19-5190; Rev 0; 3/10

MAX9613 Evaluation Kit

Evaluates: MAX9613

General Description

The MAX9613 evaluation kit (EV kit) provides a proven design to evaluate the MAX9613 low-power, MOS-input operational amplifier (op amp) in a 6-pin SC70 package. The EV kit circuit is preconfigured as a noninverting amplifier, but can easily be adapted to other topologies by changing a few components. Low-power, low-input Vos, and rail-to-rail input/output stages make this device ideal for a variety of measurement applications. The component pads accommodate 0805 packages, making them easy to solder and replace. The EV kit comes with a MAX9613AXT+ installed.

Features

- ♦ **Accommodates Multiple Op-Amp Configurations Component Pads Allow for Sallen-Key Filter**
- ♦ **Rail-to-Rail Inputs/Outputs**
- ♦ **Accomodates Easy-to-Use 0805 Components**
- ♦ **Proven PCB Layout**
- ♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX9613EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	0.1µF ±10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C104K
C2	1	4.7µF ±10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J475K
C3, C4, C8, C9	0	Not installed, ceramic capacitors (0805)
GND	2	Black multipurpose test points
INM, INP, OUTA	3	White multipurpose test points
JU1	1	2-pin header
JU2	1	3-pin header
R1, R2	2	1kΩ ±1% resistors (0805)
R5	1	10kΩ ±1% resistor (0805)
R6, R8	2	0Ω ±5% resistors (0805)
VDD	1	Red multipurpose test point
U1	1	Single low-power, rail-to-rail I/O op amp (6 SC70) Maxim MAX9613AXT+ (Top Mark: +ADK)
—	2	Shunts
—	1	PCB: MAX9613 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 MAX9613 when contacting this component supplier.*

Quick Start

Required Equipment

- MAX9613 EV kit
- +5V, 10mA DC power supply (PS1)
- Precision voltage source
- Digital multimeter (DMM)

Procedure

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

1) Verify that jumpers JU1 and JU2 are in their default positions, as shown in Table 1.
2) Connect the positive terminal of the +5V supply to the VDD test point and the negative terminal to the GND test point closest to VDD.
3) Connect the positive terminal of the precision voltage source to the INP test point. Connect the negative terminal of the precision voltage source to GND (GND or INM test points).
4) Connect the DMM to monitor the voltage on the OUTA test point. With the 10kΩ feedback resistor (R5) and 1kΩ series resistor (R1), the gain is +11 (noninverting configuration).
5) Turn on the +5V power supply.
6) Apply 100mV from the precision voltage source. Observe the output at OUTA on the DMM, which should read approximately +1.1V.
7) Apply 400mV from the precision voltage source. OUTA should read approximately +4.4V.

Detailed Description of Hardware

The MAX9613 EV kit provides a proven layout for the MAX9613 low-power, MOS-input op amp. The device is a single-supply op amp that is ideal for buffering sensor signals. A Sallen-Key 2nd-order active filter, as described in the *Sallen-Key Configuration* section, is easily accomplished by changing and removing some components. Various test points are included for easy evaluation.

Op-Amp Configurations

The device is a single-supply op amp that is ideal for differential sensing, noninverting amplification, buffering, and filtering. A few common configurations are shown in the next few sections.

Noninverting Configuration

The EV kit comes preconfigured as a noninverting amplifier with a gain of +11. The gain is set by the ratio of R5 and R1 (Figure 1). For a voltage applied to the INP test point, the output voltage for the noninverting configuration is given by the equation below:

$$V_{OUT} = \left(1 + \frac{R_5}{R_1}\right) V_{INP}$$

Differential Amplifier

To configure the EV kit as a differential amplifier, replace R1, R2, R_{C3}, and R5 with appropriate resistors. When R1 = R2 and R5 = R_{C3}, the common-mode rejection

Table 1. EV Kit Jumper Descriptions (JU1, JU2)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Connects the INM test point to GND.
	Open	Isolates the INM test point from GND.
JU2	1-2*	Connects $\overline{SHDN}$ to VDD (normal operation).
	2-3	Connects $\overline{SHDN}$ to GND (shutdown).

**Default position.*

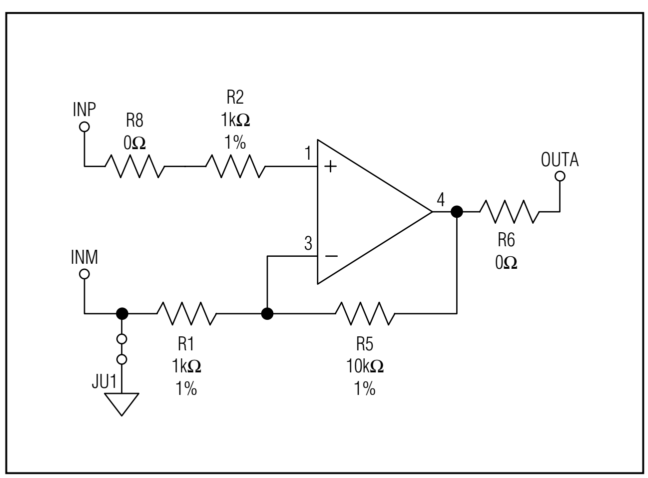

Figure 1. Default Noninverting Configuration with Gain +11

ratio (CMRR) of the differential amplifier is determined by the matching of the resistor ratios R5/R1 and R_{C3}/R2 (Figure 2).

$$V_{OUT} = GAIN\left(V_{INP} - V_{INM}\right)$$

where:

$$GAIN = \frac{R5}{R1} = \frac{R_{C3}}{R2}$$

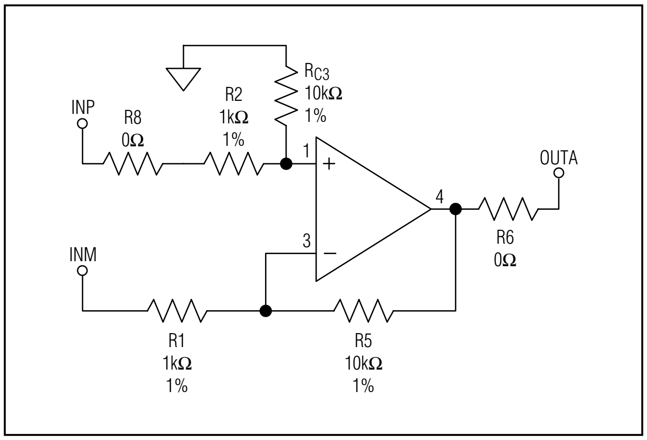

Figure 2. Differential Configuration with Gain +10

Sallen-Key Configuration

The Sallen-Key active filter topology is ideal for sensor signal conditioning with a 2nd-order filter. These filters benefit from a rail-to-rail input structure with no crossover distortion, such as that available on the device.

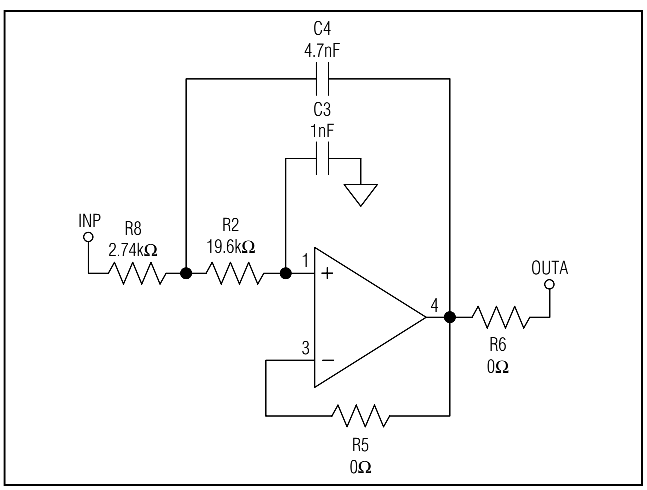

Figure 3. Lowpass 2nd-Order Filter Sallen-Key Configuration for 10kHz

Lowpass Sallen-Key Filter

To configure the Sallen-Key as a lowpass filter, populate the R2 and R8 pads with resistors, and populate the C3 and C4 pads with capacitors. The corner frequency and Q are then given by (Figure 3):

$$f_C = \frac{1}{2\pi\sqrt{R2 \times C3 \times R8 \times C4}}$$

$$Q = \frac{\sqrt{R2 \times C3 \times R8 \times C4}}{C3\left(R2 + R8\right)}$$

Highpass Sallen-Key Filter

To configure the Sallen-Key as a highpass filter, populate the C3 and C4 pads with resistors, and populate the R2 and R8 pads with capacitors. The corner frequency and Q are then given by (Figure 4):

$$f_C = \frac{1}{2\pi\sqrt{C_{R8} \times R_{C4} \times C_{R2} \times R_{C3}}}$$

$$Q = \frac{\sqrt{C_{R8} \times R_{C4} \times C_{R2} \times R_{C3}}}{R_{C4}\left(C_{R2} + C_{R8}\right)}$$

Capacitive Loads

Some applications require driving large capacitive loads. To improve the stability of the amplifier in such cases, either replace R6 with a suitable resistor value to improve amplifier phase margin in the presence of capacitive load C9, or apply a resistive load in parallel with C9.

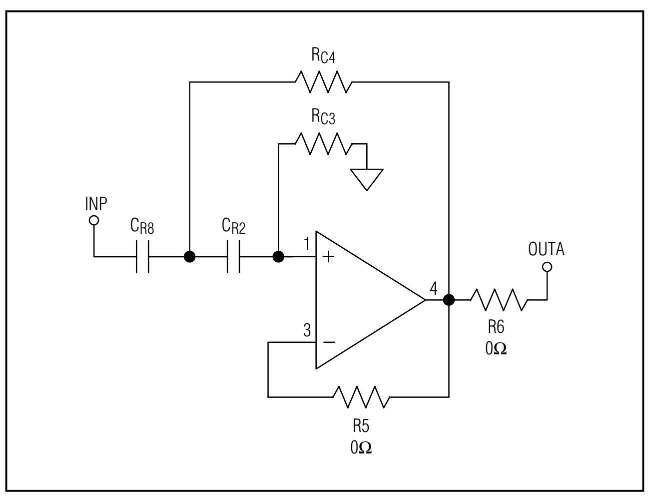

Figure 4. Generic 2nd-Order Highpass Sallen-Key Filter

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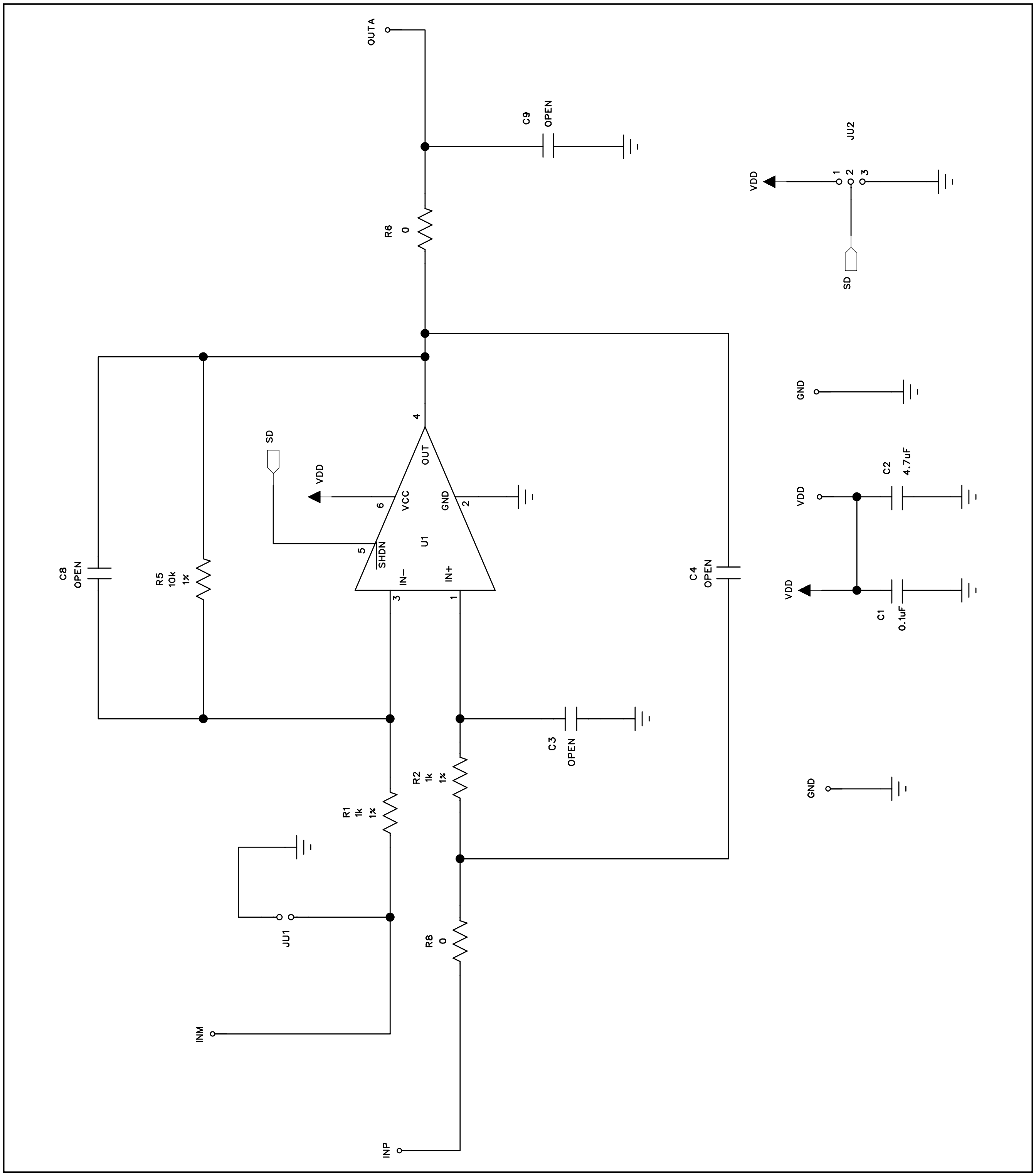

Figure 5. MAX9613 EV Kit Schematic

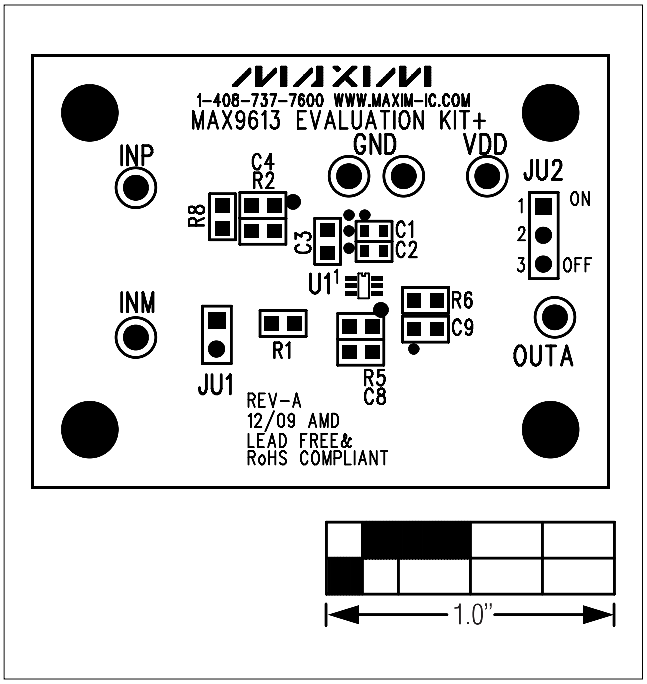

Figure 6. MAX9613 EV Kit Component Placement Guide—Component Side

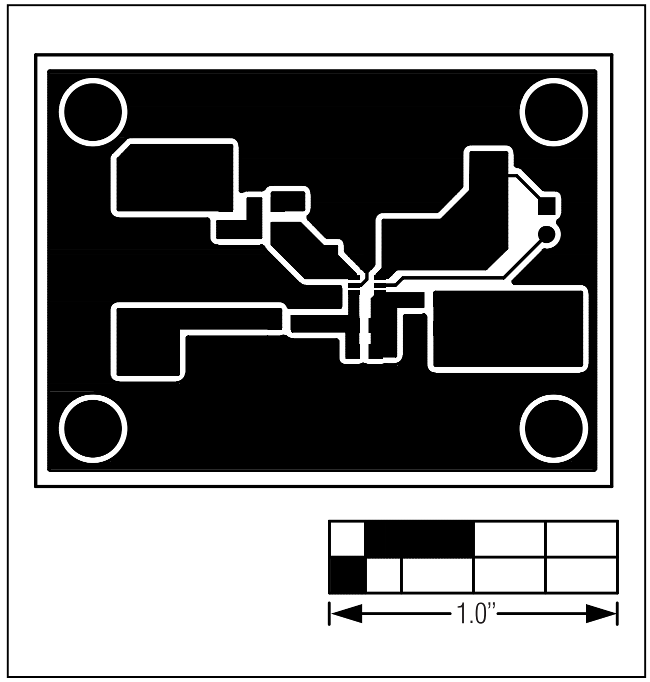

Figure 7. MAX9613 EV Kit PCB Layout—Component Side

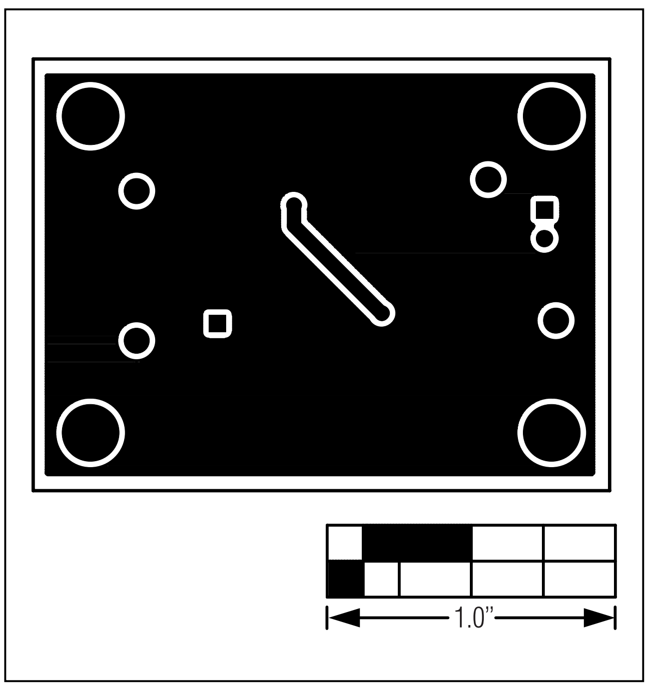

Figure 8. MAX9613 EV Kit PCB Layout—Solder Side>

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/10	Initial release	—

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Components Supply Platform

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