/V/IXI/VI

MAX5970 Evaluation Kit

Evaluates: MAX5970

General Description

The MAX5970 evaluation kit (EV kit) is an assembled and tested PCB used to evaluate the MAX5970 dual hot-swap controller, which provides protection for systems with two supply voltages between 0 and 16V. The on-board microcontroller, which is connected to the PC through the universal serial bus (USB) port, acts as the I²C master.

The EV kit also includes Windows® 2000-, Windows XP®-, and Windows Vista®-compatible software that provides a simple user interface for exercising the MAX5970 features. The program is menu-driven and offers a graphical user interface (GUI) complete with control buttons and status displays. The EV kit comes with the MAX5970ETX+ installed.

Features

♦ **Safely Hot Swaps Two Independent 0 to 16V Power Supplies After Power-Up**

♦ **Windows 2000-, Windows XP-, and Windows Vista (32-Bit)-Compatible Software**

♦ **On-Board Microcontroller to Generate I²C Commands**

♦ **Easy-to-Use, Menu-Driven Software**

♦ **USB-PC Connection (Cable Included)**

Ordering Information

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3–C10, C17, C32	11	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K
C2, C13, C15,	3	10µF ±20%, 6.3V X5R ceramic capacitors (0805) TDK C2012X5R0J106M
C11, C12	2	10pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H100J
C14, C16, C31, C33, C34	5	1µF ±10%, 25V X5R ceramic capacitors (0603) Murata GRM188R61E105K
C18, C19	2	22pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H220J
C20	1	0.033µF ±10%, 25V X5R ceramic capacitor (0603) Murata GRM188R71E333K
C22, C24, C26, C28	4	10µF ±10%, 25V X5R ceramic capacitors (1206) Murata GRM31CR61E106K
C21, C30, C25, C29	0	Not installed, electrolytic capacitors (12.5mm x 13.5mm)

DESIGNATION	QTY	DESCRIPTION
C23, C27	2	4700pF ±10%, 50V X7R ceramic capacitors (0603) TDK C1608X7R1H472K
D1, D6–D9, D14, D15	7	Green LEDs (0603)
D2, D3	2	200mA, 25V Schottky diodes (3 SOT23) Fairchild BAT54
D4	1	200mA, 30V Schottky diode (3 SOT23) Fairchild BAT54C
D5, D12, D13	3	Red LEDs (0603)
D10, D11	2	4.7V zener diodes (SOD523) Diodes Inc. BZT52C4V7T
D16, D17	2	1A, 20V Schottky diodes (SMA) Central Semi CMSH1-20M
GND (x4), VO1, VO2, VS1, VS2	8	Noninsulated banana-jack connectors
JU1–JU12	12	3-pin headers
JU13–JU16	4	2-pin headers

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DESIGNATION	QTY	DESCRIPTION
N1, N3	2	30V, 16A n-channel MOSFETs (8 PQFN) International Rectifier IRFH7936PbF
N2, N4	2	60V, 115mA n-channel MOSFETs (3 SOT23) Diodes Inc. 2N7002-7-F
P1, P2, P3	3	-50V, 130mA p-channel MOSFETs (3 SOT23) Diodes Inc. BSS84
R1, R8, R11, R18, R19, R21	0	Not installed, resistors (0603) R1, R8, R11, R18 are short (PCB trace); R19, R21 are open
R2	1	220Ω ±5% resistor (0603)
R3, R26, R30, R31, R38–R46, R48, R49	15	10kΩ ±5% resistors (0603)
R4	1	2.2kΩ ±5% resistor (0603)
R5	1	1.5kΩ ±5% resistor (0603)
R6, R7	2	27Ω ±5% resistors (0603)
R9, R10	2	4.7kΩ ±5% resistors (0603)
R12, R13	2	1kΩ ±1% resistors (0603)
R14, R15, R23, R25, R27, R29, R32	7	100kΩ ±5% resistors (0603)
R16, R17	2	0.005Ω ±1%, 2W sense resistors (2512) IRC LRC-LRF-2512LF-01-R005-F

DESIGNATION	QTY	DESCRIPTION
R20, R22	2	100kΩ ±1% resistors (0603)
R24, R28, R33–R36	6	1kΩ ±5% resistors (0603)
R37, R47	2	10Ω ±5% resistors (0603)
TP1–TP17	17	Test points, red
USB	1	USB type-B, right-angle PC-mount receptacle
U1	1	Dual, hot-swap controller (36 TQFN-EP*) Maxim MAX5970ETX+
U2	1	Microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U3	1	93C46 type 3-wire EEPROM (8 SO)
U4	1	UART-to-USB converter (32 TQFP)
U5	1	3.3V regulator (5 SOT23) Maxim MAX8888EZK33+
U6	1	2.5V regulator (5 SC70) Maxim MAX8511EXK25+
Y1	1	16MHz crystal Hong Kong X'tals SSM16000N1HK188F0-0
Y2	1	6MHz crystal Hong Kong X'tals SSL60000N1HK188F0-0
—	1	USB high-speed A-to-B cables, 6ft
—	16	Shunts
—	1	PCB: MAX5970 EVALUATION KIT+

*EP = Exposed pad.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
International Rectifier	310-322-3331	www.irf.com
IRC, Inc.	361-992-7900	www.irctt.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: Indicate that you are using the MAX5970 when contacting these component suppliers.

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MAX5970 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX5970.EXE	Application program
FTD2XX.INF	USB driver file
UNINST.INI	Uninstalls the EV kit software
USB_Driver_Help.PDF	USB driver installation help file

Quick Start

Required Equipment

- MAX5970 EV kit (USB cable included)
- User-supplied Windows 2000, Windows XP, or Windows Vista PC with a spare USB port
- Two 3.3V to 16V DC power supplies
- Two voltmeters

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 MAX5970 EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on power supplies until all connections are completed.**

1) Visit **www.maxim-ic.com/evkitsoftware** to download the latest version of the EV kit software, 5970Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.

2) 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.

3) Verify that all jumpers (JU1–JU16) are in their default positions, as shown in Tables 1 and 3.

4) Set the first DC power supply to 5V and connect to the VS1 and the GND banana-jack connectors on the EV kit board.

5) Set the second DC power supply to 5V and connect to the VS2 and the GND banana-jack connectors on the EV kit board.

6) Connect the first voltmeter to the VO1 and the GND pads on the EV kit board.

7) Connect the second voltmeter to the VO2 and the GND pads on the EV kit board.

8) Connect the USB cable from the PC to the EV kit board. A **New Hardware Found** window pops up when installing the USB driver for the first time. If a window is not seen 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.

9) Follow the directions of the **Found New Hardware** window to install the USB device driver. Manually specify the location of the device driver to be **C:\Program Files\MAX5970** (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.

10) Turn on the power supplies.

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. Observe as the program automatically detects the address of the MAX5970 and starts the main program.

12) Verify that PG1 and PG2 LEDs (D14, D15) are on.

13) Verify that both voltmeters read approximately 5V.

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Table 1. Jumper Description (JU1–JU16)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Powers the MAX5970 using the VS1, VS2 or VIN input supply
	2-3	Powers the MAX5970 using the USB or VIN input supply
	Open	Powers the MAX5970 using the VIN input supply
JU2	—	See Table 3 for SMBus/I²C address settings
JU3	—	See Table 3 for SMBus/I²C address settings
JU4	1-2*	Connects the POL pin of the MAX5970 to DREG through a pullup resistor for active-high PG_ outputs
	2-3	Connects the POL pin of the MAX5970 to GND for active-low PG_ outputs
JU5	1-2*	Connects the MODE pin of the MAX5970 to DREG through a pullup resistor for the channels to operate as a group
	2-3	Connects the MODE pin of the MAX5970 to GND for the channels to operate as an individual hot-swap controller
	Open	The MODE pin of the MAX5970 is not connected and the channels operate as a group
JU6	1-2*	Connects the PROT pin of the MAX5970 to DREG through a pullup resistor, allowing $\overline{\text{ALERT}}$ output to be asserted and respective PG_ output deasserted upon critical UV/OV fault
	2-3	Connects the PROT pin of the MAX5970 to GND, allowing $\overline{\text{ALERT}}$ output to be asserted, and shuts down respective channel upon critical UV/OV fault
	Open	The PROT pin of the MAX5970 is not connected and $\overline{\text{ALERT}}$ output asserted upon critical UV/OV fault
JU7	1-2*	Configures the LED1 pin of the MAX5970 to drive an LED
	2-3	Configures the LED1 pin of the MAX5970 as a GPIO
JU8	1-2*	Configures the LED2 pin of the MAX5970 to drive an LED
	2-3	Configures the LED2 pin of the MAX5970 as a GPIO
JU9	1-2*	Configures the LED3 pin of the MAX5970 to drive an LED
	2-3	Configures the LED3 pin of the MAX5970 as a GPIO
JU10	1-2*	Configures the LED4 pin of the MAX5970 to drive an LED
	2-3	Configures the LED4 pin of the MAX5970 as a GPIO
JU11	1-2*	Connects the IRNG2 pin of the MAX5970 to DREG, which sets the channel 2 DAC current-sense range to 50mV**
	2-3	Connects the IRNG2 pin of the MAX5970 to GND, which sets the channel 2 DAC current-sense range to 25mV**
	Open	The IRNG2 pin of the MAX5970 is not connected, which sets the channel 2 DAC current-sense range to 100mV**
JU12	1-2*	Connects the IRNG1 pin of the MAX5970 to DREG, which sets the channel 1 DAC current-sense range to 50mV**
	2-3	Connects the IRNG1 pin of the MAX5970 to GND, which sets the channel 1 DAC current-sense range to 25mV**
	Open	The IRNG1 pin of the MAX5970 is not connected, which sets the channel 1 DAC current-sense range to 100mV**

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Table 1. Jumper Description (JU1–JU16) (continued)

JUMPER	SHUNT POSITION	DESCRIPTION
JU13	Open*	Sets the ON1 bit to 1 (channel 1 is enabled if EN1 or EN2 is set to 1)
	1-2	Sets the ON1 bit to 0 (channel 1 is disabled if EN1 or EN2 is set to 0)
JU14	Open*	Sets the ON2 bit to 1 (channel 2 is enabled if EN1 or EN2 is set to 1)
	1-2	Sets the ON2 bit to 0 (channel 2 is disabled if EN1 or EN2 is set to 0)
JU15	Open*	Connects the HWEN pin of the MAX5970 to DREG, which sets the EN2 bit to 1 on each channel
	1-2	Connects the HWEN pin of the MAX5970 to GND, which sets the EN2 bit to 0 on each channel
JU16	Open*	Connects the RETRY pin of the MAX5970 to DREG, which configures the part in auto-retry mode
	1-2	Connects the RETRY pin of the MAX5970 to GND, which configures the part in latch-off mode

*Default position.

**Refer to the MAX5970 IC data sheet for adjusting the circuit breaker threshold range.

__Detailed Description of Software

The MAX5970 EV kit user interface (Figure 1) is easy to operate; use the mouse, or press the Tab key to navigate with the arrow keys. Each of the buttons correspond to bits in the command and configuration bytes. By clicking on them, the correct I²C-compatible write operation is generated to update the internal registers of the MAX5970.

Interface

Use the **Device Address** combo box to select the MAX5970 I²C address. Checking the **Silence I2C Activity** checkbox stops activity between the microcontroller and the MAX5970 when the software is idle; otherwise, the software continuously reads the device's status and data registers to check that the device is working properly. These functions create activity on the I²C bus. Use the **Read All Registers** button to perform a read of all of the MAX5970 registers and update the GUI with each register's data. The status bar located at the bottom of the GUI displays the status of the registers accessed, and the data received or sent.

Configuration

The EV kit software **Configuration** tab sheet (Figure 1) displays the **Grouping (MODE)**, **Fault Management (RETRY)**, **Critical Fault Protection (PROT)**, and **Polarity (POL)** general settings at the top, while grouping channel-specific settings below. See Table 2 for GUI control details for each channel. Check the **Deglitch** checkboxes located to the right of the **OV Critical**, **OV Warning**, **UV Warning**, **UV Critical**, and **OC Warning** input controls to enable the deglitch feature for those settings.

Control and Status

The EV kit software **Control / Status** tab sheet (Figure 2) displays the status of each channel, including the voltage and current measurements in decimal format. Each channel can be enabled, regardless of the input voltage, by configuring the software's **EN1_** and **EN2_** combo boxes, or checking the **Force-ON Keys Enable** and **Force-ON** checkboxes. Check the corresponding **Reset** or **Hold** checkbox to reset or hold the maximum and minimum voltage measurements and the maximum and minimum current measurements. Press the **Clear Alert** button to clear the alert bit and output signal.

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Table 2. Software GUI Controls

GUI CONTROL	FUNCTION
Voltage-Sense Range	Sets the maximum output voltage range to 2V, 4V, 8V, or 16V.
OV Critical	Sets the overvoltage critical limit. Enter a decimal value between 0 and 1023 (10-bit binary value).
OV Warning	Sets the overvoltage warning limit. Enter a decimal value between 0 and 1023 (10-bit binary value).
UV Warning	Sets the undervoltage warning limit. Enter a decimal value between 0 and 1023 (10-bit binary value).
UV Critical	Sets the undervoltage critical limit. Enter a decimal value between 0 and 1023 (10-bit binary value).
Max Current-Sense	Sets the maximum current-sense range to 25mV, 50mV, or 100mV across the current-sense resistor.
Fast-trip Threshold	Sets the fast-trip voltage threshold across the current-sense resistor between 40% and 100% of the **Max Current-Sense** setting. Enter a decimal value between 102 and 255 (8-bit binary value).
Fast/Slow Trip Ratio	Sets the fast-to-slow trip voltage ratio to 125%, 150%, 175%, or 200% across the current-sense resistor.
OC Warning	Sets the overcurrent warning limit. Enter a decimal value between 0 and 1023 (10-bit binary value).
PG Assertion Delay	Sets PG_ output signal assertion time delay to 50ms, 100ms, 200ms, or 400ms.
Deglitch	Enables deglitching function (two consecutive faults must be detected before the corresponding fault is asserted).
EN1_	Sets EN1 bit 0 or 1.
EN2_	Sets EN2 bit 0 or 1.
Reset	Resets the maximum and minimum voltage or current-detection registers of the corresponding channel.
Hold	Locks the maximum and minimum voltage or current-detection registers of the corresponding channel.
Force-ON Keys Enable	Enables the Force-ON control register.
Force-ON	Enables the channel regardless of the input voltage.
Clear Alert	Clears the ALERT bit/deasserts the $\overline{Alert}$ output.
Stop-Delay Buffer	Sets the number of samples that are recorded to a buffer after a shutdown event. Enter a number between 0 and 50.
Voltage Buffer	Enables the voltage buffer.
V Read Mode, 8-Bit	Sets the circular-buffer resolution to 8 bits.
V Read Mode, 10-Bit	Sets the circular-buffer resolution to 10 bits.
Current Buffer	Enables the current buffer.
C Read Mode, 8-Bit	Sets the circular-buffer resolution to 8 bits.
C Read Mode, 10-Bit	Sets the circular-buffer resolution to 10 bits.
Read Voltage Buffer	Reads and displays the voltage-buffer data.
Read Current Buffer	Reads and displays the current-buffer data.
SET	Enables the LED driver pins.
FLASH	Enables the flash on the LED driver pins.
WEAK PULLUP	Enables the weak pullup on the LED driver pins.
FLASH PHASE	Enables the flash to go out of phase on the LED driver pins.

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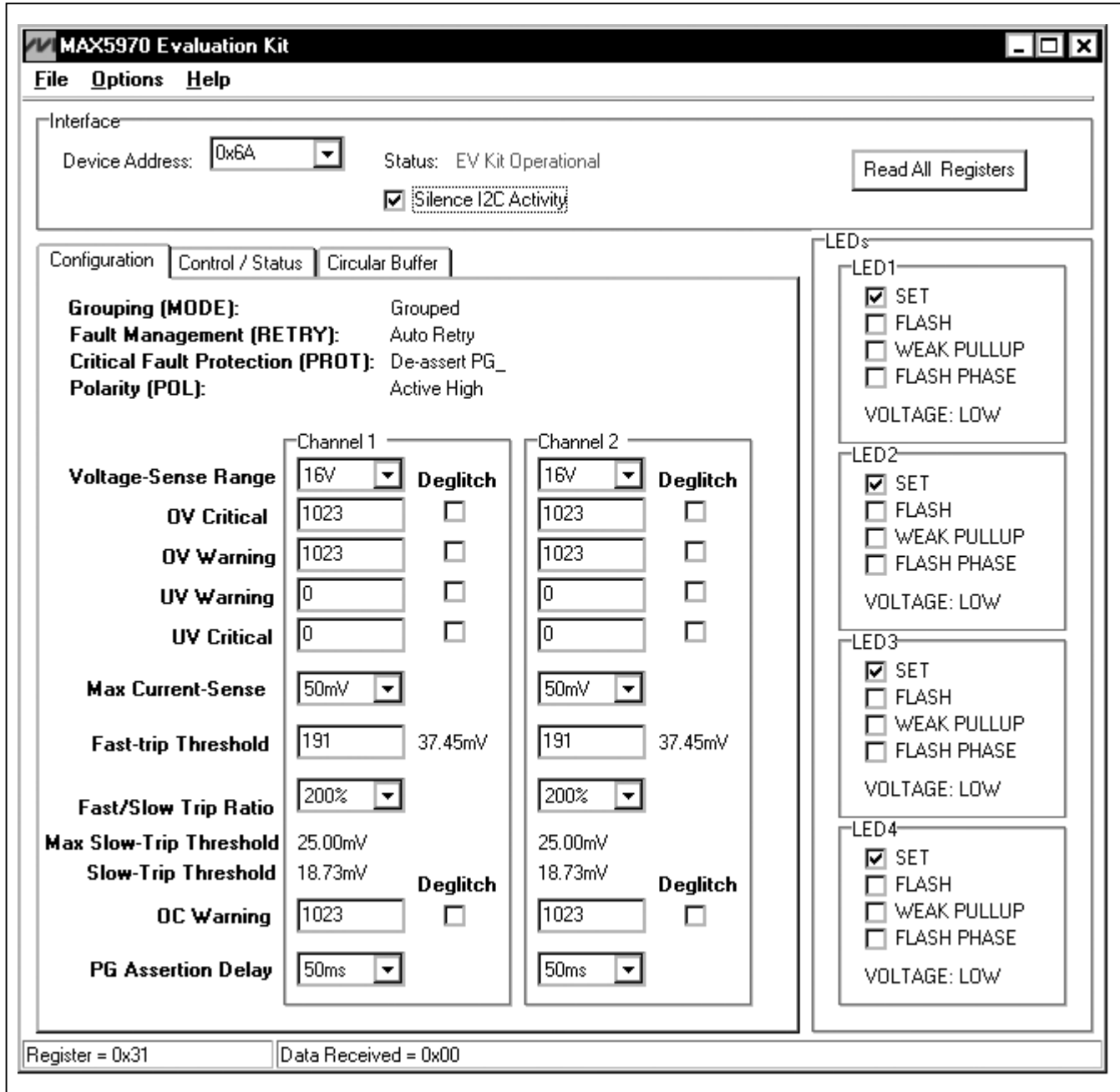
Figure 1. MAX5970 EV Kit Software Main Window (Configuration Tab)

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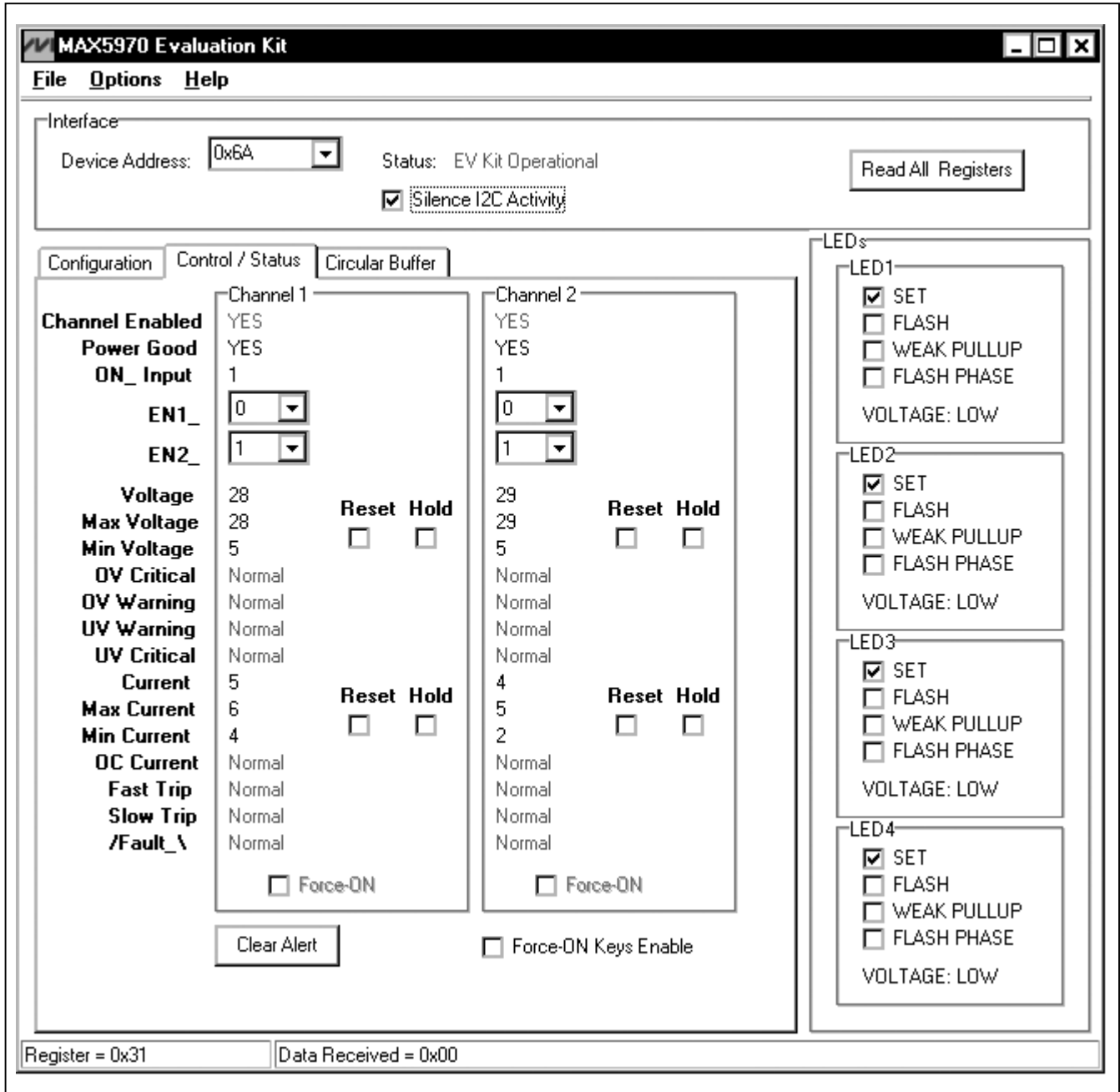
Figure 2. MAX5970 EV Kit Software Main Window (Control / Status Tab)

Circular Buffer

The EV kit software **Circular Buffer** tab sheet (Figure 3) allows the user to control and configure the voltage and current circular buffers for each channel. Each circular buffer always contains a record of the 50 most-recent digital measurements. The resolution of these measurements can be set to **8-Bit** or **10-Bit**. This measurement record includes the number of post-shutdown event measurements set by the **Stop-Delay Buffer** setting, if the corresponding buffer (**Voltage Buffer** or **Current Buffer**) is set to **Run**. The corresponding circular buffer stops recording new data if it is set to **Stop**. The 50 measurements contained in the particular buffer are read and displayed when the **Read Voltage Buffer** or **Read Current Buffer** buttons are pressed.
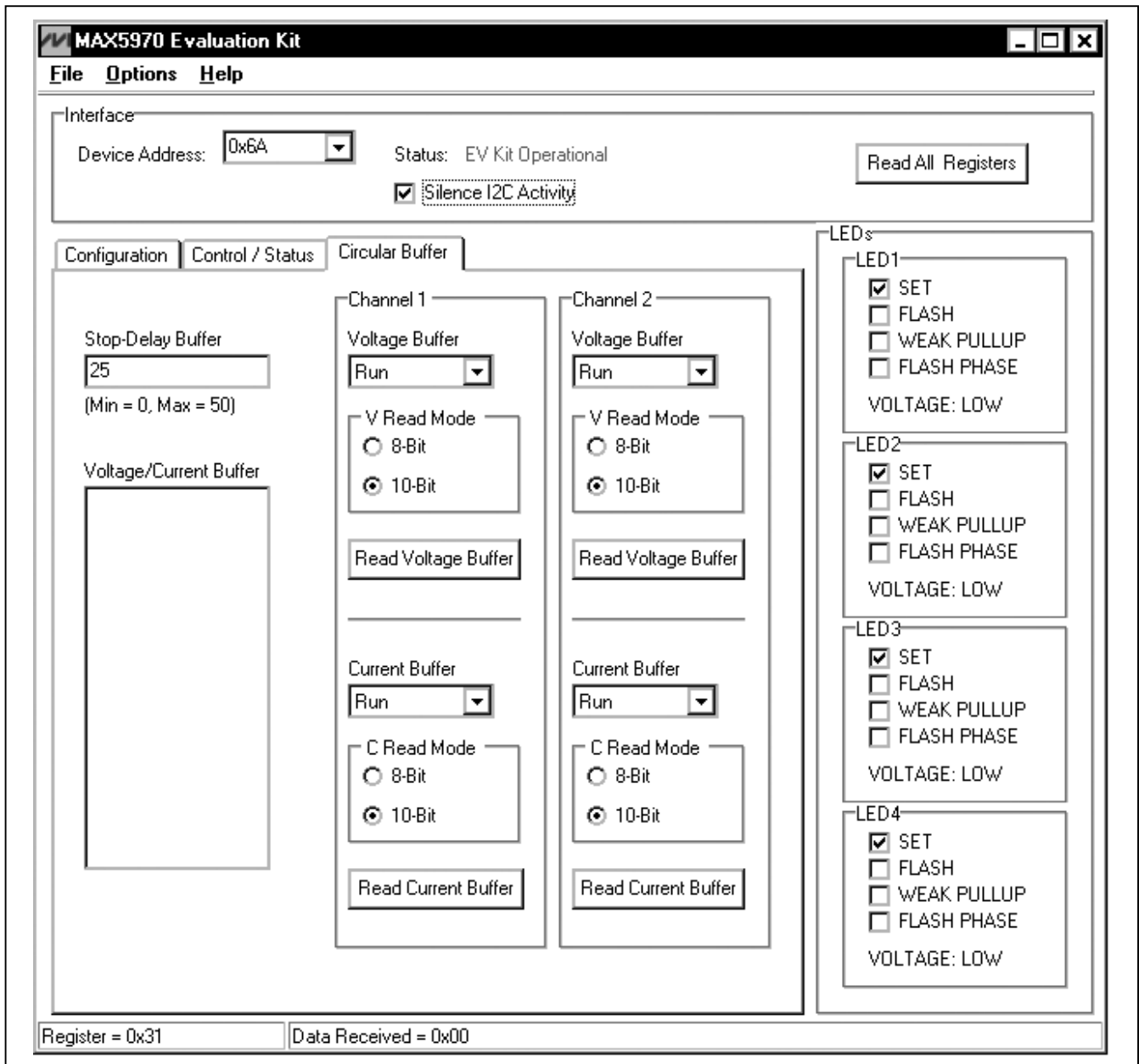
Figure 3. MAX5970 EV Kit Software Main Window (Circular Buffer Tab)

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LEDs and GPIOs

The MAX5970 has four open-drain LED driver pins that double as user-programmable GPIOs. Place shunts across the 1-2 position of jumpers JU7–JU10 and control the individual LED from the checkboxes (**SET**, **FLASH**, **WEAK PULLUP**, and **FLASH PHASE**) within the **LEDs** group box. The user can also set the LED driver pin as a GPIO by placing a shunt in the 2-3 position on jumpers JU7–JU10 and selecting the **Options | GPIO** menu item.

Advanced User Interface

There are two methods for communicating with the MAX5970, through the normal user-interface main window, or through the I²C commands available by selecting the **Options | Interface (Advanced Users)** menu item. An **Advanced User Interface** window pops up with the **2-wire interface** tab selected, which allows the SMBus™/I²C-compatible protocols, such as read byte and write byte, to be executed. The only SMBus/I²C compatible protocols used by the MAX5970 are:

1: SMBusWriteByte(addr,cmd,data8)

4: SMBusReadByte(addr,cmd) →data8

The combo and edit boxes accept numeric data in hexadecimal and should be prefixed by 0x. See Figure 4 for an example of this tool.
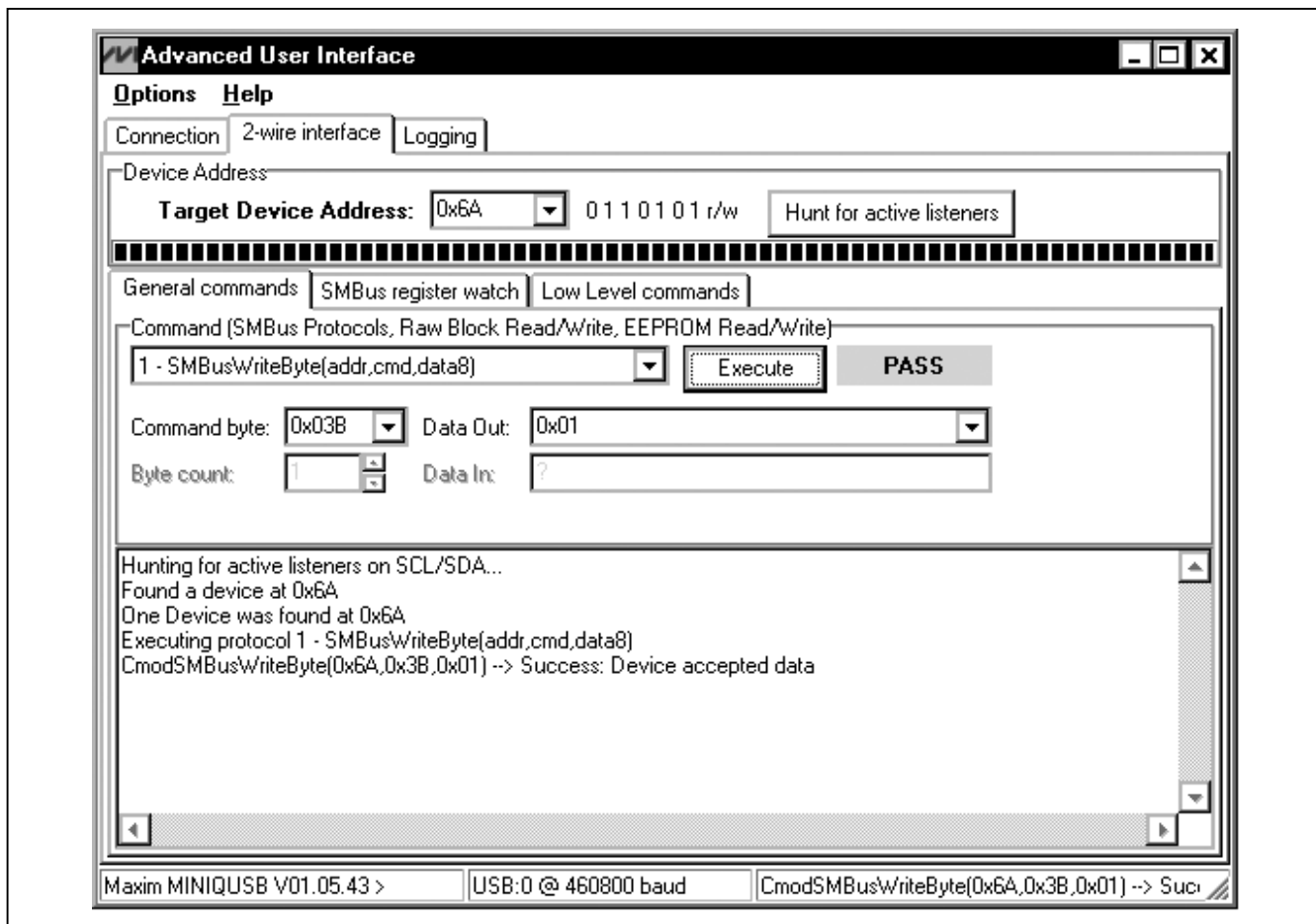

Figure 4. Example of an SMBusReadByte Operation Using the Advanced User Interface

SMBus is a trademark of Intel Corp.

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_Detailed Description of Hardware

The MAX5970 EV kit circuit demonstrates the MAX5970 dual-channel hot-swap controller that continually monitors the output current and voltage with an internal 10-bit ADC. The MAX5970 controls each channel's n-channel MOSFET, while monitoring the respective current across the sense resistor and the output voltage. The EV kit requires 3V (2.7V + Schottky diode drop) to 16V DC for normal operation. Each hot-swap channel is configured to operate with an input voltage as low as 0V.

During a startup cycle, the EV kit's two channels are off until the MAX5970's IN pin voltage exceeds 2.7V (typ). Once the MAX5970 powers up, it loads the initial operational settings to the internal registers. If any of the input channel's voltage is above the 0.6V undervoltage threshold, the respective MOSFET is turned on and the MAX5970 controller monitors the corresponding channel output current and voltage.

The EV kit features several jumpers to program the initial operational settings. These settings are maximum current-sense range for each channel, fault-protection behavior, power-good output-signal polarity, hardware enable, fault-management mode, and I²C address for the controller.

Input Power Sources

The EV kit requires a 3.3V (2.7V + Schottky diode drop) to 16V input DC source for normal EV kit operation. The EV kit circuit features jumper JU1 that allows the user to select one of three methods to provide power to the MAX5970 IC (U1). If the shunt is connected across pins 1-2 on jumper JU1, the highest voltage source connected to the VS1, VS2, or VIN inputs supplies power to the IC. If the shunt is connected across pins 2-3, the highest voltage between the 3.3V source (derived from the USB 5V supply) and the VIN input supplies power to the IC. If the shunt is removed, the VIN input supplies power to U1. Connect a 3.3V to 16V power source across the VIN and GND pads when using this option. See Table 1 for jumper JU1 configuration.

Address Selection

The MAX5970's slave I²C address is configured through the A0 and A1 pins. The EV kit features jumpers JU2 and JU3 to configure these pins. The default address is 0110 101 (R/$\overline{W}$). See Table 3 for a complete list of addresses. Verify that the new I²C address matches the address shown in the software's **Device Address** combo box.

Table 3. Shunt Setting for SMBus/I²C Address

SHUNT POSITION		B7	B6	B5	B4	B3	B2	B1	B0	WRITE ADDRESS (hex)	READ ADDRESS (hex)
JU3 (A1)	JU2 (A0)										
Open	Open	0	1	1	0	0	0	0	R/$\overline{W}$	0x60	0x61
Open	1-2	0	1	1	0	0	0	1	R/$\overline{W}$	0x62	0x63
Open	2-3	0	1	1	0	0	1	0	R/$\overline{W}$	0x64	0x65
1-2	Open	0	1	1	0	1	0	0	R/$\overline{W}$	0x68	0x69
1-2*	1-2*	0	1	1	0	1	0	1	R/$\overline{W}$	0x6A	0x6B
1-2	2-3	0	1	1	0	1	1	0	R/$\overline{W}$	0x6C	0x6D
2-3	Open	0	1	1	1	0	1	1	R/$\overline{W}$	0x70	0x71
2-3	1-2	0	1	1	1	0	0	1	R/$\overline{W}$	0x72	0x73
2-3	2-3	0	1	1	1	0	1	0	R/$\overline{W}$	0x74	0x75

Default position.

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Hot-Swap Channel Enable

During startup, each hot-swap channel is enabled if the respective EN2 bit is set to 1 and the ON_ input is high. The EN2 bit is dependent on the state of the HWEN pin. If the HWEN pin is pulled to DREG during startup, the EN2 bit for both channels is set to 1. The EV kit circuit provides jumper JU15 to configure the HWEN pin. See Table 1 for jumper JU15 configuration. Connecting the HWEN pin to GND after startup does not change the EN2 bit state to 0. However, after startup, the EN2 bit state for each channel can be changed using the EV kit GUI software.

Whenever the ON_ pin voltage exceeds the input-voltage threshold of 0.6V (typ), the ON_ bit is set to 1; otherwise, it is set to 0. The EV kit circuit is configured to pull up the ON_ pins to the respective VS_ channel inputs through resistors R20 or R22. The VS_ input undervoltage threshold can be modified by completing the resistive divider at each ON_ pin. Use the following equation to select the value for each ON_ resistor:

$$R = \frac{100k\Omega}{\left(\dfrac{VS_{-UVLO}}{0.6V} - 1\right)}$$

where VS_{UVLO} is the desired VS1 or VS2 undervoltage input and R is the resistor value in ohms for R19 and R21, respectively.

The EV kit circuit also provides jumpers JU13 and JU14 to connect the respective ON_ pins to GND, thus setting the ON_ bit to 0. See Table 1 for jumpers JU13 and JU14 configuration.

Refer to the MAX5970 IC data sheet for detailed information on enabling and disabling each hot-swap channel.

Grouping Hot-Swap Channels

Depending on the state of the MODE input pin during startup, the MAX5970 can operate as two independent hot-swap controllers, or with both controllers together. The EV kit circuit provides jumper JU5 to configure the MODE pin. See Table 1 for jumper JU5 configuration. Reconfiguring jumper JU5 after startup does not change the initial setting.

PROT and $\overline{ALERT}$

The MAX5970 fault-protection mode is programmed during startup depending on the PROT pin configuration. The PROT pin configuration determines whether the PG_ output signal for the channel(s) is cleared or the PG_ output is cleared and the channel(s) shut down. The EV kit circuit provides jumper JU6 to configure the PROT pin.

See Table 1 for jumper JU6 configuration. Reconfiguring JU6 after startup does not change the initial setting. Once a PG_ output is asserted, the $\overline{ALERT}$ output signal (red LED D5 or TP11) is always asserted low if any of the channels' output voltage is outside the warning or critical limits, or when an overcurrent-limit fault is detected.

Power-Good Outputs

The MAX5970 power-good (PG_) output signals are asserted when the output voltage is inside the undervoltage and overvoltage programmed limits. The PG_ output signal polarity is programmed depending on the POL pin configuration. If the signal polarity is set for active-high outputs, the respective channel LEDs (D14 and D15) are turned on when PG_ is asserted. If the signal polarity is set for active-low outputs, the respective channel's LED is turned off when PG_ is asserted. The PG_ output signals can also be accessed at test points TP5 and TP7. The EV kit circuit provides jumper JU4 to configure the POL pin. See Table 1 for jumper JU4 configuration.

$\overline{FAULT\_}$ Outputs

The MAX5970 $\overline{FAULT\_}$ output signal is asserted low whenever a circuit-breaker channel shutdown event occurs. A circuit-breaker shutdown event occurs whenever a fast-trip or slow-trip overcurrent-fault event is detected. The respective channel LED (D12 and D13) is turned on when the $\overline{FAULT\_}$ output is asserted. The $\overline{FAULT\_}$ output signals can also be accessed at test points TP6 and TP8. See the *RETRY Configuration* section for instructions to clear the $\overline{FAULT\_}$ outputs.

RETRY Configuration

The MAX5970 can be programmed to autoretry or latch-off mode during startup depending on the RETRY pin configuration. In autoretry mode, after a shutdown event, the $\overline{FAULT\_}$ is cleared and the MAX5970 controller automatically attempts to restart the corresponding channel after 200ms. In latch-off mode, the channel is in shutdown. The power at the IN pin must be cycled or the affected channel's ON_ pin, EN1 bit, or EN2 bit must be toggled to restart the latched-off channel and clear the $\overline{FAULT\_}$. The EV kit circuit provides jumper JU16 to configure the RETRY pin. See Table 1 for jumper JU16 configuration. Reconfiguring JU16 after startup does not change the initial RETRY setting. Refer to the MAX5970 IC data sheet when operating in autoretry mode.

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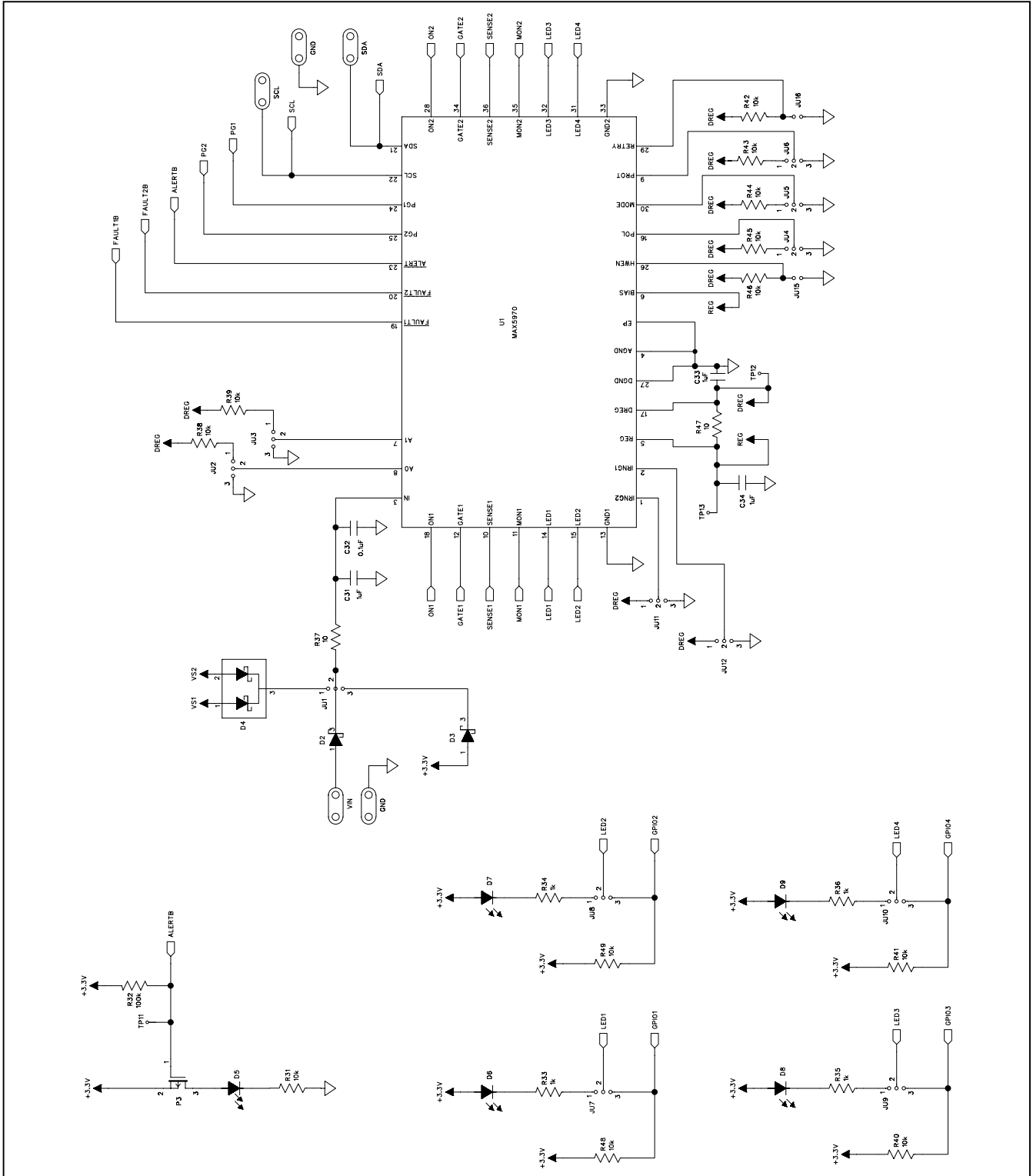Figure 5a. MAX5970 EV Kit Schematic (Sheet 1 of 3)
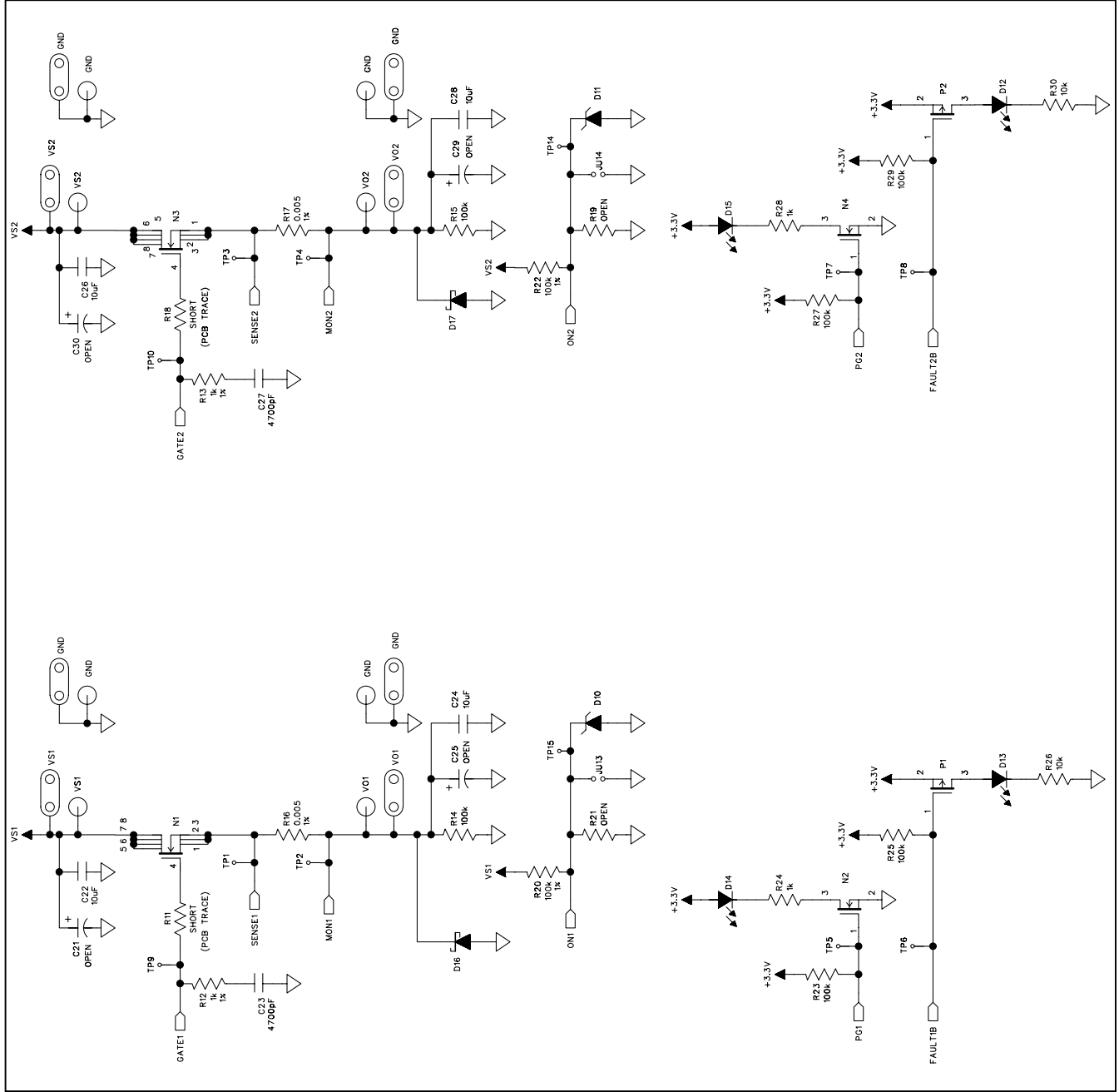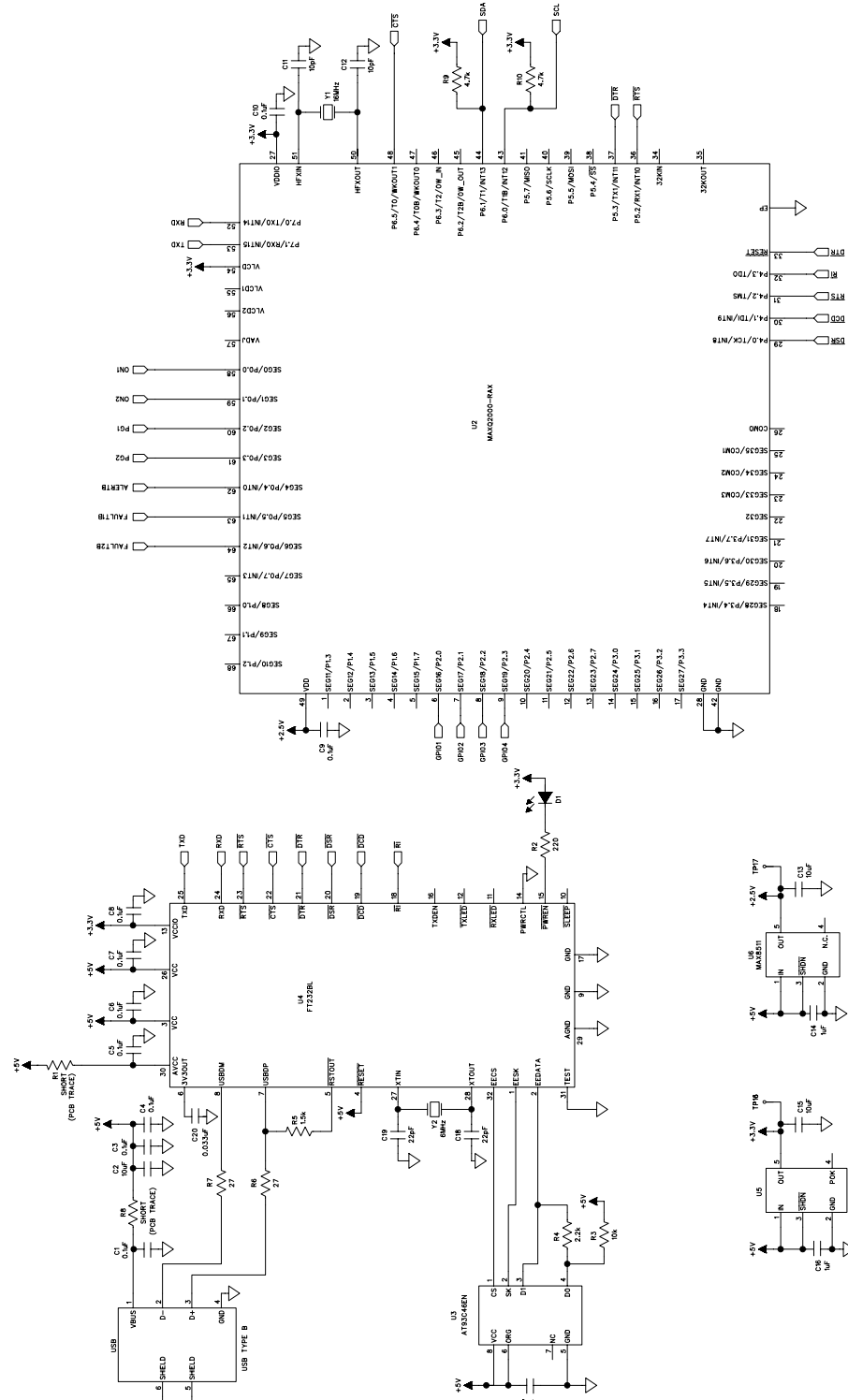
Figure 5b. MAX5970 EV Kit Schematic (Sheet 2 of 3)

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Figure 5c. MAX5970 EV Kit Schematic (Sheet 3 of 3)
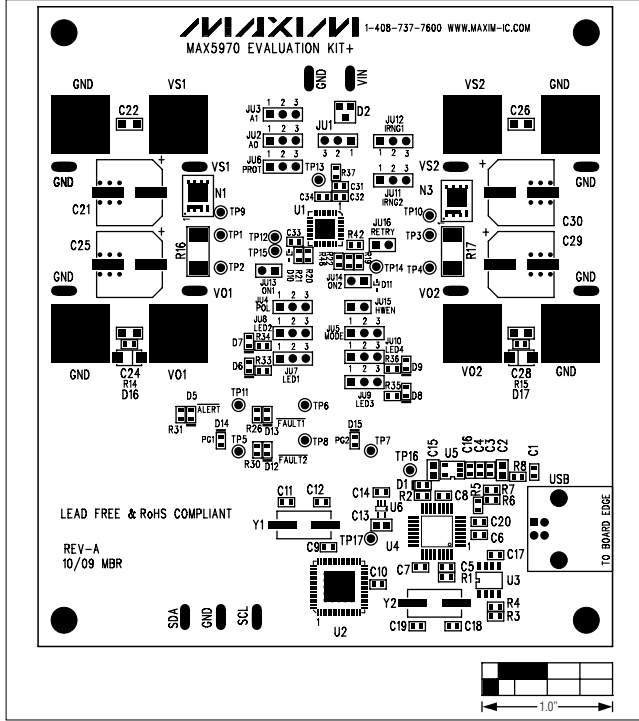
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Figure 6. MAX5970 EV Kit Component Placement Guide—
Component Side

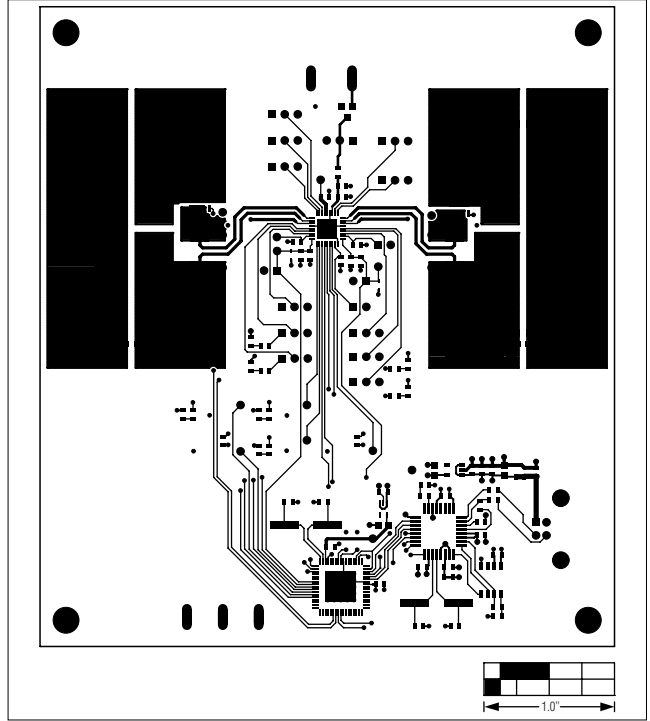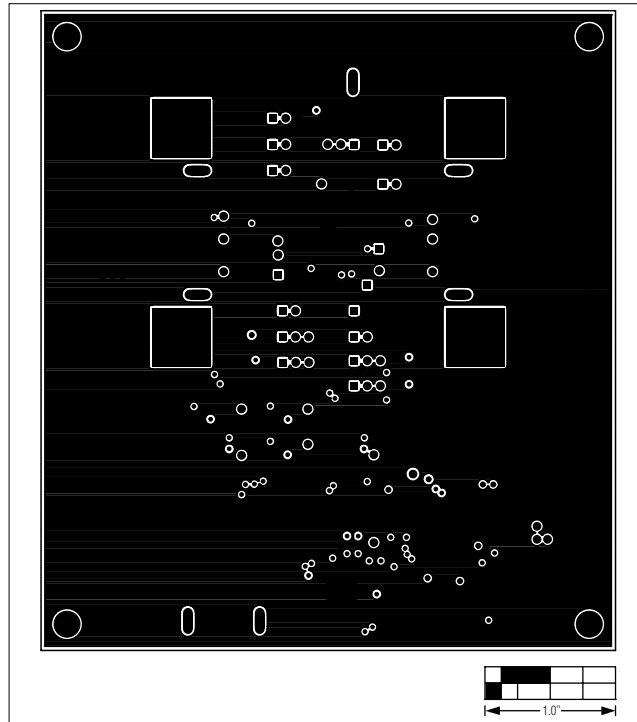Figure 7. MAX5970 EV Kit PCB Layout—Component Side

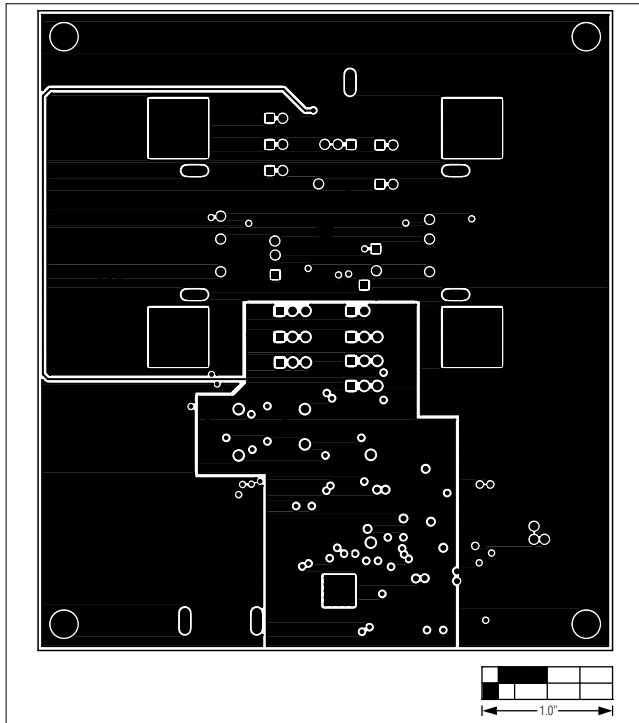Figure 8. MAX5970 EV Kit PCB Layout—Inner Layer 2
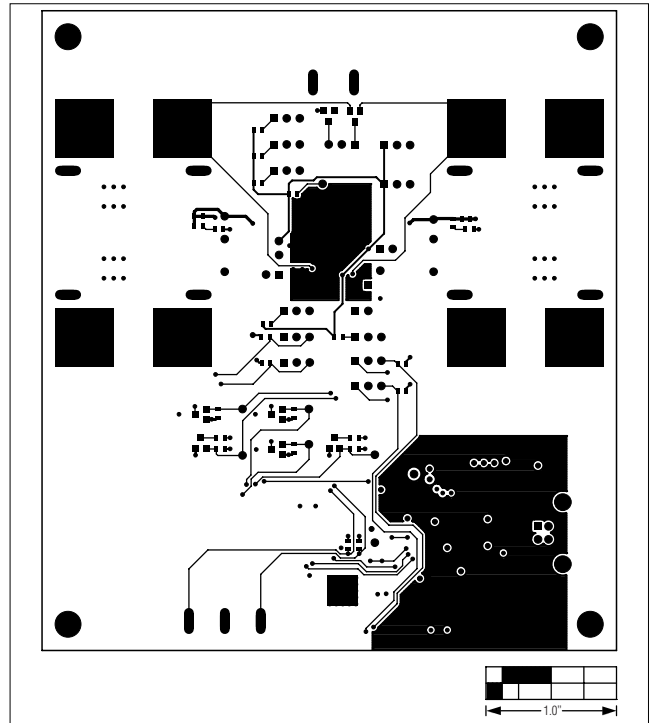
Figure 9. MAX5970 EV Kit PCB Layout—Inner Layer 3
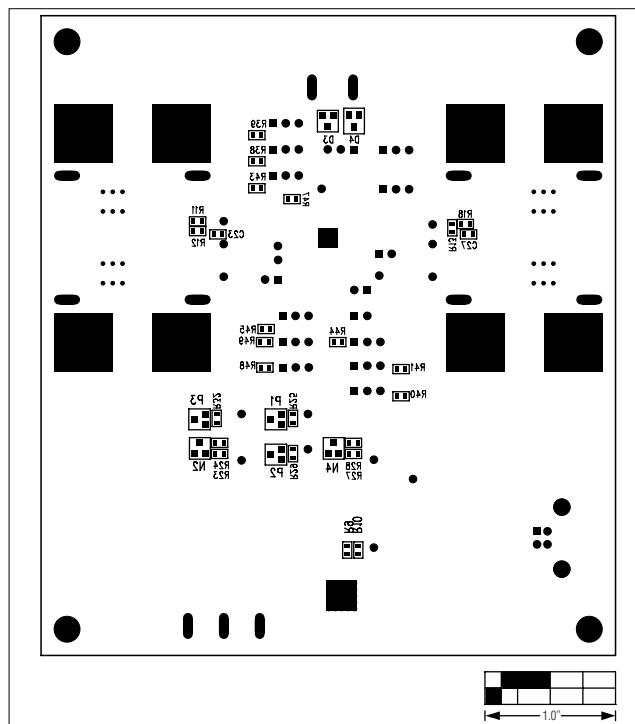

Figure 10. MAX5970 EV Kit PCB Layout—Solder Side

Figure 11. MAX5970 EV Kit Component Placement Guide—
Solder Side

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	04/10	Initial release	—

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