EV2200–60

Evaluation System User Guide Software Rev 2.0.1

Contents

Introduction

The EV2200-60 evaluation board with software provides an interface environment for a bq2060 based-smart battery pack. The EV2000-60 allows the user to read or write to the bq2060 data set, program the configuration EEPROM and calibrate a bq2060-based circuit.

Kit Contents

The EV2200–60 contains the following items:

1 EV2200 Interface Board

1 Serial PC cable

1 Serial EEPROM clip

4 Software disks entitled *EV2200-60 Software*

In addition to the contents listed above, the EV2200-60 requires the following for operation with a bq2060-based smart battery:

- A PC running Windows 95, 98 or NT
- Wire leads to connect the communication lines of the bq2060-based circuit module to the EV2200

Additional test equipment is required to calibrate a bq2060-based circuit module. The calibration routines can be performed on a stand-alone circuit module (module not incorporated in a battery pack) or on an assembled battery pack (module incorporated in a battery pack). The calibration procedure is discussed in the Advanced Functions section.

Hardware and Software Setup

Software Installation

The following steps install the EV2200-60 software,

1. Insert the setup disk into a 3 ½ inch floppy drive.
2. Select the 3 ½ inch drive using **My Computer**
3. Double click the **Setup.exe** icon.
4. The setup program prompts for the remaining disks and installs a Window's application group.

Hardware Connection

The following steps configure the hardware for interface of a smart battery,

1. Connect the bq2060 based smart battery to the EV2200 using wire leads as in the following table.

Smart Battery	EV2200
SMBC	SMBC
SMBD	SMBD
PACK-	V_{SS}

2. Connect the PC serial cable to the EV2200 and the PC COM port.

The EV2200-60 is now set up for operation.

Operation

Starting the Program

Select the ev2200-60 program from the ev2200-60 program group from **Start|Programs.** The software requests the PC communications port the first time it is run after installation. Choose the **Retry Auto-detection** button for automatic port configuration. After the port is detected, the software displays the bq2060 Data screen

To view the extended functions of the bq2060 data set, select the Extended tab as shown in Figure 2. The special scan section polls the selected 5 data registers as fast as possible. To enable this feature, select the data locations to scan and click the **Start Quick Scan** button. When enabled, the program polls only these locations. To stop the special scan click on the **Stop Quick Scan** button.

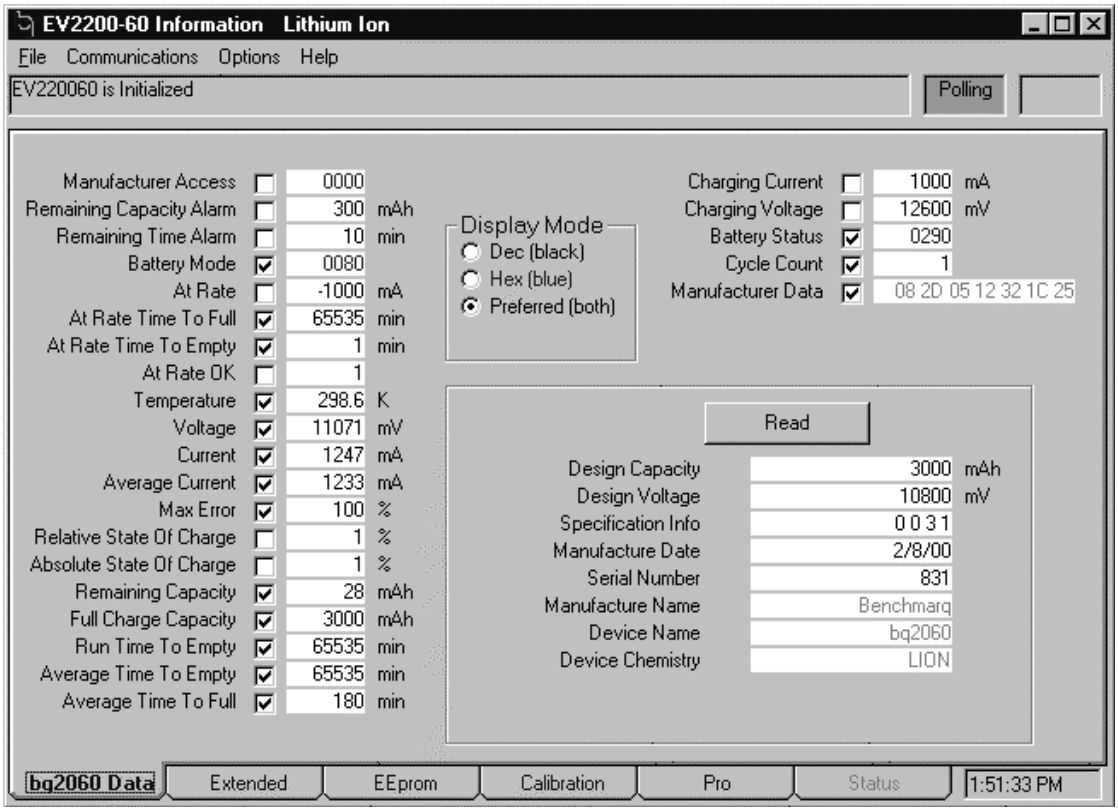

Figure 1. bq2060 Data Screen

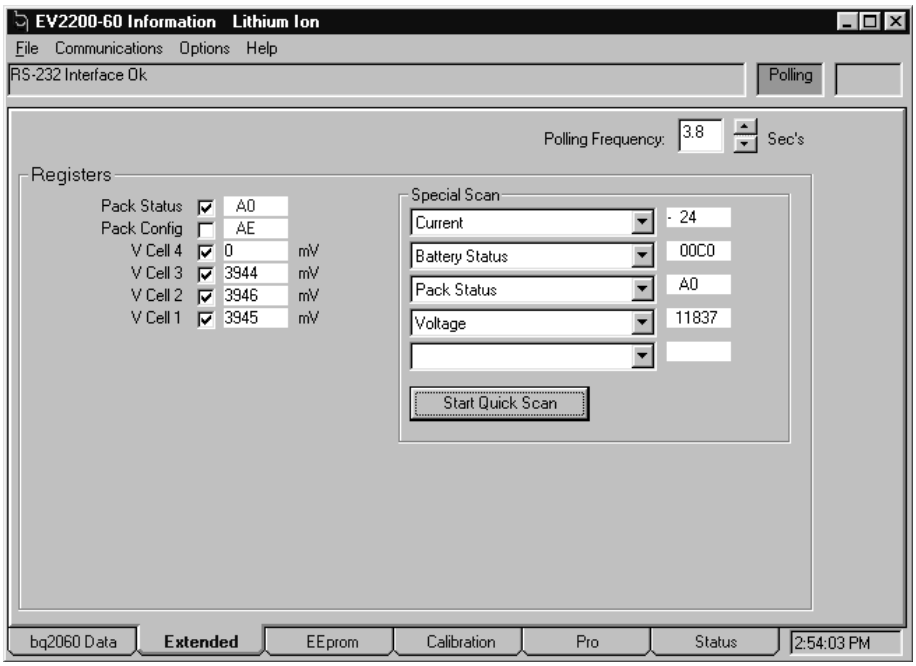

Figure 2. bq2060 Extended Data Screen

Help Information

Click on **Help About** to see what version of the software is running.

Reading the Smart Battery Data Set

The software will use the communication port detected and set the previous time the software was run. Proper communication is indicated with the **RS-232 Interface Ok** message in the upper left corner of the display screen. If communication is not established, use the pull-down menu to set the communications port and the polling rate.

To set the communications port,

- Select **Communications Settings**.
- Choose the **Force Detection on a Port** or **Retry Autodetection** button for automatic configuration.
- If **Force Detection** is chosen, select the appropriate COM port (Comm1 through Comm4) and click **OK**.
- Click **Continue with program** to return to the data screen.

To set the polling rate:

- Select **Options Poll BQ Registers** and choose **Stop, Fast** or **with Pause**. A check mark will appear next to the selection made.

The yellow box scrolls through each element of both columns. This indicates that the EV2200-60 and the smart battery are functioning properly. To read the bq2060 string data, Design Capacity and Design Voltage, click on the **Read** button.

The data screen can display information in Decimal or Hexadecimal by selecting the options in the Display Mode box. The blue data indicates the data is displayed in hexadecimal. Selecting **Preferred (both)** will present data in the most meaningful format (decimal or hexadecimal) for each data element.

Interfacing the EEPROM

The EV2200-60 can be used to read and write to the EEPROM in the bq2060 based Smart Battery circuit module. The EV2200-60 can interface the EEPROM in a circuit module connected to a battery or as a stand alone circuit module (module not connected to a battery). Since the EV2000-60 interfaces the EEPROM

over the bq2060 communications port (SMBus), there is no need to contact the EEPROM directly. To interface the EEPROM over the SMBus port, the bq2060 must be in the UNSEALED state. All evaluation modules shipped from Unitrode with an EV2200-60 kit are in the UNSEALED state.

Important Note: It is necessary to power the bq2060 when interfacing the EEPROM on stand alone circuit modules. This can be done by applying the Design Voltage (V) across the battery positive and battery negative inputs of the Smart Battery circuit module (with no battery connected).

Reading the EEPROM

To read the EEPROM in the bq2060 based Smart Battery circuit module, select the **EEprom** tab and click **Read**. Figure 3 shows an example of the EEPROM contents.

The blue data indicates the data is displayed and entered in hexadecimal.

Two additional read buttons display the EEPROM contents in binary. The **EEPROM Values to be Written** button converts the EEPROM screen contents to the appropriate binary value and illustrates the data that will be written to the EEPROM if the **Write** button is selected. The **Read EEPROM Contents** button is a direct data dump of the EEPROM.

EEprom Screen Options

The EV2200-60 software reads the CHEM bit in the Pack Configuration register when it boots and configures the screen to reflect the appropriate EEPROM contents for the battery chemistry. This can be changed be selecting **Options Set Chemistry** from the main menu and selecting a different chemistry.

EDV Calculations

The bq2060 can either dynamically calculate the EDV thresholds or use constant values stored in EEPROM. The EEPROM screen can be set to reflect either option by selecting **Options EDV Selection** from the main menu and selecting the desired mode of operation.

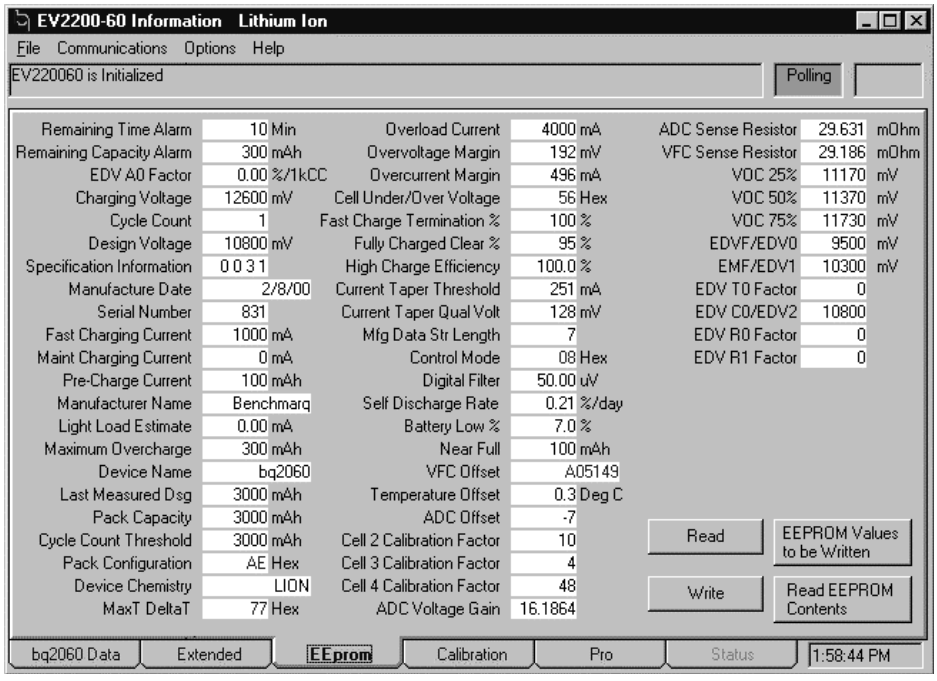

Figure 3. EEPROM Data Screen

Programming the EEPROM

The EEPROM may be programmed using the EV2200-60. The EV2200-60 uses the Smart Battery Bus (SMBus) to modify EEPROM locations.

Important Note: Please carefully review the bq2060 data sheet for details on the information required in the EEPROM configuration memory. The content of the memory affects critical aspects of bq2060 operation. The calibration elements should be set to estimated or default values initially. The calibration utility can then be used to calculate the precise values for maximum measurement accuracy. Read the description of these registers in the bq2060 data sheet for the default values and the information to estimate the initial settings. The bq2060 data sheet can be found by selecting **Help View Datasheet** from the main menu.

To write an EEPROM location,

- Place the cursor on the desired element to program and click.
- Enter the value and press **ENTER**. The EV2200-60 writes the value to the EEPROM after **ENTER** is pressed.

Once the data for each element is loaded and entered, the EEPROM configuration file may be saved to disk.

To save an EEPROM to disk,

- Select **File Store EEPROM** from the EEprom data tab main menu
- Enter the file name to be saved and click **Save**.

The file can then be loaded to program additional EEPROMs.

To load an EEPROM file,

- Select **File Load EEPROM** from the EEprom data tab main menu
- Enter the file name to be loaded and click **Open**.

Once the file is loaded, select the **Write** button to program all locations.

Important Note: The EEPROM programming will not take effect until the bq2060 is reset.

Resetting the bq2060

For the values in the EEPROM to be used by the bq2060 after programming, the bq2060 must be reset. This is done automatically when a stand alone circuit module is first connected to a battery. In the situation where the EEPROM is altered when the circuit is connected to a battery, the bq2060 can be reset in two ways:

Full Power Reset

- Disconnect and then connect the bq2060-based smart battery circuit module from the battery or power souce.

Software Reset

To reset the bq2060 using the EV2200-60 software reset:

- From the bq2060 Data screen, select **Options Initialize Device.**

The bq2060 will now load the contents of the EEPROM into its internal registers for operation.

Important Note: The software reset command works only if the bq2060 is in the UNSEALED mode.

SEALED/UNSEALED Mode

When the bq2060 is in SEAL mode, the device accepts only Register Function commands as listed in the data sheet. These commands and their read or write accessibility conform to the Smart Battery Data (SBD) set.

The bq2060 must be in the UNSEALED state to:

- Read/write the EEPROM using the SMBus
- Perform a software reset
- Perform a VFC calibration

SEALING the bq2060

The bq2060 can be SEALED in two ways,

- Selecting **Options Seal BQ2060** from the main menu
- Resetting (Full Power Reset or Software Reset) the bq2060 with bit 6 (SEAL) of *Pack Configuration* in the EEPROM set to 1.

The **Options Seal BQ2060** command sets the SEAL bit in EEPROM and the Pack Configuration register to 1 AND then issues the SEAL command of 0x062b to ManufacturersAccess().

UNSEALING the bq2060

Once SEALED, the bq2060 can be unsealed by resetting (Full Power Reset) the bq2060 with the SEAL bit in the EEPROM set to 0. To perform this on a SEALED pack:

- Connect the EEPROM programming clip to the EV2200 as shown:

Clip Wire Color	Terminal Block Outlet
Black	V_{SS}
Red	E2 V_{CC}
White	SCL
Brown	SDA

- Select **Options Unlock Device**
- Clip the EEPROM programming clip on the EEPROM as shown

Clip Wire Color	EEPROM Pin
Black	4-GND
Red	8-V_{CC}
White	6-SCL
Brown	5-SDA

- Click **OK** in the Unlock Device box
- Disconnect the clip from the EEPROM
- Remove power from the bq2060 circuit
- Reconnect power to the bq2060 circuit
- Click **OK** in the Unlock Device box

The SEAL bit in the EEPROM should now be 0 and the bq2060 should be in the UNSEALED mode.

Advanced Functions

Pro Screen

The Pro screen allows the EV2200-60 to interface and dwell on each bq2060 memory location.

To read a location:

- Click on the Hex or Dec box in the Address area
- Enter the address of the location in either hexadecimal or decimal depending on the box selected
- Click on the **read** button.

For a continuous read of a location, the Dwell feature can be used. To use the Dwell command:

- Use the pull-down tab or enter the memory location in the Hex or Dec box in the Dwell Address area
- Set the dwell frequency to the desired rate in the Dwell Frequency area
- Click on the **Dwell** button in the Dwell area

At this point data from the selected address will scroll in the Dwell area. During a dwell, the software disables polling of data for the bq2060 data screen so no updates will occur.

Use the **Clear** and **Stop** buttons to clear the Dwell box or stop the dwell procedure.

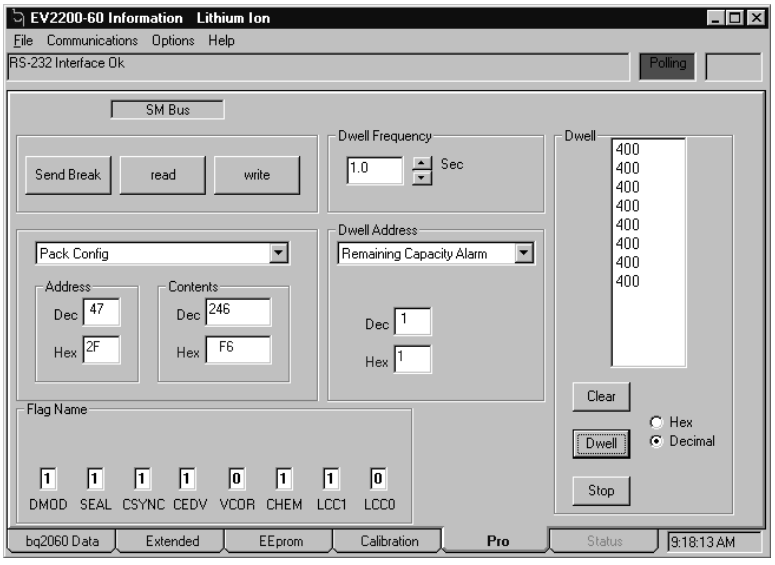

Figure 4. Pro Screen

To write a location:

- Click on the **Hex** or **Dec** box in the Address area
- Enter the address of the location in either hexadecimal or decimal depending on the box selected
- Tab over to the Contents area. The EV2200-60 will automatically display the name of the memory location that is being accessed in the box above the Address and Contents area. It will also display the current contents of the memory location in the **Contents** boxes.
- Enter the new value to be written
- Click on the **write** button

Calibration

Each bq2060-based smart battery circuit module must be calibrated for voltage, temperature, ADC offset, VFC gain, and current for maximum accuracy. The Calibraion screens allow calibration on a circuit module not connected to a battery or on a circuit module installed in an assembled battery pack. The calibration procedure requires additional equipment, including:

- A variable DC power supply with a precision voltage meter
- An electronic load or calibrated fix load (2-3A)
- A thermometer to measure ambient temperature

To calibrate the bq2060 based circuit, the bq2060 must in the UNSEALED mode and the EEPROM must be properly programmed with default values in the calibration locations. After EEPROM programming and calibration is complete, the bq2060 can be put in the SEALED mode with either SEAL method.

Important Note: The recommended calibration sequence is Voltage/Temperature/ADC Offset, VFC Gain/Current Calibration, and then VFC Offset. VFC Offset calibration should be performed last. This is because the procedure may take up to 60 minutes. However, once the procedure is started, an assembled battery pack can be unplugged from the EV2200 and the procedure will complete automatically.

Voltage/Temperature/ADC Offset Calibration

Prior to calibrating these measurements:

- Ensure the bq2060-based circuit is properly connected to the cells or a power supply. When calibrated a module not connected to a battery, a power supply must be used for the battery cell stack voltage input. The power supply should be set to the Design Voltage and applied across the battery stack

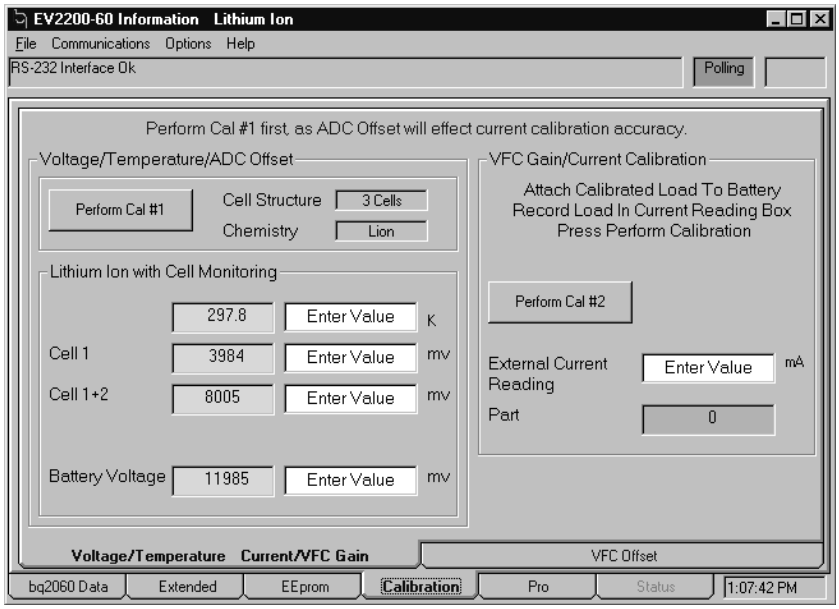

Figure 5. Calibration Screen

input. The battery stack input is the VCELL4 input in the case of Nickel battery chemistries or with Li-Ion where no individual cell monitoring is desired. In these cases, LCC0-LCC1 in *Pack Configuration* is set to 00.

For Li-Ion cells with individual cell monitoring the power supply must supply all intermediate cell voltages in addition to the overall battery stack potential. In these cases, LCC0-LCC1 is set to non 00 and the overall battery stack voltage input is VCELL1, VCELL2, VCELL3, or VCELL4 depending on the number of series cells. If using a power supply, the intermediate cell voltages can be generated with a voltage divider network off of the overall battery stack potential input.

See the LCC0 and LCC1 description in EEPROM programming section of the bq2060 data sheet for additional information on battery cell stack connection.

- Select the **Calibration** tab
- Select the **Voltage/Temperature Current/VFC Gain** tab

The first calibration screen will be displayed as shown in Figure 5.

The Chemistry and Cell Structure boxes should reflect the battery chemistry and pack configuration as defined by the CHEM and LCC0-LCC1 bits in *Pack Configuration*.

To calibrate:

- If using a power supply, set the power supply to the Design Voltage
- Enter the ambient temperature from the thermostat reading in the white **Temperature** box.

Important Note: The temperature must be entered in degrees Kelvin.

For individual cell monitoring:

- Use the voltage meter to read the Cell 1 (most negative cell) voltage
- Enter the voltage in mV in the white **Cell 1** box
- Repeat the node measurements for each series connection of the pack
- Click **Perform Cal # 1**
- Click **OK** on the **Voltage Calibration Complete** box

For no individual cell monitoring:

- Use the voltage meter to read the pack voltage
- Enter the voltage in mV in the white **Battery Voltage** box
- Click on **Perform Cal # 1**
- Click **OK** on the **Voltage Calibration Complete** box

Once the calibration routine is completed, the calibration values are written to the bq2060 and the EEPROM (*Temperature Offset, ADC Offset, Cell 2–4 Calibration Factor, and ADC Voltage Gain*). The bq2060 will immediately use the calibration values upon completion. The new readings will be displayed in the blue box within two seconds of completion.

To see the new calibration values read the EEPROM values using the **EEprom** screen.

VFC Gain/Current Calibration

Prior to calibrating:

- Connect the power supply or battery stack and electronic load as shown in Figure 6.

To calibrate:

- If using a power supply, set the power supply to the Design Voltage.
- Enter the discharge current that the calibration will be performed at in the white **External Current Reading** box.
- Apply the discharge current at the designated calibration load.
- Click on **Perform Cal # 2** button.

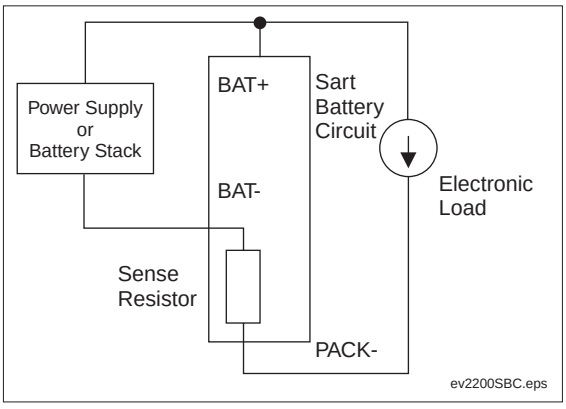

Figure 6. Current and VFC Calibration Set-up

- Click **OK** on the **VFC Sense Resistor Calibration Complete** box.

Once the calibration routine is completed, the calibration values are written to the bq2060 and the EEPROM (*ADC Sense Resistor and VFC Sense Resistor*). The bq2060 will immediately use the calibration value upon completion.

To see the new calibration values read the EEPROM values using the **EEprom** screen.

VFC Offset Calibration

Before calibrating VFC Offset,

- Ensure the bq2060-based circuit is properly connected to the cells or a power supply.
- Select the **Calibration** tab
- Select the **VFC Offset** tab

The **VFC Offset Calibration** screen will be displayed.

To calibrate VFC offset,

- If using a power supply, set the power supply to the Design Voltage.
- Click on the **Perform Calibration** Button.
- Click **OK** in the **VFC Offset Calibration Complete** box

To abort the calibration, select the **Abort** button.

To disconnect the bq2060-based circuit module or smart battery and continue the calibration, select the **Continue Calibration Offline** button. After selecting the button, click **Yes** or **No** to confirm whether the pack or module should be SEALED after VFC offset calibration completes.

Note: The bq2060-based circuit module must have power throughout the entire calibration procedure.

Once the calibration routine is completed, the calibration value is written to the bq2060 and the EEPROM (*VFC Offset*). The bq2060 will immediately use the VFC calibration value upon completion.

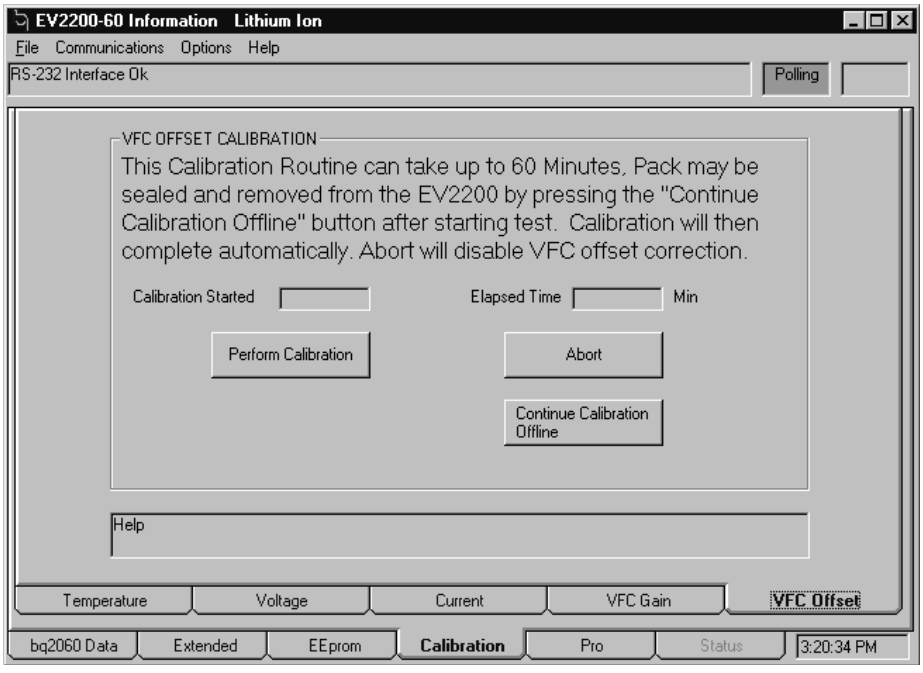

Figure 7. VFC Offset Calibration Screen

Data Logging

The EV220-60 can log the bq2060 memory locations to a file. To log data:

- Check the boxes in the **bq2060 Data** and **Extended** screens to select the information to log.
- Restart the program if the information to log was changed in the previous step.
- Select File **Start Data Log** from the main menu
- Enter the log file name (*.log) in the **Name Datalog File** pop-up box
- Set the log interval in the **Set Data Log Interval** pop-up box. The log interval sets the rate at which the log file updates.

To stop logging data:

- Select **File Close Data Log** from the main menu.

The *.log file can be opened in a notepad or word processing application for formatting and printing.

Help

Select **Help About** from the main menu to see what version of the software is running.

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