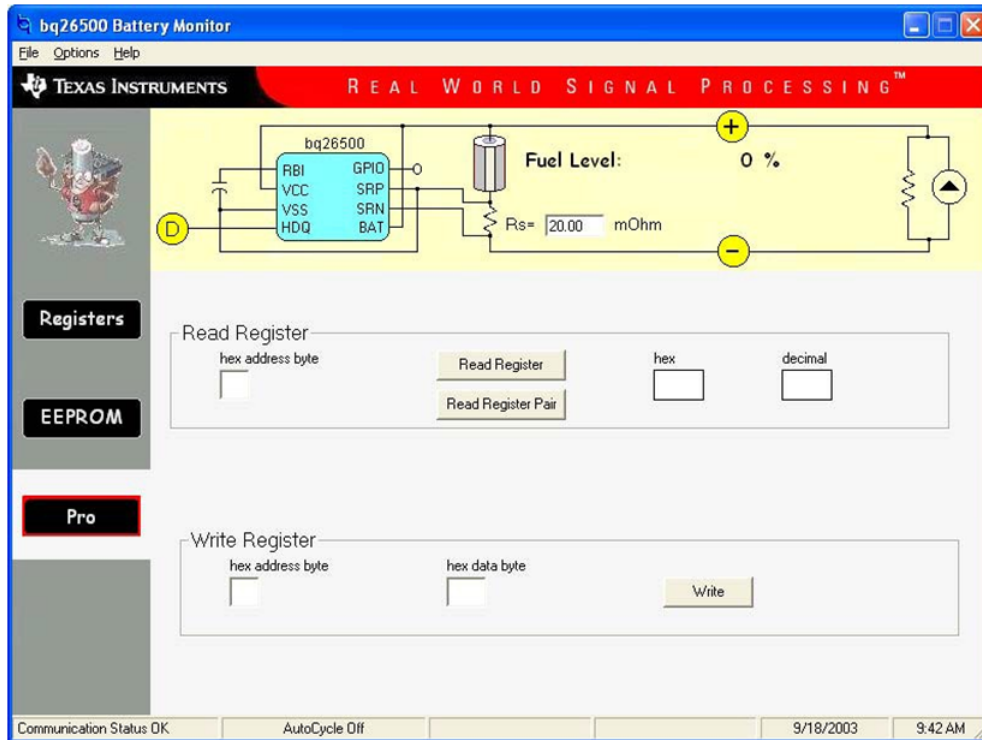
Figure 9. Pro Screen

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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Caution

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

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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

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- 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.

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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.

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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.

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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.

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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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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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