bq2060AEVM-001 and bq2060AEVM-002

SBS1.1 Battery Management Solution Evaluation Module

User's Guide

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High Performance Analog

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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 \pm 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.

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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

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Chapter 1

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
- Deputated circuit module for quick setup
- D 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 <u>www.ti.com</u>
- 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

Chapter 2

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 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						
-001	-002	RefDes	Description	Size	Part Number	MFG
10	10	C1, C11, C3, C4, C5, C6, C7, C8, C9, C10	Capacitor, ceramic, 0.1 μF, X7R, 25 V	603	VJ0603Y104KXXX	Vishay
1	1	C2	Capacitor, ceramic, 0.001 μF, 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 kΩ, 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 kΩ, 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

Count						
-001	-002	RefDes	Description	Size	Part Number	MFG
1	1	R31	Resistor, chip, 267 kΩ 1%	805	CRCW08052673F	Vishay
1	1	R32	Resistor, chip, 806 kΩ 1%	603	CRCW06038063F	Vishay
1	1	R36	Resistor, chip, 1 kΩ, 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

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

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	Тур	Max	Units
Input voltage Pack+ to Pack-	3.0		25	V
Charge and Discharge Current			See Note	А

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

Chapter 3

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. bq2060AEVM-00X Layout





Chapter 4

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.
- 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:

 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.

Chapter 5

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

🔄 EV2200-60 Informatio	n L	ithium Io.	n						×
File Communications Opti	ions	Help							
🜵 Texas Instrum	ENT	s	Тн	E WORL	D LEAD	ER IN	DSP AND	A N A L	0 G
bq2060 Data Extend	ed	EEpron	n Ca	dibration [Pro				
Manufacturer Access	Log	0000		Charging	Log	3000	mΔ		MODE
Bemaining Capacity Alarm	닅	450	máh	Charging	Voltage	12600	nV		black)
Bemaining Time Alarm	ΗĽ	10	min	Batter	no Status 🔽	0080		0000	
Battery Mode		0080		Cyc	le Count 🔽	0		🛛 🔿 Hex (t	olue)
At Rate	Ē	0	mΑ	Manufactu	irer Data 🔽	OC 2D 05	12 64 CC 29	Prefer	red (both)
At Rate Time To Full		65535	min						
At Rate Time To Empty		65535	min						
At Rate OK		1							
Temperature		296.8	K		Desir	n Canacitu			méh
Voltage		10800	mV		Des	ian Voltage			mV
Current		0	mA		Speci	fication Info			
Average Current	⊡.	0	mA ov		Manufa	acture Date			
Max Error		100	% •.		Se	rial Number			
Absolute State Of Charge	닐	50	/o 9/		Manufac	turer Name			
Remaining Capacity	닅	2250	∽ m∆h		De	evice Name			
Full Charge Capacity		4500	mAh		Devic	e Chemistry			
Bun Time To Emoty		65535	min						
Average Time To Empty		65535	min					Deed	
Average Time To Full	, V	65535	min					Head	
				L					
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).





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.



🔄 E¥2200-60 Information Nickel Metal Hydride	×
Eile Communications Options Help	
TEXAS INSTRUMENTS THE WORLD LEADER IN DSP AND ANAL	0 6 Polling
bq2060 Data Extended EEprom Calibration Pro	
Registers Pack Status ▼ 80 Pack Config A6 V Cell 4 ✓ 0 V Cell 3 ✓ 3485 V Cell 2 ✓ 3684 V Cell 1 ✓ ✓ Start Quick ✓	Polling Frequency: Sec's
RS-232 Interface Ok	10:26:25 AM

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.

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

Table 5–1. Example Log File

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

Contraction Lithium Ion											
Eile Communications Op	tions Help										
🜵 Texas Instrum	IENTS	THE WORLD LE	ADER IN D	SP AND ANAL	0 G	olling					
bq2060 Data Extend	ded 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	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 F	ast Charge Termination %	100 %	VOC 75%	11730	mV					
Design Voltage	10900 mV	Fully Charged Clear %	95 %	EDV0	9000	mV					
Specification Information	0021	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	OC 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	[PROM Va						
Device Name	bq2060A	VFC Offset	A03800	Read to	be Written						
Last Measured Disg	4500 mAh	Temperature Offset	0.0 Deg C								
Pack Capacity	4500 mAh	ADC Offset	0	Write B	ead EEPRI	ом					
Cycle Count Threshold 3600 mAh Cell 2 Calibration Factor 0											
RS-232 Interface Ok					9:49:00 /	١M					

Figure 5–5. NiMH EEPROM Data Screen

CV2200-60 Information Nickel Metal Hydride											
Eile Communications Options Help											
🐺 Texas Instrum	IENTS	THE WORLD LE	ADER IN D	SPAND ANAL	0 6	Polling					
bq2060 Data Extend	ded EEprom	Calibration Pro									
Remaining Time Alarm	10 Min	Pack Configuration	A0 Hex Eff	iciency Reduction Rate	0.000	%					
Remaining Capacity Alarm	400 mAh	Device Chemistry	NiMH	ADC Voltage Gain	16.0000						
EDV A0 Factor	0.00 %/1kC	C 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	mV						
Specification Information	0021	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	OC 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	FE	PROM V=						
Device Name	bq2060	Temperature Offset	0.0 Deg C	Read to	be Written						
Last Measured Dsg	4000 mAh	ADC Offset	0								
Pack Capacity	4000 mAh	Efficiency Temp Comp	0.000 %/Deg 0	Write Re	ead EEPR	ом					
Cycle Count Threshold	3200 mAh	Efficiency Drop Off %	80 %	Co	ontents						
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
------------------	--------	--------	--------

💐 EEPI	🐂 EEPROM values as read from EEPROM															
0000	7F	3C	0A	00	C2	01	00	00	00	00	38	31	80	00	00	00
0010	00	00	94	2A	21	00	64	2E	01	00	B8	OB	00	00	64	00
0020	02	42	71	FF	00	00	00	D4	FE							
0030	06	62	71	32	30	36	30	FF	94	11	94	11	FO	F1	00	A6
0040	04	4C	49	4F	4E	77	A0	OF	0C	ЗE	56	9C	A1	FF	16	40
0050	07	0C	2D	05	12	64	00	00	00	00	00	00	00	00	00	38
0060	A0	00	00	00	00	00	20	4E	61	51	55	35	5E	D4	96	D3
0070	2E	D2	28	23	3C	28	7B	11	CC	29	E6	14	FA	00	5A	A5
00/0 2E D2 28 23 3L 28 7B TT UL 29 E6 14 FA 00 5A A5																

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 EERPOM, 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

💐, EEP	ROM	valu	es t	o be	written	to E	EPR	OM									
0000	7F	3C	0A	00	C2	01	00	00		00	00	38	31	80	00	00	00
0010	00	00	94	2A	21	00	64	2E		01	00	B8	OB	00	00	64	00
0020	02	42	71	FF	FF	FF	FF	FF		FF	FF	FF	00	00	00	D4	FE
0030	06	62	71	32	30	36	30	FF		94	11	94	11	FC	F1	00	A6
0040	04	4C	49	4F	4E	77	A0	0F		0C	ЗE	56	9C	A1	FF	16	40
0050	07	0C	2D	05	12	64	00	00		00	00	00	00	00	00	00	38
0060	A0	00	00	00	00	00	20	4E		61	51	55	35	5E	D4	96	D3
0070	2E	D2	28	23	3C	28	7B	11		CC	29	E6	14	FA	00	5A	A5
	Close																

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 Informati	on Lithium Ion						×
<u>File</u> Communications Op	tions Help						
🤹 Texas Instrum	IENTS	THE WORLD LE	ADER IN D	SP AND A	NALO	G	Polling
bq2060 Data Exten	ded EEprom	Calibration Pro					
Remaining Time Alarm	10 Min	Pack Configuration	A6 Hex	Cell 3 Calibration I	Factor	0	
Remaining Capacity Alarm	450 mAh	Device Chemistry	LION	Cell 4 Calibration I	Factor	0	
EDV A0 Factor	0.00 %/1kCC	MaxT DeltaT	77 Hex	ADC Voltage	e Gain 1	6.0000	
EDV TC Factor	0	Overload Current	4000 mA	ADC Sense Re	esistor	30.000	mOhm
Misc Options	00 Hex	Overvoltage Margin	192 mV	VFC Sense Re	esistor	30.001	mOhm
Safety Overtemperature	80.0 Deg C	Overcurrent Margin	992 mA	VO	C 25%	11170	mV
Charging Voltage	12600 mV	Cell Under/Over Voltage	56 Hex	VO	C 50%	11370	mV
Cycle Count	0 F	ast Charge Termination %	100 %	VO	C 75%	11730	mV
Design Voltage	10800 mV	Fully Charged Clear %	95 %		EDV0	9000	mV
Specification Information	0021	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	OC Hex				
Pre-Charge Current	100 mAh	Digital Filter	50.00 uV	Cali	bratio	n	
Manufacturer Name	Bq	Self Discharge Rate	0.21 %/day	Data		-	
Light Load Estimate	0.00 mA	Battery Low %	7.0 %		•		
Maximum Overcharge	300 mAh	Near Full	200 mAh	[FEP		lues
Device Name	bq2060	VFC Offset	A03800	Read	tobe	Written	
Last Measured Dsg	4500 mAh	Temperature Offset	0.0 Deg C				
Pack Capacity	4500 mAh	ADC Offset	0	Write	Rea	dEEPR	ом
Cycle Count Threshold	3600 mAh	Cell 2 Calibration Factor	0		Cont	ents	
RS-232 Interface Ok					8	3:01:437	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 Calibratic removed from after starting t VFC offset co	on Routine can take up to 60 Minutes. The pack may be sealed and the EV2200 by pressing the "Continue Calibration Offline" button test. Calibration will then complete automatically. Abort will disable prrection. 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 appies 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.



oltage/Temperature	Current/VFC Ga	in VFC Offset			
VOLTAGE/TEMPERATURE					
Temperature	Part 296.2	Reference Standard	к	Chemistry Cell Structure	Lion
Cell 1	3574	Enter Value	тV	Do this calibration first, as ADC Offset will	,
Cell 1 + 2	7208	Enter Value	mV	affect current calibration accuracy.	Start
				is flowing through the sense resistor.	
Battery Voltage	10653	Enter Value	mV		
CURRENT /VFC GAIN					
Current Reading	0	Enter Value	mΑ	Attach load to battery, then enter actual current at left	Start
	oltage/Temperature -VOLTAGE/TEMPEI Temperature Cell 1 Cell 1 + 2 Battery Voltage -CURRENT/VFC GA	oltage/Temperature Current/VFC Ga -VOLTAGE/TEMPERATURE Part Temperature 296.2 Cell 1 3574 Cell 1 + 2 7208 Battery Voltage 10653 CURRENT/VFC GAIN 0	oltage/Temperature Current/VFC Gain VFC Offset VOLTAGE/TEMPERATURE Part Reference Standard Temperature 296.2 Enter Value Cell 1 3574 Enter Value Cell 1 + 2 7208 Enter Value Battery Voltage 10653 Enter Value CURRENT/VFC GAIN 0 Enter Value	oltage/Temperature Current/VFC Gain VFC Offset VOLTAGE/TEMPERATURE Part Reference Standard Temperature 296.2 Enter Value K Cell 1 3574 Enter Value mV Cell 1 + 2 7208 Enter Value mV Battery Voltage 10653 Enter Value mV CURRENT/VFC GAIN 0 Enter Value mA	oltage/Temperature Current/VFC Gain VFC Offset VOLTAGE/TEMPERATURE Part Reference Standard Chemistry Temperature 296.2 Enter Value K Cell Structure Cell 1 3574 Enter Value mV Do this calibration first, as ADC Offset will affect current calibration accuracy. INSURE that no current is flowing through the sense resistor. Battery Voltage 10653 Enter Value mV Attach load to battery, then enter actual current at left Current Reading 0 Enter Value mA 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.



Sevent Seve	×
Eile Communications Options Help	
THE WORLD LEADER IN DSP AND	ANALOG Polling
bq2060 Data Extended EEprom Calibration Pro	
[SM Bus]	
REGISTER FUNCTION EDITOR	ELL
▼ 1.0 ♣ Sec	Clear
ADDRESS CONTENTS	
Dec Dec DwELL ADDRESS	
Hex Hex	
Send Break read write	
Hex 1	C. 11.11
	 Hex Decimal

5.7 Schematic

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



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



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Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный) **Факс:** 8 (812) 320-02-42 **Электронная почта:** <u>org@eplast1.ru</u> **Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.