

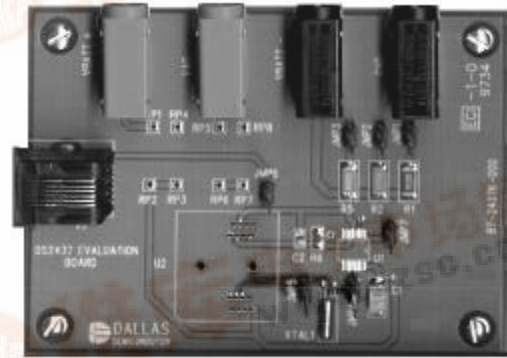


# DS2437K Smart Battery Monitor Evaluation Kit

[www.dalsemi.com](http://www.dalsemi.com)

## FEATURES

- Demonstrates the capabilities of the DS2437 Smart Battery Monitor, including:
  - Temperature measurement
  - Voltage measurement
  - Current measurement
  - Capacity tracking
  - Elapsed time
  - Information storage
  - Identification
- Provides small-volume DS2437 programming support
- Interfaces to the serial port of a PC running Windows 95 or Windows NT



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## EVALUATION KIT CONTENTS

- 1 pc. DS2437K evaluation board
- 2 pcs DS2437K software diskettes (3.5" format)
- 1 pc. DS9097U Universal Serial Port Adapter
- 1 pc. RJ-11 phone cable
- 1 pc. DS2437K data sheet
- 1 pc. DS2437 data sheet

## EQUIPMENT NEEDED

1. An IBM-compatible PC running Windows 95 or Windows NT with a 3.5" floppy drive and an available serial port
2. A battery or power supply and cabling to interface to the evaluation board

## INTRODUCTION

The DS2437K Evaluation Kit makes performance evaluation, software development, and prototyping with the DS2437 Smart Battery Monitor easy. The 3" x 4" evaluation board interfaces to an IBM-compatible PC through a DS9097U Universal Serial Port Adapter and RJ-11 cable connection. Two floppy disks contain the DS2437K software, which can be run under Windows 95 or Windows NT.



The evaluation board comes populated with one DS2437, a crystal, and various resistors, capacitors, jumpers and connectors (refer to the schematic in Appendix 1 and to the evaluation board itself). Although multiple DS2437 devices can be connected to a 1-Wire™ bus simultaneously, the DS2437K Evaluation Kit only supports communication with one DS2437 device at a time. To evaluate the DS2437 that comes with the board (component U1), jumpers JMP4 and JMP7 should be in place and jumpers JMP5 and JMP6 should be excluded. To evaluate or program additional DS2437 parts, install an SSOP socket (not included in the kit) at location U2, put jumpers JMP5 and JMP6 in place and exclude jumpers JMP4 and JMP7. The SSOP socket is available from the following source:

Supplier: [Enplas](http://www.enplas.com)  
 Part Number: OTS-16 (34)0.65-01  
 Phone: 408-749-8124  
 Fax: 408-749-8125  
 Web: [www.enplas.com](http://www.enplas.com)

Resistors R1, R2 and R5 on the evaluation board serve as current-sense resistors for the DS2437. Various sense resistance values can be obtained by connecting different combinations of these resistors using jumpers JMP1, JMP2 and JMP3. The DS2437K software calculates which of these three jumpers should be in place to match the desired battery capacity. Table 1 below shows the sense resistance values that can be constructed and the corresponding battery capacities.

#### JUMPER CHART FOR C-RATE SELECTION Table 1

JMP1 0.100Ω	JMP2 0.050Ω	JMP3 0.025Ω	R <sub>SENSE</sub> Ohms	Capacity mAh
X	X	X	0.0143	3500
-	X	X	0.0167	3000
X	-	X	0.0200	2500
-	-	X	0.0250	2000
X	X	-	0.0330	1500
-	X	-	0.0500	1000
X	-	-	0.1000	500

X = jumper in place

The DS2437K evaluation board comes with 0-Ohm resistors in place for R3 and R4, while resistors R7 and R8 are not installed. For battery voltages greater than 10V, the DS2437K software prompts the user to place voltage dividers in these positions. Resistor R6 and capacitor C2 on the evaluation board implement the  $V_{\text{SENS}}$  low-pass filter recommended by the DS2437 data sheet.

The evaluation board can be connected to a power supply and an external load in configurations that simulate either charging or discharging for the DS2437. Figure 1a below illustrates the charging configuration while Figure 1b shows the discharging configuration.

## CONNECTIONS TO SIMULATE CHARGING OR DISCHARGING Figure 1

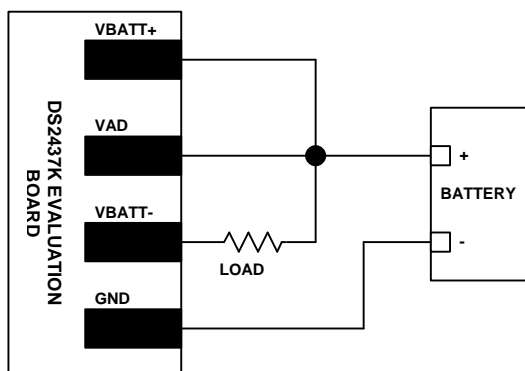


Figure 1a Charging

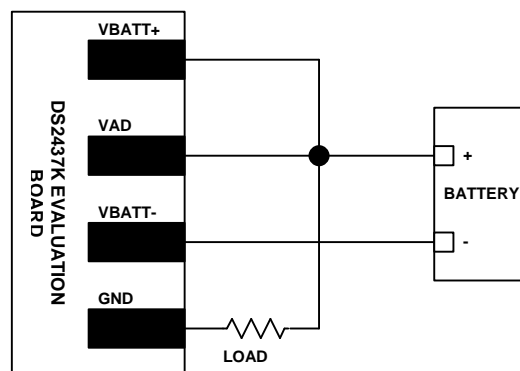


Fig 1b Discharging

## SETUP AND INSTALLATION

Note: The DS2437K software is a 32-bit application that runs only under Windows 95 or Windows NT. Windows 3.1 and DOS are not supported.

To install the DS2437K software, exit all programs currently running and insert Installation Disk 1. Run SETUP.EXE and the installation process is launched. Follow the prompts to complete the installation. The DS2437K software can be uninstalled in the Add/Remove Programs tool in the Control Panel.

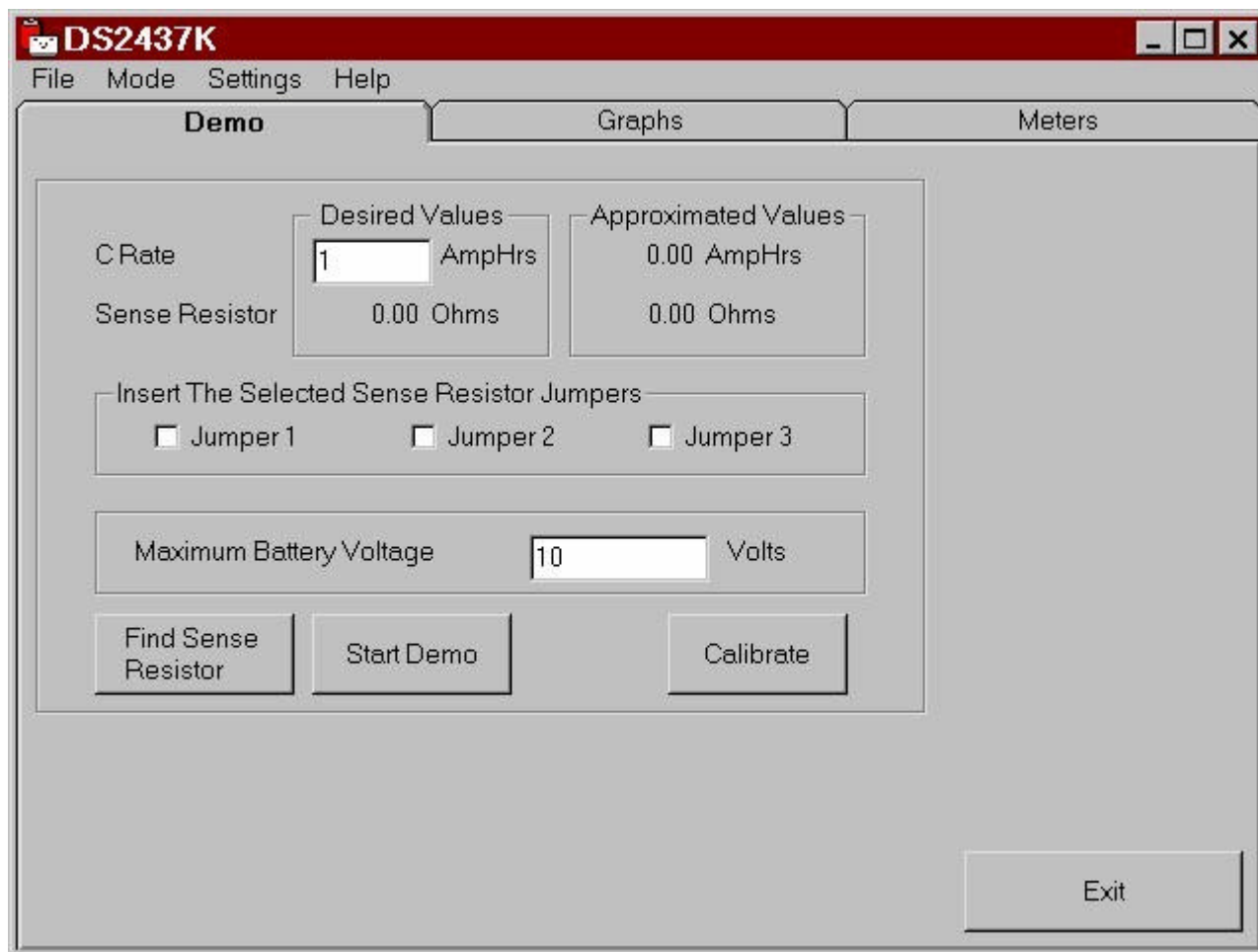
After the installation is complete, open the DS2437K folder and run DS2437K.EXE. A splash screen containing information about the evaluation kit appears as the program is being loaded.

## SELECTING THE COM PORT

The first time the software runs the Select Preferences window appears. In this window, select the COM port to which the DS9097U is attached and then hit OK. The DS2437K software saves this COM port selection and automatically uses the selection each time the program starts. To change the COM port later, click the Settings option on the menu bar and select the appropriate port.

## DEMO MODE

The Demo Mode of the Evaluation Kit is set up to display the basic functionality of the DS2437 and is the default mode of the kit. Before starting the demonstration, connect the evaluation board to a power supply and a load as shown in Figure 1a or Figure 1b. Also, be sure that the evaluation board is connected to the DS9097U through the RJ-11 cable and that the DS9097U is plugged into an unused serial port on the computer. Finally, verify that jumpers JMP4 through JMP7 are configured as needed. To begin the demonstration, fill in the battery capacity (C Rate) and Maximum Battery Voltage fields on the Demo Screen (see Figure 2 below).

**DEMO SCREEN** Figure 2

After filling in the required fields, click the Find Sense Resistor button. The software calculates the appropriate sense resistance for the desired battery capacity and then finds the closest approximation to that resistance that can be made with the three sense resistors on the evaluation board. From these calculations, the software indicates which of the three sense resistor jumpers (JMP1, JMP2 and JMP3) should be in place to construct the resistance and then recalculates and displays the battery capacity based on the actual resistance used on the board. Configure the sense resistor jumpers as directed by the software.

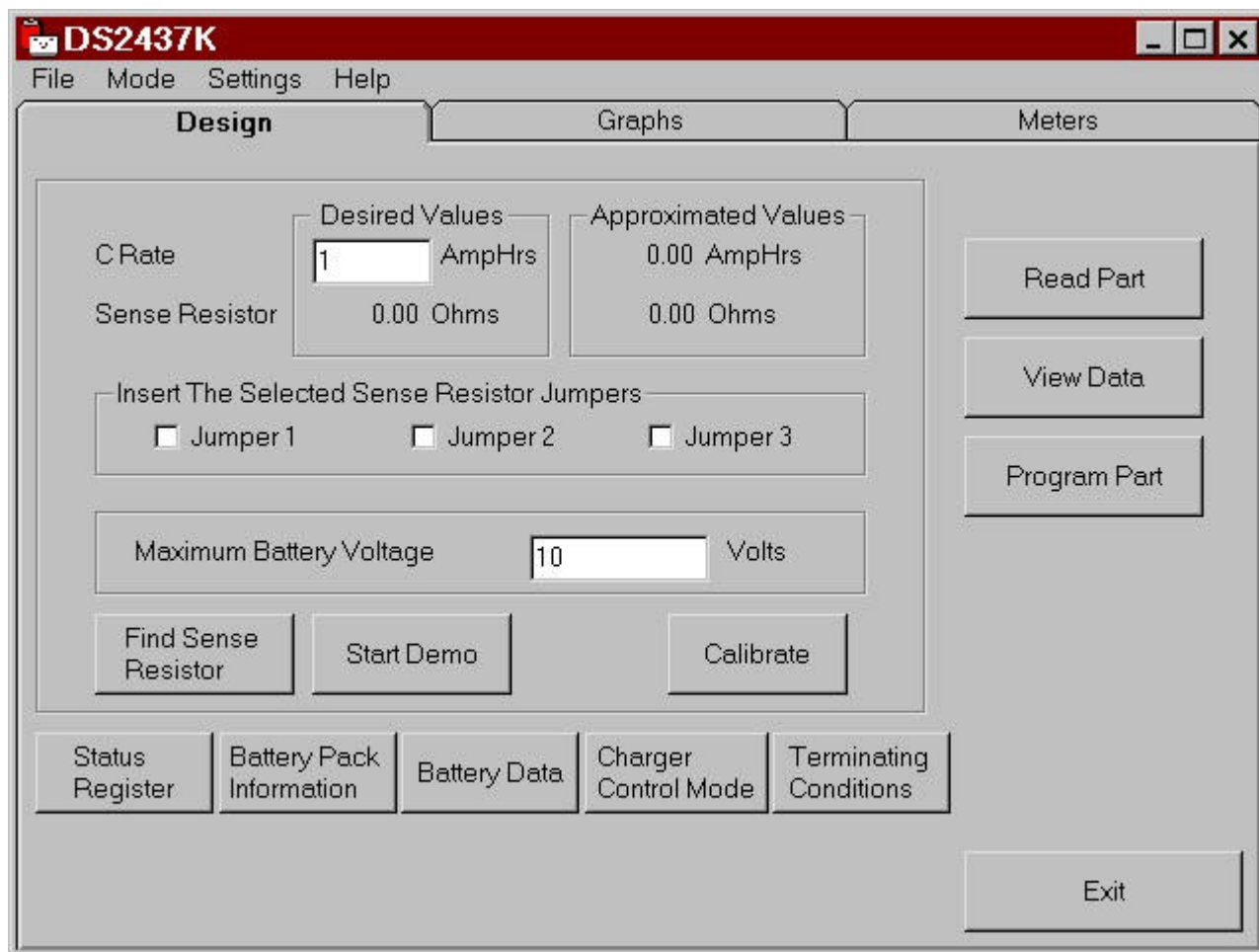
The Start Demo button starts the demonstration and switches over to the Meters Screen so that measurements from the DS2437 can be monitored in real time. The Demo Screen, the Graphs Screen and the Meters Screen can all be viewed as needed while in Demo Mode.

If the Maximum Battery Voltage entered in the Demo Screen is greater than 10 volts, the DS2437K software prompts the user to install resistors on the evaluation board to form a voltage divider on the  $V_{DD}$  pin of the DS2437. After the voltage divider is in place, the software scales up the voltage measured by the DS2437 in order to accurately display the full supply voltage.

## DESIGN MODE

The Design Mode of the DS2437K provides a more in-depth look at the functionality and programmability of the DS2437. The Design Mode can be accessed by clicking on the Mode option on the menu bar and selecting Design Mode. Once this selection is made, the Demo Screen is replaced by the Design Screen, as shown in Figure 3. The Graphs and Meters screens are not altered by the mode selection.

## DESIGN SCREEN Figure 3



The main difference between the Demo and Design modes is that the Design Mode includes features to set the values of various data fields, program the DS2437 with these values, and read the data back from the DS2437. The Design Screen includes the Read Part, View Data and Program Part buttons on the right side of the screen as well as a number of buttons across the bottom of the screen, each of which pops up a separate data entry window.

**Setting the Data.** Of the programmable data fields managed by the DS2437K software, only the Status Register fields actually affect the configuration of the DS2437. The other data fields merely demonstrate the DS2437's data storage capabilities and may be omitted or altered as needed when the DS2437 is implemented in a system design. The manner in which the DS2437 memory is allocated in this evaluation kit is outlined in detail in Application Note 110, which can be obtained from Dallas Semiconductor's web site at: <http://www.dalsemi.com/DocControl/PDFs/app110.pdf>.

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The data entry buttons at the bottom of the Design Screen provide a simple means to enter and view the data stored in the DS2437's EEPROM memory. The data fields are divided among five buttons: Status Register, Battery Pack Information, Battery Data, Charger Control Mode, and Terminating Conditions. Press any of these buttons to pop up a data entry window in which several data fields can be set.

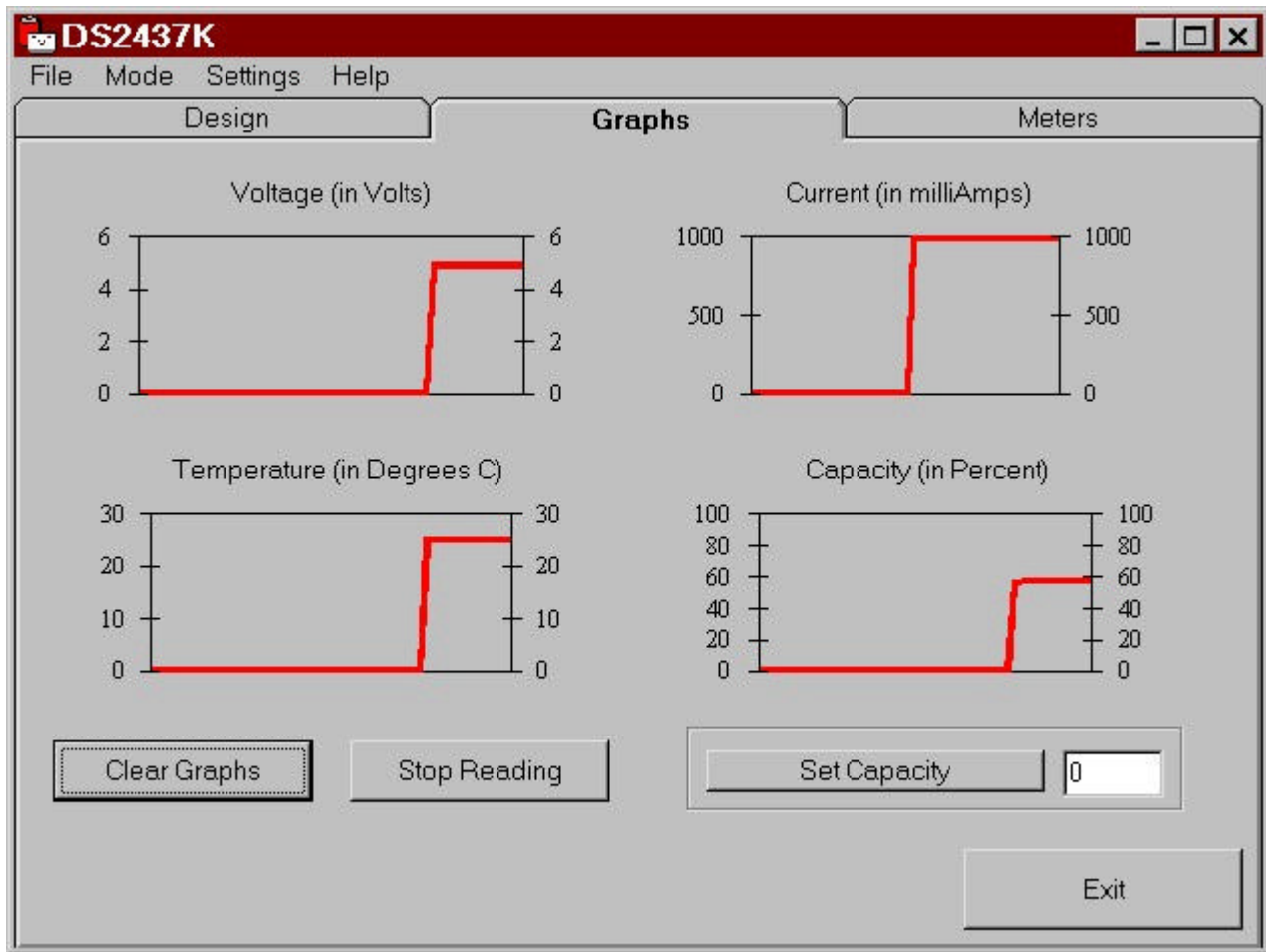
Most data fields have an associated Tool Tip that can be viewed by holding the mouse pointer on the name of the field. These Tool Tips indicate the expected units or format in which the data should be entered, such as "Up to 2 Digits" or "In Tenths of Volts." After all desired data values have been set in a given data entry screen, press OK to leave that window. When OK is pressed, the software checks the values entered to ensure that they are in the proper format and within the allowable range. Invalid values must be corrected before the data entry window will close. After entering data as desired, click the View Data button on the Design Screen to pop up a read-only summary of all data fields.

**Programming the DS2437.** After data has been entered as desired, click the Program Part button to write the information into the DS2437's EEPROM memory.

**Saving and Opening Configurations.** To save a particular configuration of entered data to a file for future use, click File in the menu bar, select Save, and specify a file name. To load a configuration from a file, click File in the menu bar, select Open, and select the file. This loads all of the software data fields with the values stored in the file.

**Reading the DS2437.** Press the Read Part button to read the data currently stored in the DS2437. The data values are displayed in the same format (decimal, hex, and character) in which they were previously programmed.

## GRAPHS SCREEN Figure 4

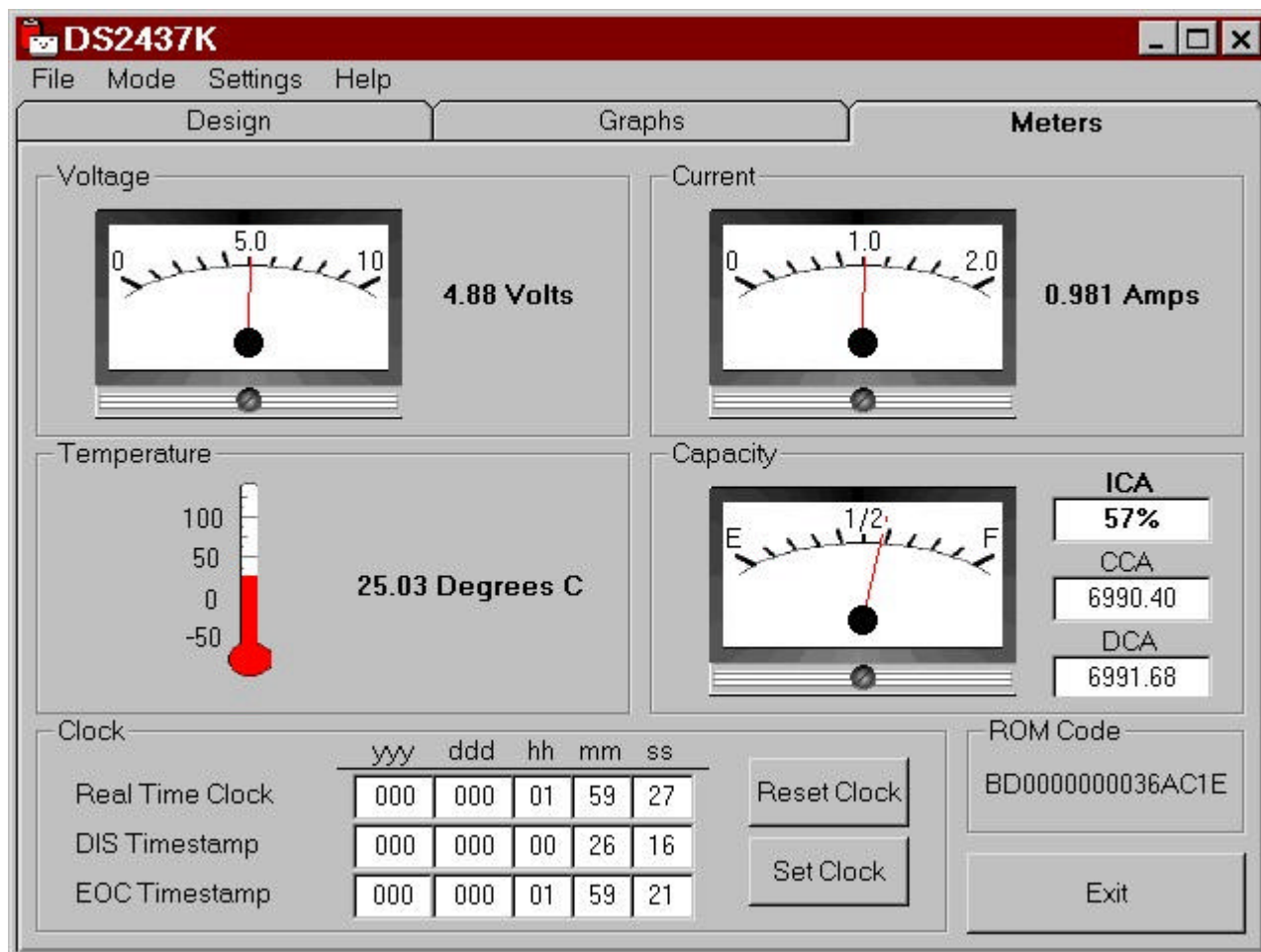


### REAL-TIME GRAPHS

The Graphs Screen displays the last 50 seconds of real-time measurements of battery voltage, current, temperature and remaining capacity, as illustrated in Figure 4. The Clear button erases all the data in the graphs and resets all the values to 0. If the Graphs Screen is viewed prior to starting the demonstration, the demo can be started from this screen by clicking on the Start Reading button. When the demo is running, the Stop Reading button stops the flow of real-time data.

To set the remaining capacity to a particular percentage, type the value into the text box and hit the Set Capacity button. The Capacity Graph immediately reflects the new capacity, as does the Capacity Meter on the Meters Screen. Note that the capacity values displayed on the graph and the meter are affected by the use of the Calibrate feature on the Demo and Design screens. See the section on Current Measurement Calibration below for details.

## METERS SCREEN Figure 5



### REAL-TIME METERS

The Meters Screen displays the latest real-time measurements of battery voltage, current, temperature and remaining capacity with both analog meter readouts and digital values. Also displayed on the Meters Screen are the values in the charge current accumulator (CCA), discharge current accumulator (DCA), real-time clock, disconnect (DIS) timestamp register, and end-of-charge (EOC) timestamp register. The 64-bit ROM ID of the DS2437 is also displayed at the bottom of this screen. The Meters Screen is shown in Figure 5.

**Setting and Resetting the Real-Time Clock.** The clock register in the DS2437 is a 32-bit seconds counter that starts from 0 when a power supply is connected to the part. The DS2437K software reads this 32-bit value and formats it into years, days, hours minutes and seconds. Press the Reset Clock button to reset the clock register to 0. To set the clock, press the Set Clock button and then enter the appropriate years, days, hours, minutes and seconds information in the Set Clock window. The evaluation kit software reformats this information into a 32-bit binary value and writes that value to the DS2437.

**End-of-Charge and Disconnect Timestamps.** To demonstrate the DS2437's end-of-charge timestamp, wire the evaluation board in the charging configuration shown in Figure 1a, start the demonstration, and then disconnect one side of the load resistor. As soon as this is done, the end-of-charge timestamp register updates to reflect the end-of-charge time. To demonstrate the disconnect timestamp feature, simply unplug the RJ-11 cable from the evaluation board. During the time the cable is unplugged, the displayed values of the real-time clock and both timestamp registers become invalid because the software



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is not able to communicate with the DS2437. When the RJ-11 cable is plugged back in, the software updates the displayed values to reflect the contents of the DS2437, including the new disconnect timestamp value.

## **CURRENT MEASUREMENT CALIBRATION**

When an external current meter is connected to the DS2437K Evaluation Kit, the kit software will often display a measured current value that is as much as 20% different from the current displayed on the external meter. This is not an inaccuracy on the part of the DS2437 device but rather the result of inaccuracies on the evaluation board. To calibrate out these factors, use the Calibrate feature on the Demo Screen or the Design Screen.

After pressing the Calibrate button, fill in the Actual Current field with the current displayed on the external meter. Fill in the Displayed Current field with the current displayed by the DS2437K software on the Meters Screen. After both fields are filled in, hit the Calibrate button and then switch over to the Meters Screen. The software's Current Meter now displays the same current as the external meter. In addition, the Capacity Meter increments or decrements at the new calibrated rate as well.

This current measurement calibration feature is optional. The DS2437K Evaluation Kit does not work better or worse with or without calibration. When using the calibration feature, keep in mind that the calibration is done by the DS2437K software, not the DS2437 device itself. To display calibrated current and remaining capacity values, the software simply reads the uncalibrated information from the DS2437 and multiplies by the ratio of Actual Current to Displayed Current. As a result, whenever the calibration is changed, the ICA value displayed on the Meters Screen changes as well, because the software begins to multiply the raw ICA value in the DS2437 by the new calibration ratio. The Capacity Graph on the Graphs Screen is affected in the same manner. To reset the Capacity Graph and the displayed ICA value after entering a new calibration, use the Set Capacity feature on the Graphs Screen.

# APPENDIX 1: EVALUATION BOARD SCHEMATIC

