MAXIM

MAX9638 Evaluation Kit

Evaluates: MAX9638

General Description

The MAX9638 evaluation kit (EV kit) provides a proven design to evaluate the MAX9638 low-power, low-noise, CMOS input op amp, which is suitable for photodiode transimpedance front-ends in portable medical instruments. The EV kit circuit is preconfigured as a noninverting amplifier, but can easily be adapted to other topologies by changing a few components. The EV kit comes with a MAX9638AVB+ installed.

Features

♦ **Accommodates Noninverting and Differential Op-Amp Configurations**

♦ **Component Pads Allow for Lowpass and Highpass Sallen-Key Filter**

♦ **Proven PCB Layout**

♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX9638EVKIT+	EV Kit

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3	2	0.1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GCM188R71C104K
C2, C4	2	4.7µF ±10%, 16V X7R ceramic capacitors (0805) Murata GRM21BR71C475K
C5, C6, C10, C11, C12, C16	0	Not installed, ceramic capacitors—shorted by PCB trace (0603)
C7, C8, C9, C13, C14, C15	0	Not installed, ceramic capacitors (0603)
JU1–JU4	4	3-pin headers
R1, R2, R15, R16	4	1kΩ ±1% resistors (0603)

DESIGNATION	QTY	DESCRIPTION
R3, R4, R7, R9, R13, R14	0	Not installed, resistors (0603)
R5, R10	2	10kΩ ±1% resistors (0603)
R6, R8, R11, R12	4	0Ω ±5% resistors (0603)
TP1–TP8	8	Red test points
U1	1	Dual low-power, rail-to-rail I/O op amp (10 UTQFN) Maxim MAX9638AVB+
—	4	Shunts (JU1–JU4)
—	1	PCB: MAX9638 EVALUATION KIT+

Component Supplier

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

Note: *Indicate that you are using the MAX9638 when contacting this component supplier.*

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Quick Start

Required Equipment

- MAX9638 EV kit
- 3.3V DC power supply (e.g., Agilent E3620A)
- Precision voltage source
- Digital multimeter (DMM)

Procedure

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

1) Connect the positive terminal of the power supply to the VDD pad and the ground terminal to the nearest GND and VSS pads.

2) Connect the positive terminal of the precision voltage source to INAP (TP2). Connect the negative terminal of the precision voltage source to the GND pad.

3) Connect the INAM (TP1) to the GND pad.

4) Connect the DMM to monitor the voltage on OUTA (TP4). With the 10kΩ feedback resistor (R5) and 1kΩ series resistor (R1), the gain is 11 (noninverting configuration).

5) Turn on the 3.3V power supply.

6) Apply 100mV from the precision voltage source. Observe the output at OUTA on the DMM. OUTA should read approximately 1.1V.

7) Apply 200mV from the precision voltage source. OUTA should read approximately 2.2V.

Detailed Description of Hardware

The MAX9638 EV kit provides a proven design to evaluate the MAX9638 low-power, low-noise, CMOS input op amp, which is suitable for photodiode transimpedance front-ends in portable medical instruments. The EV kit circuit is preconfigured as a noninverting amplifier, but can easily be adapted to other topologies by changing a few components.

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. The gain is set by the ratio of R5 and R1 for op amp A and R10 and R15 for op amp B. The EV kit comes preconfigured for a gain of 11 on both op amps. The output voltage for the noninverting configuration is given by the equation below:

$$V_{OUTA} = (1 + \frac{R5}{R1})(V_{INAP} + V_{OS})$$

and

$$V_{OUTB} = (1 + \frac{R10}{R15})(V_{INBP} + V_{OS})$$

Table 1. Jumper Descriptions (JU1–JU4)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Connects $\overline{SHDNA}$ of the device to VDD to put U1-A (op amp A) in normal operation.
	2-3	Connects $\overline{SHDNA}$ of the device to VSS to put op amp A in shutdown mode.
JU2	1-2*	Connects $\overline{SHDNB}$ of the device to VDD to put U1-B (op amp B) in normal operation.
	2-3	Connects $\overline{SHDNB}$ of the device to VSS to put op amp B in shutdown mode.
JU3	1-2*	Connects INA+ to INAP (TP2) through R2 and R8.
	2-3	Connects INA+ to GND through R2 and R8.
JU4	1-2*	Connects INB+ to INBP (TP6) through R12 and R16.
	2-3	Connects INB+ to GND through R12 and R16.

Default position.

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Differential Amplifier

To configure the EV kit as a differential amplifier, replace R1, R2, R3, and R5 with appropriate resistors for op amp A and R9, R10, R15, and R16 for op amp B. When R1 = R2 and R5 = R3, and R10 = R9 and R15 = R16, the CMRR of the differential amplifiers is determined by the matching of the resistor ratios R1/R2 and R3/R5, and R9/R10 and R15/R16:

$$V_{OUTA} = GainA\,(V_{INAP} - V_{INAM})$$

where:

$$GainA = \frac{R5}{R1} = \frac{R3}{R2}$$

and

$$V_{OUTB} = GainB\,(V_{INBP} - V_{INBM})$$

where:

$$GainB = \frac{R10}{R15} = \frac{R9}{R16}$$

Sallen-Key Configuration

The Sallen-Key topology is ideal for filtering sensor signals with a 2nd-order filter and acting as a buffer. Schematic complexity is reduced by combining the filter and buffer operations. The EV kit can be configured in a Sallen-Key topology by replacing and populating a few components. The Sallen-Key topology is typically configured as a unity-gain buffer, which can be done by replacing R1 and R5 with 0Ω resistors for op amp A. The signal is noninverting and applied to INAP. The filter component pads are R2, R3, R4, and R8, where some have to be populated with resistors and others with capacitors. The same idea applies for op amp B; replace R10 and R15 with 0Ω resistors and the filter component pads are R9, R12, R14, and R16.

Lowpass Sallen-Key Filter

To configure the op amp A Sallen-Key as a lowpass filter, populate the R2 and R8 pads with resistors and populate the R3 and R4 pads with capacitors. The corner frequency and Q are then given by:

$$f_C = \frac{1}{2\pi\sqrt{R_{R2}R_{R8}C_{R3}C_{R4}}}$$

$$Q = \frac{\sqrt{R_{R2}R_{R8}C_{R3}C_{R4}}}{C_{R4}(R_{R2} + R_{R8})}$$

The same idea applies for op amp B by replacing R9, R12, R14, and R16 with the appropriate components.

Highpass Sallen-Key Filter

To configure the op amp A Sallen-Key as a highpass filter, populate the R3 and R4 pads with resistors and populate the R2 and R8 pads with capacitors. The corner frequency and Q are then given by:

$$f_C = \frac{1}{2\pi\sqrt{R_{R3}R_{R4}C_{R2}C_{R8}}}$$

$$Q = \frac{\sqrt{R_{R3}R_{R4}C_{R2}C_{R8}}}{R_{R3}(C_{R2} + C_{R8})}$$

The same idea applies for op amp B by replacing R9, R12, R14, and R16 with the appropriate components.

Capacitive Loads

Some applications require driving large capacitive loads. To improve the stability of the amplifiers in such cases, replace R6 and R11 with a suitable resistor value to improve amplifier phase margin.

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Figure 1. MAX9638 EV Kit Schematic
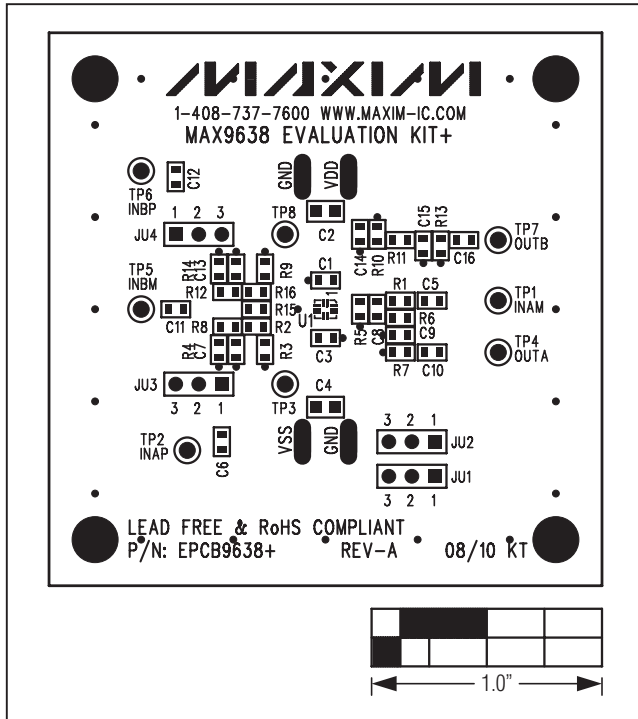
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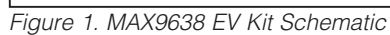
Figure 2. MAX9638 EV Kit Component Placement Guide—Component Side
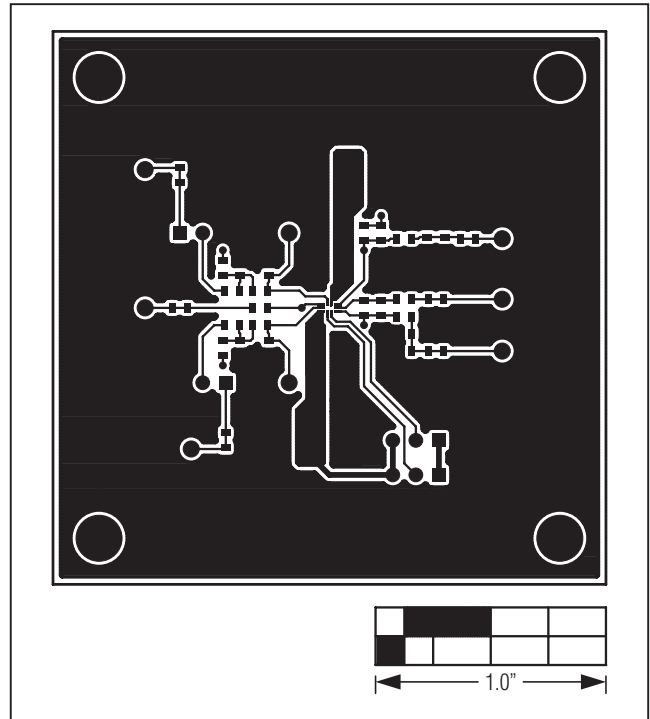

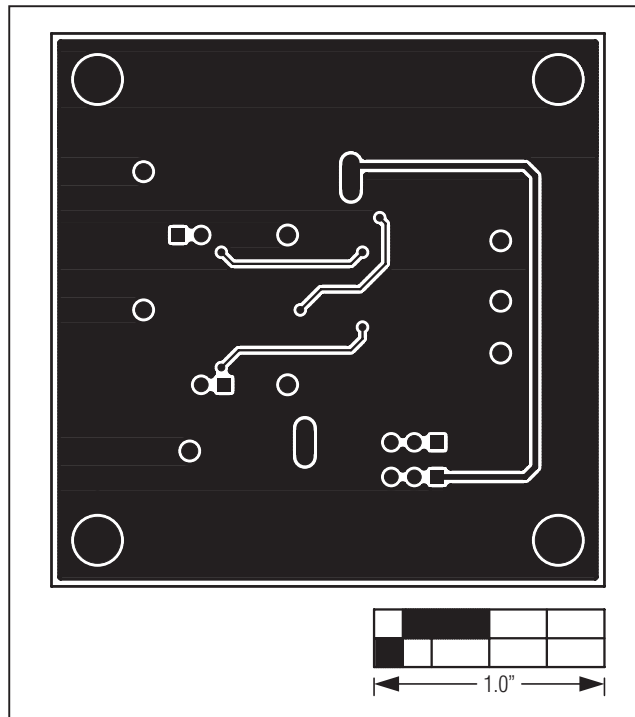Figure 3. MAX9638 EV Kit PCB Layout—Component Side

Figure 4. MAX9638 EV Kit PCB Layout—Solder Side

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/10	Initial release	—

Mouser Electronics

Authorized Distributor

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