19-4829; Rev 1; 8/09

DS2438EVKIT+
Smart Battery Monitor Evaluation Kit

www.maxim-ic.com

FEATURES

- **Demonstrates the Capabilities of the DS2438 Smart Battery Monitor, Including:**
  - **Temperature Measurement**
  - **Voltage Measurement**
  - **Current Measurement**
  - **Current Accumulation**
  - **Elapsed Time**
  - **Information Storage**
  - **Identification**
- **Provides Small-Volume DS2438 Programming Support**
- **Interfaces to the USB Port of a PC Running Windows XP® or Older Operating System**

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EVALUATION KIT CONTENTS

1 pc. Evaluation Board
1 pc. DS9123O USB Port Adapter
1 pc. RJ-11 Cable

EQUIPMENT NEEDED

1. A PC running Windows XP or older operating system and an available USB port.
2. Cables with mini-grabber style clips or the ability to solder directly to connection pads.
3. A lithium-ion (Li+) battery and a power supply and/or load circuit.

ORDERING INFORMATION

PART	TYPE
DS2438EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

INTRODUCTION

The DS2438 evaluation kit (EV kit) makes performance evaluation, software development, and prototyping with the DS2438 smart battery monitor easy. The evaluation board interfaces to a PC through a DS9123O USB adapter and RJ-11 cable connection. All related data sheets can be found on our website at www.maxim-ic.com.

Resistor R1 on the evaluation board is a 50mΩ current sense resistor. Resistor R2 and capacitor C1 implement the VSENS- lowpass filter recommended by the DS2438 data sheet. Component site R3, which is intentionally unpopulated, allows another sense resistor to be soldered down in parallel with or in place of resistor R1. Component site C3, intentionally unpopulated, allows a capacitor to be connected to the VAD input if needed.

The evaluation board can be connected to a power supply and an external load in configurations that simulate either charging or discharging for the DS2438. Figure 1a below illustrates the charging configuration while Figure 1b shows the discharging configuration.

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Figure 1. Connections to Simulate Charging or Discharging

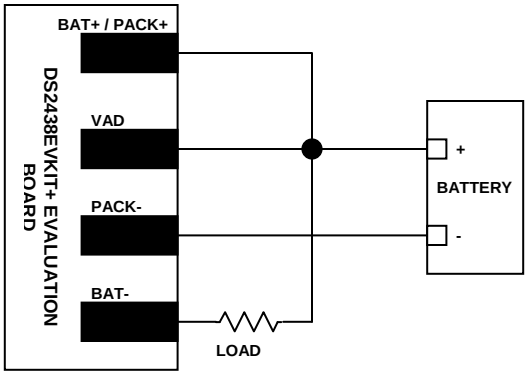


Figure 1a. Charging

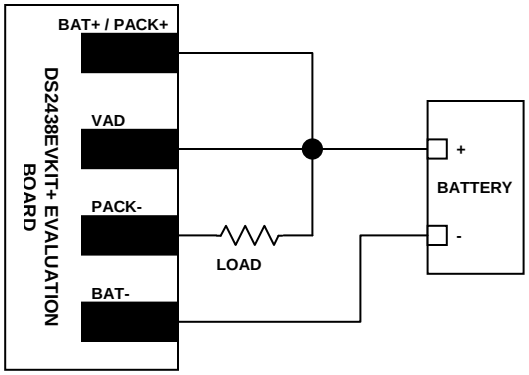


Fig 1b. Discharging

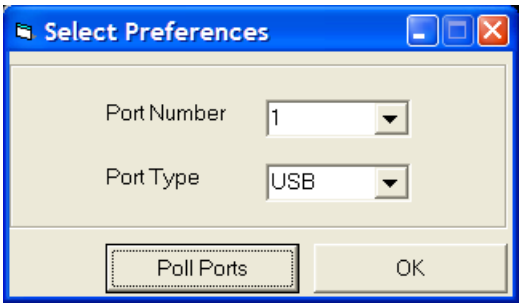
SETUP AND INSTALLATION

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 DS9123O through the RJ-11 cable and that the DS9123O is plugged into a USB port on the computer.

To install the DS2438 EV kit software, download the latest revision from our website at www.maxim-ic.com. Unzip the compressed folder and double-click the SETUP.EXE icon to begin the installation process. Follow the prompts to complete the installation. The DS2438 EV kit software can be uninstalled in the Add/Remove Programs tool in the Control Panel. After the installation is complete, open the DS2438K folder and run DS2438K.EXE or select DS2438K from the program menu. A splash screen containing information about the evaluation kit appears as the program is being loaded.

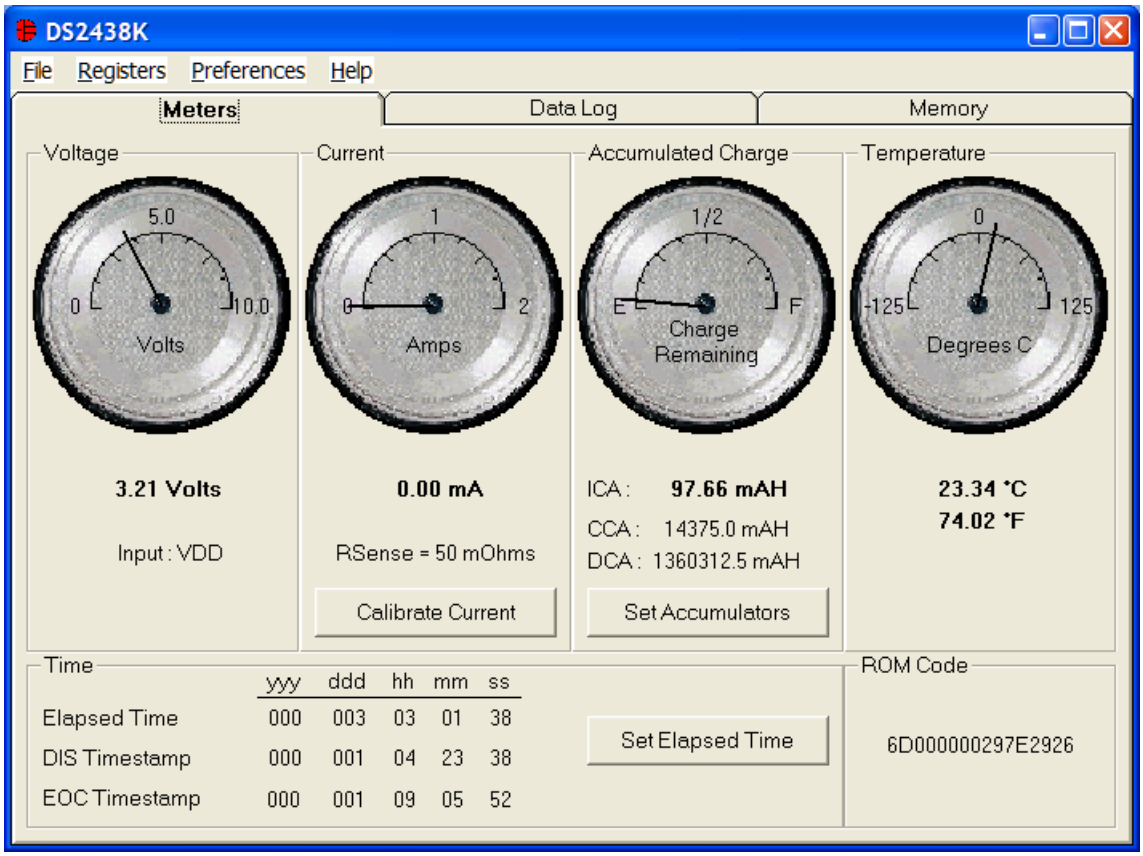
SELECTING THE COM PORT

The first time the software runs, the Select Preferences window may appear. In this window, select either serial port or USB communication and the port number; then hit OK. The DS2438 EV kit software saves this port selection and automatically uses the selection each time the program starts. To change the port later, click the Preferences option on the menu bar, select Port Settings, and then select the appropriate port. To attempt to automatically locate the DS9123, click the Poll Ports button. Warning: automatically polling for the DS9123 can disrupt other devices connected to your computer's COM ports.



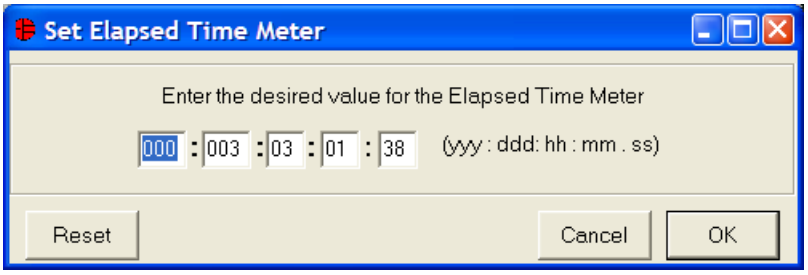
REAL-TIME METERS

The Meters Screen displays the latest real-time measurements of battery voltage, temperature, current and remaining capacity (ICA) 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), Elapsed Time Meter, Disconnect (DIS) Timestamp Register, End-of-Charge (EOC) Timestamp Register, and Status Register. The 64-bit ROM ID of the DS2438 is also displayed at the bottom right portion of this screen.



SETTING THE ELAPSED TIME METER

The Elapsed Time Meter (ETM) in the DS2438 is a 32-bit seconds counter that starts counting from zero when a power supply is connected to the part. The DS2438 EV kit software reads this 32-bit value and formats it into years, days, hours, minutes, and seconds. To set the ETM, press the Set Elapsed Time button and then enter the appropriate years, days, hours, minutes and seconds information in the Set Elapsed Time Meter window. The evaluation kit software reformats this information into a 32-bit binary value and writes that value to the DS2438. Pressing the Reset button in the Set Elapsed Time Meter window clears ETM fields.

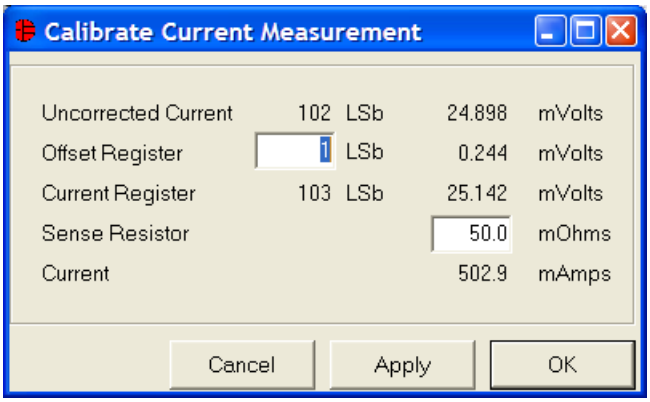


END-OF-CHARGE AND DISCONNECT TIMESTAMPS

To demonstrate the DS2438'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 (BAT– or PACK–). 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 Elapsed Time Meter and both Timestamp Registers become invalid because the software is not able to communicate with the DS2438. When the RJ-11 cable is plugged back in, the software updates the displayed values to reflect the contents of the DS2438, including the new Disconnect Timestamp Register value.

CURRENT MEASUREMENT CALIBRATION

The Calibrate Current button on the Meters Screen opens the Calibrate Current Measurement window. This window gives a real-time demonstration of how current measurements are acquired, corrected and reported using the DS2438. First, the DS2438 takes an uncorrected measurement of the voltage drop across the current sense resistor. The DS2438 then adds the contents of the Offset Register to the uncorrected current measurement and writes the corrected result to the Current Register. The host system then divides the voltage value in the Current Register by the value of the sense resistor to obtain the measured current.



To calibrate DS2438 current measurements for offset error, follow these steps:

1. Press the Calibrate Current button in the Meters Screen.
2. Reduce the actual current driven through the sense resistor to zero.
3. Set the Offset Register value to 0 and press the Apply button.
4. Set the Offset Register value to -1 times the observed Uncorrected Current value and press the Apply button. This uncorrected current value is the DS2438's offset error.
5. The Current Register line should now be reporting 0 LSb, 0mV.

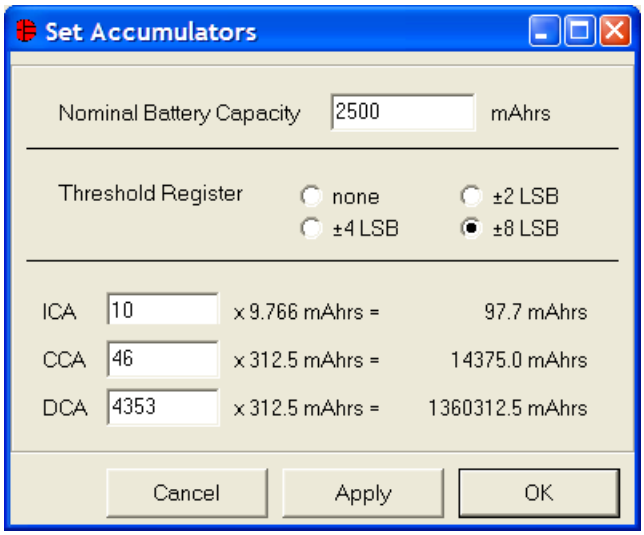
To calibrate DS2438 current measurements for sense resistor variation and the effects of trace resistance, follow these steps:

6. Force a known current through the sense resistor.
7. Enter a different sense resistor value and click the Apply button.
8. Repeat step 7 until the Current reading shown by the software equals the actual current being forced.
9. Click the OK button to leave the Calibrate Current Measurement window. The DS2438 should now be correctly calibrated, and the Current Meter on the Meters Screen should now show the actual current flowing through the sense resistor.

SETTING THE CURRENT ACCUMULATORS

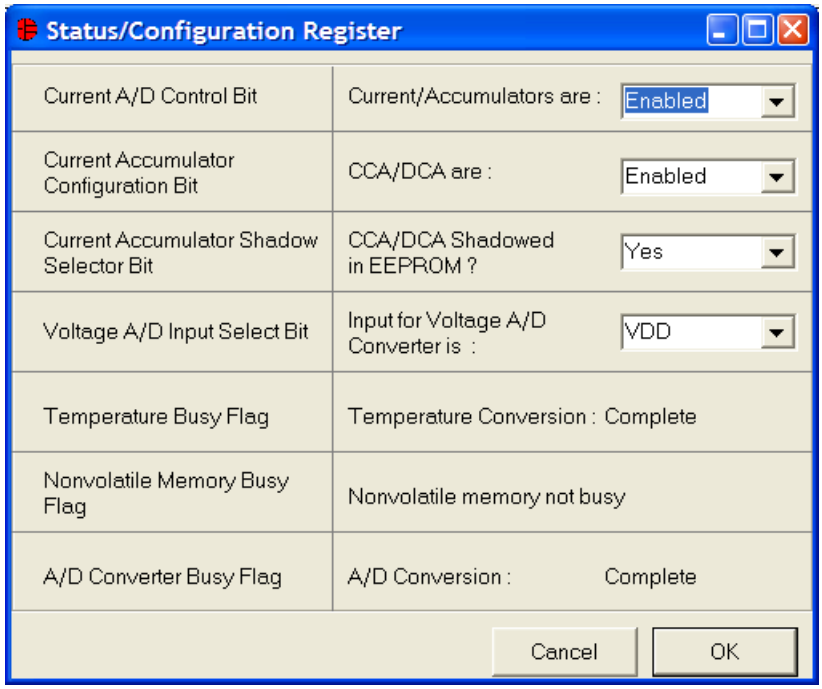
The Set Accumulators button on the Meters Screen opens the Set Accumulators window. This window allows the user set the values of the ICA, CCA and DCA Registers and configure accumulator-related items. The value entered in the Nominal Battery Capacity field becomes the full-scale reading of the Capacity Meter on the Meters Screen. The Threshold Register setting configures the DS2438 to only accumulate currents above a particular threshold.

To set the values of the ICA, CCA and DCA, enter the decimal value to be stored in the register and then press the Apply button. The DS2438 EV kit software multiples the entered value by the value of an LSb in units of mAhrs (calculated from the sense resistor value entered in the Calibrate Current Measurement window) to obtain the value of the register in units of mAhrs. If any of the ICA, CCA or DCA Registers are disabled by Status Register settings, their values cannot be set in the Set Accumulators window.



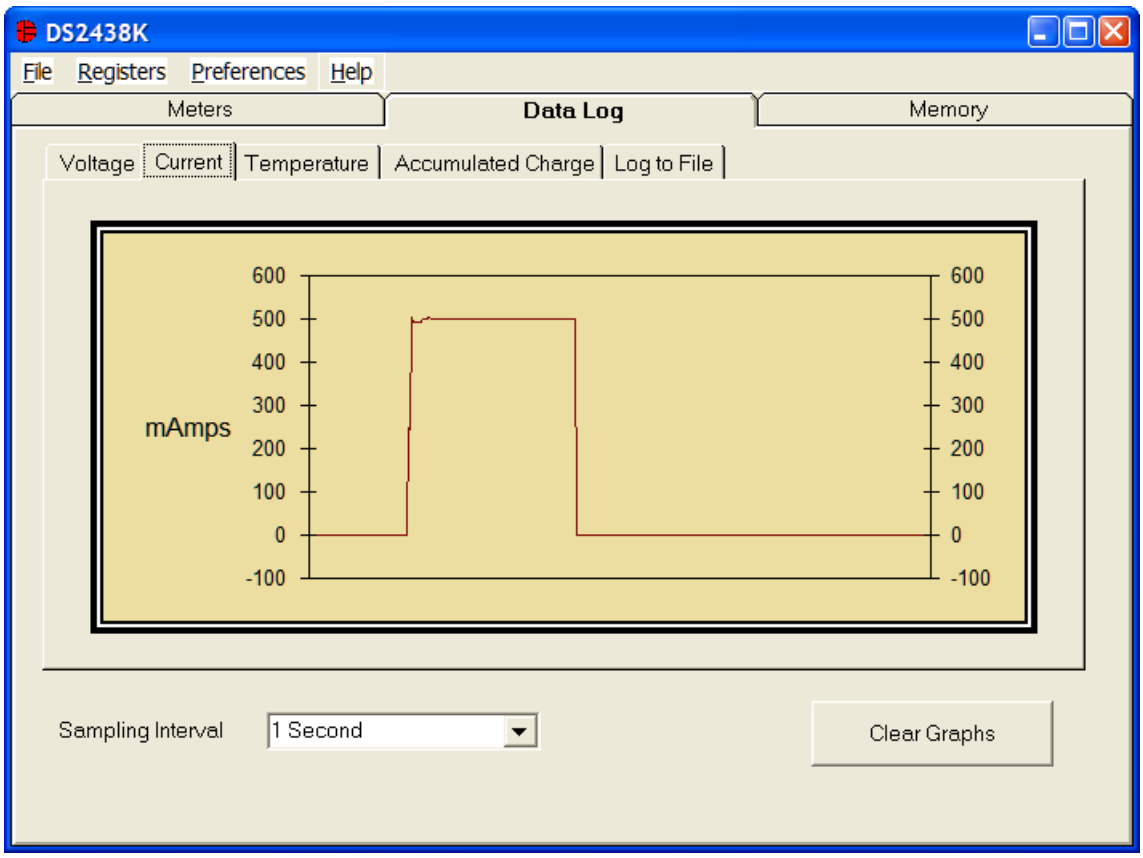
STATUS/CONFIGURATION REGISTER

The DS2438 has four bits in its Status/Configuration Register that can affect the operation of the part. To change the values of the bits, left-click on the Status/Configuration item of the Registers menu to open the Status/Configuration Register window. When the Current A/D Control Bit (IAD) is set to “Disabled,” Current, ICA, CCA and DCA functions are disabled in the DS2438 and on the Meters Screen. When the Current A/D Control Bit is set to “Enabled” and the Current Accumulator Configuration Bit (CA) is set to “Disabled,” only the CCA and DCA Registers are disabled in the DS2438 and on the Meters Screen. The Current Accumulator Shadow Selector Bit (EE) controls whether or not the DS2438 copies changes in the CCA and DCA Registers to EEPROM memory or not. The Voltage A/D Input Select Bit (AD) configures the DS2438 to use either the VDD pin or the VAD pin as input for voltage A/D conversion. The currently selected input is indicated next to the Voltage Meter on the Meters Screen.



REAL-TIME GRAPHS

The Graphs Screen in the DS2438 EV kit software displays the last 500 real-time measurements of battery voltage, temperature, current and remaining capacity. The Clear button erases all the data in the graphs.



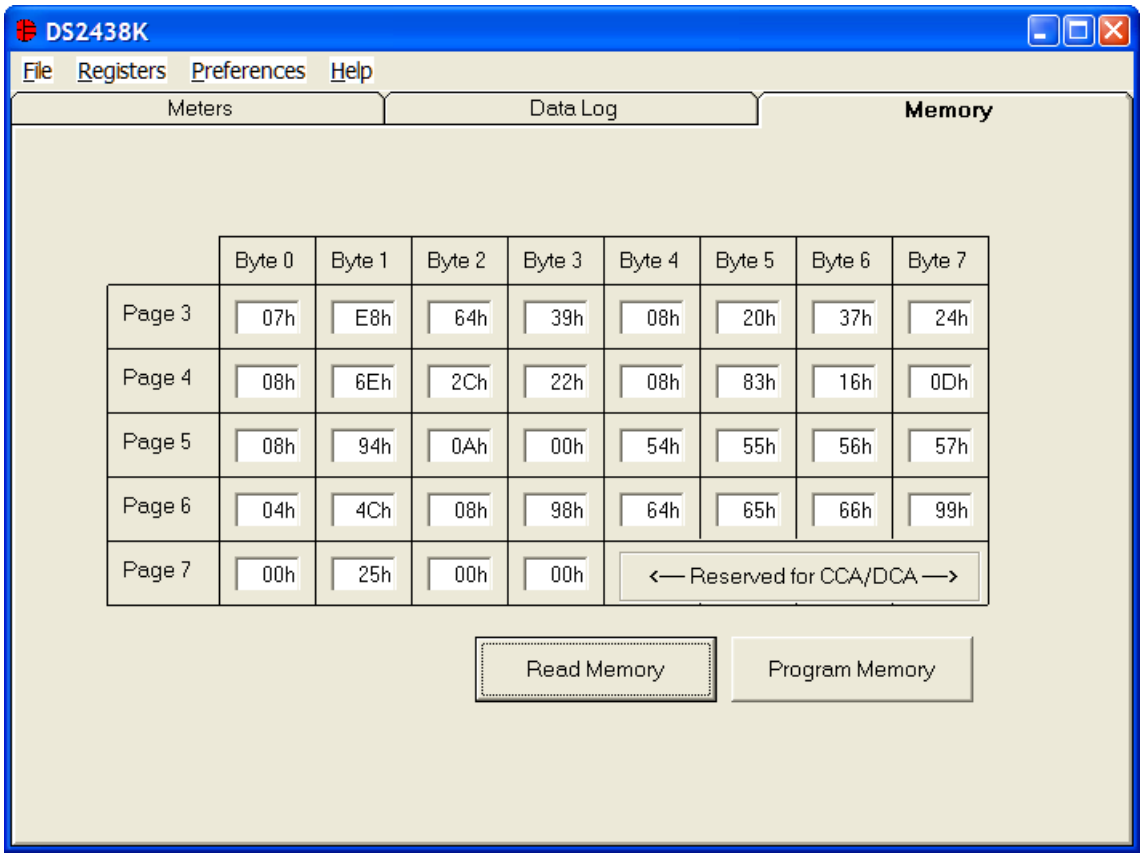
The Log to File Sub Tab contains control information for storing all data to an ASCII file. The default filename is c:\DS2438K_datalog.txt, but can be modified in the filename text field. The Log Data button toggles data logging off and on. Data will be stored at the same interval selected for updating the graphs in the tab-delimited format of

"Time<*tab*>Voltage<*tab*>Current<*tab*>Temperature<*tab*>ICA<*tab*>CCA<*tab*>DCA

for easy import into a spreadsheet. The most recent 50 samples are displayed in the window for observation. Warning: the Log Data function overwrites previous file information. Data previously stored in the file will be lost.

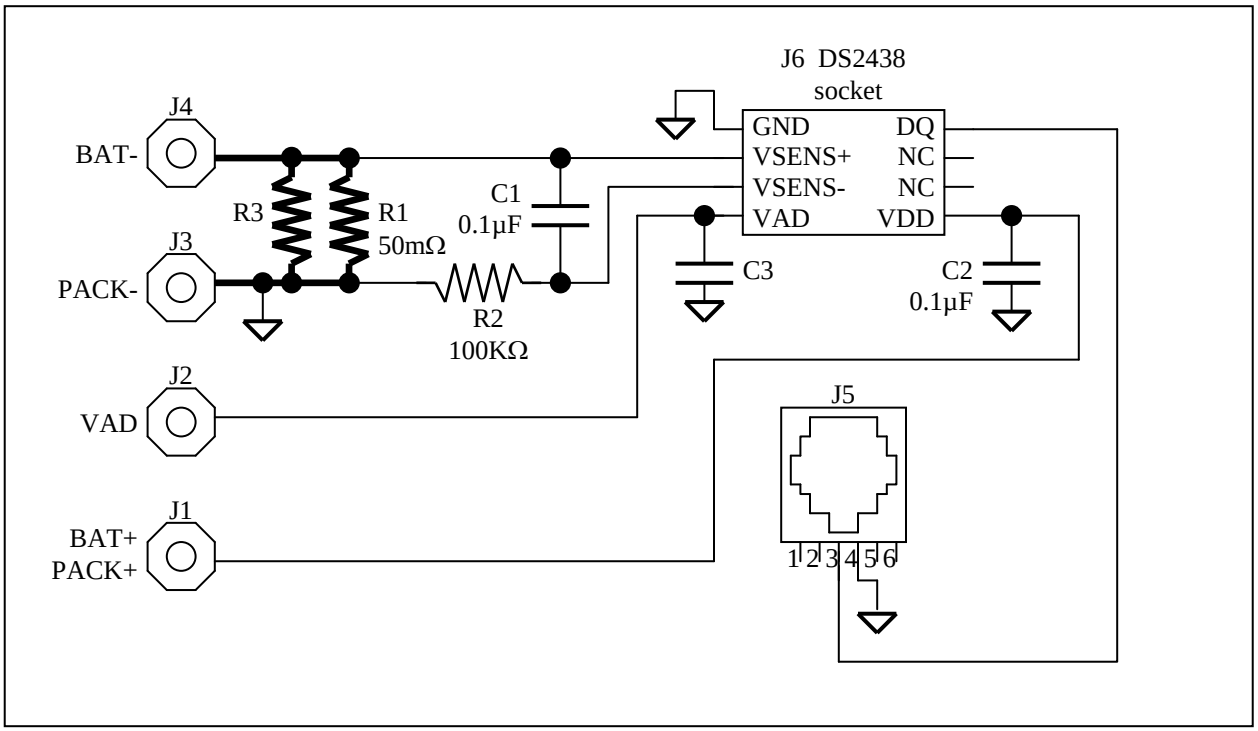
NONVOLATILE MEMORY

The Memory Screen in the DS2438 EV kit software (shown in Figure 4) allows the user to read and program the EEPROM memory in the DS2438. Memory pages 3 through 6 are general purpose data storage that can be programmed and read at any time. The upper 4 bytes of Page 7 are only accessible when the CCA and DCA are disabled via the IAD or CA bits in the Status/Configuration Register. To display the contents of DS2438 memory, press the Read Memory button. To program DS2438 memory, enter the desired data and press the Program Memory button.



Saving and Opening Data Sets. To save a particular set of data to a file for future use, click File in the menu bar, select Save, and specify a file name. To load a data set from a file, click File in the menu bar, select Open, and select the file.

EVALUATION BOARD SCHEMATIC



REVISION HISTORY

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	040307	Initial release.	—
1	8/09	Changed the ordering part number from DS2438K to DS2438EVKIT+; deleted references to DS2438K software CD and added where the software can be downloaded from the Internet.	1, 2

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