

# **bq26231EVM-001**

## **Single Cell Battery Monitor Evaluation Module**

# *User's Guide*

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## **EVM WARNINGS AND RESTRICTIONS**

It is important to operate this EVM within the input voltage range of 2.8–5.5 V and the output voltage range of 2.8–5.5 V.

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 70°C. The EVM is designed to operate properly with certain components above 70°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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# Introduction

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The bq26231EVM-001 is a complete evaluation system for the battery monitoring IC bq26231. The EVM includes one bq26231 circuit module, an EV2200 PC interface board for gas-gauge evaluation, a PC serial cable, and Windows-based PC software. The circuit module includes one bq26231 and all other components onboard necessary to monitor capacity and other critical parameters in a one-cell Li-Ion battery pack. The circuit module connects directly across the cell in a battery. With the EV2200 interface board and EV2200-231 software, the user can read the bq26231 data registers and evaluate the functions of the bq26231 under different charge and discharge conditions.

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## 1.1 Features

- Complete evaluation system for the bq26231 battery monitor IC
- Populated circuit module for quick setup
- PC software and interface board for easy evaluation
- Software that allows data logging for system analysis

## 1.2 Kit Contents

- bq26231 circuit module with sense resistor
- EV2200 PC interface board
- Set of evaluation software disks entitled EV220–231
- PC serial cable
- Set of support documentation

## 1.3 Ordering Information

Table 1–1. Ordering Information

<b>EVM Part Number</b>	<b>Additional ICs</b>	<b>Chemistry</b>	<b>Pack Voltage</b>	<b>Capacity</b>
bq26231EVM–001	None	Li-Ion/NiMH/NiCd	2.8–5.5 V	Any



# Circuit Module

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The bq26231EVM-001 based circuit module is a complete and compact example of a circuit for battery monitoring of a single-cell Li-Ion pack. The circuit module incorporates a bq26231 battery monitor IC and all other components necessary to accurately protect and monitor the charge and discharge of single Li-Ion cell. This EVM can also be used for 3-series NiMH applications.

Contacts on the circuit module provide direct connection to the cell, serial communications port, system load, and charger.

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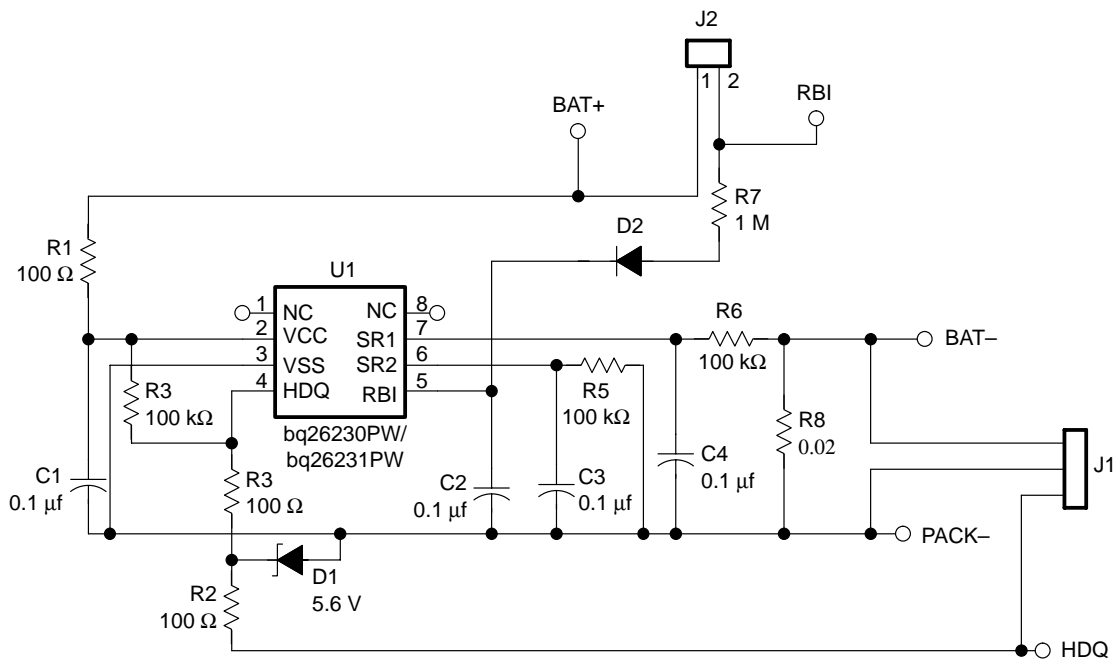
## 2.1 Pin Descriptions

BAT+	Cell positive/pack positive (PACK+)
BAT_	Cell negative
PACK-	Pack negative
HDQ	Serial communications port
RBI	Register backup input

## 2.2 Schematic

Figure 2–1 is the bq26231EVM-001 (SLUP148) circuit module schematic diagram.

Figure 2–1. bq26231EVM-001 Schematic



## 2.3 Board Layout

Figure 2-2 shows the PCB layers and assembly drawing for the bq26231EVM-001 circuit module (SLUP148).

Figure 2-2. bq26231EVM-001 Circuit Module Layout

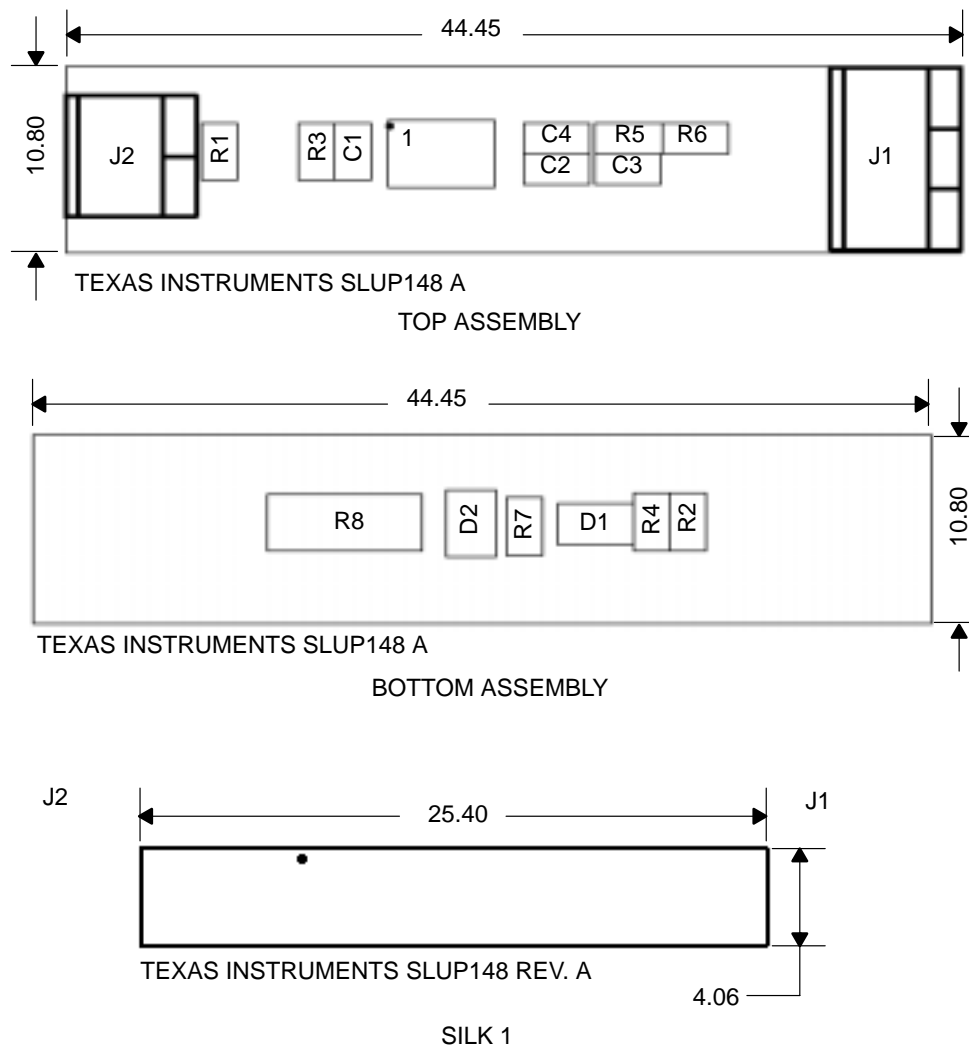
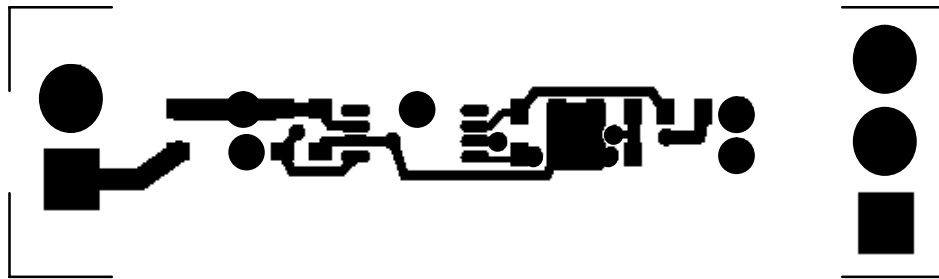
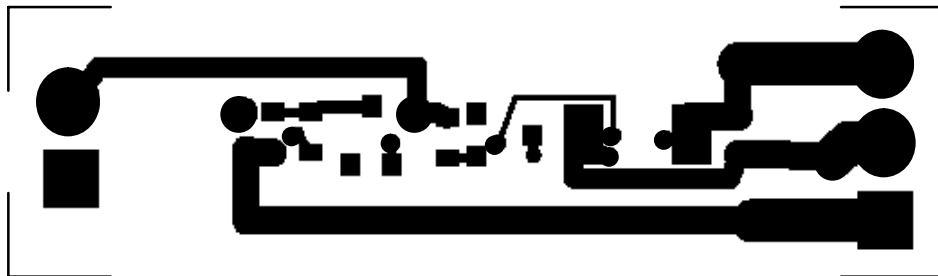


Figure 2–2. bq26231EVM-001 Circuit Module Layout (Continued)



TEXAS INSTRUMENTS SLUP148 REV. A

LAYER 1



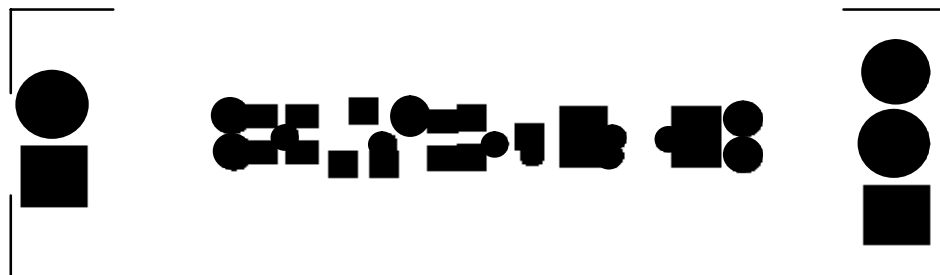
TEXAS INSTRUMENTS SLUP148 REV. A

LAYER 2



TEXAS INSTRUMENTS SLUP148 REV. A

MASK 1



TEXAS INSTRUMENTS SLUP148 REV. A

MASK 2

## 2.4 Bill of Materials

Table 2–1 lists materials required for the bq26231EVM-001 circuit module.

Table 2–1. Bill of Materials

Ref Des	Qty-002	Description	MFG	MFG Part No.	Size
PCB	1	Printed circuit board, 0.031, FR4, SMOBC, HASI	Any		See FAB DWG
Terminal	2	Terminal block 3,5 mm	On Shore	ED555/2DS	3,5 mm × 2
C1, C2, C3, C4	4	Capacitor, ceramic, 0.1 μF, 16 V, ±10%, X7R	Panasonic	ECJ-1VB1C1104K	603
R1	1	Resistor, 1 MΩ, 1/16 W, 5%	Panasonic	ERJ-3GSYJ105	603
R8	1	Resistor, 0.020 Ω, 1/2 W, 1%	IRC	LR2010-01-R020-F	2010
R3, R5, R6	3	Resistor, 100 kΩ, 1/16 W, 5%	Panasonic	ERJ-3GSYJ104	603
R1, R2, R4	3	Resistor, 100 Ω, 1/16 W, 5%	Venkel	ERJ-3GSYJ101	603
D1	1	Diode, zener, 5.6 V	Zetex	BZX84C5V6	SOT-23
D2	1	Diode, 1N914	Diode Inc.	MMBD914	SOT-23
U1	1	Integrated circuit, gas gauge, bq26231PW	Benchmark/TI	bq26231PW	TSSOP-8
Component count	18				

### Assembly Notes:

- 1) This assembly is ESD sensitive.
- 2) This assembly must comply with IPC-A-610 class 2 or better.
- 3) This assembly must be clean of flux residues and contaminants.
- 4) Use of no clean flux is not acceptable.

## 2.5 Performance Specifications

Table 2–2 summarizes the performance specifications of the bq26231EVM-001 circuit module (SLUP148). Table 2–2 gives the performance specifications of the circuit.

Table 2–2. Performance Specification Summary

Specification	MIN	TYP	MAX	UNIT
Input voltage BAT+/BAT–	2.8		5.5	V
Charge and discharge current			4	A

**Note:** Charge and discharge current: maximums are limited by the PCB design and power dissipation of the 20-mΩ, 0.5-W sense resistor on the PCB.



# **EVM Hardware and Software Setup**

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This section describes how to install the EV2200-231 PC software and how to connect the components of the EVM.

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### 3.1 Software Installation

The following steps install the EV2200–231 software:

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

### 3.2 Hardware Connection

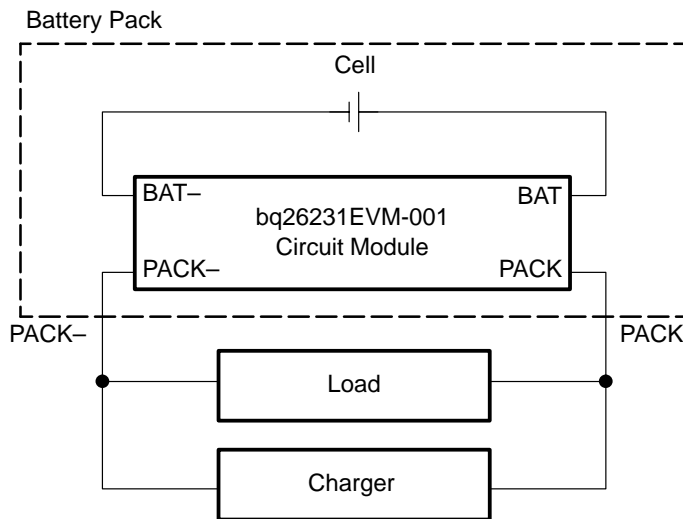
There are three hardware components to the bq26231EVM-001:

- 1) bq26231EVM-001 circuit module
- 2) EV2200 PC interface board
- 3) PC

#### 3.2.1 Connecting the bq26231EVM-001 Circuit Module to a Battery Pack

Figure 3–1 shows how to connect the bq26231EVM-001 circuit module to a Li-Ion cell and the system load/charger.

Figure 3–1. bq26231EVM-001 Circuit Module Connection to Cells and System Load/Charger





### 3.2.2 PC Interface Connection

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

- 1) Connect bq26231EVM-001 to the EV2200 using wire leads as shown in Table 3–1.

*Table 3–1. Circuit Module-to-EV2200 Connection*

<b>bq26231 Based Battery</b>	<b>EV2200</b>
HDQ	SMBD/HDQ1
PACK–	VSS

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

The bq26231EVM–001 is now set up for operation.



# Operation

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This chapter details the installation operation of the EVM2200-231 software.

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## 4.1 Software Installation

The following steps install the EV2200–231 software:

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

## 4.2 Starting the Program

The installation process creates an icon labeled *EV2200-231*. Find this icon and double-click it. Run this EV2200-231 from the Start|Programs|Texas Instruments menu sequence. The software defaults to PC com port 1 for communication. The evaluation software loads in 3 to 10 seconds, depending on the speed of the PC. During this time the EV2200 software is testing the communications to the EV2200. The subsequent message indicates the board status. After the communications port is detected, the software displays the bq26231 Registers screen. See Figure 4–1.

If bq26231 Registers screen is not displayed, then the software is not communicating with the EV2200 interface board. In such case, you will see a window as in Figure 4–2 when you first clicked on the EV2200-231 icon, which indicates that the serial link is not connected correctly. Secure the serial cable connection at the EV2200 and the PC and check with the computer manual to verify the com port selection. Once an appropriate com port is selected, the program loads the initial register screen.

Figure 4–1. Initial Register Screen

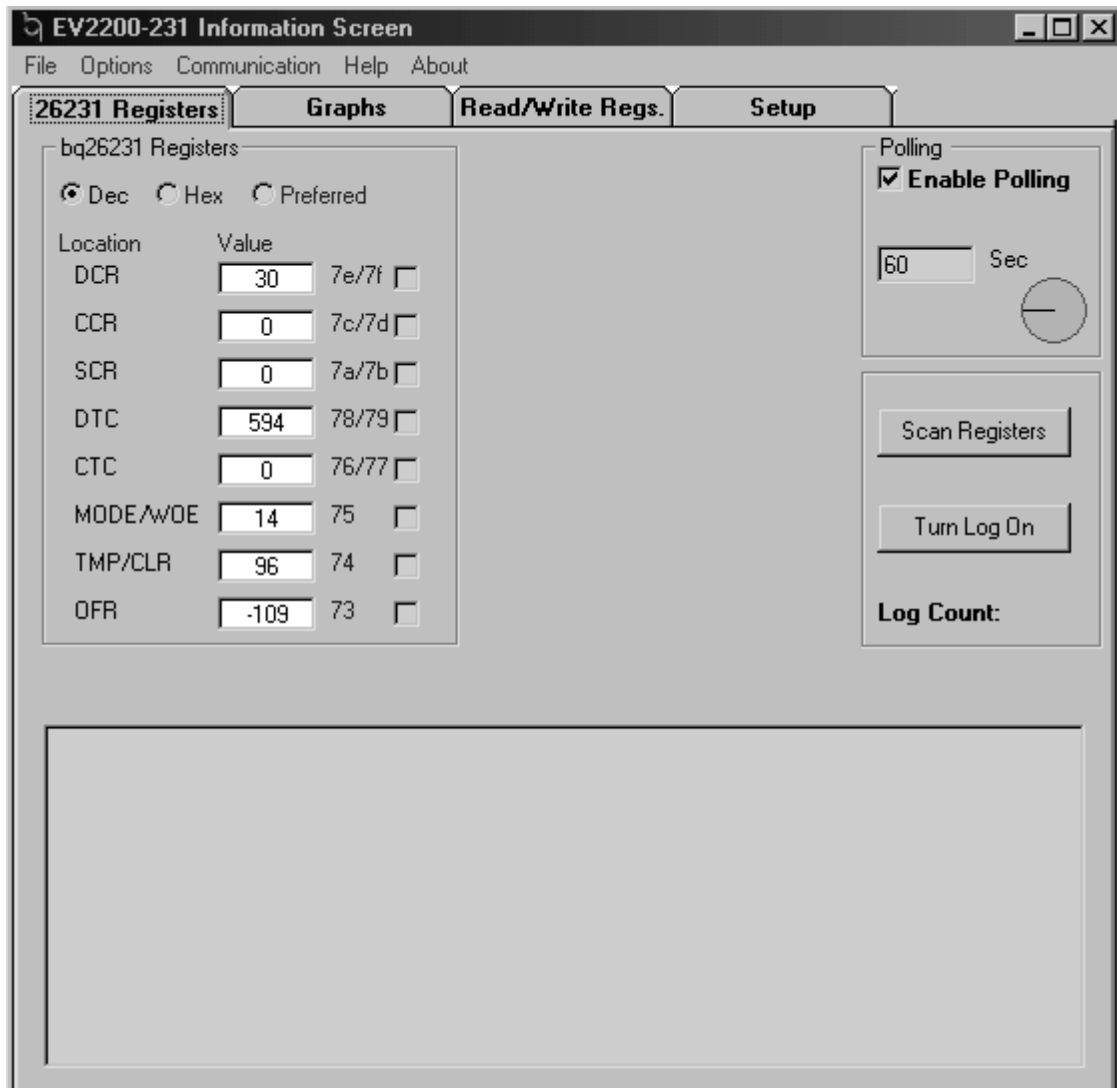
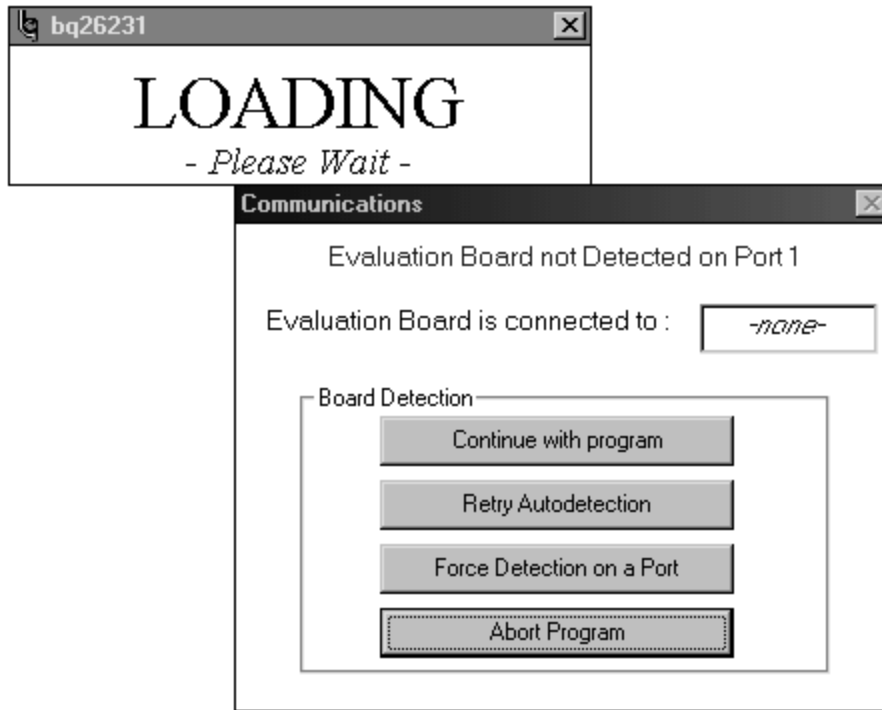


Figure 4–2. Loading Screen That Shows the Board Detection Is Failing



### 4.3 Software Instructions

When the software is running, you can select 4 tabs: 26231 Registers, Graphs, Read/Write Regs., and Setup.

#### 4.3.1 bq26231 Registers Screen

The register section at the top of this screen is common to the Graphs and the Read/Write Regs. tabs. In the register display section, each of the allocated bq26231 registers can be viewed in hexadecimal (Hex) or decimal (Dec). To update each register, click Scan Registers. This can be made automatic by checking the Enable Polling box. The period of each scan is set in the timing box provided beneath the automatic polling check boxes. The bottom of this screen shows the data being collected when the data logging is active. Click the Turn Log On button and follow the instructions on the screen to activate this function. See Figure 4–1.

#### 4.3.2 Graphs Screen

Below the register set display on this tab is shown a graph. The user chooses the data for this graph by checking the appropriate box on the right of the register desired. Any of the registers can be displayed, as many together as the user desires. An example of the Graph feature is shown in Figure 4–3.

### 4.3.3 Read/Write Regs Screen

The function of this tab is to allow the user to program any of the data registers, counters, and control registers within the bq26231. Use the memory map in the bq26231 data sheet for a guide to their individual uses. Simply enter the address and any data (for writes), and click the appropriate button. The control registers show the binary version below the address and data entry boxes to indicate the state of the device at that time. See Figure 4–4.

### 4.3.4 Setup Screen

You can format the graph axis here. After the correct settings have been entered, you can save the settings by clicking the Write Settings to File button. See Figure 4–5.

Figure 4–3. Graph Screen

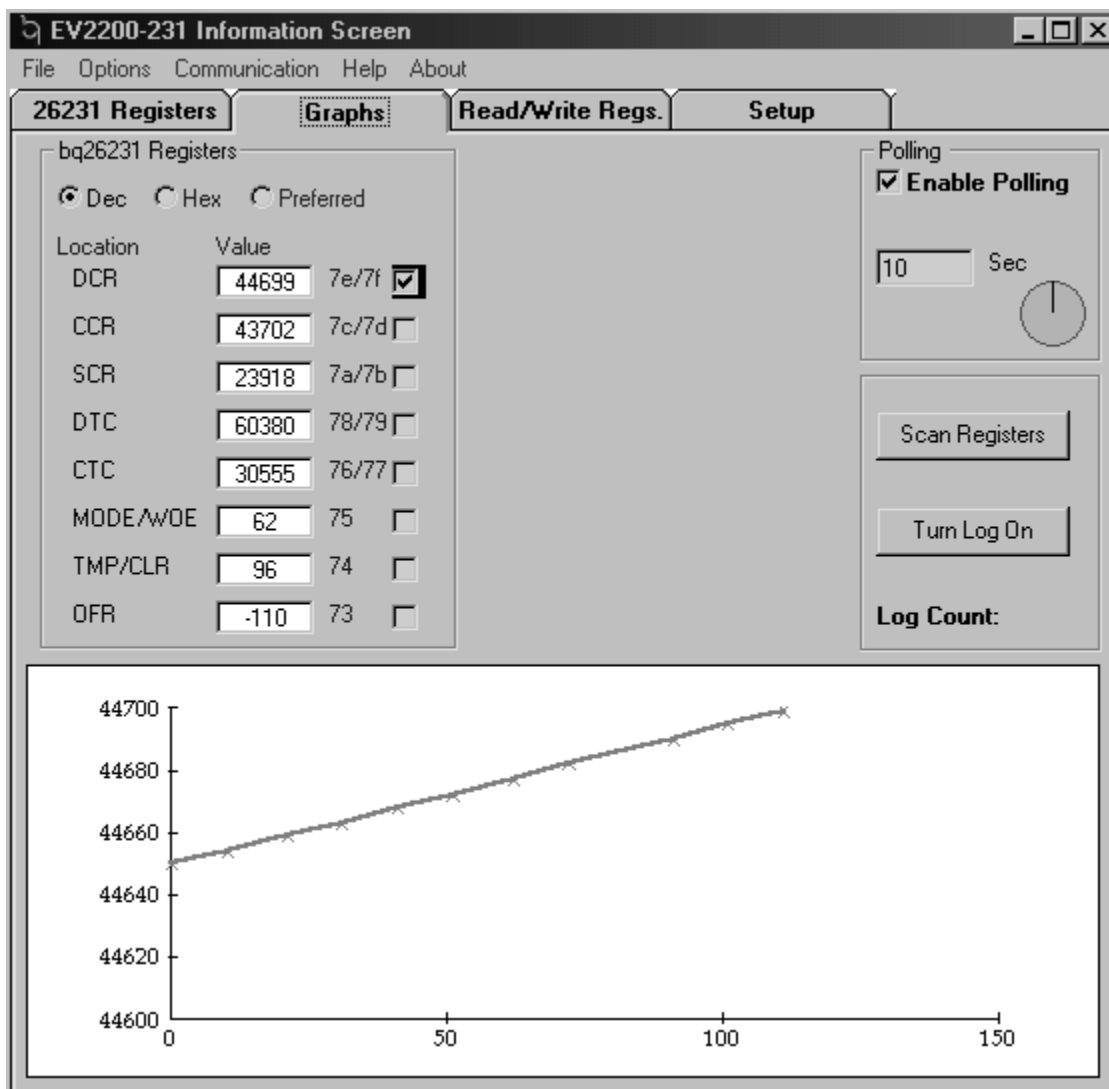


Figure 4-4. Read/Write Regs. Screen

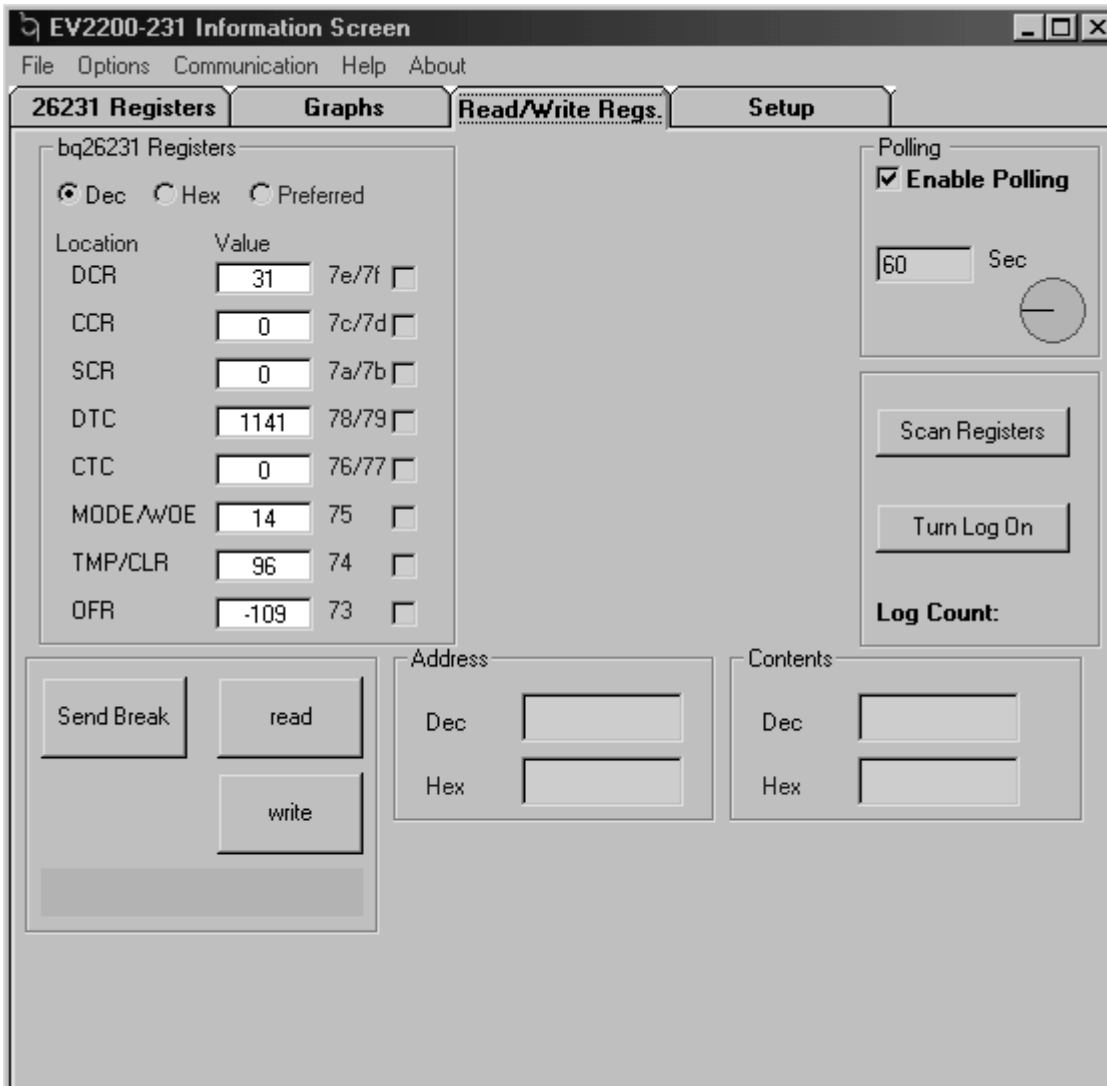
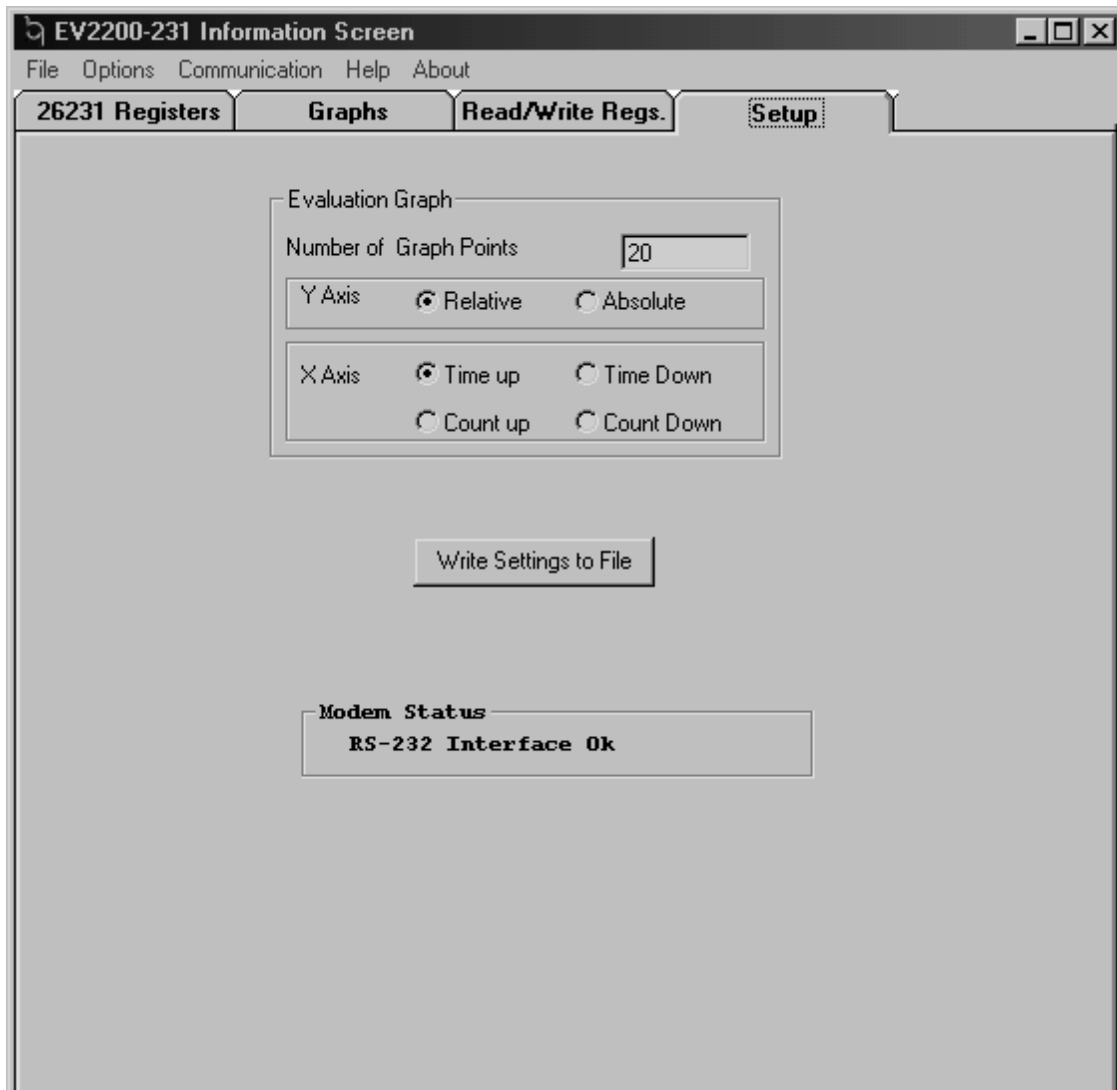




Figure 4-5. Setup Screen



## 4.4 Data Logging

The bq26231 registers data are logged by clicking the Turn Log On button of 26231 Registers screen. This creates a log file and shows the data on the 26231 Registers screen. See Figure 4–6 and Figure 4–7.

Figure 4–6. Data Logging Screen

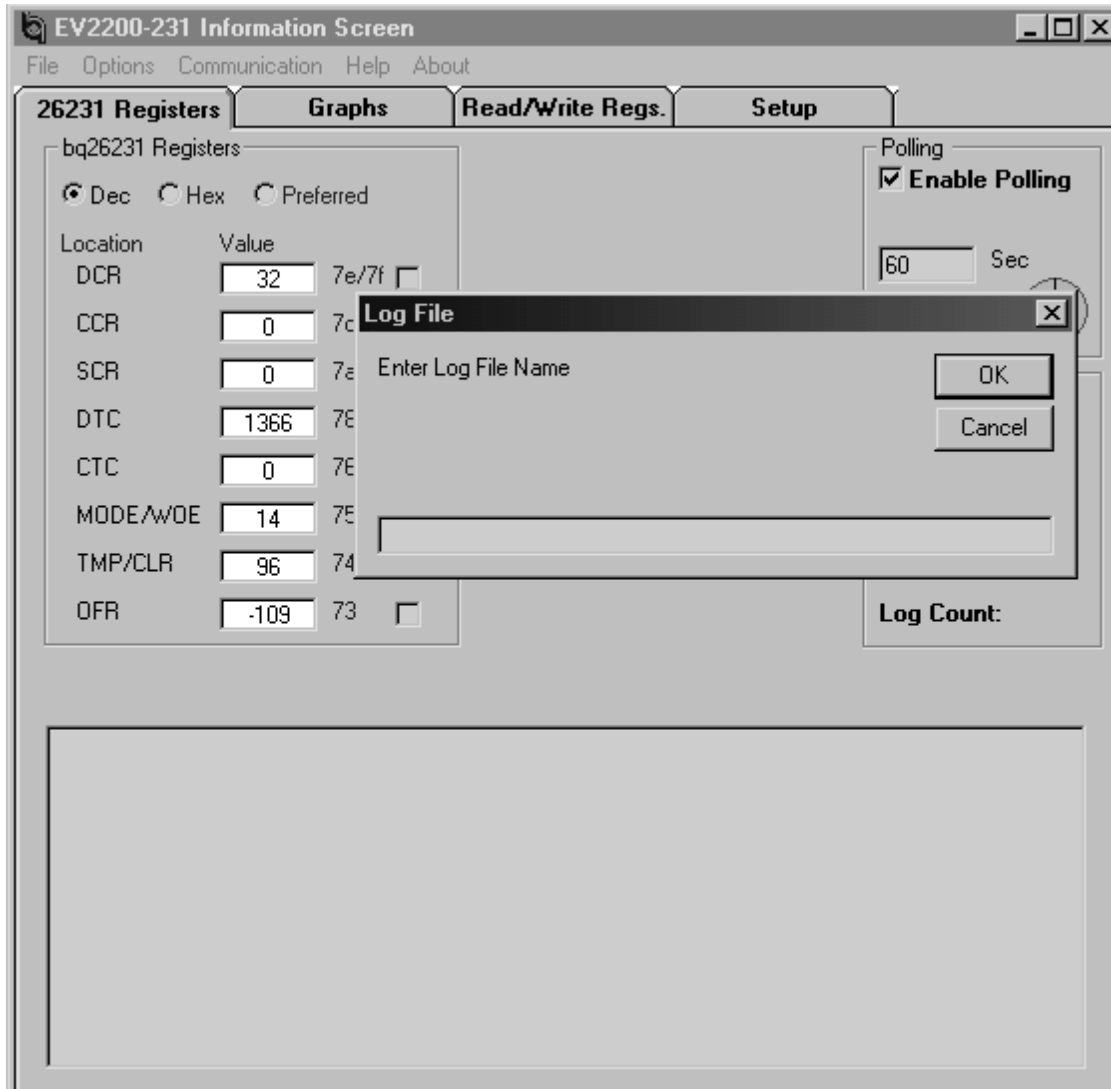


Figure 4–7. Example of Data Logged Screen

**EV2200-231 Information Screen**

File Options Communication Help About

**26231 Registers**   **Graphs**   **Read/Write Regs.**   **Setup**

bq26231 Registers

Dec    Hex    Preferred

Location	Value	
DCR	175	7e/7f <input type="checkbox"/>
CCR	0	7c/7d <input type="checkbox"/>
SCR	0	7a/7b <input type="checkbox"/>
DTC	1820	78/79 <input type="checkbox"/>
CTC	0	76/77 <input type="checkbox"/>
MODE/WOE	14	75 <input type="checkbox"/>
TMP/CLR	96	74 <input type="checkbox"/>
OFR	-109	73 <input type="checkbox"/>

Polling

**Enable Polling**

10 Sec

Scan Registers

Turn Log Off

**Log Count: 14**

TIME	DCR	CCR	SCR	DTC	CTC	MODE/WOE	TMP/CL	OFR	0
17:29:31	120	0	0	1682	0	14	96	-109	0
17:29:41	124	0	0	1694	0	14	96	-109	0
17:29:51	129	0	0	1705	0	14	96	-109	0
17:30:01	133	0	0	1717	0	14	96	-109	0
17:30:11	138	0	0	1728	0	14	96	-109	0
17:30:22	143	0	0	1740	0	14	96	-109	0
17:30:32	147	0	0	1751	0	14	96	-109	0
17:30:42	152	0	0	1763	0	14	96	-109	0
17:30:52	156	0	0	1774	0	14	96	-109	0
17:31:02	161	0	0	1786	0	14	96	-109	0
17:31:13	166	0	0	1797	0	14	96	-109	0
17:31:23	170	0	0	1809	0	14	96	-109	0

