MAX8971 Evaluation System
Evaluates: MAX8971

General Description

The MAX8971 evaluation system (EV system) consists of the MAX8971 evaluation kit (EV kit) and the Maxim CMAXQUSB or MINIQUSB with extender board command module.

The EV kit demonstrates the IC 1.55A, 1-cell lithium-ion (Li+) DC-DC battery charger with I²C capability. The EV kit charges a single-cell Li+ battery from a DC input (AC adapter) or a USB 100mA/500mA source and provides system power from the DC input, USB input, or battery. Battery-charge current and input-current limits are independently set. Charge current and input-current limit can be set up to 1500mA. USB suspend mode is also supported.

The EV kit comes standard with the MAX8971EWP+ installed. The MINIQUSB interface board can be used to enable PC communication through the USB interface board. Windows® 2000-, Windows XP®-, Windows Vista®-, and Windows 7-compatible software along with an extender board allows an IBM-compatible PC to use to the USB port to emulate an I²C 2-wire interface. This program is menu-driven and offers a graphical user interface (GUI) with control buttons.

Features

- **DC-DC Converter Input-Current Limit**
  - ✧ **100mA to 1500mA Adjustment Range (EV Kit Standard Configuration: 500mA)**
- **250mA to 1550mA Battery-Charge Current-Limit Adjustment Range (EV Kit Standard Configuration: 500mA)**
- **50mA to 200mA Done Threshold-Adjustment Range**
- **Battery-Regulation Voltage-Adjustment Range: 4.1V, 4.15V, 4.2V, 4.35V**
- **Fast-Charge and Top-Off Timer-Adjustment Range**
- **Efficient 4MHz Switching Li+ Battery Charger**
- **I²C Serial Interface with IRQB Indicator**
- **Selectable Charge Sources Connector**
  - ✧ **2.1mm Barrel or Micro-USB**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

Ordering Information appears at end of data sheet.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3	2	4.7µF ±20%, 6.3V X5R ceramic capacitors (0402) Taiyo Yuden JMK105BBJ475MV-F or Murata GRM155R60J475ME87D
C2	1	1µF ±20%, 6.3V X5R ceramic capacitor (0402) Taiyo Yuden JMK105BJ105KV-M or equivalent
C4, C5, C8	3	1µF, 25V X5R ceramic capacitors (0603) Vishay VJ0603Y105KXXAC
C6	1	2.2µF ±20%, 6.3V X5R ceramic capacitor (0603) TDK C1608X5R0J225M or equivalent

DESIGNATION	QTY	DESCRIPTION
C7, C12	2	0.1µF, 10V X5R ceramic capacitors (0402)
C9	1	47µF ±20%, 6.3V X5R ceramic capacitor (0805) Taiyo Yuden JMK212BJ476MG-T
C10, C11	0	Not installed, ceramic capacitors
D1	0	Not installed, diode
J1	1	2 x 10 right-angle female receptacle
J2	0	Not installed, 1.25mm (0.049in) lead-free, surface-mount, right-angle-pitch header (10 circuits)
J3	0	Not installed, Micro-USB Hirose Electric ZX62-AB-5PA

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.

19-6323; Rev 1; 9/12

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
J4	0	Not installed, 2.1mm male power connector CUI Inc. PJ-002A-SMT
JU1, JU2	2	2-pin headers Sullins PEC36SAAN Digi-Key S1012E-36-ND
JU3, JU4	2	3-pin headers Sullins PEC36SAAN Digi-Key S1012E-36-ND
JU5	1	6-pin (2 x 3) header Sullins PEC36SAAN
L1	1	1µH, 0.050Ω, 2.7A inductor TOKO DFE25202C-1R0N
R1	1	0.047Ω ±1%, 0.125W resistor (0402) Panasonic ERJ2BWGR047
R2, R3, R5–R7	5	10kΩ ±1% resistors (0402)
R4	1	200kΩ, 25-turn potentiometer Bourns 3296Y-1-204LF
THRM	0	Not installed, 20kΩ NTC thermistor (0402) Murata NCP15XH103F03 (ß = 3380K)
U1	1	1-cell Li+ DC-DC charger (20 WLP) Maxim MAX8971EWP+
U2	1	Not installed
—	2	Shunts (see Table 1) Digi-Key S9000-ND or equivalent
—	1	PCB: MAX8971 EVALUATION KIT

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Bourns, Inc.	408-496-0706	www.bourns.com
CUI Inc.	503-612-2300	www.cui.com
Digi-Key Corp.	800-344-4539	www.digikey.com
Hirose Electric Co., Ltd.	81-3-3491-9741	www.hirose.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic Corp.	800-344-2112	www.panasonic.com
Sullins Electronics Corp.	760-744-0125	www.sullinselectronics.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp	847-803-6100	www.component.tdk.com
TOKO America, Inc.	847-297-0070	www.tokoam.com
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX8971 when contacting these component suppliers.*

MAX8971 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on the computer
MAX8971.EXE	Application programs
FTD2XX.INF	USB driver file
UNINST.INI	Uninstalls the EV kit software
USB_Driver_Help.PDF	USB driver installation help file

Note: *EV kit software can be found at* ***www.maximintegrated.com/evkitsoftware*** *(step 7 of procedure).*

Quick Start

Required Equipment

- MAX8971 EV kit
- MINIQUSB command module (USB cable included)
- Adjustable DC power supply capable of at least 2.3A at 14V
- A 3.3V DC power supply (optional)
- Battery or simulated battery (Figure 4)

  1-cell Li+

  Simulated battery, preloaded power supply
- Digital multimeter (DMM)
- Two 3A multimeters

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

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. Use twisted wires of appropriate gauge (20AWG) that are as short as possible to connect the battery and power sources.

1) Ensure that the EV kit has the correct jumper settings, as shown in Table 1.
2) Connect the MINIQUSB interface board J3 and J4 to the EV kit corresponding connectors.
3) Preset the DC power supply to 5V. Turn off the power supply. Do not turn on the power supply until all connections are completed.
4) Connect the EV kit to the power supply, battery or preloaded power supply, and meters. Adjust the ammeters to their largest current range to minimize their series impedance. Do not allow the ammeters to operate in their autorange mode. If current readings are not desired, short across the ammeters.
5) If jumper JU2 is not populated with a shunt, connect a second power supply to the I2CIN jumper.
6) Turn on the power supply.
7) Visit **www.maximintegrated.com/evkitsoftware** to download the latest version of the EV kit software, MAX8971Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
8) Install the EV kit software on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.
9) Connect the USB cable from the PC to the MINIQUSB board. A **Building Driver Database** window pops up in addition to a **New Hardware Found** message when installing the USB driver for the first time. If you do not see a window that is similar to the one described above after 30s, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows 2000, Windows XP, Windows Vista, and Windows 7.
10) Follow the directions of the **Add New Hardware Wizard** to install the USB device driver. Choose the **Search for the best driver for your device** option. Specify the location of the device driver to be **C:\Program Files\MAX8971** (default installation directory) using the **Browse** button. During device driver installation, Windows may show a warning message indicating that the device driver Maxim uses does not contain a digital signature. This is not an error condition and it is safe to proceed with installation. Refer to the USB_Driver_Help.pdf document included with the software for additional information.
11) Start the EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 1.
12) Normal device operation is verified when **EVKIT Operational** is displayed in the upper left corner of the EV kit window.
13) The EV kit is now ready for additional testing.

Detailed Description of Software

Graphical User Interface (GUI) Panel

The GUI shown in Figure 1 is the main window of the MAX8971 EV kit software that provides a convenient means to control the MAX8971 IC. Use the mouse or press the Tab key to navigate through the GUI controls. The correct SMBus read and write operations are generated to update the IC's internal memory registers when any of these controls are executed.

The EV kit software main window consists of two tabs, **MAIN** (Figure 1) and **Registers** (Figure 2), to provide control of the IC software-configurable features. The **MAIN** tab sheet provides group boxes, checkboxes, and pushbuttons of the charger configuration registers. Status indicators are also available to indicate the read-only registers bit setting. The **Registers** tab sheet provides a map of the device registers, as well as configuration control of each register bit.

Figure 1. MAX8971 Evaluation Kit Software Main Window (MAIN Tab)

MAIN Tab

The MAIN tab sheet provides group box controls for the **Charger Configuration** and **Status Indicators** group boxes. Changes to the controls result in a write operation that updates the appropriate registers of the charger. **Read All** buttons are available for reading the IC registers associated with the respective group box. The **Status** group box displays the **Device Address**, **Register Address**, and the last **Data Sent** in hex format. In addition, the **Status** group box also displays the values set using the **Charger Configuration** group box settings.

A **Default Settings** button resets the IC registers to their power-on default state and a **Connect** button is available for connecting to the IC when exiting demo mode. The **Auto Read** checkbox enables periodic polling of all register status indicators listed in the **Status Indicators** group box.

Charger Configuration

The **Charger Configuration** group box consists of several group boxes, checkboxes, and radio buttons that configure the IC registers.

Current Settings

The **Current Settings** group box consists of the **Input Current Limit (mA)**, **Fast-Charge Current (mA)**, and **Top OFF Current (mA)** drop-down lists, used to set the system input-current limit, fast-charge current, and top-off current, respectively. The **Pre-Qual Current (mA)** drop-down list is inactive and displays the prequalification current, which is equivalent to 10% of the fast-charge value.

The **Voltage Setting** group box consists of the **Charge Termination Voltage (V)** and **Fast-Charge Restart Threshold (mV)** drop-down lists used for setting the charger termination voltage and fast-charge reset voltage, respectively.

Status Indicators

The **Charger Interrupts** group box consists of checkboxes to disable the IRQB interrupt output during a fault condition and status indicators obtained from the IC registers. When the checkbox is not checked, the respective status indicator background is blue and the IRQB output goes low when there is a fault condition. When the checkbox is checked, the respective checkbox and status indicator background colors are dark and the IRQB output remains unaffected. A **Read Interrupts** button performs a read command of the IC Charger Interrupt Mask (CHGINT_MSK, address 0x01) and Charger Interrupt Request (CHGINT, address 0x0F) registers. When a read command is performed, the indicator displays **LOW** if the Charger Interrupt Request status bit has not changed since the last read of the register, or **HIGH** if the status bit has changed since the last read of the register.

The **Charger Status** and **Details** group boxes consist of indicators used to obtain event/status information from the IC Charger Status (CHG_STAT, address 0x02) and DETAILS1 (address 0x03) registers using the **Read Status** and **Read Details** buttons, respectively. The **Charger Status** group box indicators display **VALID** when the charger is operating within its specificed settings and displays **INVALID** when the charger is operating outside its settings. The **Details** group box displays the status conditions of the battery connected at the battery, charger, and thermistor.

The **Read All** button updates the **Bit MASK** checkboxes and all status indicators listed in the **Status Indicators** group box. The **Auto Read** checkbox polls every 10s and updates all status indicators. Check the **Auto Read** checkbox to activate this function.

Register Map Control Interface (Registers Tab)

To view the IC's register settings, select the **Registers** tab (Figure 2). The value of all control registers is displayed and updated automatically when changes are made using the GUI. Click on bit names or enter register values in hexadecimal format to manually program the IC's registers. Changes to the register map automatically update the GUI.

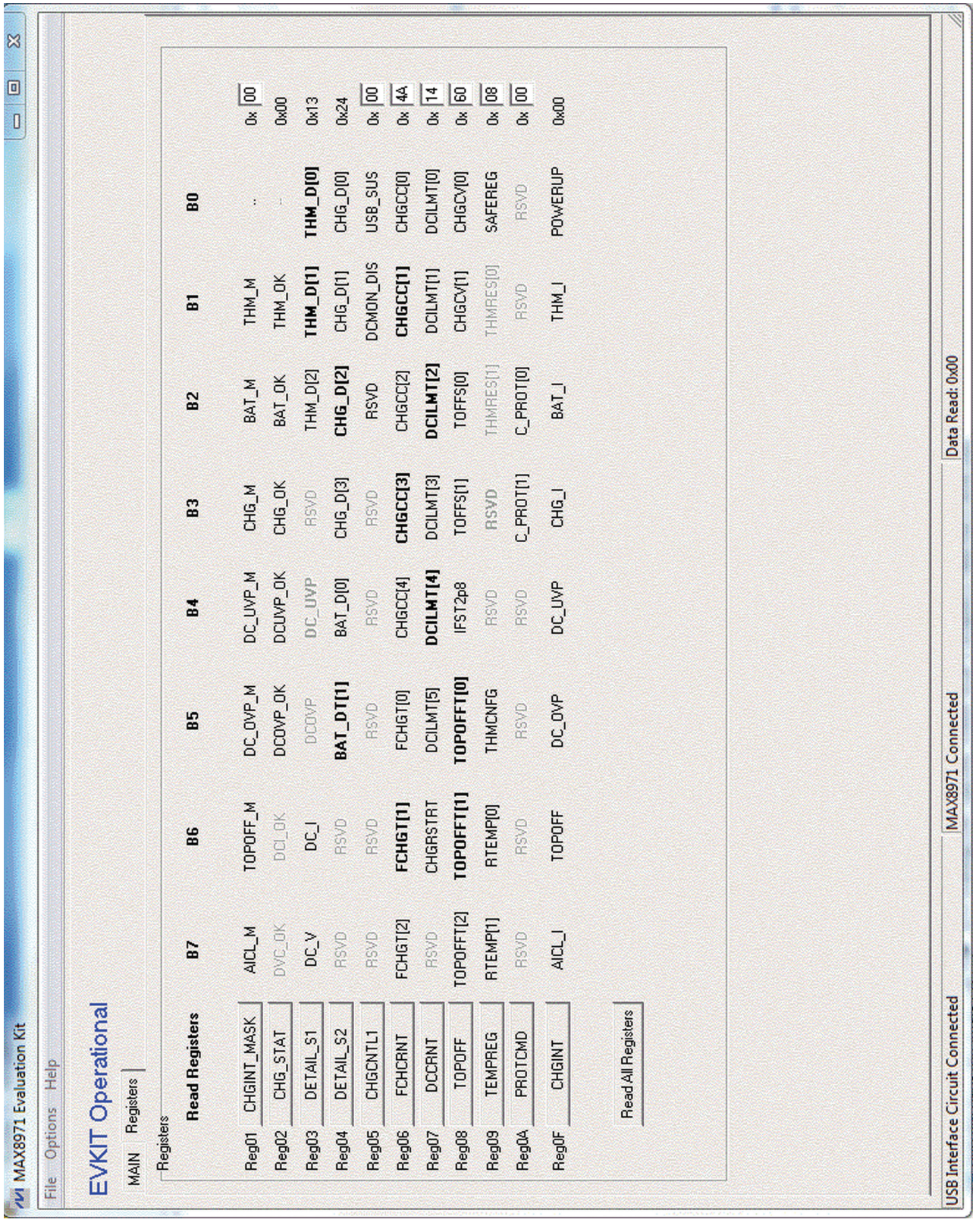

Figure 2. MAX8971 Evaluation Kit Main Window (Registers Tab)

Software Startup

Upon starting the program, the EV kit software automatically searches for the MINIQUSB interface board and the IC default 0x6A ID address. If the MINIQUSB board is not found, an error box appears (Figure 3), allowing the user to try to reconnect to the board, exit the software, or enter demo mode. See the *Demo Mode* section for additional information.

Demo Mode

The EV kit software can enter the demo mode, when the USB connection is not detected, by pressing the **Cancel** button on the popup window shown in Figure 3. The software can also enter demo mode at any time by selecting the **Options | Demo Mode** menu item from the main window menu bar. When in demo mode, all software communication to the EV kit circuit is disabled; however, most of the software GUI is functional. Demo mode allows the user to evaluate the software without hardware connectivity. To exit demo mode, select **Options | Demo Mode** from the menu bar or press the **Connect** button located at the bottom of the MAIN tab (Figure 1). In demo mode, **Demo Mode** is displayed on the panel and all indicators in the **Status Indicators** group boxes display **N/A**.

Detailed Description of Hardware

The MAX8971 EV kit demonstrates the MAX8971 switch-mode charger to charge a one-cell Li+ battery. It delivers up to 1.55A of current to the battery from inputs up to 7.5V and withstands transient inputs up to 22V. The EV kit is suited with a general DC input or USB. By connecting an external MINIQUSB, and launching the EV kit software, the user can adjust the capability of the charger. The status of charge is also reported on the EV kit GUI. Table 1 lists jumpers and associated functions that are available on the EV kit.

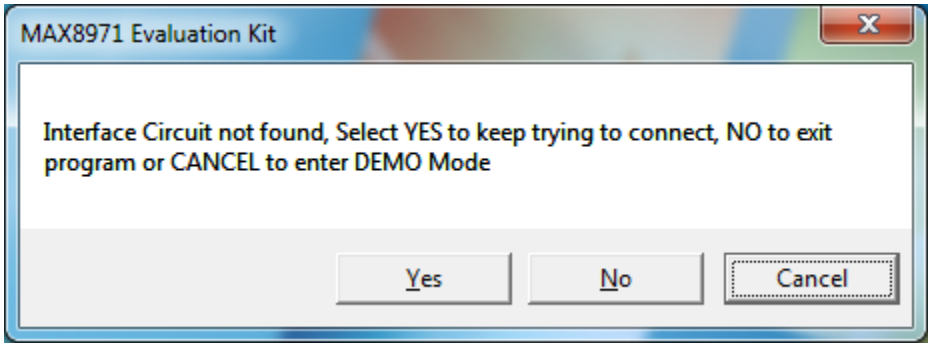

Figure 3. MAX8971 Evaluation Kit Interface Pop-Up Window

Table 1. Jumper Functions

JUMPER	NODE OR FUNCTION	SHUNT POSITION	FUNCTION
JU1	I2CIN input selector	Open	Requires an external source to I2CIN.
		1-2*	I2CIN is powered from the MINIQUSB.
JU2	THM	Installed	Shunt to disable the thermistor temperature sensor.
		Open	Open for normal thermistor function.
JU3	I2CIN	1-2*	R6/R7 (SCL/SDA) resistors pull up to I2CIN.
		2-3	R6/R7 (SCL/SDA) resistors pull up to BATT.
JU4	DC_INPUT selector	1-2	Powers DC_INPUT from USB1 (Micro-USB).
		2-3	Powers DC_INPUT from J4 (DC adapter).
		Open*	Powers DC_INPUT from power supply.
JU5	Thermistor adjustment	1-2*	THRM1 (10kΩ) is connected to THM.
		3-4	R3 (10kΩ) is connected to THM.
		5-6	R4 (20kΩ potentiometer) is connected to THM.

**Default position.*

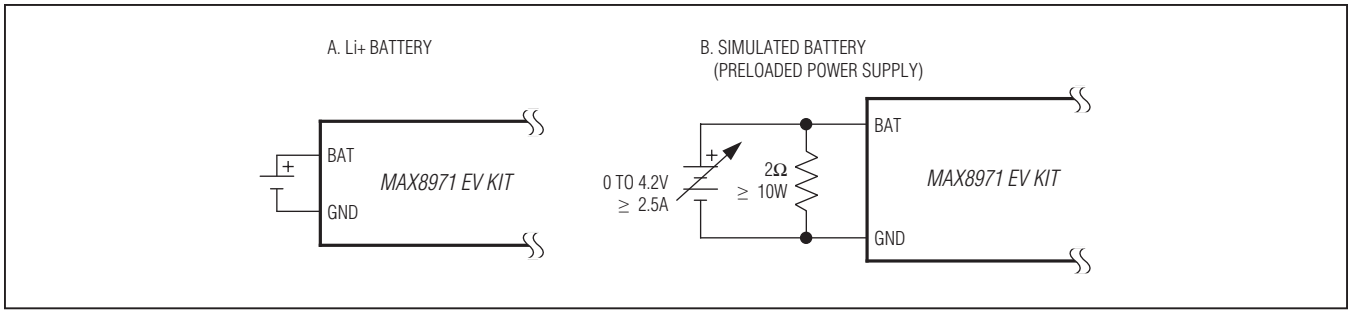

Figure 4. Battery Options for Evaluating the MAX8971 EV Kit

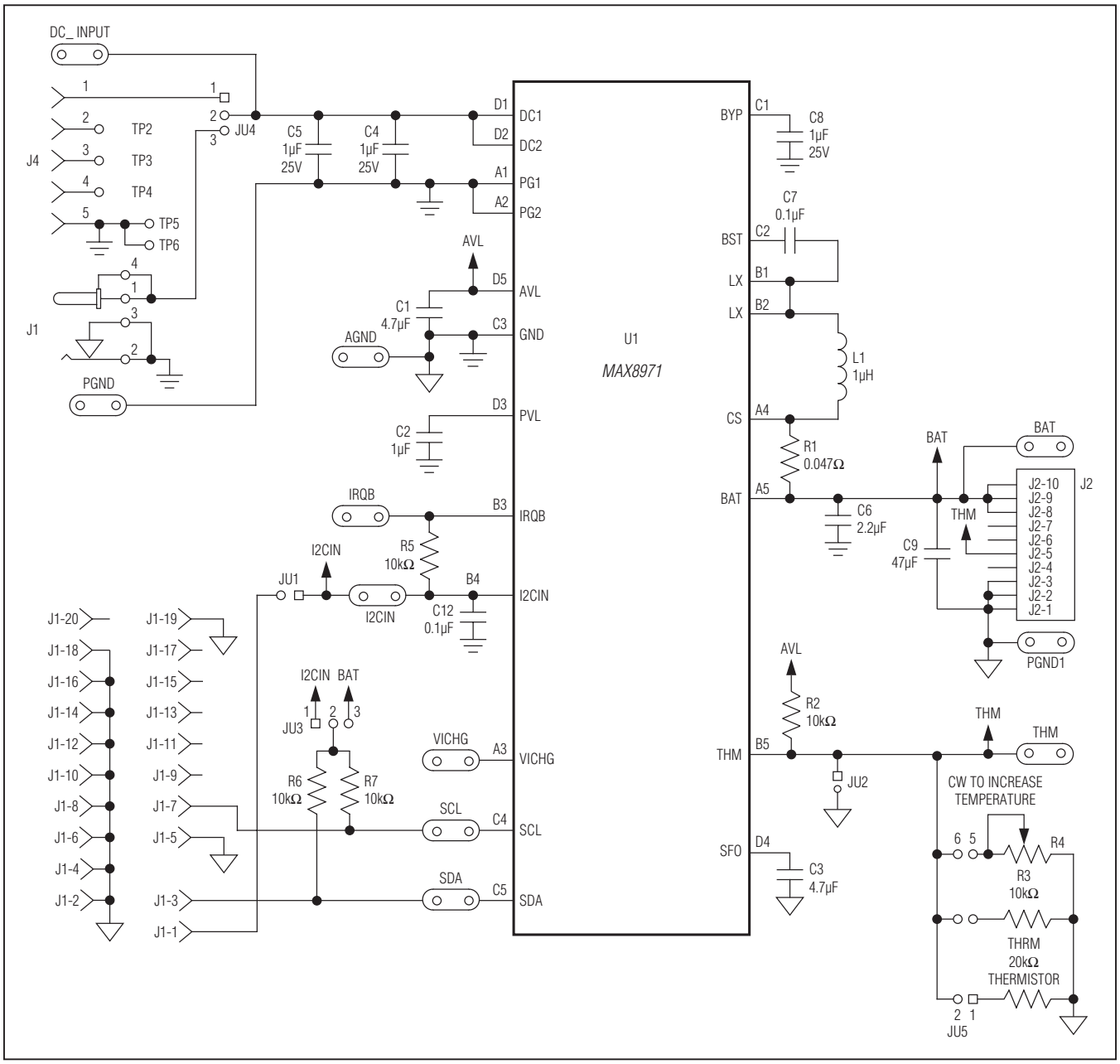

Figure 5. MAX8971 EV Kit Schematic

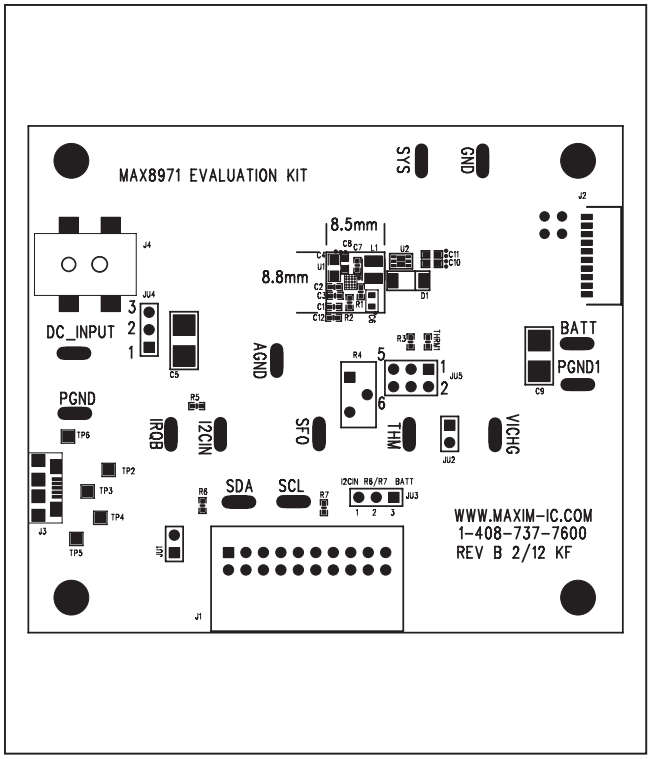

Figure 6. MAX8971 EV Kit Component Placement Guide—Component Side

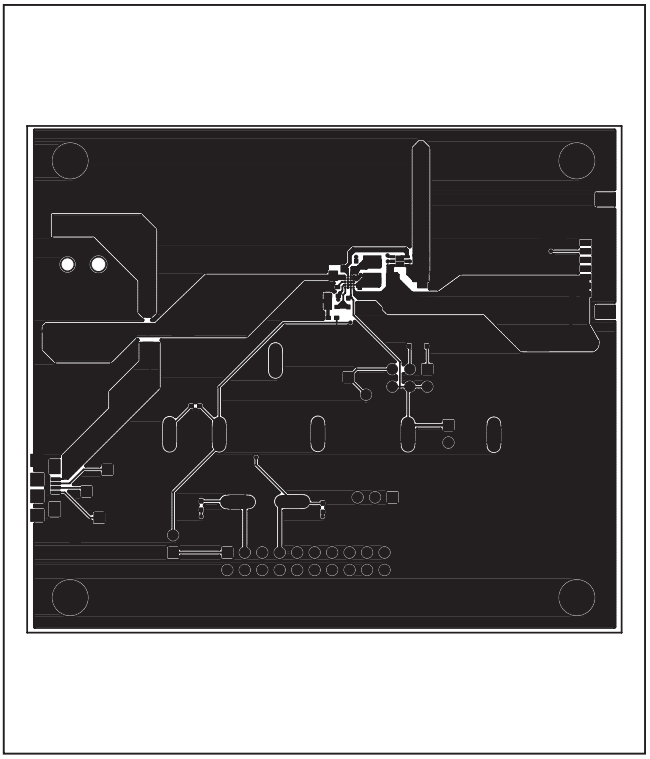

Figure 7. MAX8971 EV Kit PCB Layout—Component Side

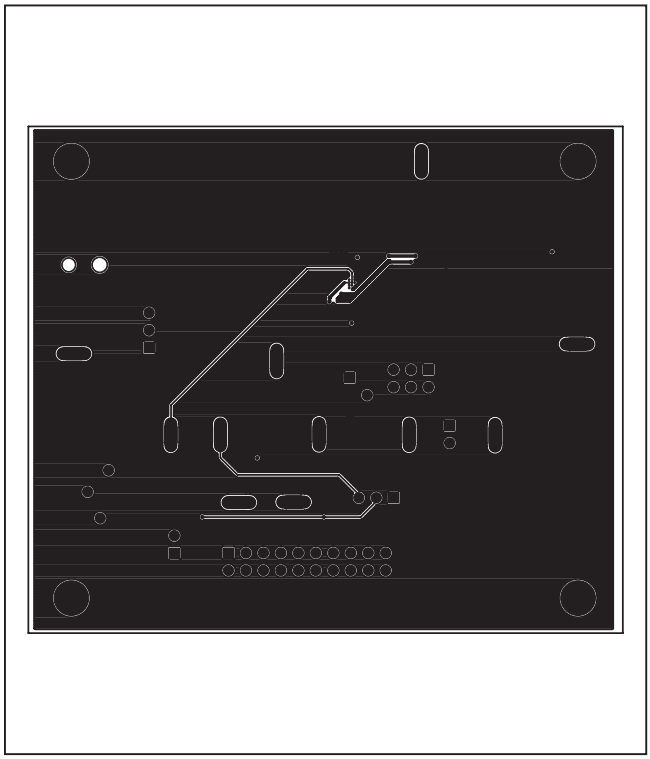

Figure 8. MAX8971 EV Kit PCB Layout—Inner Layer 2

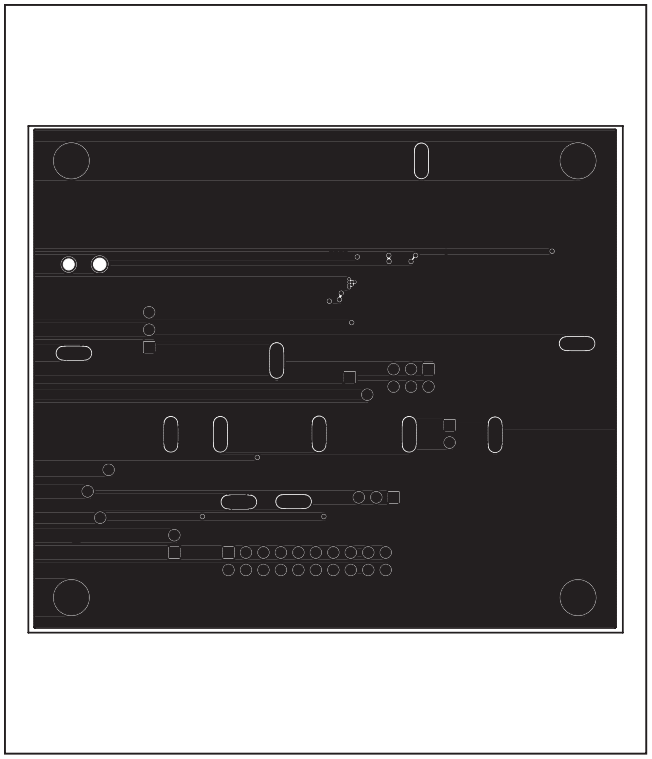

Figure 9. MAX8971 EV Kit PCB Layout—Inner Layer 3

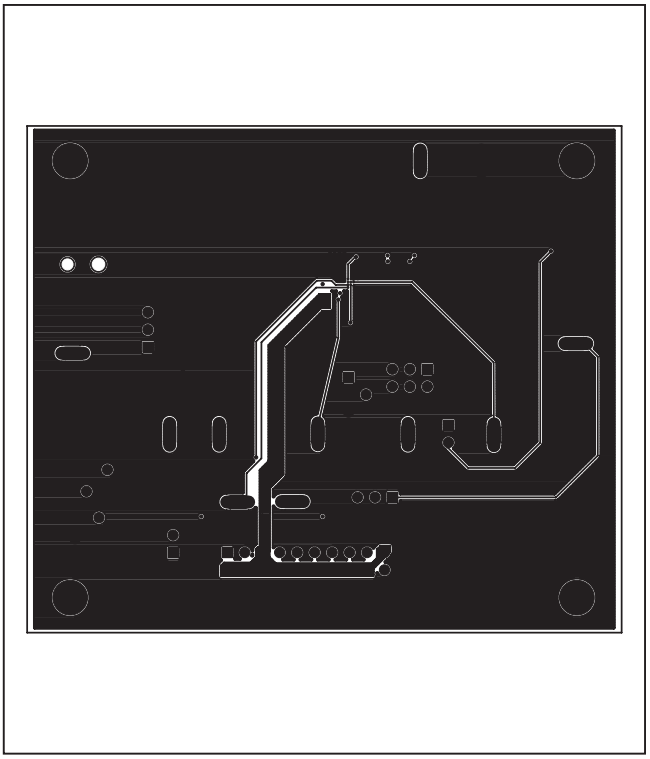

Figure 10. MAX8971 EV Kit PCB Layout—Solder Side

Ordering Information

PART	TYPE
MAX8971EVKIT#	EV Kit
MAXC8971EVMINIQU+	EV System

#Denotes RoHS compliant.

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

Note: *The EV kit software controls the EV kit, but is designed for use with the complete EV system. The EV system includes both the Maxim MINIQUSB module and the EV kit. If Windows software will not be used, the EV kit board can be purchased without the MINIQUSB.*

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/12	Initial release	—
1	9/12	Added R6 and R7 to *Component List* and Figure 5	2, 8