



MAX9713 Evaluation Kit

General Description

The MAX9713 evaluation kit (EV kit) is a fully assembled and tested circuit board that contains the MAX9713 filterless class D amplifier. The EV kit is capable of delivering 6W into an 8Ω load and is designed to operate from a 10V to 25V DC power supply. The MAX9713 EV kit accepts differential or single-ended input signals and provides an option to select between different switching frequencies.

Features

- ◆ 10V to 25V Single-Supply Operation
- ◆ Up to 85% Efficiency
- ◆ Drives 6W into 8Ω or 8W into 16Ω
- ◆ Differential or Single-Ended Input Modes
- ◆ Pin-Selectable Frequency Options
- ◆ Pin-Selectable Gain Options
- ◆ Low 0.1% THD+N
- ◆ Surface-Mount Construction
- ◆ Fully Assembled and Tested

Ordering Information

| PART | TEMP RANGE | IC PACKAGE |
|--------------|--------------|------------------------------------|
| MAX9713EVKIT | 0°C to +70°C | 32 TQFN-EP* (5mm x 5mm x 0.8mm) |

*Exposed paddle.

Component List

| DESIGNATION | QTY | DESCRIPTION |
|-------------|-----|--|
| C1 | 1 | 0.1μF ±10%, 25V X5R ceramic capacitor (0402) TDK C1005X5R1E104K |
| C2, C3 | 2 | 33μF ±10%, 35V tantalum capacitors (D case) AVX TAJD336K035 |
| C4, C5 | 2 | 0.1μF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E104K TDK C1608X7R1E104K or equivalent |
| C6, C7, C8 | 3 | 100pF ±5%, 50V C0G ceramic capacitors (0402) Murata GRP1555C1H101J Taiyo Yuden UMK105CG101JW TDK C1005COG101J |
| C9, C10 | 2 | 0.47μF ±20%, 10V tantalum capacitors (0402) AVX TACK474M010 |
| C11, C12 | 2 | 0.47μF ±10%, 6.3V X5R ceramic capacitors (0402) Murata GRM155R60J474K TDK C1005X5R0J474K |

| DESIGNATION | QTY | DESCRIPTION |
|-------------|-----|--|
| C13 | 1 | 1μF ±10%, 25V X7R ceramic capacitor (0805) TDK C2012X7R1E105K or equivalent |
| C14 | 1 | 1000pF ±10%, 50V X7R ceramic capacitor (0603) ECM0083 GRM188R71H102K TDK C1608X7R1H102KT |
| C15 | 0 | Not installed, ceramic capacitor (0603) |
| C16–C22 | 0 | Not installed, ceramic capacitors (0402) |
| D1 | 1 | 5.1V, 20mA zener diode (SOT-23) Central CMPZ5231B (top mark C8F) |
| JU1–JU5 | 5 | 3-pin headers |
| JU6, JU7 | 2 | 2-pin headers |
| L1 | 1 | 100Ω ±25%, 1.7A ferrite bead (0603) Taiyo Yuden BKP1608HS101 |
| L2, L3 | 2 | 1kΩ ±25%, 150mA ferrite beads (0402) Taiyo Yuden BK1005HM102 |

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Component List (continued)

| DESIGNATION | QTY | DESCRIPTION |
|---|-----|--|
| L4, L5 | 0 | Not installed, power inductors |
| R1 | 1 | 10k Ω \pm 5% resistor (0402) |
| R2, R3 | 0 | Not installed, resistors (0402) |
| T1 | 0 | Not installed, common-mode choke |
| FOUT1+, FOUT1-, FOUT2+, FOUT2- | 0 | Not installed, test points |
| U1 | 1 | MAX9713ETJ (32-pin TQFN 5mm x 5mm x 0.8mm) |
| None | 7 | Shunts |
| None | 1 | MAX9713 PC board |

Quick Start

The MAX9713 EV kit is fully assembled and tested. Follow the steps listed below to verify board operation.

Do not turn on the power supply until all connections are completed.

Recommended Equipment

- 15V, 2A power supply
 - Audio source (i.e., CD player, cassette player)
 - 8 Ω /16 Ω speaker
- 1) Verify that no shunt is across jumper JU6 (differential input mode).
 - 2) Verify shunt across pins 1 and 2 of jumper JU1. Install shunt across jumper JU7 (EV kit is enabled).
 - 3) Verify shunts across pins 1 and 2 of jumpers JU2 and JU3 (Gain = 16dB).
 - 4) Verify shunts across pins 1 and 2 of jumpers JU4 and JU5 (spread-spectrum mode, frequency centered at 335kHz).
 - 5) Connect the speaker across the OUT+ and OUT- pads.
 - 6) Connect the positive terminal of the 15V power supply to the V+ pad and the ground terminal of the power supply to the GND pad.
 - 7) Connect the audio source across the VIN+ and VIN- pads.
 - 8) Turn on the power supply, and then turn on the audio source.

Detailed Description

The MAX9713 EV kit contains the MAX9713 filterless class D amplifier IC. The EV kit operates from a 10V to 25V DC power supply and accepts a differential or single-ended audio input source. The single-ended input mode accepts up to 2V_{P-P} signals, and the differential mode accepts up to 4V_{P-P} signals. The audio input source is amplified to drive 6W into an 8 Ω speaker.

The MAX9713 EV kit provides three sets of differential outputs. The device outputs (OUT+/-) can be connected directly to a speaker load without any filtering. However, a filter can be added to ease evaluation. The filtered outputs (FOUT1+/-) require installation of filtering components T1, C21, and C22. The LCR filtered outputs (FOUT2+/-) require installation of filtering components L4, L5, C15–C20, R2, and R3. See Table 1 for the suggested filtering component values for an 8 Ω load and a 30kHz cutoff frequency. For a 16 Ω load and 35kHz cutoff, see Table 2 for the suggested values. All recommended filtering components for an 8 Ω load are included with the MAX9713 EV kit.

Table 1. Recommended Filter Component for Outputs with 8 Ω Load

| PART NUMBER | RECOMMENDED VALUE |
|---------------|-------------------|
| L4, L5 | 22 μ H |
| C15 | 0.1 μ F |
| C16, C17, C18 | 0.022 μ F |
| C19, C20 | 0.01 μ F |
| R2, R3 | 100 Ω |

Table 2. Recommended Filter Component for Outputs with 16 Ω Load

| PART NUMBER | RECOMMENDED VALUE |
|---------------|-------------------|
| L4, L5 | 47 μ H |
| C15 | 0.15 μ F |
| C16, C17, C18 | 0.022 μ F |
| C19, C20 | 0.01 μ F |
| R2, R3 | 100 Ω |

Jumper Selection

Shutdown Mode

Jumpers JU1 and JU7 control the shutdown pin (SHDN) of the MAX9713. See Table 3 for the JU1 and JU7 functions.

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Table 3. JU1 and JU7 Functions ($\overline{\text{SHDN}}$)

| JU1 SHUNT POSITION | JU7 SHUNT POSITION | EV KIT FUNCTION |
|--------------------|---|---|
| Pins 1 and 2 | Installed ($\overline{\text{SHDN}}$ = high) | EV kit enabled (default) |
| Pins 2 and 3 | Installed, without external signal ($\overline{\text{SHDN}}$ = low) | Shutdown mode |
| Pins 1 and 2 | Not installed, with external signal connected to $\overline{\text{SHDN}}$ pad | $\overline{\text{SHDN}}$ pin driven by external signal. Shutdown is active low. |

Gain Selection

Jumpers JU2 and JU3 provide an option to select the output voltage gain. See Table 4 for JU2 and JU3 functions. See Table 7 for power vs. gain and input levels.

Switching Frequency

The MAX9713 has two operating modes, fixed-frequency modulation (FFM) mode and spread-spectrum modulation (SSM) mode. Jumpers JU4 and JU5 control pins FS1 and FS2. See Table 5 for JU4 and JU5 functions.

Table 4. JU2 and JU3 Functions (G1 and G2)

| JU2 SHUNT LOCATION | JU3 SHUNT LOCATION | MAX9713 OUTPUT GAIN (dB) |
|--------------------------|--------------------------|--------------------------|
| Pins 1 and 2 (G1 = high) | Pins 1 and 2 (G2 = high) | 16 (default) |
| Pins 1 and 2 (G1 = high) | Pins 2 and 3 (G2 = low) | 13 |
| Pins 2 and 3 (G1 = low) | Pins 1 and 2 (G2 = high) | 19.1 |
| Pins 2 and 3 (G1 = low) | Pins 2 and 3 (G2 = low) | 22.1 |

Note: Make sure a shunt is installed across pins 1 and 2 of jumper JU1.

Table 5. JU4 and JU5 Functions (FS1 and FS2)

| JU4 SHUNT LOCATION | JU5 SHUNT LOCATION | MAX9713 SWITCHING FREQUENCY (kHz) |
|---------------------------|---------------------------|-----------------------------------|
| Pins 1 and 2 (FS1 = high) | Pins 1 and 2 (FS2 = high) | 335 ±10%, SSM (default) |
| Pins 1 and 2 (FS1 = high) | Pins 2 and 3 (FS2 = low) | 236, FFM |
| Pins 2 and 3 (FS1 = low) | Pins 1 and 2 (FS2 = high) | 460, FFM |
| Pins 2 and 3 (FS1 = low) | Pins 2 and 3 (FS2 = low) | 335, FFM |

Note: Make sure a shunt is installed across pins 1 and 2 of jumper JU1.

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Input Mode

Jumper JU6 provides an option to select between a differential or single-ended input mode of the EV kit. See Table 6 for JU6 functions.

Table 6. JU6 Functions

| SHUNT POSITION | EV KIT INPUT MODE |
|--|-----------------------------------|
| Not installed | Differential input mode (default) |
| Installed (VIN- pad AC-coupled to GND) | Single-ended input mode |

Table 7. MAX9713 Power vs. Gain and Input Levels at 10% THD+N

| GAIN (dB) | V _{IN} DIFF RMS (V) | R _L (Ω) | P _{OUT} AT 10% THD+N (W) |
|-----------|------------------------------|--------------------|-----------------------------------|
| 13.0 | 1.27 | 16 | 8 |
| 16.1 | 0.89 | 16 | 8 |
| 19.1 | 0.63 | 16 | 8 |
| 22.1 | 0.45 | 16 | 8 |
| 13.0 | 0.78 | 8 | 6 |
| 16.1 | 0.54 | 8 | 6 |
| 19.1 | 0.39 | 8 | 6 |
| 22.1 | 0.27 | 8 | 6 |

Component Suppliers

| SUPPLIER | PHONE | FAX | WEBSITE |
|-------------|--------------|--------------|-----------------------|
| AVX | 843-946-0238 | 843-626-3123 | www.avxcorp.com |
| Central | 631-435-1110 | 631-435-1824 | www.centalsemi.com |
| Murata | 770-436-1300 | 770-436-3030 | www.murata.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: Indicate that you are using the MAX9713 when contacting these suppliers.

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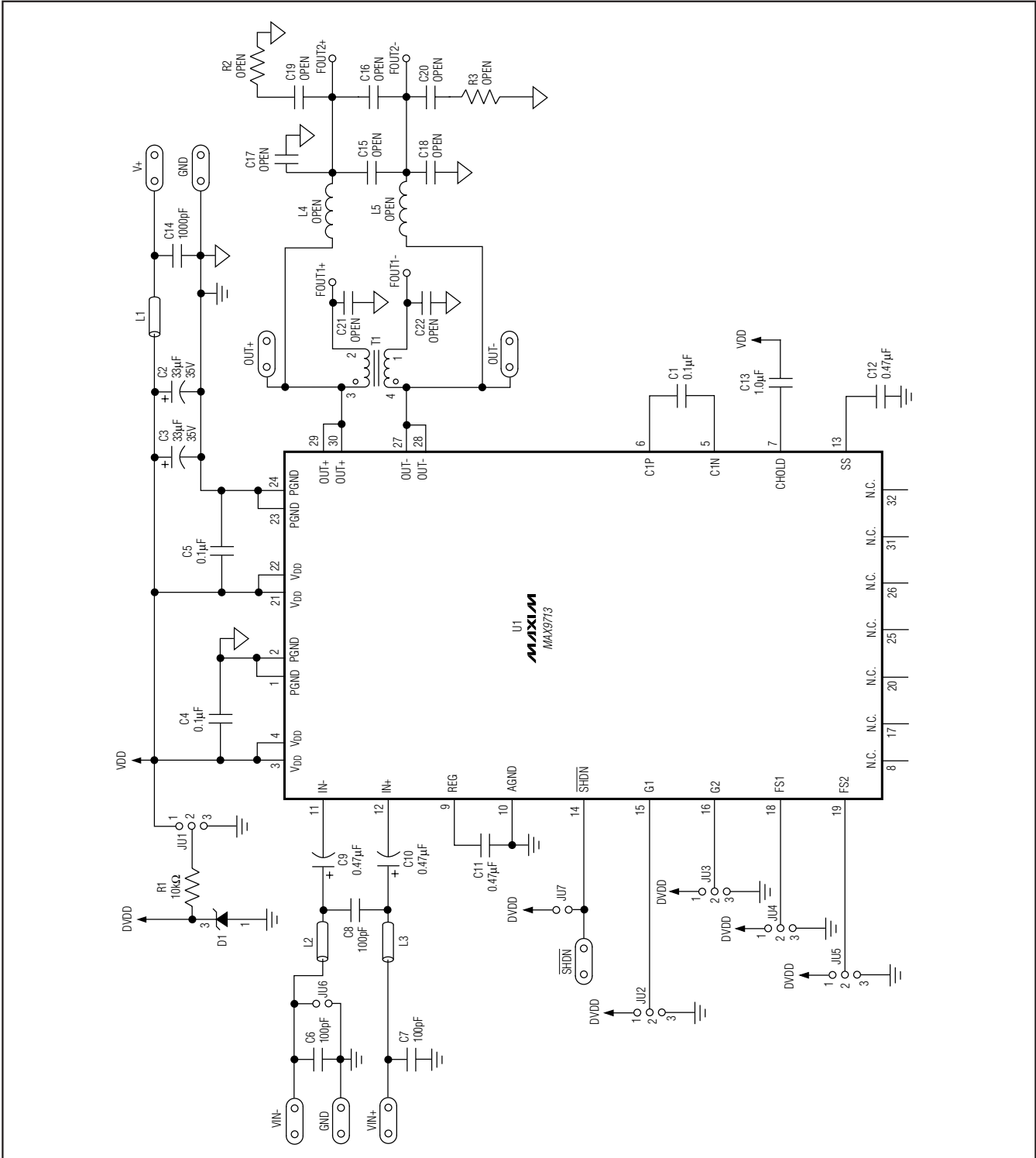


Figure 1. MAX9713 EV Kit Schematic

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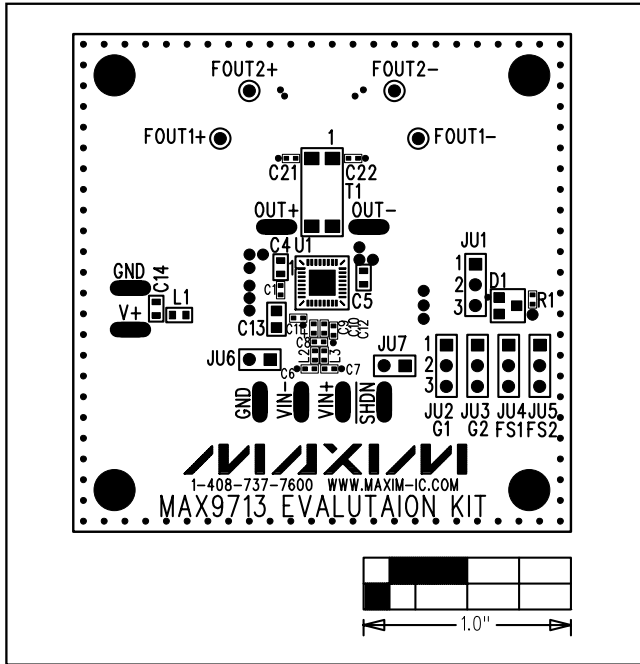


Figure 2. MAX9713 EV Kit Component Placement Guide—Component Side

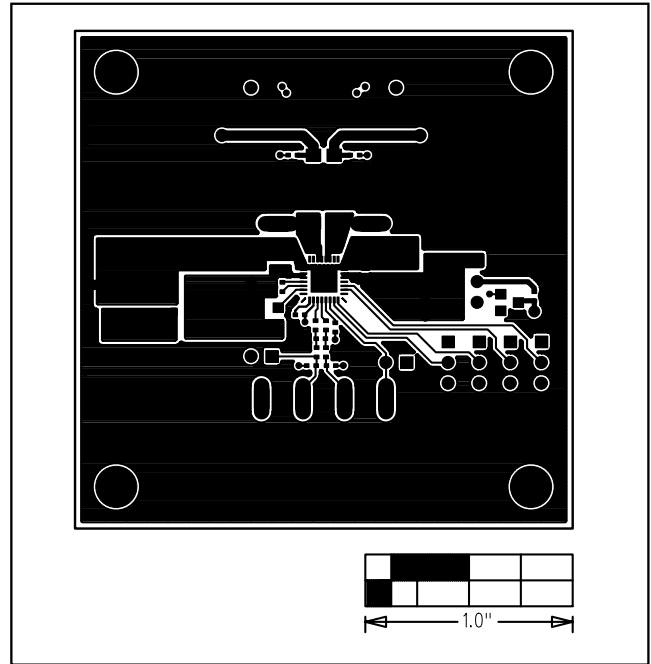


Figure 3. MAX9713 EV Kit PC Board Layout—Component Side

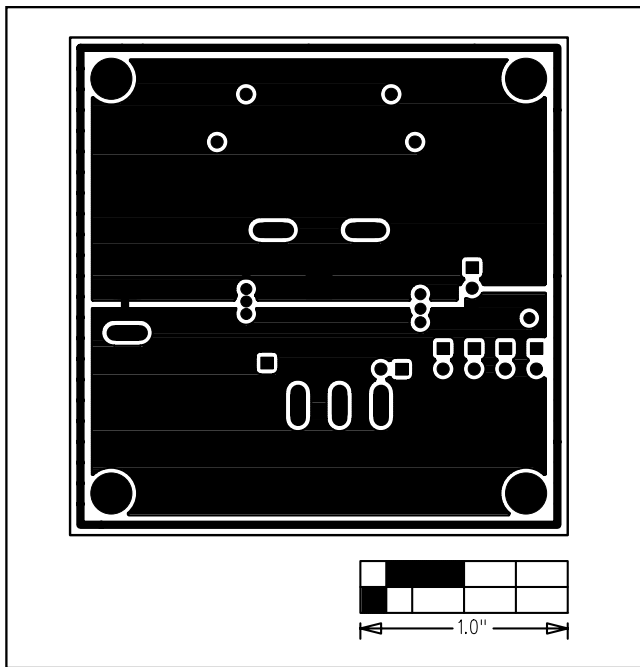


Figure 4. MAX9713 EV Kit PC Board Layout—Layer 2 (GND)

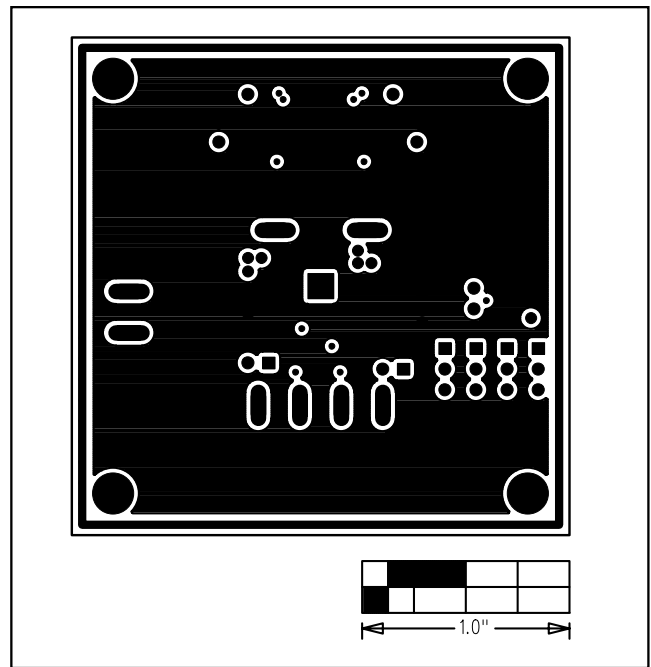


Figure 5. MAX9713 EV Kit PC Board Layout—Layer 3 (VDD)

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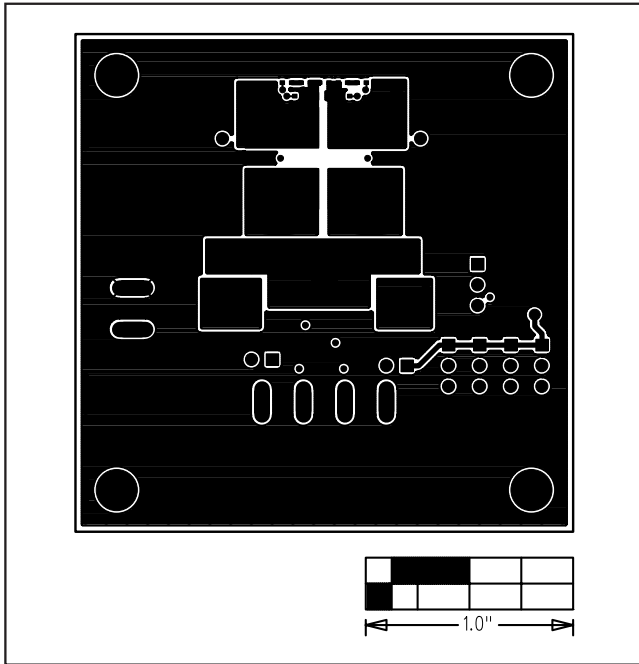


Figure 6. MAX9713 EV Kit PC Board Layout—Solder Side

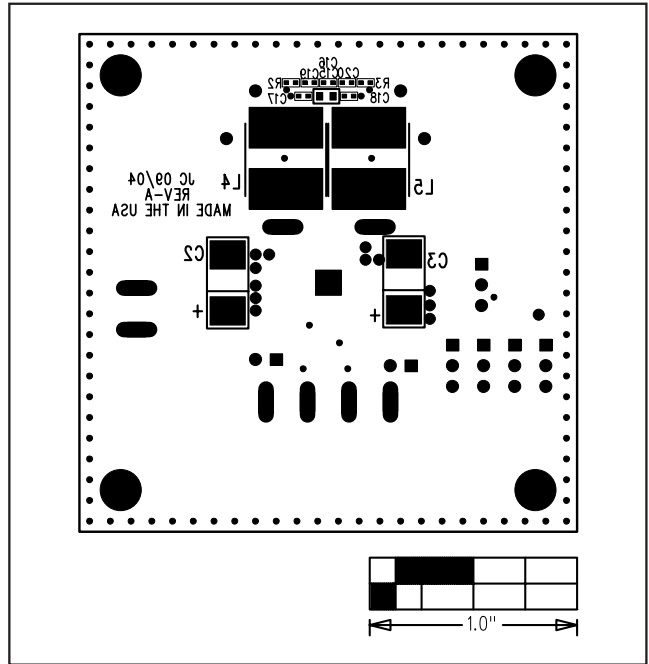


Figure 7. MAX9713 EV Kit Component Placement Guide—Solder Side

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