



MAX4470 Evaluation Kit

Evaluates: MAX4470

General Description

The MAX4470 evaluation kit (EV kit) is a fully assembled and tested circuit board that contains all the components necessary to evaluate the MAX4470 IC, offered in a space-saving 1.27mm x 0.86mm WLP package. 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 Configuration
- ◆ Demonstrates Super-Capacitor Charge Balancing Using Op-Amp Buffer Configuration
- ◆ Evaluates the Device in a 6-Bump Wafer-Level Package (WLP)
- ◆ Fully Assembled and Tested

Ordering Information

PART	TYPE
MAX4470EVKIT+	EV Kit

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

Component List

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

DESIGNATION	QTY	DESCRIPTION
JU1, JU3	2	2-pin headers
JU2	1	3-pin header
R1, R6	0	Not installed, resistors (0603) R1 is short (PC trace) and R6 is open
R2	1	0 Ω \pm 5% resistor (0603)
R3, R4	2	2M Ω \pm 5% resistors (0603)
R5	1	10 Ω \pm 5% resistor (0603)
U1	1	Rail-to-rail op amp (6 WLP) Maxim MAX4470EWT+ (Top Mark: +BP)
—	3	Shunts (JU1, JU2, JU3)
—	1	PCB: MAX4470 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 MAX4470 when contacting this component supplier.



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Quick Start

Required Equipment

- MAX4470 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) Set jumpers JU1, JU2, and JU3, as shown in Table 1, to configure the EV kit as an op-amp buffer to balance super capacitors C1 and C2 charge.
- 2) Set the power supply to provide 5V, 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 (near the VDD PCB pad).
- 5) Enable the power supply.
- 6) Verify that the OUT PCB pad is at 2.5V.

Table 1. Default Shunt Positions

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

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	Not installed		
Buffer			
Super-capacitor buffer	Not installed	2-3	Installed

Detailed Description of Hardware

The MAX4470 EV kit contains the MAX4470 IC, which is a rail-to-rail micropower op amp with an ultra-low 750nA supply current designed in a 6-bump WLP package. The EV kit operates from a single 1.8V to 5.5V DC power supply.

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.

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Important Note: Remove super capacitors C1 and C2 when not demonstrating super-capacitor charge balancing in the following four configurations.

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 non-inverting 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}) may have to 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- 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:

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

where:

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

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 in all four configurations just listed.

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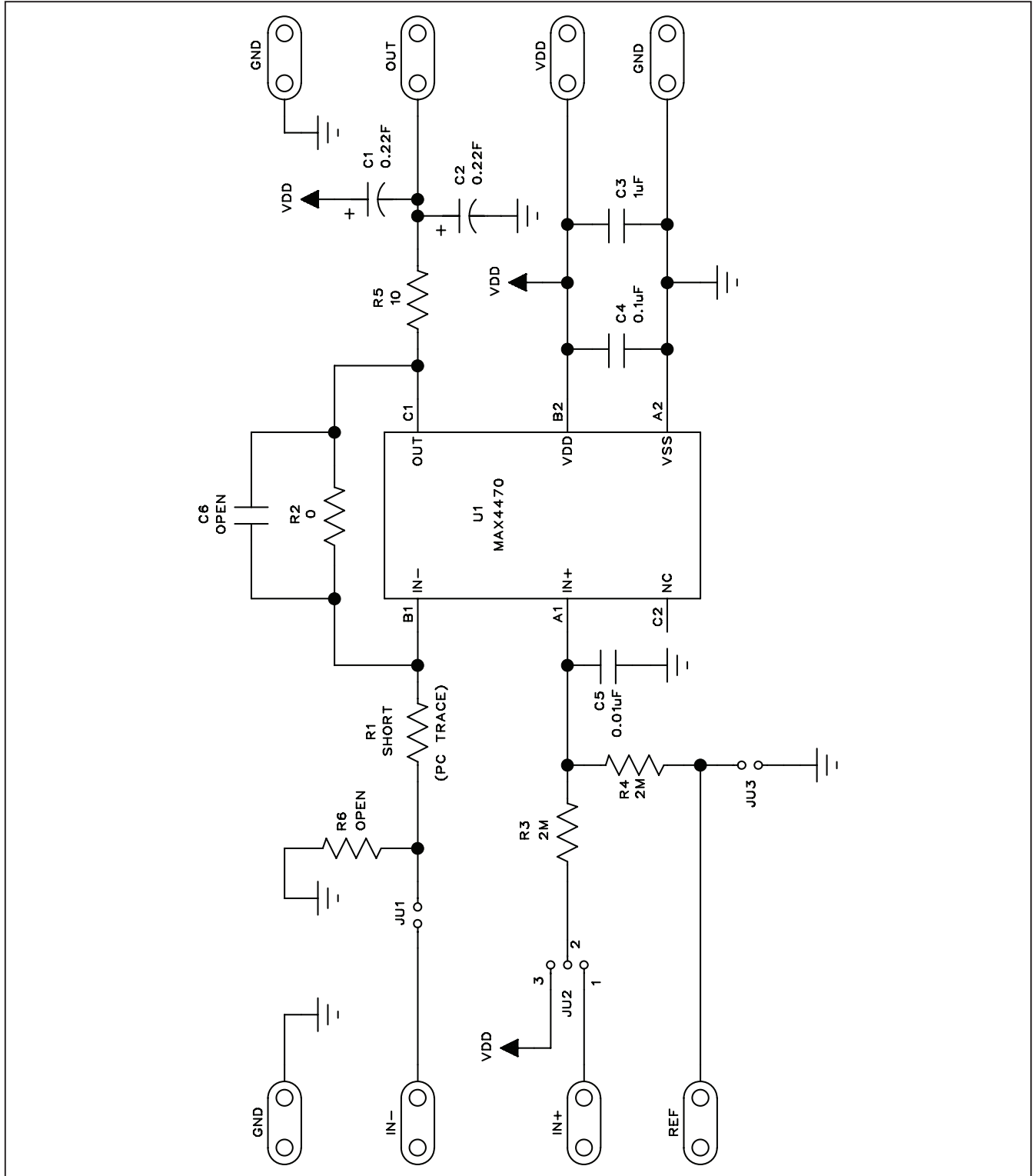


Figure 1. MAX4470 EV Kit Schematic

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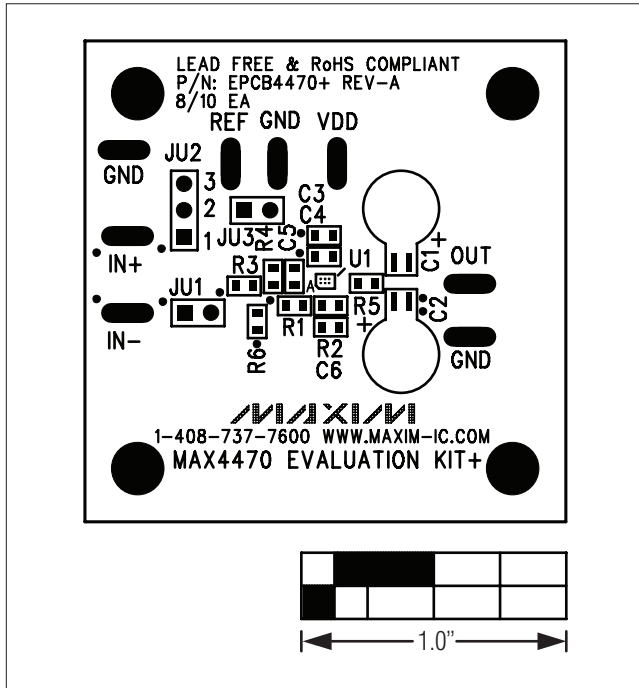


Figure 2. MAX4470 EV Kit Component Placement Guide—Component Side

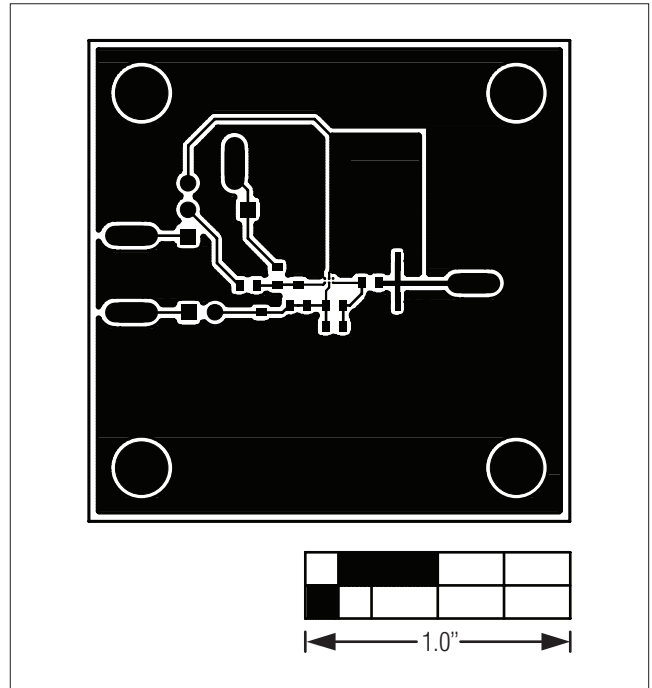


Figure 3. MAX4470 EV Kit PCB Layout—Component Side

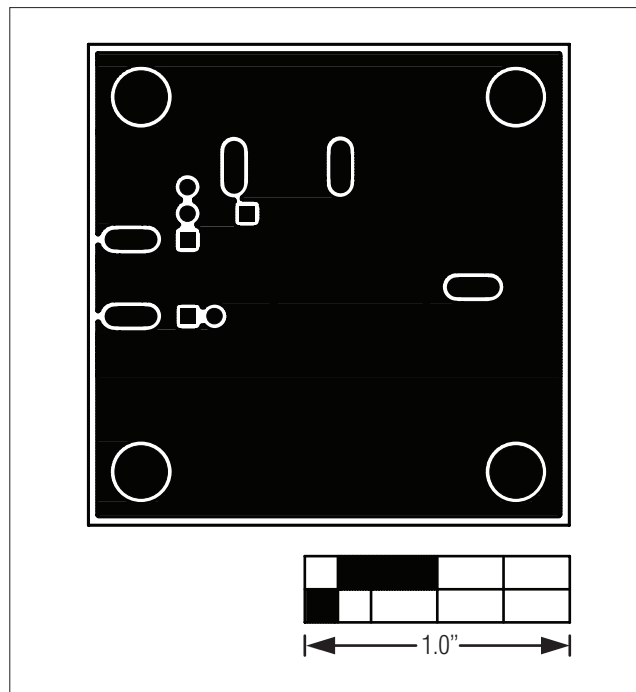


Figure 4. MAX4470 EV Kit PCB Layout—Solder Side

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/10	Initial release	—
1	11/10	Updated <i>Component List</i> and <i>Component Suppliers</i>	1

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