

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

User's Guide

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products & application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address:
Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user is **not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

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).

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 60°C. The EVM is designed to operate properly with certain components above 60°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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Preface

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

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

Contents

1	Introduction	1-1
1.1	Overview	1-2
1.2	Features	1-2
1.3	Kit Contents	1-2
1.4	Ordering Information	1-2
2	bq2060A-Based Circuit Module	2-1
2.1	Pin Descriptions	2-2
2.2	bq2060A Circuit Module Bill of Materials	2-2
2.3	bq2060A Circuit Module Performance Specification Summary	2-3
3	Circuit Module Physical Layouts	3-1
3.1	Board Layout	3-2
4	EVM Hardware and Software Setup	4-1
4.1	Software Installation	4-2
4.2	Hardware Connection	4-2
4.2.1	Connecting the bq2060A Circuit Module to a Battery Pack	4-2
4.2.2	PC Interface Connection	4-4
5	Operation	5-1
5.1	Starting the Program	5-2
5.2	Extended Data Screen	5-4
5.3	Data Logging	5-5
5.4	Setting Programmable bq2060A Options	5-5
5.5	Calibration of a bq2060A Based Module Using the EV2200-60 Software	5-10
5.6	Direct Access Communication	5-12
5.7	Schematic	Appended to the PDF document

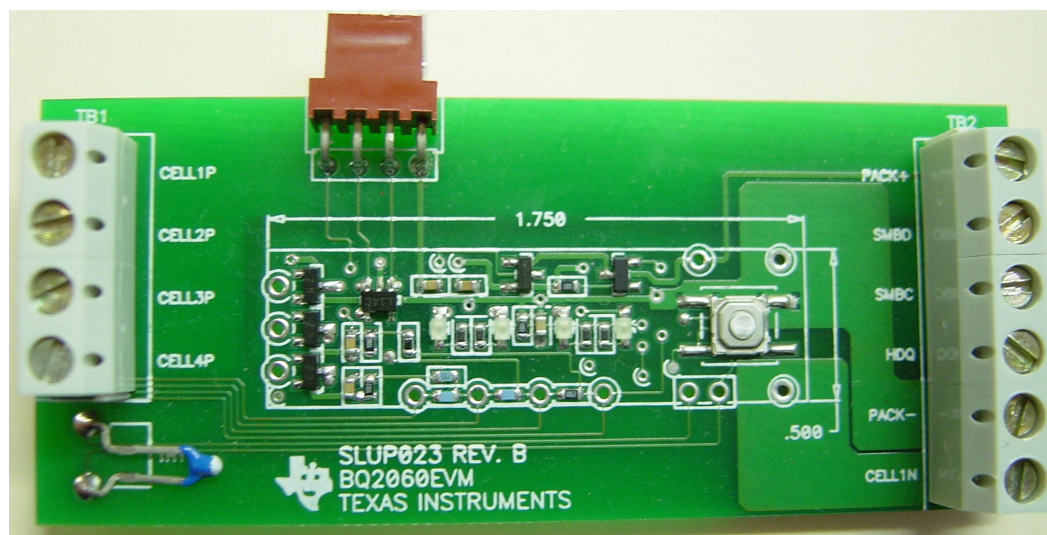
Figures

3-1	bq2060AEVM-00X Layout	3-2
4-1	bq2060A Circuit Module Connection to LION Cells and System Load/Charger	4-3
4-2	bq2060A Circuit Module Connection to NiMH Cells and System Load/Charger	4-4
5-1	SBS Data Screen	5-2
5-2	SBS Data Screen—Static Data Window	5-3
5-3	SBS Extended Data Screen	5-4
5-4	LION EEPROM Data Screen	5-6
5-5	NiMH EEPROM Data Screen	5-7
5-6	Read EEPROM Values Screen	5-8
5-7	EEPROM Values to be Written Screen	5-8
5-8	EEPROM Data Screen—bq2060A Module Calibration Locations	5-9
5-9	VFC Offset Screen	5-10
5-10	3 Cell LION Calibration Screen	5-11
5-11	Pro Screen	5-12

Tables

1-1	Ordering Information	1-2
2-1	SLUP023-00X Bill of Materials	2-2
2-2	Performance Specification Summary	2-3
4-1	Circuit Module to EV2200 Connections	4-4
4-2	Circuit Module EEPROM Connector to EV2200 Connections	4-4
5-1	Example Log File	5-5

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.

Topic	Page
1.1 Overview	1-2
1.2 Features	1-2
1.3 Kit Contents	1-2
1.4 Ordering Information	1-2

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.

Topic	Page
2.1 Pin Descriptions	2-2
2.2 bq2060A Circuit Module Bill of Materials	2-2
2.3 bq2060A Circuit Module Performance Specification Summary	2-3

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

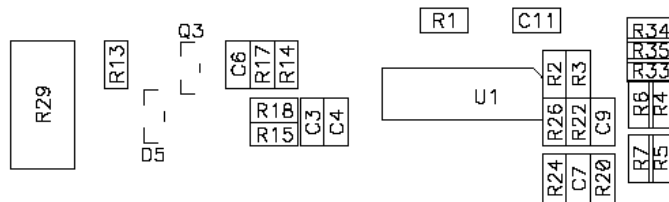
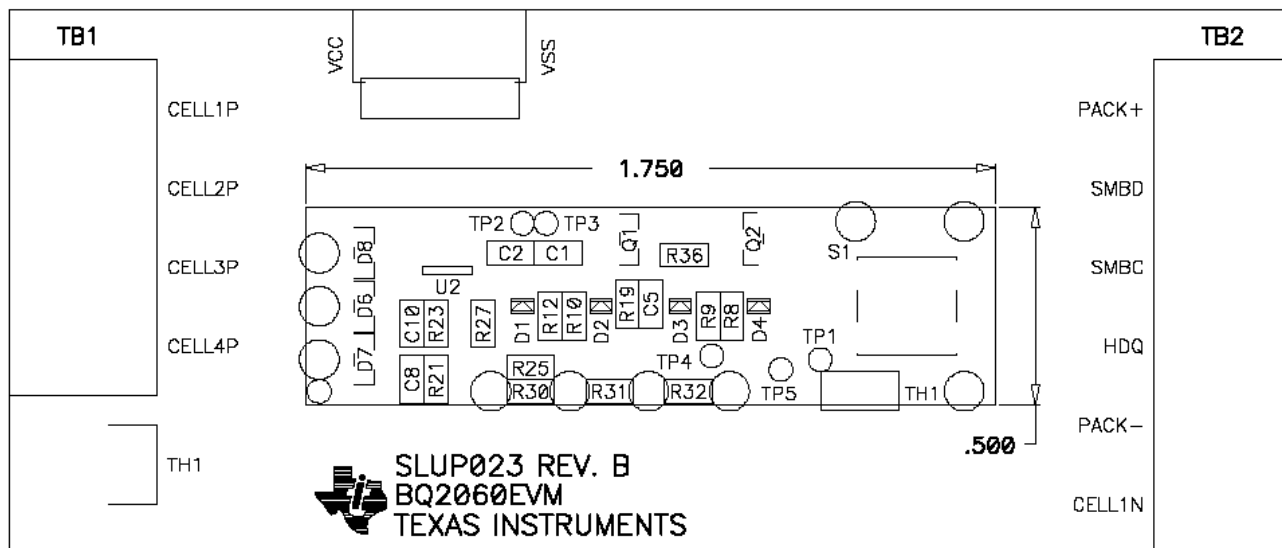
This chapter contains the board layout and assembly drawings for the bq2060A circuit module.

Topic	Page
3.1 Board Layout	3-2

3.1 Board Layout

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

Figure 3–1. bq2060AEVM-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.

Topic	Page
4.1 Software Installation	4-2
4.2 Hardware Connection	4-2

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

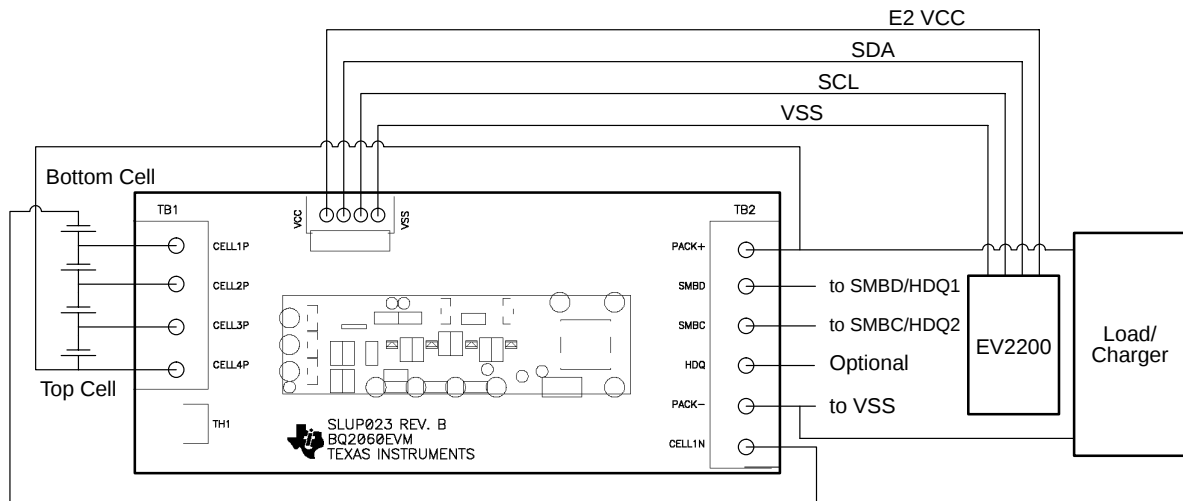
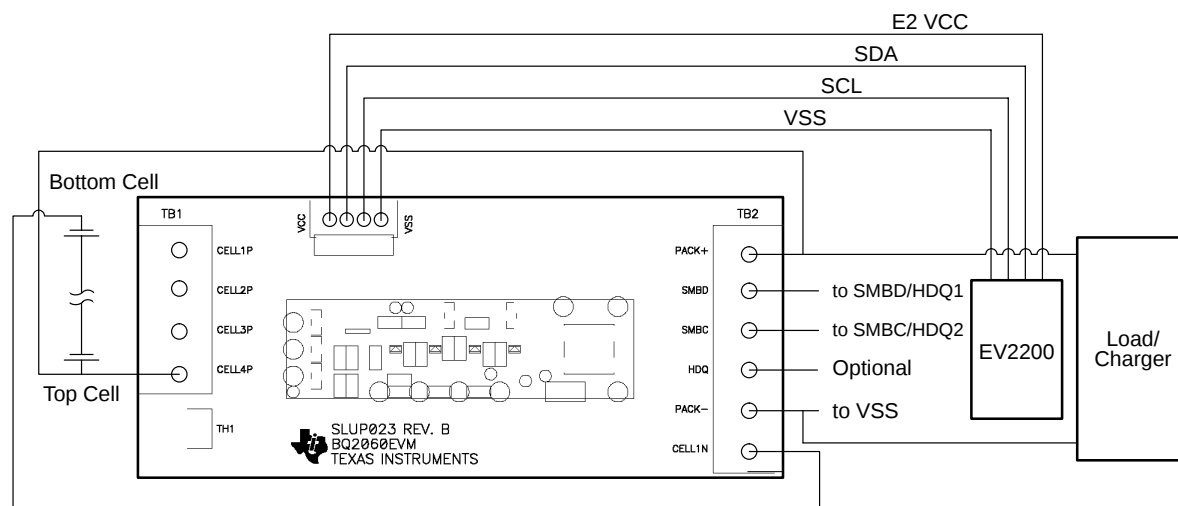


Figure 4–2. bq2060A Circuit Module Connection to NiMH Cells and System Load/Charger



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.

Topic	Page
5.1 Starting the Program	5-2
5.2 Extended Data Screen	5-4
5.3 Data Logging	5-5
5.4 Setting Programmable bq2060A Options	5-5
5.5 Calibration of a bq2060A Based Module Using the EV2200-60 Software	5-10
5.6 Direct Access Communication	5-12
5.7 Schematic	5-13

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

EV2200-60 Information Lithium Ion

File Communications Options Help

TEXAS INSTRUMENTS THE WORLD LEADER IN DSP AND ANALOG

Polling

bq2060 Data Extended EEprom Calibration Pro

Log		Log	
Manufacturer Access	☐ 0000	Charging Current	☐ 3000 mA
Remaining Capacity Alarm	☐ 450 mAh	Charging Voltage	☐ 12600 mV
Remaining Time Alarm	☐ 10 min	Battery Status	☒ 0080
Battery Mode	☒ 0080	Cycle Count	☒ 0
At Rate	☐ 0 mA	Manufacturer Data	☒ 0C 2D 05 12 64 CC 29
At Rate Time To Full	☒ 65535 min		
At Rate Time To Empty	☒ 65535 min		
At Rate OK	☐ 1		
Temperature	☒ 296.8 K		
Voltage	☒ 10800 mV		
Current	☒ 0 mA		
Average Current	☒ 0 mA		
Max Error	☒ 100 %		
Relative State Of Charge	☐ 50 %		
Absolute State Of Charge	☐ 50 %		
Remaining Capacity	☒ 2250 mAh		
Full Charge Capacity	☒ 4500 mAh		
Run Time To Empty	☒ 65535 min		
Average Time To Empty	☒ 65535 min		
Average Time To Full	☒ 65535 min		

DISPLAY MODE

☐ Dec (black)

☐ Hex (blue)

☒ Preferred (both)

Design Capacity _____ mAh

Design Voltage _____ mV

Specification Info _____

Manufacture Date _____

Serial Number _____

Manufacturer Name _____

Device Name _____

Device Chemistry _____

Read

RS-232 Interface Ok 10:42:24 AM

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).

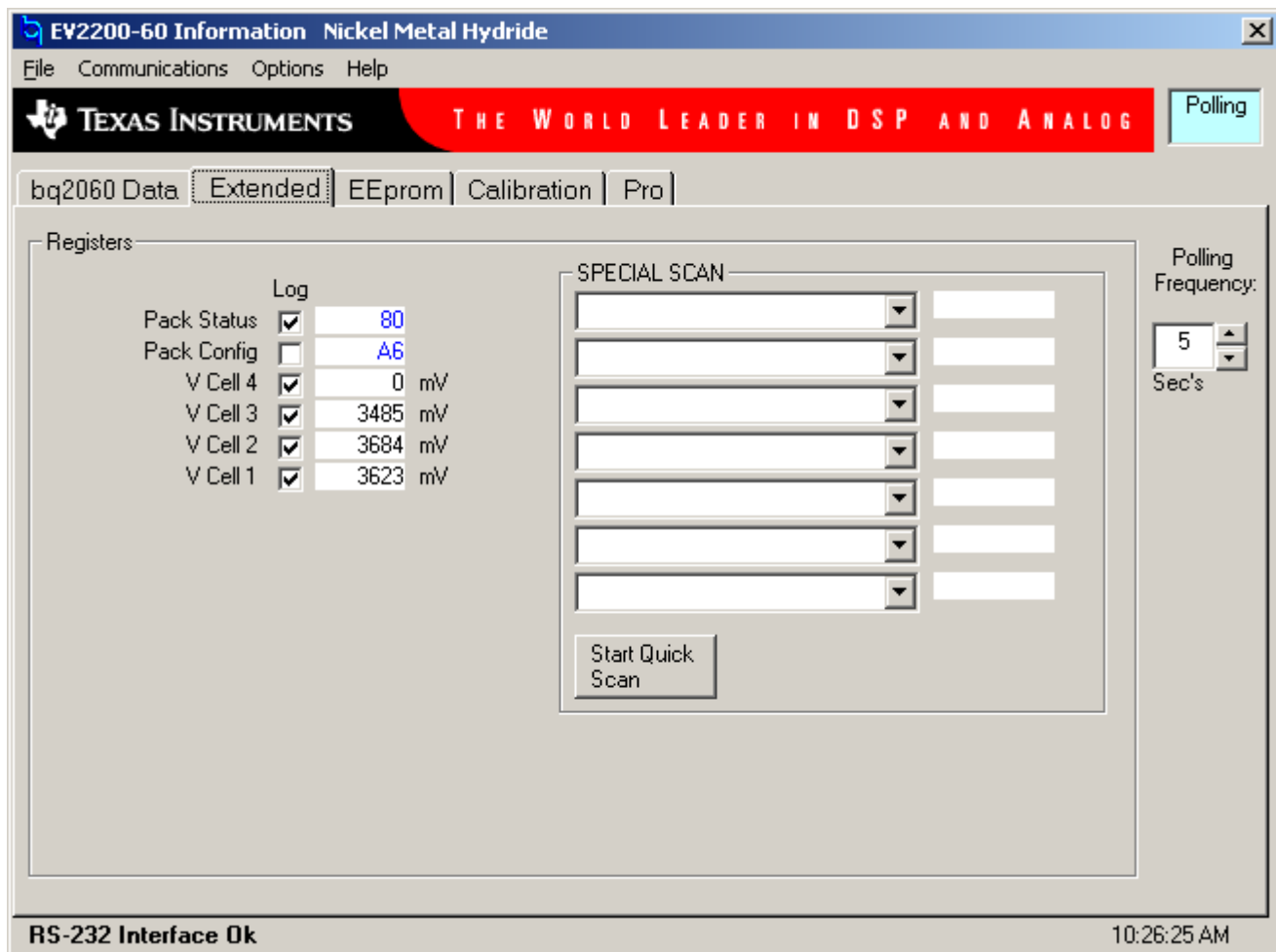
Figure 5-2. SBS Data Screen—Static Data Window

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

EV2200-60 Information Lithium Ion

File Communications Options Help

TEXAS INSTRUMENTS THE WORLD LEADER IN DSP AND ANALOG Polling

bq2060 Data | Extended | **EEPROM** | Calibration | Pro

Remaining Time Alarm	10 Min	Pack Configuration	A6 Hex	Cell 3 Calibration Factor	0
Remaining Capacity Alarm	450 mAh	Device Chemistry	LION	Cell 4 Calibration Factor	0
EDV A0 Factor	0.00 %/kCC	MaxT DeltaT	77 Hex	ADC Voltage Gain	16.0000
EDV TC Factor	0	Overload Current	4000 mA	ADC Sense Resistor	30.000 mOhm
Misc Options	00 Hex	Overvoltage Margin	192 mV	VFC Sense Resistor	30.001 mOhm
Safety Overtemperature	94.5 Deg C	Overcurrent Margin	992 mA	VOC 25%	11170 mV
Charging Voltage	12600 mV	Cell Under/Over Voltage	56 Hex	VOC 50%	11370 mV
Cycle Count	0	Fast Charge Termination %	100 %	VOC 75%	11730 mV
Design Voltage	10900 mV	Fully Charged Clear %	95 %	EDV0	9000 mV
Specification Information	0 0 2 1	Charge Efficiency	100.0 %	EDV1	10300 mV
Manufacture Date	3/4/2003	Current Taper Threshold	412 mA	EDV2	10700 mV
Serial Number	1	Current Taper Qual Volt	128 mV		
Fast Charging Current	3000 mA	Mfg Data Str Length	7		
Maint Charging Current	0 mA	Control Mode	0C Hex		
Pre-Charge Current	100 mAh	Digital Filter	50.00 uV		
Manufacturer Name	Bq	Self Discharge Rate	0.21 %/day		
Light Load Estimate	0.00 mA	Battery Low %	7.0 %		
Maximum Overcharge	300 mAh	Near Full	200 mAh		
Device Name	bq2060A	VFC Offset	A03800	Read	EEPROM Values to be Written
Last Measured Dsg	4500 mAh	Temperature Offset	0.0 Deg C	Write	Read EEPROM Contents
Pack Capacity	4500 mAh	ADC Offset	0		
Cycle Count Threshold	3600 mAh	Cell 2 Calibration Factor	0		

RS-232 Interface Ok 9:49:00 AM

Figure 5-5. NiMH EEPROM Data Screen

EV2200-60 Information Nickel Metal Hydride

File Communications Options Help

TEXAS INSTRUMENTS THE WORLD LEADER IN DSP AND ANALOG

Polling

bq2060 Data | Extended | **EEprom** | Calibration | Pro

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 %/kCC	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 %		

Read Write

EEPROM Values to be Written

Read EEPROM Contents

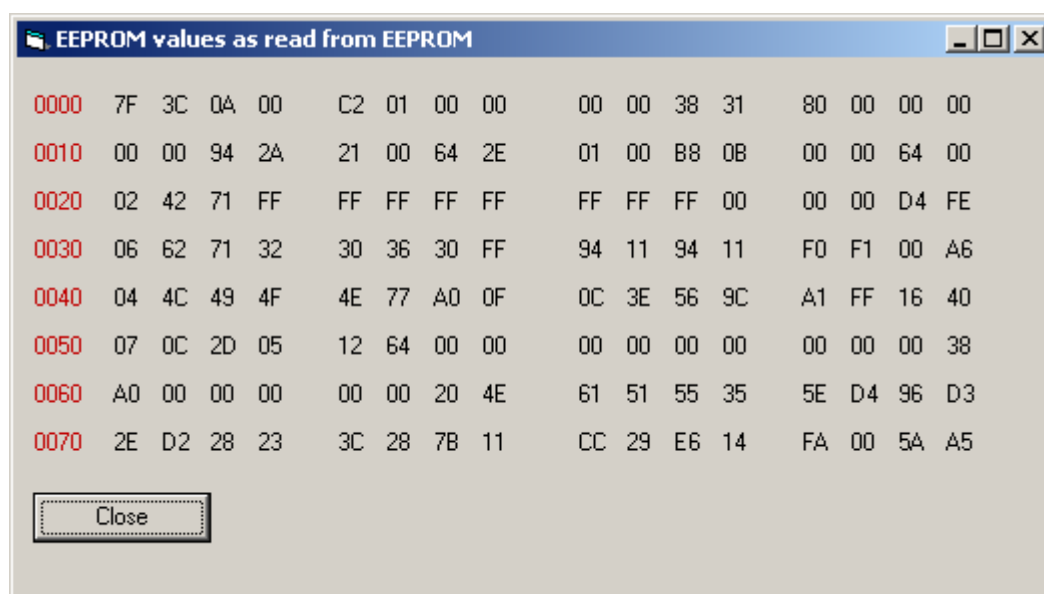
RS-232 Interface Ok 7:52:28 AM

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.

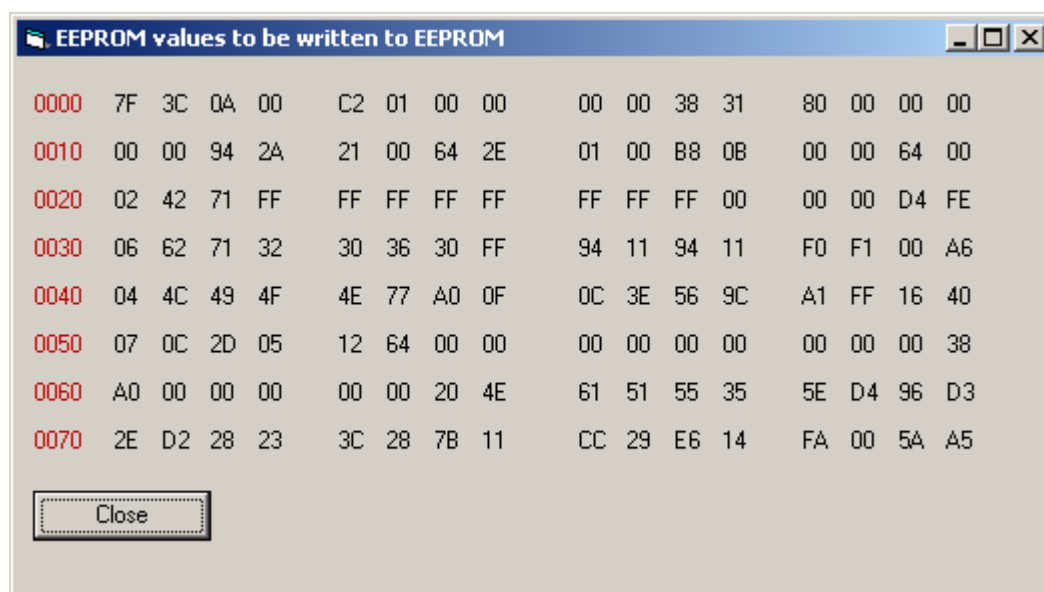
To read the raw Hex data in the EEPROM, click on | Read EEPROM Contents |. This reads the entire EEPROM contents and displays it in a new window.

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

EV2200-60 Information Lithium Ion

File Communications Options Help

TEXAS INSTRUMENTS THE WORLD LEADER IN DSP AND ANALOG **Polling**

bq2060 Data | Extended | **EEprom** | Calibration | Pro

Remaining Time Alarm	10 Min	Pack Configuration	A6 Hex	Cell 3 Calibration Factor	0
Remaining Capacity Alarm	450 mAh	Device Chemistry	LION	Cell 4 Calibration Factor	0
EDV A0 Factor	0.00 %/1kCC	MaxT DeltaT	77 Hex	ADC Voltage Gain	16.0000
EDV TC Factor	0	Overload Current	4000 mA	ADC Sense Resistor	30.000 mOhm
Misc Options	00 Hex	Overvoltage Margin	192 mV	VFC Sense Resistor	30.001 mOhm
Safety Overtemperature	80.0 Deg C	Overcurrent Margin	992 mA	VOC 25%	11170 mV
Charging Voltage	12600 mV	Cell Under/Over Voltage	56 Hex	VOC 50%	11370 mV
Cycle Count	0	Fast Charge Termination %	100 %	VOC 75%	11730 mV
Design Voltage	10800 mV	Fully Charged Clear %	95 %	EDV0	9000 mV
Specification Information	0 0 2 1	Charge Efficiency	100.0 %	EDV1	10300 mV
Manufacture Date	3/4/2003	Current Taper Threshold	206 mA	EDV2	10700 mV
Serial Number	1	Current Taper Qual Volt	200 mV		
Fast Charging Current	3000 mA	Mfg Data Str Length	7		
Maint Charging Current	0 mA	Control Mode	0C Hex		
Pre-Charge Current	100 mAh	Digital Filter	50.00 uV		
Manufacturer Name	Bq	Self Discharge Rate	0.21 %/day		
Light Load Estimate	0.00 mA	Battery Low %	7.0 %		
Maximum Overcharge	300 mAh	Near Full	200 mAh		
Device Name	bq2060	VFC Offset	A03800		
Last Measured Dsg	4500 mAh	Temperature Offset	0.0 Deg C		
Pack Capacity	4500 mAh	ADC Offset	0		
Cycle Count Threshold	3600 mAh	Cell 2 Calibration Factor	0		

Calibration Data

Read EEPROM Values to be Written

Write Read EEPROM Contents

RS-232 Interface Ok 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

Voltage/Temperature Current/VFC Gain **VFC Offset**

This Calibration Routine can take up to 60 Minutes. The pack may be sealed and removed from the EV2200 by pressing the "Continue Calibration Offline" button after starting test. Calibration will then complete automatically. Abort will disable VFC offset correction. INSURE that no current is flowing through the sense resistor.

Start Calibration Calibration Started Min

Start Alternate Calibration Elapsed Time

Abort

Continue Calibration Offline

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 two tabs: 'Voltage/Temperature' and 'VFC Offset'. The 'Voltage/Temperature' tab is active. It contains the following fields and controls:

- Temperature:** Value 296.2, Unit K, Reference Standard 'Enter Value'.
- Cell 1:** Value 3574, Unit mV, Reference Standard 'Enter Value'.
- Cell 1 + 2:** Value 7208, Unit mV, Reference Standard 'Enter Value'.
- Battery Voltage:** Value 10653, Unit mV, Reference Standard 'Enter Value'.
- Chemistry:** Dropdown menu set to 'Lion'.
- Cell Structure:** Dropdown menu set to '3 Cells'.
- Start Button:** A button labeled 'Start'.
- Note:** 'Do this calibration first, as ADC Offset will affect current calibration accuracy. INSURE that no current is flowing through the sense resistor.'

The 'CURRENT/VFC GAIN' tab is also visible below the first tab. It contains:

- Current Reading:** Value 0, Unit mA, Reference Standard 'Enter Value'.
- Start Button:** A button labeled 'Start'.
- Note:** '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.

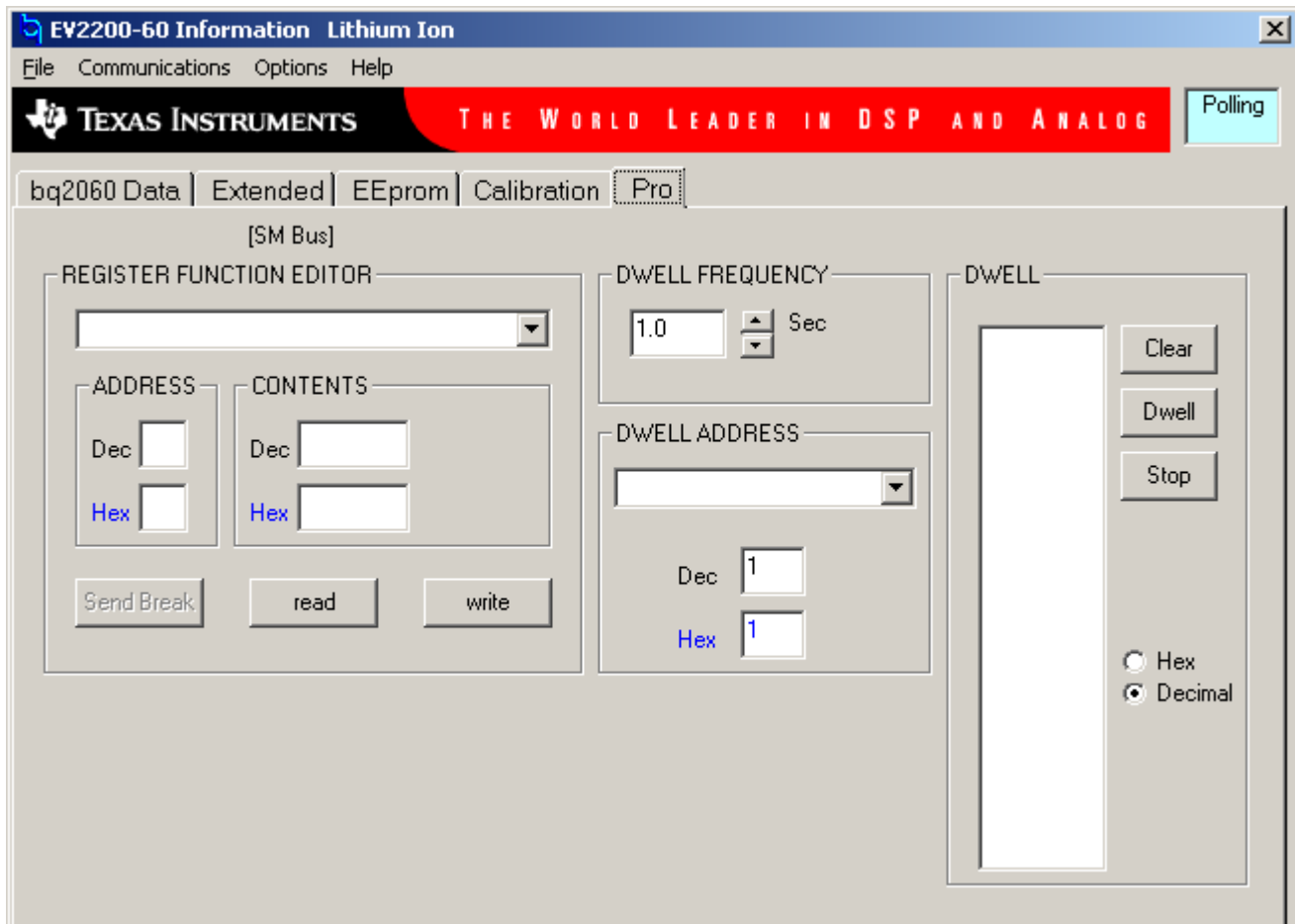
To perform the Voltage/Temperature calibration, enter values in the Reference Standard column that were recorded using a traceable calibrated standard. Be sure to measure the voltage at the connections to the bq2060AEVM-00X module to get the most accurate results. Also be sure to add the cells together 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

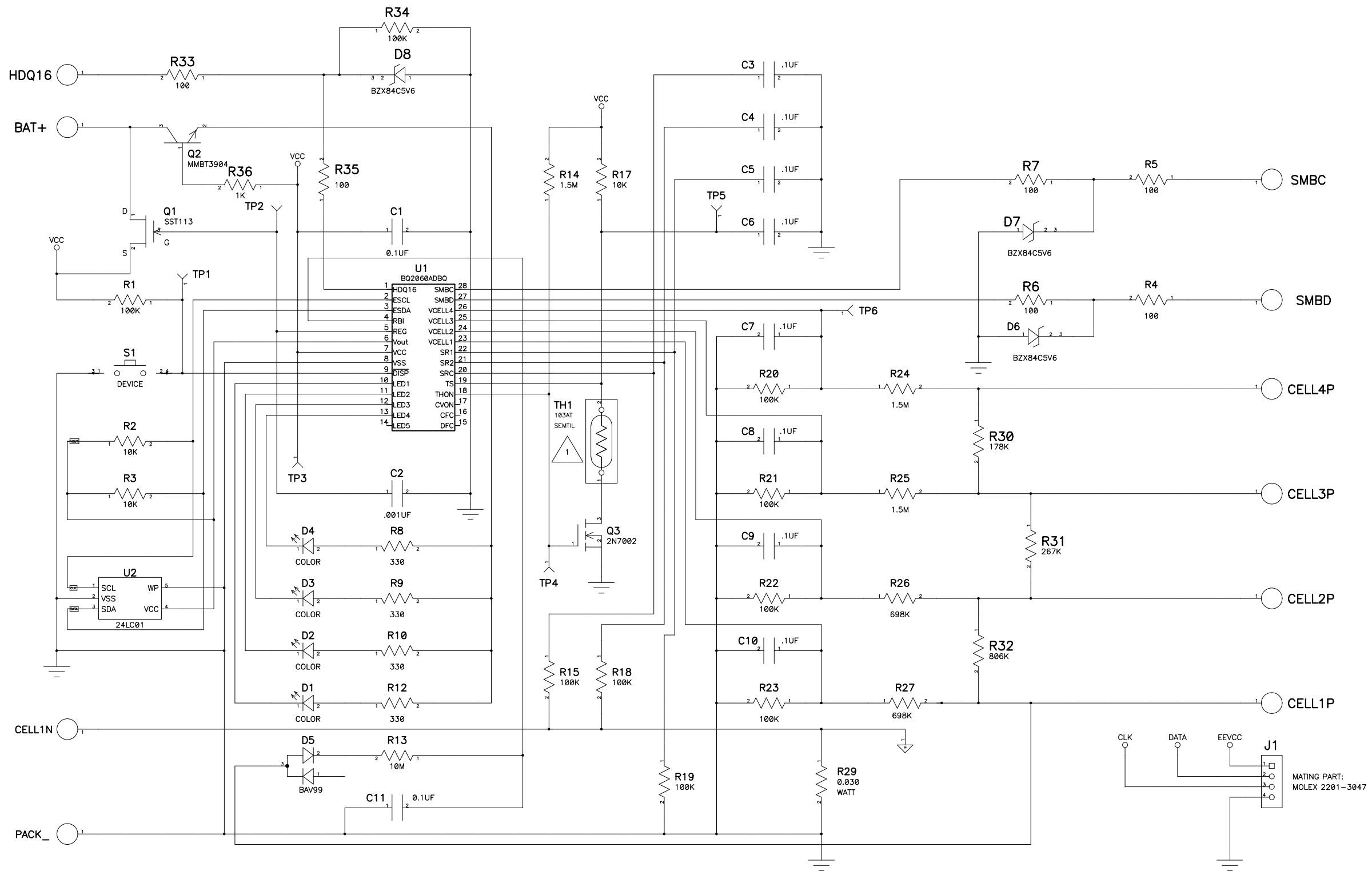
The Pro Screen allows direct access to all the memory in the bq2060A including the memory above the SMBus locations providing that the bq2060A is unsealed. The scan tool called Dwell is useful for scanning a specific location.

Figure 5–11. Pro Screen



5.7 Schematic

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



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