

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

### General Description

The MAX44264 evaluation kit (EV kit) is a fully assembled and tested circuit board that contains all the components necessary to evaluate the MAX44264 IC, offered in a space-saving 0.9mm x 1.3mm, 6-bump wafer-level package (WLP). The device is a rail-to-rail micropower op amp, drawing only 750nA of supply current. The EV kit operates from a single 1.8V to 5.5V DC power supply.

### Features

- ◆ 1.8V to 5.5V Single-Supply Operation
- ◆ Jumper Selectable for Inverting, Noninverting, Differential, and Buffer Op-Amp Configurations
- ◆ Demonstrates Super-Capacitor Charge Balancing Using the Op-Amp Buffer Configuration
- ◆ Evaluates the Device in a 6-Bump WLP
- ◆ Proven PCB Layout
- ◆ Fully Assembled and Tested

*Ordering Information appears at end of data sheet.*

### Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	0.22F -20% to +80%, 3.3V super capacitors (6.8mm)
C3	1	1 $\mu$ F $\pm$ 10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J105K
C4	1	0.1 $\mu$ F $\pm$ 10%, 16V X5R ceramic capacitor (0603) Murata GRM188R61C104K
C5	1	0.01 $\mu$ F $\pm$ 10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C103K
C6	0	Not installed, ceramic capacitor (0603)
JU1, JU3	2	2-pin headers

DESIGNATION	QTY	DESCRIPTION
JU2	1	3-pin header
R1, R6	0	Not installed, resistors (0603) R1 is short (PC trace) and R6 is open
R2	1	0 $\Omega$ $\pm$ 5% resistor (0603)
R3, R4	2	2M $\Omega$ $\pm$ 5% resistors (0603)
R5	1	10 $\Omega$ $\pm$ 5% resistor (0603)
U1	1	Rail-to-rail op amp (6 WLP) Maxim MAX44264EWT+ (Top Mark: +CB)
—	3	Shunts (JU1, JU2, JU3)
—	1	PCB: MAX44264 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 MAX44264 when contacting this component supplier.

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

### Quick Start

#### Required Equipment

- MAX44264 EV kit
- 1.8V to 5.5V, 100mA DC power supply
- Voltmeter

#### Procedure

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

- 1) To configure the EV kit as an op-amp buffer to balance super capacitors C1 and C2 charge, set jumpers JU1, JU2, and JU3 in their default positions, as shown in Table 1.
- 2) Set the power supply to provide 5V and then disable the power supply.
- 3) Connect the power-supply positive terminal to the VDD PCB pad.
- 4) Connect the power-supply ground to the GND PCB pad (nearest the VDD PCB pad).
- 5) Enable the power supply.
- 6) Verify that the OUT PCB pad is at 2.5V.

#### Detailed Description of Hardware

The MAX44264 EV kit contains the MAX44264 IC, which is a rail-to-rail micropower op amp with an ultra-low 750nA supply current designed in a 6-bump WLP. The EV kit operates from a single 1.8V to 5.5V DC power supply.

**Table 1. Default Shunt Positions**

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	Not installed	IN- = OUT (through resistor R2)
JU2	2-3	IN+ = VDD/2
JU3	Installed	

#### Default Application Circuit

The EV kit comes preconfigured as a buffer used in a super-capacitor charge-balancing circuit. Super capacitors offer exceptional charge storage density and are widely used to prolong the life of weak batteries subject to high current-load pulses, or to buffer a weak energy source to a high-power load in energy-harvesting devices. In such applications, it is common to have a stack of super capacitors connected in series to achieve the desired working voltage. The EV kit demonstrates an active, super-capacitor charge-balancing circuit that distributes the charge equally across two series-connected super capacitors (C1 and C2), ensuring identical voltage across each capacitor. This circuit prevents overvoltage conditions from occurring across either of the super capacitors due to a difference in leakage currents and tolerance in the capacitor values. The IC's ultra-low power consumption of 750nA and CMOS inputs allow a power-efficient solution to the super-capacitor charge-balancing problem.

#### Op-Amp Configurations

While super-capacitor charge balancing is the featured application, the EV kit also provides flexibility to easily reconfigure the op amp into any of the four common circuit topologies: inverting amplifier, noninverting amplifier, differential amplifier, or buffer. Table 2 lists the JU1, JU2, and JU3 jumper settings for the various op-amp configurations. The configurations are described in the next few sections.

**Important Note:** Remove super capacitors C1 and C2 when not demonstrating super-capacitor charge balancing in the four configurations detailed in the *Noninverting Amplifier*, *Inverting Amplifier*, *Differential Amplifier*, and *Buffer Amplifier* sections.

**Table 2. JU1, JU2, JU3 Jumper Functions (IN-, IN+, REF)**

OP-AMP CONFIGURATION	SHUNT POSITION		
	JU1	JU2	JU3
Inverting	Installed	1-2	Not installed
Differential			
Noninverting			
Buffer	Not installed		
Super-capacitor buffer	Not installed	2-3	Installed

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

### **Noninverting Amplifier**

To configure the device as a noninverting amplifier, replace R2 and R6 with suitable resistors. Replace R3 with a short and remove C5 (follow the jumper settings listed in Table 2). The output voltage ( $V_{OUT}$ ) for the noninverting configuration is given by the following equation:

$$V_{OUT} = \left(1 + \frac{R2}{R6}\right)(V_{IN+} + V_{OS})$$

where:

$V_{OS}$  = Input-referred offset voltage.

$V_{IN+}$  = Input voltage applied at the IN+ PCB pad.

### **Inverting Amplifier**

To configure the device as an inverting amplifier, cut open the shorted PCB trace on R1. Replace R3 with a short and remove C5. Replace R1 and R2 with suitable gain resistors (follow the jumper settings listed in Table 2). An appropriate DC voltage ( $V_{DC}$ ) should be applied to the IN+ PCB pad to level shift the output voltage of the op amp if the applied input voltage ( $V_{IN-}$ ) at the IN- PCB pad is positive:

$$V_{OUT} = -\frac{R2}{R1} V_{IN-} + \left(1 + \frac{R2}{R1}\right)(V_{OS} + V_{DC})$$

### **Differential Amplifier**

To configure the device as a differential amplifier, cut open the shorting PCB trace on R1. Replace R1–R4 with appropriate resistors. Remove C5 (follow the jumper settings listed in Table 2). Apply a reference voltage ( $V_{REF}$ ) to the REF PCB pad to level shift the output voltage of the op amp, if required. When  $R1 = R3$  and  $R2 = R4$ , the CMRR of the differential amplifier is determined by the matching of ratios  $R1/R2$  and  $R3/R4$ :

$$V_{OUT} = \text{GAIN}(V_{IN+} - V_{IN-}) + \left(1 + \frac{R2}{R1}\right)V_{OS} + V_{REF}$$

where:

$$\text{GAIN} = \frac{R2}{R1} = \frac{R4}{R3}$$

### **Buffer Amplifier**

To configure the device as a standard unity-gain buffer, replace R3 with a short and remove C5:

$$V_{OUT} = V_{IN+} + V_{OS}$$

**Important Note:** Remove super capacitors C1 and C2 when not demonstrating super-capacitor charge balancing for the four configurations just listed.

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

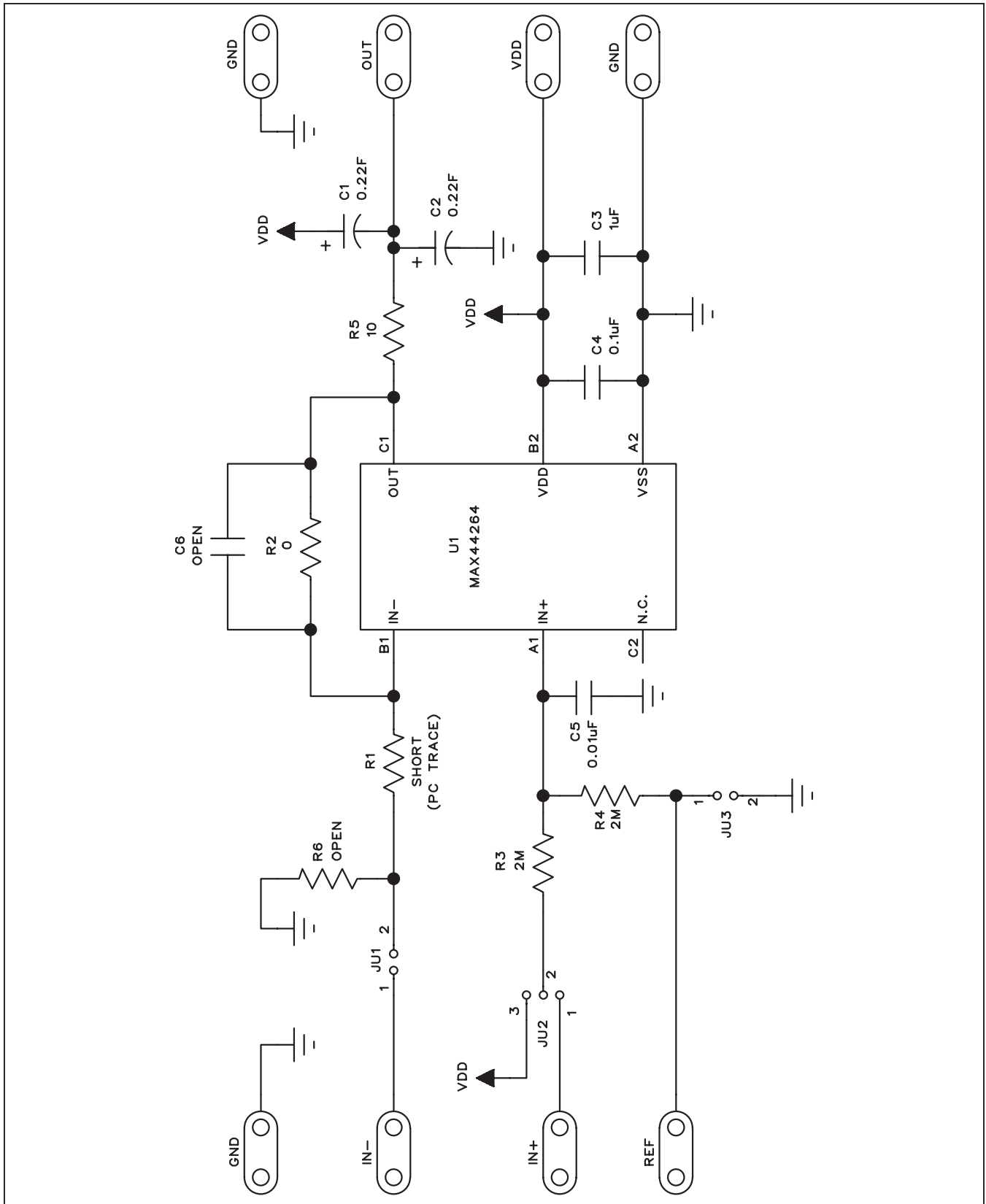


Figure 1. MAX44264 EV Kit Schematic

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

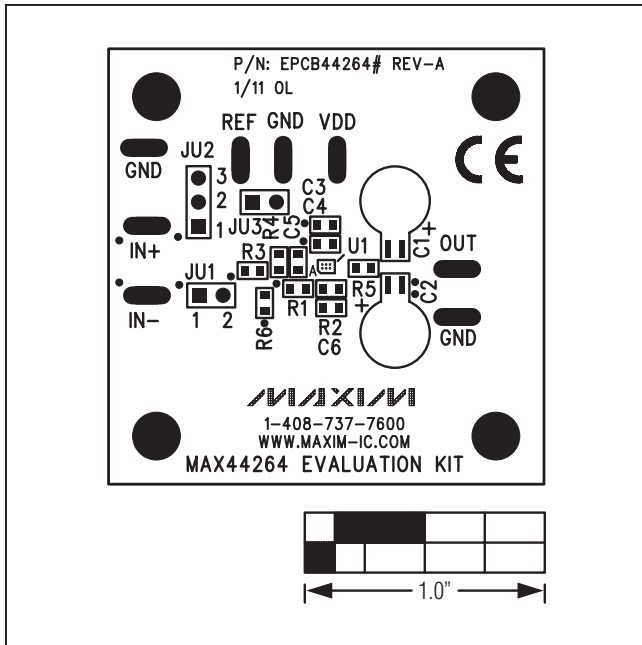


Figure 2. MAX44264 EV Kit Component Placement Guide—Component Guide

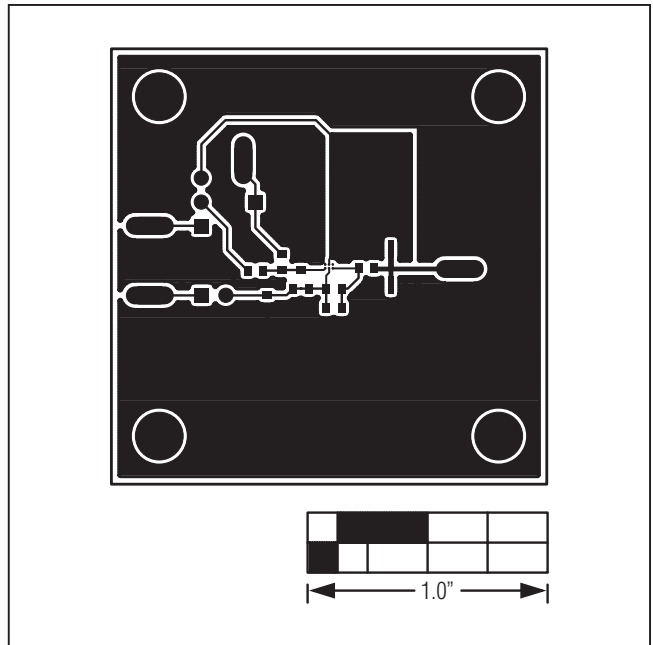


Figure 3. MAX44264 EV Kit PCB Layout—Component Side

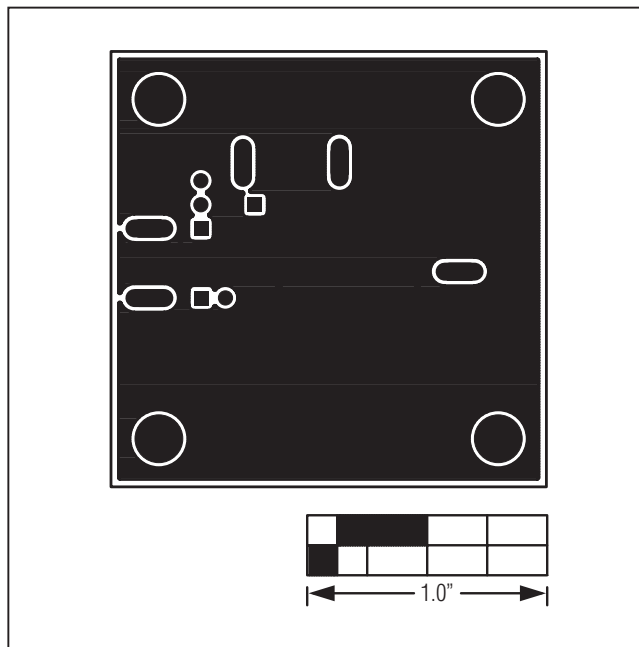


Figure 4. MAX44264 EV Kit PCB Layout—Solder Side

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

### **Ordering Information**

---

PART	TYPE
MAX44264EVKIT#	EV Kit

#Denotes RoHS compliant.

# MAX44264 Evaluation Kit

## Evaluates: MAX44264

### Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/11	Initial release	—

*Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.*

**Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600 \_\_\_\_\_ 7**

© 2011 Maxim Integrated Products

Maxim is a registered trademark of Maxim Integrated Products, Inc.