# EV2200–45

# Evaluation System User Guide

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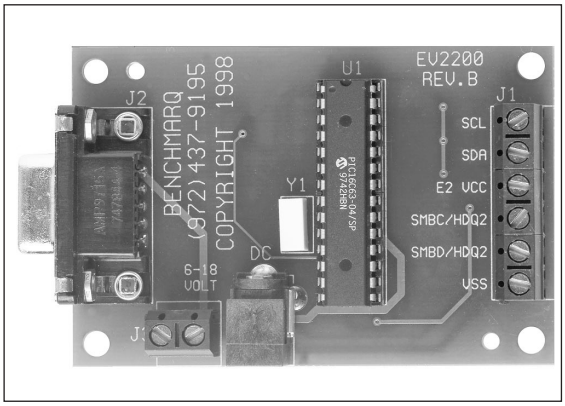
## Introduction

The EV2200–45 evaluation board with software provides an interface enviroment for a bq2945-based smart battery. The EV2200 allows the user to read or write to the bq2945 data set, program the configuration EEPROM, and interface a smart battery selector, a smart battery charger, or the host controller in the smart battery system.




## Kit Contents

The EV2200–45 contains the following items:

1 EV2200 Interface Board

1 Serial PC cable

1 Serial EEPROM clip

2 Software disks entitled *EV2200-45 Software*

**Important Note: There are two versions of the interface software: rev1.0 and rev1.4. This user's guide reflects the rev1.4 interface; however, the other is similar. Rev1.4 adds support for current and temperature measurement calibraton over the SMBus. This is useful to calibrate current and temperature measurements in sealed packs.**

In addition to the contents listed above, the EV2200 requires the following for operation with a bq2945-based smart battery:

- A PC running Windows 3.x or 95 compatible PC
- A smart-battery connector with wire leads

Additional test equipment is required to calibrate a bq2945-based circuit module. The calibration routines can be performed on a stand-alone circuit module (module not incorporated in a battery pack) or on a sealed battery pack (module incorporated in a battery pack). The calibration procedure is discussed in the Advanced Function section.

# Hardware and Software Setup

## Software Installation

The following steps install the EV2200 software,

1. Insert the setup disk into a 3 ½ inch floppy drive.
2. Select the 3 ½ inch drive using **My Computer** or **File Manager**.
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 wire leads of the smart battery connector to the VSS, SMBC, and SMBD outlets of the terminal block on the EV2200.
2. Connect the wire leads of the blue EEPROM clip to the VSS, E2 VCC, SCL and SDA outlets of the terminal block on the EV2200 according to the color code:

| Wire Color | Terminal Block Outlet |
|---|---|
| Black | VSS |
| Red | E2 VCC |
| White | SCL |
| Brown | SDA |

3. Connect the PC serial cable to the EV2200 and the PC COM port.
4. Insert the smart battery connector into the smart battery.

The EV2200 is now set up for operation.

# Operation

## Starting the Program

To start the program,

1. Click the bq2945 pro icon in the applications group to start the interface program. The software requests the PC communications port the first time it is run after installation.
2. Choose the **Retry Auto detection** button for automatic port configuration. After the port is detected, the software displays the bq2945 data screen:

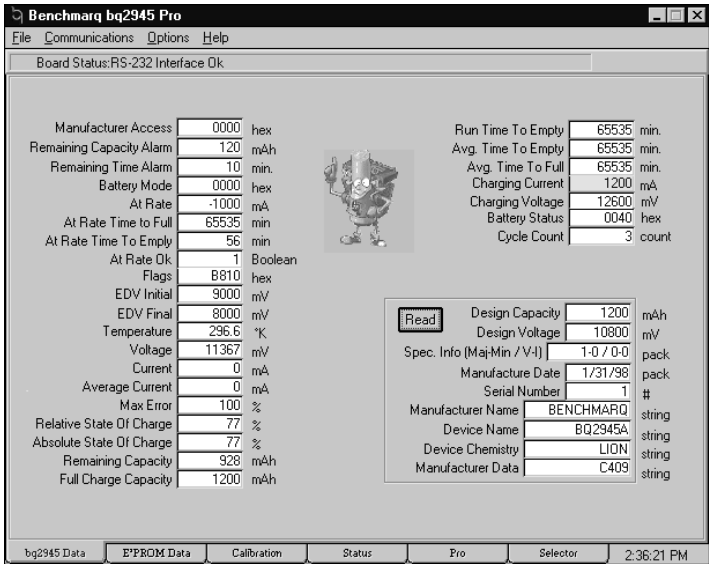



**Figure 1. bq2945 Data Screen**

## Version Information

Click **Options Version Info** or **About** to see what version of the software is running.

## Reading the Smart Battery Data Set

The software uses the communication port detected or set the previous time the software ran. Proper communication is indicated with the **Board Status: 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 bq2945** registers.
- Choose **Fast** or **With Pause**. A check mark appears next to the selection made.

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

## Interfacing the EEPROM

The EV2200 can be used to read and write to the EEPROM in a bq2945 based smart battery circuit. The EV2200 interfaces the EEPROM in a circuit module connected to a battery or as a stand-alone circuit module (module not connected to a battery).

**Important Note: Depending on the type of EEPROM used in the circuit, it may be necesary to power the bq2945 when interfacing the EEPROM on a stand-alone circuit module. To power the bq2945, apply the Design Voltage (V) across the battery positive and battery negative contacts of the smart battery circuit module (with no battery connected).**

## Reading the EEPROM

To read the EEPROM in a bq2945 based smart battery circuit, the serial EEPROM clip must be connected to the EV2200 as described in the Hardware Connection section and attached to the EEPROM according to the following color coding:

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

Once the clip is securely attached to the EEPROM, click the **Read** button in the EEPROM box. The yellow box scrolls through each element on the screen and displays the contents of each location. Figure 2 shows an example of the EEPROM contents.

## Programming the EEPROM

The EEPROM may be programmed using the EV2200. There are two methods available to do this. One method programs the EEPROM directly over the serial EEPROM clip; the other uses the smart battery bus (SMBus) to modify EEPROM locations.

**Important Note: Please carefully review the bq2945 data sheet for details on the information required in the EEPROM configuration memory. The content of the memory affects critical aspects of bq2945 operation. The elements marked with an asterisk are calibration locations that vary from circuit to circuit. They should set to an estimated or a default value 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 bq2945 data sheet for the default values and the information to estimate the initial settings.**

To select the write method,

- Select **Options EEPROM Write Mode** and choose **Direct I2C** or **Through SMBus**. A check mark appears next to the selection made.

## Programming with Direct I2C

To write an EEPROM location,

- Connect the serial EEPROM clip to the EEPROM.
- Make sure **Direct I2C** is selected as the EEPROM write mode.

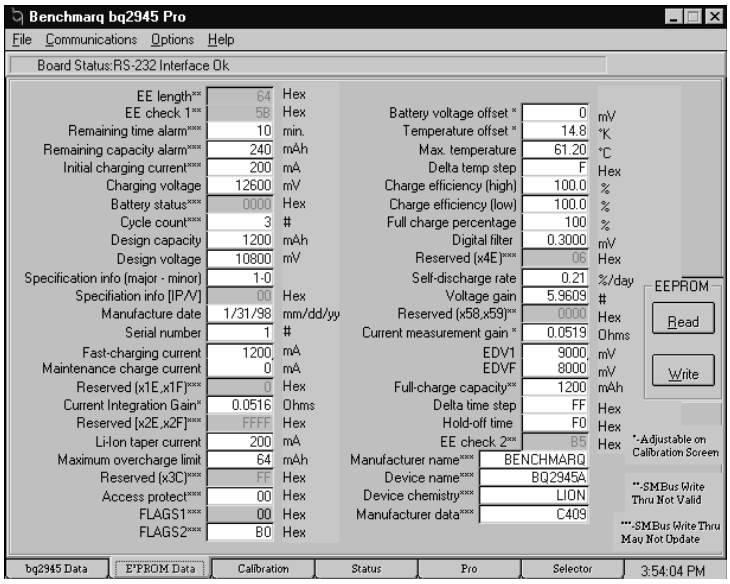



**Figure 2. EEPROM Data Screen**

- Place the cursor on the desired element to program and click.
- Enter the value and press ENTER.

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 Save EEPROM Configuration**.
- Enter the file name to be saved and click **Ok**.

The file can then be loaded to program additional EEPROMs.

To load an EEPROM file,

- Select **File Retrieve EEPROM Configuration**.
- Enter the file name to be loaded and click **OK**

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

The gray elements can only be programmed one way. During a write operation, the gray elements will be programmed with factory recommended values. Be sure to individually select and press ENTER for each gray box or use the **Write** button in the EEPROM box to properly program the gray elements.

Once the EEPROM is programmed, select the **Read** button in the EEPROM box to verify the data.

**Important Note: With the Direct I2C mode, the EEPROM programming will not take effect until the bq2945 is reset.**

## Programming with Through SMBus

Most EEPROM locations can also be written with commands over the SMBus. This is particularly useful when it is required to change the contents in an EEPROM contained in a sealed smart battery that leaves no direct access to the configuration memory. The bq2945 must be in the unprotected mode for programming with **Through SMBus** to function. New EEPROM values take effect immediately in the bq2945 when the EEPROM is programmed with the **Through SMBus** mode.

To write an EEPROM location:

- Make sure **Through SMBu**s is selected as the EEPROM write mode
- Place the cursor on the desired element to program and click.
- Enter the value and press ENTER.

Each element must be selected individually, loaded, and ENTER pressed to write the contents of the EEPROM when using the **Through SMBus** mode.

**Important Note: The Through SMBus method only works if the bq2945 in the smart battery circuit module is in the unprotected mode. The elements marked with ** or *** cannot or may not program correctly using the Through SMBus method. The Direct I2C method should be used to program these locations. With the Direct I2C method, the EEPROM programming will not take effect until the bq2945 is reset.**

## Resetting the bq2945

For the values in the EEPROM to be used by the bq2945 after **Direct I2C** programming, the bq2945 must be reset. Resetting is automatic 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 bq2945 can be reset in two ways:

- Disconnecting and then connecting the smart battery circuit from the battery
- Issuing a software reset command with the EV2200

To reset the bq2945 using the EV2200 software reset,

- From the bq2945 Data screen select **Options Initialize bq2945**

The bq2945 will now load the contents of the EEPROM into its internal registers for operation.

**Important Note: Removal of power from the curcuit module may be used to force a reset of an access-protected pack.**

## Access Protect

The bq2945 enters the access protect mode when it is reset and the Access protect register in the EEPROM is set to 00h. In the access protect mode, only access to the SBD data set is allowed. The bq2945 is in the unprotected mode if it is reset and the Access protect register in the EEPROM is set to 08h. The **Through SMBus** EEPROM programming and software reset works only if the bq2945 is in the unprotected mode.

## Status Screen

The status screen gives a summary of the smart battery's condition, including state-of-charge, current, voltage, alarm, status, and error settings.

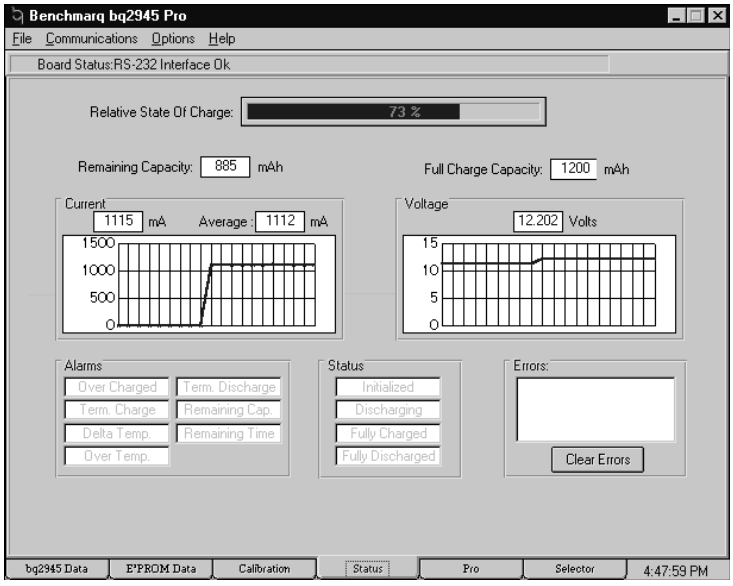



**Figure 3. Status Screen**

# Advance Functions

## Adding a Smart Charger and Selector

The EV2200 also interfaces a smart charger and selector as defined in a smart battery system. The DV2043S7 smart charger and selector development board from Benchmarq can be used in conjunction with the EV2200 to implement the additional functionality.

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

1. Connect GND, SCL, and SDA of the DV2043S7 terminal block (TB1) to corresponding connections on the EV2200 terminal block.
2. Connect the charging supply (18V, 3A) across the TB1, GND and VI terminals.
3. Connect an optional load (2A max) across the TB1, GND and VO terminals for discharge evaluation.
4. Insert the smart battery into J1 or J2 of the DV2043S7.

The EV2200 can now interface the smart battery, smart charger, and selector using the Pro screen.

## Pro Screen

The Pro screen allows the EV2200 to interface any subsystem in the smart battery system using the SMBus.

To select a subsystem and send a command:

- Click the SMBus Address bar arrow.
- Highlight the subsystem to address.
- Enter the command code.
- If writing a location, enter the LD and MS byte in the Write SMBus Word box and click **Send**.
- If reading a location, select the data format either Hex or Decimal in the **Read SMBus Word** box and click **Read**.
- For a continuous read of the location, click **Dwell** in the **SMBus Word Dwell** box.

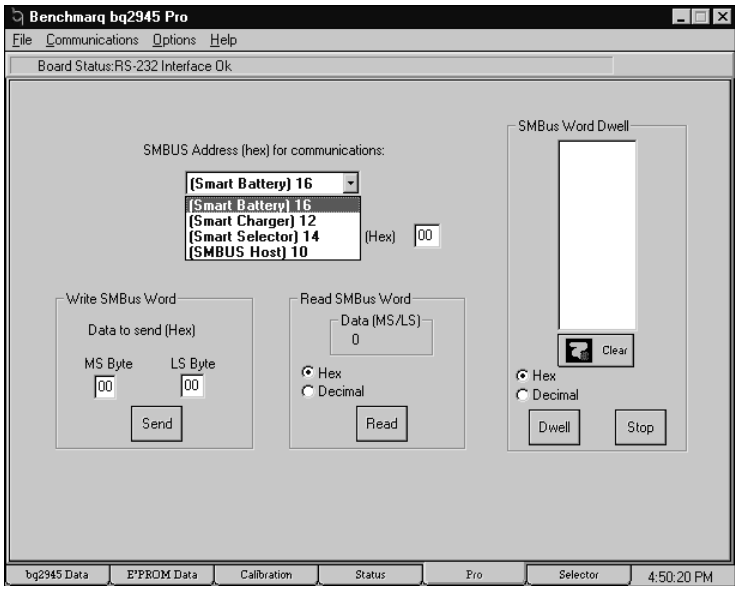



**Figure 4. Pro Screen**

## Selector Screen

The Selector screen illustrates the status of the selector and allows the EV2200 to interface it directly with the **Read** and **Write** buttons.

## Calibration

Each bq2945 based smart battery circuit module must be calibrated for voltage, current, and temperature measurements for maximum accuracy. The Calibration screen allows a circuit module to be calibrated when not connected to a battery or installed in a sealed battery pack. Only temperature and current can be calibrated on a module connected to a battery. The calibration procedure requires additional equipment, including the following:

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

To calibrate the bq2945 based circuit, the bq2945 must not be in the access protect mode. After EEPROM programming and calibration is complete, the bq2945 can be put in access protect mode by writing the EEPROM access protect register to 00h and resetting the part.

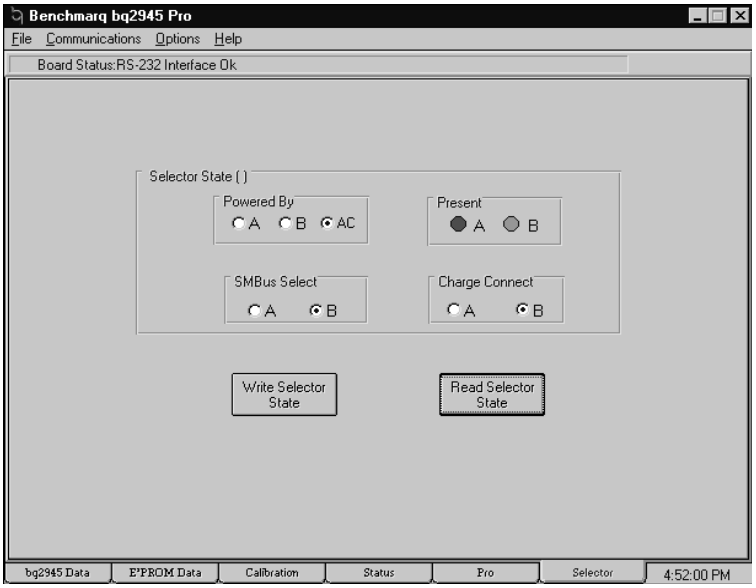



**Figure 5. Selector Screen**

## Voltage Calibration

Before calibrating voltage,

- Connect the power supply between BAT+ (positive connection for the battery stack) and BAT- (negative connection for the battery stack).
- Select the EEPROM write mode under **Options**. If **Direct I2C** is selected, connect the serial EEPROM clip to the EEPROM.

Once the Calibration screen is selected, the Voltage calibration screen is displayed.

To calibrate voltage,

- Click the **Begin Calibration** button.
- Set the power supply voltage to the requested voltage displayed in the blue box.
- Click **OK**.

The program requests two more power supply settings. After each request enter the value and click **OK**.

**Important Note: After setting the power supply to the requested value, wait 15–20 seconds before clicking OK. This allows the voltage reported by the bq2945 to update properly.**

Once the calibration routine is completed, the calibration values appear in the **Calculated EEPROM Data** box. Click the **Save to EEPROM** button to save the calculated values to the EEPROM. If the calculated values are written with the **Direct I2C** method, the values will not take effect until the bq2945 is reset.

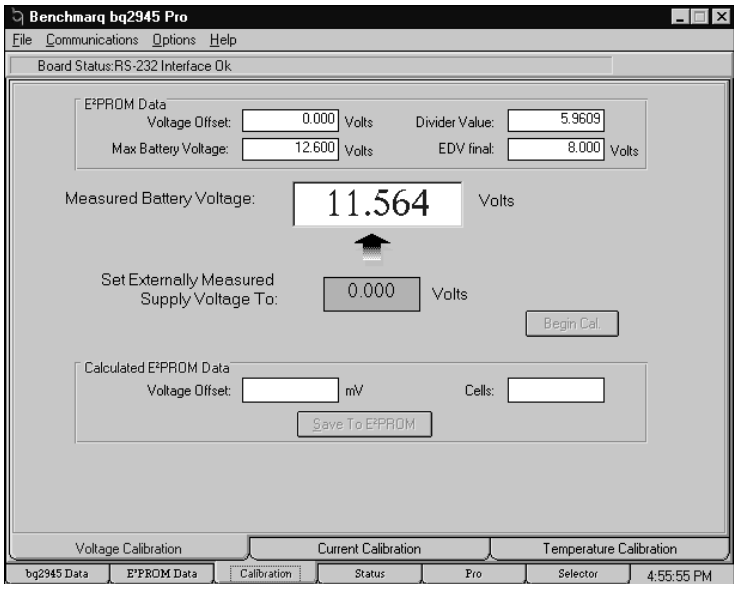



**Figure 6. Voltage Calibration Screen**

## Current Calibration

Prior to calibrating voltage:

- Connect the power supply or battery stack and electronic load as shown in Figure 7.
- Select the EEPROM write mode under **Options**.

**Important Note: Do not connect the serial EEPROM clip to the EEPROM during the current calibration procedure. If Direct I2C is chosen as the EEPROM write mode, wait until the procedure calculates the new EEPROM values before attaching the clip to the EEPROM.**

Once the Calibration screen is selected, the Current Calibration screen is displayed.

To calibrate current:

- If using a power supply, set the power supply to the Design Voltage.
- click the **Begin Calibration** button.
- Enter the typical discharge current of the application in the **Enter Calibration Parameter** box and click **OK**.
- Set the electronic load to the requested discharge current displayed in the blue box.
- Wait 15–20 seconds.

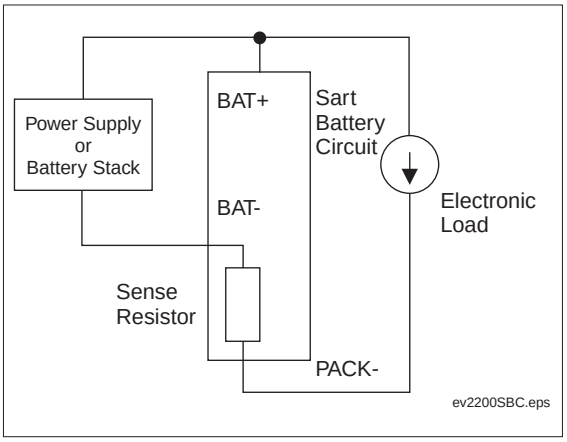



**Figure 7. Current Calibration Set-up**

- Click **OK**.

Once the calibration routine is completed, the calibration value appears in the Calculated EEPROM Data box. Click the **Save to EEPROM** button to save the calculated values to the EEPROM. If the calculated values are written with the **Direct I2C** method, the values will not take effect until the bq2945 is reset.

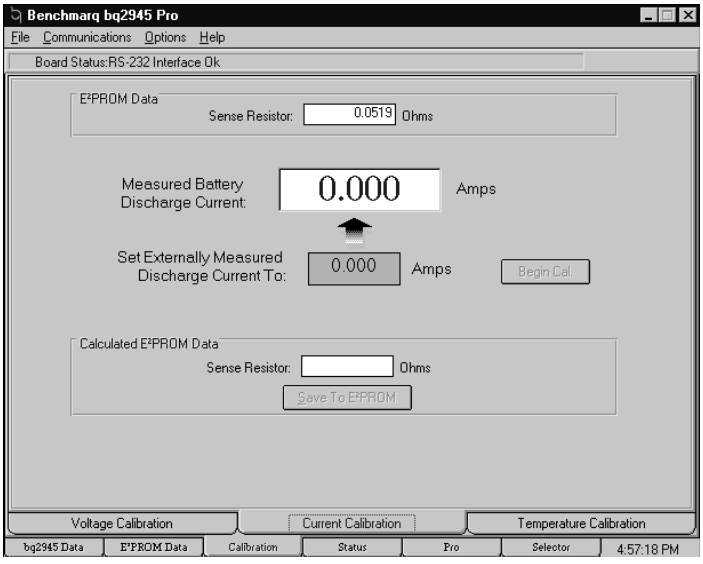



**Figure 8. Current Calibration Screen**

## Temperature Calibration

Before calibrating voltage,

- Connect the power supply or battery stack between BAT+ (positive connection for the battery stack) and BAT- (negative connection for the battery stack).
- Select the EEPROM write mode under **Options**. If **Direct I2C** is selected, connect the serial EEPROM clip to the EEPROM.
- Once the Calibration screen is selected, the Temperature Calibration screen displays.

To calibrate temperature,

- Set the power supply to the Design Voltage.
- Click the **Begin Calibration** button.
- Enter the ambient temperature from the thermostat reading in the **Enter Calibration Externally Measured Temperature** box and click **Ok**.

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

Once the calibration routine is completed, the calibration value appears in the **Calculated EEPROM Data** box. Click the **Save to EEPROM** button to save the calculated values to the EEPROM. If the calculated values are written with the **Direct I2C** method, the values will not take effect until the bq2945 is reset.

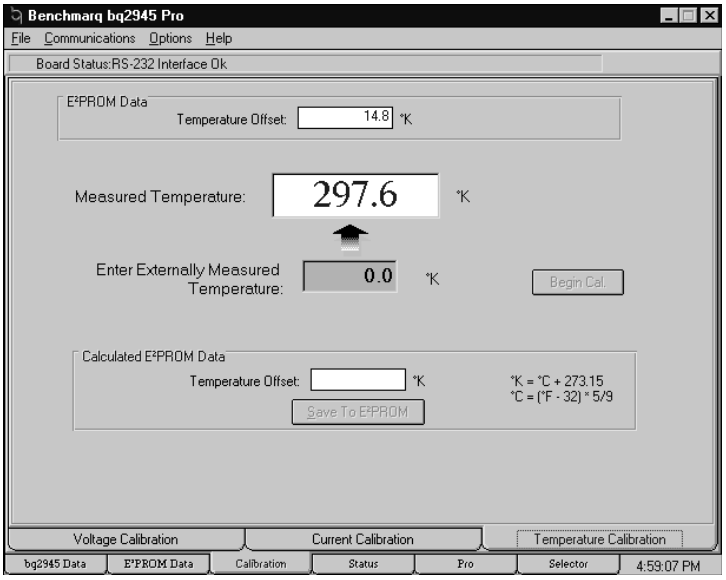



**Figure 9. Temperature Calibration Screen**

## Notes

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