



MAX2450 Evaluation Kit

General Description

The MAX2450 evaluation kit (EV kit) simplifies evaluation of the MAX2450 3V, ultra-low-power quadrature modulator/demodulator. It enables testing of all MAX2450 functions, with no additional support circuitry. The MAX2451 (demodulator) and MAX2452 (modulator) function as subsets of the MAX2450, and can also be evaluated using this EV kit.

Component List

DESIGNATION	QTY	DESCRIPTION
C1-C6, C9, C11, C12, C15, C16	11	0.1 μ F, 10% ceramic capacitors Vitraron VJ1206Y104MXX
C7, C8	2	56pF, 5% ceramic capacitors Vitraron VJ1206A330JXA
C13, C14	2	0.01 μ F ceramic capacitors Vitraron VJ1206103MXX
C17, C18, C19	3	10 μ F, 10V, 20% tantalum capacitors Sprague 293D106X001B or AVX TAJB106010
L1	1	100nH, 10% inductor CoilCraft 1008CS-101XKBC
L2, L3	0	Not included. Use 1 μ H for additional power-supply rejection, if needed.
Q_IN, I_IN, IF_OUT, IF_IN	4	BNC connectors
R1, R4	2	10k Ω , 5% resistors
R2	1	56 Ω , 5% resistor
R3, R5	2	47k Ω , 5% resistors
R6	1	2k Ω potentiometer
R17	1	5.6k Ω , 5% resistor
R18	1	49.9 Ω , 1% resistor
R19	1	200 Ω , 5% resistor
R23, R24	2	100k Ω , 5% resistors
JU10	1	3-pin header
D1	1	Varactor Diode M/A-COM MA4ST080CK-287
U1	1	Maxim MAX2450CWP
U3	1	Maxim MAX436CSD

Features

- ♦ 130MHz to 160MHz VCO (2x the IF frequency)
- ♦ Single-Ended Modulator I and Q Inputs
- ♦ Single-Ended 50 Ω Modulator Output
- ♦ Single-Ended 50 Ω Demodulator Input
- ♦ CMOS-Compatible Enable Input
- ♦ Single-Ended or Differential Demodulator I and Q Outputs
- ♦ Fully Assembled and Tested

Ordering Information

PART	TEMP. RANGE	BOARD TYPE
MAX2450EVKIT-SO	0°C to +70°C	Surface Mount

Component Suppliers

SUPPLIER	PHONE	FAX
AVX	(803) 946-0690	(803) 626-3123
Coilcraft	(708) 639-6400	(708) 639-1469
M/A-COM	(617) 564-3100	(617) 564-3050
Sprague	(603) 224-1961	(603) 224-1430
Vishay/Vitramon	(203) 268-6261	(203) 452-5670

Quick Start

The MAX2450 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section.

Test Equipment Required

- Dual-output function generator capable of generating quadrature signals
- Signal generator up to 100MHz
- Dual-channel oscilloscope with a 100MHz minimum bandwidth
- Low capacitance (<3.0pF) oscilloscope probes (example: Tektronix P6201)
- Spectrum analyzer with range $\geq$ 500MHz
- Power supplies with $\pm$ 5V and +3V outputs

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Connections and Setup

General Setup

- 1) Verify that the shunt on jumper JU10 is in the ENABLE position.
- 2) Connect the power supplies to the appropriate terminals marked on the EV kit, and apply power. The +3V supply provides power for the MAX2450. The ±5V supplies are required only to power the MAX436 buffer amplifier and provide varactor bias.

Modulator Setup

- 1) Connect a cable from the spectrum analyzer to the IF_OUT BNC connector on the EV kit.
- 2) Set the spectrum analyzer's center frequency to 70MHz and its frequency span to 1MHz/div.
- 3) Configure the dual-output function generator to the following settings:
For Channel 1: A 600kHz sine wave with a 1.2Vp-p amplitude.
For Channel 2: A 600kHz sine wave with a 1.2Vp-p amplitude and 90 degrees offset from Channel 1.
- 4) Connect a cable from Channel 1 of the dual-output function generator to the I_IN BNC input on the EV kit. Similarly, connect a cable from Channel 2 of the dual-function generator to the Q_IN BNC input on the EV kit.

Demodulator Setup

- 1) Connect a low-capacitance probe from I_OUT (TP2) to Channel 1 of the oscilloscope. TP3 and TP6 are available as ground connections.
- 2) Connect another low-capacitance probe from Q_OUT (TP5) to Channel 2 of the oscilloscope.
- 3) Configure the signal generator output from a 50Ω source to 2.82mVp-p (1mVRMS) at 70.1MHz.
- 4) Connect a cable from the signal generator to IF_IN on the EV kit.

Analysis

- 1) Using the spectrum analyzer to observe the modulator output spectrum, you will notice three tones. If needed, adjust the oscillator frequency using the FREQ ADJ potentiometer (R6) until there are three tones at 69.4MHz, 70MHz, and 70.6MHz. The tone at 70.6MHz is the desired modulated output signal. Its magnitude should be around -19.8dBm, which translates to 65mVp-p:

$$V_{p-p} = 2 \sqrt{2} \times \sqrt{50} \times 10^{\frac{\text{dBm} - 30}{20}}$$

The 70MHz tone is the leakage from LO, with a magnitude typically 36dB below the modulated output. This is due to V_{BE} mismatch of the input transistors internal to the IC. AC coupling of the I and Q signals on the EV kit is used to get the maximum LO suppression. The tone at 69.4MHz is the suppressed sideband signal from the upconversion process, with a magnitude typically 38dB below the desired modulated output.

- 2) Using the scope to observe the demodulator I and Q channel outputs, you will see that they are 90 degrees offset from each other. Any deviation from 90 degrees is the phase mismatch. The I and Q output amplitudes are approximately 500mVp-p. Any difference in the I and Q output amplitudes produces the amplitude mismatch:

$$\text{Amplitude Mismatch} = 20 \times \log \frac{A_I}{A_Q}$$

Low-capacitance probes are recommended for higher-frequency baseband signals (<5MHz). The Tektronix P6201 (or equivalent)—a 1X, 100kΩ probe with less than 3pF of capacitance—is well suited for these applications.

- 3) To observe the 17.5MHz output of the divide-by-8 prescaler, use a low-capacitance active scope probe (such as the Tektronix P6201) at TP1. A typical scope probe adds too much capacitive load and will slew limit the output. (See the MAX2450 data sheet for a typical output waveform example.)
- 4) The MAX2450 ENABLE pin connects to V_{CC} through a jumper. To test the power-down function, move the JU10 shunt from the ENABLE to the $\overline{\text{ENABLE}}$ position. This shorts the ENABLE pin to ground. The supply current for the MAX2450 (+3V) should drop below 2μA. (Note that this supply current may be affected by leakage from bypass capacitor C17.)

Adjustments and Control

FREQ ADJ

The FREQ ADJ potentiometer (R6) controls the frequency of the on-chip oscillator by varying the capacitance of the parallel LC resonant network on the EV kit. Use the following formula to determine the oscillation frequency:

$$f_o = \frac{1}{2\pi\sqrt{L_{EQ}C_{EQ}}}$$

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where

$$L_{EQ} = L_1 + L_{STRAY}$$

and

$$C_{EQ} = \frac{1}{\frac{1}{C_7} + \frac{1}{C_8} + \frac{2}{C_{VAR}}} + C_{STRAY}$$

where C_{VAR} is the capacitance of each varactor diode.

This EV kit uses a common-cathode dual varactor diode (D1) as a tuning element. Applying different voltages across the diode junction produces different capacitances. The oscillator's frequency tuning range is 130MHz to 160MHz. To alter this range, change the inductance, the capacitance, or both.

Using an External Oscillator

The MAX2450 EV kit can be used with an external oscillator by overdriving the on-board VCO. This can be accomplished by removing the varactor diode (D1) and injecting a single-ended signal between C7 and R3. The signal and ground should be connected between C8 and R5. Place a shunt across R5, or remove it completely and shunt it directly on the PC board. The external oscillator amplitude should be 200mVp-p.

ENABLE

Jumper JU10 controls the MAX2450 enable function. Refer to Table 1 for jumper selection. To use an external control signal, remove the shunt of JU10 completely and connect the external signal to the center pin of JU10. The external control signal should not exceed the MAX2450 supply voltage.

Table 1. Jumper JU10 Functions

SHUNT LOCATION	ENABLE PIN	MAX2450
ENABLE	Connected to V_{CC}	Enabled
$\overline{\text{ENABLE}}$	Connected to GND	Disabled

Layout Considerations

The MAX2450 EV board can serve as a guide for layout of your board. Make sure the input traces to the I and Q input pins are of equal length and in the same environment as much as possible, to keep the I and Q signals in quadrature for maximum sideband rejection at the modulated output. Lay out the parallel resonant network symmetrically and as close to the IC as possible to minimize the effects of parasitic capacitance. The IF input and output traces should be as short as possible, due to the low signal levels and high frequencies involved.

The MAX2450 quadrature demodulator and modulator sections are functionally equivalent to the MAX2451 and MAX2452, respectively. Therefore, the MAX2450 EV kit can be used to evaluate all three parts. Note that the supply currents for the MAX2451 and MAX2452 are lower.

The MAX2451 and MAX2452 are not pin compatible with the MAX2450. The MAX2450 is also available in a smaller, QSOP package.

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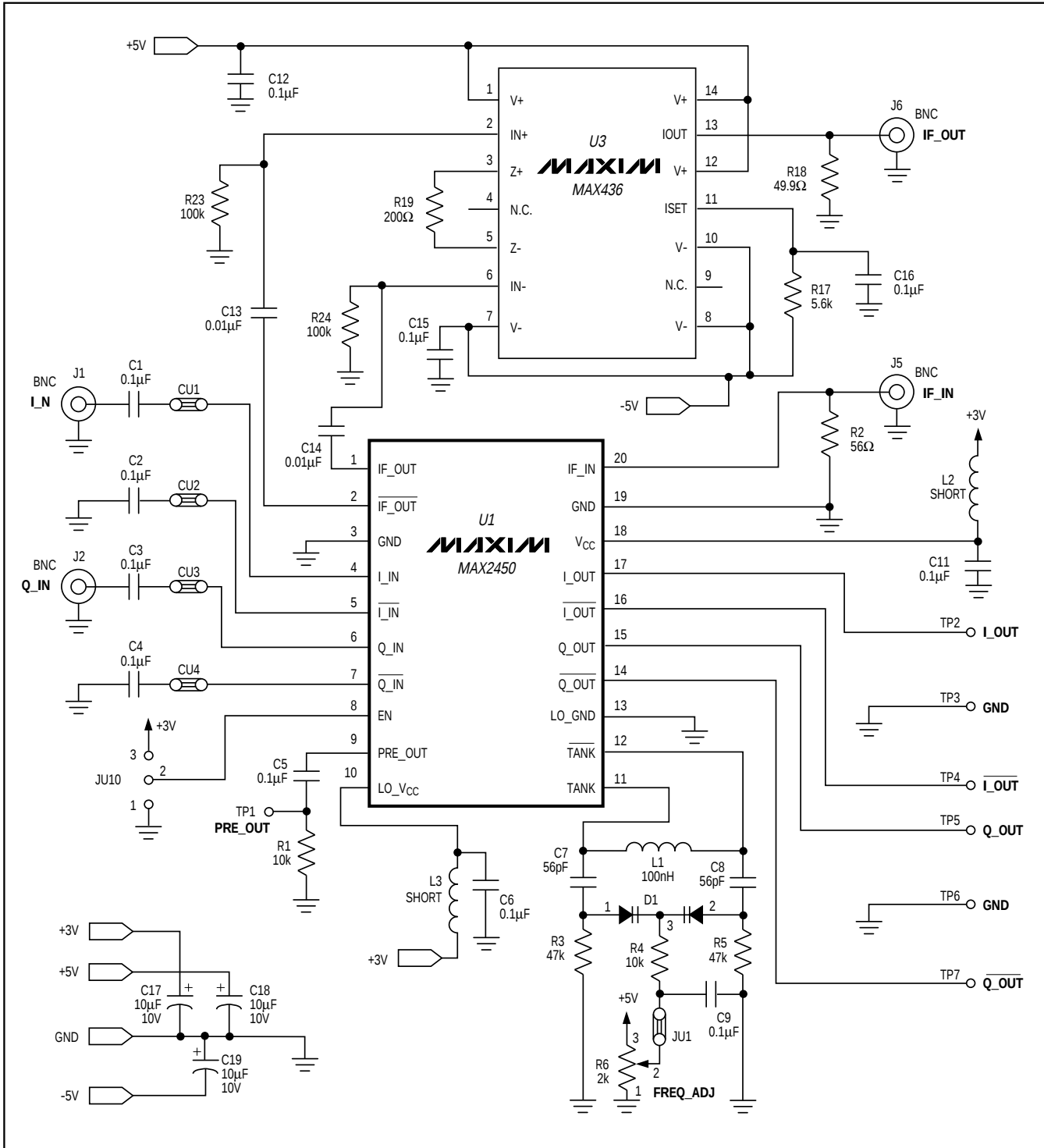


Figure 1. MAX2450 EV Kit Schematic

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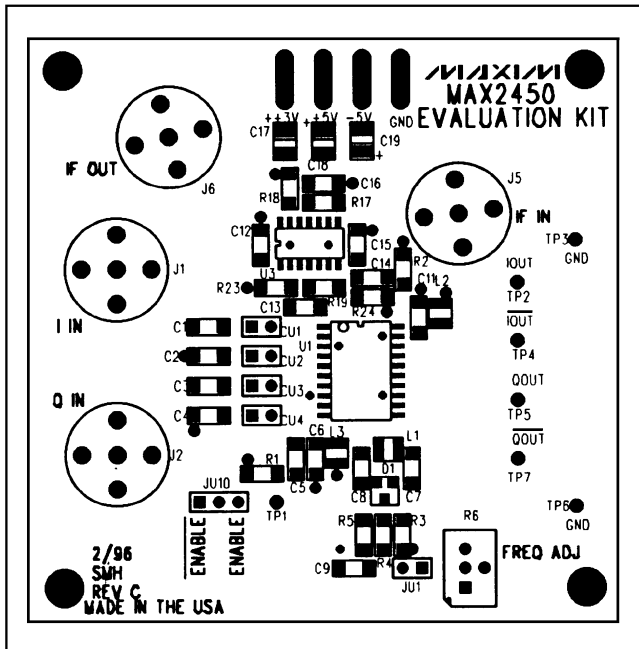


Figure 2. MAX2450 EV Kit Component Placement Guide—Component Side

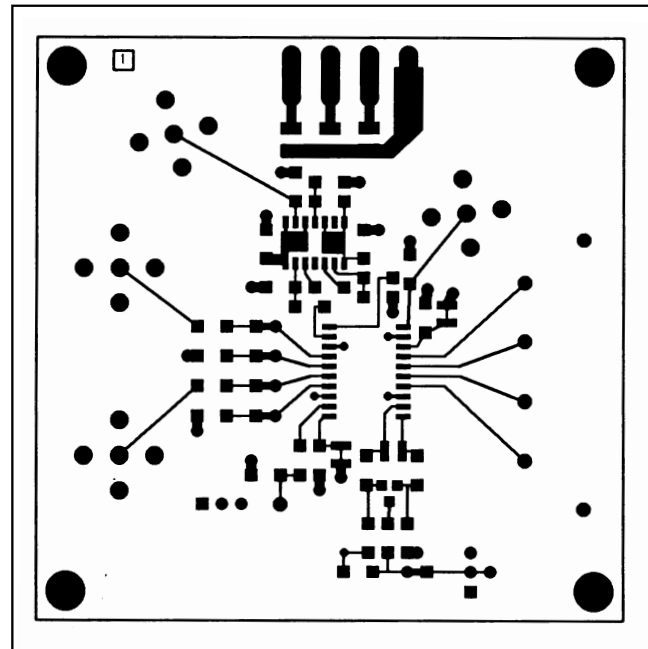


Figure 3. MAX2450 EV Kit PC Board Layout—Component Side

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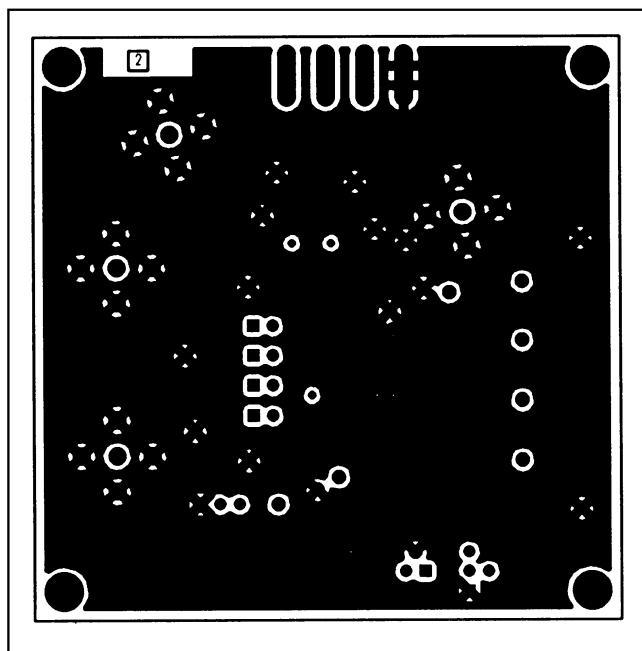


Figure 4. MAX2450 EV Kit PC Board Layout—Ground Plane

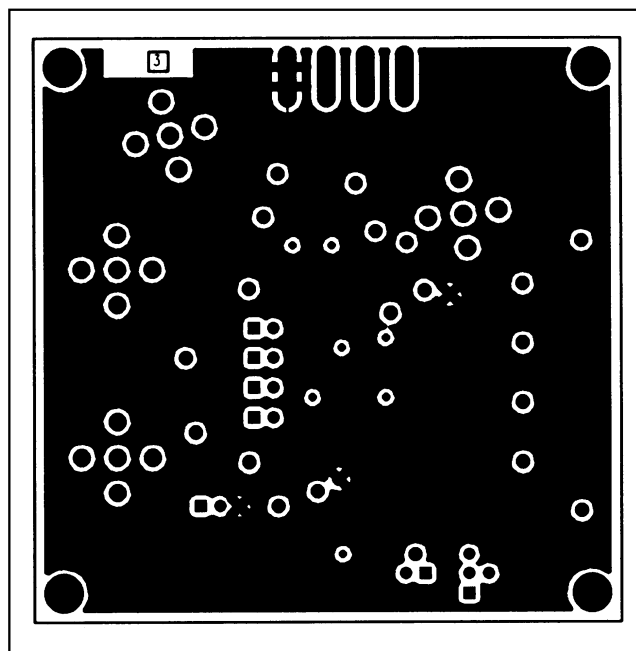


Figure 5. MAX2450 EV Kit PC Board Layout—Power Plane

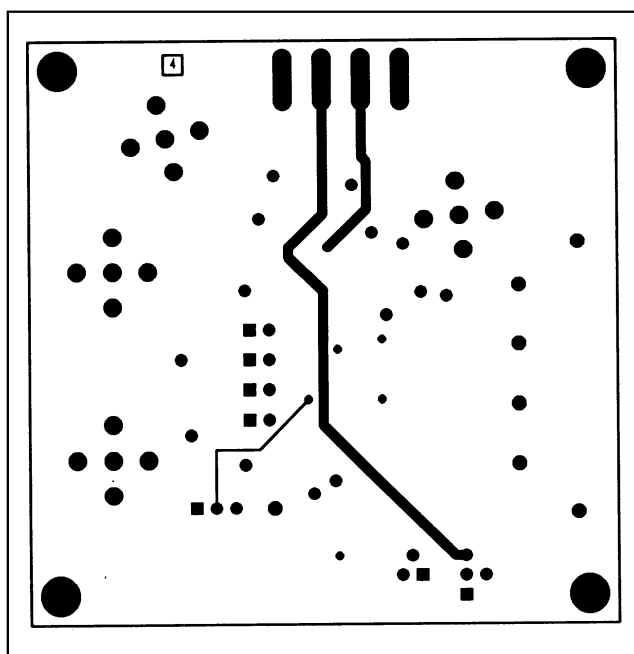


Figure 6. MAX2450 EV Kit PC Board Layout—Solder Side

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