



# MAX5774 Evaluation Kit

## General Description

The MAX5774 evaluation kit (EV kit) demonstrates the operation of the MAX5774 32-channel, 14-bit, voltage-output digital-to-analog converter (DAC). The DAC integrates an SPI™/DSP-compatible serial interface to control each channel output. Each DAC channel has its own programmable input, gain, and offset register, and its output voltage can be set in the -2.5V to +7.5V range.

The MAX5774 EV kit circuit includes USB-to-SPI communication circuitry that generates the proper SPI signals to program the DAC outputs.

The MAX5774 EV kit includes Windows® 2000/XP® and Windows Vista® (32-bit)-compatible software that provides a simple graphical user interface (GUI) for exercising the MAX5774 features.

The MAX5774 EV kit can also evaluate the MAX5773 and MAX5775. The MAX5773 has a 0 to +10V range, and the MAX5775 has a -5V to +5V range. To evaluate the MAX5773 or MAX5775, replace U1 with a MAX5773UCB+ or MAX5775UCB+.

## Features

- ◆ 32 Individual DACs
- ◆ -2.5V to +7.5V Output Range
- ◆ Demonstrates Glitch-Free Power-Up
- ◆ SPI Interface
- ◆ Easy-to-Use Menu-Driven Software
- ◆ On-Board SPI Communication Interface Circuitry and USB Interface
- ◆ Windows 2000/XP- and Windows Vista (32-Bit)-Compatible Evaluation Software
- ◆ Lead(Pb)-Free and RoHS Compliant
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TYPE
MAX5774EVKIT+	EV Kit

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

## Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3–C10, C17, C21, C23, C25, C26, C48	15	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K Murata GRM188R71C104K
C2, C13, C15, C27, C28, C29	6	10µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J106K
C11, C12	2	10pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H100J or Murata GRM1885C1H100J
C14, C16, C31, C33, C36, C37, C39, C40, C43–C47	13	1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C105K
C18, C19	2	22pF ±5%, 50V C0G ceramic capacitors (0603) TDK C1608C0G1H220J
C20	1	3300pF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H332K

DESIGNATION	QTY	DESCRIPTION
C22	1	0.01µF ±10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C103K
C24, C35, C38, C41, C42	0	Not installed, ceramic capacitors (0603)
C30	1	10µF ±10%, 16V X5R ceramic capacitor (0805) Murata GRM21BR61C106K
C32	1	100pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H101J
C34	1	47pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H470J
D1	1	Green LED (0603) Panasonic LNJ314G8TRA
J1	1	Dual-row (2 x 10) 20-pin header
J2, J3	2	Dual-row (2 x 11) 22-pin headers
J4	1	8-pin header
J5	1	Dual-row (2 x 5) 10-pin header

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Evaluates: MAX5773/MAX5774/MAX5775

# MAX5774 Evaluation Kit

## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
J6	1	4-pin header
JU1	1	3-pin header
JU2, JU3, JU4	3	2-pin headers
JU5	0	Not installed, 2-pin header
L1, L2, L3	3	Ferrite chip bead, (0805) Murata BLM21AG102SN1
R1, R8, R9, R12-R15	0	Not installed, resistors (0603)
R2	1	220Ω ±5% resistor (0603)
R3	1	10kΩ ±5% resistor (0603)
R4	1	2.2kΩ ±5% resistor (0603)
R5	1	1.5kΩ ±5% resistor (0603)
R6, R7	2	27Ω ±5% resistors (0603)
R10	1	20kΩ ±5% resistor (0603)
R11	1	200kΩ ±5% resistor (0603)
U1	1	32-channel, 14-bit DAC (64 TQFP) Maxim MAX5774UCB+
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)

DESIGNATION	QTY	DESCRIPTION
U5	1	3.3V regulator (5 SC70) Maxim MAX8511EXK33+ (Top Mark: AEI)
U6	1	2.5V regulator (5 SC70) Maxim MAX8511EXK25+ (Top Mark: ADV)
U7	1	Dual-level translator (8 SOT23) Maxim MAX3373EEKA+ (Top Mark: AAKS)
U8	1	Quad-level translator (14 TSSOP) Maxim MAX3378EEUD+
U9	1	3V regulator (5 SC70) Maxim MAX8510EXK30+ (Top Mark: ADT)
USB	1	USB series type-B right-angle PC-mount receptacle
Y1	1	16MHz crystal
Y2	1	6MHz crystal
—	4	Shunts (JU1-JU4)
—	1	PCB: MAX5774 EVALUATION KIT+

\*EP = Exposed pad.

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic	800-344-2112	www.panasonic.com
TDK	847-803-6100	www.component.tdk.com

**Note:** Indicate that you are using the MAX5774 when contacting these component suppliers.

## MAX5774 EV Kit Software Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX5774.EXE	Application program
FTD2XX.INF	USB device driver file
UNINST.INI	Uninstalls the EV kit software
USB_Driver_Help.PDF	USB driver installation help file

# MAX5774 Evaluation Kit

Evaluates: MAX5773/MAX5774/MAX5775

## Quick Start

### Required Equipment

- MAX5774 EV kit (USB cable included)
- One +5V DC power supply for AVDD
- One -2.75V DC power supply for VSS
- One +8V DC power supply for AVCC
- One +2.7V DC power supply for DVDD
- One voltmeter
- User-supplied Windows 2000/XP or Windows Vista PC with a spare USB port

**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 MAX5774 EV kit is a fully assembled and tested surface-mount board. Follow the steps below to verify board operation. **Caution: Do not turn on the power supplies until all connections are completed.**

- 1) Visit [www.maxim-ic.com/evkitsoftware](http://www.maxim-ic.com/evkitsoftware) to download the latest version of the EV kit software, 5774Rxx.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) Install a shunt across pins 1-2 of jumper JU1 (SPI interface mode).
- 4) Install shunts across jumpers JU2 and JU3 (GS1 and GS2 connected to ground).
- 5) Install a shunt across jumper JU4 (REF = 3V).
- 6) Connect the +5V power supply between AVDD and AGND pads.
- 7) Connect the -2.75V power supply between VSS and AGND pads.
- 8) Connect the +8V power supply between AVCC and AGND pads.
- 9) Connect the +2.7V power supply between DVDD and DGND pads.
- 10) 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.
- 11) 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\MAX5774** (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.
- 12) Turn on the power supplies.
- 13) Start the MAX5774 EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 1.
- 14) Press the **Default** button in the main window.
- 15) Verify that the REF pad voltage measures +3V.
- 16) Verify that channel OUT0, located at pin J1-20, measures approximately -2.5V. Pin J1-19 can be used as a ground reference.
- 17) Use the software to program the DAC's output channels to various voltages.

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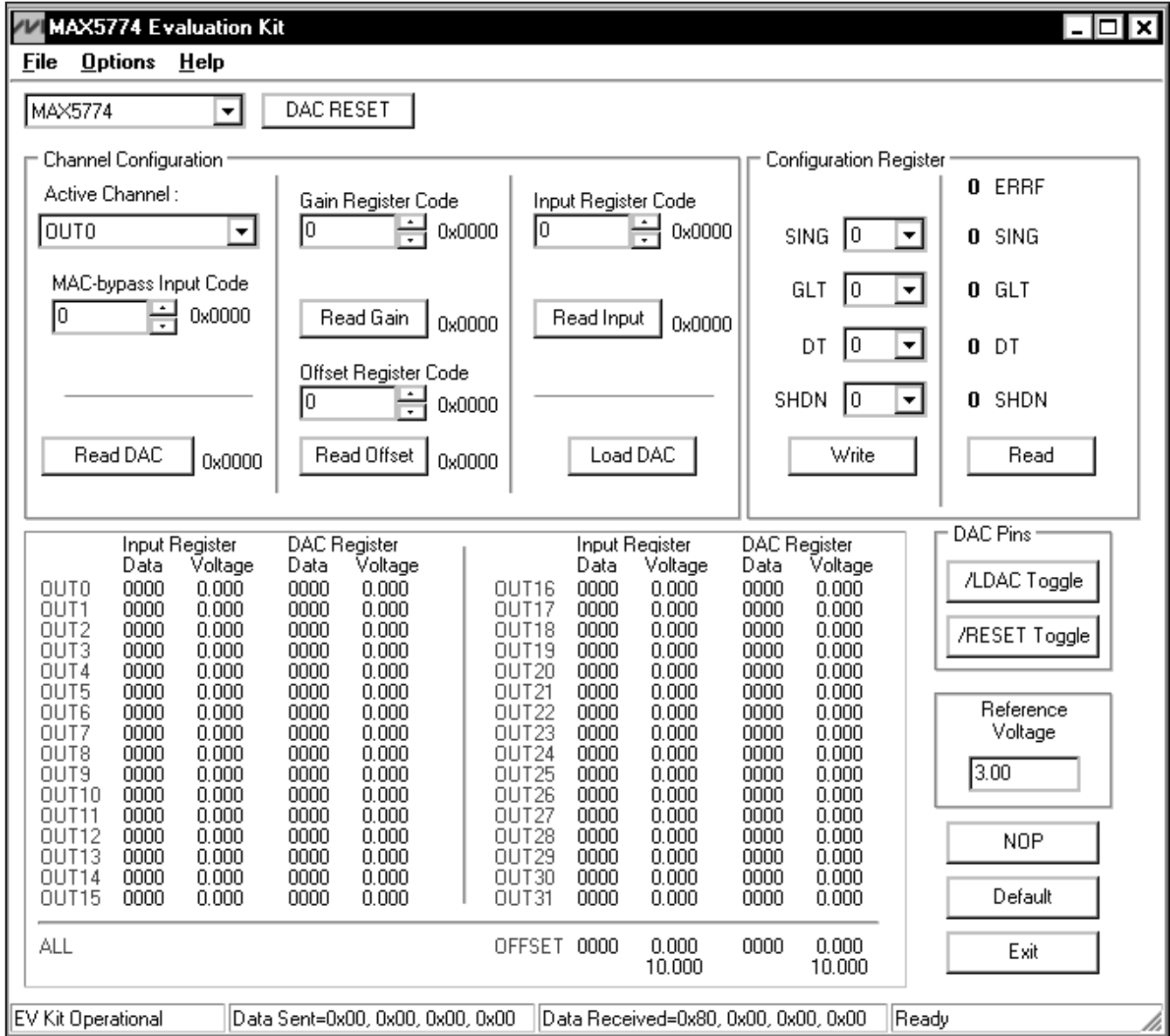


Figure 1. MAX5774 EV Kit Software Main Window (User-Interface Panel)

## Detailed Description of Software

The MAX5774 EV kit GUI software provides a user interface (Figure 1) to control each of the 32 channels on the MAX5774 DAC. To start the MAX5774 EV kit software, double-click the MAX5774 EV kit icon created during installation. The user will have to wait approximately 15s while the software detects and configures the MAX5774 EV kit.

## User-Interface Panel

The user interface (Figure 1) is easy to operate; use the mouse, or press the Tab and arrow keys to navigate the window. After updating a value in a spin or edit box, press the keyboard's Enter key or exit the box to submit the value to the EV kit software. The status bar located at the bottom of the GUI window displays the status of the EV kit board during power-up, data sent and data received in hexadecimal format, and general software status.

# MAX5774 Evaluation Kit

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The user can exit the software using the **File | Exit** menu item. Select the **Options | Demo Mode** menu item to exit or enter demo mode. When in demo mode, all software communication to the EV kit hardware is disabled and most of the software's GUI is functional. This feature enables a user to evaluate the software without hardware connectivity. The **Help** menu item provides help and additional information about the EV kit software.

## DAC Registers

Select the desired channel(s) from the **Active Channel** combo box in the **Channel Configuration** group box or by clicking a channel name in the software's IC register table beneath. A single channel (0–31), pair of channels, all channels, and the offset channel are selectable.

The **MAC-bypass Input Code**, **Gain Register Code**, **Offset Register Code**, and **Input Register Code** spin boxes accept 14-bit hexadecimal data (range: 0x0000–0x3FFF) and 14-bit decimal data (range: 0–16383). After updating spin-box data, press the keyboard's Enter key or exit the spin box to write data to the output DAC, input, gain, or offset register(s), respectively. The spin-box up/down arrow keys update the spin-box data and write data to the IC simultaneously. The number displayed to the right of the spin box is the hexadecimal equivalent of data written to the IC.

Press the **Load DAC** button to load the output DAC register(s) with the input register code(s) calibrated with the gain and offset register codes for the selected channel(s). The **MAC-bypass Input Code** spin box loads data directly into the output DAC register(s), does not modify the input register(s), and bypasses gain and offset calibration for the selected channel(s).

The voltage for the 32 DACs is given by the following equation:

$$V_{OUT} = \frac{GAIN \times V_{REF} \times (DAC \text{ Code} - \text{Offset DAC Code})}{2^{14}} + V_{GS}$$

where  $GAIN = 10/3$  for the MAX5774,  $V_{REF}$  = the reference voltage (3V by default),  $V_{GS}$  = is the ground-sense voltage (0V by default), and DAC code = output DAC register code.

$V_{REF}$  can be modified using the **Reference Voltage** edit box, which accepts a 2.9V to 3.1V unconnected point value. After updating the edit-box value, press the keyboard's Enter key or exit the edit box to update the software's reference-voltage value.

## Read Registers

In the **Channel Configuration** group box, press the **Read DAC**, **Read Gain**, **Read Offset**, or **Read Input** button to read the active channel's output DAC, gain, offset, or input register, respectively. The number displayed to the right of the button is the hexadecimal equivalent of data read. **Note:** Only a single channel (0–31) or the offset channel registers can be read. Channel pair and all channel selections are write only.

## DAC RESET

Reset the MAX5774 to its power-up state, where all register codes are 0x0000, by using one of the following:

- 1) Hardware reset ( $\overline{RESET}$  pin):
  - a) Press the **RESET Toggle** button in the **DAC Pins** group box.
- 2) Software reset:
  - a) Select "1" from the **SING** combo box in the **Configuration Register** group box.
  - b) Press the **Write** button in the **Configuration Register** group box.
  - c) Press the **DAC RESET** button in the main window.

Lastly, press the **Default** button in the main window to set the MAX5774 to its default configuration.

## Configuration Register

The configuration register controls the operating mode of the MAX5774, and communicates the status during a read command. Use the **SING**, **GLT**, **DT**, and **SHDN** combo boxes to select the configuration. Press the **Write** button to actually write to the configuration register. Press the **Read** button to read the configuration register. Refer to the *Configuration Register* section in the MAX5773/MAX5774/MAX5775 IC data sheet for more details.

## LDAC and RESET Pins

The MAX5774 features a load DAC (LDAC) pin. Toggle this pin by pressing the **LDAC Toggle** button in the **DAC Pins** group box to cause all DAC outputs to update simultaneously.

The MAX5774 also features a clear ( $\overline{RESET}$ ) pin. Drive this pin by pressing the **RESET Toggle** button in the **DAC Pins** group box to set all the channels to 0V, the offset to 0V, and the input and DAC registers to 0 code.

## Simple SPI Commands

There are two methods for communicating with the MAX5774, through the normal user-interface panel or through the SPI commands available by selecting the **Options | Interface (Advanced Users)** menu item. A window is displayed that executes an SPI read/write operation (Figure 2).

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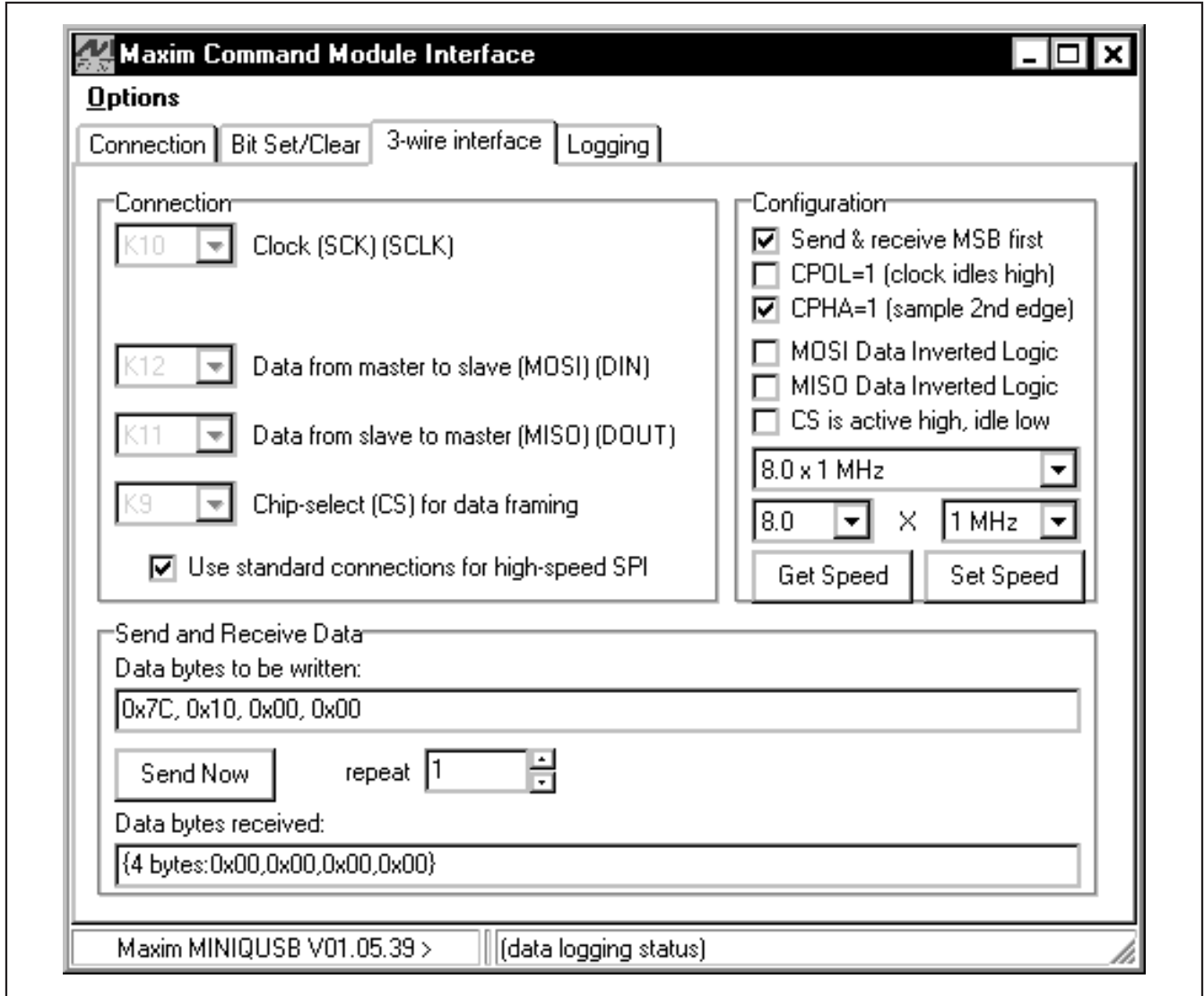


Figure 2. Advanced SPI User Interface Window (3-Wire Interface Tab)

The SPI (**3-Wire Interface**) tab sheet accepts numeric data in hexadecimal format. Hexadecimal numbers should be prefixed by a \$ or 0x. Data entered in the **Data bytes to be written** edit box is sent to the device. Eight-bit hexadecimal numbers should be comma delimited. Data appearing in the **Data bytes received** edit box is data read from the device.

Pressing the **Send Now** button transmits the hexadecimal numbers 0x7C, 0x10, 0x00, and 0x00. The received values from the device are 0x00, 0x00, 0x00,

and 0x00. Refer to the MAX5773/MAX5774/MAX5775 IC data sheet for a detailed description of SPI communications with the MAX5774. **Note:** The advanced SPI user interface window settings are preconfigured and should not be changed. This interface is used only for low-level communication and only the **Data bytes to be written** edit box, the **Data bytes received** edit box, and the **Send Now** button should be used.

Enter and exit demo mode for the software's IC register table to reflect changes made to the MAX5774 registers.



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Evaluates: MAX5773/MAX5774/MAX5775

## Detailed Description of Hardware

The MAX5774 EV kit demonstrates the operation of the MAX5774 32-channel, 14-bit, voltage-output DAC. The EV kit circuit includes circuitry that generates the proper SPI signals to program each DAC channel input, gain, and offset register. Each DAC output can be set to the -2.5V to +7.5V range.

The MAX5774 EV kit can also evaluate the MAX5773 or MAX5775 DACs. The MAX5773 DAC has a 0 to +10V output-voltage range, while the MAX5775 DAC has a -5V to +5V output-voltage range. Replace the MAX5774 DAC (U1) with either of these two DACs and use the EV kit software's DAC drop-down list to select the new converter for proper evaluation.

### SPI/DSP

The MAX5774 DAC is programmable with SPI or DSP signals. Installing a shunt across pins 1-2 of jumper JU1 places the MAX5774 in SPI mode. Installing a shunt across pins 2-3 places the MAX5774 in DSP mode (Table 1). **Note:** The EV kit USB interface circuit only communicates to the DAC using SPI protocols. To operate in DSP mode, disconnect the USB cable from the EV kit and supply the proper DSP signals to header J4. See Figure 3a.

### GS1 and GS2

Ground-sense analog inputs GS1 and GS2 can be accessed at the GS1 and GS2 pads located near headers J1, J2, and J3. The EV kit provides jumpers JU2

and JU3 to ground the GS1 and GS2 signals, respectively. Remove the shunts from jumper JU2 or JU3 to supply an external offset signal for GS1 or GS2 at the respective PCB pad. Refer to the *Ground Sense (GS1 and GS2)* section in the MAX5773/MAX5774/MAX5775 IC data sheet for more details.

### Reference Voltage

The MAX8510 regulator (U9) supplies a +3V reference to the MAX5774's reference input (REF). To use a different reference voltage, remove the shunt from jumper JU4 and connect the external reference to the pad labeled REF. The voltage must be between +2.90V and +3.10V. The MAX5774 EV kit software assumes a reference voltage of +3V.

### Analog Outputs

The 32-channel outputs can be accessed at headers J1, J2, and J3. Each output is properly labeled on the EV kit PCB silkscreen (Figure 4). The analog signal is connected to the inside pin of the header, while the ground connection is available on all the outside pins of the headers.

### EV Kit SPI Signals

Header J4 provides a location to monitor the digital signals, digital ground (DGND), and digital VDD (DVDD). The digital signals are chip select ( $\overline{CS}$ ), master-in, slave-out (MISO), serial clock (SCK), master-out, slave-in (MOSI), load DAC (LDAC), and reset (RESET).

Table 1. SPI/DSP Mode (Jumper JU1)

SHUNT POSITION	DSP PIN	EV KIT FUNCTION
1-2	Connected to DVDD	SPI operation
2-3	Connected to DGND	DSP operation, user-supplied signal at J4

Table 2. GS1 Configuration (Jumper JU2)

SHUNT POSITION	GS1 PIN	GS1 REFERENCE
Installed	Connected to AGND	AGND (ground)
Not installed	Not connected	$\pm 0.5V$ user-supplied reference, with respect to GND, at GS1

Table 3. GS2 Configuration (Jumper JU3)

SHUNT POSITION	GS2 PIN	GS2 REFERENCE
Installed	Connected to AGND	AGND (ground)
Not installed	Not connected	$\pm 0.5V$ user-supplied reference, with respect to AGND, at GS2

Table 4. REF Configuration (Jumper JU4)

SHUNT POSITION	REF PIN	EV KIT FUNCTION
Installed	Connected to U9 output	REF = +3V
Not installed	Not connected	User-supplied voltage reference at the REF pad

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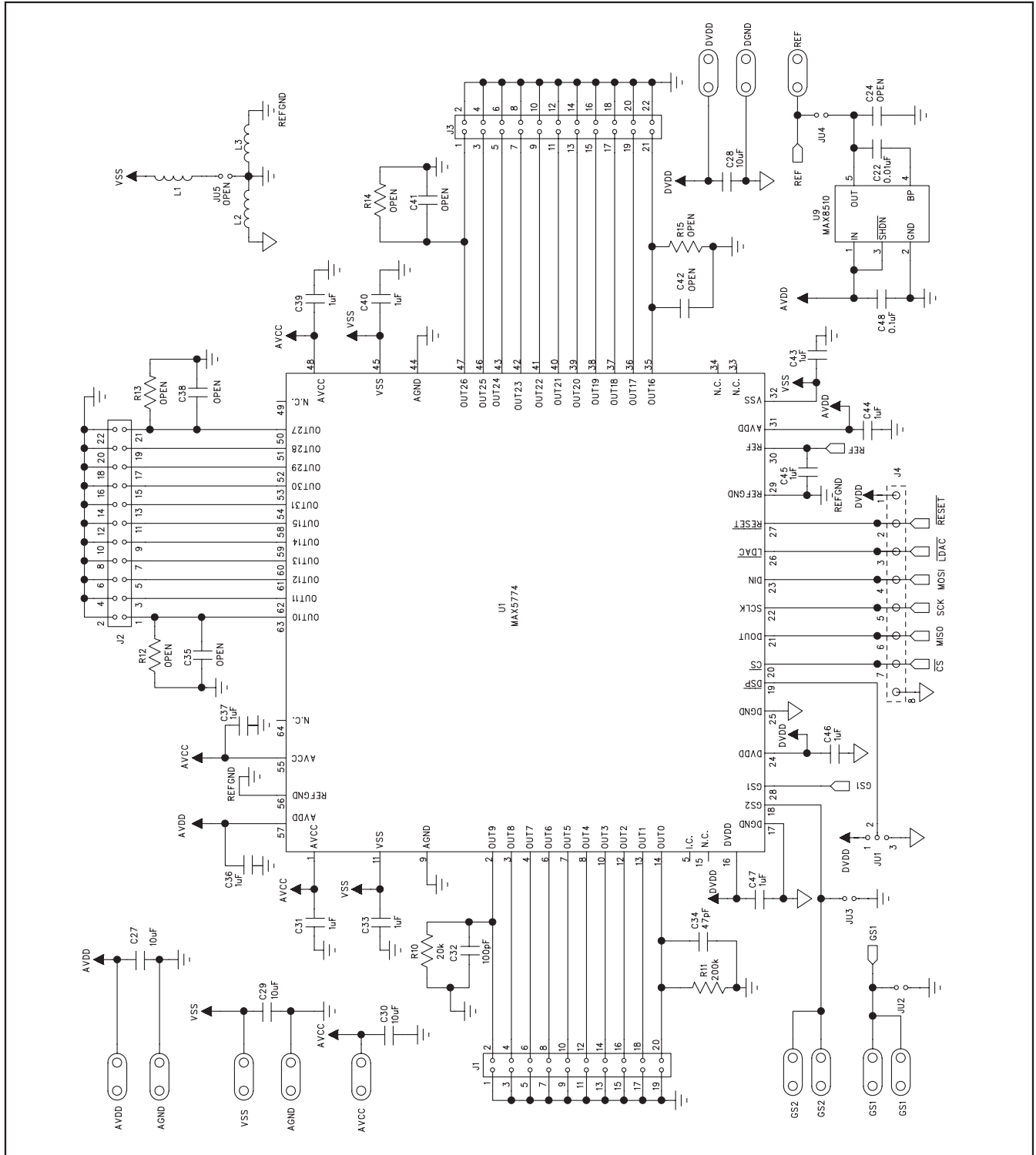


Figure 3a. MAX5774 EV Kit Schematic (Sheet 1 of 2)



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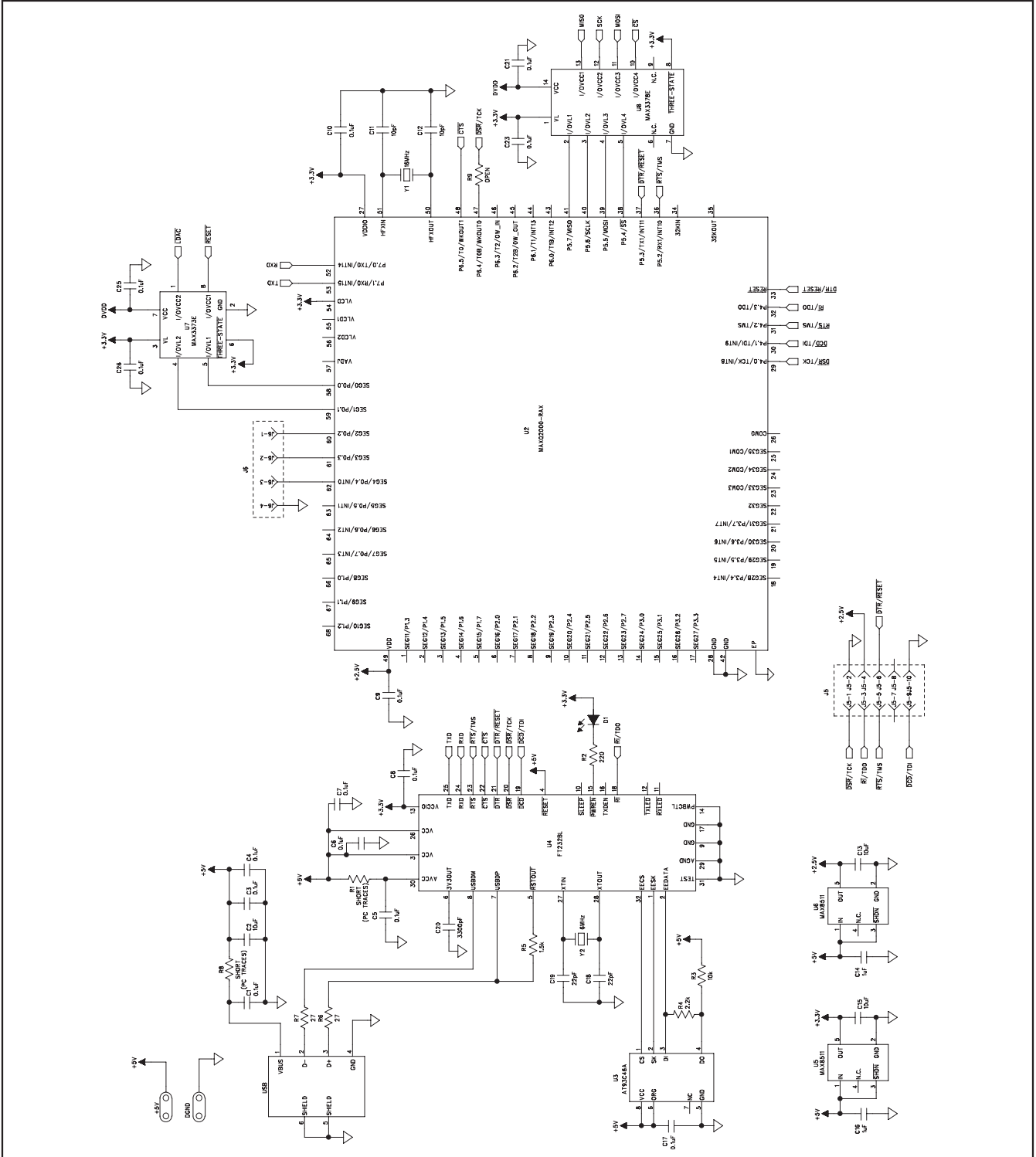


Figure 3b. MAX5774 EV Kit Schematic (Sheet 2 of 2)

# MAX5774 Evaluation Kit

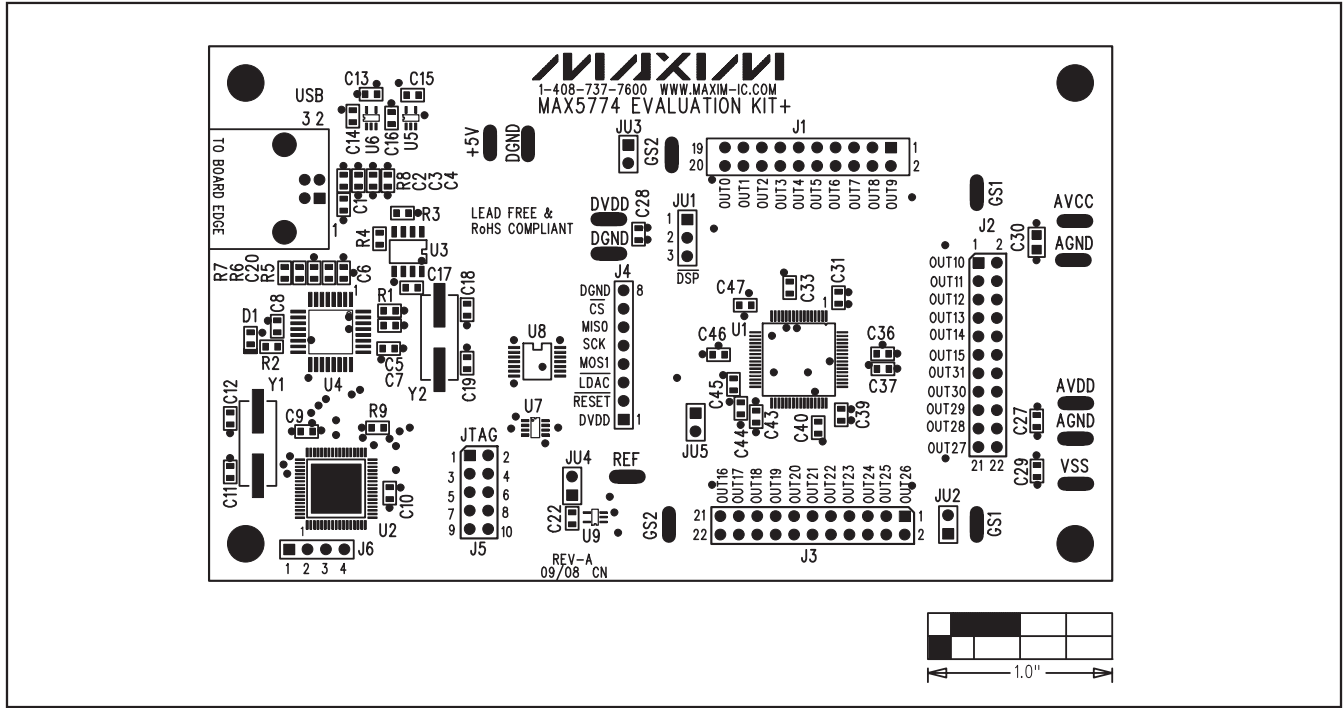


Figure 4. MAX5774 EV Kit Component Placement Guide—Component Side

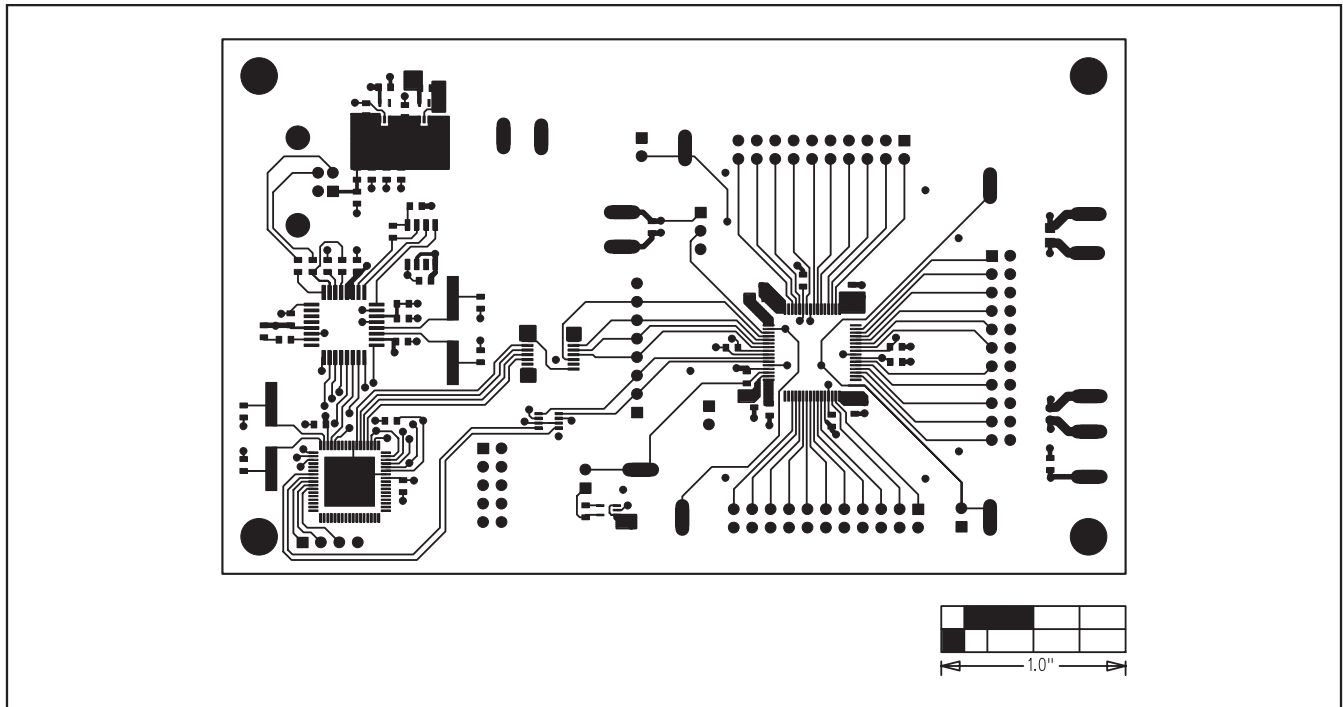


Figure 5. MAX5774 EV Kit PCB—Component Side

# MAX5774 Evaluation Kit

Evaluates: MAX5773/MAX5774/MAX5775

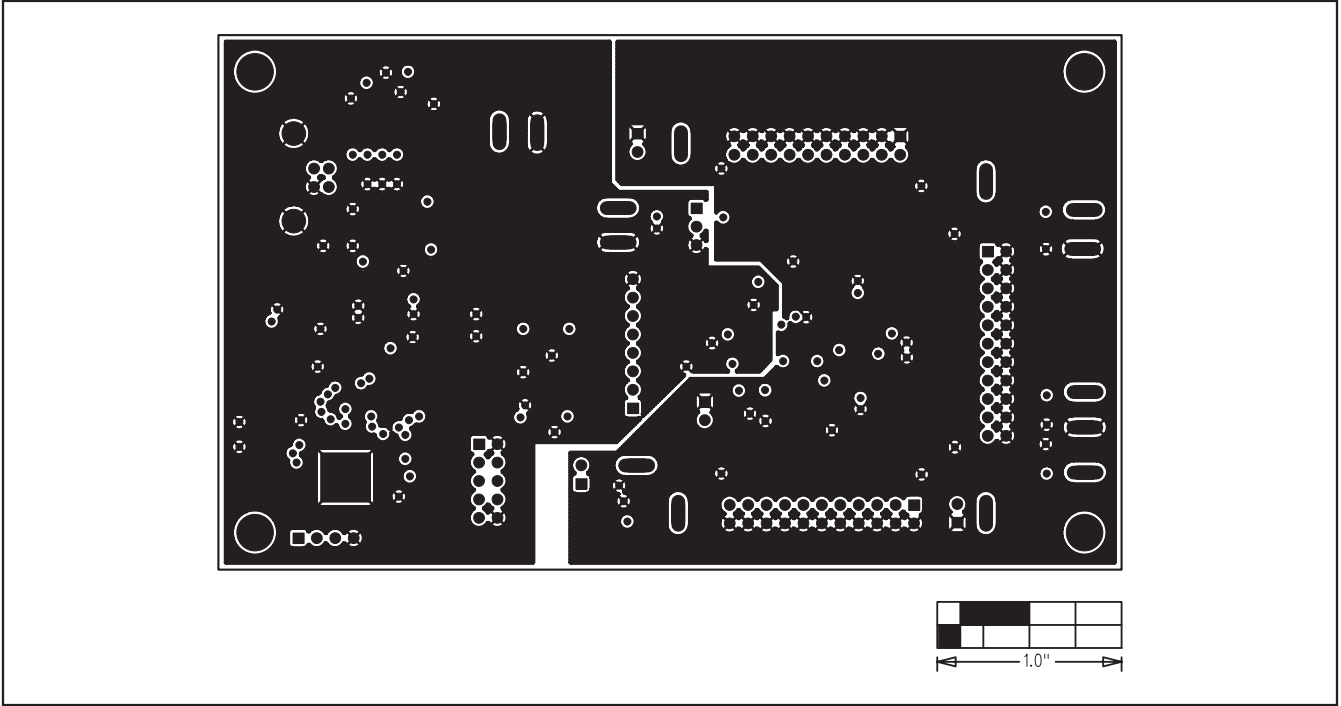


Figure 6. MAX5774 EV Kit PCB—Ground Planes (Layer 2)

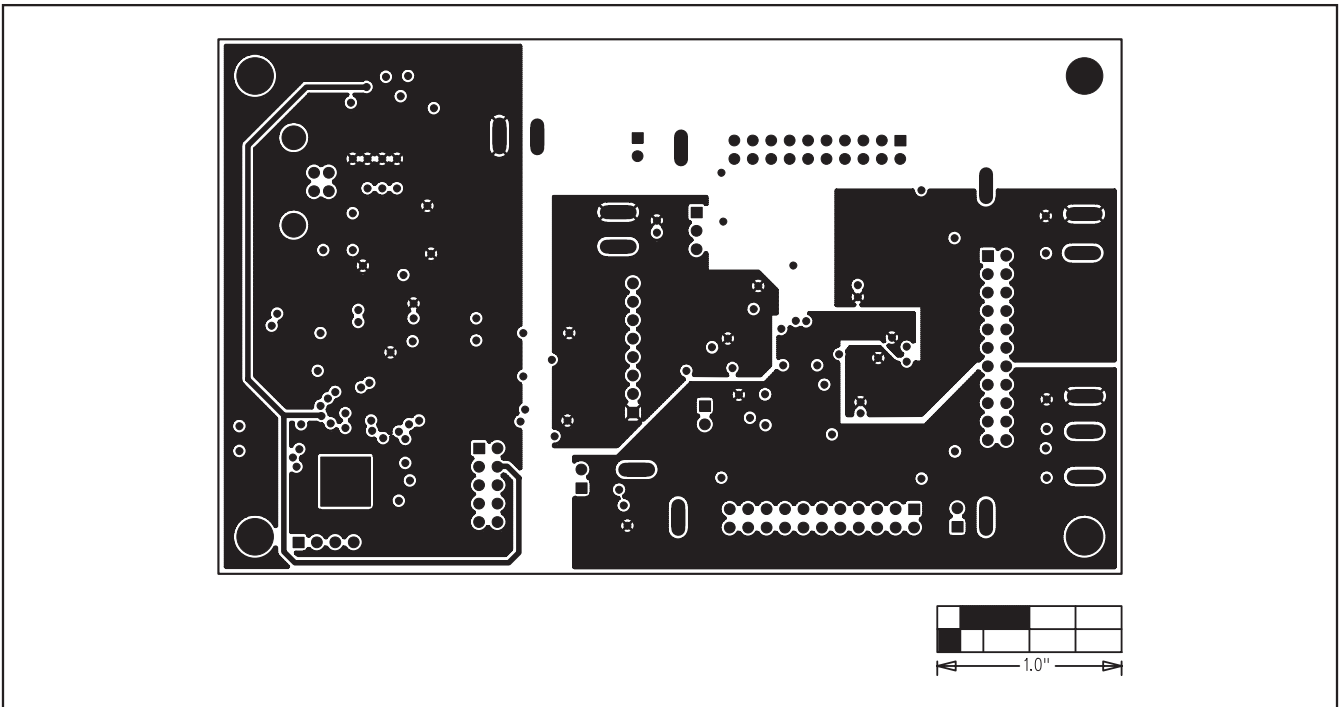


Figure 7. MAX5774 EV Kit PCB—Power Planes (Layer 3)

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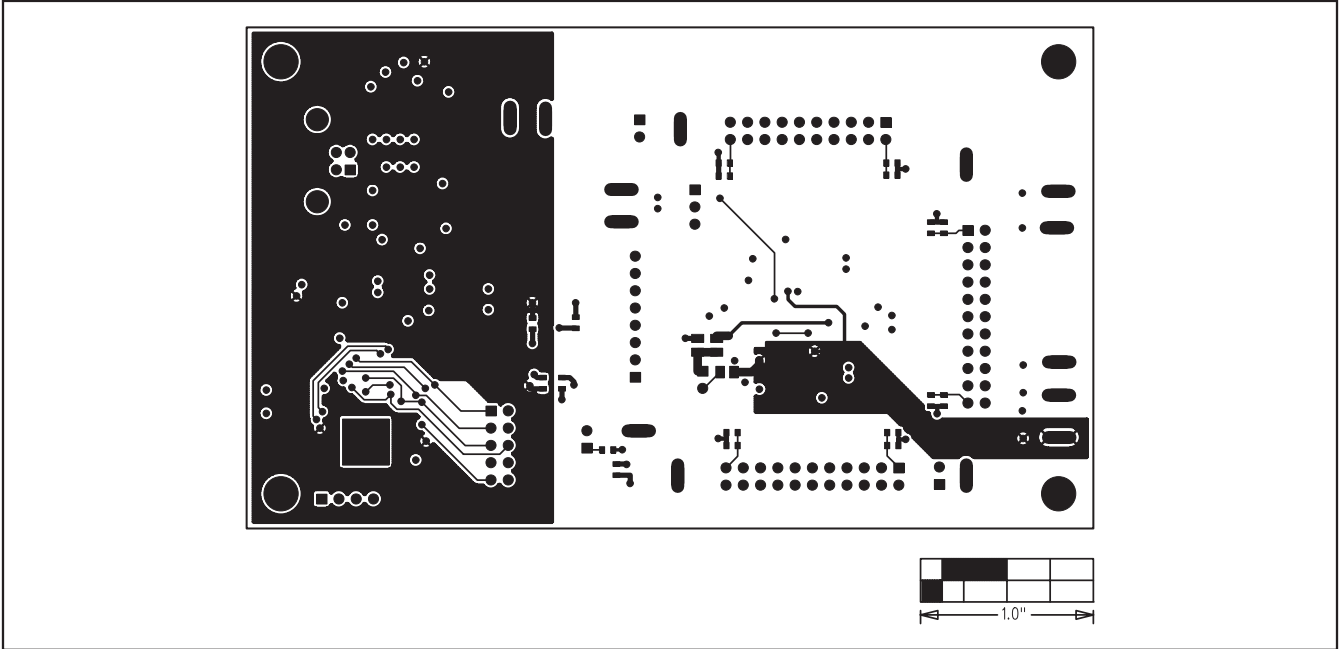


Figure 8. MAX5774 EV Kit PCB—Solder Side

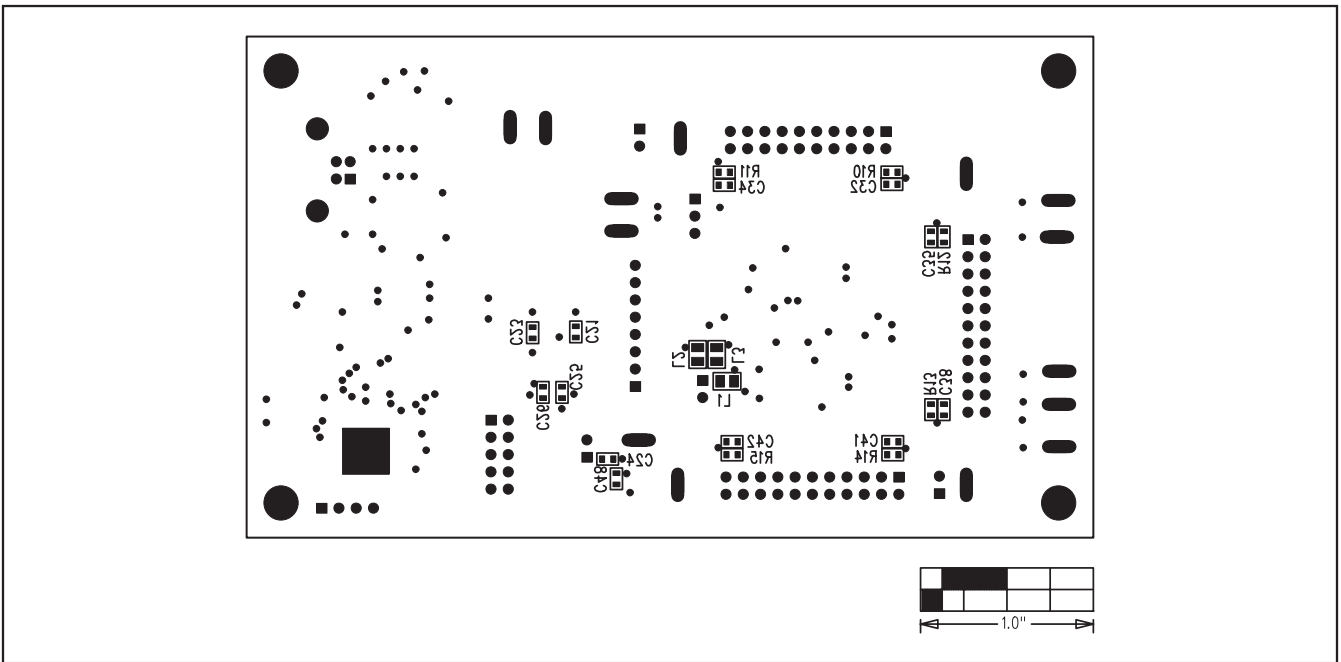


Figure 9. MAX5774 EV Kit Component Placement Guide—Solder Side

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