

MAX44269 Evaluation Kit

Evaluates: MAX44269

General Description

The MAX44269 evaluation kit (EV kit) is a fully assembled and tested PCB that evaluates the MAX44269 dual comparator in a 1.3mm x 1.3mm wafer-level package (WLP). The EV kit circuit can be easily configured by installing shunts and changing a few components to support multiple comparator application circuits, such as window detector, jack detection, relaxation oscillator, pulse-width modulated (PWM) generator, logic-level translator, or power-on-reset circuit. The EV kit provides 0603 component PCB pads for ease of evaluation. The EV kit circuit operates from a +1.8V to +5.5V VCC supply.

Features

- ◆ 1.8V to 5.5V Input Voltage-Supply Range
- ◆ Configurable for:
 - Window Detector
 - Jack Detection
 - Relaxation Oscillator
 - PWM Generator
 - Logic-Level Translator
 - Power-on-Reset Circuit
- ◆ Evaluates 9-Bump WLP Package
- ◆ Proven PCB Layout
- ◆ Fully Assembled and Tested

[Ordering Information](#) appears at end of data sheet.

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	4.7 μ F \pm 10%, 6.3V X5R ceramic capacitor (0805) Murata GRM21BR60J475K
C2	1	0.1 μ F \pm 10%, 50V X5R ceramic capacitor (0603) Murata GRM188R71H104k
D1, D2	0	Not installed, diodes (0603)
GND	4	Small black test points
J1, J2	2	3.5mm audio jacks
JU1, JU2	2	3-pin headers
JU3, JU4, JU5	3	2-pin headers
OUTA, OUTB, TP1-TP4, VCC	7	Small red test points

DESIGNATION	QTY	DESCRIPTION
R1, R2, R6-R9, R12, R13, R15	0	Not installed, resistors (0603)
R3, R5, R10, R14	4	0 Ω \pm 5% resistors (0603)
R4, R11	2	100k Ω \pm 5% resistors (0603)
U1	1	Low-power dual comparator (9 WLP) Maxim MAX44269EWL+ (Top Mark: +AJL)
—	5	Shunts
—	1	PCB: MAX44269 EVALUATION KIT

Component Supplier

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com

Note: Indicate that you are using the MAX44269 when contacting this component supplier.

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Quick Start

Required Equipment

- MAX44269 EV kit
- Three adjustable 0 to 5V DC power supplies
- Dual-channel oscilloscope

Procedure

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

- 1) Verify that shunts are installed as followed:
 - JU1: Pins 1-2
 - JU2: Pins 2-3
 - JU3: Installed
 - JU4: Not installed
 - JU5: Installed
- 2) Set a DC power supply to 3.3V. Connect the positive terminal of the power supply to the VCC PCB pad and the ground terminal to the GND PCB pad.
- 3) Set another DC power supply to 2.5V. Connect the positive terminal of the power supply to the IN1+ PCB pad and the ground terminal to the GND PCB pad.
- 4) Set another DC power supply to 2V. Connect the positive terminal of the power supply to the IN1- PCB pad and the ground terminal to the GND PCB pad.
- 5) Enable all three DC power supplies.
- 6) Verify that OUTA and OUTB are at logic-high (3.3V).
- 7) Increase the IN1- voltage to 3V and verify that OUTA and OUTB are now at logic-low (0V).

Detailed Description of Hardware

The MAX44269 EV kit is a fully assembled and tested PCB that evaluates the MAX44269 open-drain, dual comparator. The EV kit requires a 1.8V to 5.5V input supply voltage at VCC for normal operation.

The EV kit circuit is configured for independent evaluation of comparator A and comparator B. The comparators have rail-to-rail inputs and an internal 4mV hysteresis. Comparator A input signals are applied at the IN1+/IN1- PCB pads. Resistors R1, R2, and R3 are available to provide additional hysteresis using positive feedback. The comparator output can be monitored at the OUTA test point. Comparator B input signals are applied at the IN2+/IN2- PCB pads. Resistors R8, R9, and R10 are available to provide additional hysteresis using positive feedback. The comparator output can be monitored at the OUTB test point. Refer to the MAX44269 IC data sheet for additional information on adding external hysteresis using the on-board resistors.

The EV kit provides various jumpers and 0603 PCB resistor pads, allowing easy configuration for various comparator application circuits such as a window detector, jack detection, relaxation oscillator, power-on-reset, or PWM generator. Jumpers JU1 and JU2 are available to provide flexibility on the number of voltage sources used for driving the comparator inputs. Jumper JU2 (in addition to JU4) can also be used for configuring the EV kit circuit for window detection or PWM generator operation. Jumpers JU3 and JU5 are available for logic-level translation using external voltage sources applied at the VPULLA and VPULLB PCB pads, respectively. Refer to this document for proper jumper configuration when evaluating the various application circuits.

Input Configuration

Jumpers JU1 and JU2 are provided to allow flexibility for configuring the voltage source for the comparators' inputs and configuring the inputs for the various comparator applications. See Table 1 for jumper JU1 and JU2 configurations.

Table 1. Input Source (JU1, JU2)

JUMPER	SHUNT POSITION	EV KIT CONFIGURATION
JU1	1-2*	Single source driving noninverting inputs.
	2-3	Single source driving IN1+ and IN2- PCB pads.
	Not installed	Independent voltage sources driving noninverting inputs.
JU2	1-2	Single source driving IN1- and IN2+ PCB pads.
	2-3*	Single source driving inverting inputs.
	Not installed	Independent voltage source driving inverting inputs.

*Default position.

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Comparator Application Circuits

Logic-Level Translation

Jumpers JU3 and JU5 are available to select the output logic voltage for the comparators' open-drain outputs (Figure 1). Install a shunt at the jumpers to set VCC as the comparator output logic level. Remove the shunt and apply the desired voltage source at the VPULLA and/or VPULLB PCB pads to set the comparator output logic level independent of the supply voltage. Note that the OUTA and OUTB pins have an absolute maximum voltage of -0.3V to 6V. See Table 2 for proper jumper configurations. Jumper JU4 is also provided to connect Comparator A and B outputs together for window-detection operation. See Table 3 for proper JU4 configuration.

Jack Detection

Each of the EV kit comparators can be configured as a simple jack-detection circuit, as follows:

- 1) Short the IN1+ (or IN2+) PCB pads to VCC.
- 2) Install a pullup resistor greater than 1kΩ at the R3 (or R10) pad to minimize the power dissipated across the resistors when inserting a standard 3-conductor plug at the corresponding jack (J1 or J2).
- 3) Uninstall jumpers JU1, JU2, and JU4.
- 4) Apply a suitable external reference voltage at the IN1- (or IN2-) PCB pad. The value of the pullup resistor and the reference voltage can be adjusted to select the threshold voltage for accessory detection.
- 5) When no accessory is plugged into the jack ($IN_{+} > IN_{-}$), the corresponding OUT_{-} is at logic-high. When the plug is inserted at jack J1 (or J2), the IN_{+} voltage falls below IN_{-} , causing the corresponding OUT_{-} to trip low.

Table 2. OUTA and OUTB Logic Level (JU3, JU5)

SHUNT POSITION	OUT_ PIN	LOGIC-HIGH VOLTAGE
Installed*	Pulled up to VCC through resistors R4/R11	VCC
Not installed	Pulled up to PULLA/VPULLB through resistors R4/R11	External voltage applied at the VPULLA/VPULLB PCB pads

*Default position.

Table 3. Jumper JU4 Configuration

SHUNT POSITION	EV KIT CONFIGURATION
Installed	Window detector
Not installed*	Normal operation

*Default position.

Relaxation Oscillator

Comparator A can be configured to operate as a simple relaxation oscillator (Figure 2), as follows:

- 1) Add a suitable resistor and capacitor at the R7 and R6 pads, respectively.
- 2) Short IN1+ to VCC.
- 3) The trip thresholds are set by applying suitable external hysteresis using resistors R1, R2, and R3.
- 4) Uninstall jumpers JU1, JU2, and JU4.
- 5) Comparator B can also be independently configured to operate as a relaxation oscillator, as follows:
 - a) Add a suitable resistor and capacitor at the R13 and R12 pads, respectively.
 - b) Short IN2+ to VCC.
 - c) The trip thresholds are set by applying suitable external hysteresis using resistors R8, R9, and R10.
 - d) Uninstall jumpers JU1, JU2, and JU4.

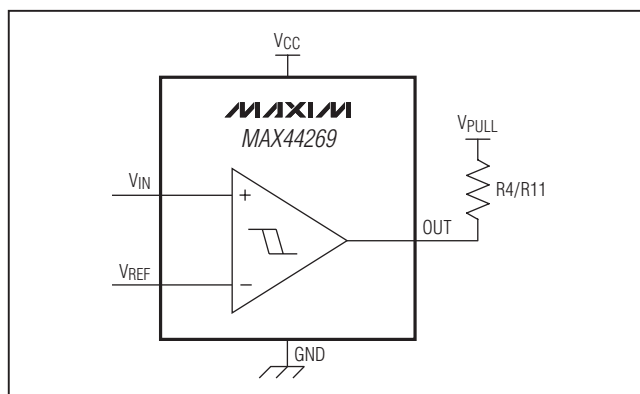


Figure 1. Logic-Level Translator

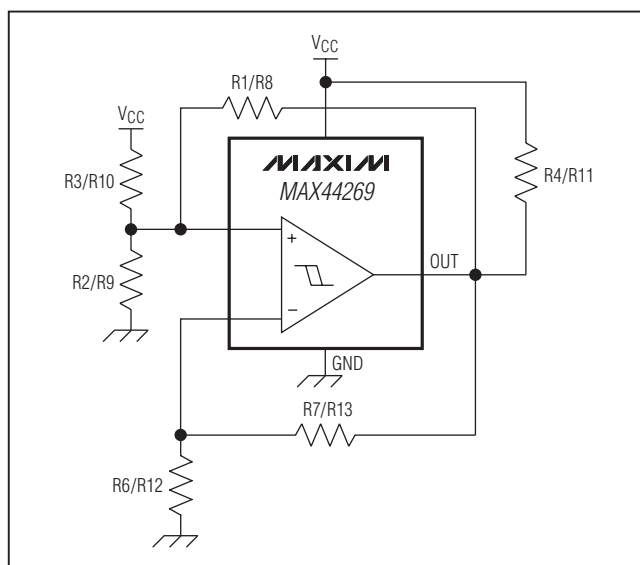


Figure 2. Relaxation Oscillator

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Use the equations below to determine the optimum component values:

COMPARATOR A:

$$V_{T_RISE} = V_{CC} \left(\frac{R1R2}{R3R1 + R3R2 + R1R2} \right)$$

$$V_{T_FALL} = V_{CC} \left(\frac{R2R7(R3 + R1) + (R1R2)}{R2R7(R3 + R1) + R1R2 + R3(R1 + R1R7 + R7)} \right)$$

Using the basic time-domain equations for the charging and discharging of the respective comparator RC circuit, the Comparator A oscillator frequency can be calculated using the equation below:

$$f_{OSCA} = \frac{1}{R7R6 \ln \left(\frac{V_{T_FALL} (V_{IN1+} - V_{T_RISE})}{V_{T_RISE} (V_{IN1+} - V_{T_FALL})} \right)}$$

where V_{IN1+} is in k Ω , $R6$ is in μ F, and the oscillator frequency is in kHz.

COMPARATOR B:

$$V_{T_RISE} = V_{CC} \left(\frac{R8R9}{R10R8 + R10R9 + R8R9} \right)$$

$$V_{T_FALL} = V_{CC} \left(\frac{R9R13(R10 + R8) + (R1R2)}{R9R13(R10 + R8) + R8R9 + R10 + (R8 + R8R13 + R13)} \right)$$

Using the basic time-domain equations for the charging and discharging of the respective comparator RC circuit, the Comparator B oscillator frequency can be calculated using the equation below:

$$f_{OSCB} = \frac{1}{R13R12 \ln \left(\frac{V_{T_FALL} (V_{INB+} - V_{T_RISE})}{V_{T_RISE} (V_{INB+} - V_{T_FALL})} \right)}$$

where $V_{IN2+} = V_{CC}$, $R13$ is in k Ω , $R12$ is in μ F, and the oscillator frequency is in kHz.

Window Detector Circuit

Table 4 depicts the proper jumper configuration for evaluating the EV kit window detector application circuit (Figure 3) using Comparators A and B. See Table 4 for proper jumper configurations.

Resistors $R3$, $R15$, and $R12$ pads are available for setting the overvoltage, and undervoltage-threshold levels. OUTA provides an active-low undervoltage indication and OUTB provides an active-low overvoltage indication. The open-drain outputs of both comparators are wired in an OR configuration using jumper JU4 to give an active-high power-good signal on either OUTA or OUTB.

For accurate threshold settings, use the following equations:

Select resistor $R12$'s value so the current through $R12$ exceeds 1.5 μ A:

$$R12 = \frac{V_{IN1-}}{1.5\mu A} \quad (\text{Equation 1})$$

where V_{IN1-} is the reference voltage applied at the $IN1-$ or $IN2+$ PCB pads and $R12$ is in k Ω .

Choose the desired overvoltage threshold and calculate resistance R_T using Equation 1 for resistor $R12$ value:

$$R_T = R12 \times \left[\left(\frac{V_{OTH}}{V_{IN1-}} \right) - 1 \right] \quad (\text{Equation 2})$$

where $R_T = R3 + R15$ in k Ω and V_{OTH} is the desired overvoltage threshold in volts.

Table 4. Window Detector Jumper Configurations

JUMPER	SHUNT POSITION
JU1, JU5	Not installed
JU2	1-2
JU3, JU4	Installed

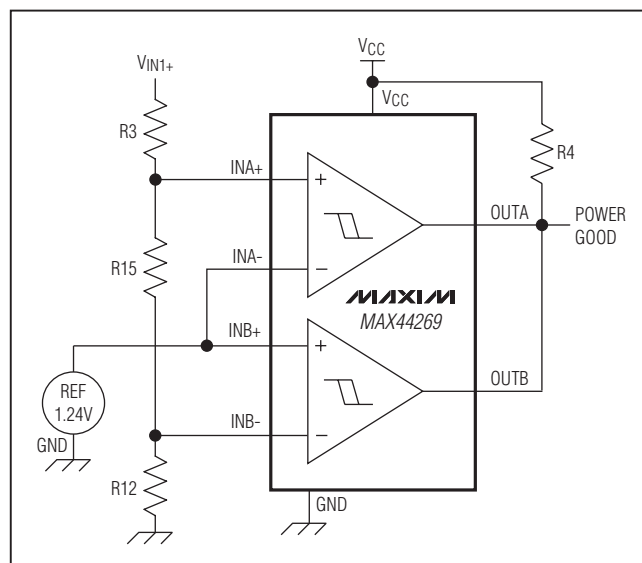


Figure 3. Window Detector Circuit

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Calculate R15 using the following equation:

$$R15 = (R12 + RT) \times \left(\frac{V_{IN1-}}{V_{UTH}} \right) - R12 \quad (\text{Equation 3})$$

where V_{UTH} is the desired undervoltage threshold and R15 is in $k\Omega$.

Calculate the R3 resistor value using Equation 3 to obtain R15 value:

$$R3 = RT - R15$$

where R3 is in $k\Omega$.

PWM Generator

The EV kit can be configured to generate a simple PWM signal using Comparators A and B (Figure 4). See Table 5 for proper jumper configurations on the EV kit for a simple PWM generation circuit. Configure Comparator A as a relaxation oscillator as described in the previous section. Jumper JU2 connects the sawtooth waveform generated on Comparator A's inverting input to Comparator B's inverting input. The analog control voltage, applied on the noninverting input of Comparator B (IN2+), determines the pulse width. **Note:** Since the relaxation oscillator generates a sawtooth waveform, the duty cycle is not a linear function of the applied analog control voltage.

Power-On-Reset (POR) Circuit

The EV kit can be used to evaluate a POR circuit (Figure 5). Comparator A can be configured as a POR circuit, as follows:

- 1) Short the IN1+ and IN1- PCB pads to the VCC pad.
- 2) Replace the R5 and R6 pads with suitable resistors to create a resistive-divider between VCC and GND at the comparator's inverting input.
- 3) Populate a suitable resistor and capacitor on the R3 and R2 pads, respectively. The RC time constant provides the required power-up delay time at the noninverting input.
- 4) Diode D1 (optional) can be used to rapidly discharge the capacitor (C_{R2}) in the event of sudden power loss.

To configure Comparator B for a POR circuit instead, do the following:

- 1) Short the IN2+ and IN2- PCB pads to the VCC pad.
- 2) Replace the R14 and R12 pads with suitable resistors to create a resistive-divider between VCC and GND at the comparator's inverting input.
- 3) Populate a suitable resistor and capacitor on the R10 and R9 pads, respectively. The RC time constant provides the required power-up delay time at the noninverting input.
- 4) Diode D2 (optional) can be used to rapidly discharge the capacitor (C_{R9}) in the event of sudden power loss.

Table 5. PWM Generation Circuit Jumper Configuration

JUMPER	SHUNT POSITION
JU1	Not installed
JU2	2-3
JU3, JU5	Installed
JU4	Not installed

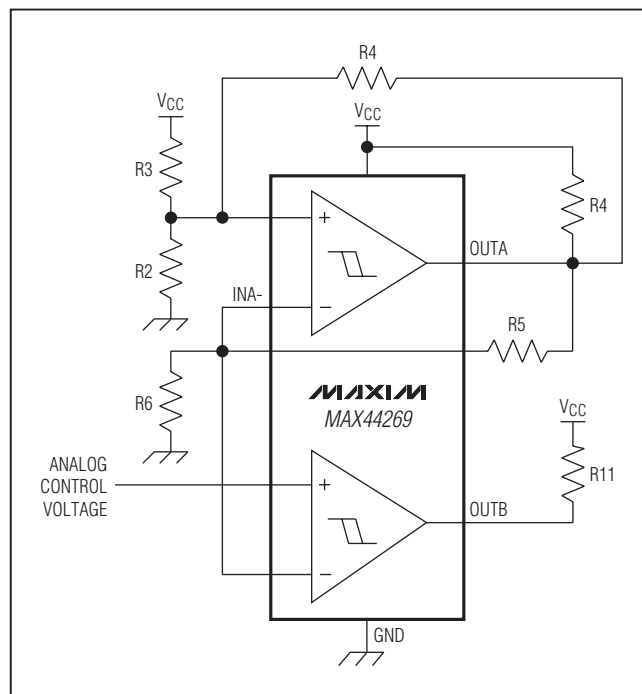


Figure 4. PWM Generator

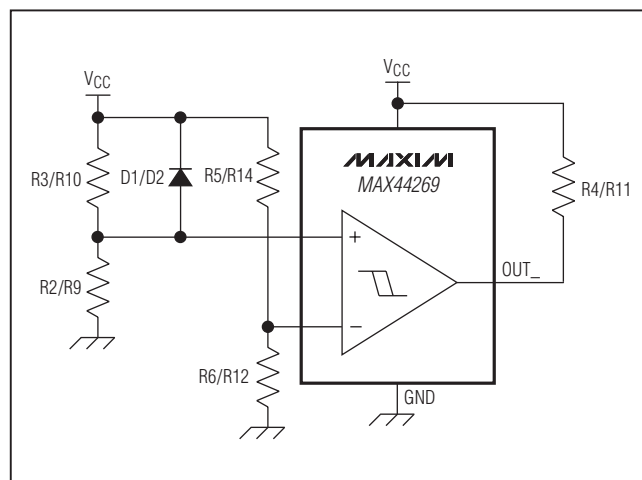


Figure 5. Power-on-Reset Circuit

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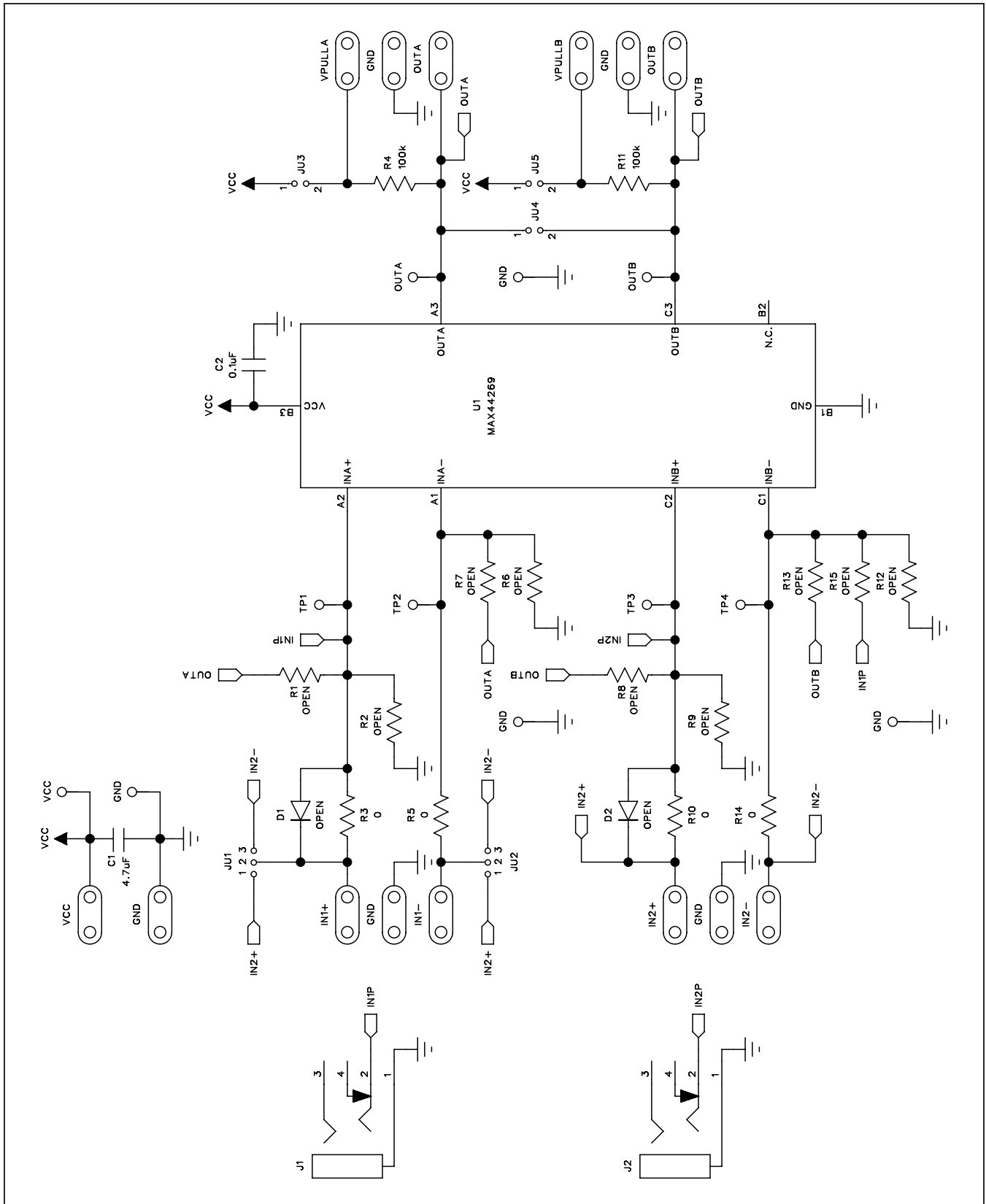


Figure 6. MAX44269 EV Kit Schematic

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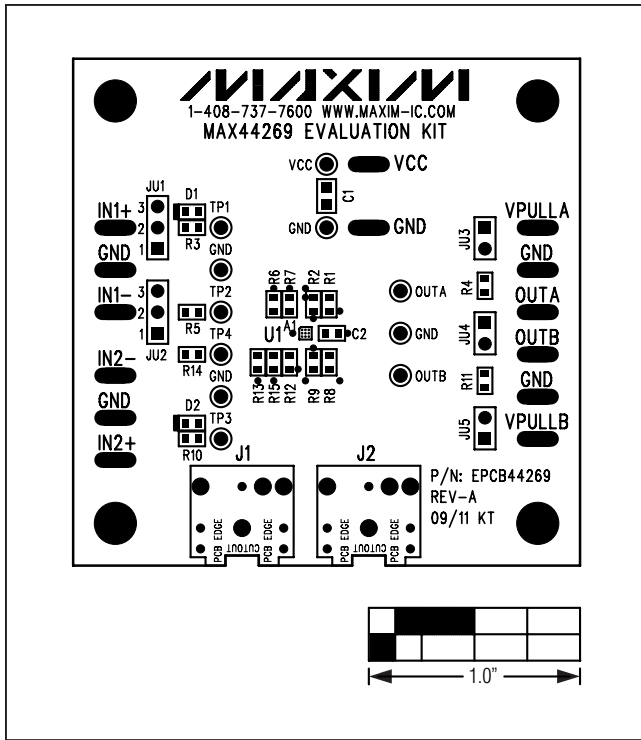


Figure 7. MAX44269 EV Kit Component Placement Guide

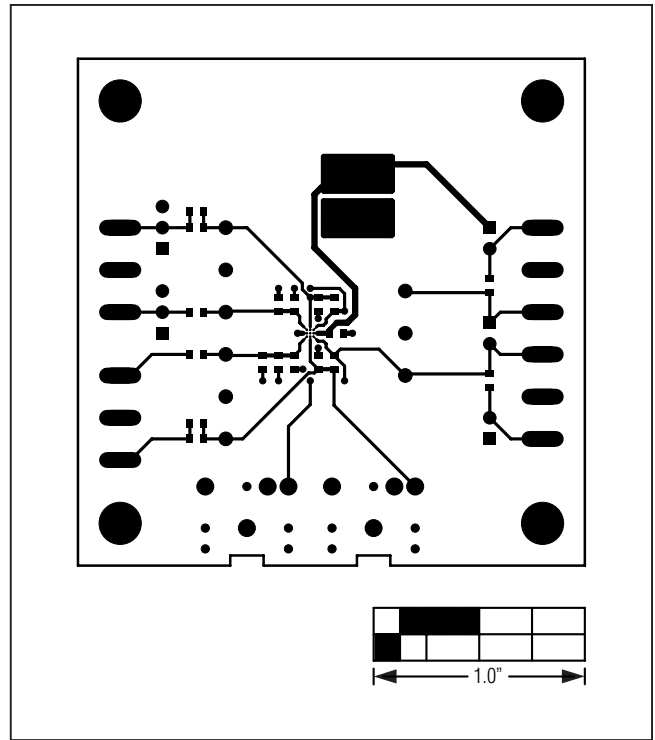


Figure 8. MAX44269 EV Kit PCB Layout—Component Side

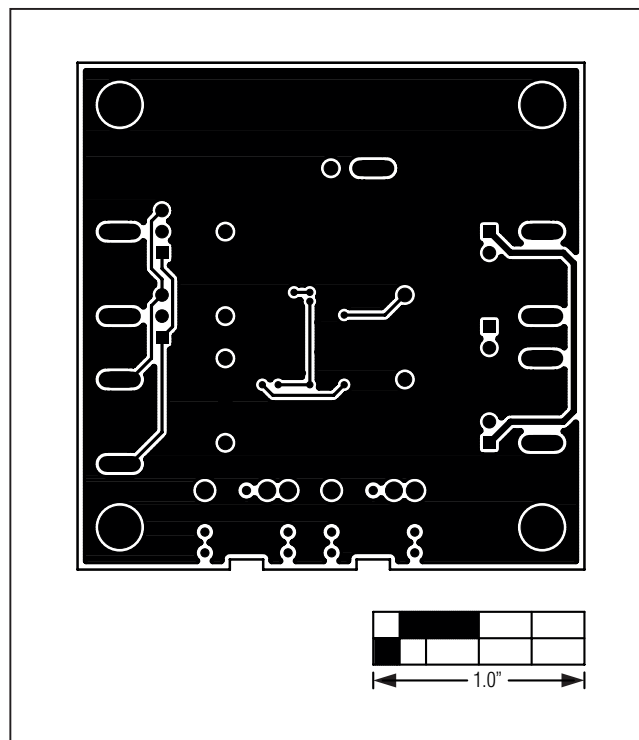


Figure 9. MAX44269 EV Kit PCB Layout—Solder Side

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Ordering Information

PART	TYPE
MAX44269EVKIT#	EV Kit

#Denotes RoHS compliant.

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/11	Initial release	—

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