19-5524; Rev 1; 11/10

MAX4470 Evaluation Kit

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	1µF ±10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J105K
C4	1	0.1µF ±10%, 16V X5R ceramic capacitor (0603) Murata GRM188R61C104K
C5	1	0.01µF ±10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C103K
C6	0	Not installed, ceramic capacitor (0603)
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	0Ω ±5% resistor (0603)
R3, R4	2	2MΩ ±5% resistors (0603)
R5	1	10Ω ±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.*

MAX4470 Evaluation Kit

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.

MAX4470 Evaluation Kit

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 (VOUT) for the noninverting configuration is given by the following equation:

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

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 (VDC) 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 (VIN-) at the IN- pad is positive:

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

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.

MAX4470 Evaluation Kit

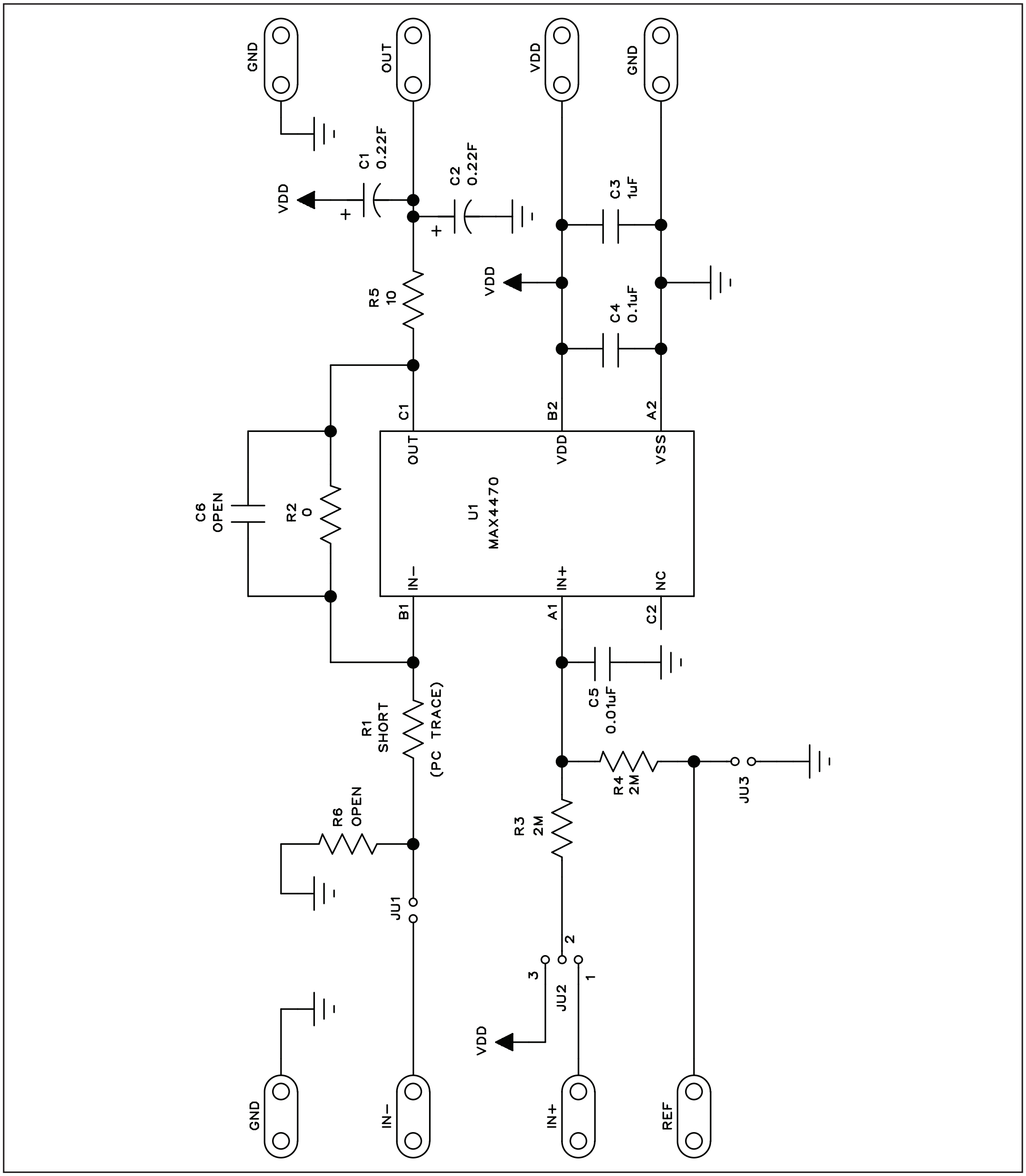

Figure 1. MAX4470 EV Kit Schematic

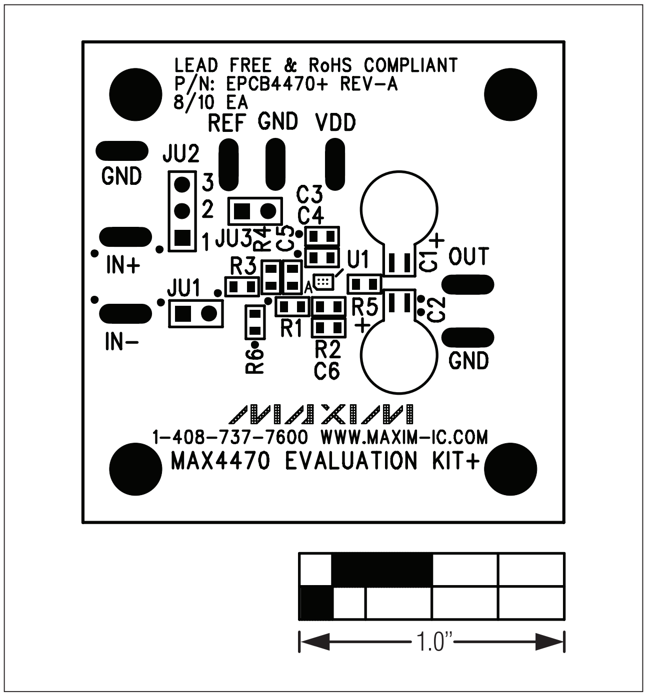

Figure 2. MAX4470 EV Kit Component Placement Guide—Component Side

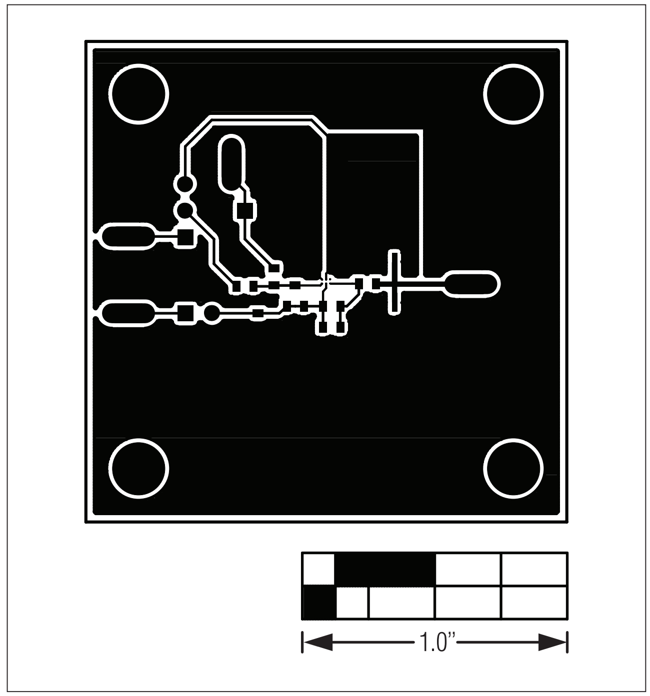

Figure 3. MAX4470 EV Kit PCB Layout—Component Side

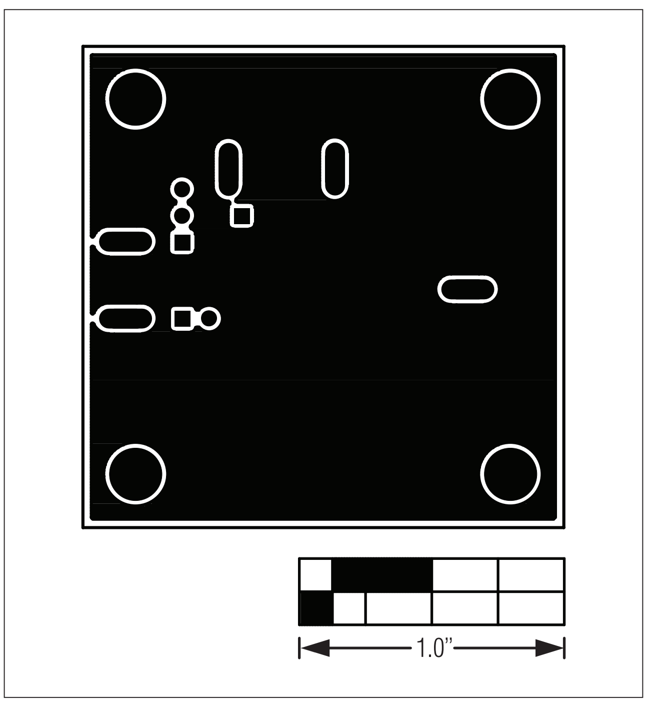

Figure 4. MAX4470 EV Kit PCB Layout—Solder Side

MAX4470 Evaluation Kit

Revision History

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