

## MAX5886/MAX5887/MAX5888 Evaluation Kits

## Evaluate: MAX5886/MAX5887/MAX5888

### General Description

The MAX5886/MAX5887/MAX5888 evaluation kits (EV kits) are fully assembled and tested circuit boards that contain all the components necessary to evaluate the performance of the MAX5886 (12-bit), MAX5887 (14-bit), and MAX5888 (16-bit), 500Mbps, current-output, digital-to-analog converters (DACs). Each EV kit requires low-voltage differential-signaling (LVDS)-compatible data inputs, a single-ended clock input, and 3.3V power supplies for simple board operation.

### Part Selection Table

PART	RESOLUTION (BITS)	SPEED (Mbps)
MAX5886EGK-D+	12	500
MAX5887EGK-D+	14	500
MAX5888EGK-D+	16	500

+Denotes lead-free package.

D = Dry pack.

### Common 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 capacitor (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)
JU1–JU5	5	2-pin headers
JU6	0	Not installed
L1–L4	4	Ferrite bead cores (4532) Würth Elektronik 74279226101
R1–R4	4	100Ω ±0.1% resistors (0603)
R5	1	100Ω ±1% resistor (0603)

### Features

- Quick Dynamic Performance Evaluation
- LVDS-Compatible Data Inputs
- 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

### Ordering Information

PART	TEMP RANGE	IC PACKAGE
<b>MAX5886EVKIT#</b>	0°C to +70°C	68 QFN-EP**
<b>MAX5887EVKIT#</b>	0°C to +70°C	68 QFN-EP**
<b>MAX5888EVKIT#</b>	0°C to +70°C	68 QFN-EP**

\*EV kit PC board temperature range only.

\*\*EP = Exposed paddle.

#Denotes ROHS compliant with exemption.

DESIGNATION	QTY	DESCRIPTION
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)
CLK, OUT	2	SMA PC-mount vertical connectors
OUTP, OUTN	0	Not installed, scope probe connectors Tektronix 131-4244-00
T1, T3	2	Transformers Mini-Circuits ADTL1-12
T2	1	1:1 balun transformer Coilcraft TTTWB3010-1L
TP1, TP2, TP3	3	PC test points, black
TP4	1	PC test point, red
U1	1	See the <i>EV Kit Specific Component List</i>
U2	1	1.25V voltage reference (8-pin SO) Maxim MAX6161AESA or MAX6161BESA
—	5	Shunts (JU1–JU5)
—	1	MAX5886/MAX5887/MAX5888 EV kit PC board

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### EV Kit Specific Component List

DESIGNATION	DESIGNATION	DESCRIPTION
MAX5886EVKIT	U1	MAX5886EGK-D (68 QFN-EP 10mm x 10mm x 0.9mm)
MAX5887EVKIT		MAX5887EGK-D (68 QFN-EP 10mm x 10mm x 0.9mm)
MAX5888EVKIT		MAX5888EGK-D (68 QFN-EP 10mm x 10mm x 0.9mm)

### Quick Start

#### Recommended Equipment

- Three 3.3VDC, 1A power supplies
- RF signal generator with low phase noise and low jitter for clock input (e.g., HP/Agilent 8644B)
- 12-bit (MAX5886EVKIT), 14-bit (MAX5887EVKIT), or 16-bit (MAX5888EVKIT) digital pattern generator for LVDS data inputs (e.g., Agilent 81250)
- Spectrum analyzer (e.g., Rohde & Schwartz FSU)
- Voltmeter

These EV kits are fully assembled and tested surface-mount boards. Follow the steps below for board operation. **Do not 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 (Agilent 81250) to the clock signal generator (HP/Agilent 8644B).
- 5) Connect the clock signal generator to the CLK SMA connectors on the EV kit.
- 6) Verify that the digital pattern generator is programmed for LVDS outputs.

### Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX	843-946-0238	www.avxcorp.com
Coilcraft	847-639-6400	www.coilcraft.com
Kemet	864-963-6300	www.kemet.com
Mini-Circuits	718-934-4500	www.minicircuits.com
Panasonic	714-373-7366	www.panasonic.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK	847-803-6100	www.component.tdk.com
Würth Elektronik	+49 7942 945	www.we-online.com

**Note:** Indicate that you are using the MAX5886/MAX5887/MAX5888 when contacting these component suppliers.

- 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 the ground terminal of a 3.3V power supply to GND\_CK. Next, connect the positive terminal of this supply to VDD\_CK.
- 10) Connect the ground terminal of a 3.3V power supply to DGND. Next, connect the positive terminal of this supply to DVDD.
- 11) Connect the ground terminal of a 3.3V power supply to AGND. Next, connect the positive terminal of this supply to AVDD.
- 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 signal generator and the digital pattern generator. Set the clock signal 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 EV kit output spectrum or view the output waveform using an oscilloscope.

## Detailed Description

The MAX5886/MAX5887/MAX5888 EV kits are designed to simplify the evaluation of the MAX5886 (12-bit), MAX5887 (14-bit), or MAX5888 (16-bit), 500Msps, current-output DACs. The DACs require LVDS-compatible data inputs, differential clock input signals, a 1.2V reference voltage, and 3.3V power supplies for simple board operation.

The EV kits provide 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 EV kits 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 PC board layout is divided into three sections: digital, analog, and clock. Using separate power supplies for each section reduces crosstalk and improves the output signal integrity. 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 (clock), and across the AVDD and AGND PC board pads (analog) on the EV kit.

## LVDS Input Data

These EV kits provide two 0.1in 2 x 20 header connectors (J1 and J2) to allow interface of a 12-bit, 14-bit, or 16-bit LVDS pattern generator. 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 DAC 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<sub>P-P</sub> (+10dBm) amplitude is recommended and for a square wave greater than a 0.5V<sub>P-P</sub> signal is recommended.

## Reference Voltage Options

The DAC requires a reference voltage to set the full-scale analog signal voltage output. The 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 1.2V bandgap reference. The reference voltage can be measured at the VREF pad on the EV kit. The internal reference can be overdriven by an external reference to enhance accuracy and drift performance or for gain control. 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 DAC. 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.

**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	DAC internal 1.2V bandgap reference
Not installed	User-supplied voltage reference at the VREF pad (0.125V to 1.25V)

Table 2. Power-Down (Jumper JU3)

SHUNT	FUNCTION
Installed	Power-down mode
Not installed	Normal operation

Full-Scale Output Current

The DAC requires an external resistor to set the full-scale output current. The 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 DAC data sheet to select different values for R7.

Analog Output

The DAC complementary current outputs are terminated into 50Ω resistance to generate differential voltage signals with amplitudes of 1V<sub>P-P</sub> differential. The positive and negative rails of the differential signal can be sampled at the OUTP and OUTN probe pads. 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.**

Power-Down

The DAC 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.

Table 3. Segment-Shuffling Mode (Jumper JU5)

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

Segment Shuffling

The segment-shuffling function on the DAC can improve the high-frequency spurious-free dynamic range (SFDR) at the cost of an increase in the DAC's noise floor. The EV kits provide jumper JU5, which allows the user to enable or disable this function. See Table 3 to configure jumper JU5.

Board Layout

The EV kit boards are 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.

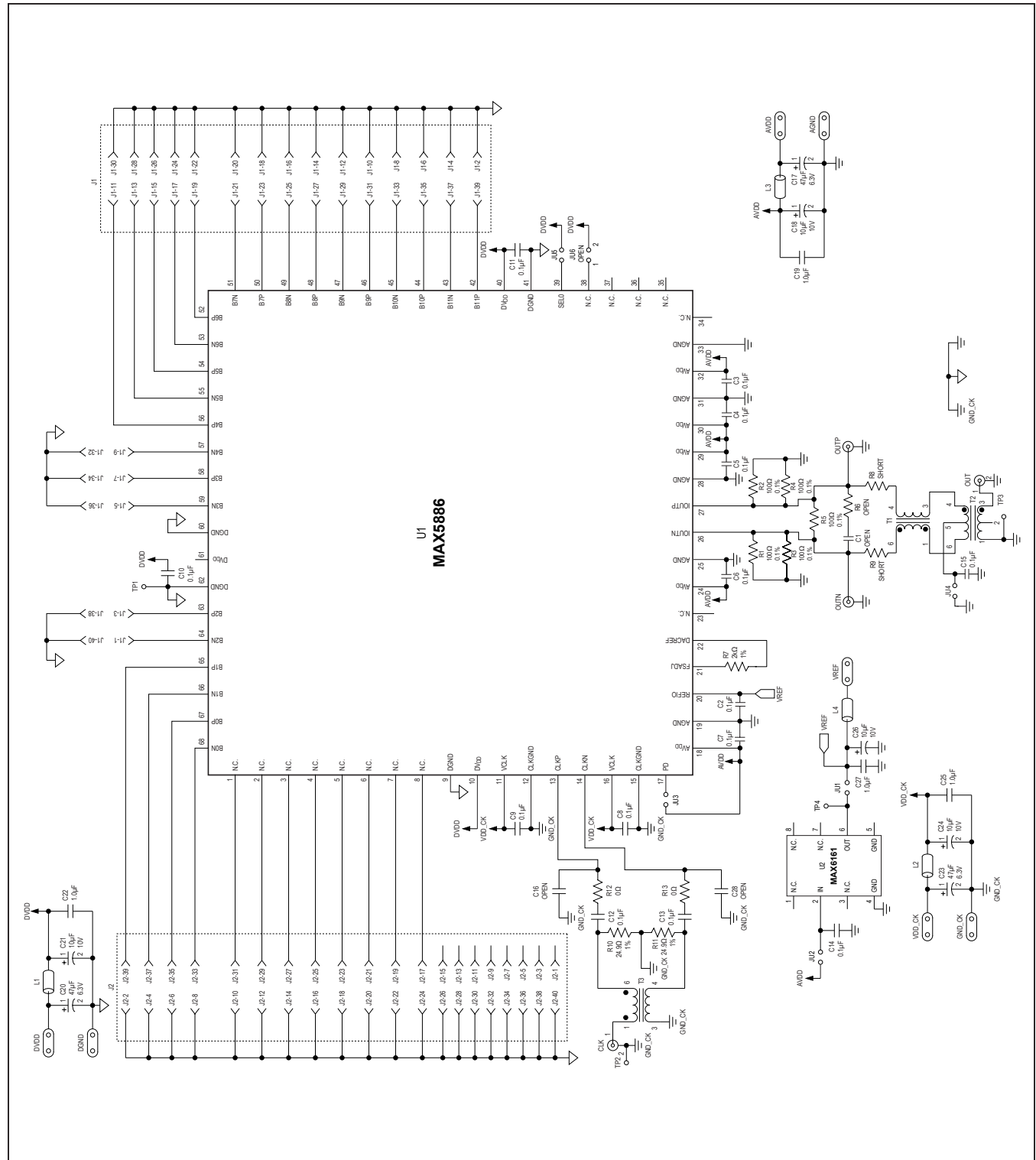


Figure 1. MAX5886 EV Kit Schematic

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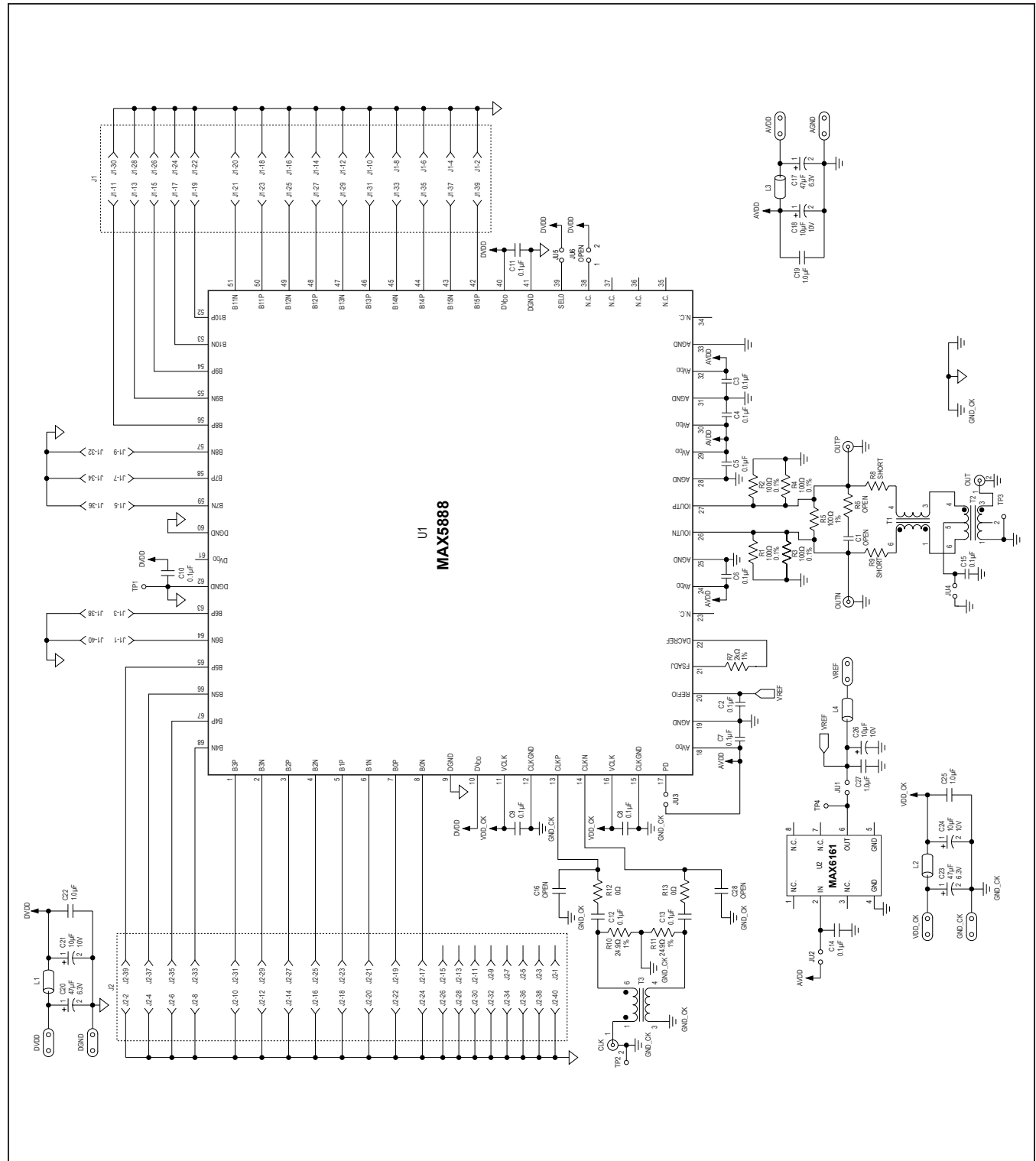


Figure 3. MAX5888 EV Kit Schematic

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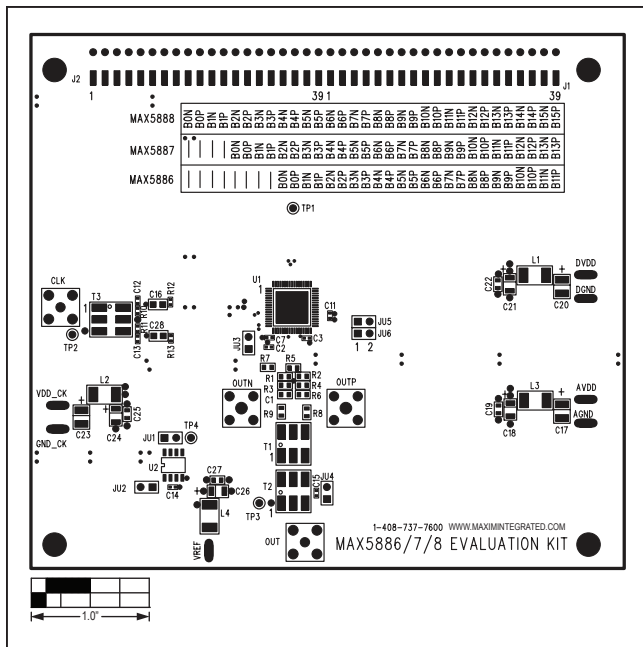


Figure 4. MAX5886/MAX5887/MAX5888 EV Kit Component Placement Guide—Component Side

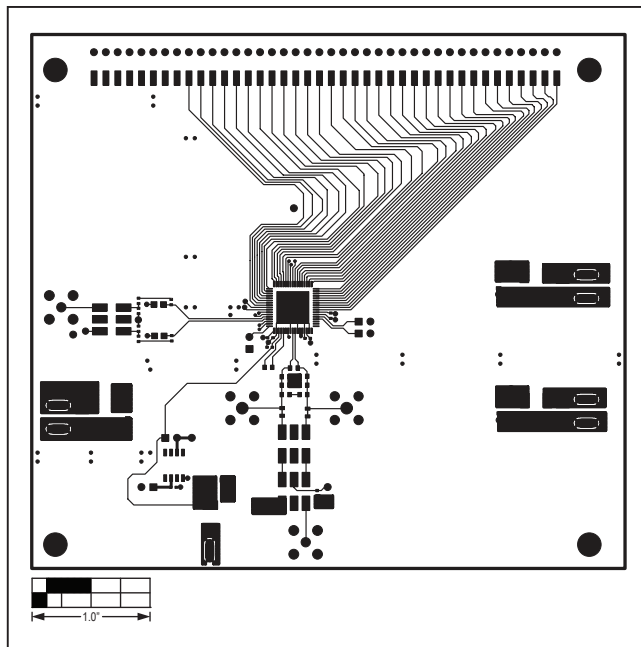


Figure 5. MAX5886/MAX5887/MAX5888 EV Kit PC Board Layout—Component Side

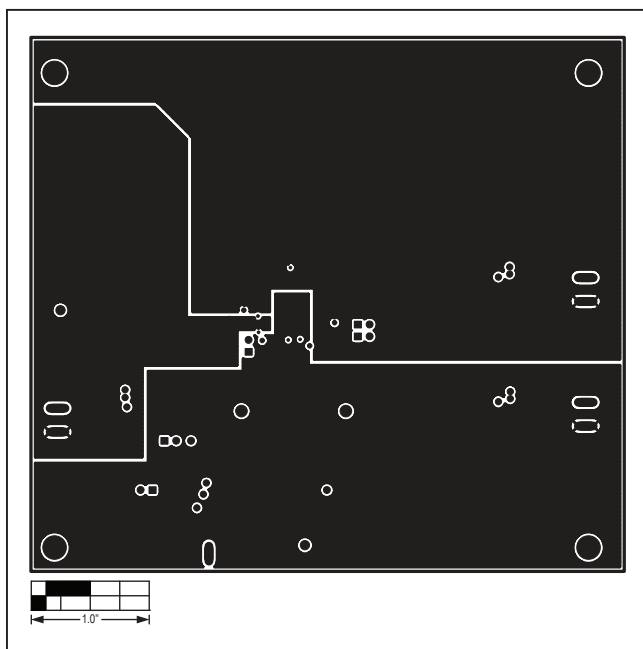


Figure 6. MAX5886/MAX5887/MAX5888 EV Kit PC Board Layout—Ground Planes

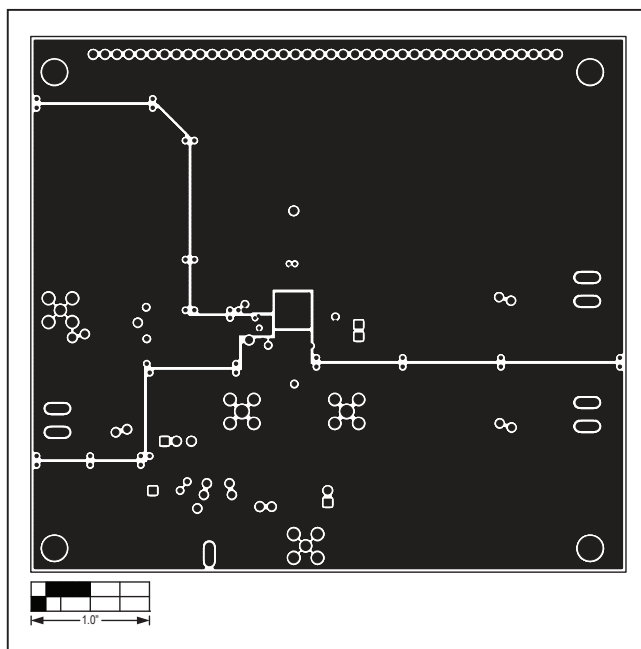


Figure 7. MAX5886/MAX5887/MAX5888 EV Kit PC Board Layout—Power Planes



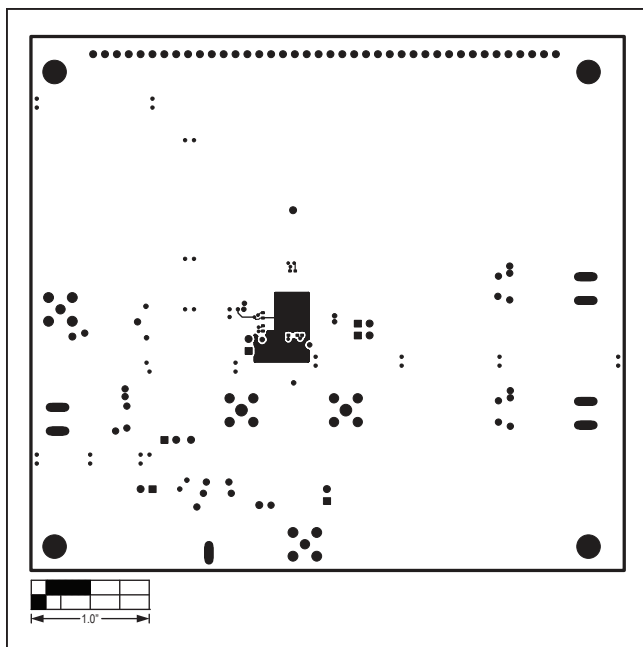


Figure 8. MAX5886/MAX5887/MAX5888 EV Kit PC Board Layout—Solder Side

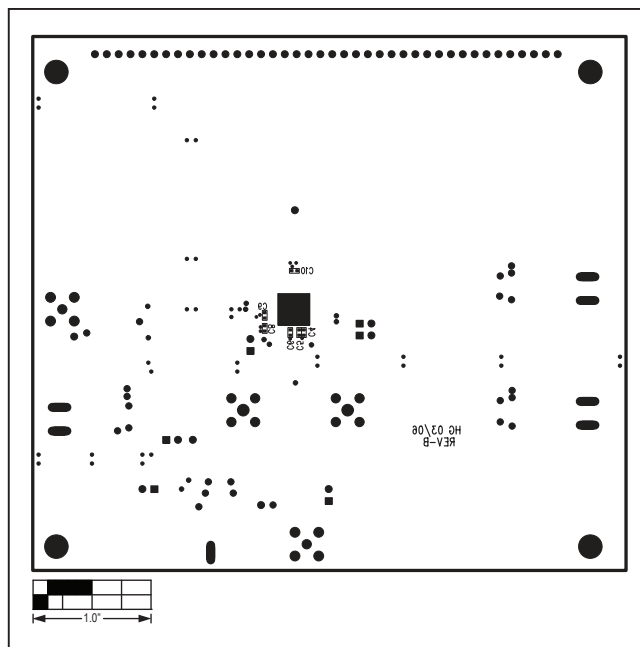


Figure 9. MAX5886/MAX5887/MAX5888 EV Kit Component Placement Guide—Solder Side

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### Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/06	Initial Release	—
1	1/21	Updated MAX5886, MAX5887, and MAX5888 to ROHS compliance with exemption in <i>Ordering Information Table</i> , Updated <i>Common Component List</i> and <i>Component Supplier Tables</i>	1-2

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