Click here for production status of specific part numbers.

MAX8971 Evaluation Kit

Evaluates: MAX8971

General Description

The MAX8971 evaluation kit (EV kit) demonstrates the MAX8971 IC, a 1.55A capable, 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 included 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 with an available USB port to emulate an I²C 2-wire interface. This program is menu-driven and offers a graphical user interface (GUI) with control buttons.

***Ordering Information* appears at end of data sheet.**

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

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19-6323; Rev 2; 5/19

maxim integrated™

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 Kit 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/products/MAX8971** under the **Design Resources** tab to download the latest version of the EV kit software. Save the EV kit software to a temporary folder and unpack the ZIP file.
8) Install the EV kit software on your computer by running the MAX8971GUISetupx.x.xx.exe program inside the temporary folder. The program files are copied, and icons are created in the Windows **Start** menu. The software requires the .NET Framework 4.5 or later. If you are connected to the Internet, Windows automatically updates .NET framework as needed. The EV kit software can be uninstalled from the **Add/Remove** Programs tool in the Control Panel.
9) The EV kit software launches automatically after install, or alternatively, it can be launched by clicking on its icon in the Windows **Start** menu. A splash screen containing information about the evaluation kit appears as the program is being loaded (Figure 1).

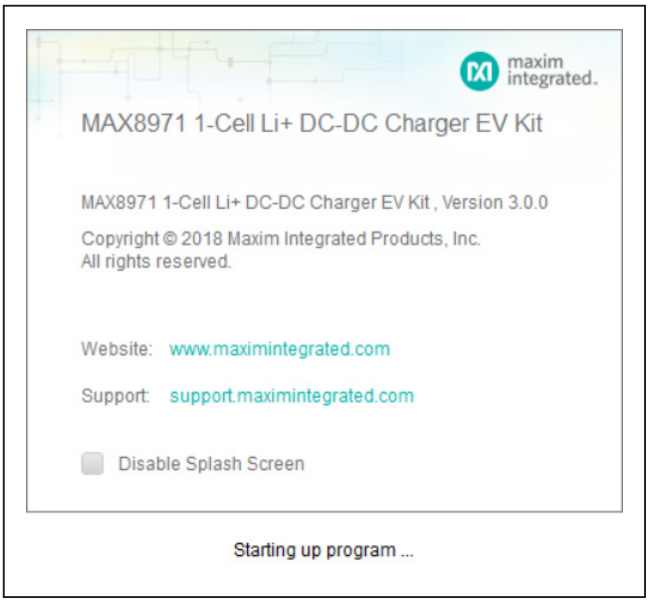


Figure 1. MAX8971 GUI Splash Screen

Detailed Description of Software

Communication

The software automatically finds the EV Kit board through USB identification. If the connection cannot be found, then a **Not Connected** message is displayed. Once the micro-USB cable is attached, click on the main window option, **Device > Connect**, and a synchronization window appears. This window shows the IC sub-blocks and their corresponding slave addresses. Choose **Read and Close** and the status bar displays **Connected** to signify active communication. An example of a successful connection is shown in Figure 2.

Main Display

Status bits and programmable functions of **Interrupt/ Status** and **Charger Control** can be accessed through their respective interface tabs from the left column of the window (Figure 3).

Interrupt/Status Indicators

The **Interrupts** group box consists of slider switches to mask or unmask the interrupt output during a fault condition and status indicators obtained from the IC registers. When unmasked, the interrupt status indicator lights up when there is a fault condition. When the slider is in the masked position, the respective interrupt status indicator remains unaffected in the event of a fault. A **Refresh** button performs a read command of the IC Charger Interrupt Mask (CHGINT_MSK, address 0x01) and Charger Interrupt Request (CHGINT, address 0x0F) registers. The CHGINT register is cleared when its value is read. If an alert is set on the MAX8971, reading the CHGINT register displays the status on the GUI while

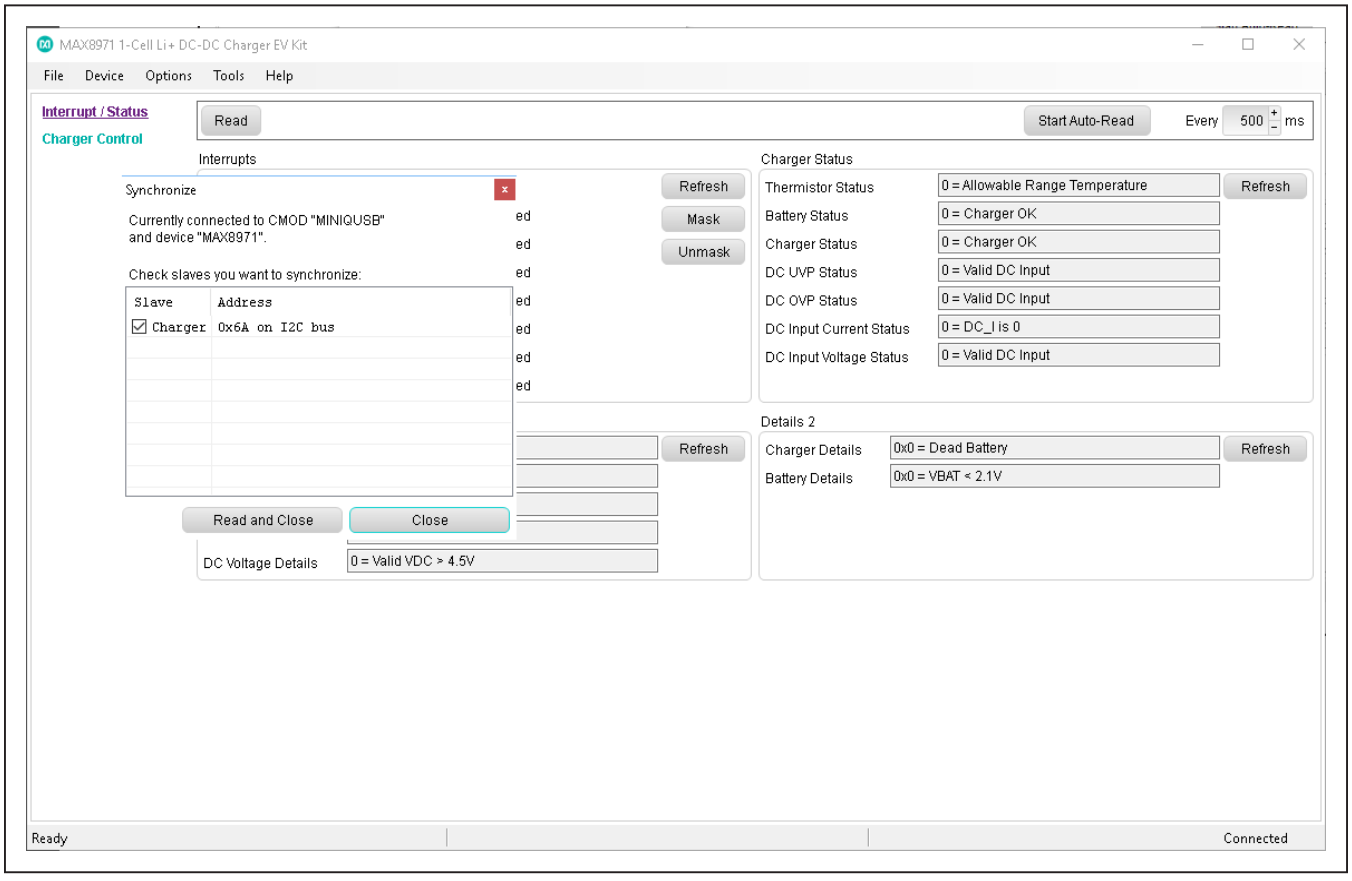


Figure 2. MAX8971 Communication Window

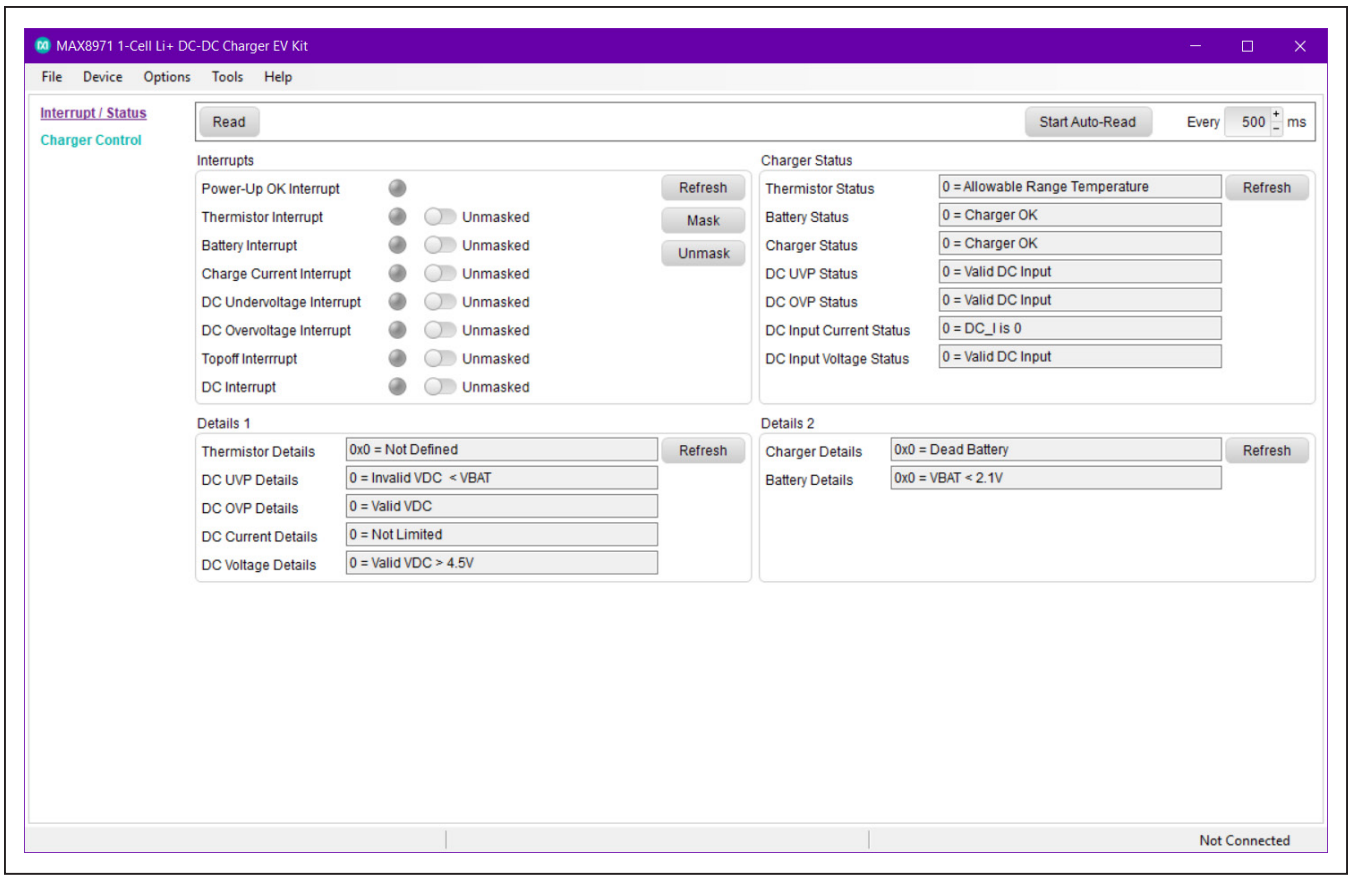


Figure 3. MAX8971 GUI Interrupt/Status Display

simultaneously clearing the alert on the IC. When a second read command is performed, the indicator on the GUI goes DARK if the Charger Interrupt Request status bit has not been set again, or GREEN if the Charger Interrupt Request status bit has been set again 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), DETAILS1 (address 0x03) and DETAILS2(address 0x04) registers using the respective **Refresh** buttons. The **Charger Status** group box indicators display VALID when the charger is operating within its specified settings and displays INVALID when the charger is operat-ing outside its settings. The **Details** group box displays the status conditions of the battery connected at the battery, charger, and thermistor.

The **Read** button updates all the status indicators listed in the **Interrupt/Status** group box. The **Start Auto-Read** button repeatedly polls the device at the selected interval and updates all status indicators.

Charger Control

The **Charger Control** group box consists of several group box slider buttons and pull-down selection fields that configure the IC registers. Each group box provides configuration settings for one IC register. Changes to the controls are made using the respective **Write** button for each register and the register values can be read using the respective **Read** button.

Charge Control 1 (CHGCNTL1, address 0x05) provides controls for USB Suspend mode and DC Monitoring. **Charge Control 2** group box (FCHGCRNT, address 0x06) consists of the Fast-Charge Current and Timer control register. **Charge Control 3** (DCCRNT, address 0x07) provides the Input Current Limit and Charger Restart Threshold control. **Charge Control 4** (TOPOFF, address 0x08) provides selection for Charge Termination Voltage, Top-off current threshold, Top-off Timer and enable/disable the 2.8A Fast-Charge Current. **Charger Control 5** (TEMPREG, address 0x09) is the Temperature Regulation and JEITA Safety Region selection register. **Charger Control 6** (PROTCMD, address 0x0A) configures the Charger-Setting Protection settings.

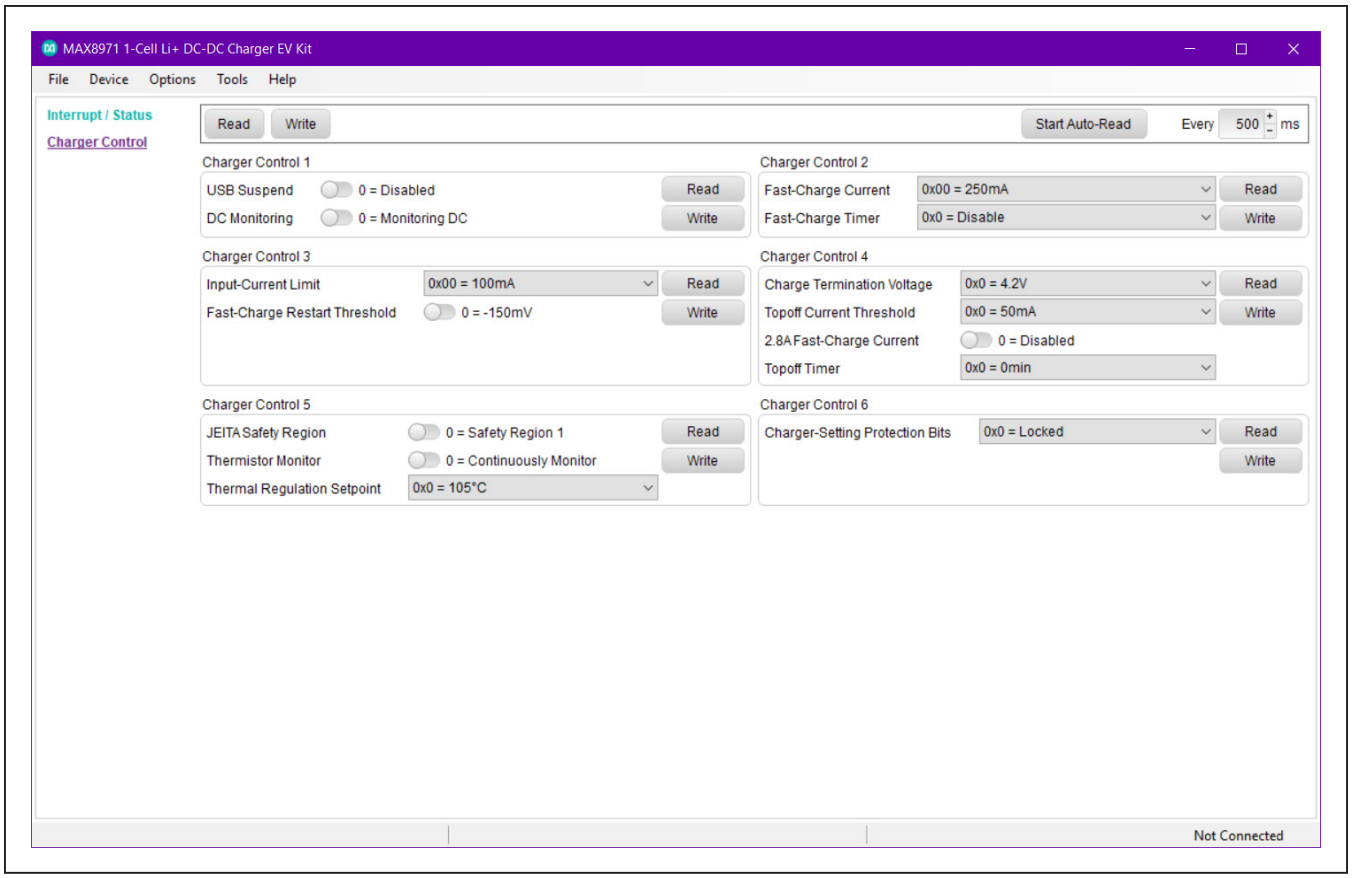


Figure 4. MAX8971 GUI Charger Control Display

Register Explorer

To view the ICs register map, select the **Tools > Register Explorer** menu from the main window. The value of all control registers is displayed and updated automatically when changes are made using the GUI. Double-click on register names or bit names to open the selection to manually program the ICs registers. Writeable registers are indicated with a teal colored background in the **Meaning** column. Changes to the registers are indicated by a gold colored background in the **Register Value** column.

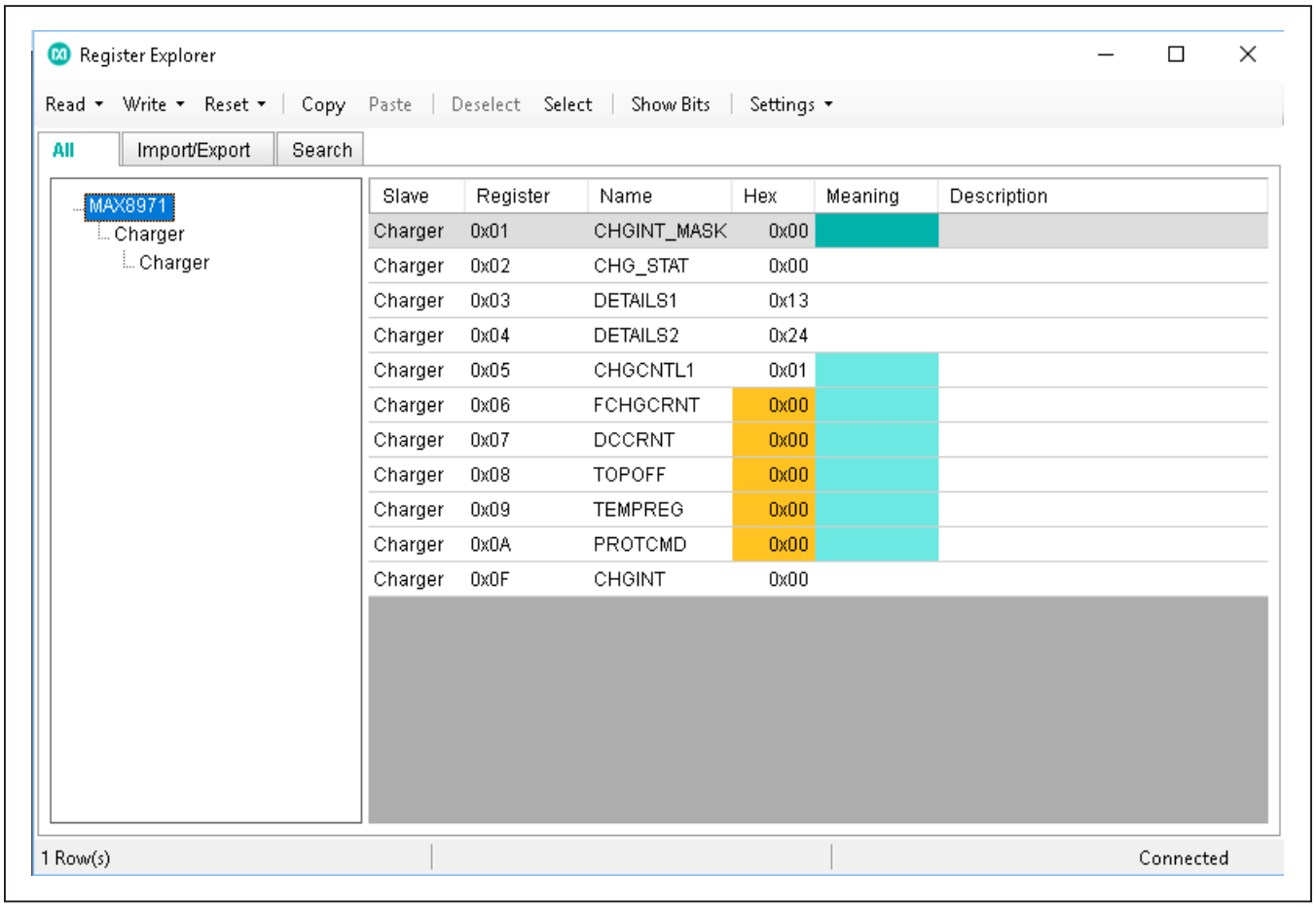


Figure 5. MAX8971 Register Explorer

Register Dashboard

A **Register Dashboard** is also provided under **Tools > Register Dashboard**. In this interface, clicking on the empty slots allows the user to display specific registers of interest and their values in a compact window as shown in Figure 6.

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 powered 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.

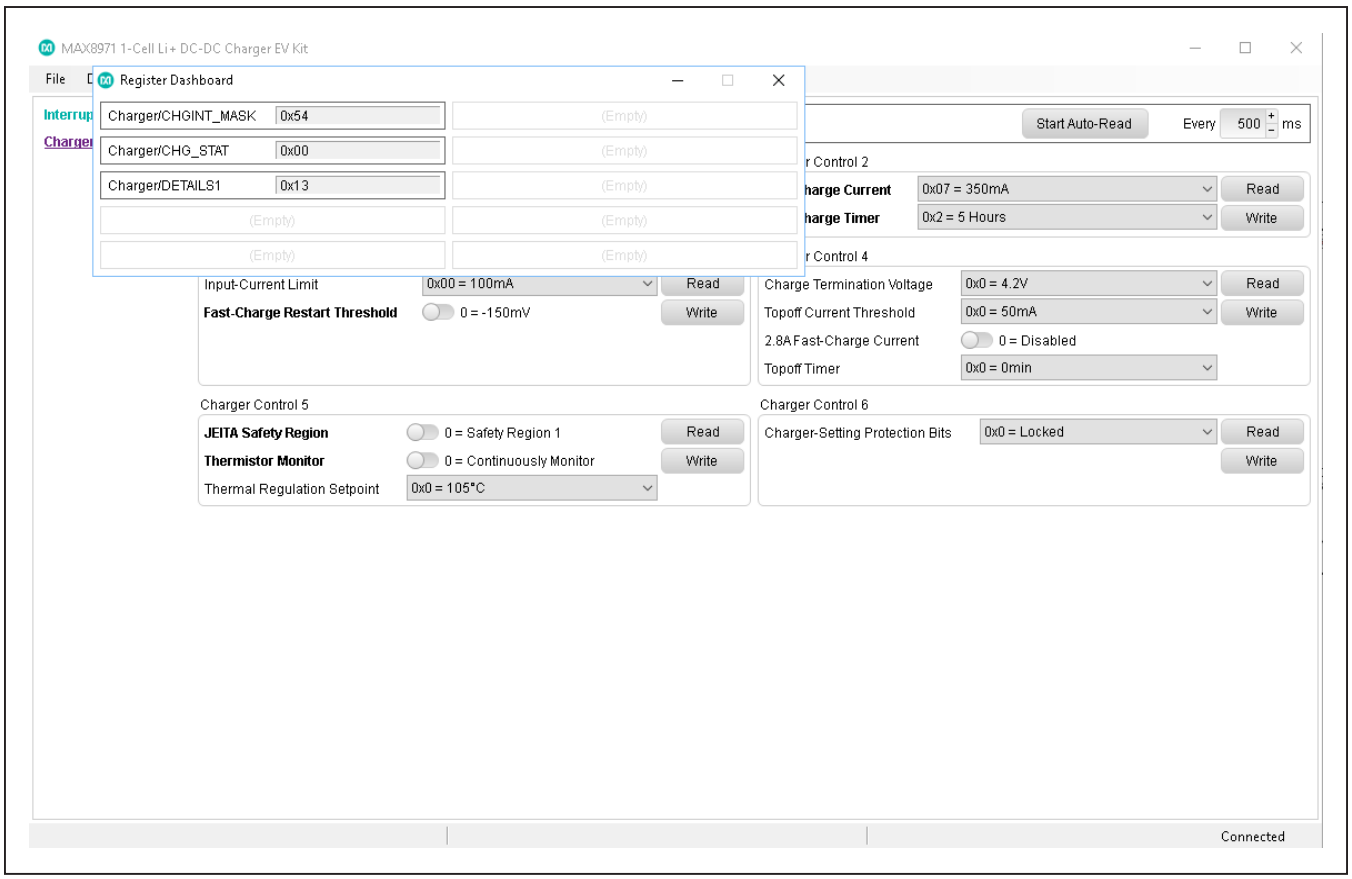


Figure 6. MAX8971 Register Dashboard

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.*

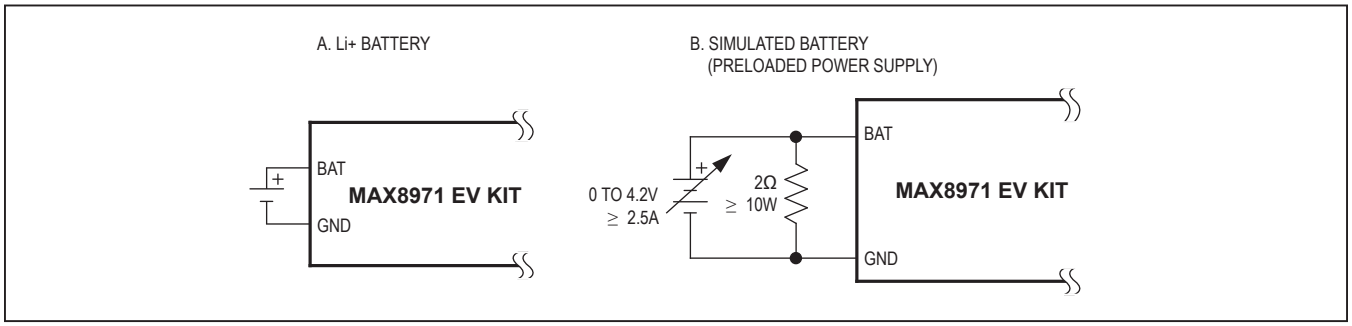


Figure 7. Battery Options for Evaluating the MAX8971 EV Kit

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.*

Ordering Information

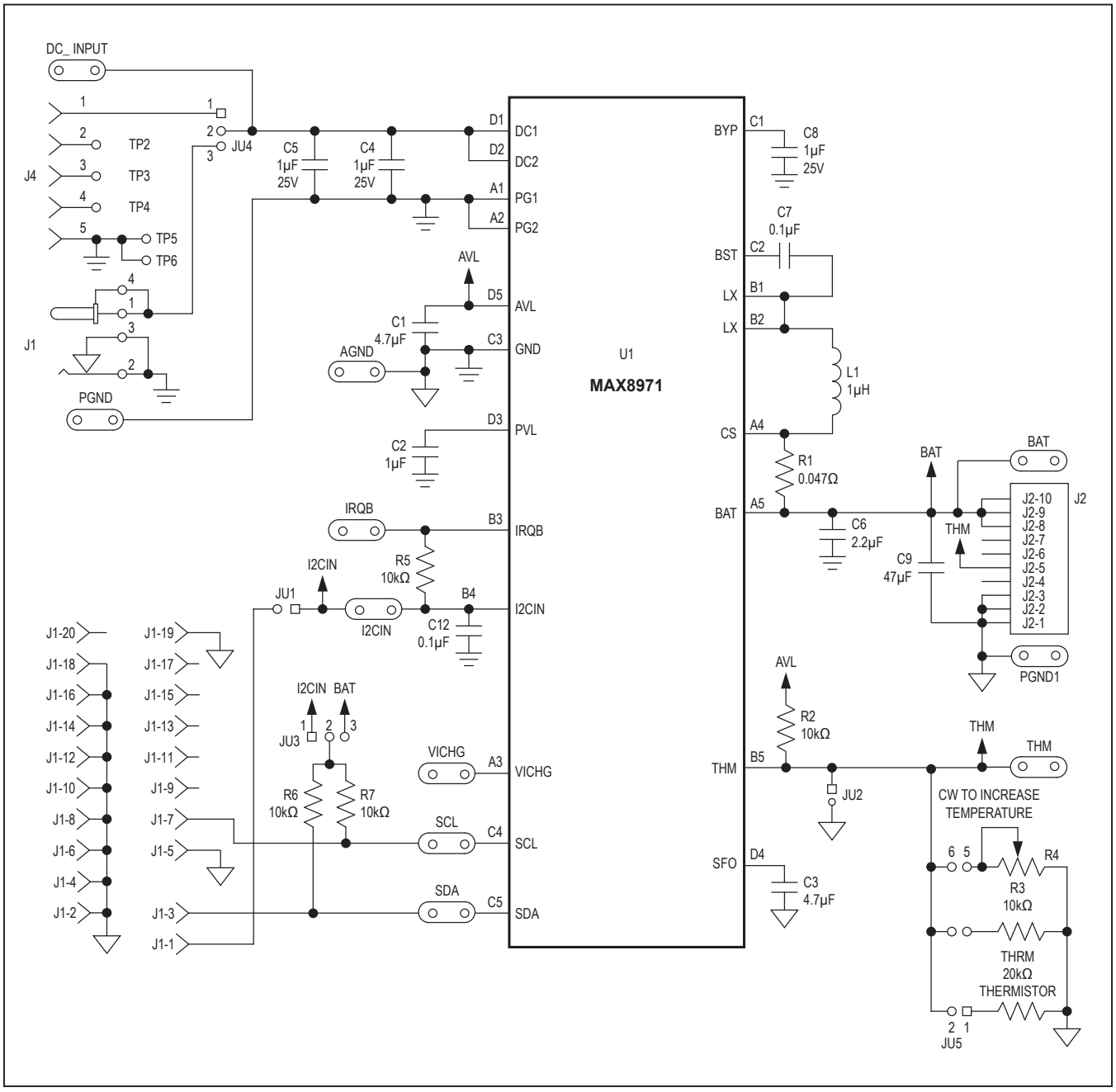
PART	TYPE
MAX8971EVKIT#	EV Kit

#Denotes RoHS compliant.

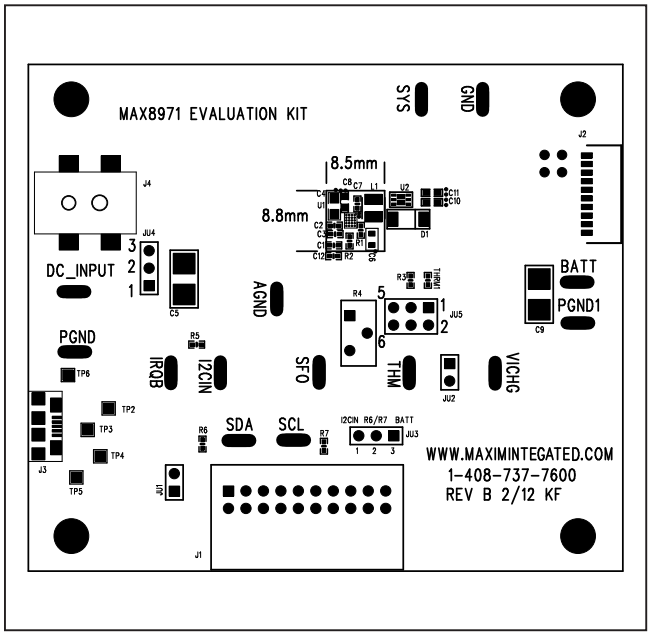
Component List

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
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
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 (β = 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

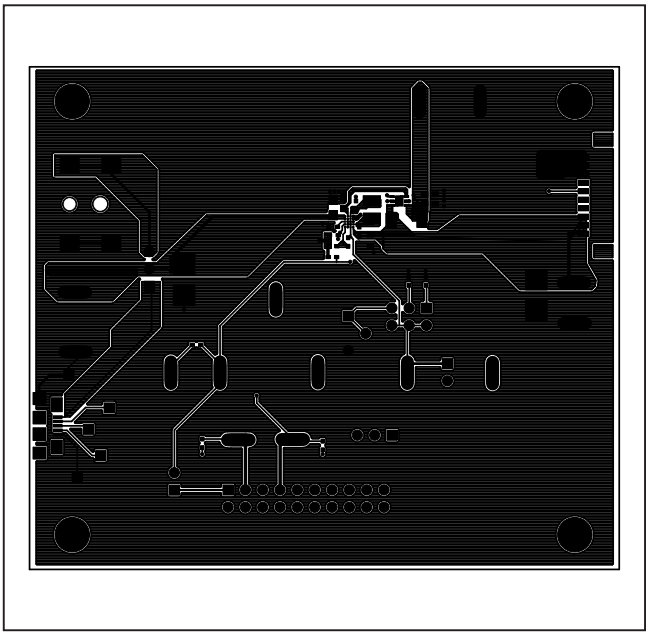
MAX8971 EV kit Schematic



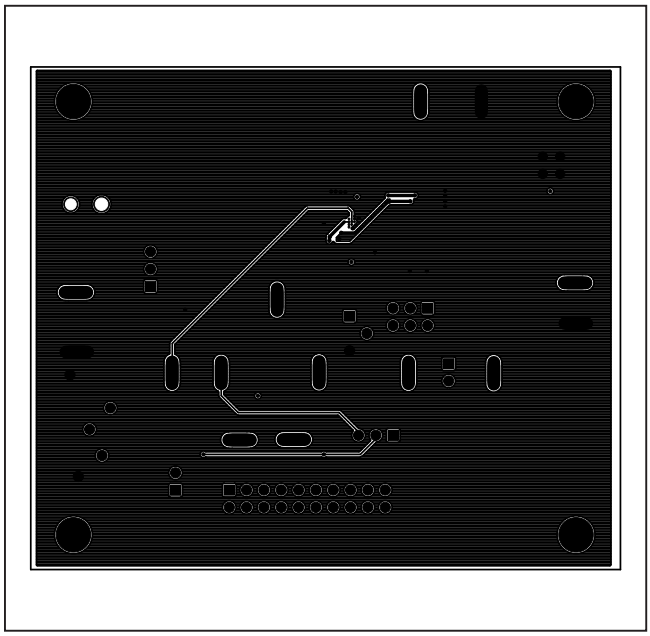
MAX8971 EV Kit PCB Layout Diagrams



MAX8971 EV Kit Component Placement Guide—Component Side

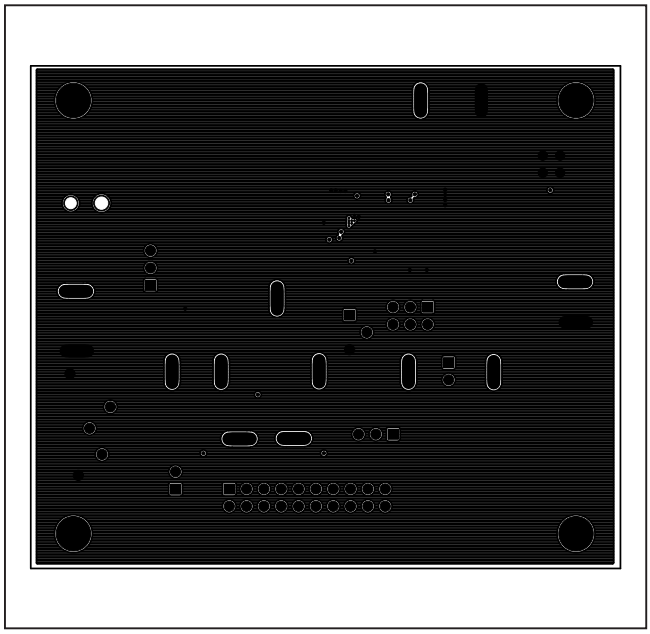


MAX8971 EV Kit PCB Layout—Component Side

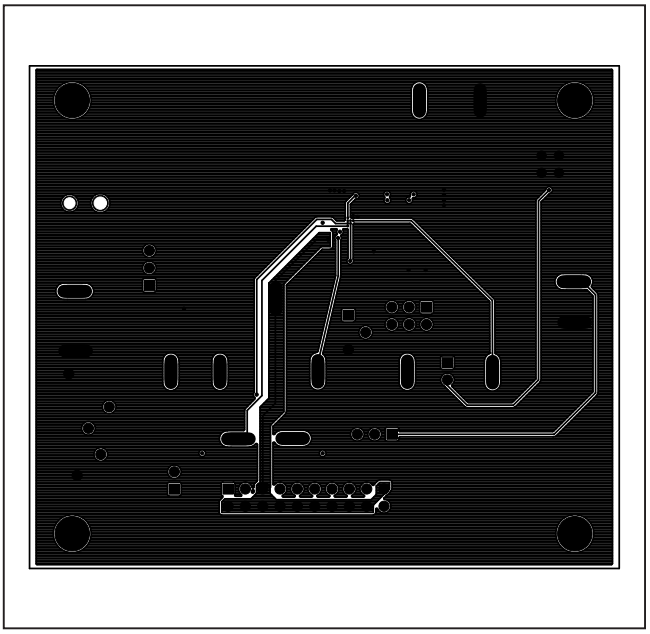


MAX8971 EV Kit PCB Layout—Inner Layer 2

MAX8971 EV Kit PCB Layout Diagrams (continued)



MAX8971 EV Kit PCB Layout—Inner Layer 3



MAX8971 EV Kit PCB Layout—Solder Side