

MAXIM

MAX9752A Evaluation Kit

General Description

The MAX9752A evaluation kit (EV kit) is a fully assembled and tested PC board that evaluates the MAX9752A as well as the MAX9752B/MAX9752C/MAX9753/MAX9754 ICs. All of these Class D amplifiers drive stereo bridged-load (BTL) speakers and a stereo headphone. The ICs' high efficiency make them well suited for portable audio applications.

The speaker amplifiers operate from a 4.5V to 5.5V DC power supply, and deliver 2.2W continuous power into a pair of 4 Ω speakers. Three different speaker output configurations are available for ease of evaluation.

The headphone amplifiers operate from a 3V to 5.5V DC power supply, and deliver up to 63mW per channel into a 16 Ω stereo headphone. When the switch on the headphone jack detects the insertion of a headphone, the MAX9752A automatically enters the headphone mode from the speaker mode.

The MAX9752A EV kit maximum gain is jumper selectable. The EV kit features an analog volume control and an audible alert input for evaluating the MAX9752A/MAX9752B/MAX9752C. The volume control and audible alert input can be reconfigured to accept a second audio source when evaluating the MAX9753, which features a 2:1 multiplexer that allows two audio sources to feed the EV kit.

Features

- ◆ 4.5V to 5.5V Single-Supply Operation
- ◆ Drives 2 x 2.2W into a Pair of 4 Ω Speakers
- ◆ Drives 2 x 63mW into a 16 Ω Stereo Headphone
- ◆ Analog Volume Control
- ◆ Beep Input with Glitch Filter
- ◆ 100nA (typ) Shutdown Current
- ◆ Small 28-Pin TQFN Package (Also Available in 28-Pin TSSOP)
- ◆ Fully Assembled and Tested
- ◆ Evaluates MAX9752A/MAX9752B/MAX9752C/MAX9753/MAX9754 (IC Replacement Required)

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX9752AEVKIT	0°C to +70°C	28 TQFN-EP*

*EP = Exposed paddle.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C12, C14	3	0.1 μ F $\pm$ 10%, 25V X7R ceramic capacitors (0603) TDK C1608X7R1E104K
C2	1	10 μ F $\pm$ 20%, 6.3V X5R ceramic capacitor (0805) TDK C2012X5R0J106M
C4–C8, C10, C16	7	1 μ F $\pm$ 10%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A105K
R1	1	47k Ω $\pm$ 5% resistor (0603)
U1	1	MAX9752AETI (28-pin TQFN-EP, 5mm x 5mm)
OPTIONAL COMPONENTS FOR CUSTOMER EVALUATION		
C3	1	1000pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H102K
C9	1	1 μ F $\pm$ 10%, 10V X5R ceramic capacitor (0603) TDK C1608X5R1A105K
C11	1	0.1 μ F $\pm$ 10%, 25V X7R ceramic capacitor (0603) TDK C1608X7R1E104K

DESIGNATION	QTY	DESCRIPTION
C13*, C15*	2	100 μ F $\pm$ 20%, 6.3V X5R ceramic capacitors (1210) TDK C3225X5R0J107M
C17–C30	0	Not installed, capacitors (0603)
J1	1	3.5mm switched stereo jack
JU1–JU4	4	3-pin headers
JU5	1	2-pin header
L1–L5	5	100 Ω at 100MHz, 50m Ω DCR, 3A (0603) ferrite beads TDK MPZ1608S101A
L6–L9	0	Not installed, inductors TOKO D53LC series recommended
R2	1	10k Ω thumb-wheel potentiometer
R3–R6	0	Not installed, resistors (0603)
T1, T2	0	Not installed, common-mode chokes 50VDC, 1ADC, 800 Ω at 100MHz TDK ACM4532-801-2P-X recommended
—	5	Shunts
—	1	MAX9752A EV kit PC board

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

*System-level requirement

MAX9752A Evaluation Kit

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
TDK	847-803-6100	847-390-4405	www.component.tdk.com
TOKO America	847-297-0070	847-699-1194	www.tokoam.com

Note: Indicate that you are using the MAX9752A EV kit when contacting these component suppliers.

Quick Start

Recommended Equipment

- One 5V, 3A power supply
- Optional 3V, 1A power supply
- Audio source
- Two 4Ω to 8Ω speakers
- Stereo headphone

The MAX9752A 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:

- 1) Install a shunt across pins 1 and 2 of jumper JU1 (IC enabled).
- 2) Install a shunt across pins 1 and 2 of jumpers JU2 and JU3 (speaker gain = 13.5dB, headphone gain = 3dB).
- 3) Install a shunt across pins 2 and 3 of jumper JU4 (volume control is selected).
- 4) Install a shunt on jumper JU5 (speaker enable).
- 5) Connect the first speaker to the OUTL+ and the OUTL- test points.
- 6) Connect the second speaker to the OUTR+ and the OUTR- test points.
- 7) Connect the 5V power supply to the VDD pad. Connect the ground terminal of the power supply to the GND pad.
- 8) Connect the 5V or optional 3V power supply to the HPVDD pad. Connect the ground terminal of the power supply to the GND pad.
- 9) Connect the audio source to the IN_L and the IN_R pads. Connect the ground from the audio source to the GND pad.

- 10) Turn on both power supplies and the audio source.
- 11) Adjust potentiometer R2 to change the speakers' volume.
- 12) Connect the headphone to the phone jack J1.
- 13) Adjust potentiometer R2 to adjust the headphone's volume.

Detailed Description

The MAX9752A EV kit is designed to evaluate the MAX9752A, as well as the MAX9752B/MAX9752C/MAX9753/MAX9754. All of these Class D amplifiers drive stereo BTL speakers, and stereo headphones in portable audio applications. The EV kit comes with a MAX9752A IC installed.

The EV kit can operate from a 4.5V to 5.5V DC power supply, and deliver 2 x 2.2W continuous power into a pair of 4Ω speakers. Three different speaker output configurations are available for ease of evaluation. The headphone amplifiers deliver 63mW per channel into a 16Ω stereo headphone. Optionally, the headphone amplifier can operate from a 3V power supply.

The MAX9752A EV kit speaker and headphone volume is adjustable by the thumb-wheel potentiometer (R2) connected to the analog volume control (VOL) of U1. The MAX9752A's maximum gain is configurable using jumpers JU2 and JU3. The MAX9752A EV kit features an audible alert input, PC_BEEP, on the PC board pad.

The EV kit can also evaluate the MAX9752B/MAX9752C/MAX9753/MAX9754. To evaluate these ICs, replace the MAX9752A with the desired IC. See the *Evaluating the MAX9753* or the *Evaluating the MAX9754* section for additional information.

The speaker and headphone outputs on the EV kit can be selected by jumper JU5 and headphone jack J1. See Table 6 in the *Jumper Selection* section.

MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

Output Filtering

The speaker outputs (OUTL+/- and OUTR+/-) can be connected directly to a pair of speaker loads without any filtering. Use the OUTL+/- and OUTR+/- test points to connect the speakers directly to the EV kit outputs. This configuration is for a typical audio application.

The MAX9752A EV kit features PC board pads for filters that can be added to ease evaluation. Audio analyzers typically cannot accept pulse-width-modulated (PWM) signals at their inputs. The PWM output signal can be low-pass filtered by installing components L6–L9, C21–C30, and R3–R6. The filtered outputs should then be monitored at the FOUTL+/- and FOUTR+/- PC board pads. See Table 1 below for the suggested filtering component values to evaluate a 4Ω load with a 30kHz cutoff frequency.

The MAX9752A/MAX9752B/MAX9752C/MAX9753/MAX9754 are designed to pass FCC Class B radiated emissions without additional filtering. In applications where medium length cables are required, or the circuit is near EMI-sensitive devices, output capacitors C17–C20 and common-mode chokes T1 and T2 can be added to reduce radiated emission. The EMI-filtered outputs should then be monitored at the TOUTL+/- and TOUTR+/- test points. Table 2 lists the recommended EMI filter components.

Table 1. Suggested Filtering Components for a 4Ω Load with a 30kHz Cutoff Frequency

COMPONENT	VALUE
L6–L9	15μH
C21–C24	0.033μF
C25–C26	0.15μF
C27–C30	0.068μF
R3–R6	22Ω

Jumper Selection

Shutdown Mode ($\overline{\text{SHDN}}$)

Jumper JU1 controls the shutdown mode ($\overline{\text{SHDN}}$) of the MAX9752A/MAX9752B/MAX9752C/MAX9753/MAX9754 ICs. The shutdown mode can also be controlled by an external logic controller connected to the EV kit $\overline{\text{SHDN}}$ pad. Remove the shunt from jumper JU1 before connecting an external controller to the $\overline{\text{SHDN}}$ PC board pad. See Table 3 for shunt positions.

Gain Selection (MAX9752A/MAX9752B/MAX9752C)

For the MAX9752A/MAX9752B/MAX9752C, jumpers JU2 and JU3 provide an option to set the speaker and headphone amplifiers' maximum gain on the EV kit. See Table 4 for shunt positions.

Analog Volume Control (MAX9752A/MAX9752B/MAX9752C)

Jumper JU4 selects between the analog volume control (VOL) for the MAX9752A/MAX9752B/MAX9752C ICs, and the right input channel when evaluating the MAX9753/MAX9754. See Table 5 for shunt positions.

Speaker/Headphone Mode (HPS)

Jumper JU5 selects between the speaker mode and the headphone mode for the MAX9752A/MAX9752B/MAX9752C/MAX9753/MAX9754 ICs. See Table 6 for shunt positions.

Table 2. Recommended EMI Filter Components

COMPONENT	VALUE
C17–C20	100pF
T1, T2	Common-mode chokes 800Ω at 100MHz, 50V DC, 1 ADC TDK ACM4532-801-2P-X

Table 3. JU1 Jumper Selection ($\overline{\text{SHDN}}$)

SHUNT POSITION	$\overline{\text{SHDN}}$ PIN	EV KIT FUNCTION
1-2 (default)	High	Enabled
2-3	Low	Disabled
None (external logic controller connected to $\overline{\text{SHDN}}$ pad)	Connected to external controller	$\overline{\text{SHDN}}$ driven by external logic controller. Shutdown is active low.

MAX9752A Evaluation Kit

Table 4. JU2 and JU3 Jumper Selection (GAIN)

SHUNT POSITION		SPEAKER MODE GAIN (dB) JU5 INSTALLED			HEADPHONE MODE GAIN (dB) JU5 NOT INSTALLED
JU3 (GAIN2)	JU2 (GAIN1)	MAX9752A	MAX9752B	MAX9752C	MAX9752A or MAX9752B or MAX9752C
2-3 (Low)	2-3 (Low)	9	15	6	0
2-3 (Low)	1-2 (High)	10.5	16.5	7.5	0
1-2 (High)	2-3 (Low)	12	18	9	3
1-2 (High)	1-2 (High)	13.5	19.5	10.5	3

Table 5. JU4 Jumper Selection (VOLUME)

SHUNT POSITION	MAX9752A/MAX9752B/MAX9752C PIN 28 (VOL)	EV KIT FUNCTION
1-2	Not allowed when evaluating the MAX9752A/MAX9752B/MAX9752C	See <i>Evaluating the MAX9753</i> or <i>Evaluating the MAX9754</i> section
2-3	Connected to the thumb-wheel potentiometer R2	MAX9752A/MAX9752B/MAX9752C's analog volume control is selected

Table 6. JU5 Jumper Selection (SPKR/HP)

SHUNT POSITION	EV KIT FUNCTION
Not Installed	Forced headphone mode
Installed (No headphone plug into J1)	Speaker mode
Installed (Headphone plug into J1)	Headphone mode

Evaluating the MAX9753

Required EV Kit Modification

- Replace U1 with the MAX9753 IC
- Replace R1 with a 0Ω resistor
- Set jumper JU4 to pins 1 and 2

To evaluate the MAX9753, replace the MAX9752A with the MAX9753. The MAX9753 features a 2:1 multiplexer, allowing two sets of audio sources to be connected to the inputs of the MAX9753. The first set of audio input signals are connected to the IN_L and IN_R pads (same as the MAX9752A), while the second set of audio signals are connected to the PC_BEEP (left channel) and INRB (right channel) pads. To utilize the PC_BEEP and INRB pads for the second set of audio

input signals, replace R1 with a 0Ω resistor and install a shunt on pins 1 and 2 of jumper JU4. Either audio source is selectable by jumper JU3. The speaker and headphone amplifiers' maximum gain is set by jumper JU2. Refer to the MAX9752/MAX9753/MAX9754 IC data sheet for the correct pinout and function. The speaker and headphone outputs on the EV kit can be selected by jumper JU5 and headphone jack J1. See Table 6 in the *Jumper Selection* section for configuring JU5.

MAX9753 Gain Selection

When evaluating the MAX9753, jumper JU2 provides an option to set the speaker and headphone amplifiers' maximum gain on the EV kit. See Table 7 for shunt positions.

MAX9753 Stereo Input Selection

When evaluating the MAX9753, jumper JU3 provides an option to select between two stereo input sources. See Table 8 for shunt positions.

MAX9753 Second Right Input Channel (INR2)

Jumper JU4 selects between the analog volume control (VOL) for the MAX9752A/MAX9752B/MAX9752C and the second right input channel (INR2) for the MAX9753. See Table 9 for shunt positions.

MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

Table 7. JU2 Jumper Selection (MAX9753 GAIN)

SHUNT POSITION	MAX9753 PIN 24 (GAIN) CONNECTED	SPEAKER MODE GAIN (dB) JU5 INSTALLED	HEADPHONE MODE GAIN (dB) JU5 NOT INSTALLED
1-2	VDD	9	0
2-3	GND	10.5	3

Table 8. JU3 Jumper Selection (MAX9753 INPUT)

SHUNT POSITION	MAX9753 PIN 23 (IN1/2) CONNECTED	STEREO INPUT SOURCE SELECTED
1-2	VDD	The stereo source that is connected to the IN_L and IN_R pads is selected.
2-3	GND	The stereo source connected to the PC_BEEP and INRB pads is selected.*

*Replace R1 with a 0Ω resistor, and install a shunt on pins 1 and 2 of jumper JU4.

Table 9. JU4 Jumper Selection (MAX9753 SECOND RIGHT INPUT)

SHUNT POSITION	MAX9753 PIN 28 (INR2)	EV KIT FUNCTION
1-2	AC-coupled to the INRB PC board pad on the EV kit.	MAX9753's second right input channel is selected.
2-3	Not allowed when evaluating the MAX9753.	See the <i>Jumper Selection</i> section.

MAX9752A Evaluation Kit

Evaluating the MAX9754

Required EV Kit Modification

- Replace U1 with the MAX9754 IC
- Replace R1 with a 0Ω resistor
- Set jumper JU4 to pins 1 and 2
- Set jumper JU3 to pins 2 and 3

To evaluate the MAX9754, replace the MAX9752A with the MAX9754. The MAX9754's audio input signals INL and INR are connected to the PC_BEEP and INRB PC board pads on the EV kit, respectively. To utilize the PC_BEEP and INRB pads for audio input signals, replace resistor R1 with a 0Ω resistor and install a shunt on pins 1 and 2 of jumper JU4. When evaluating the MAX9754, U1 pin 23 must be connected to ground for proper operation. Install a shunt on pins 2 and 3 of jumper JU3 to connect the MAX9754 pin 23 to ground. The speaker and headphone amplifiers' maximum gain is set by jumper JU2. Refer to the MAX9752/MAX9753/MAX9754 IC data sheet

for the pinout. The speaker and headphone outputs on the EV kit can be selected by jumper JU5 and headphone jack J1. See Table 6 in the *Jumper Selection* section for configuring JU5.

MAX9754 Gain Selection

When evaluating the MAX9754, jumper JU2 provides an option to set the speaker and headphone amplifiers' maximum gain on the EV kit. See Table 10 for shunt positions.

MAX9754 Jumper JU3

When evaluating the MAX9754, pin 23 must be connected to ground for proper operation. Install a shunt across pins 2 and 3 on jumper JU3 to connect the MAX9754 pin 23 to ground. See Table 11.

MAX9754 Right Input Channel (INR)

Jumper JU4 selects between the analog volume control (VOL) for the MAX9752A/MAX9752B/MAX9752C and the right input channel (INR) for the MAX9754. See Table 12 for shunt positions.

Table 10. JU2 Jumper Selection (MAX9754 GAIN)

SHUNT POSITION	MAX9754 PIN 24 (GAIN) CONNECTED	SPEAKER MODE GAIN (dB) JU5 INSTALLED	HEADPHONE MODE GAIN (dB) JU5 NOT INSTALLED
1-2	VDD	9	0
2-3	GND	10.5	3

Table 11. JU3 Jumper Selection (MAX9754 PIN 23)

SHUNT POSITION	MAX9754 PIN 23 (GND) CONNECTED	EV KIT FUNCTION
1-2 (Not Allowed)	VDD (Not Allowed)	Not Functional
2-3 (Required)	GND	Normal Operation

Table 12. JU4 Jumper Selection (MAX9754 INR)

SHUNT POSITION	MAX9754 PIN 28 (INR)	EV KIT FUNCTION
1-2	AC coupled to the INRB pad on the EV kit	MAX9754's right input channel is selected.
2-3	Not allowed when evaluating the MAX9754	See the <i>Jumper Selection</i> section.

MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

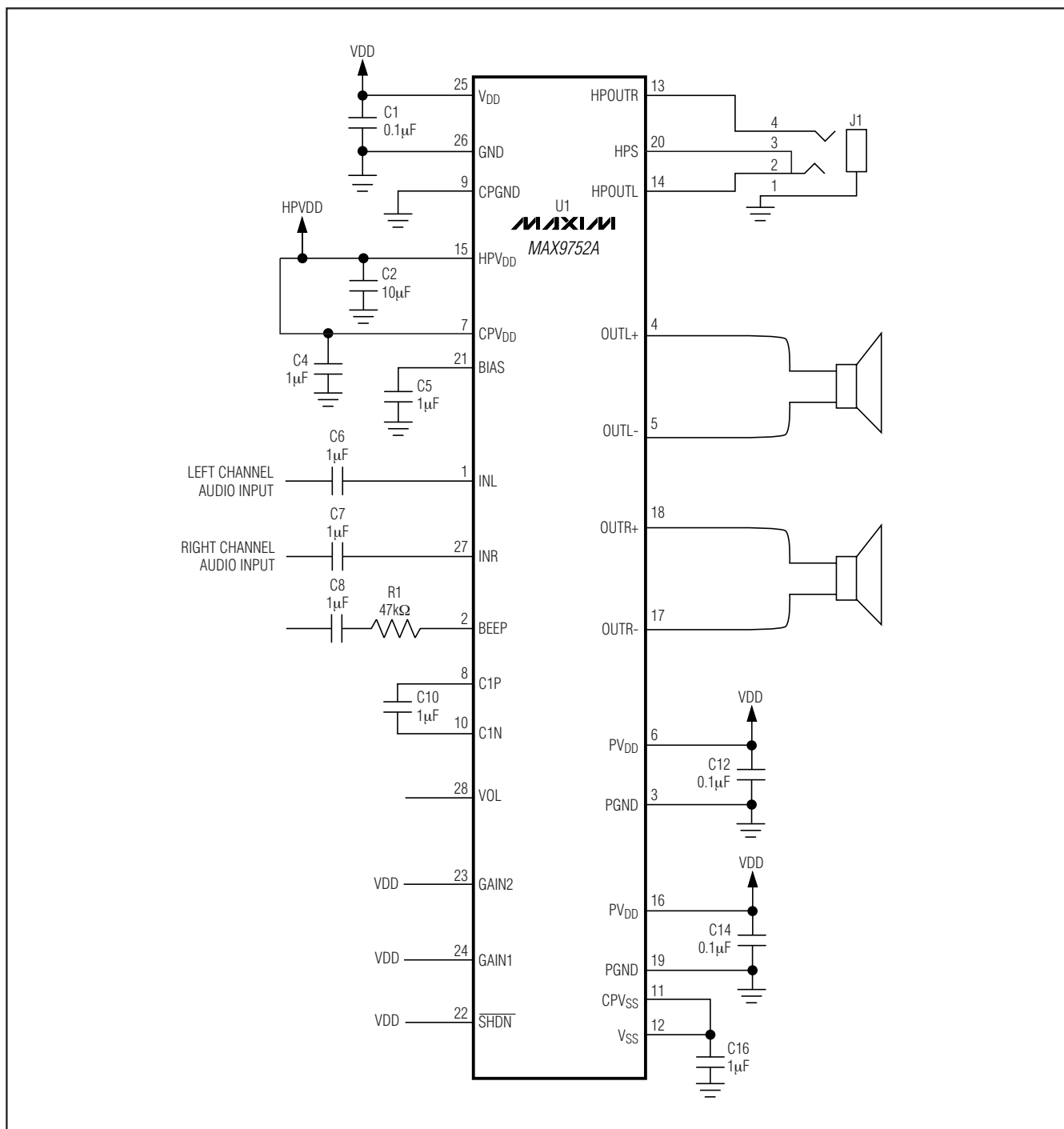


Figure 1. MAX9752A Customer Design Schematic

MAX9752A Evaluation Kit

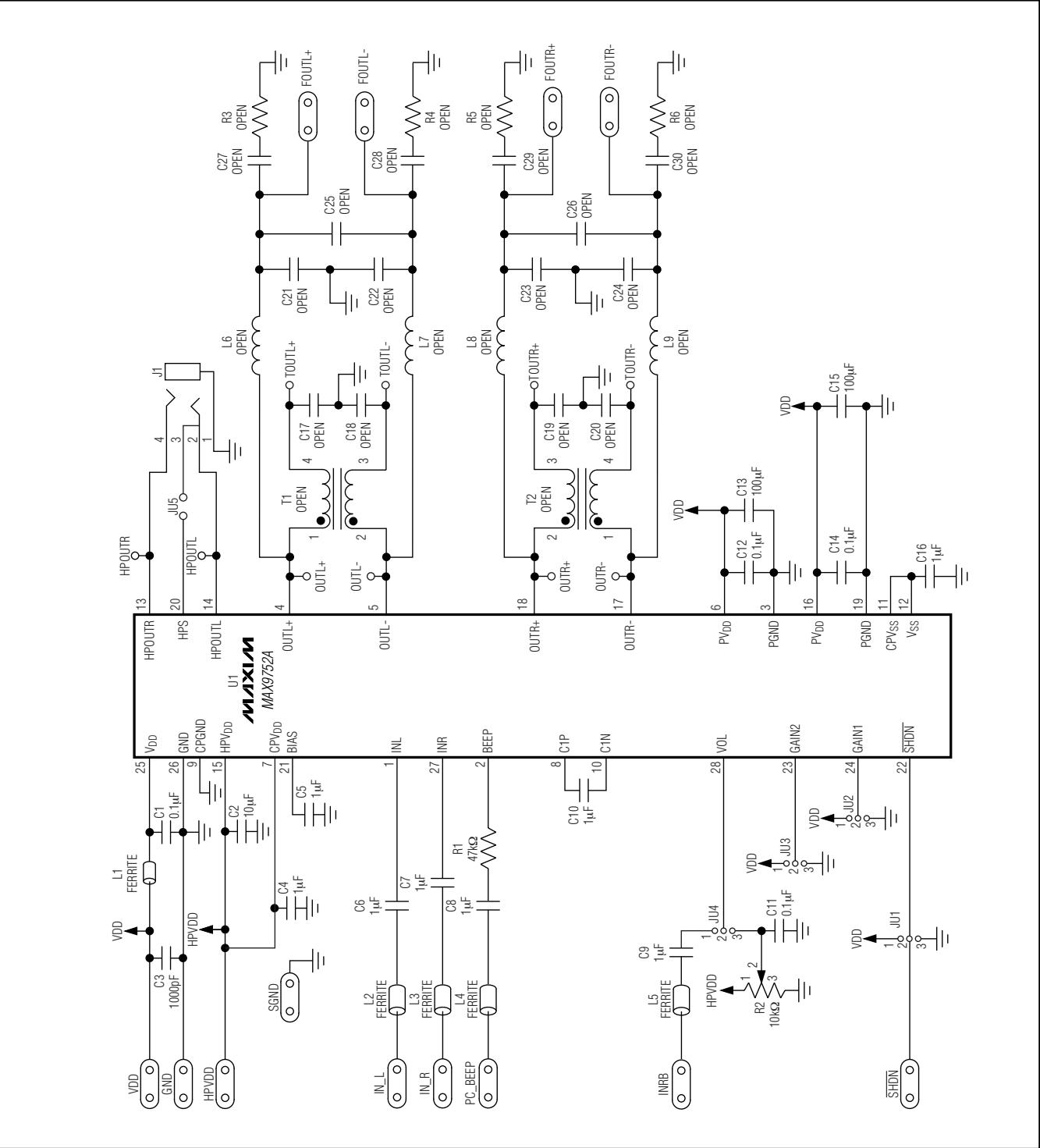


Figure 2. MAX9752A EV Kit Schematic

MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

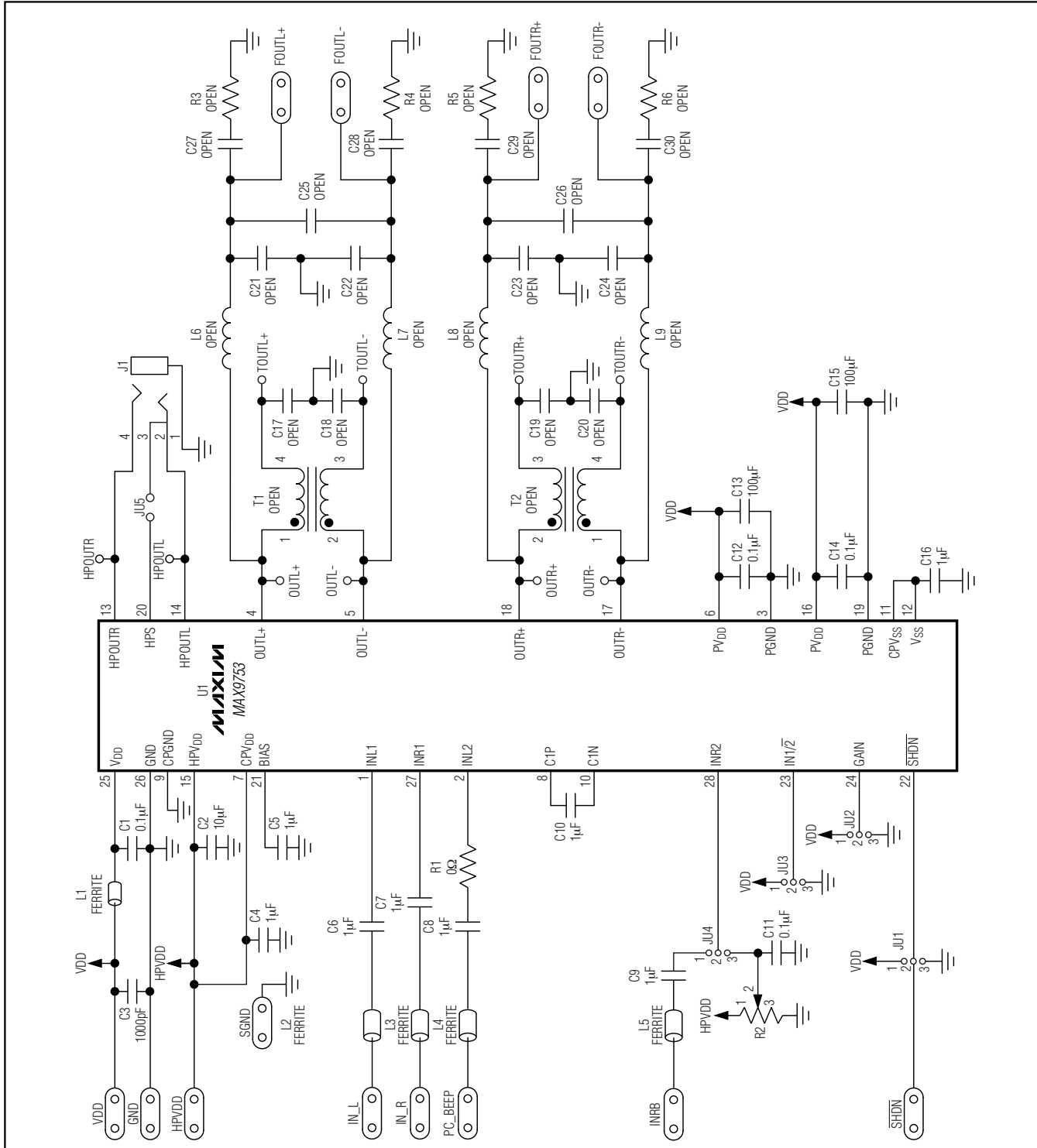


Figure 3. Evaluation Circuit for the MAX9753

Evaluates: MAX9752A/B/C/MAX9753/MAX9754



MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

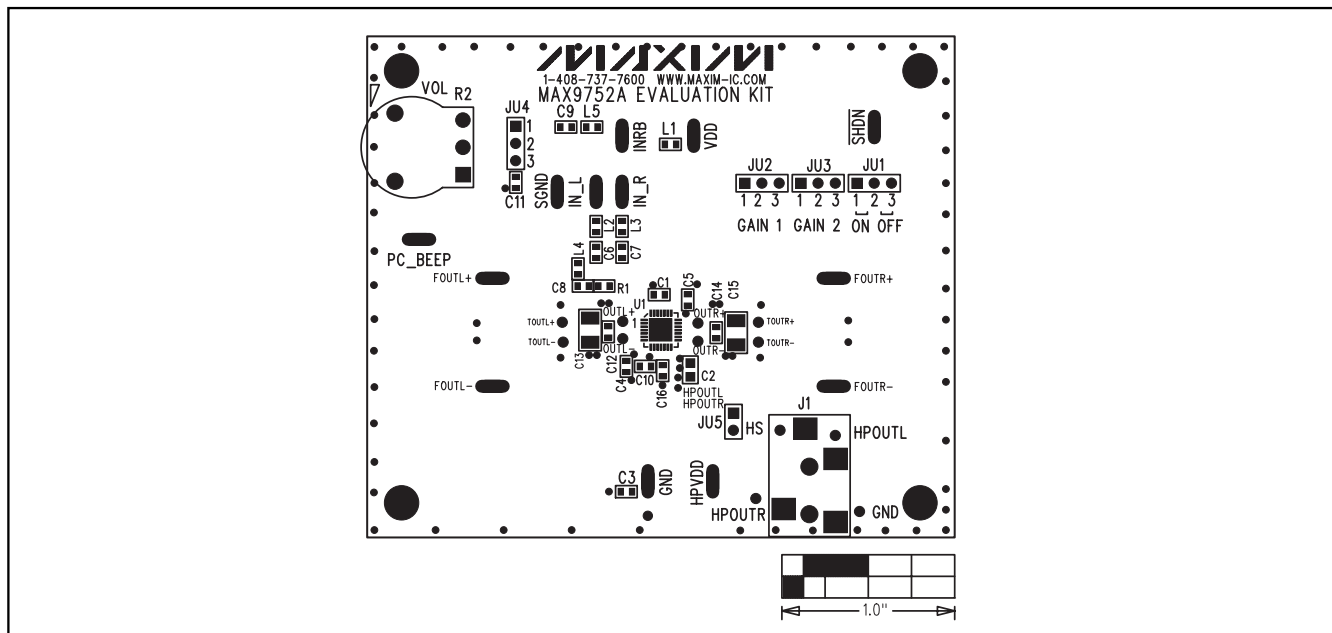


Figure 5. MAX9752A EV Kit Component Placement Guide—Component Side

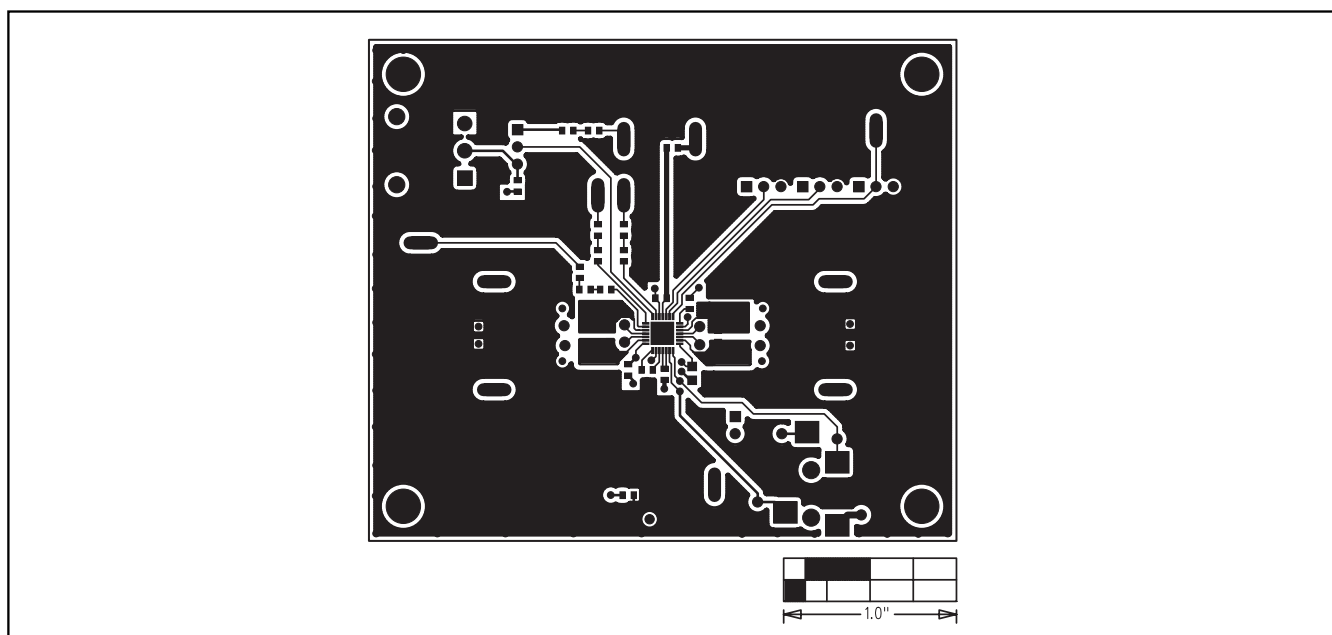


Figure 6. MAX9752A EV Kit PC Board Layout—Component Side

MAX9752A Evaluation Kit

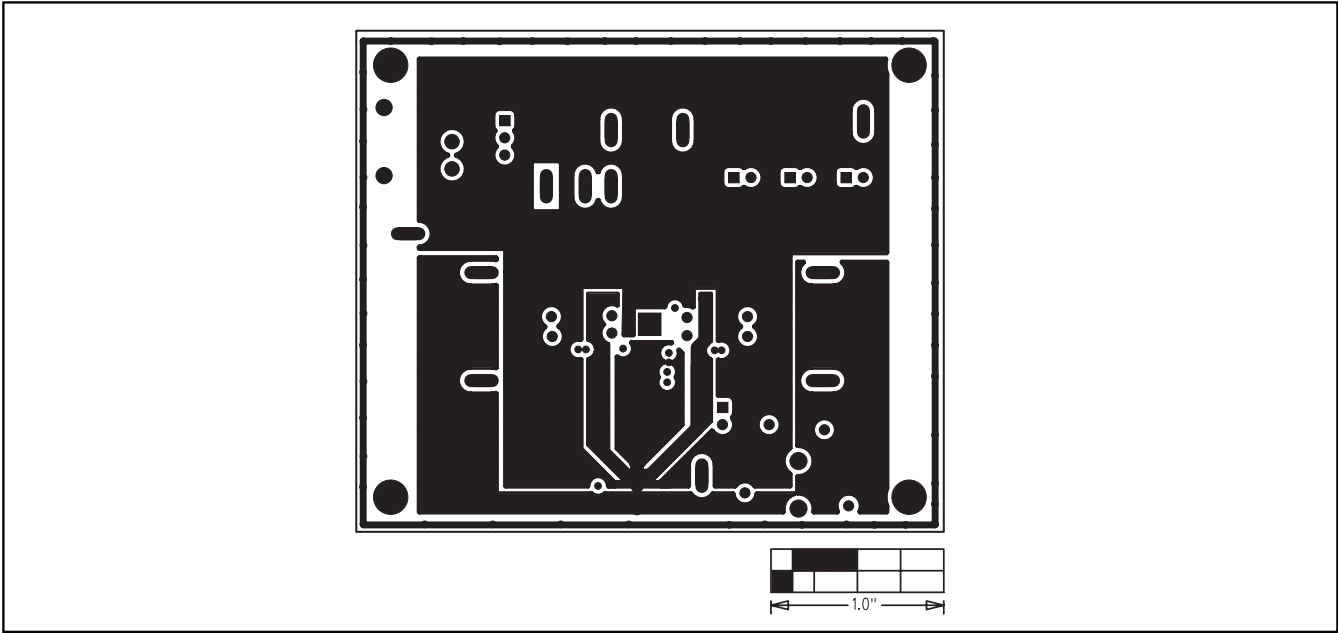


Figure 7. MAX9752A EV Kit PC Board Layout—GND Layer 2

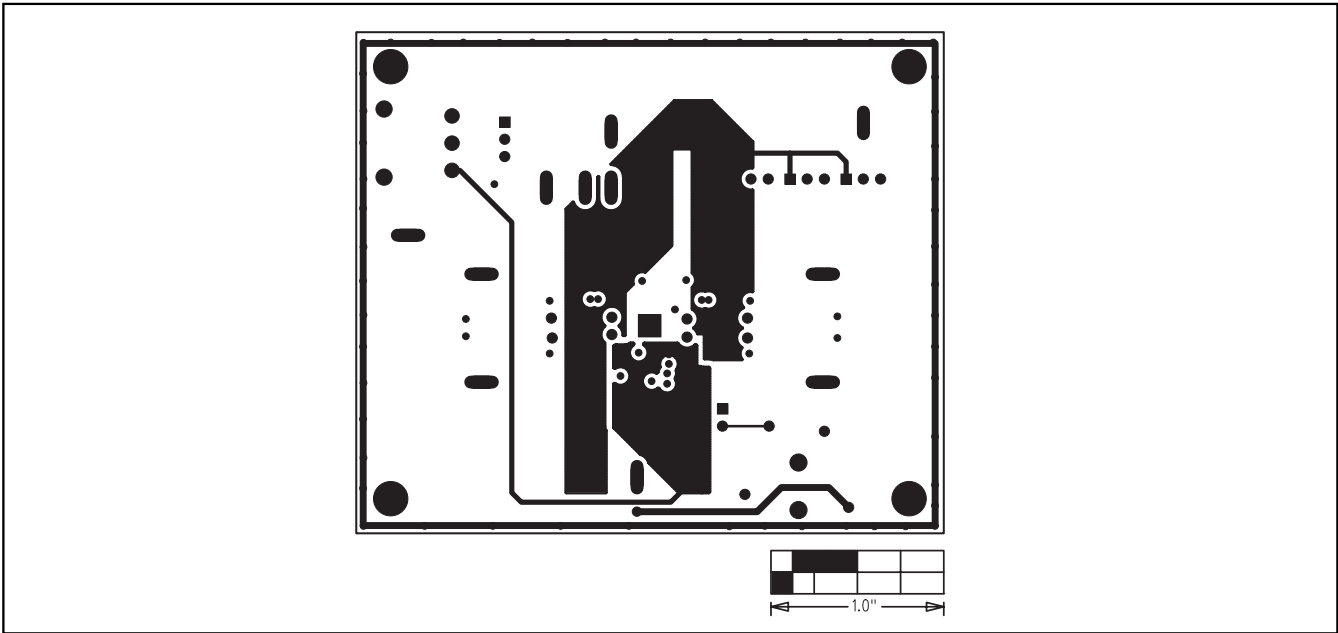


Figure 8. MAX9752A EV Kit PC Board Layout—VDD Layer 3

MAX9752A Evaluation Kit

Evaluates: MAX9752A/B/C/MAX9753/MAX9754

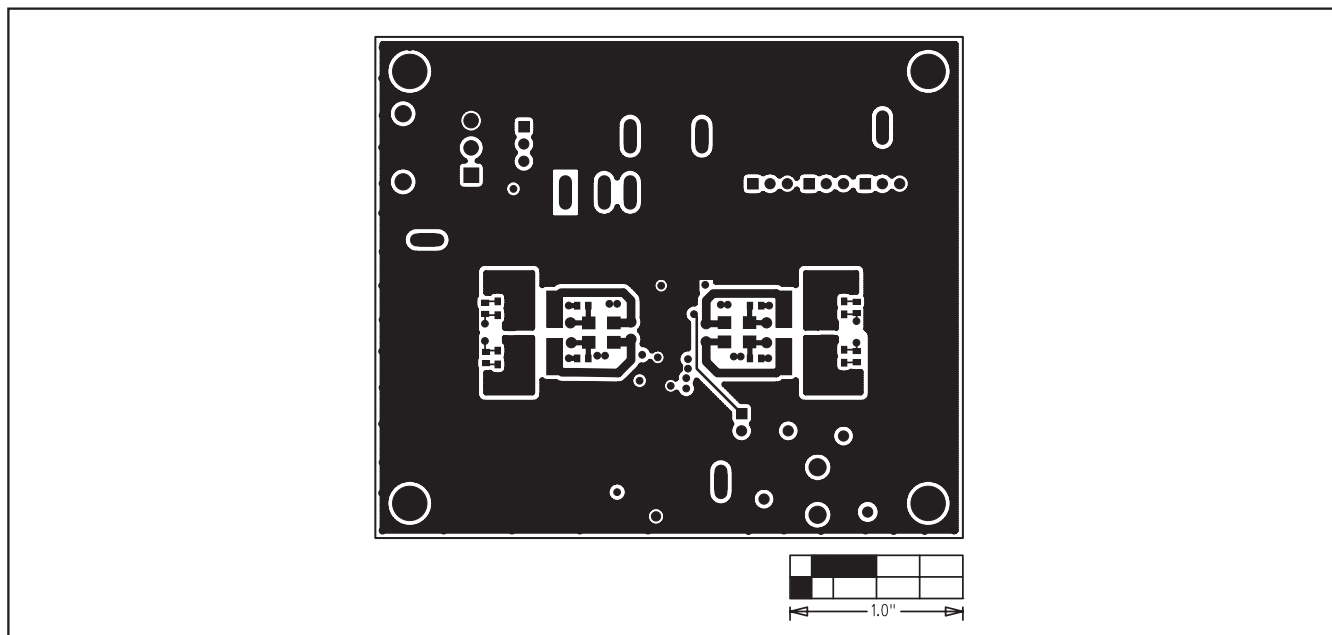


Figure 9. MAX9752A EV Kit PC Board Layout—Solder Side

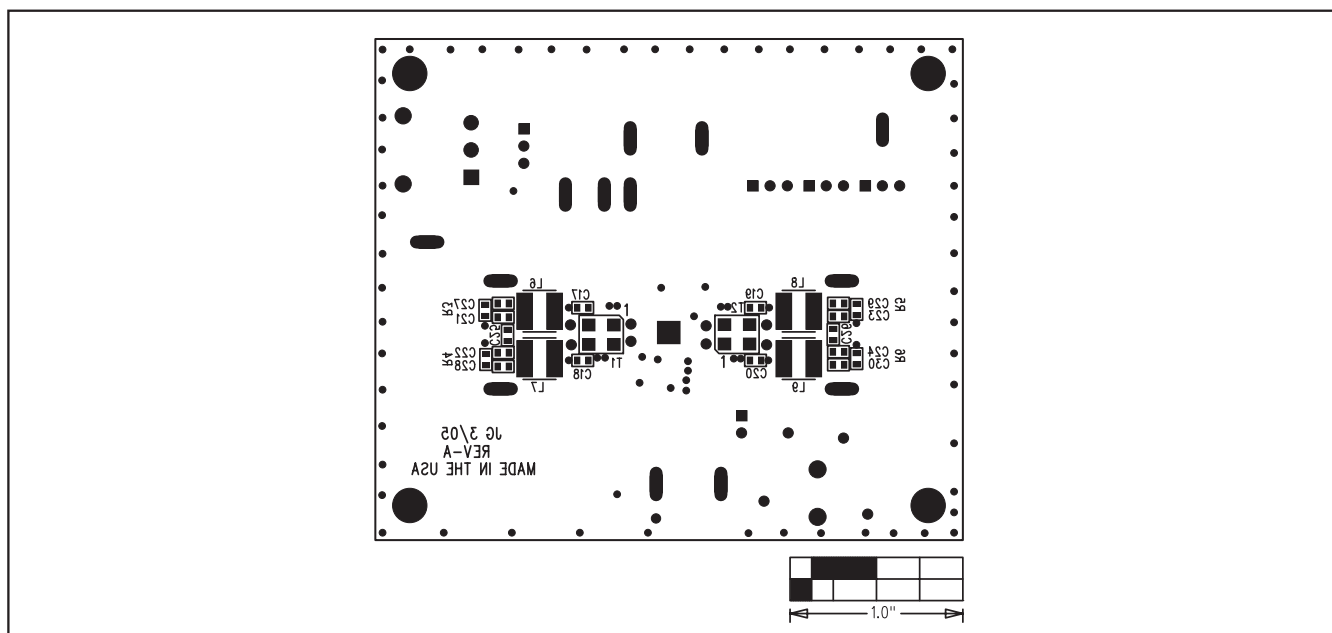


Figure 10. MAX9752A EV Kit Component Placement Guide—Solder Side

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600 13