



## DS2782EVKIT+ Standalone Fuel Gauge IC Evaluation Kit

[www.maxim-ic.com](http://www.maxim-ic.com)

### FEATURES

- Demonstrates the capabilities of the DS2782 Standalone Fuel Gauge, including:
  - Estimation of available capacity for Li+ cells
  - Voltage measurement
  - Current measurement
  - Current accumulation
  - Temperature measurement
  - Information storage
  - Identification
- Interfaces to the USB port of a PC running Windows® XP or older operating system

### EVALUATION KIT CONTENTS

1 pc. Evaluation Board  
1 pc. DS9123O USB 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 battery and a power supply and/or load circuit.

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## INTRODUCTION

The DS2782 evaluation kit (EV kit) makes performance evaluation, software development, and prototyping with the DS2782 Standalone Fuel Gauge easy. The evaluation board interfaces to a PC through a DS91230 USB Adapter and RJ-11 cable connection.

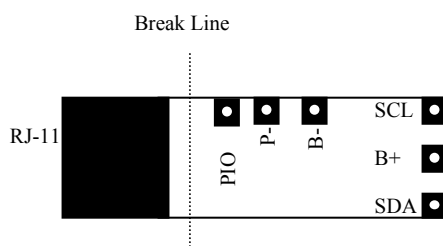
The DS2782 EV kit evaluation software gives the user complete control of all functions of the DS2782. Separate control tabs allow the user access to all EEPROM and RAM memory locations, all control registers, and real-time updates of all monitored parameters. The software also incorporates a data-logging feature to monitor a cell over time.

The evaluation board circuit is designed to provide the DS2782 with accurate parameter measurements. Kit demonstration boards will vary as they are improved upon over time. For information on the demonstration board circuits refer to the individual board datasheets located online at [www.maxim-ic.com](http://www.maxim-ic.com).

## SETUP AND INSTALLATION

### BOARD CONNECTIONS

Connections to the TSSOP demonstration board are best made either by soldering directly to the pads or by using cables with mini-grabber clips. Communication to the TSSOP board can be accomplished either through the RJ-11 jack by connecting the provided standard six conductor RJ-11 cord or by wiring directly to the SDA, SCL and P- pads. In the latter case, the size of the board can be reduced by snapping off the RJ-11 jack along the break line, see Figure 1. To utilize the demonstration software, the SDA, SCL and PAC- lines must be connected to the DS91230 communication brick using either of the two methods described.



**Figure 1: Communication Connections**

Figures 2a and 2b show the recommended circuits to simulate charging and discharging. The Lithium-Ion cell is connected between the B+ and B- pads. The battery charger/power supply or circuit load is connected between the B+ and P- pads. The evaluation software can be run in either configuration as long as a cell is connected between the B+ and B- terminals providing a minimum of 2.5 volts to power the DS2782. Leaving the PIO pin unconnected does not interfere with the operation of the demonstration board. Refer to the datasheet for the operation of this pin.

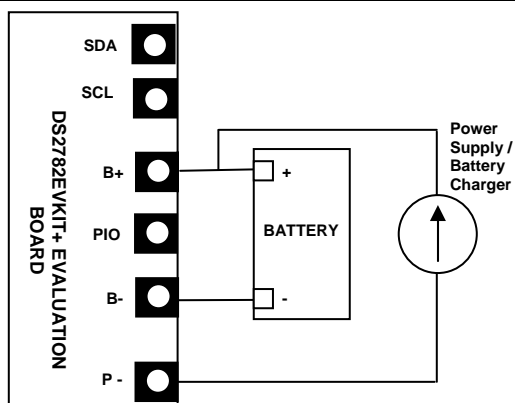


Figure 2a: Charging Circuit

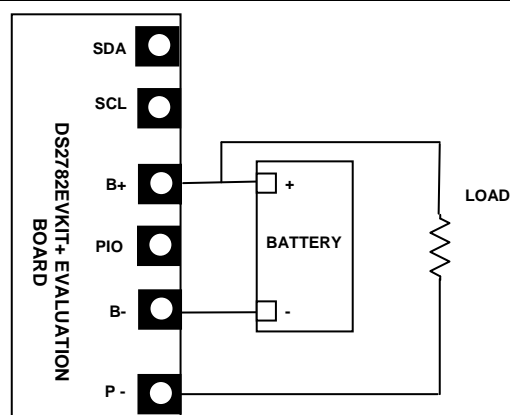


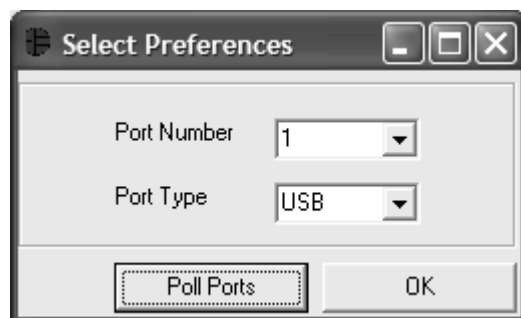
Fig 2b: Discharging Circuit

## SOFTWARE INSTALLATION

To install the DS2782 EV kit software, exit all programs currently running and download the latest version at [www.maxim-ic.com](http://www.maxim-ic.com). Unzip the compressed file and double click the SETUP.EXE icon to begin the installation process. Follow the prompts to complete the installation. The DS2782 EV kit software can be uninstalled in the Add/Remove Programs tool in the Control Panel. After the installation is complete, open the DS2782K folder and run DS2782K.EXE or select DS2782K from the program menu. A splash screen containing information about the evaluation kit appears as the program is being loaded.

## SELECTING THE COMMUNICATION PORT

The first time the software runs, the Select Preferences window may appear. In this window, select either serial or USB communication and the port number; then hit OK. The DS2782 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 DS91230, click the Poll Serial Ports button. Warning - automatically polling for the DS91230 can disrupt other devices connected to your computer's COM ports.



## PROGRAM MENUS

Several pull down menu options have been provided to simplify use of the DS2782 EV kit software for the user. Their functions are individually detailed below.

### FILE MENU



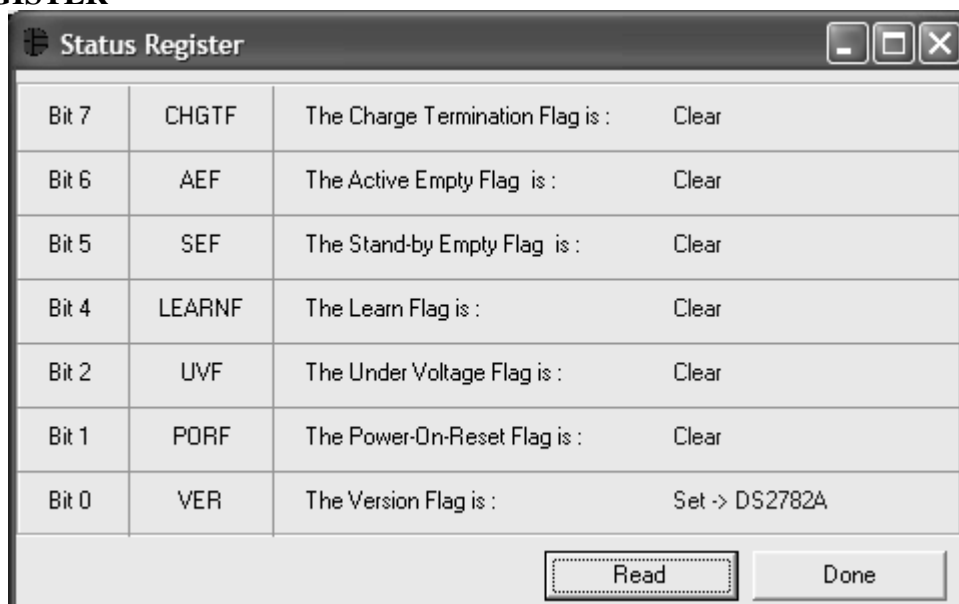
The File Menu allows the user to store and recall information to and from a file directly into the text boxes on the Parameters Tab. These functions do not directly write or read the DS2782. It is still necessary for the user to store or recall this information to or from the device by clicking on the Write & Copy or Recall & Read buttons on the Parameters Tab.

### REGISTERS MENU



The Registers Menu gives immediate access to all four status and function registers of the DS2782. Selecting any of the registers will open an individual control window giving the user a description of each register bit and the ability to read or write it. See the status register window example.

### STATUS REGISTER



The present state of all register bits are displayed immediately upon opening the register window. R/W locations contain a selection field or command button to allow the user to determine their state. Pressing

the WRITE button will write the new value to the register and read the corresponding register inside the DS2782 to verify the correct value was written. The Control Register is stored in EEPROM, so when the WRITE command is issued, the value is written and copied to EEPROM without changing the values of the remainder of the Parameter EEPROM block.

## PREFERENCES MENU



The Preferences Menu allows the user to change COM port settings at any time. Edit Preferences opens the Select Preferences window. See Selecting the Communication Port above.

## HELP MENU



Selecting the About topic from the Help Menu will open a window containing information about the current revision of this program and Dallas Semiconductor.

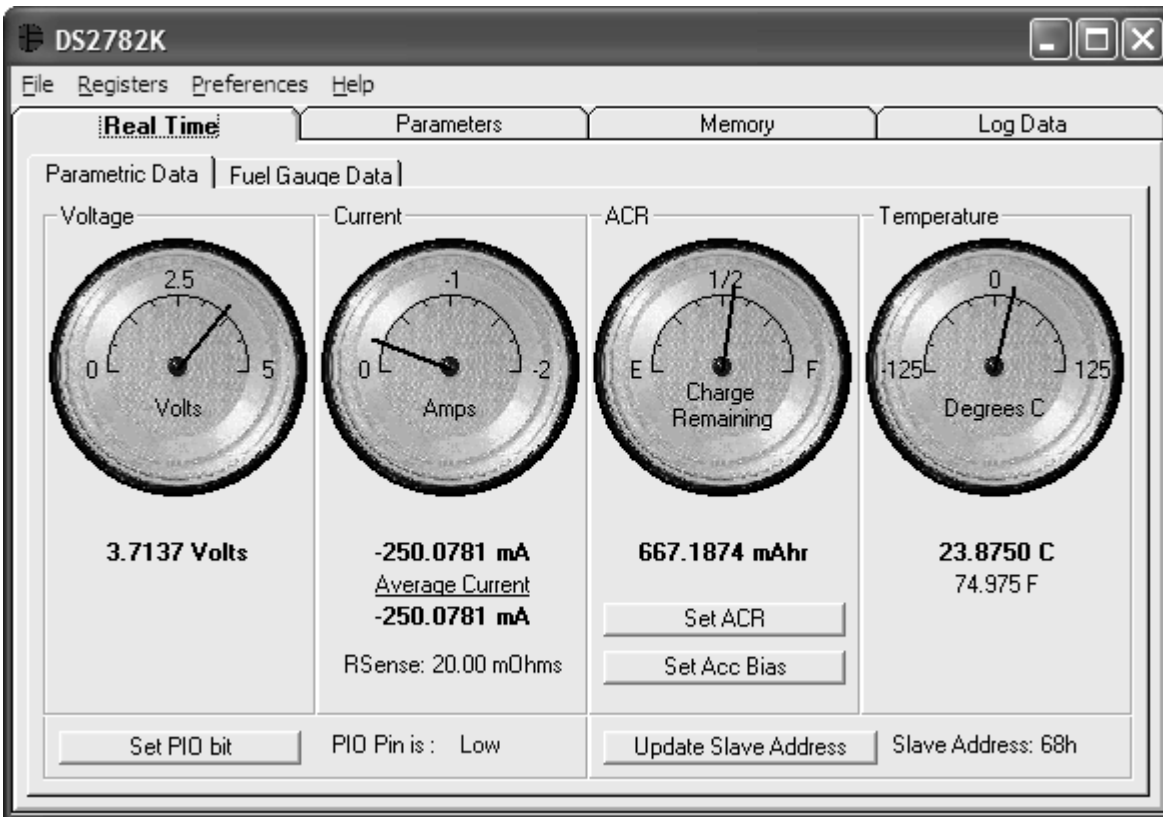
## PROGRAM TABS

All functions of the program are divided under four tabs in the main program window. Left click on the appropriate tab to move to the desired function page. Located on the Real Time tab is all of the information measured and calculated by the DS2782. That data is divided between the Parametric Data Tab and Fuel Gauging Tab. The Parameters Tab gives the user access to the entire Parameter EEPROM memory block in terms of Application Units and Device Units. The Memory tab displays the contents of every register and memory location inside the DS2782 and allows the user to alter the data. The Data Log tab allows the user to store all real time information to a file and view the data in a graphical form.

## REAL TIME TAB

The Real Time data is divided into two tabs: Parametric Data and Fuel Gauge Data. The Parametric Data Tab contains all of the real time measurements taken by the DS2782. The Fuel Gauge Data contains all of the values calculated by the DS2782.

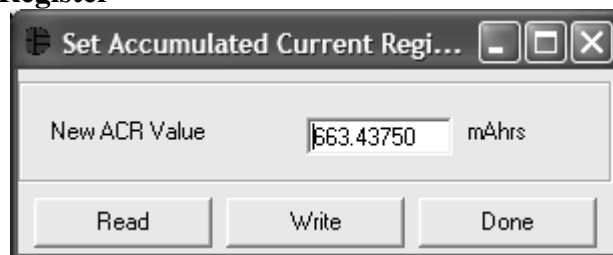
## Parametric Data Tab



The Parametric Data Sub Tab displays the latest real-time measurements of cell voltage, temperature, current and accumulated charge with both analog meter readouts and digital values. The sense resistor value used to calculate the current reading is shown in the current section. Go to the sense resistor value on the Parameters Tab to change this value

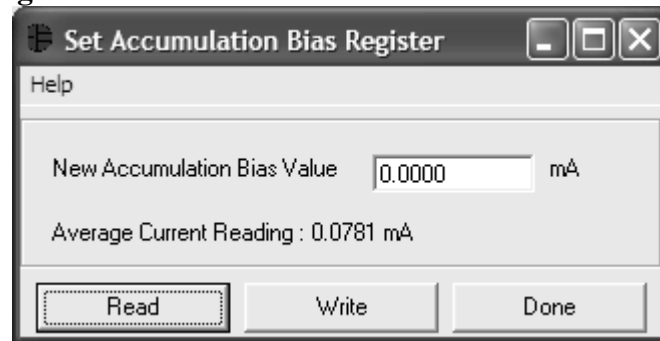
The present states of PIO pin is shown at the bottom left of the window. There is also a button to toggle the state of the PIO pin.

### Set Accumulated Current Register



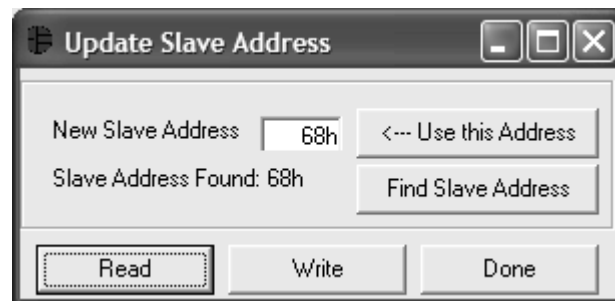
The user can bring up the Set Accumulated Current Register window by left clicking the Set ACR button. This window allows the user to enter a value for the Accumulated Current Register in mAH.

## Set Accumulation Bias Register



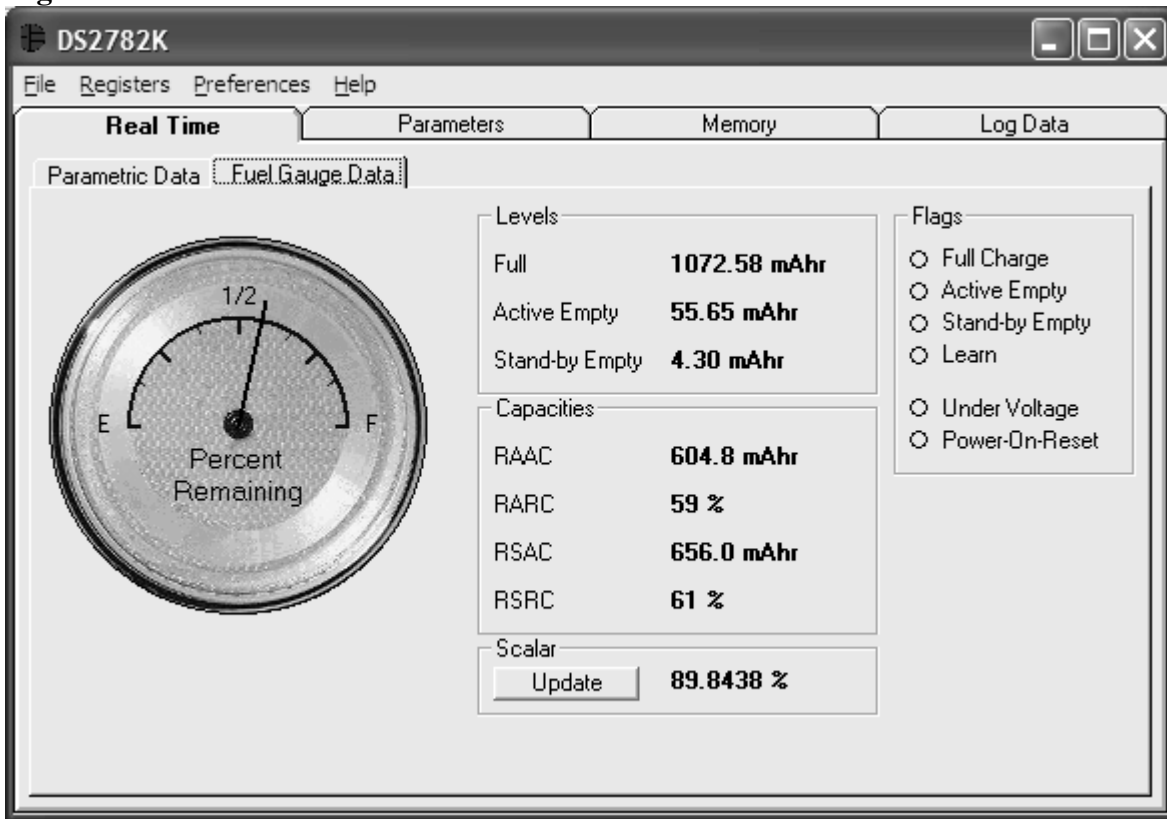
The user can bring up the Set Accumulation Bias Register window by left clicking the Set Acc Bias button. This window allows the user to enter values for the Accumulation Bias Register in mA. The value entered here will be added to the Accumulated Current Register during each current conversion. The bias value will not affect the Current Register reading, but will be reflected in the Accumulated Current Register.

## Update Slave Address



When the DS2782 EV kit software starts up, it will attempt to find the Slave Address of the device connected to the DS91230. If the device is not found at start up, the user can edit the Slave Address by left clicking on the Update Slave Address button. If the user knows the Slave Address, simply enter the correct Slave address in the text box and click the Use this Address button. If the Slave Address is unknown, clicking on the Find Slave Address button will begin a search of all addresses on the 2-wire bus. The slave address of the device can be changed by entering a new slave address in the text box and clicking the Write Slave Address button.

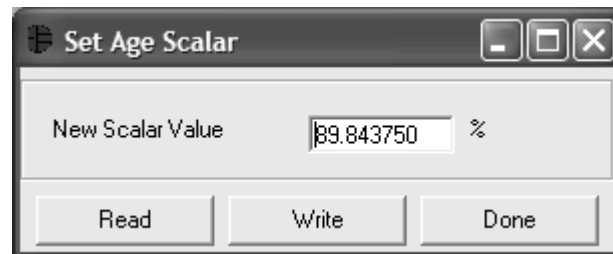
## Fuel Gauge Data Tab



The Fuel Gauge Data Sub Tab displays the latest fuel gauge calculations. The Full, Active Empty, and Standby Empty levels are calculated from the data input on the Parameters Tab. The Remaining Active Absolute Capacity (RAAC) and the Remaining Stand-by Absolute Capacity (RSAC) are displayed in terms of mAh. The Remaining Active Relative Capacity (RARC), Remaining Stand-by Relative Capacity (RSRC) are displayed in terms of percent of capacity remaining. The Analog Meter on the left displays the Remaining Active Absolute Capacity (RAAC).

The flags found in the Status Register are displayed on the right side of the window. When the Under Voltage Flag or the Power-on-Reset Flag is set, a button will appear that will allow the user to clear those bits.

### Scalar Register



The user can bring up the Set Age Scalar window by left clicking the Update button in the Scalar area. This window allows the user to read and write the Scalar value in terms of percent of the nominal capacity.



## PARAMETERS TAB

The Parameters Tab gives the user access to the entire Parameter EEPROM memory block (block 1, addresses 60h-7Fh) in terms of Application Units and Device Units. The Application Units Tab displays the parameters in units like mA, mAh, and volts. The Device Units Tab performs the calculations needed to get the application units into the units that are stored in the device like  $\mu\text{V}$ ,  $\mu\text{Vhrs}$ , and ppm as well as show the hexadecimal values that get written to the device.

### Application Units Tab

Application Units | Device Units (Read Only)

Cell Characteristics

|                        | 0 C  | 10 C | 20 C | 30 C | 40 C |
|------------------------|------|------|------|------|------|
| Full (mAhrs)           | 1108 | 1152 | 1190 | 1204 | 1214 |
| Active Empty (mAhrs)   | 100  | 71   | 58   | 50   | 46   |
| Stand-by Empty (mAhrs) | 27   | 10   | 5    | 2    | 0    |

Charge Voltage (V)  Rated Cell Capacity (mAhrs)

Terminating Current (mA)  Accumulation Bias (mA)

Active Empty Voltage (V)  Control Register

Active Empty Current (mA)

Sense Resistor (mOhms)

RSGain

The Application Units Sub Tab allows the user to read and write the Parameter EEPROM memory block. To change any of this information, simply click on the desired text field and enter the new value.

Clicking on the Load Default Set Up button will enter example data into the information fields of the Application Units Sub Tab. Once all data is in the desired format, click on the Write & Copy button to copy it to the EEPROM of the DS2782.

This information can also be stored to a file and recalled later using the Load/Save Set Up buttons or the Load/Save Parameters Set Up Menu Items. These functions do not directly write or read the DS2782. It is still necessary for the user to store or recall this information to or from the device by issuing a Write & Copy or Recall & Read buttons.

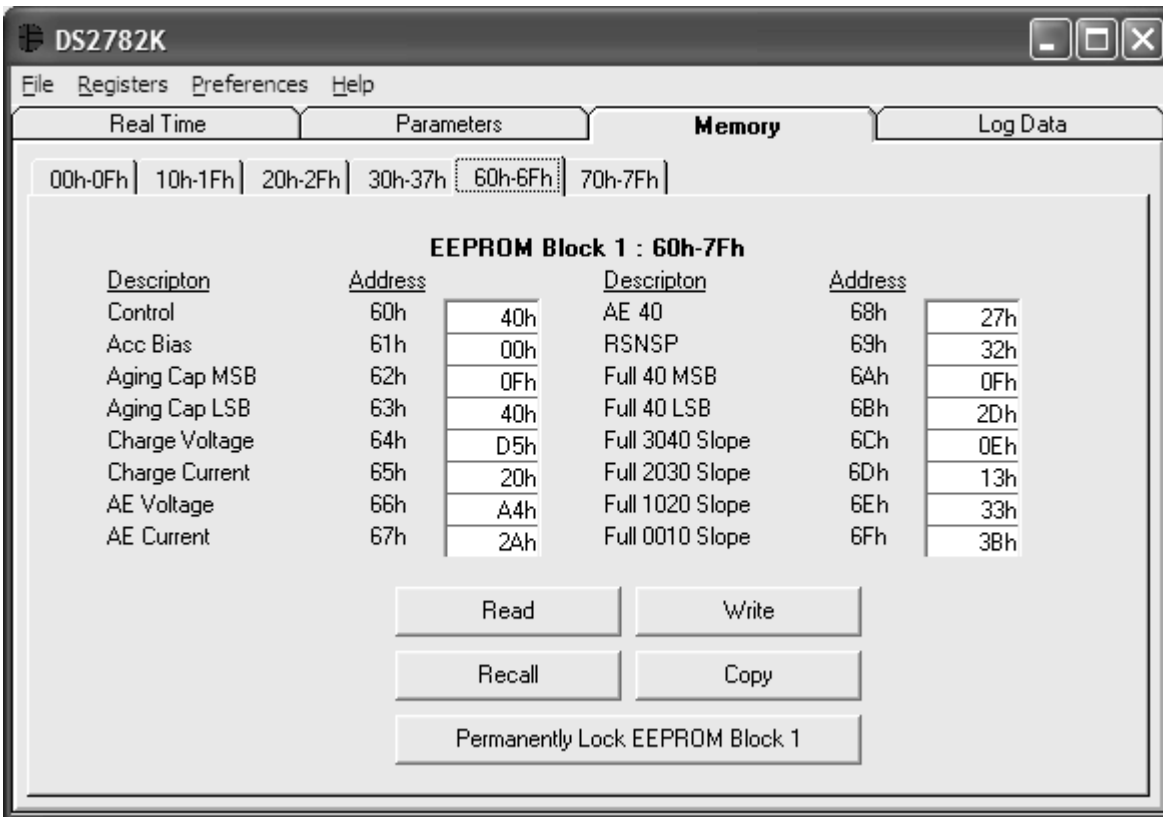
## Device Units Tab

The screenshot shows the DS2782K software interface with the 'Device Units (Read Only)' sub-tab selected. The window title is 'DS2782K' and it has a menu bar with 'File', 'Registers', 'Preferences', and 'Help'. Below the menu bar are four tabs: 'Real Time', 'Parameters', 'Memory', and 'Log Data'. The 'Parameters' tab is active, and the 'Device Units (Read Only)' sub-tab is selected. The main area displays a table of device parameters with their hex values and units. A 'Recall & Read' button is located at the bottom of the table area.

|                      | Hex Value | Device Units   |                       | Hex Value | Device Units |
|----------------------|-----------|----------------|-----------------------|-----------|--------------|
| 60h: Control         | 40h       |                | 6Ch: Full 30-40 Slope | 0Eh       | 854 ppm      |
| 61h: Acc Bias        | 00h       | 0.000000 mV    | 6Dh: Full 20-30 Slope | 13h       | 1160 ppm     |
| 62/63h: Capacity     | 0F40h     | 24.40000 mVhrs | 6Eh: Full 10-20 Slope | 33h       | 3113 ppm     |
| 64h: Charge Voltage  | D5h       | 4.15776 V      | 6Fh: Full 00-10 Slope | 38h       | 3601 ppm     |
| 65h: Charge Current  | 20h       | 1.60 mV        | 70h: AE 30-40 Slope   | 05h       | 305 ppm      |
| 66h: AE Voltage      | A4h       | 3.20128 V      | 71h: AE 20-30 Slope   | 08h       | 671 ppm      |
| 67h: AE Current      | 2Ah       | 8.4 mV         | 72h: AE 10-20 Slope   | 12h       | 1099 ppm     |
| 68h: Active Empty 40 | 27h       | 0.0380859      | 73h: AE 00-10 Slope   | 27h       | 2380 ppm     |
| 69h: RSNRP           | 32h       | 20.0000 mOhms  | 74h: SE 30-40 Slope   | 03h       | 183 ppm      |
| 6A/6Bh: Full 40      | 0F2Dh     | 24.28125 mVhrs | 75h: SE 20-30 Slope   | 04h       | 244 ppm      |
|                      |           |                | 76h: SE 10-20 Slope   | 07h       | 427 ppm      |
|                      |           |                | 77h: SE 00-10 Slope   | 17h       | 1404 ppm     |
|                      |           |                | 78/79h: RSGAIN        | 041Fh     | 1.03         |

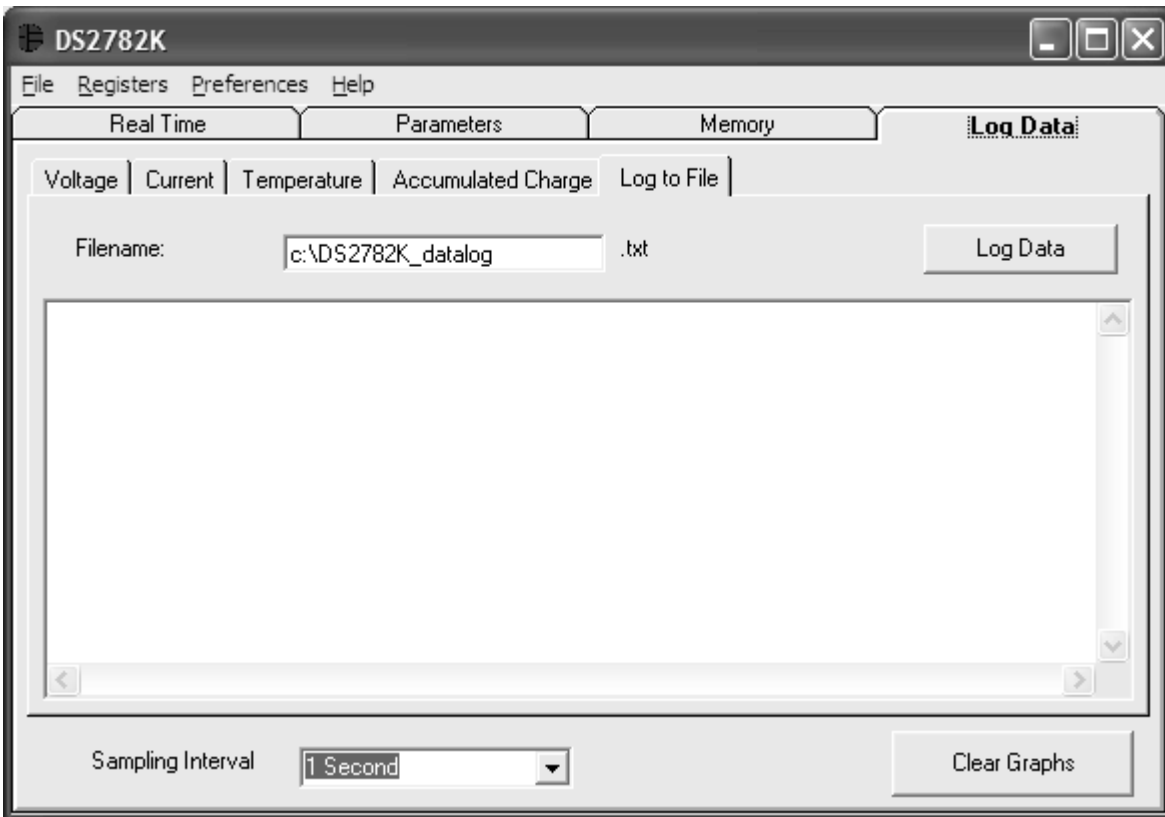
The Device Units Sub Tab is read-only. It displays the actual hexadecimal values read from the DS2782 and displays the units that are stored in the device.

## MEMORY TAB



The Memory Tab gives the user access to all 32 bytes of SRAM and all 56 bytes of EEPROM inside the DS2782. They are separated into 6 sub-tabs for convenience. Any value can be modified by clicking in that address' text box and typing a new value in hexadecimal format. The Write button will copy the entire block of data to the corresponding location inside the DS2782 (Scratchpad RAM on the EEPROM blocks). The Read button will update the entire block's text boxes with data from the DS2782 (Scratchpad RAM on the EEPROM blocks). Sub-tabs displaying any EEPROM data will also have Copy and Recall buttons to allow the user to transfer the data between Scratchpad and EEPROM memory internal to the DS2782. The Permanently Lock Block 0/1 buttons will permanently store the data currently located in that block's EEPROM. Warning – this data can never be changed once locked. Verify your data first by issuing a Recall and a Read.

## LOG DATA TAB

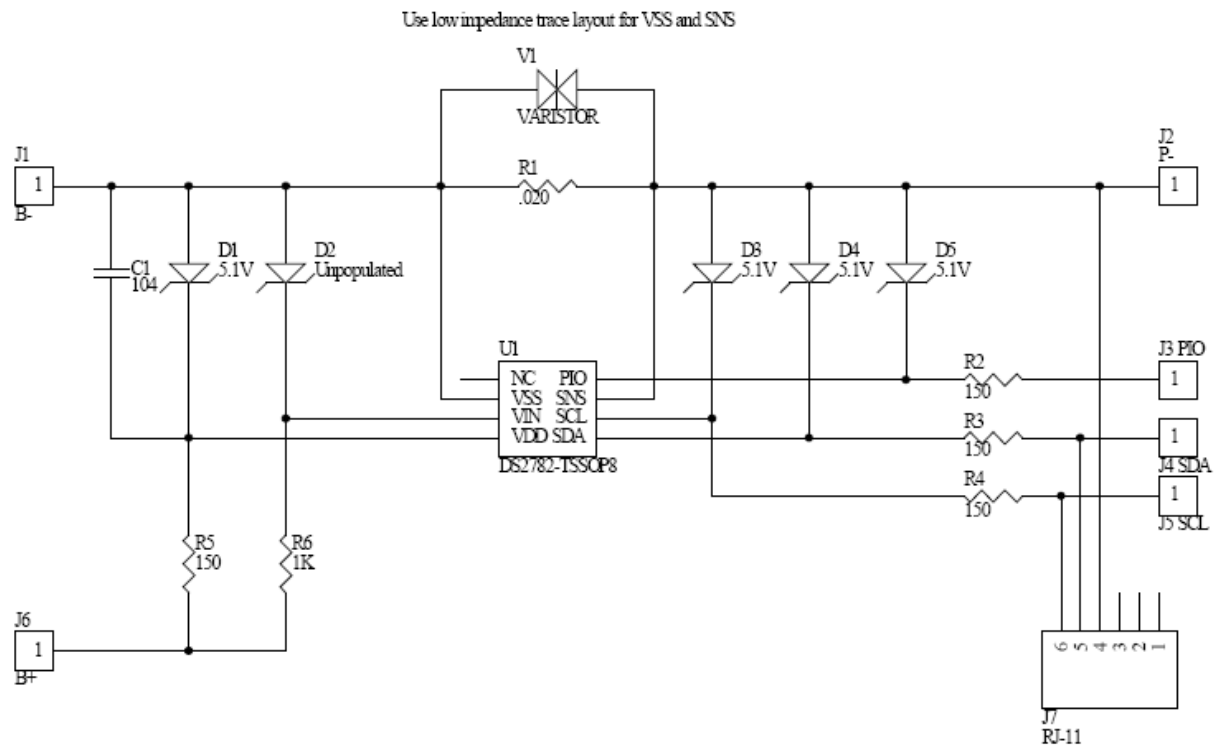


The Log Data tab allows the user to see the DS2782's real time measurements graphed over time. There are separate sub-tabs for voltage, current, temperature, and accumulated charge. Each graph displays the last 500 data points collected by the DS2782 EV kit software. The sampling interval can be adjusted from as fast as possible to 15 minutes and can be adjusted from the Sampling Interval Menu at the bottom of the window. The Clear Graphs button will clear all data from all four graphs, but does not reset the log to file function. When the Fastest sampling interval is selected, the graphs will not be updated, only the data logging is enabled.

The Log to File Sub Tab contains control information for storing all data to an ASCII file. The default filename is c:\DS2782K\_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>AveCurrent<tab>Temperature<tab>ACR<tab>Full<tab>
AE<tab> SE<tab> RAAC<tab> RARC<tab> RSAC<tab> RSRC<tab> Status<tab> Scalar”
```

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.



**REVISION HISTORY**

| <b>REVISION<br/>DATE</b> | <b>DESCRIPTION</b>                                    | <b>PAGES<br/>CHANGED</b> |
|--------------------------|---|--------------------------|
| 9/09                     | Changed the part number from DS2782K to DS2782EVKIT+. | All                      |