19-2867; Rev 0; 5/03

MAX5888 Evaluation Kit

Evaluates: MAX5886/MAX5887/MAX5888

General Description

The MAX5888 evaluation kit (EV kit) is a fully assembled and tested circuit board that contains all the components necessary to evaluate the performance of the MAX5888 16-bit, 500Msps, current-output, digital-to-analog converter (DAC). The EV kit requires low-voltage differential-signaling (LVDS)-compatible data input, a single-ended clock input, and 3.3V power supplies for simple board operation.

The MAX5888 EV kit may also be used to evaluate the MAX5887 (14-bit) and MAX5886 (12-bit) DACs.

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX5888EVKIT	0°C to +70°C	68 QFN-EP*

**EP = Exposed pad.*

Features

- **Quick Dynamic Performance Evaluation**
- **LVDS Compatible**
- **SMA Coaxial Connectors for Clock Input and Analog Output**
- **50Ω Matched Clock Input and Analog Output Signal Lines**
- **Single-Ended to Differential Clock-Signal Conversion Circuitry**
- **Differential Current Output to Single-Ended Voltage Signal Output Conversion Circuitry**
- **Full-Scale Current Output Configured for 20mA**
- **External 1.25V Reference Source Available**
- **Fully Assembled and Tested**
- **Evaluates the 16-Bit MAX5888, 14-Bit MAX5887, and 12-Bit MAX5886 DACs**

Component List

DESIGNATION	QTY	DESCRIPTION
C1	0	Not installed, ceramic capacitor (0603)
C2–C15	14	0.1µF ±10%, 10V X5R ceramic capacitors (0402) TDK C1005X5R1A104KT or Taiyo Yuden LMK105BJ104KV
C16, C28	0	Not installed, ceramic capacitors (0805)
C17, C20, C23	3	47µF ±10%, 6.3V tantalum capacitors (B) AVX TAJB476K006R or Kemet T494B476K006AS
C18, C21, C24, C26	4	10µF ±10%, 10V tantalum capacitors (A) AVX TAJA106K010R or Kemet T494A106K010AS
C19, C22, C25, C27	4	1µF ±10%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A105KT
J1, J2	2	2 x 20-pin surface-mount headers (0.1in) Samtec TSM-120-02-S-MT
JU1–JU5	5	2-pin headers

DESIGNATION	QTY	DESCRIPTION
R1–R4	4	100Ω ±0.1% resistors (0603)
R5	1	100Ω ±1% resistor (0603)
R6, R8, R9	0	Not installed, resistors (0603)
R7	1	2kΩ ±1% resistor (0603)
R10, R11	2	24.9Ω ±1% resistors (0402)
R12, R13	2	0Ω ±5% resistors (0402)
L1–L4	4	Ferrite bead cores (4532) Panasonic EXC-CL-4532U1
T1, T3	2	Transformers Mini-Circuits ADTL1-12
T2	1	1:1 balun transformer Coilcraft TTWB3010-1
CLK, OUT	2	SMA PC-mount vertical connectors
OUT+, OUT-	2	Scope probe connectors Tektronix 131-4244-00 (100 quantity)
TP1, TP2, TP3	3	PC test points, black
TP4	1	PC test point, red
U1	1	MAX5888EGK (68-pin QFN-EP)
U2	1	1.25V voltage reference (8-pin SO) Maxim MAX6161AESA
None	5	Shunts (JU1–JU5)
None	1	MAX5888 PC board

MAX5888 Evaluation Kit

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
AVX	843-946-0238	843-626-3123	www.avxcorp.com
Coilcraft	847-639-6400	847-639-1469	www.coilcraft.com
Kemet	864-963-6300	864-963-6322	www.kemet.com
Mini-Circuits	718-934-4500	718-934-7092	www.minicircuits.com
Panasonic	714-373-7366	714-737-7323	www.panasonic.com
Samtec	812-944-6733	812-948-5047	www.samtec.com
Taiyo Yuden	800-348-2496	847-925-0899	www.t-yuden.com
TDK	847-803-6100	847-390-4405	www.component.tdk.com

Note: *Please indicate that you are using the MAX5888 when contacting these component suppliers.*

Quick Start

Recommended equipment:

- Three 3.3VDC power supplies
- Function generator with low phase noise and low jitter for clock input (e.g., HP 8662A)
- 16-bit digital pattern generator for LVDS data inputs (e.g., Agilent 81250)
- Spectrum analyzer (e.g., Rohde & Schwartz FSEA30)
- Voltmeter

The MAX5888 EV kit is a fully assembled and tested surface-mount board. Follow the steps below for board operation. **Do not turn on power supplies or enable signal generators until all connections are completed:**

1) Verify that no shunts are installed across jumpers JU1, JU2 (DAC uses the 1.2V internal voltage reference), and JU3 (DAC in normal operation mode).
2) Verify that a shunt is installed across jumper JU4.
3) Verify that no shunt is installed across jumper JU5.
4) Synchronize the digital pattern generator (HP 81250) to the clock function generator (HP 8662A).
5) Connect the clock function signal generator to the CLK SMA connectors on the EV kit.
6) Verify that the 16-bit digital pattern generator is programmed for LVDS outputs.
7) Connect the digital pattern generator output to the input header connectors J1 and J2 on the EV kit board. The input header pins are labeled for proper connection with the digital pattern generator (i.e., connect the positive rail of bit 0 to the header pin labeled B0P and complementary negative rail to the header pin labeled B0N, etc.).
8) Connect the spectrum analyzer to the OUT SMA connector.
9) Connect a 3.3V power supply to VDD_CK. Connect the ground terminal of this supply to GND_CK.
10) Connect a 3.3V power supply to DVDD. Connect the ground terminal of this supply to DGND.
11) Connect a 3.3V power supply to AVDD. Connect the ground terminal of this supply to AGND.
12) Turn on the three power supplies.
13) With a voltmeter verify that 1.2V is measured at the VREF PC board pad on the EV kit.
14) Enable the clock function generator and the digital pattern generator. Set the clock function generator output power to 10dBm and the frequency (f_{CLK}) to less than or equal to 500MHz.
15) Use the spectrum analyzer to view the MAX5888 output spectrum or view the output waveform using an oscilloscope.

Detailed Description

The MAX5888 EV kit is designed to simplify the evaluation of the MAX5888 16-bit, 500Msps, current-output DAC. The MAX5888 requires LVDS-compatible data inputs, differential clock input signals, a 1.2V reference voltage, and 3.3V power supplies for simple board operation.

The MAX5888 EV kit provides header connectors to easily interface with an LVDS pattern generator, circuitry to convert the differential current outputs to a single-ended voltage signal, and circuitry to convert a user-supplied single-ended clock signal to a differential clock signal required by the DAC. The EV kit circuit includes different options for supplying a reference voltage to the DAC. The EV kit circuit can operate with a single 3.3V power supply, but also supports the use of

three separate 3.3V power supplies by dividing the circuit grounds into digital, analog, and digital clock ground planes that improve dynamic performance. The three ground planes are connected together on the back of the PC board.

Power Supplies

The MAX5888 EV kit can operate from a single 3.3V power supply connected to the VDD_CK, DVDD, AVDD input power pads and their respective ground pads for simple board operation. However, three separate 3.3V power supplies are recommended for optimum dynamic performance. The EV kit board layout is divided into three sections: digital, analog, and digital clock circuits. Using separate power supplies for each section reduces noise crosstalk and improves the integrity of the output signal. When using separate power supplies, connect each power supply across the DVDD and DGND PC board pads (digital), across the VDD_CK and GND_CK PC board pads (digital clock), and across the AVDD and AGND PC board pads (analog) on the EV kit.

LVDS Input Data

The MAX5888 EV kit provides two 0.1in 2 x 20 header connectors (J1 and J2) to interface a 16-bit LVDS pattern generator to the EV kit. The header data pins are labeled on the board with the appropriate data bit designation. Use the labels on the EV kit to match the data bits from the LVDS pattern generator to the corresponding data pins on J1 and J2. The positive rail of a bit is labeled BxP (positive) and the complementary rail is labeled BxN (negative) where x is the bit number.

Clock Signal

The MAX5888 requires a differential clock input signal with minimal jitter. The EV kit circuit provides single-ended to differential conversion circuitry. The user must supply a single-ended clock signal at the CLK SMA connector.

The clock signal can be either a sine wave or a square wave. For a sine wave, $2V_{P-P}$ (10dBm) amplitude is recommended and for a square wave greater than a $0.5V_{P-P}$ signal is recommended.

Reference Voltage Options

The MAX5888 requires a reference voltage to set the full-scale analog signal voltage output. The DAC contains an internal stable on-chip bandgap reference of 1.2V that can be used by decoupling the REFIO pin. The internal reference can be overdriven by an external reference to enhance accuracy and drift performance or for gain control.

The MAX5888 EV kit features three ways to provide a reference voltage to the DAC: internal, on-board external, and user-supplied external reference. Verify that no shunt is connected across jumper JU1 to use the internal reference. The reference voltage can be measured at the VREF pad on the EV kit. The EV kit circuit is designed with an on-board 1.25V temperature-stable external voltage reference source U2 (MAX6161) that can be used to overdrive the internal reference provided by the MAX5888. Install shunts across jumpers JU1 and JU2 to use the on-board external reference. The user can also supply an external voltage reference in the range of 0.125V to 1.25V by connecting a voltage source to the VREF pad and removing the shunts across jumpers JU1 and JU2. See Table 1 to configure the shunts across jumpers JU1 and JU2 and select the source of the reference voltage.

Full-Scale Output Current

The MAX5888 requires an external resistor to set the full-scale output current. The MAX5888 EV kit full-scale current is set to 20mA with resistor R7. Replace resistor R7 to adjust the full-scale output current. Refer to the *Reference Architecture and Operation* section in the MAX5888 data sheet to select different values for R7.

Differential Output

The MAX5888 complementary current outputs are terminated into differential 50Ω resistance to generate voltage signals with amplitudes of $1V_{P-P}$ differential. The positive and negative rails of the differential signal can be sampled at the OUT+ and OUT- probe connectors. The differential signal is converted into a 50Ω singled-ended signal with balun transformer T2 and can be sampled at the OUT SMA connector. A shunt on jumper JU4 connects the center tap of transformer T2 to AGND, thus enhancing the dynamic performance of the DAC. The single-ended output signal after the transformer generates a -3dBm full-scale output power when terminated into 50Ω. **A shunt on jumper JU4 should always be installed for optimum dynamic performance.**

Table 1. Reference Voltage Selection

JU1 AND JU2 SHUNT POSITIONS	VOLTAGE REFERENCE MODE
Installed	External 1.25V reference (U2) connected to REFIO pin
Not installed	MAX5888 DAC internal 1.2V bandgap reference
Not installed	User-supplied voltage reference at the VREF pad (0.125V to 1.25V)

Power-Down

The MAX5888 can be powered down or powered up by configuring jumper JU3. In power-down mode, the total power dissipation of the DAC is reduced to less than 1mW. See Table 2 for jumper JU3 configuration.

Segment Shuffling

The segment-shuffling function on the MAX5888 improves the high-frequency spurious-free dynamic range (SFDR) at the cost of a slight increase in the DAC's noise floor. The MAX5888 EV kit provides jumper JU5, which allows the user to enable or disable this function. See Table 3 to configure jumper JU5.

Evaluating the MAX5887 or MAX5886

The MAX5888 EV kit can be used to evaluate the MAX5887 or MAX5886 DACs. The MAX5887 is a 14-bit DAC and the MAX5886 is a 12-bit DAC. Except for the input pins, these DACs are pin-for-pin compatible with the MAX5888. Replace the MAX5888 (U1) with the MAX5887 or the MAX5886 and refer to the respective data sheet to compare the difference in input pins and how to modify the connections between the pattern generator and the EV kit input connectors.

Board Layout

The MAX5888 EV kit is a four-layer board design optimized for high-speed signals. All high-speed signal lines are routed through 50Ω impedance-matched transmission lines. The length of these 50Ω transmission lines is matched to within 40 mils (1mm) to minimize layout-dependent data skew. The board layout separates the analog, digital, and digital clock sections of the circuit for optimum performance.

Table 2. Jumper JU3 (Power-Down)

SHUNT	FUNCTION
Installed	Power-down mode
Not installed	Normal operation

Table 3. Segment-Shuffling Mode (Jumper JU5)

SHUNT	SEL0 PIN	SEGMENT-SHUFFLING MODE
Installed	Connected to DVDD	Enabled
Not installed	Connected to DGND with internal pulldown resistor	Disabled

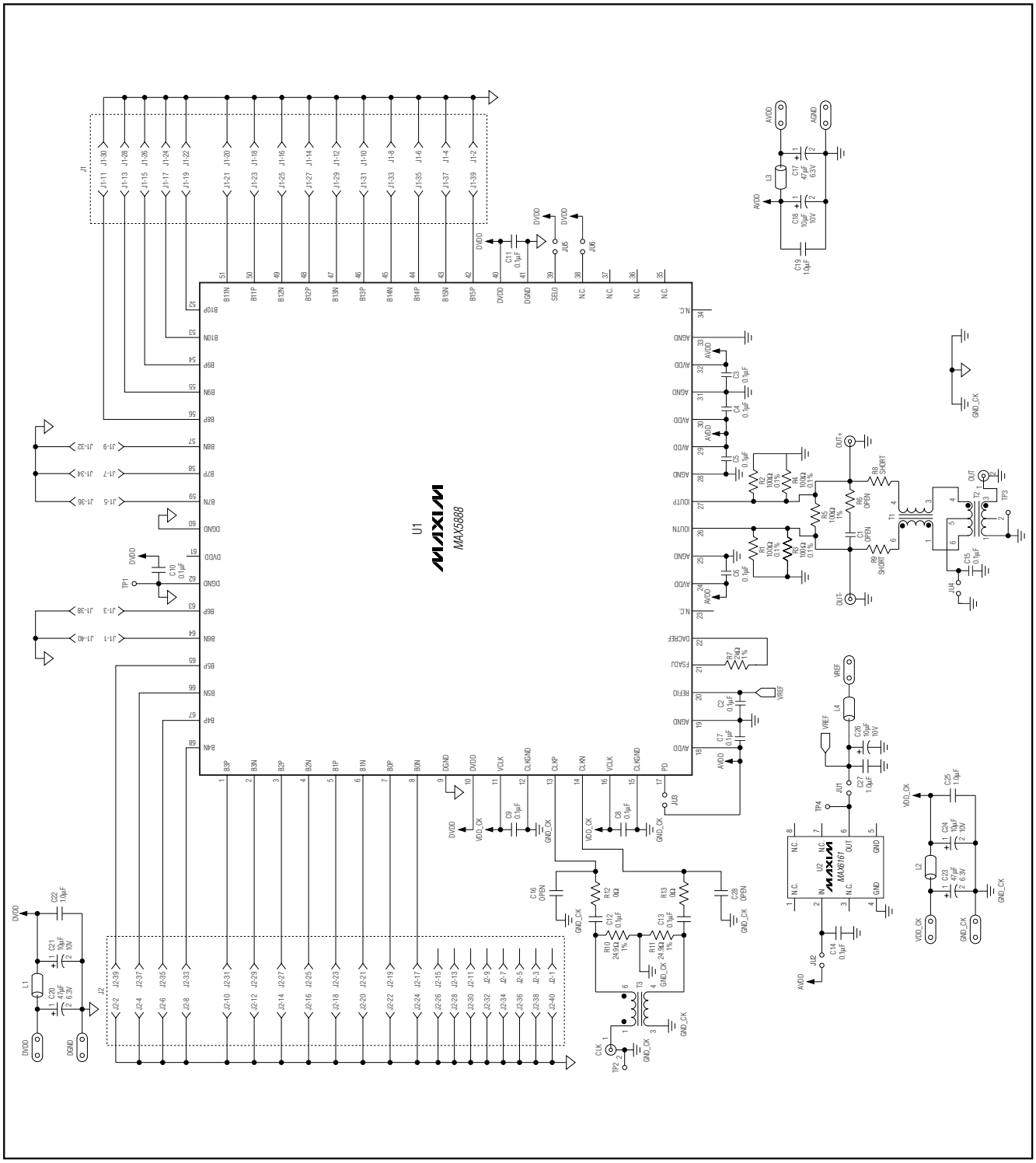

Figure 1. MAX5888 EV Kit Schematic

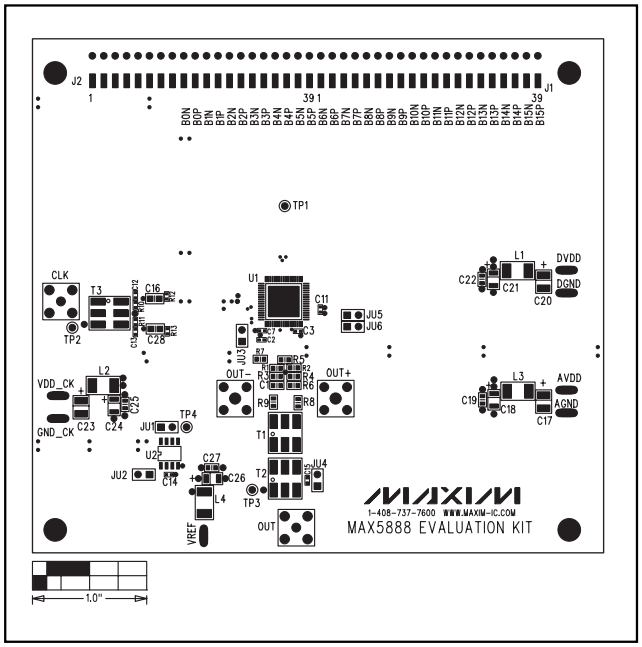

Figure 2. MAX5888 EV Kit Component Placement Guide—Component Side

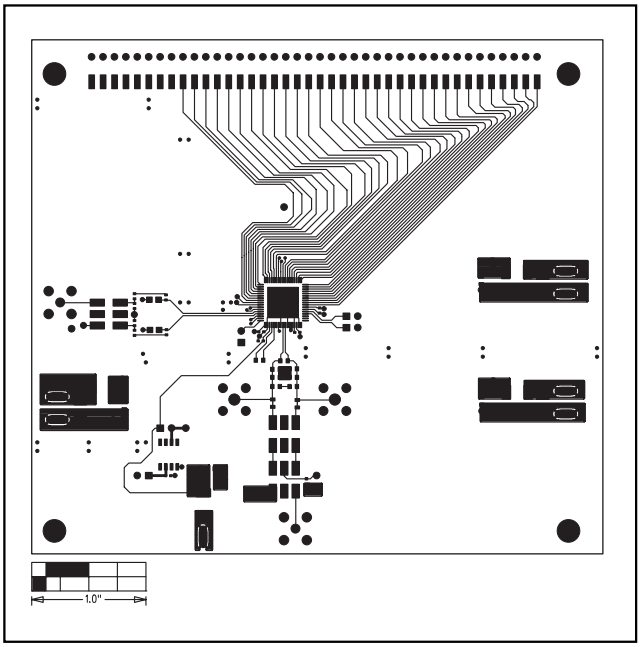

Figure 3. MAX5888 EV Kit PC Board Layout—Component Side

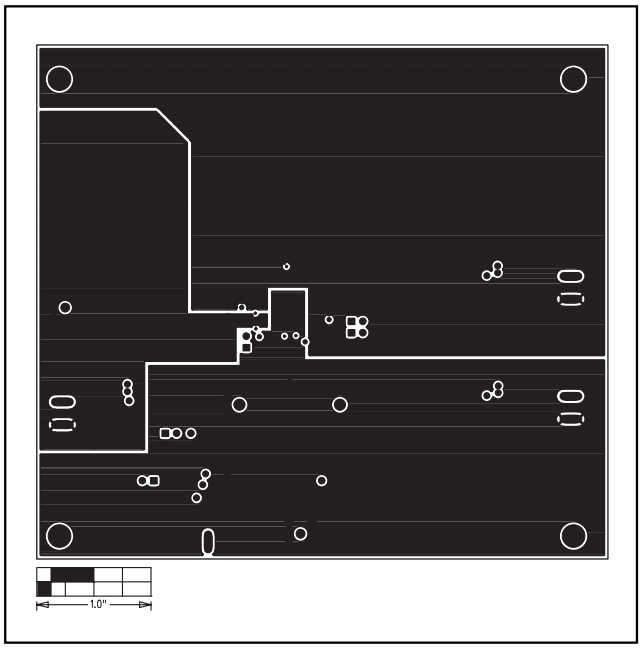

Figure 4. MAX5888 EV Kit PC Board Layout—Ground Planes

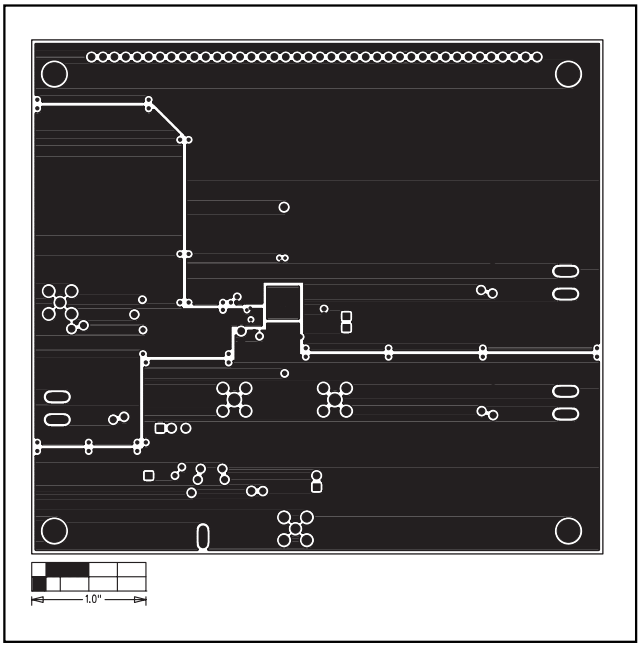

Figure 5. MAX5888 EV Kit PC Board Layout—Power Planes

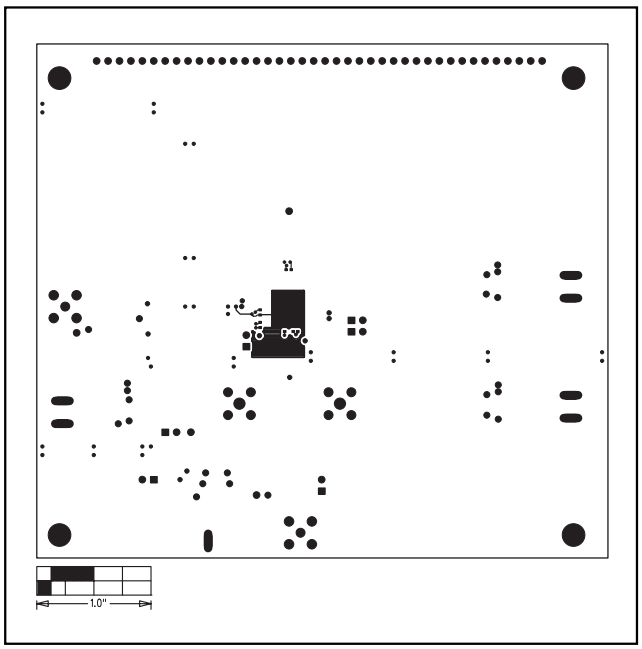

Figure 6. MAX5888 EV Kit PC Board Layout—Solder Side

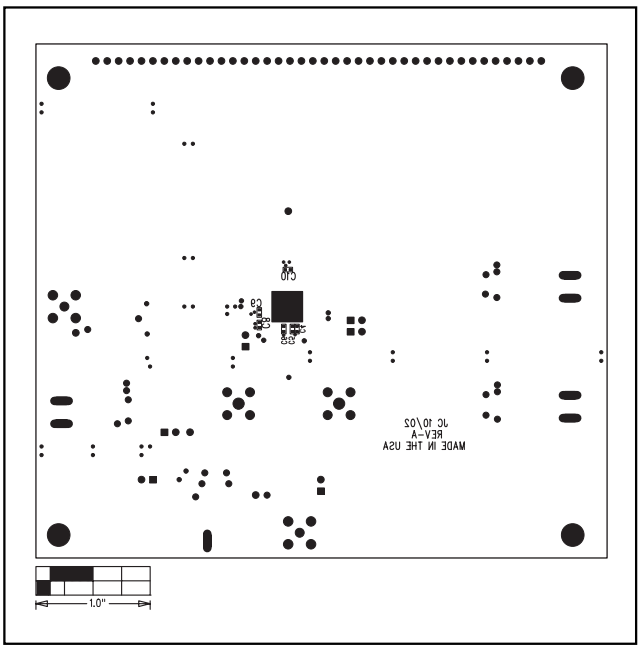

Figure 7. MAX5888 EV Kit Component Placement Guide—Solder Side