

***bq2060AEVM-001 and
bq2060AEVM-002
SBS 1.1 Battery Management Solution
Evaluation Module***

User's Guide

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3 V and 25 V, with a maximum voltage drop across the sense resistor of ± 250 mV (1-W power dissipation).

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Read This First

About This Manual

This user's guide describes the characteristics and operation of the bq2060AEVM-001 and bq2060AEVM-002 evaluation module. The EVM is used to evaluate the bq2060A battery management system. A complete circuit description, operating procedures, and bill of materials are included. The EVM schematic is appended to the user's guide PDF.

How to Use This Manual

This document contains the following chapters:

- Chapter 1—Introduction
- Chapter 2—bq2060A-Based Circuit Module
- Chapter 3—Circuit Module Physical Layout
- Chapter 4—EVM Hardware and Software Setup
- Chapter 5—Operation

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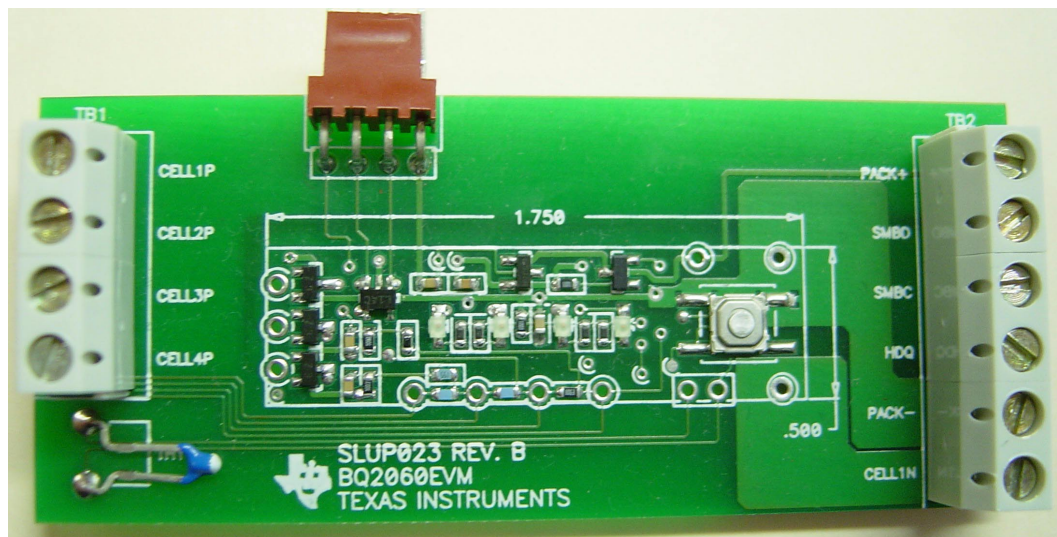
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Introduction



This EVM is a complete evaluation system for the bq2060A battery management system. The bq2060A is backwards compatible with the bq2060. New features in the bq2060A can be accessed from the EEPROM screen in the EV2200-60 software.

For this document bq2060AEVM-00X is used for both the bq2060AEVM-001 and the bq2060AEVM-002.

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1.1 Overview

The EVM includes one bq2060A circuit module, a current sense resistor, a thermistor, an EV2200 PC interface board for gas gauge interface, a PC serial cable, and an EEPROM connector. The latest windows based EV2200-60 PC software can be downloaded from the TI web site. The circuit module includes one bq2060A IC and all other onboard components necessary to monitor and predict capacity of Li-Ion or Li-Polymer (bq2060AEVM-001) or NiMH (bq2060AEVM-002) cells. Protection for Li-Ion or Li-Polymer cells is not included on this module. The circuit module connects directly across the cells in a battery. With the EV2200 interface board and software, the user can read the bq2060A data registers, program the chipset for different pack configurations, log cycling data for further evaluation and evaluate the overall functionality of the bq2060A solution under different charge and discharge conditions.

1.2 Features

- Complete evaluation system for the bq2060A SBS 1.1 compliant advanced gas gauge
- Populated circuit module for quick setup
- PC software and interface board for easy evaluation
- Software that allows data-logging for system analysis

1.3 Kit Contents

- bq2060A circuit module
- EEPROM Interface connector with wires
- Sense resistor
- EV2200 PC interface board
- PC serial cable
- Set of support documentation
- Set of evaluation software disks entitled EV2200-60

To download the latest EVM software:

- 1) Go to www.ti.com
- 2) Search for bq2060A, and open the product folder.
- 3) Click on | Development Tools |
- 4) Click the appropriate EVM (LION-001 or NiMH-002) and download the EV2200-60 software under the Contents section.
- 5) You will find software and hardware setup guidelines in Chapter 5 of this document.

1.4 Ordering Information

Table 1–1. Ordering Information

| EVM Part Number | Chemistry | Configuration | Capacity |
|-----------------|-----------|---------------|----------------------|
| bq2060AEVM-001 | Li-Ion | 3 or 4 cell | 800 mAH to 32000 mAH |
| bq2060AEVM-002 | NiMH | 10 cell | 800 mAH to 32000 mAH |

bq2060A-Based Circuit Module

The bq2060A-based circuit module includes all components required for a complete battery management solution. It includes the bq2060A gas gauge IC, 24LC01 EEPROM and other components to accurately predict and monitor capacity of NiMH, Li-Ion, and Li-Polymer cells.

Contacts on the circuit module provide direct connection to the cells (BAT-, 1P, 2P, 3P, BAT+) and the serial communications port (SMBC, SMBC). The system load and charger connect across PACK+ and PACK-.

The $\overline{\text{SAFE}}$ output reflects the state of the safety output from the bq2060A and has extra ESD protection just for evaluation purposes.

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2.1 Pin Descriptions

| | |
|-------|--|
| BAT- | Negative connection of first (bottom) cell |
| 1P | Positive connection of first (bottom) cell |
| 2P | Positive connection of second cell |
| 3P | Positive connection of third cell |
| 4P | Positive connection of fourth (top) cell |
| SMBC | Serial communication port clock |
| SMBD | Serial communication data port |
| SAFE | bq2060A safety output |
| PACK- | Pack negative terminal |
| VSS | Pack negative terminal |
| PACK+ | Pack positive terminal. Used by bq2060A to derive VCC. |

2.2 bq2060A Circuit Module Bill of Materials

Table 2-1 lists materials required for the bq2060A circuit module.

Table 2-1. SLUP023-00X Bill of Materials

| Count | | RefDes | Description | Size | Part Number | MFG |
|-------|------|--|--|--------------|----------------|------------------|
| -001 | -002 | | | | | |
| 10 | 10 | C1, C11, C3, C4, C5, C6, C7, C8, C9, C10 | Capacitor, ceramic, 0.1 μ F, X7R, 25 V | 603 | VJ0603Y104KXXX | Vishay |
| 1 | 1 | C2 | Capacitor, ceramic, 0.001 μ F, X7R, 25 V | 603 | VJ0603Y102KXXX | Vishay |
| 4 | 4 | D1, D2, D3, D4 | Diode, LED, green, Gullwing | SMT Gullwing | LN1371G | Panasonic |
| 1 | 1 | D5 | Diode, dual | SOT23 | BAV99 | Zetex |
| 3 | 3 | D6, D7, D8 | Diode, Zener, 5.6 V | SOT23 | BZX84C5V6 | On Semi |
| 1 | 1 | Q1 | Transistor, JFET, N-channel | SOT23 | SST113 | Vishay Siliconix |
| 1 | 1 | Q2 | Transistor, NPN | SOT23 | MMBT3904 | On Semi |
| 1 | 1 | Q3 | Transistor, N-Channel, 2N7002, SOT23 | SOT23 | 2N7002 | Zetex |
| 9 | 9 | R1, R15, R18, R19, R20, R21, R22, R23, R34 | Resistor, chip, 100 k Ω , 5% | 603 | CRCW0603104J | Vishay |
| 1 | 1 | R13 | Resistor, chip, 10 M Ω , 5% | 603 | CRCW0603106J | Vishay |
| 3 | 3 | R14, R24, R25 | Resistor, Chip, 1.5 M Ω , 5% | 603 | CRCW0603155J | Vishay |
| 3 | 3 | R17, R2, R3 | Resistor, chip, 10 k Ω , 5% | 603 | CRCW0603103J | Vishay |
| 2 | 2 | R26, R27 | Resistor, chip, 698 k Ω , 1% | 603 | CRCW06036983F | Vishay |
| 1 | 1 | R29 | Resistor, chip, 0.03 Ω , 2%, 1W | 2512 | WSL-2512.03 1% | Vishay |
| 1 | 0 | R30 | Resistor, chip, 178 k Ω 1% | 603 | CRCW06031783F | Vishay |

Table 3–1. SLUP023-00X Bill of Materials (Continued)

| Count | | RefDes | Description | Size | Part Number | MFG |
|-------|------|-----------------------------|--|----------|-----------------|------------------------|
| -001 | -002 | | | | | |
| 1 | 1 | R31 | Resistor, chip, 267 k Ω 1% | 805 | CRCW08052673F | Vishay |
| 1 | 1 | R32 | Resistor, chip, 806 k Ω 1% | 603 | CRCW06038063F | Vishay |
| 1 | 1 | R36 | Resistor, chip, 1 k Ω , 5% | 603 | CRCW0603102J | Vishay |
| 6 | 6 | R6, R7, R33, R35, R4, R5 | Resistor, chip, 100 Ω , 5% | 603 | CRCW0603101J | Vishay |
| 4 | 4 | R8, R9, R10, R12 | Resistor, chip, 330 Ω , 5% | 603 | CRCW0603331J | Vishay |
| 1 | 1 | S1 | Switch, momentary, push button, EVQPLHA | SMT | EVQ-PLHA15 | Panasonic |
| 1 | 1 | TH1 | Thermistor | Radial | 103AT-2 | Semitec |
| 1 | 1 | U1 | IC, gas gauge | 28P-SSOP | bq2060A-E619DBQ | Texas Instruments |
| 1 | 1 | U2 | IC, EEPROM, 128 byte | SOT23-5 | 24LC01BI/OT | Micro Chip, Atmel |
| 1 | 1 | J1 | Connector, header, right angle, male, 4 pin, 0.100 inch centers | | 22-12-2044 | Molex |
| 1 | 1 | J1 mate | Connector, female, 0.100 inch centers | | 22-01-3047 | Molex |
| 4 | 4 | N/A | Terminals, crimp, tin | | 08-50-0114 | Molex |
| 1 | 1 | N/A | Wire, insulated 22 Awg, red, 8 inches (VCC) | | Any | Any |
| 1 | 1 | N/A | Wire, insulated 22 Awg, white, 8 inches (SMBC) | | Any | Any |
| 1 | 1 | N/A | Wire, insulated 22 Awg, black, 8 Inches (GND) | | Any | Any |
| 1 | 1 | N/A | Wire, insulated 22 Awg, brown, 8 inches (SMBD) | | Any | Any |
| 1 | 1 | TB1 | Terminal block, 0.200-mil centers, 4 position, 90 degree | | ED120/4DS | On Shore Technology |
| 1 | 1 | TB2 | Terminal block, 0.200-mil centers, 6 position, 90 degree | | ED120/6DS | On Shore Technology |

2.3 bq2060A Circuit Module Performance Specification Summary

Table 2–2 gives the performance specifications of the circuit.

Table 2–2. Performance Specification Summary

| Specification | Min | Typ | Max | Units |
|------------------------------|-----|-----|----------|-------|
| Input voltage Pack+ to Pack- | 3.0 | | 25 | V |
| Charge and Discharge Current | | | See Note | A |

Note: Maximum currents are determined by the value of the sense resistor used. Do not exceed ± 250 mV across sense resistor. For the supplied sense resistor do not exceed 1 Watt.



Circuit Module Physical Layouts

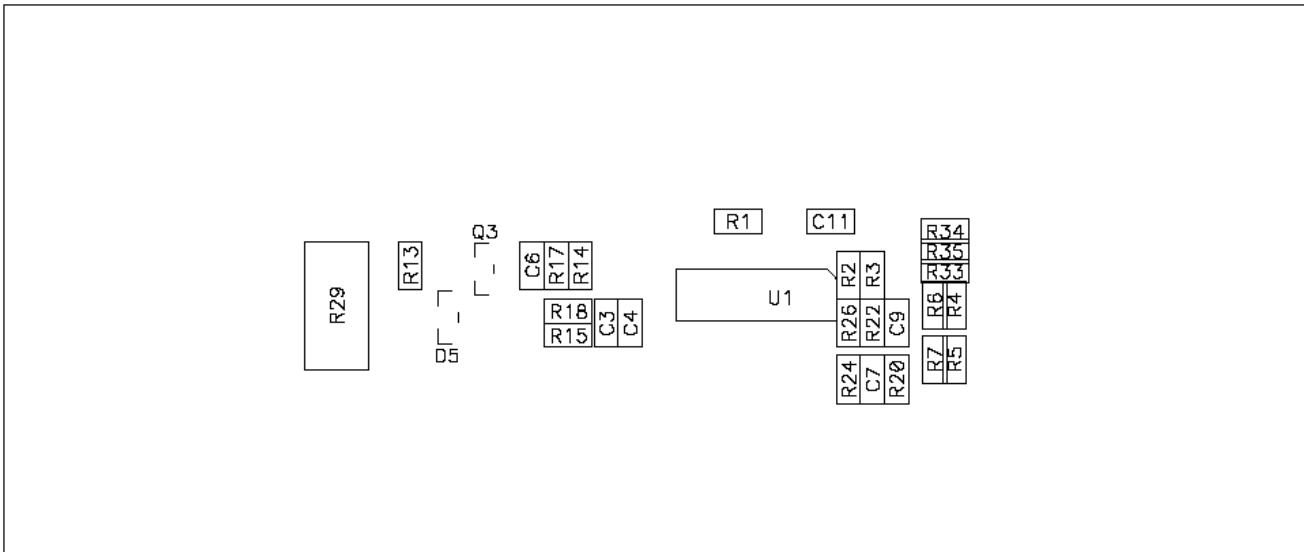
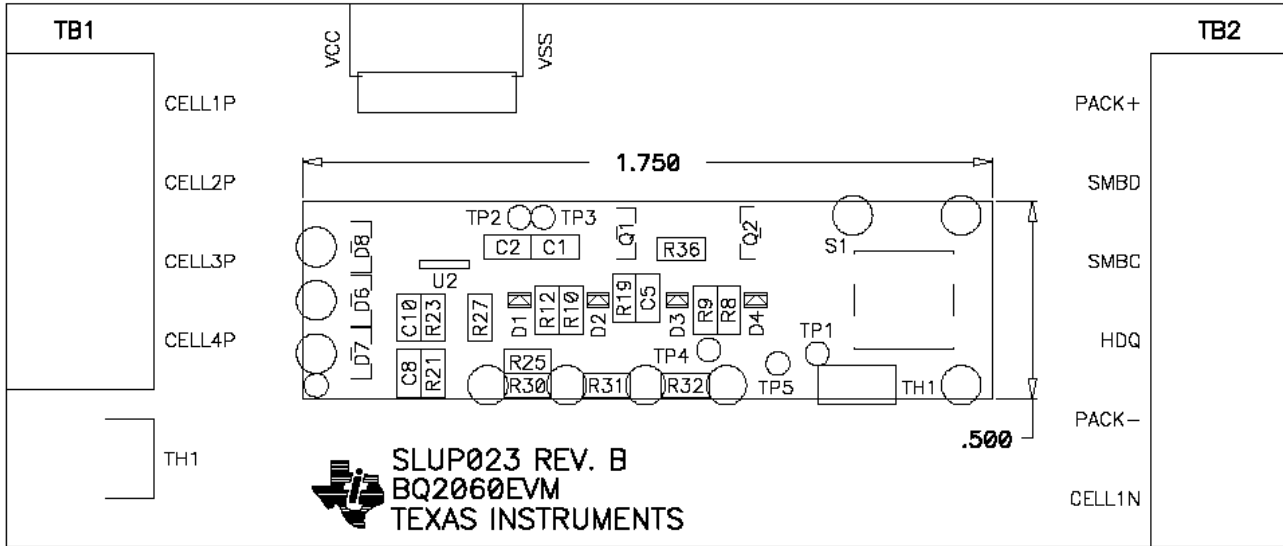
This chapter contains the board layout and assembly drawings for the bq2060A circuit module.

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3.1 Board Layout

Figure 3–1 shows the dimensions, PCB layers, and assembly drawing for the bq2060A module.

Figure 3–1. bq2060A EVM-00X Layout



EVM Hardware and Software Setup

This section describes how to install the bq2060AEVM-00X PC software and how to connect the different components of the EVM.

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4.1 Software Installation

Follow these steps to install the EV2200-60 software from the included disks:

- 1) Insert disk 1 into a 3 1/2 inch floppy drive.
- 2) Select the 3 1/2 inch drive using My Computer or File Manager.
- 3) Double-click on the Setup.exe icon.
- 4) The setup program prompts for the remaining disks and installs a Windows application group.

Follow these steps to install the latest EV2200-60 software downloaded from the TI website: www.ti.com

- 1) Unzip the self-extracting EXE file to a temporary directory.
- 2) Double-click on the Setup.exe icon.
- 3) Follow the onscreen instructions and the setup program will install a Windows application group.

4.2 Hardware Connection

The four hardware components of the bq2060AEVM-00X are: the bq2060A circuit module, the EEPROM interface connector, the EV2200 PC interface board, and the PC.

4.2.1 Connecting the bq2060A Circuit Module to a Battery Pack

Figure 4–1 and Figure 4–2 show how to connect the bq2060A circuit module to the cells and system load/charger. Connect the cells in the following order.

NOTE: The cell terminal connections not listed below should remain open.

4-Cell LION Pack:

- Connect the PACK+ terminal to the Cell4P terminal on the bq2060AEVM-00X module.
- Connect the BAT– terminal to the negative side of the bottom (first) cell.
- Connect the Cell4P terminal to the positive side of the top (fourth) cell.
- Connect the Cell1 terminal to the positive side of the first cell.
- Connect the Cell2 terminal to the positive side of the second cell.
- Connect the Cell3 terminal to the positive side of the third cell.

3-Cell LION Pack:

- Connect the PACK+ terminal to the Cell3P terminal on the bq2060AEVM-00X module.
- Connect the BAT– terminal to the negative side of the bottom (first) cell.
- Connect the Cell3P terminal to the positive side of the top (third) cell.
- Connect the Cell1 terminal to the positive side of the first cell.
- Connect the Cell2 terminal to the positive side of the second cell.

- 2-Cell LION Pack:
 - Connect the PACK+ terminal to the Cell2P terminal on the bq2060AEVM-00X module.
 - Connect the BAT- terminal to the negative side of the bottom (first) cell.
 - Connect the Cell2P terminal to the positive side of the top (second) cell.
 - Connect the Cell1 terminal to the positive side of the first cell.
- No Individual Cell Voltage Monitoring/NiMH:
 - Connect the PACK+ terminal to the Cell4P terminal on the bq2060AEVM-00X module.
 - Connect the BAT- terminal to the negative side of the bottom (first) cell.
 - Connect the Cell4P terminal to the positive side of the top cell.

Figure 4–1. bq2060A Circuit Module Connection to LION Cells and System Load/Charger

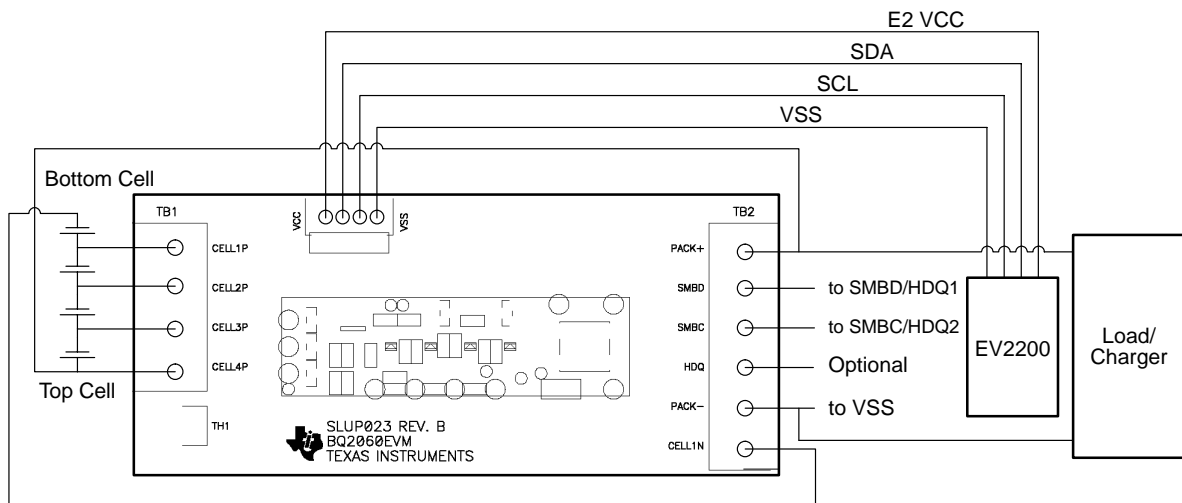
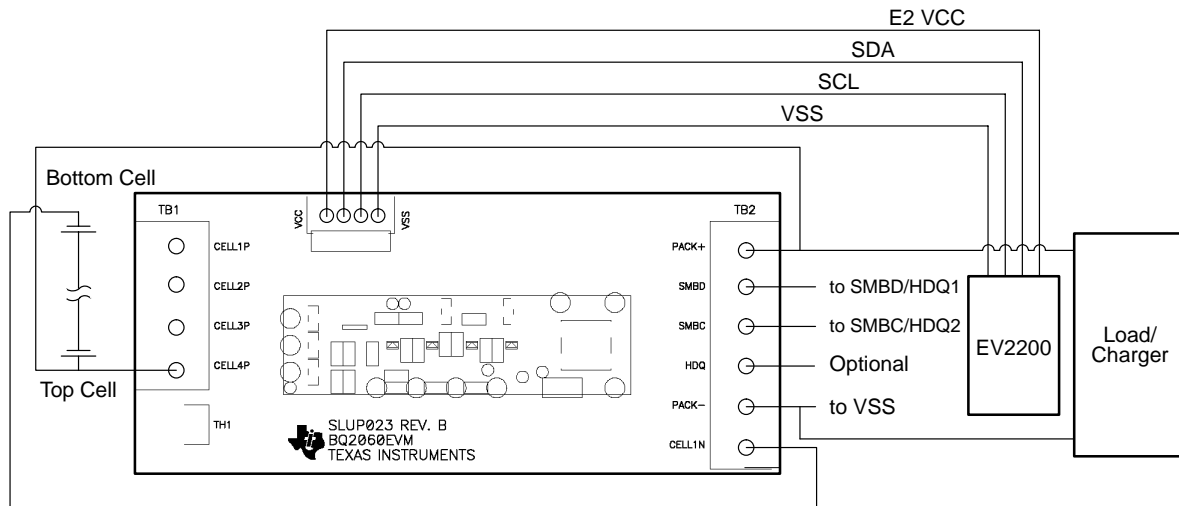


Figure 4–2. bq2060A Circuit Module Connection to NiMH Cells and System Load/Charger



4.2.2 PC Interface Connection

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

- 1) Connect the bq2060A-based smart battery (bq2060AEVM-00X) to the EV2200 using wire leads as listed in Table 4–1.

Table 4–1. Circuit Module to EV2200 Connections

| bq2060AEVM-00X | EV2200 |
|----------------|-----------|
| SMBD | SMBD/HDQ1 |
| SMBC | SMBC/HDQ2 |
| PACK- | VSS |

- 2) Connect the EEPROM connector to the bq2060AEVM-00X and the wire leads of the EEPROM connector to the EV2200 as listed in Table 4–2.

Table 4–2. Circuit Module EEPROM Connector to EV2200 Connections

| bq2060AEVM-00X | EV2200 |
|----------------|--------|
| VCC | E2 VCC |
| EEPROM data | SDA |
| EEPROM clock | SCL |
| VSS | VSS |

- 3) Connect the PC serial cable to the EV2200 and the PC COM port.

The bq2060AEVM-00X is now set up for operation.

Operation

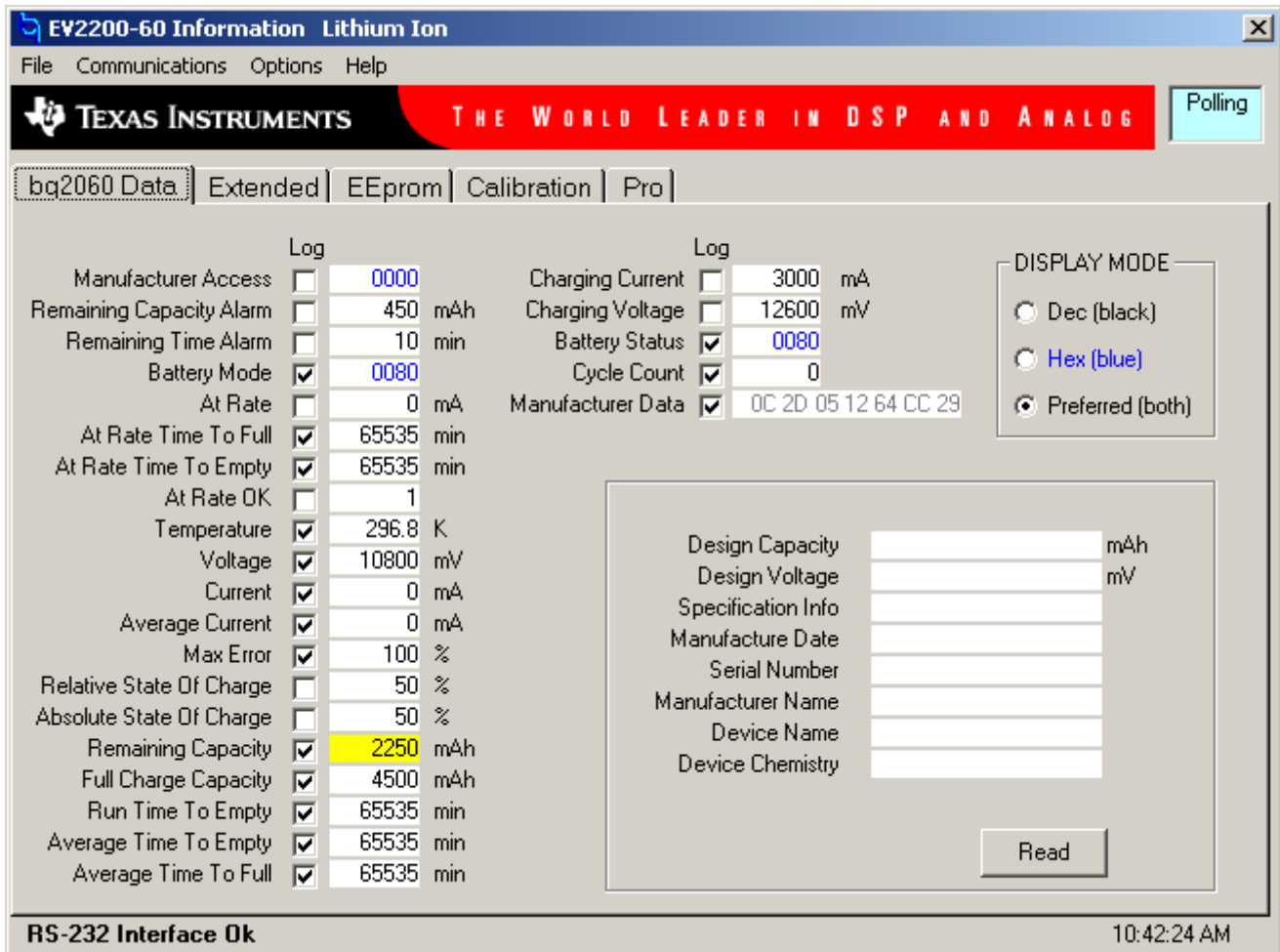
This chapter details the operation of the EV2200-60 software.

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5.1 Starting the Program

Run EV2200–60 from the *Start | Programs | Texas Instruments | EV2200–60* menu sequence. The SBS Data screen appears. Data begins to populate the fields on the screen as the indicator scans (e.g., *Remaining Capacity* is highlighted in Figure 5–1). To disable the scan feature, select *| Options | Poll BQ Registers | Stop |*.

Figure 5–1. SBS Data Screen



This screen shows the SBS data set along with additional Static data which is shown in a box in the bottom right quadrant. By clicking on the *Read* button, the box changes to show the static data from the bq2060A (see Figure 5–2).

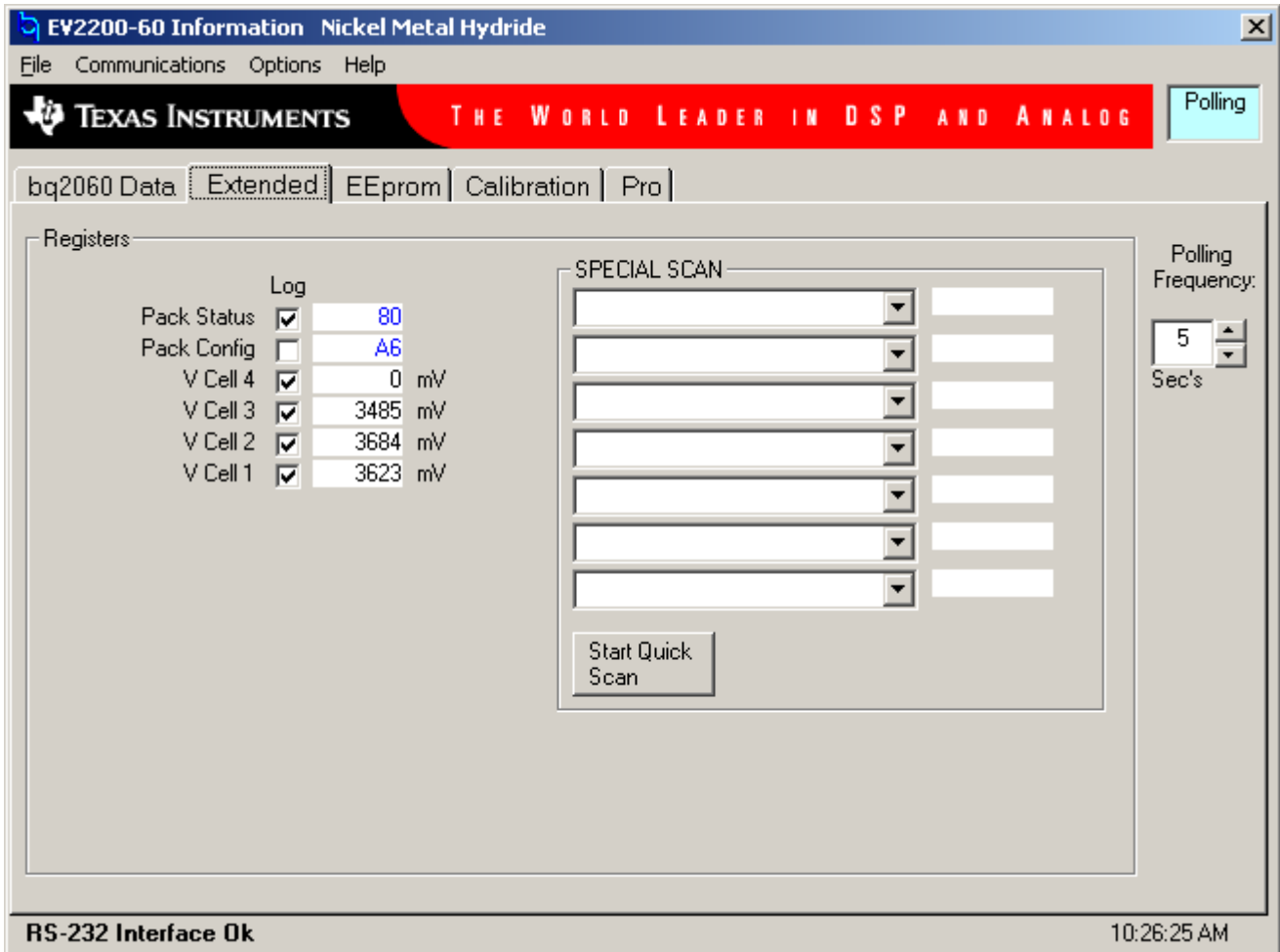
Figure 5–2. SBS Data Screen—Static Data Window

| | |
|--------------------|----------|
| Design Capacity | 4500 mAh |
| Design Voltage | 10900 mV |
| Specification Info | 0 0 2 1 |
| Manufacture Date | 3/4/2003 |
| Serial Number | 1 |
| Manufacturer Name | Bq |
| Device Name | bq2060A |
| Device Chemistry | LION |

5.2 Extended Data Screen

The SBS Extended Data Screen has two frames. The first frame contains the SBS Extended data that continues scanning from the bq2060A Data Screen. The second frame is for high speed scanning up to 7 SBS data values. When the | Start Quick Scan | button is clicked, these scans take precedence over all other scanning to get the highest update rate possible.

Figure 5–3. SBS Extended Data Screen



5.3 Data Logging

SBS Data can be logged for further evaluation by using the File | Start Data Log menu options. Then enter the desired file name and click on | SAVE |. A window appears asking for the desired log interval. Select a desired interval and click | CLOSE |. An example of a data log file is shown in Table 5–1. To stop the data log, follow the same sequence. The log file can be customized by clicking on the check box (in the Log column) next to the data fields on the bq2060A Data and Extended screens. All the data fields that are checked are recorded in the log file. It is important to select the desired data fields prior to starting a log because check-box updates made after logging starts are ignored.

Table 5–1. Example Log File

| Elapsed Time(s) | Temperature | Voltage | Current | Max Error | Remaining Capacity | Full Charge Capacity |
|-----------------|-------------|---------|---------|-----------|--------------------|----------------------|
| 2 | 296.3 | 10797 | 0 | 100 | 2025 | 4050 |
| 5 | 296.3 | 10791 | 0 | 100 | 2025 | 4050 |
| 8 | 296.3 | 10800 | 0 | 100 | 2025 | 4050 |
| 10 | 296.3 | 10799 | 0 | 100 | 2025 | 4050 |
| 13 | 296.3 | 10800 | 0 | 100 | 2025 | 4050 |
| 15 | 296.3 | 10802 | 0 | 100 | 2025 | 4050 |
| 18 | 296.3 | 10793 | 0 | 100 | 2025 | 4050 |
| 21 | 296.3 | 10792 | 0 | 100 | 2025 | 4050 |
| 23 | 296.3 | 10794 | 0 | 100 | 2025 | 4050 |
| 26 | 296.4 | 10798 | 0 | 100 | 2025 | 4050 |
| 29 | 296.4 | 10797 | 0 | 100 | 2025 | 4050 |
| 32 | 296.4 | 10791 | 0 | 100 | 2025 | 4050 |
| 34 | 296.3 | 10797 | 0 | 100 | 2025 | 4050 |
| 37 | 296.3 | 10794 | 0 | 100 | 2025 | 4050 |
| 39 | 296.3 | 10797 | 0 | 100 | 2025 | 4050 |
| 42 | 296.3 | 10793 | 0 | 100 | 2025 | 4050 |
| 44 | 296.3 | 10795 | 0 | 100 | 2025 | 4050 |
| 47 | 296.3 | 10791 | 0 | 100 | 2025 | 4050 |

5.4 Setting Programmable bq2060A Options

The EEPROM on the EVM is configured as an example LION battery for the bq2060AEVM-001 and for an example Nickel battery for the bq2060AEVM-002 on delivery. The bq2060A includes 3 new EEPROM locations that are not in the bq2060. They are: EDV TC factor, Misc Options, and Safety Over Temperature. The bq2060A is backwards compatible with the bq2060. Special attention should be paid to make sure the settings are correctly changed for the pack, and application with which the bq2060A solution is being evaluated. Do this prior to calibrating the module, described in the following section. The bq2060A must be reset after changing EEPROM

data or calibration for the changes to take effect. To reset the bq2060A click | Options | Initialize Device |.

EEPROM data cannot be accessed on a sealed bq2060A (*Pack Configuration* bit 6 is set). To unseal the pack, connect the EEPROM connector, and click | Options | Unlock Device |. Be sure to remove power from the device and re-apply to finish the unsealing procedure. To reseal the part, click | Options | Seal | bq2060A |. Then reset the bq2060A by clicking | Options | Initialize Device |.

IMPORTANT:

The correct setting of these options is essential to get the best performance. The settings can be configured using the EEPROM Data Screen.

Figure 5–4. LION EEPROM Data Screen

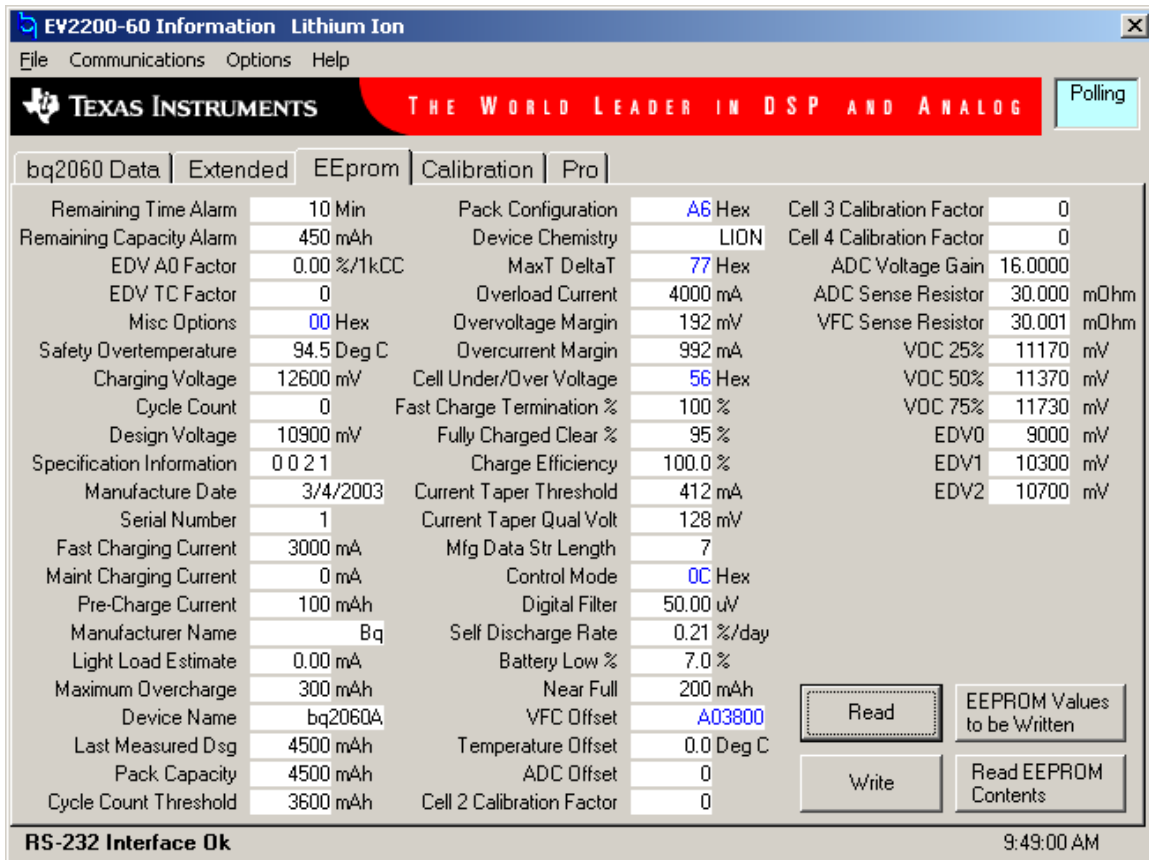


Figure 5-5. NiMH EEPROM Data Screen

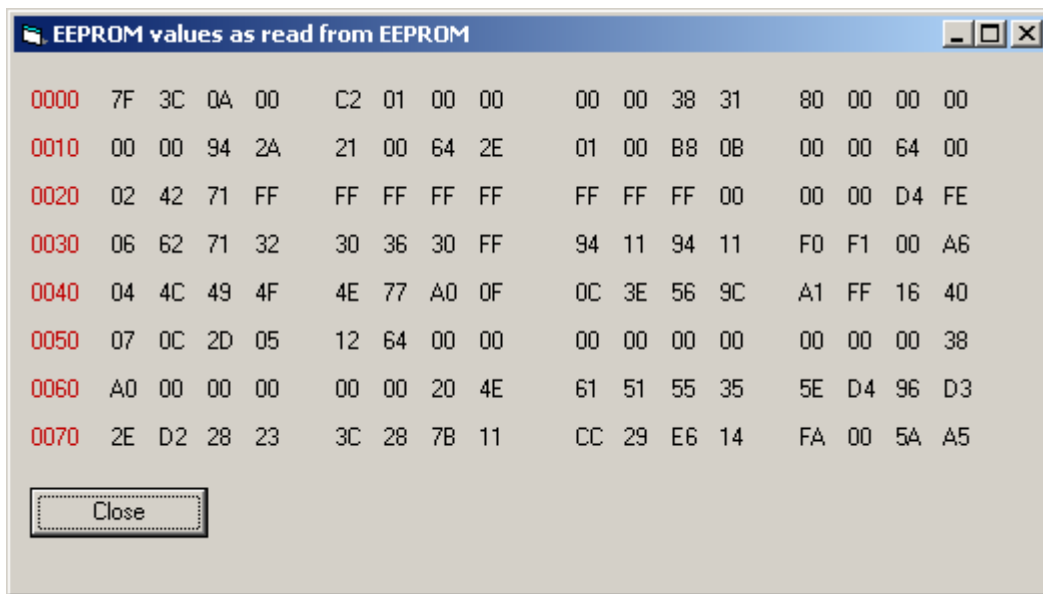
| | | | | | |
|---------------------------|-------------|---------------------------|---------------|---------------------------|-------------|
| Remaining Time Alarm | 10 Min | Pack Configuration | A0 Hex | Efficiency Reduction Rate | 0.000 % |
| Remaining Capacity Alarm | 400 mAh | Device Chemistry | NiMH | ADC Voltage Gain | 16.0000 |
| EDV A0 Factor | 0.00 %/1kCC | MaxT DeltaT | 77 Hex | ADC Sense Resistor | 30.000 mOhm |
| EDV TC Factor | 0 | Overload Current | 2600 mA | VFC Sense Resistor | 30.001 mOhm |
| Misc Options | 00 Hex | Overvoltage Margin | 896 mV | VOC 25% | 11500 mV |
| Safety Overtemperature | 80.0 Deg C | Overcurrent Margin | 496 mA | VOC 50% | 12000 mV |
| Charging Voltage | 16000 mV | Fast Charge Termination % | 95 % | VOC 75% | 12500 mV |
| Cycle Count | 0 | Fully Charged Clear % | 95 % | EDV0 | 10000 mV |
| Design Voltage | 12000 mV | Charge Efficiency | 100.0 % | EDV1 | 10500 mV |
| Specification Information | 0 0 2 1 | DeltaT Time | 200 sec | EDV2 | 10700 mV |
| Manufacture Date | 2/19/2003 | Holdoff Time | 320 sec | | |
| Serial Number | 1 | Mfg Data Str Length | 7 | | |
| Fast Charging Current | 2000 mA | Control Mode | 0C Hex | | |
| Maint Charging Current | 50 mA | Digital Filter | 50.00 uV | | |
| Pre-Charge Current | 100 mAh | Self Discharge Rate | 0.99 %/day | | |
| Manufacturer Name | Bq | Battery Low % | 7.0 % | | |
| Light Load Estimate | 0.00 mA | Near Full | 200 mAh | | |
| Maximum Overcharge | 300 mAh | VFC Offset | A03800 | | |
| Device Name | bq2060 | Temperature Offset | 0.0 Deg C | | |
| Last Measured Dsg | 4000 mAh | ADC Offset | 0 | | |
| Pack Capacity | 4000 mAh | Efficiency Temp Comp | 0.000 %/Deg C | | |
| Cycle Count Threshold | 3200 mAh | Efficiency Drop Off % | 80 % | | |

To read all the data from the bq2060A EEPROM click on | Read |. To write to a selected location, click on the desired location, type in the desired data, and press the ENTER key. After a moment, the next location is highlighted. The entire EEPROM can be written this way.

The EEPROM configuration data can be saved to a file by selecting | File | Store EEPROM | and entering a file name. An EEPROM file can also be retrieved in this way and written to the bq2060A using the | Write | button.

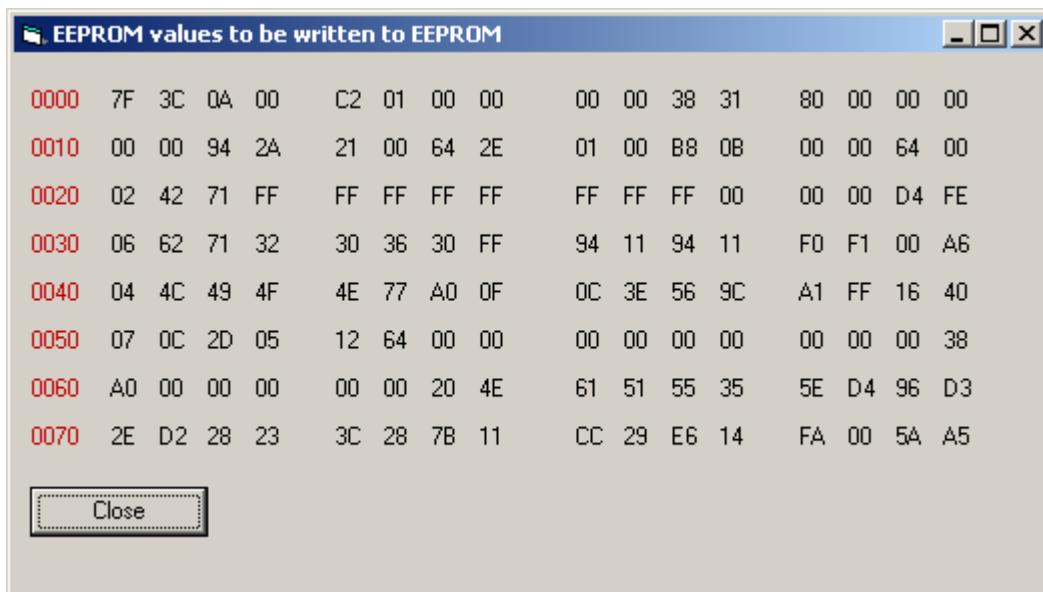
To read the raw Hex data in the EEPROM, click on | Read EEPROM Contents |. This reads the entire EEPROM contents and displays it in a new window.

Figure 5–6. Read EEPROM Values Screen



To view the raw Hex data prior to writing it to the EEPROM, click on | EEPROM Values to be Written |. This reading is not from the EEPROM, but rather from the locations as they are displayed. It translates all locations to a raw Hex EEPROM map that is displayed in a new window exactly as it would go into the EEPROM once written.

Figure 5–7. EEPROM Values to be Written Screen



All data required for calibration is also held in the EEPROM for the bq2060A as highlighted in Figure 5–8.

Figure 5–8. EEPROM Data Screen—bq2060A Module Calibration Locations

The screenshot shows the 'EV2200-60 Information Lithium Ion' software interface. The 'Calibration' tab is selected, displaying a list of parameters. A red box highlights the following calibration data:

| | |
|---------------------------|-------------|
| Cell 3 Calibration Factor | 0 |
| Cell 4 Calibration Factor | 0 |
| ADC Voltage Gain | 16.0000 |
| ADC Sense Resistor | 30.000 mOhm |
| VFC Sense Resistor | 30.001 mOhm |
| VOC 25% | 11170 mV |
| VOC 50% | 11370 mV |
| VOC 75% | 11730 mV |
| EDV0 | 9000 mV |
| EDV1 | 10300 mV |
| EDV2 | 10700 mV |

Other parameters visible in the interface include:

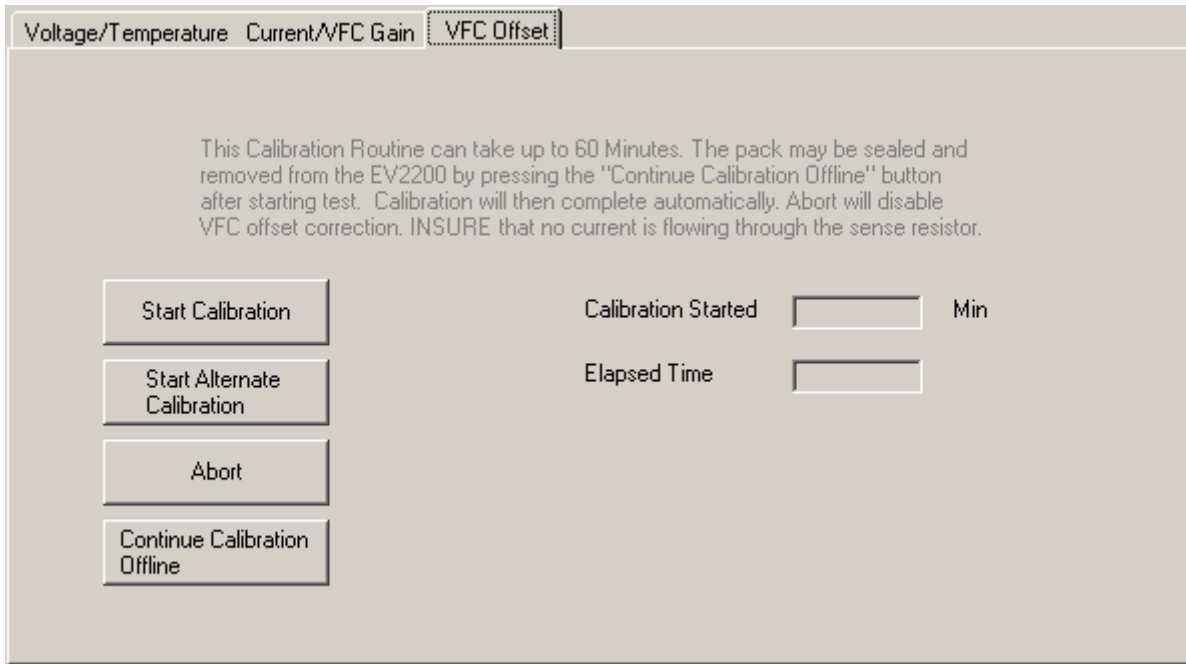
- Remaining Time Alarm: 10 Min
- Remaining Capacity Alarm: 450 mAh
- EDV A0 Factor: 0.00 %/1kCC
- EDV TC Factor: 0
- Misc Options: 00 Hex
- Safety Overtemperature: 80.0 Deg C
- Charging Voltage: 12600 mV
- Cycle Count: 0
- Design Voltage: 10800 mV
- Specification Information: 0 0 2 1
- Manufacture Date: 3/4/2003
- Serial Number: 1
- Fast Charging Current: 3000 mA
- Maint Charging Current: 0 mA
- Pre-Charge Current: 100 mAh
- Manufacturer Name: Bq
- Light Load Estimate: 0.00 mA
- Maximum Overcharge: 300 mAh
- Device Name: bq2060
- Last Measured Dsg: 4500 mAh
- Pack Capacity: 4500 mAh
- Cycle Count Threshold: 3600 mAh
- Pack Configuration: A6 Hex
- Device Chemistry: LION
- MaxT DeltaT: 77 Hex
- Overload Current: 4000 mA
- Overvoltage Margin: 192 mV
- Overcurrent Margin: 992 mA
- Cell Under/Over Voltage: 56 Hex
- Fast Charge Termination %: 100 %
- Fully Charged Clear %: 95 %
- Charge Efficiency: 100.0 %
- Current Taper Threshold: 206 mA
- Current Taper Qual Volt: 200 mV
- Mfg Data Str Length: 7
- Control Mode: 0C Hex
- Digital Filter: 50.00 uV
- Self Discharge Rate: 0.21 %/day
- Battery Low %: 7.0 %
- Near Full: 200 mAh
- VFC Offset: A03800
- Temperature Offset: 0.0 Deg C
- ADC Offset: 0
- Cell 2 Calibration Factor: 0

Buttons for 'Read', 'Write', 'EEPROM Values to be Written', and 'Read EEPROM Contents' are visible at the bottom right. The status bar shows 'RS-232 Interface Ok' and the time '8:01:43 AM'.

5.5 Calibration of a bq2060A Based Module Using the EV2200-60 Software

The VFC Offset tab is used in the calibration routine. The VFC Offset screen offers a simple-to-use interface for calibrating the Offset of the VFC. Two different types of offset can be selected.

Figure 5–9. VFC Offset Screen



Default VFC Offset: To select this offset method, click on | Start Calibration |. This method applies an internal short (inside the bq2060A) across the sense resistor. With the sense resistor shorted inside the bq2060A, there is less chance that an external current can cause a poor offset calculation. If the circuit board induces a slight offset, then it is not compensated for with this method.

Alternate VFC Offset: To select this offset method, click on | Start Alternate Calibration |. This method does not apply an internal short across the sense resistor. Care must be taken that no current is flowing through the sense resistor. If there is current, the bq2060A applies this current to its calculations, resulting in an inaccurate VFC offset. With no short across the sense resistor, this method compensates for board offset as long as no current is flowing.

Once calibration is started, the Calibration Started Field displays the time when the calibration was initiated. The Elapsed Time continually updates the amount of time in minutes since the calibration began.

To abort the offset attempt, click on | Abort |. This halts the offset calculation process and stores a value of 0x003800 in to the EEPROM.

If this module is installed on a pack where VCC will be present to the bq2060A after disconnecting from the EV2200, then you can click | Continue Calibration Offline | and the bq2060A automatically finishes the calibration and stores the

final result in the EEPROM when it is complete. When this option is selected, a popup window appears asking if you wish to seal the pack after the calibration is complete. Click | Yes | to seal the pack after calibration or | No | to finish calibration without sealing the pack. This also is done automatically by the bq2060A after it completes calibration.

Figure 5–10. 3 Cell LiON Calibration Screen

The screenshot shows the '3 Cell LiON Calibration Screen' with the following details:

- Navigation Tabs:** Voltage/Temperature | Current/VFC Gain | VFC Offset
- VOLTAGE/TEMPERATURE Section:**
 - Temperature: Part 296.2, Reference Standard Enter Value, Unit K
 - Cell 1: Part 3574, Reference Standard Enter Value, Unit mV
 - Cell 1 + 2: Part 7208, Reference Standard Enter Value, Unit mV
 - Battery Voltage: Part 10653, Reference Standard Enter Value, Unit mV
 - Chemistry: Lion
 - Cell Structure: 3 Cells
 - Start Button
 - Warning: Do this calibration first, as ADC Offset will affect current calibration accuracy. INSURE that no current is flowing through the sense resistor.
- CURRENT/VFC GAIN Section:**
 - Current Reading: 0, Reference Standard Enter Value, Unit mA
 - Start Button
 - Instruction: Attach load to battery, then enter actual current at left

The LiON Calibration screen differs from the NiMH calibration screen by the individual cell voltages and cell structure. If the Chemistry or Cell Structure fields do not show the proper configuration in their respective fields, then select the bq2060A Data Screen Tab, select | Options | Initialize Device |, wait 5 seconds and then return to the Calibration Tab.

The Voltage/Temperature and Current/VFC Gain screen has two frames. The top frame is for calibrating voltage and temperature. Perform this calibration procedure prior to the Current/VFC Gain calibration.

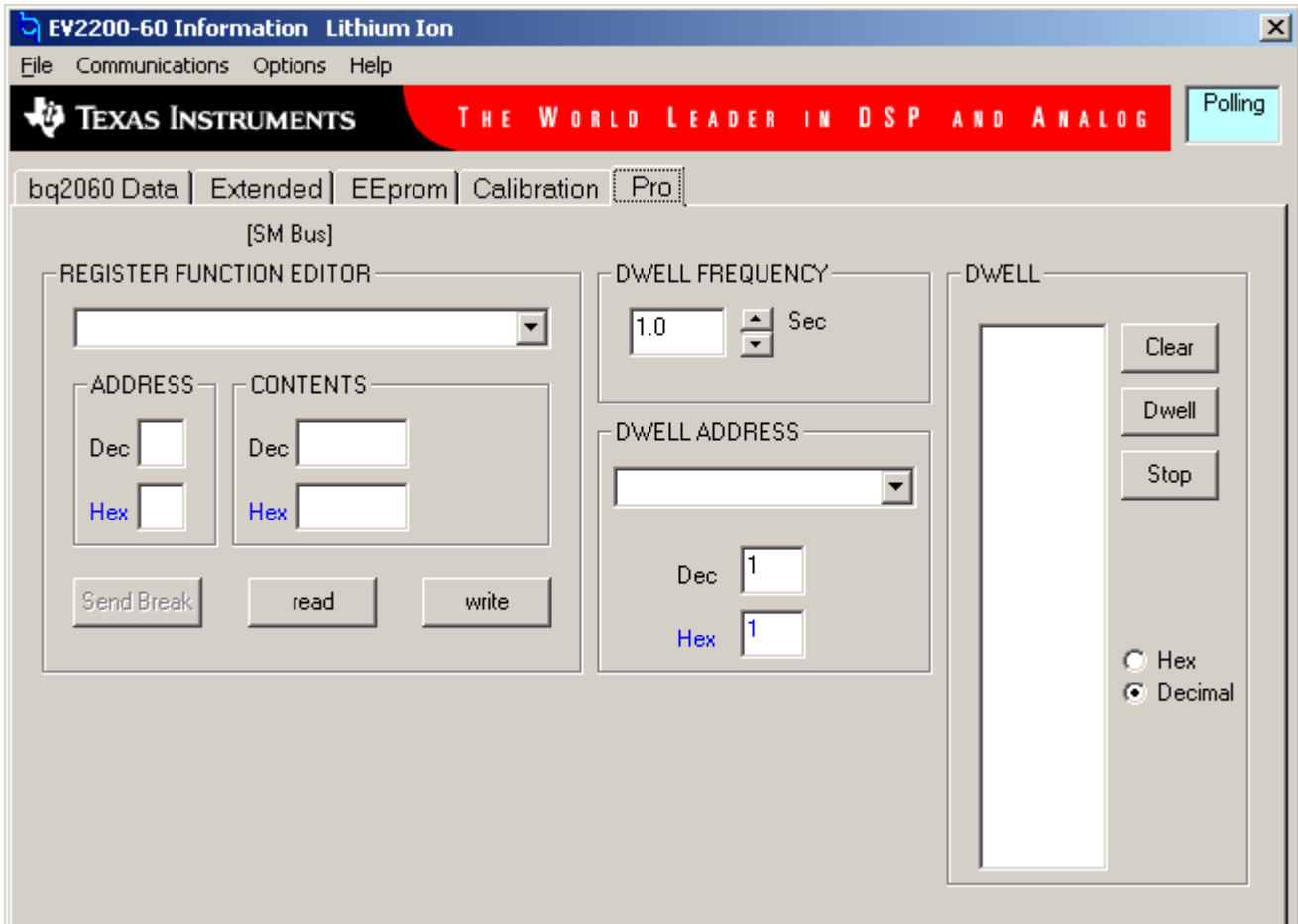
To perform the Voltage/Temperature calibration, enter values in the Reference Standard column that were recorded using a traceable calibrated standard. Be sure to measure the voltage at the connections to the bq2060AEVM-00X module to get the most accurate results. Also be sure to add the cells together at each individual cell field for all the cells below it. The Battery Voltage Field should be derived from all the cells added together. If this application does not have individual cell voltage monitoring, then only the Battery Voltage field is displayed. Enter the temperature in the appropriate field in the Reference Standard column. Click on the | Start | button to finish the Voltage/Temperature calibration.

To perform the Current/VFC Gain calibration, connect a traceable calibrated load to the bq2060AEVM-00X module as shown in Figure 5–1 or 5–2. Then enter the Load current in the Reference Standard column, and click | Start | to finish the Current/VFC Gain calibration.

5.6 Direct Access Communication

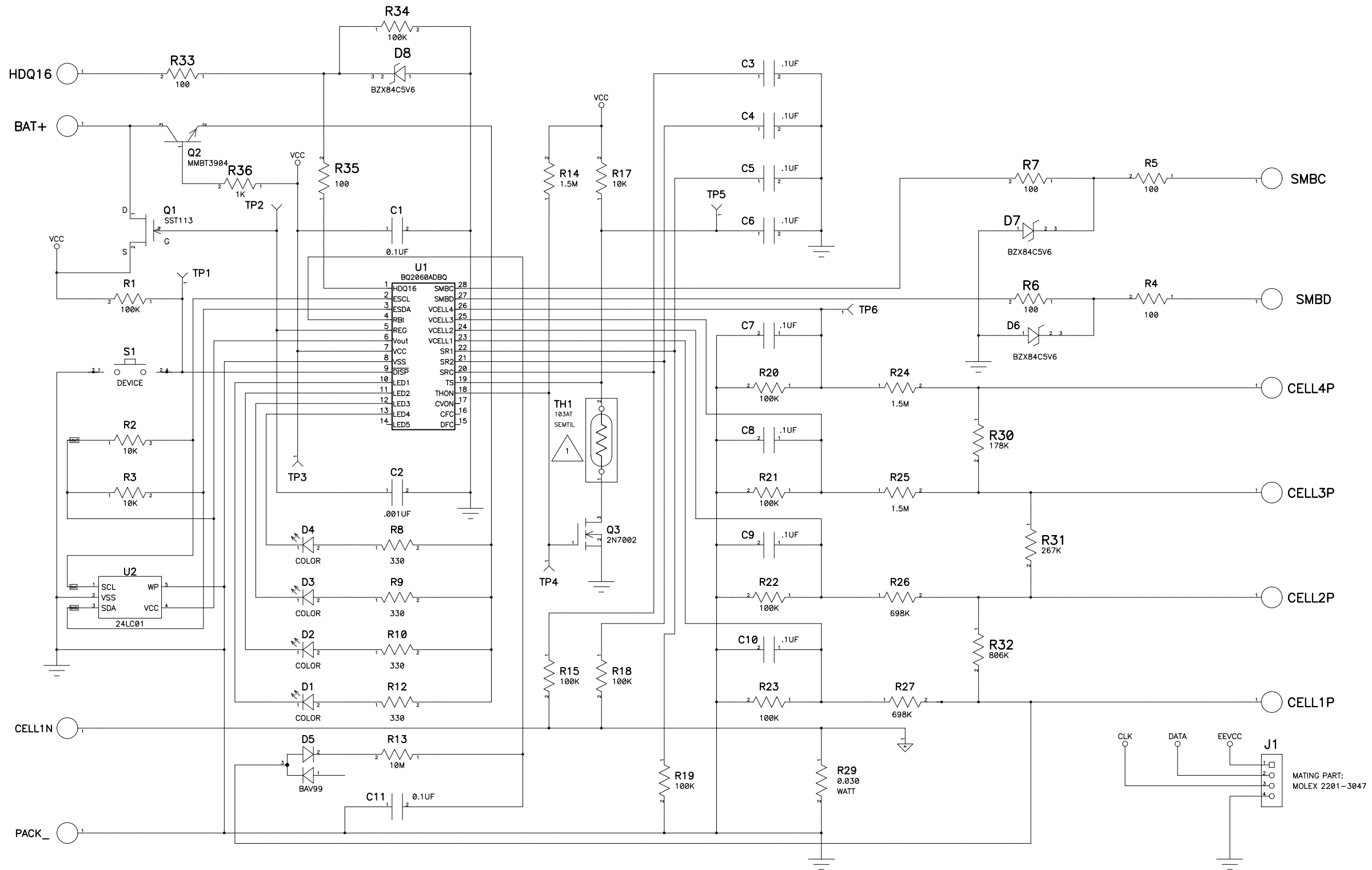
The Pro Screen allows direct access to all the memory in the bq2060A including the memory above the SMBus locations providing that the bq2060A is unsealed. The scan tool called Dwell is useful for scanning a specific location.

Figure 5–11. Pro Screen



5.7 Schematic

(The schematic diagram is appended to the PDF document).



1 TH1 IS LOCATED OFF BOARD AND ATTACHED THROUGH TERMINALS P1 AND P2.