

**General Description**

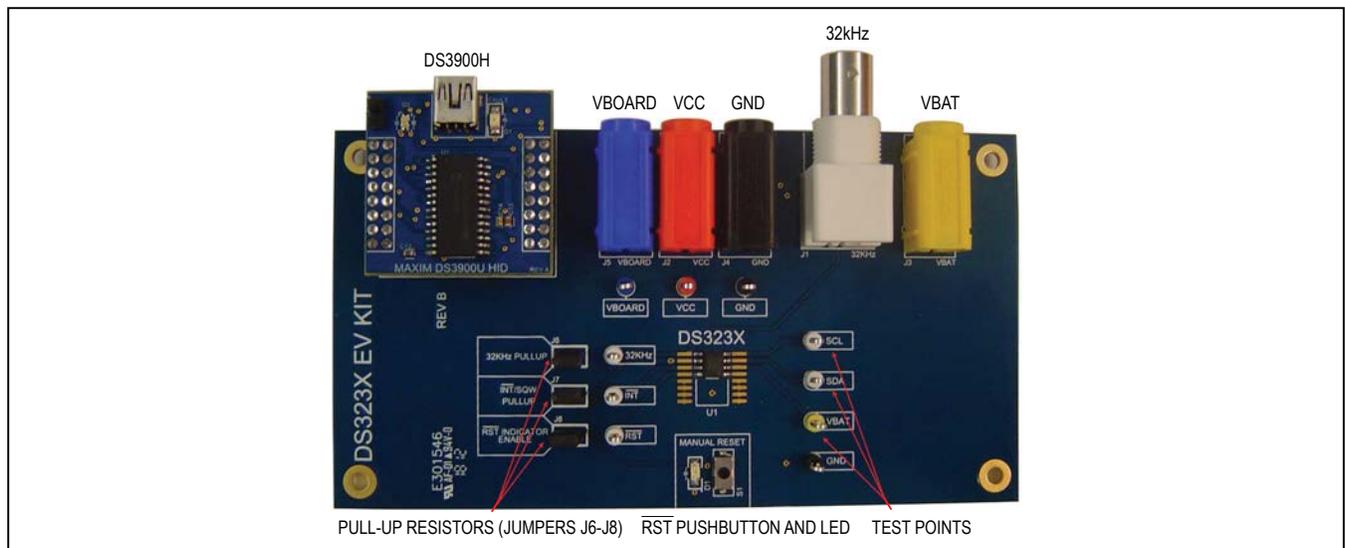
The DS3231MZ/DS3232M (DS323X) evaluation kit (EV kit) is a fully assembled and tested circuit board with an accompanying application program that demonstrates the operation of the DS3231M or DS3232M temperature-compensated real-time clocks. The DS3231M and DS3232M I<sup>2</sup>C real-time clocks contain an internal silicon (MEMS) resonator for its timekeeping reference. Both components constantly monitor the operating temperature, periodically adjusting the internal oscillator frequency to maintain highly accurate time information.

The EV kit includes one TCXO component soldered onto the demonstration board, a USB I/O communications module for evaluation kits (DS3900H2), and a CD containing the application program and instructions. System requirements are a Windows®-compatible PC running Windows XP®, Windows Vista®, or later, and a USB port.

The EV kit allows for optional user configuration to a single power-supply operation, and the accompanying I<sup>2</sup>C interface and application program provides easy access to manipulate register settings, while observing the various component functions of timekeeping and real-time alarm-initiated interrupts.

The EV kit also allows the user to connect their I<sup>2</sup>C master to the sample component for operational verification and/or code generation.

**EV Kit Photo**



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**Features and Benefits**

- Aid to Fast Hardware and Software Debugging
- GUI-Based Application for Ease of Use
- Allows for User-Configurable Single- or Dual-Supply Operation
- Optional Footprint Accepts 8-Pin or 16-Pin SO

**EV Kit Contents**

- Assembled Circuit Board Including the TCXO Component
- USB Communications Module for Evaluation Kits (DS3900H2)

**EV Kit Files**

FILE	DESCRIPTION
DS323XEVKit.exe	Application program

*Ordering Information appears at end of data sheet.*

## Quick Start

### Recommended Equipment

- DS3231MZ or DS3232M EV kit
- 5V, 1A power supply (PS1 = VBOARD optional I/O power)
- 5V, 1A power supply (PS2 = VCC device power)
- 5V, 1A power supply (PS3 = VBAT backup power)
- Windows XP/Vista/7 PC with USB capability
- USB-Mini type A to type B cable
- Oscilloscope (optional)

**Note:** In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software.

### Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify the EV kit dual-supply board operation.

**Caution: Do not enable the power supplies until all connections are completed.**

- 1) Verify that jumpers J6–J8 are installed, where noted. J6 and J7 connect the 32kHz and  $\overline{\text{INT}}/\text{SQW}$  output pin pullup resistors (respectively/if populated) to the VBOARD bias. J8 connects the  $\overline{\text{RST}}$  (active-low) LED anode to the VCC bias.
- 2) If using a separate VBOARD (I/O) power supply, connect the PS1 power supply across the VBOARD (J5) and GND (J4) connectors. If I/O power is going to be derived from the VCC supply, connect a banana jumper from VBOARD (J5) to VCC (J2).
- 3) Connect the PS2 power supply across the VCC (J2) and GND (J4) connectors.
- 4) Connect the PS3 power supply across the VBAT (J3) and GND (J4) connectors.
- 5) Set PS3 for +3V, 100mA, and enable the PS3 output.
- 6) Set PS2 for +3.3V, 200mA, and enable the PS2 output. The reset LED (D1) illuminates for ~250mS.
- 7) If using separate VBOARD power, set PS1 for +3.3V, 200mA, and enable the PS1 output.
- 8) Connect the USB cable (not provided) from the PC to the DS3900H2 mini-B USB connector. The D2 LED will illuminate red/blinking. Allow Windows time to recognize the new USB device and load the device driver before proceeding.

See the *Software Procedure* section.

## Software Procedure

### DS3900 USB-to-I<sup>2</sup>C Setup

**Note:** The DS3900H2 is the small daughter card located on the top-left corner of the EV kit. It converts USB to I<sup>2</sup>C and allows the GUI to communicate to the DS323X. It is important to allow Windows the time necessary to install the device driver, prior to first use.

When initially connecting the USB cable, Windows should automatically recognize this new USB device. Wait until you see the message indicating that the device is ready for use.

The application is a self-contained exe file and can now be executed from the CD or copied to any directory on the PC. No installation script is required, nor included.

### Device Prompt

On program start, select the appropriate device type and click on **OK** (see [Figure 1](#)).

If I/O is operational, the D2 LED turns green and the application automatically proceeds to the **Monitor** tab display (see [Figure 3](#)).

If I/O initialization fails, an error message is displayed (see [Figure 2](#)).

To ignore the I/O error and simply browse the GUI in demo mode (i.e., screen display only), click **OK** to view the tabs. No component or I/O operations are active in demo mode.

Otherwise, power off all supplies, recheck the connections, exit, and restart the application.



Figure 1. Device Prompt

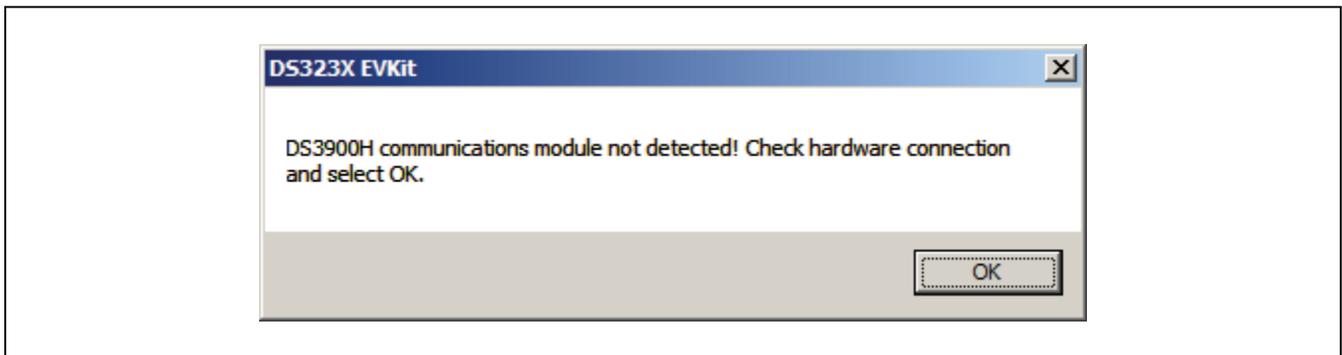


Figure 2. Error Message

## Detailed Description of Software

### Monitor Tab

The **Monitor** tab graphical user interface (GUI) screen is organized into several basic sections, as highlighted in [Figure 3](#).

When entering the **Monitor** tab, an I/O read of the component registers automatically executes to display the present contents in a human-formatted graphical display.

New register values can be entered into the appropriate registers by field using the **Monitor** tab, or alternatively, by hexadecimal register address using the **Memory** tab (see [Figure 6](#)).

In each section of the **Monitor** tab, the component settings can be manually written or read using the **Read** or **Write** buttons provided in that section. Double-click in the field desired to enter new data. A <Tab> then moves the cursor to the next dialog box.

### Monitor Tab Notes:

- Unused dialog boxes display “-.”
- Day register (classic calendar arrangement) defines Sunday = “1,” Monday = “2,” etc.
- Digital clock display: Century bit value 0 displays “20,” and Century bit value 1 displays “21.”

### Device Polling

Clicking on the **Start Real Time Monitoring** button puts the application into a continuous-read loop, updating the real-time, alarm, status, control, and temperature-sensor register contents. Once started, this button toggles to **Stop Real Time Monitoring**, and the green LED (D2) on the DS3900H2 blinks red upon each component read (see [Figure 4](#)).

If looping, clicking on the **Stop Real Time Monitoring** button halts the read loop and returns I/O control to the application. Once stopped, this button toggles back to **Start Real Time Monitoring**.

Access to all other buttons is inhibited during real-time monitoring.

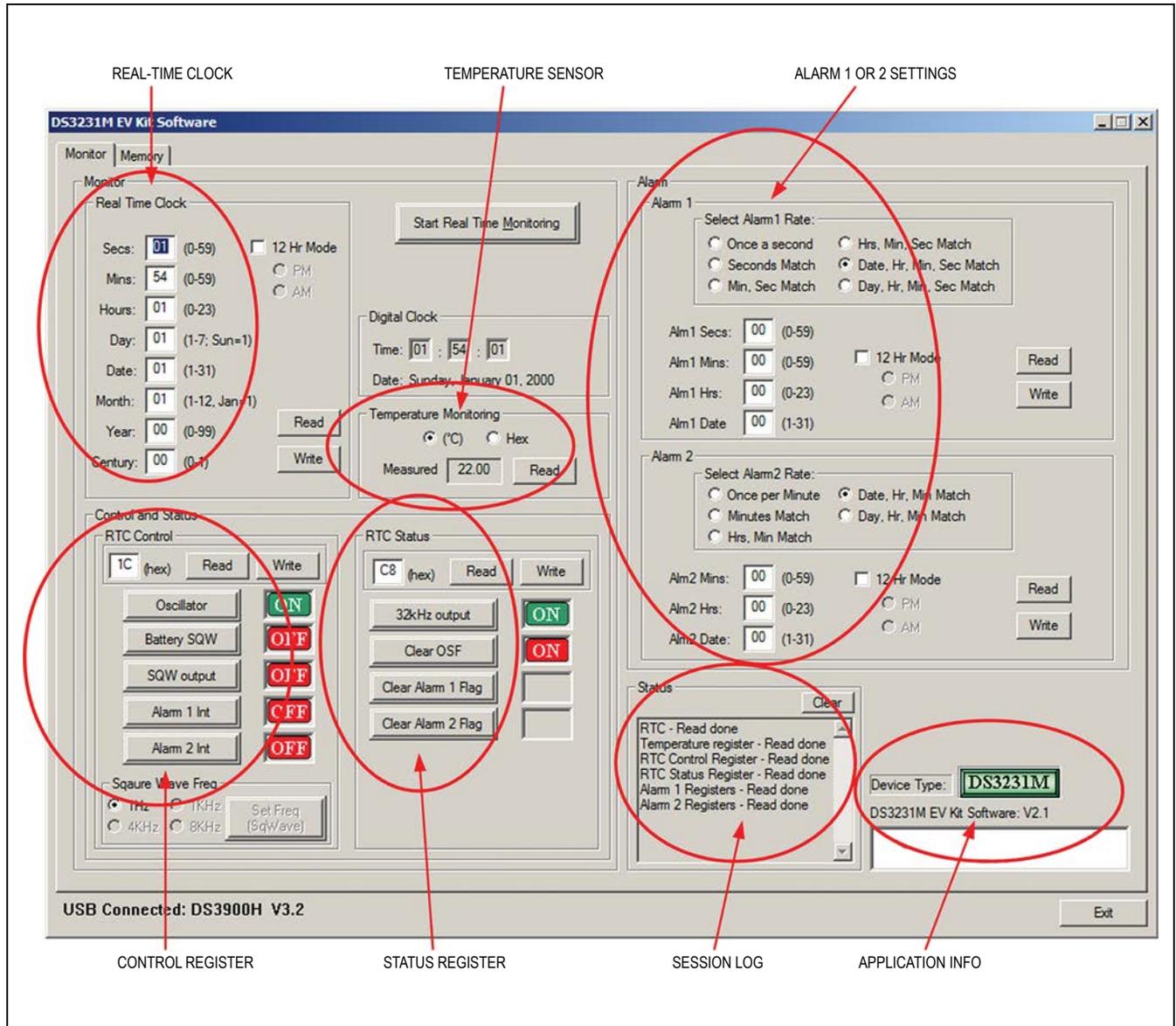


Figure 3. Monitor Tab

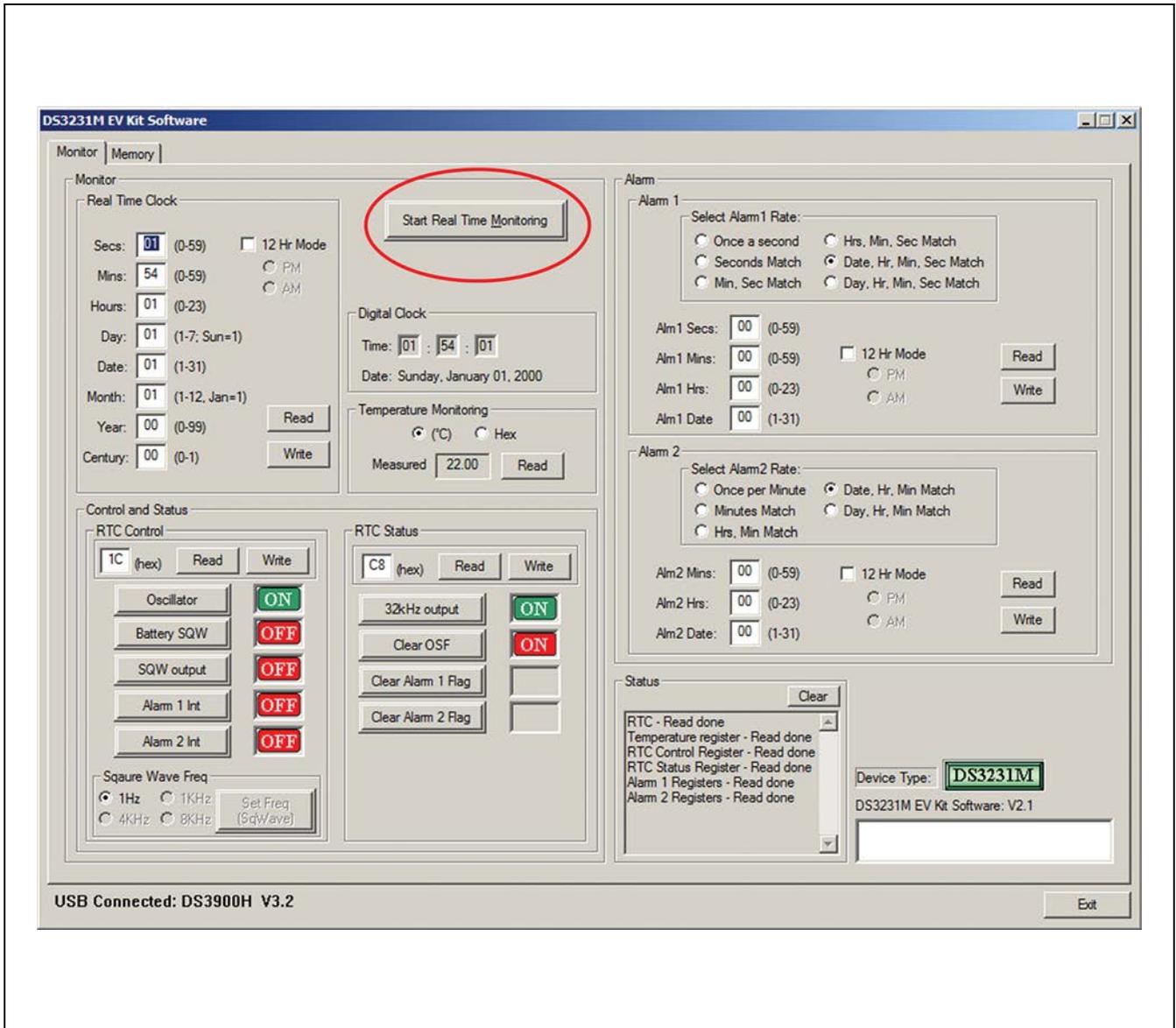


Figure 4. Monitor Loop

### Power Switching

In dual-voltage configuration, and to facilitate testing the battery-related timekeeping or alarm functions, follow the steps below:

- 1) With the power supplies enabled and the application running, stop any real-time monitoring.
- 2) Load and verify time and/or alarm values, as needed.  
**Note:** Do not exit the application.
- 3) Set PS1 (VBOARD) to 0V.
- 4) Set PS2 (VCC) to 0V. The Reset LED illuminates momentarily as the supply voltage falls below  $V_{PF}$ .  
**Note:** The component is now being powered by PS3 (VBAT).

To restore I/O, restore PS2 (VCC) and PS1 (VBOARD) to their valid conditions (in that order) and return to the desired application operation.

### Changing Tabs

To go to the desired tab, simply click on a tab located in the upper left-hand corner (see [Figure 5](#)). For example, to select the **Memory** tab, click on **Memory**; to select the **Monitor** tab, click on **Monitor**.

### Memory Tab

The **Memory** tab (see [Figure 6](#)) includes a series of manual dialog boxes, providing basic I<sup>2</sup>C communication strings to pass to and from the EV kit.

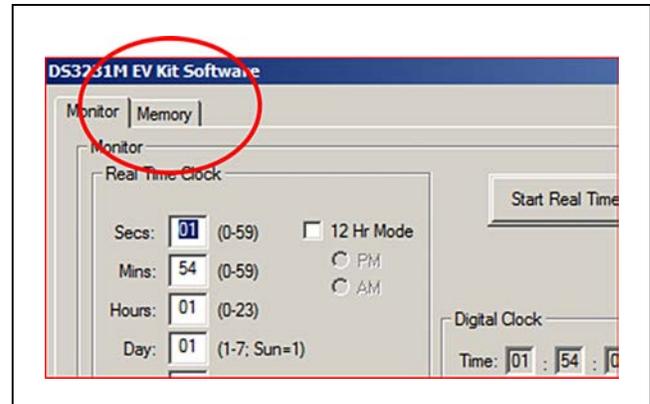


Figure 5. Changing Tabs

Buttons have been provided to execute four unique single-byte write or read instructions, two dual-byte write or read instructions, a singular bit-wise modification tool, a burst write or read of the component's RTC registers, two multi-byte (8 byte) write or read instructions, and (if DS3232M is selected) a **Memory Fill Tool** for the NV SRAM. A session log and application information are also presented.

Unused dialog boxes display "-" until some user-initiated action has occurred in that write or read dialog.

Double-click in the **Addr** box to enter a hex register address; tab to the **Data** box to enter new data. Click on the appropriate **Write** or **Read** button to execute the I/O transmission.

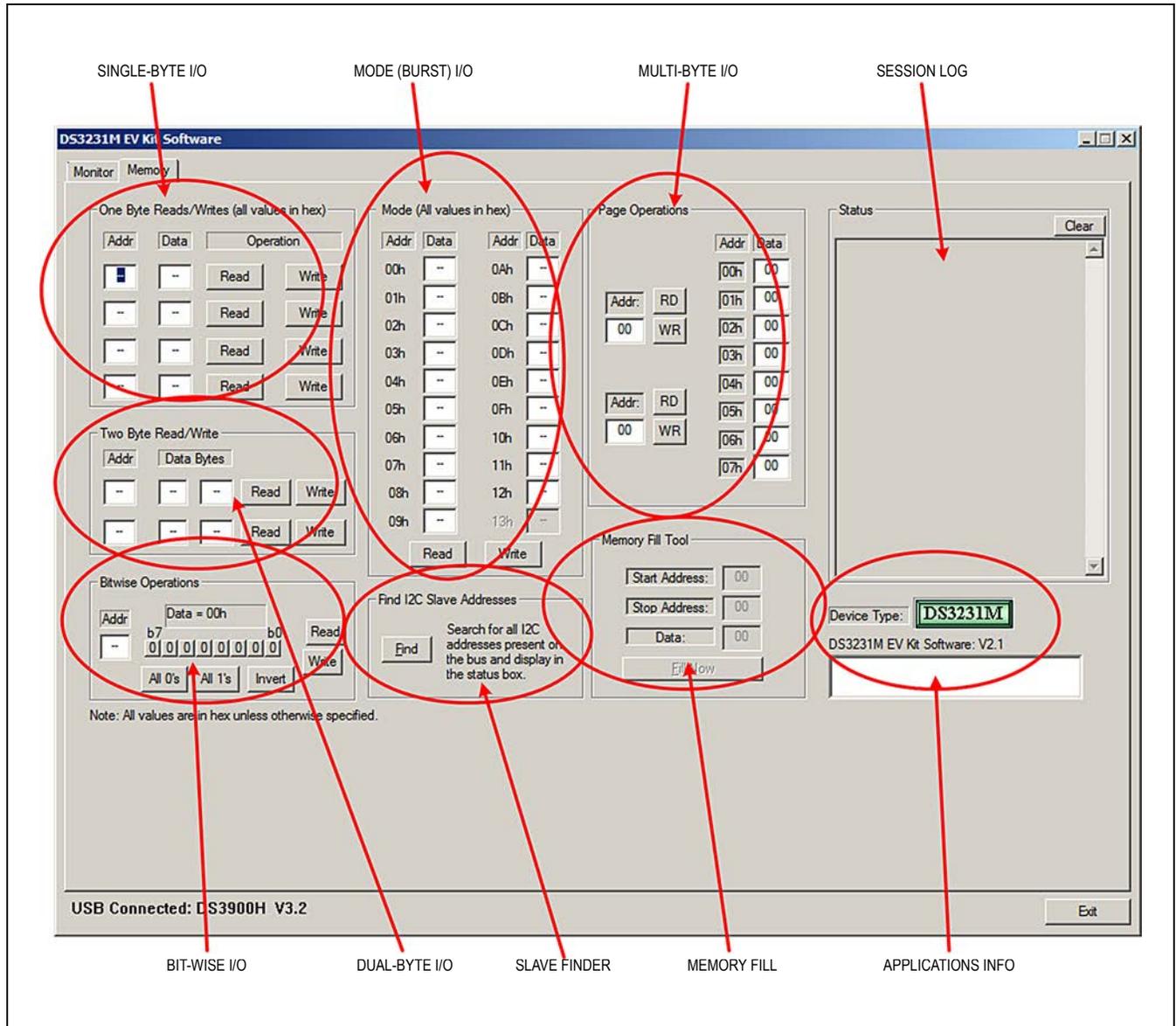


Figure 6. Memory Tab

## Register Programming

As previously noted, the **Monitor** tab **Read** or **Write** buttons are assigned and function within the predefined sections of the targeted component under evaluation. For example, clicking the **Read** button in the **Real Time Clock** group box executes a device read of only the seven RTC registers (00h–06h) and displays the result in a human-formatted 8-field display.

On the **Memory** tab, the general-purpose single-byte and dual-byte write and read functions are not predefined for any specific register or component function. The user must enter a register address, as well as the new data to be written (if applicable), and then manually initiate the I/O transfer by clicking on the **Read** or **Write** button.

Whenever a **Write** button is clicked, the new data is sent to the component and a subsequent verification read is automatically executed. The **Data** field then displays the verified contents of that register.

### Examples

#### Read Register 0Eh (Using a One-Byte Read)

Place the cursor on any one of the four optional **Addr** boxes in the **One Byte Reads/Writes** group box. Left-click to open the box and enter the hexadecimal address (in this case, “E” is sufficient and preceding zeros can be omitted).

Click on the **Read** button to the right of that **Addr** box and the **Data** field displays the content of the register (in hexadecimal). The session log also records a transaction.

#### Write 04h to Control Register 0Eh (Using a One-Byte Write)

Place the cursor on any one of the four optional **Addr** boxes in the **One Byte Reads/Writes** group box. Left-click to open the box and enter the hexadecimal address (in this case, “E” is sufficient and preceding zeros can be omitted). Tab to the next field (or move the cursor manually), and enter the new data (in this case, “4” is sufficient).

Click on the **Write** button to the right of that **Addr** box and the **Data** field displays the new verified content of the register (in hexadecimal). The session log also records a transaction.

#### Read Registers 0Eh and 0Fh (Using a Two-Byte Read)

Utilizing the internal address autoincrement feature of the component, the user can read two adjacent registers in one I/O transaction.

Place the cursor on either one of the two optional **Addr** boxes in the **Two Byte Read/Write** group box. Left-click to open the box and enter the first register address (“E” is the first and preceding zeros can be omitted).

Click on the **Read** button to the right of that **Addr** box and the two **Data** fields display the contents of the registers (in hexadecimal) in the order of their addressing. The session log also records a transaction.

#### Write 01h to Day and 23h to Date Registers [03h–04h (Using a Two-Byte Write)

Utilizing the internal address autoincrement feature of the component, the user can write two adjacent registers in one I/O transaction.

Place the cursor on either one of the two optional **Addr** boxes in the **Two Byte Read/Write** group box. Left-click to open the box and enter the first register address (“3” is the first and preceding zeros can be omitted). Tab to the first **Data** field and enter the data for the first register (“1”). Tab to the second **Data** field and enter the new data for the second register (“23”).

Click on the **Write** button to the right of that **Addr** box and the **Data** field displays the new verified content of the registers (in hexadecimal). The session log also records a transaction.

#### Bit-Wise Operations to Toggle OSF Bit in the Status Register (0Fh)

One single-byte window is designated for bit-wise operations.

Place the cursor on the **Addr** box in the **Bitwise Operations** group box. Left-click to open the box and enter the hexadecimal address (in this case, “F” is sufficient and preceding zeros can be omitted).

Click on the **Read** button to the right of that **Addr** box and the **Data** box displays the content of the register (in hexadecimal); directly below that box, each bit is represented in its weighted position by a “1” or “0.”

Assuming the register contents were initially found to be 83h (OSF, A2F, and A1F), the display should show **Data = 83** (hex) and **10000011**, respectively. If the user wants to clear only bit 7, then pressing the **bit7** button should invert the content of only that specific bit.

Click on the **Write** button and the **Data** field displays the updated and verified content of the registers (in hexadecimal). The session log also records a transaction.

### Mode (Burst Write or Read)

**Read** or **Write** buttons in the **Mode** group box are provided to load or read all component RTC registers in sequential address order.

### Memory Fill Tool

To facilitate loading of the DS3232M NV SRAM data space (14h–FFh), a user-definable **Memory Fill Tool** group box is provided to sequentially load memory space bounded by the START and STOP addresses.

**Example:** To fill the entire NV SRAM area with AAh, enter a **Start Address** of “14” (hex), a **Stop Address** of “FF” (hex), a **Data** of “AA” (hex), and click on the **Fill Now** button.

Verification (reads) can be accomplished using either a single, dual, or multiple (8) byte read function.

### Find I<sup>2</sup>C Slave Addresses

To validate I<sup>2</sup>C communications, the **Find** button in the **Find I<sup>2</sup>C Slave Addresses** group box queries for all slave addresses presently connected to the SDA bus.

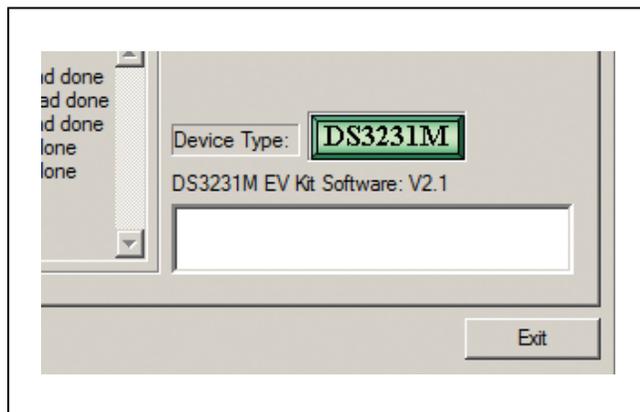


Figure 7. USB Version

### Pushbutton Reset Detection

The EV kit provides an external, manual pushbutton switch that is connected to the  $\overline{\text{RST}}$  output pin. When VCC power is present, the  $\overline{\text{RST}}$  pin is continuously monitored for a low-going edge on that signal. If an edge is detected, the DS323X component debounces the switch by pulling the  $\overline{\text{RST}}$  line low (illuminating D1). After a timeout has expired, the DS323X releases  $\overline{\text{RST}}$  to restart the CPU.

Whenever VCC is valid, depressing switch S1 pulls the reset line to ground and illuminates D1 (red LED) for ~250ms from the release of the pushbutton.

The  $\overline{\text{RST}}$  output function and D1 LED are not available when component power is provided from VBAT.

### Applications Information

On the **Monitor** or **Memory** tabs, in the lower right-hand corner, the application displays:

- The **Device Type** selected when the program was started
- The software revision identity (see [Figure 7](#))

In the lower left-hand corner of the **Monitor** tab, the USB identity and firmware version is displayed (see [Figure 8](#)).

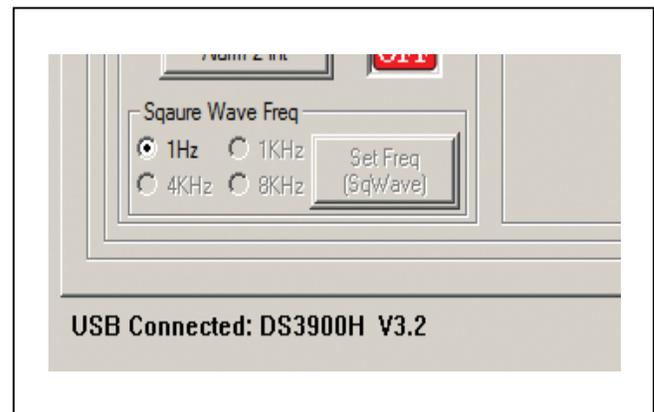


Figure 8. Apps Information

### Single-Supply Operation

The DS323X can operate using three unique power-supply configurations:

- 1) Dual supply (VCC for operation, VBAT for backup)
- 2) Single supply (VCC only)
- 3) Single supply (VBAT only)

The EV kit is assembled for use in dual-supply mode. See the *Quick Start* section.

### Single-Supply Operation Using VCC Only

To utilize the EV kit in VCC-only mode, connect a banana cable from VBAT (J3) to GND (J4); do not use PS3. Perform the following:

- 1) Verify that jumpers J6–J8 are installed (where noted). J6 and J7 connect the 32kHz and  $\overline{\text{INT}}/\text{SQW}$  output pin pullup resistors (respectively) to the VBOARD bias. J8 connects the RST (active-low) LED anode to the VCC bias.
- 2) If using a separate VBOARD (I/O) power supply, connect the PS1 power supply across the VBOARD (J5) and GND (J4) connectors. If I/O power is going to be derived from the VCC supply, connect a banana jumper from VBOARD (J5) to VCC (J2).
- 3) Connect the PS2 power supply across the VCC (J2) and GND (J4) connectors.
- 4) Verify that a USB cable (not provided) is properly connected from the PC to the DS3900H2 Mini-USB connector.
- 5) Set PS2 for +3.3V, 200mA, and enable the PS2 output. The reset LED illuminates for ~250mS.
- 6) If using separate VBOARD power, set PS1 for +3.3V, 200mA and enable the PS1 output.

See the *Software Procedure* section.

### Single-Supply Operation Using VBAT Only

To utilize the EV kit in VBAT-only mode, connect a banana cable from VCC (J2) to GND (J4); do not use PS2. Perform the following:

- 1) Verify that component C3 (0.1μF 0805 SMT capacitor) is placed (from VBAT to GND) on the pads labeled C3 (bottom side of the EV kit board).

- 2) Verify that jumpers J6 and J7 are installed (where noted). J6 and J7 connect the 32kHz and  $\overline{\text{INT}}/\text{SQW}$  output pin pullup resistors (respectively) to the VBOARD bias. J8 is not used; the  $\overline{\text{RST}}$  output is not operational in the VBAT-only power configuration.
- 3) If using a separate VBOARD (I/O) power supply, connect the PS1 power supply across the VBOARD (J5) and GND (J4) connectors. If I/O power is going to be derived from the VBAT supply, connect a banana jumper from VBOARD (J5) to VBAT (J3).
- 4) Connect the PS3 power supply across the VBAT (J3) and GND (J4) connectors.
- 5) Verify that a USB cable (not provided) is connected from the PC to the DS3900H2 Mini-USB connector.
- 6) Set PS3 for +3V, 100mA, and enable the PS3 output.
- 7) If using separate VBOARD power, set PS1 for +3.3V, 200mA, and enable the PS1 output.

See the *Software Procedure* section.

### User-Provided I<sup>2</sup>C Bus Master

If desired, the user can configure the EV kits to operate from an existing I<sup>2</sup>C bus master, providing external pullup resistors already existing on that communications bus. Perform the following:

- 1) Power off all the supplies.
- 2) Disconnect the USB cable and remove the DS3900H2 subassembly from the EV kit by lifting the module vertically from its headers.
- 3) Connect VBOARD to the desired I/O power reference (from the customer's board).
- 4) Connect GND to the ground reference from the customer's board.
- 5) Jumper the SDA signal from the SDA test point to SDA on the customer's board.
- 6) Jumper the SCL signal from the SCL test point to SCL on the customer's board.
- 7) If using dual-supply mode, power on the VBAT supply.
- 8) Power on the VCC supply.
- 9) Power on the customer's board.

See the *Software Procedure* section.

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C6	2	0.1 $\mu$ F X7R ceramic capacitors (0805) TDK CGA4J2X7R2A104K
C2	1	0.01 $\mu$ F X7R ceramic capacitor (0805) TDK C2012X7R2A103KT
C3	1	0.1 $\mu$ F X7R ceramic capacitor (0805)
C4	1	47 $\mu$ F 16V 20% tantalum capacitor Vishay/Sprague 595D476X0016C2T
C5	1	1 $\mu$ F X7R ceramic capacitor (0805) TDK CGJ4J2X7R1C105K
D1	1	LED
J1	1	Right-angle BNC AMP 5227161-1
J2	1	Red banana jack Deltron 571-0500
J3	1	Yellow banana jack Deltron 571-0700
J4	1	Black banana jack Deltron 571-0100

DESIGNATION	QTY	DESCRIPTION
J5	1	Blue banana jack Deltron 571-0200
J6–J8	3	2-pin headers 3M 961102-6404-AR or Sullins SPC02SYAN
R1, R2	2	10k $\Omega$ $\pm$ 1% resistors (0805)
R3	1	499 $\Omega$ $\pm$ 1% resistor (0805)
S1	1	Pushbutton switch C&K KSR231GLFS
U1	1	$\pm$ 5ppm, I <sup>2</sup> C real-time clock (8 SO) Maxim DS3231MZ+
		$\pm$ 5ppm, I <sup>2</sup> C real-time clock with SRAM (8 SO) Maxim DS3232MZ+
U2	1	USB HID communications module for evaluation kits Maxim DS3900H2EVKIT#
U3	2	Header, 8 x 2 FCI 67997-116HLF
—	1	PCB: DS323X EV KIT

#Denotes an RoHS-compliant device that may include lead(Pb) that is exempt under the RoHS requirements.

+Denotes a lead(Pb)-free/RoHS-compliant package.

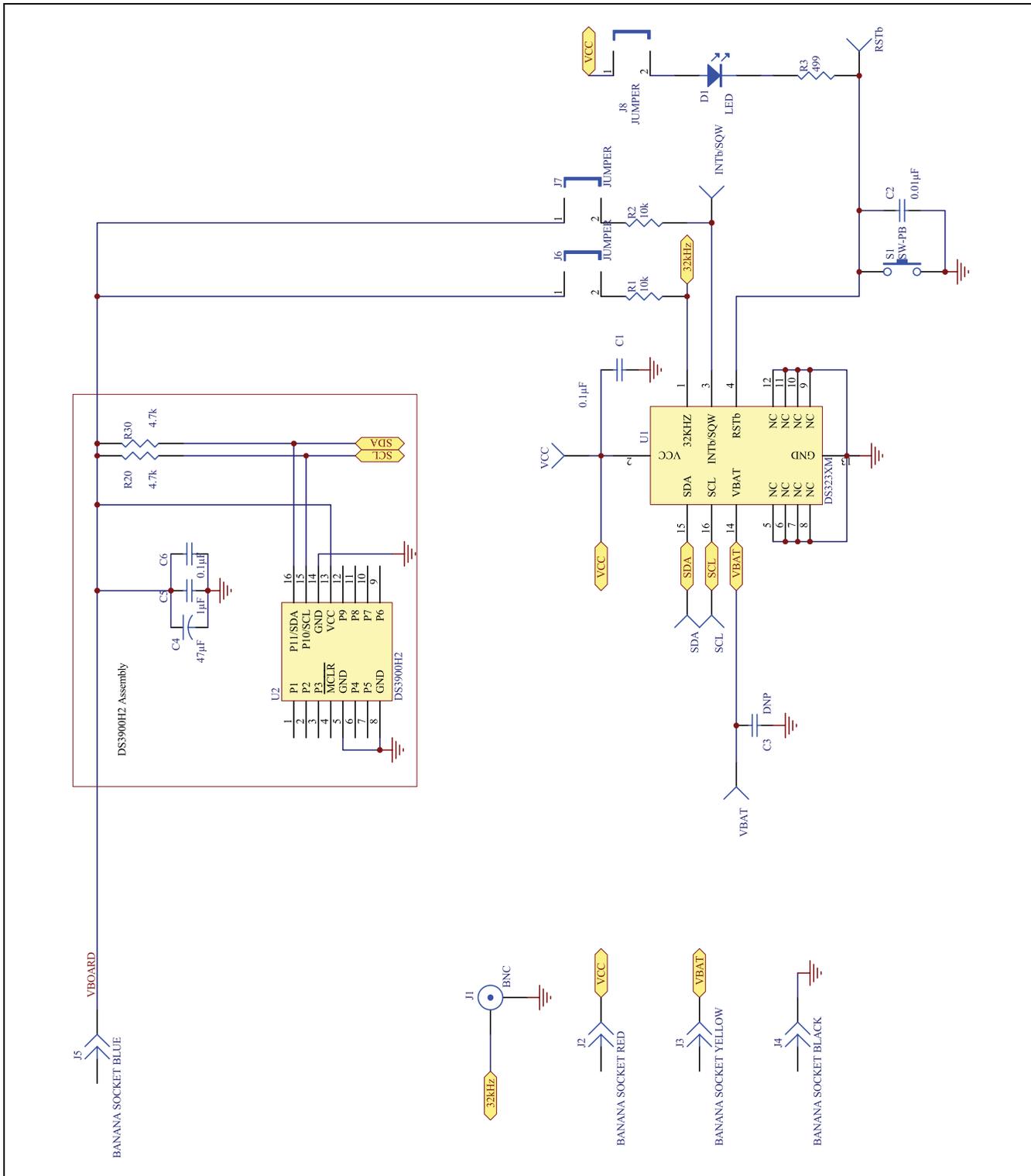


Figure 9. DS323X EV Kit Schematic

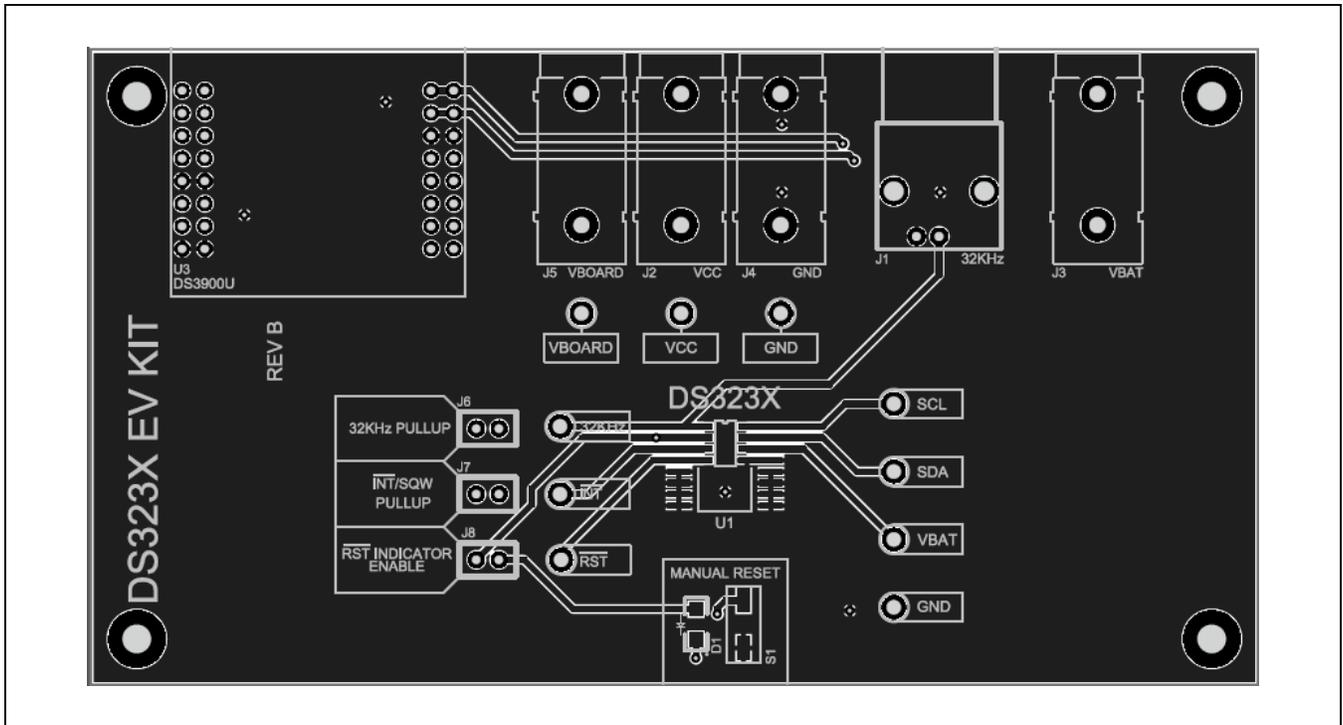


Figure 10. DS323X EV Kit PCB Layout—Top

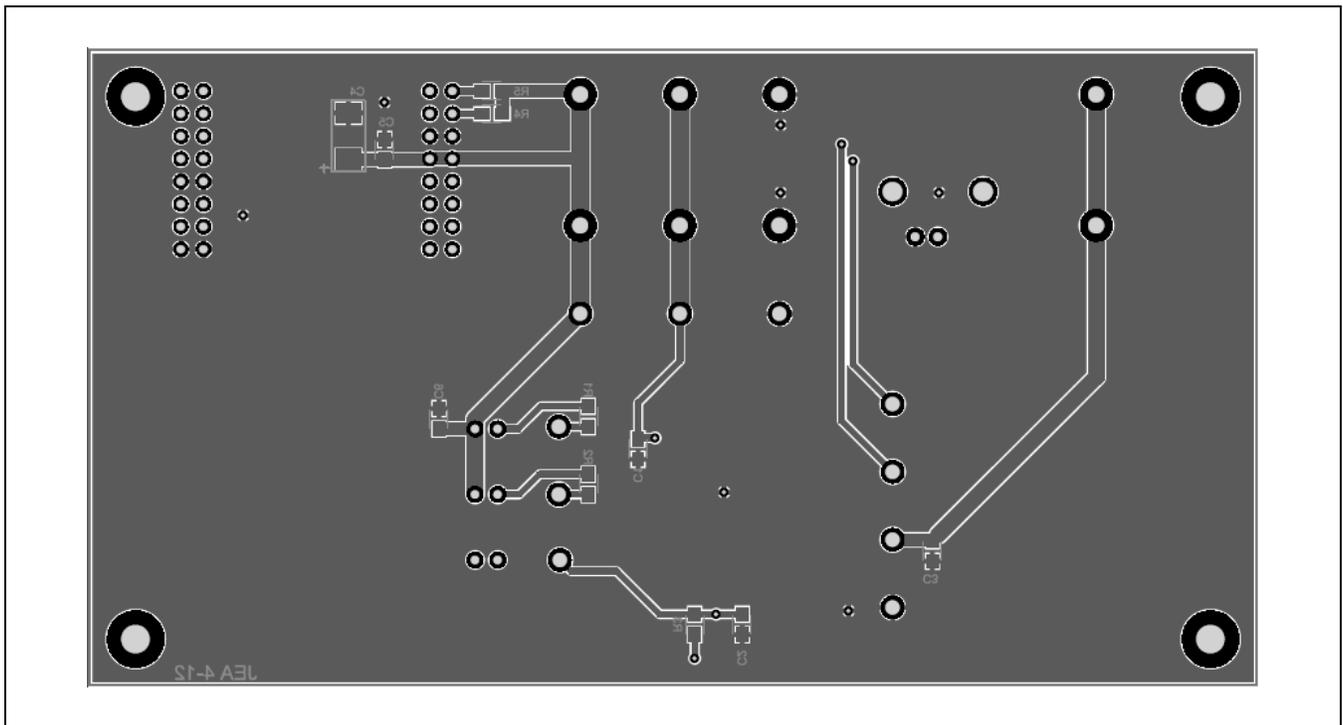


Figure 11. DS323X EV Kit PCB Layout—Bottom

### Ordering Information

PART	TYPE
<b>DS3231MZ</b> EVKIT#	EV Kit
<b>DS3232M</b> EVKIT#	EV Kit

*#Denotes an RoHS-compliant device that may include lead(Pb) that is exempt under the RoHS requirements.*

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/14	Initial release	—

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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