19-4656; Rev 1; 8/09

MAX9945 Evaluation Kit

Evaluates: MAX9945

General Description

The MAX9945 evaluation kit (EV kit) provides a proven design to evaluate the MAX9945 low-noise, MOS-input, low-power op amp in an 8-pin µMAX® package. Various test points are provided for easy evaluation. The EV kit circuit is preconfigured as a transimpedance amplifier (TIA), but can easily be adapted to act as a noninverting, inverting, or differential amplifier by changing a few components. MOS-input bias currents, low input-voltage noise, and rail-to-rail output stage make this device ideal for photodiode transimpedance amplifiers, piezo buffers, and audio line out applications. The components have pads that accommodate 0805 packages, making them easy to solder and replace. The MAX9945 EV kit PCB comes with a MAX9945AUA+ installed. Note that the MAX9945 is also available in a 3mm x 3mm TDFN package.

Features

- **Accommodates Multiple Op-Amp Configurations**
- **Wide Input Supply Range**
- **0805 Components**
- **Lead(Pb)-Free and RoHS Compliant**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX9945EVKIT+	EV Kit

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

Component List

DESIGNATION	Qty	DESCRIPTION
C1, C3	2	0.1µF ±10%, 50V X7R ceramic capacitors (0805) TDK C2012X7R1H104K
C2, C4	2	4.7µF ±10%, 25V X5R ceramic capacitors (0805) Murata GRM21BR6E475K
C5, C6, C7	0	Not installed, ceramic capacitors (0805)
D1, D2	2	Not installed, pico-amp diodes Linear Integrated Systems SSTPAD (provided with the EV kit)

DESIGNATION	Qty	DESCRIPTION
R1, R2, R3, R5	4	0Ω ±5% resistors (0805)
R4	1	100kΩ ±1% resistor (0805)
TP1, TP2, TP5, TP6, TP7	5	Red multipurpose test points
TP3, TP4	2	Black multipurpose test points
U1	1	38V, low-noise, MOS-input op amp (8 µMAX) Maxim MAX9945AUA+
—	1	PCB: MAX9945 EVALUATION KIT+

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX9945 when contacting these component suppliers.*

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Quick Start

Required Equipment

- MAX9945 EV kit
- ±15V, 10mA DC power supply (PS1)
- +1V precision voltage source
- External 10kΩ and 20kΩ resistors
- Digital multimeter (DMM)

Procedure

The MAX9945 EV kit is fully assembled and tested. Follow the steps below to verify board operation:

1) Connect the positive terminal of the +15V supply to VCC (TP1) and the GND terminal to GND (TP4). Connect the negative terminal of the -15V supply to VEE (TP2) and the GND terminal to GND (TP3). The power supply should be off.
2) Connect the positive terminal of the precision voltage source to INM (TP5) through an external 10kΩ series resistor. Connect the negative terminal of the precision voltage source to INP (TP6). TP6 is shorted to the board GND through an on-board 0Ω resistor.
3) With the 100kΩ feedback resistor and external 10kΩ series resistor, the gain is -10 (inverting configuration). Connect the DMM to monitor the voltage on OUTA (TP7).
4) Turn on the ±15V power supply.
5) Apply 100mV from the precision voltage source. Observe the output at OUTA (TP7) on the DMM. OUTA should read approximately -1V.
6) Replace the external 10kΩ resistor with a 20kΩ resistor. The gain is now -5. OUTA should read approximately -500mV.

Detailed Description of Hardware

The MAX9945 EV kit provides a proven layout for the MAX9945 low-noise op amp. The MAX9945 accepts a single-supply voltage from +4.75V to +38V or dual supply from ±2.4V to ±19V. The IN+ trace completely wraps the IN- trace for shielding against parasitic leakage. Optional low-leakage pico-amp diodes are included on the EV kit, but not installed. Various test points are included for easy evaluation.

Op-Amp Configurations

Transimpedance Application

The MAX9945 EV kit comes preconfigured as a transimpedance amplifier (TIA) to interface to a photodiode. MOS inputs on the MAX9945 ensure extremely low input bias currents (50fA typ) that channel nearly all of the photodiode output current into the feedback resistor (R4). The output voltage of the TIA is the photodiode current multiplied by the feedback resistor:

$$V_{OUT} = I_{PD} \times R4 + V_{OS}$$

where R4 comes installed as a 100kΩ resistor, IPD is defined as photodiode current, and V_{OS} is the input offset voltage of the op amp.

When the photodiode is located at a distance from the op amp (e.g., at the end of a cable), it is sometimes advantageous to place the photodiode between the IN+ and IN- terminals of the op amp, instead of referencing it to GND. For good common-mode noise rejection in this scenario, replace R1 with a 100kΩ resistor as well. The output voltage is then given by the following equation:

$$V_{OUT} = I_{PD} \times (R1 + R4) + V_{OS}$$

Use capacitor C6 (and C5, if applicable) to stabilize the op amp by rolling off high-frequency gain due to a large photodiode capacitance or cable capacitance.

Inverting Configuration

To configure the MAX9945 EV kit as an inverting amplifier, replace R2 with the desired 1% gain-setting resistor and feed a voltage V_{IN} between TP5 and GND. The output voltage is given by the following equation:

$$V_{OUT} = \frac{R4}{R2} \times (V_{IN} + V_{OS})$$

The offset voltage V_{OS} can be either positive or negative.

Differential Amplifier

To configure the MAX9945 EV kit as a differential amplifier, replace R1–R4 with appropriate resistors. Make sure R1 = R4 and R2 = R3. The resulting output voltage and gain are shown in the equations below. The CMRR of the differential amplifier will be determined by the matching of the resistor ratios R4/R2 and R1/R3:

$$V_{OUT} = Gain \times (INP - INN)$$

where

$$Gain = \frac{R4}{R2} = \frac{R1}{R3}$$

Differential Pico-Amp Protection Diodes

The PCB layout provides pads on the bottom of the PCB for two back-to-back pico-amp diodes that can be used for differential-voltage protection of the op amp, if necessary. These low-leakage diodes ensure that the extremely low bias currents of the MAX9945 are not seriously degraded. The pico-amp diodes are not installed on the EV kit board.

Capacitive Loads

Some applications require driving large capacitive loads. To improve the stability of the amplifier in such cases, replace R5 with a suitable resistor value to improve amplifier phase margin. The R5/C7 filter can also be used as an anti-alias filter or to limit amplifier output noise by reducing its output bandwidth.

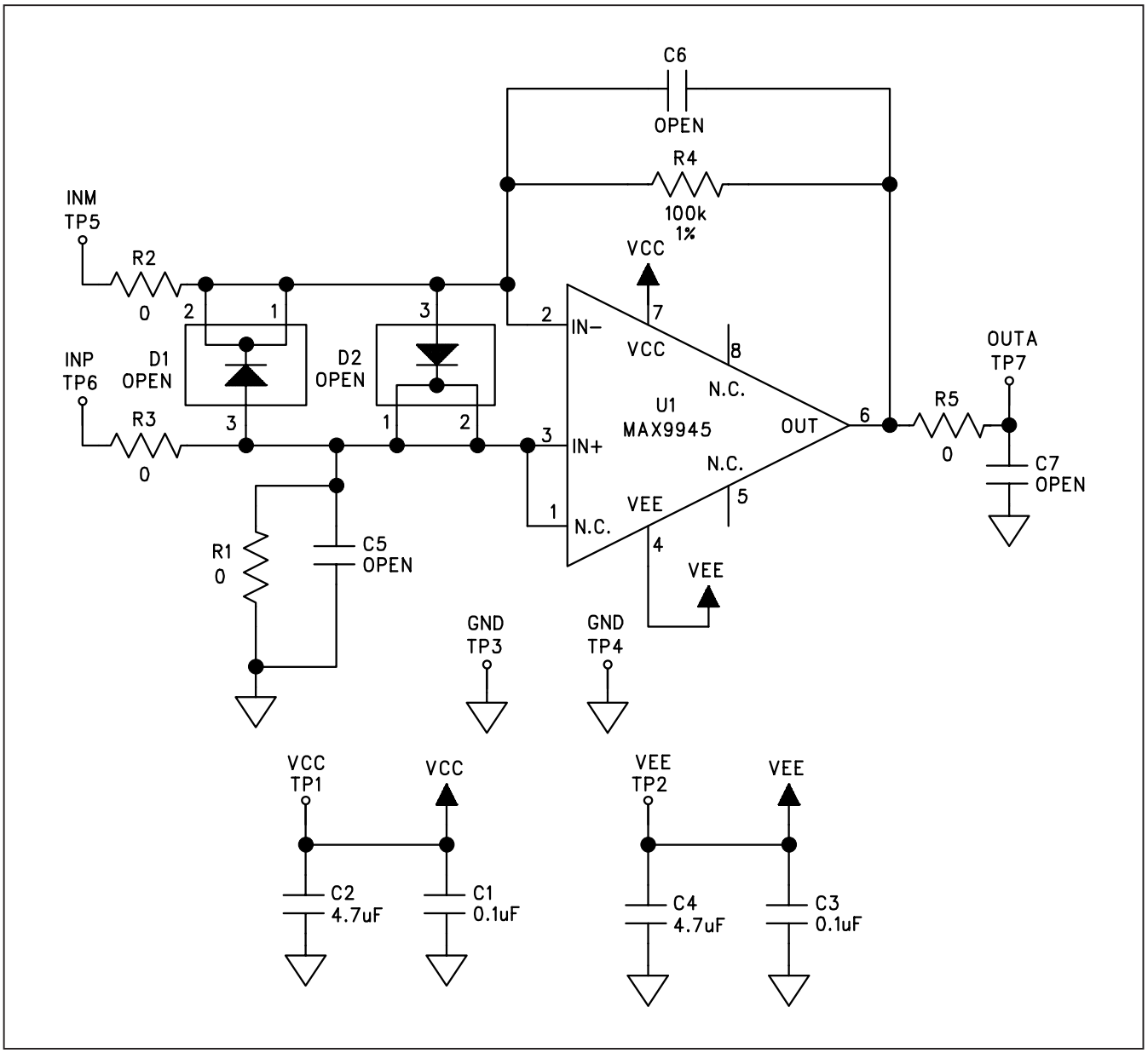

Figure 1. MAX9945 EV Kit Schematic

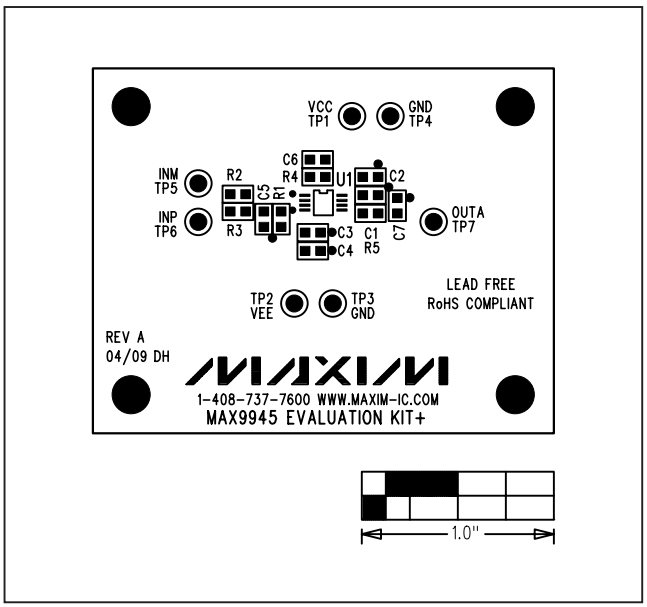

Figure 2. MAX9945 EV Kit Component Placement Guide—Component Side

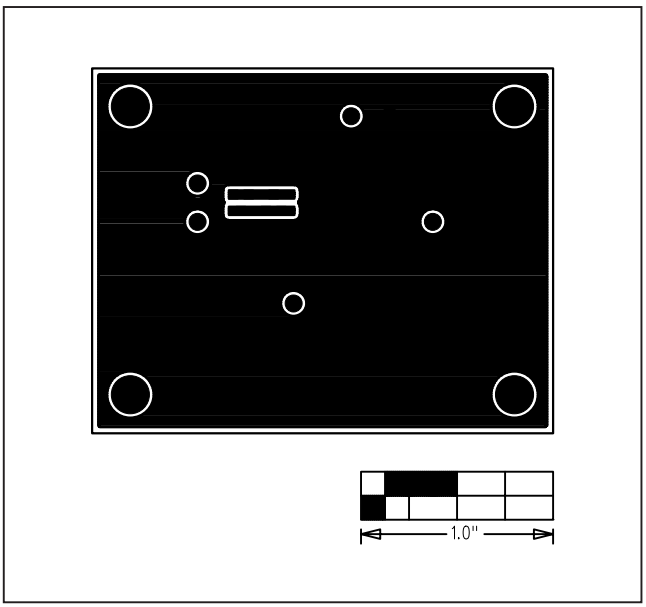

Figure 4. MAX9945 EV Kit PCB Layout—Solder Side

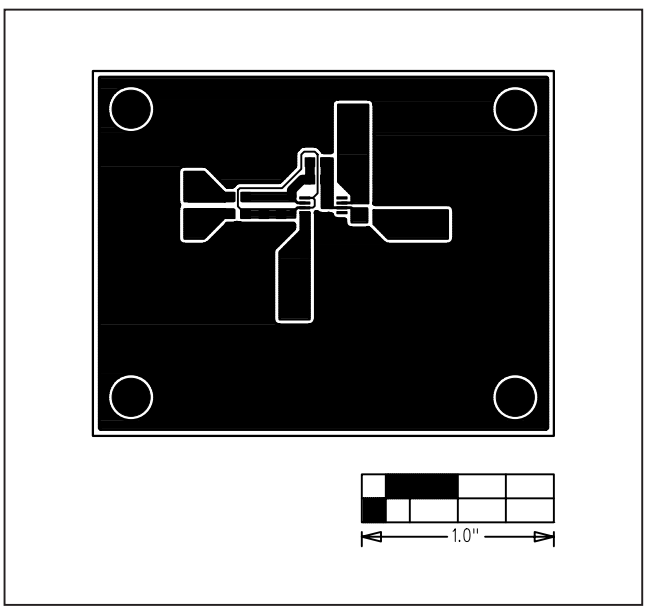

Figure 3. MAX9945 EV Kit PCB Layout—Component Side

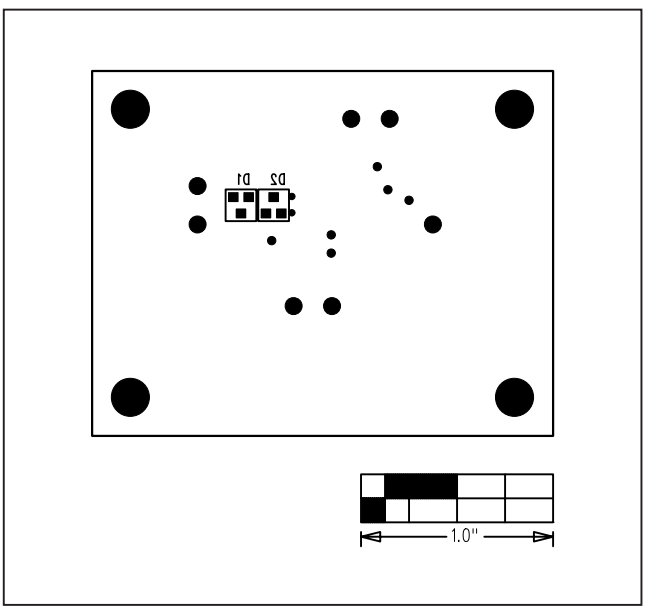

Figure 5. MAX9945 EV Kit Component Placement Guide—Solder Side

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/09	Initial release	—
1	8/09	Added diode part number in *Component List*	1