## General Description

The MAX44250 evaluation kit (EV kit) provides a proven design to evaluate the MAX44250 low-power, low-drift operational amplifier (op amp) in a 5-pin SOT23 package. The EV kit circuit is preconfigured as noninverting amplifiers, but can be adapted to other topologies by changing a few components. Low power, low-drift input offset voltage, and rail-to-rail input/output stages make this device ideal for applications requiring ultra-low noise and DC precision. The component pads accommodate 0805 packages, making them easy to solder and replace. The EV kit comes with a MAX44250AUK+ installed.

## Features

- Accommodates Multiple Op-Amp Configurations
- Rail-to-Rail Inputs/Output
- Accommodates Easy-to-Use 0805 Components
- Proven PCB Layout
- Fully Assembled and Tested

***Ordering Information* appears at end of data sheet.**

## Quick Start

### Required Equipment

- MAX44250 EV kit
- +5V, 10mA DC power supply (PS1)
- Precision voltage source
- Digital voltmeter (DVM)

### Procedure

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

1) Verify that the jumpers are in their default positions, as shown in Table 1.
2) Connect the positive terminal of the +5V supply to VDD and the negative terminal to GND and VSS.
3) Connect the positive terminal of the precision voltage source to INP. Connect the negative terminal of the precision voltage source to GND.
4) Connect INM to GND.
5) Connect the DMM to monitor the voltage on OUT. With the 10kΩ feedback resistors and 1kΩ series resistors, the gain of each noninverting amplifier is +11.
6) Turn on the +5V power supply.
7) Apply 100mV from the precision voltage source. Observe the output at OUT on the DMM. OUT should read approximately +1.1V.
8) Apply 400mV from the precision voltage source. OUT should read approximately +4.4V.

## Table 1. Jumper Descriptions (JU1, JU2, JU5)

| JUMPER | SHUNT POSITION | DESCRIPTION |
|---|---|---|
| JU1 | Installed | Connects INM to GND for noninverting configuration. |
| | Open* | INM is not connected to GND. |
| JU2 | Installed | Connects INP to GND for inverting configuration. |
| | Open* | INP is not connected to GND. |
| JU5 | Installed* | Connects VSS to GND for single-supply operation. |
| | Open | VSS and GND are independently supplied for dual-supply operation. |

**Default position.*



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## Detailed Description of Hardware

The MAX44250 EV kit provides a proven layout for the MAX44250 low-power, low-drift single op amp. The IC is an ultra-high-precision op amp with a high (20V) supply voltage range designed for load cell, medical instrumentation, and precision instrumentation applications. Various test points are included for easy evaluation.

The IC is a single-supply single op amp whose primary application is operating in the noninverting configuration; however, the IC can operate with a dual supply as long as the voltage across the VDD and GND pins of the IC do not exceed the *Absolute Maximum Ratings*. When operating with a single supply, short VSS to GND.

### Op-Amp Configurations

The IC is a single-supply single op amp 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. The EV kit comes preconfigured for a gain of +11. The output voltage for the noninverting configuration is given by the equation below:

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

#### Differential Amplifier

To configure the EV kit as a differential amplifier, replace R1–R3, and R5 with appropriate resistors. When R1 = R2 and R3 = R5, the CMRR of the differential amplifier is determined by the matching of the resistor ratios R1/R2 and R3/R5.

$$V_{OUTA} = GAIN (V_{INAP} - V_{INAM})$$

where:

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

#### Sallen-Key Filter Configuration

The Sallen-Key filter topology is ideal for filtering sensor signals with a second-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. The noninverting signal is applied to the INP test point. The filter component pads are R2–R4, and R8, where some have to be populated with resistors and others with capacitors.

#### Lowpass Sallen-Key Filter

To configure the 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:

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

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

#### Highpass Sallen-Key Filter

To configure the 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:

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

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

#### Transimpedance Application

To configure op-amp U1-A as a transimpedance amplifier (TIA), replace R1 with a 0Ω resistor and install a shunt on jumper JU2. The output voltage of the TIA is the input current multiplied by the feedback resistor:

$$V_{OUT} = (I_{IN} + I_{BIAS}) \times R4 + V_{OS}$$

where R4 is installed as a 10kΩ resistor, $I_{IN}$ is defined as the input current source applied at the INAM PCB pad, $I_{BIAS}$ is the input bias current, and $V_{OS}$ is the input offset voltage of the op amp. Use capacitor C7 (and C3, if applicable) to stabilize the op amp by rolling off high-frequency gain due to a large cable capacitance.

#### Capacitive Loads

Some applications require driving large capacitive loads. To improve the stability of the amplifier, replace R6 with a suitable resistor value to improve amplifier phase margin. The R6/C8 filter can also be used as an anti-alias filter, or to limit amplifier output noise by reducing its output bandwidth.

## Component List

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C1, C17 | 2 | 0.1µF ±10%, 25V X7R ceramic capacitors (0805) Murata GRM21BR71E104K |
| C2, C18 | 2 | 4.7µF ±10%, 25V X5R ceramic capacitors (0805) Murata GRM21BR61E475K |
| C3–C9 | 0 | Not installed, ceramic capacitors (0805) C4, C5, C9 are short (PC trace); C3, C6–C8 are open |
| JU1, JU2, JU5 | 3 | 2-pin headers, 0.1in centers |
| INM, INP, OUT | 3 | 50Ω PCB vertical-mount BNC connectors |

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| INMA, INPA, OUTA, TP1 | 0 | Not installed, miniature test points |
| R1, R2 | 2 | 1kΩ ±1% resistors (0805) |
| R3, R4, R7 | 0 | Not installed, resistors (0805) |
| R5 | 1 | 10kΩ ±1% resistor (0805) |
| R6, R8 | 2 | 0Ω ±5% resistors (0805) |
| U1 | 1 | Low-power, rail-to-rail I/O op amp (5 SOT23) Maxim MAX44250AUK+ (Top Mark: AFMA) |
| — | 3 | Shunts |
| — | 1 | PCB: MAX44250 EVALUATION KIT |

## Component Supplier

| SUPPLIER | PHONE | WEBSITE |
|---|---|---|
| Murata Americas | 770-436-1300 | www.murataamericas.com |

***Note:*** *Indicate that you are using the MAX44250 when contacting this component supplier.*

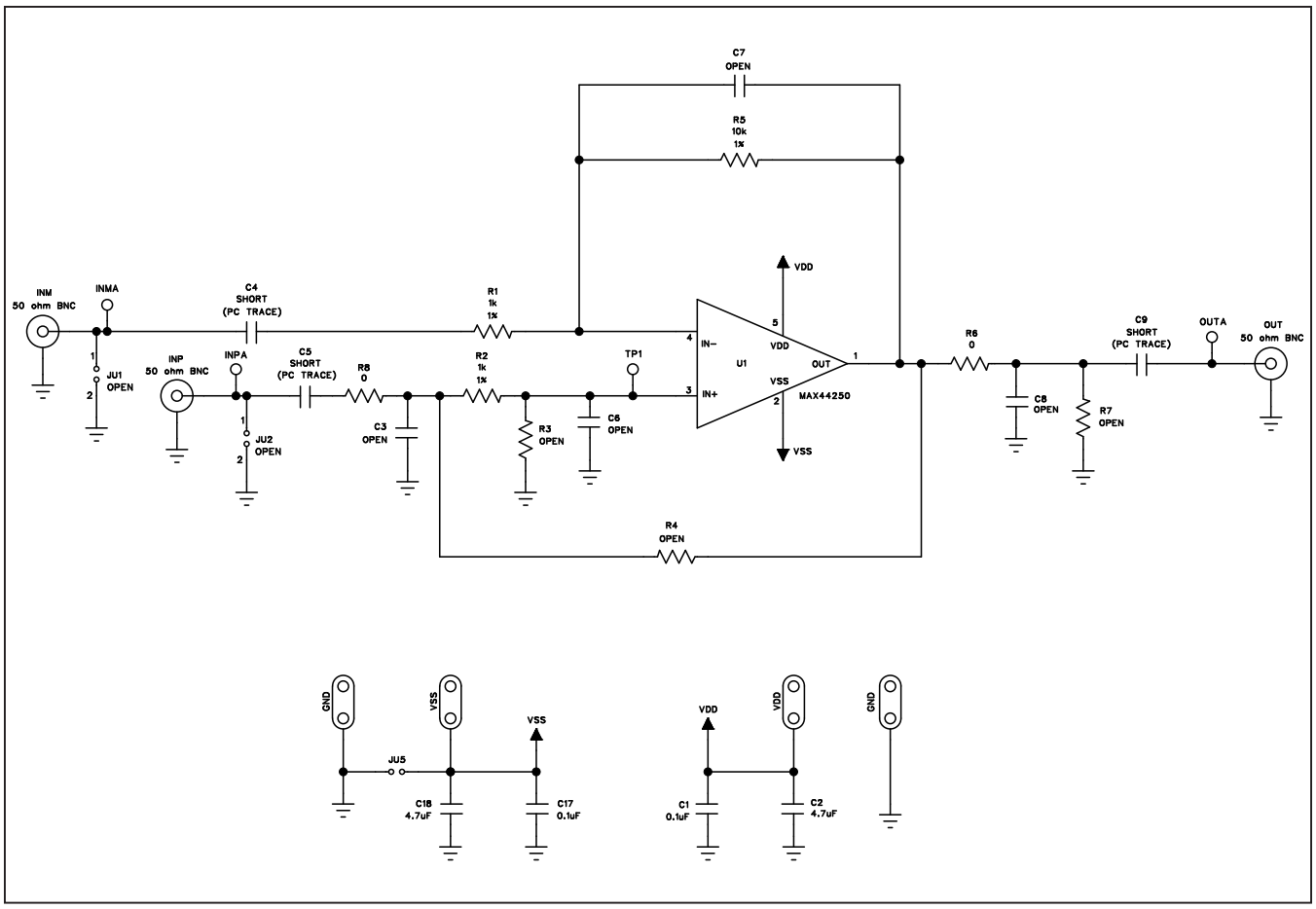


*Figure 1. MAX44250 EV Kit Schematic*

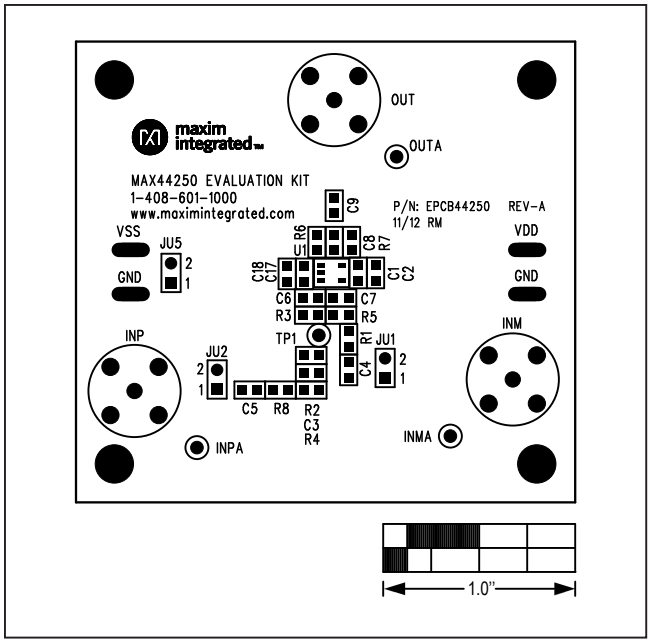


*Figure 2. MAX44250 EV Kit Component Placement Guide—Component Side*

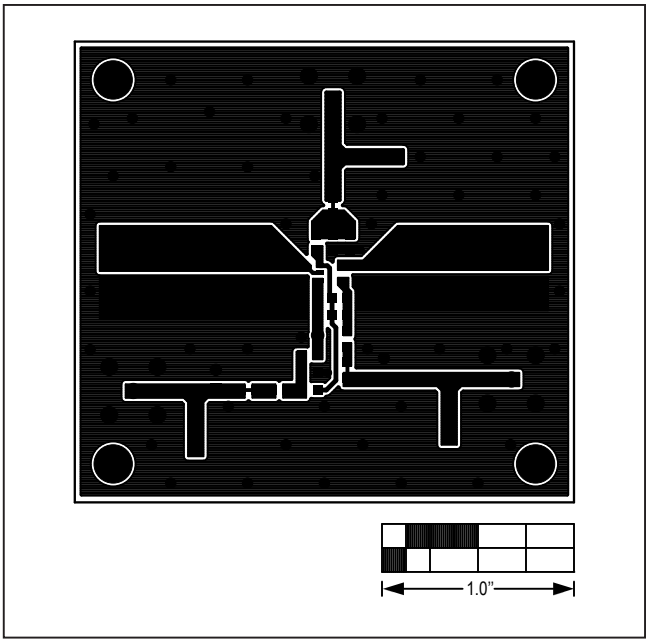


*Figure 3. MAX44250 EV Kit PCB Layout—Component Side*

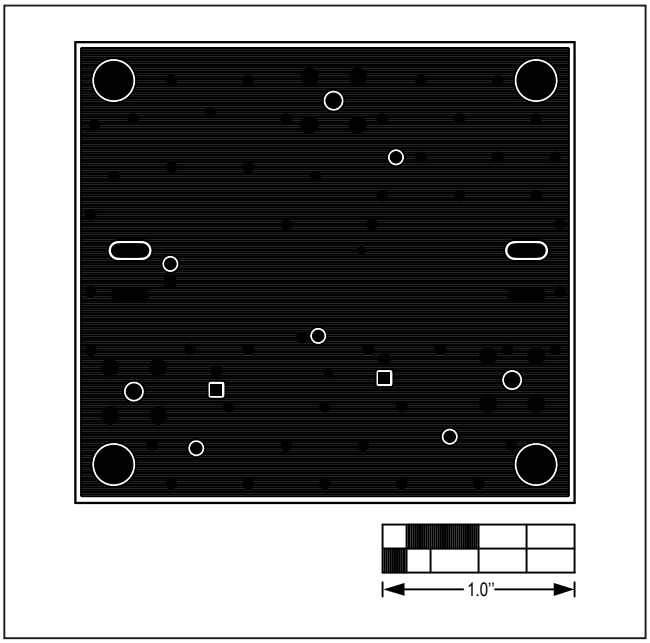


*Figure 4. MAX44250 EV Kit PCB Layout—Solder Side*

## Ordering Information

| PART | TYPE |
|---|---|
| MAX44250EVKIT# | EV Kit |

*#Denotes RoHS compliant.*

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 12/13 | Initial release | — |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.

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