MAX2690 Evaluation Kit

Evaluates: MAX2690

General Description

The MAX2690 evaluation kit (EV kit) simplifies the evaluation of the MAX2690 downconverter mixer. It enables testing of all MAX2690 functions, with no additional support circuitry. Inputs and outputs utilize SMA connectors for ease of connection to test equipment. The MAX2690 EV kit contains matching components for operation with a 1.95GHz RF input; however, these components may be changed for matching to other frequencies from 400MHz to 2.5GHz.

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	0.5pF, 25V, 10% ceramic capacitor (0603 footprint)
C2, C3	2	1pF, 25V, 10% ceramic capacitors (0603 footprint)
C4, C5	2	1000pF, 25V, 10% ceramic capacitors (0603 footprint)
C6, C7, C8, C15, C16, C24, C25, C26	8	1000pF, 25V, 10% ceramic capacitors
C17	1	10µF, 16V, ±10% tantalum capacitor AVX TAJC-106K016
C27	1	0.1µF, 25V, 10% ceramic capacitor (0603 footprint)
J1, J2	2	SMA connectors (edge mount)
J3, J4	2	SMA connectors (PC mount)
JU1	1	3-pin header (0.1" center)
	1	Shunt
L1	1	27nH inductor Toko LL1608-FN27NK
L2	1	3.3nH inductor Toko LL1608-FN3N3K
L3, L4	2	220nH inductors Coilcraft 0805CS-221XKBC
R2, R3, R4	0	Not installed
R6, R7	2	499Ω, 1% resistors
R8, R9	2	453Ω, 1% resistors
R14	1	100Ω, 5% resistor
U1	1	MAX2690EUB
None	1	MAX2690 circuit board
None	1	MAX2690 data sheet

NOTE: All resistors and capacitors have a 0805 footprint, unless otherwise noted.

Features

- **2.7V to 5.5V Single-Supply Operation**
- **Low-Power Shutdown Mode**
- **Differential IF Port**
- **50Ω Broadband LO Port**
- **Customizable Gain and Linearity**

Ordering Information

PART	TEMP. RANGE	BOARD TYPE
MAX2690EVKIT	-40°C to +85°C	Surface Mount

Component Suppliers

SUPPLIER	PHONE	FAX
AVX	(803) 946-0690	(803) 626-3123
Coilcraft	(847) 639-6400	(847) 639-1469
Toko America	(708) 297-0070	(708) 699-1194

Quick Start

The MAX2690 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section.

Test Equipment Required

1) DC power supply capable of supplying 2.7V to 5.5V.
2) HP8561E spectrum analyzer or equivalent high-sensitivity spectrum analyzer capable of operation to at least 2GHz.
3) Digital multimeter (DMM) to monitor DC supply current and voltage, if desired.
4) Two RF signal generators capable of generating signals up to 2.5GHz for the LO and RF signals (HP8648C or equivalent).
5) Balun (optional): transformer to convert the MAX2690's differential IF output to single-ended output for ease of measurement (Anzac H-9 or equivalent).
6) 50Ω terminator.

Connections and Setup

1) Connect the +2.7V to +5.5V power supply between V_{CC} and GND, and set the voltage to 3.0V.
2) Verify that the shunt on jumper JU1 ($\overline{SHDN}$) is connected between pins 1 and 2 on JU1 ($\overline{SHDN}$ = V_{CC}). Placing the shunt between pins 2 and 3 on JU1 ($\overline{SHDN}$ = GND) puts the MAX2690 into low-current shutdown mode.
3) Connect a balun to the differential IF port. IF+ goes to the balun's 0° input, and IF- goes to the 180° input. Connect the appropriate end of the balun to the spectrum analyzer, and terminate the remaining port with the 50Ω terminator, if required.

   If a balun is not available, connect IF+ directly to the spectrum analyzer, and connect the 50Ω terminator directly to IF-; however, a 6dB decrease in gain will be observed.
4) Connect a high-frequency signal generator to the LO input port. Set the LO frequency to 1.75GHz and the power level to -3.0dBm.
5) Connect a high-frequency signal generator to the RF input port. Set the RF frequency to 1.95GHz and the power level to -25.0dBm. This sets the IF frequency to 200MHz.

Analysis

1) Set the spectrum analyzer's center frequency to 200MHz and the total frequency span to 1MHz.
2) Read the peak output power at 200MHz. This power level should be approximately -29dBm. If a balun is not used at IF+ and IF-, the output power will be approximately 6dB lower (-35dBm).
3) The MAX2690's IF port typically presents a 1kΩ differential source impedance (500Ω per side, single ended). For ease of measurement with 50Ω test equipment, a resistive-matching network is used on the EV kit. This network has attenuation that must be compensated for when calculating the mixer's true conversion gain. To calculate conversion gain, the mismatch loss from the 500Ω IF output (single ended) to the 50Ω spectrum analyzer input must be taken into account. The MAX2690's IF output is an open-collector configuration with output impedance at high frequency dominated by 499Ω, external pull-up resistors (R6 and R7). The 50Ω spectrum analyzer input is resistively matched with series 453Ω resistors (R8 and R9). This yields a mismatch loss of 10dB, which can be compensated for in calculating the conversion gain as shown in the following equation:

   Conversion gain = (P_{OUT} - P_{IN}) + mismatch loss
   = (-29dBm - -25dBm) + 10dB

   Therefore, conversion gain = 6.0dB.

If a balun is not used, increase the mismatch loss from 10dB to 16dB.

These calculations assume no additional loss in the balun or cables. For maximum accuracy, these losses must be taken into account.

Mismatch Loss

The 10dB figure for mismatch loss was calculated as shown in the following equations. These calculations are shown for single-ended IF operation; however, the equations for differential operation are identical (see Figure 1). The open-collector AC output current is represented by "i" in these equations.

$$P_A = \frac{i^2 \cdot R_6}{4} = \text{power available from MAX2690}$$

$$P_D = \left[\frac{i \cdot R_6}{R_6 + R_8 + R_L}\right]^2 \cdot R_L = \text{power delivered to spectrum analyzer}$$

$$\text{Mismatch loss} = -10\log\left(\frac{P_D}{P_A}\right) \text{dB}$$

$$= -10\log\left[\frac{4 \cdot R_6 \cdot R_L}{(R_6 + R_8 + R_L)^2}\right] \text{dB}$$

$$= -10\log\left[\frac{4 \cdot 499\Omega \cdot 50\Omega}{(499\Omega + 453\Omega + 50\Omega)^2}\right] \text{dB}$$

$$= -(-10\text{dB})$$

$$\text{Mismatch loss} = 10\text{dB}$$

These calculations assume that the capacitance at the MAX2690's IF output is resonated with the output inductors (L3 and L4) so that the output impedance at the IF frequency is dominated by the external pull-up resistors (R6 and R7).

900MHz and 2.45GHz Operation

The MAX2690 EV kit is shipped for use at 1.95GHz. The EV kit can be modified for use over a much wider frequency range (f_{RF} = 400MHz to 2.5GHz). Example RFIN matching networks are shown in Figure 3 for 900MHz operation and Figure 4 for 2.45GHz operation. Consult the MAX2690 data sheet for information on matching this input to other frequencies.

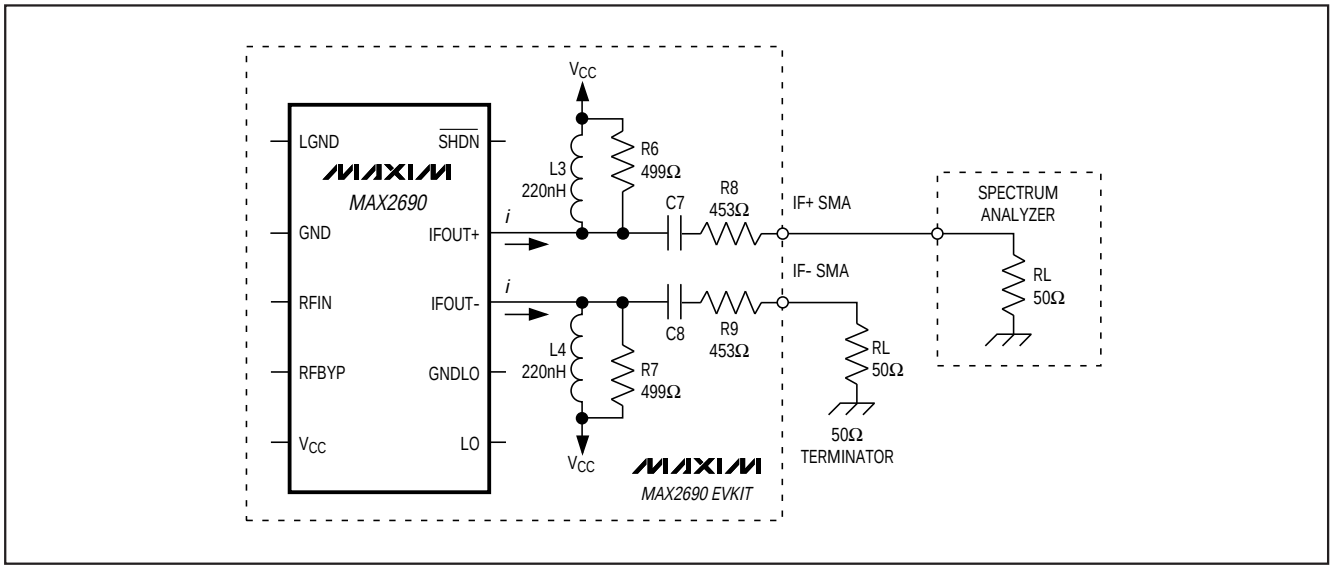

Figure 1. IF Output Schematic

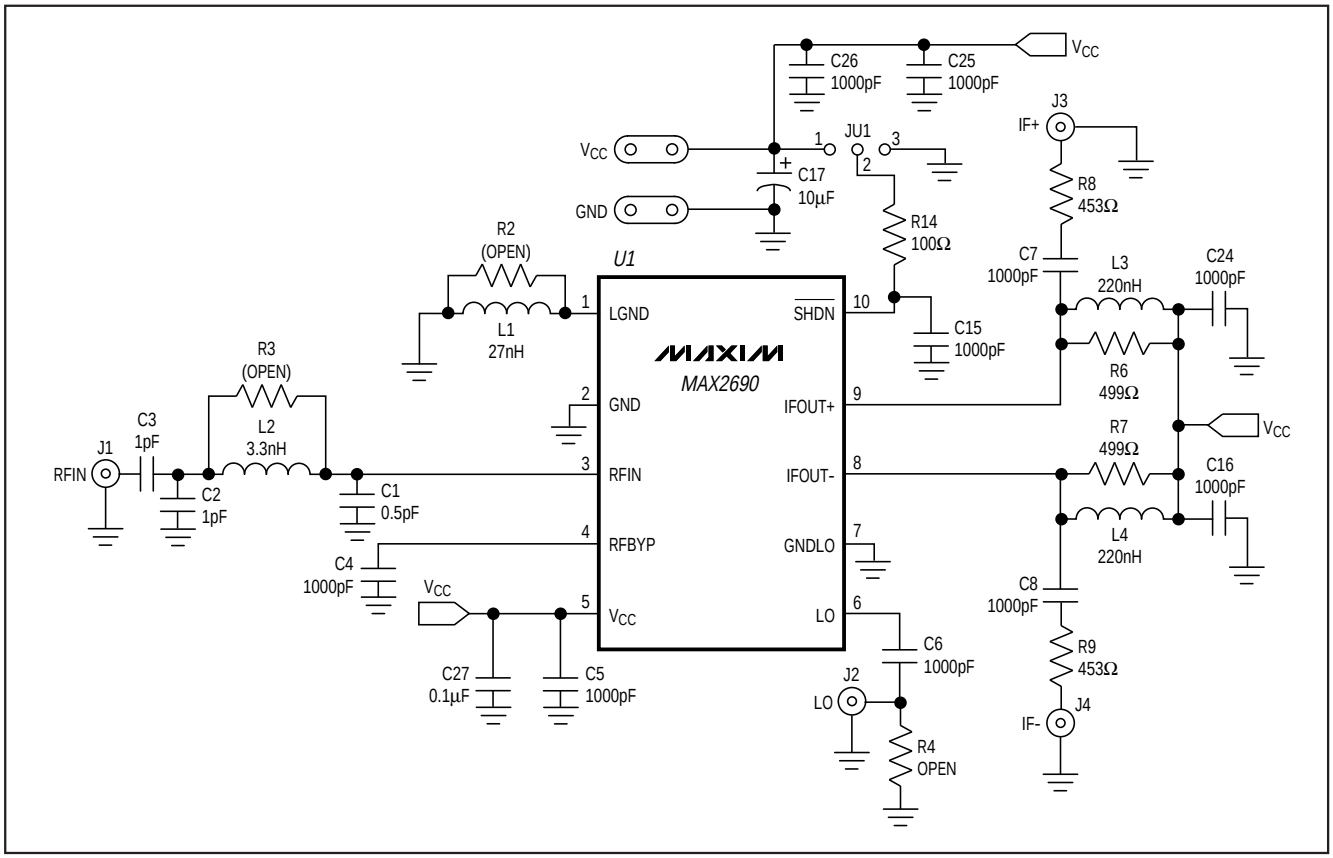

Figure 2. MAX2690 EV Kit Schematic (1.95GHz Operation)

Layout Considerations

The MAX2690 EV kit can serve as a guide for your board layout. To minimize the effects of parasitic elements (which can alter circuit performance), the ground plane around and under the components that make up the matching network (C1, C2, C3, and L2) and inductor L1 (used for LGND) were removed. Keep PC board trace lengths as short as possible to minimize parasitic inductance. Also, keep decoupling capacitor C5 as close to the MAX2690 as possible, with direct connection to the ground plane. Keep traces away from LGND and L1 to reduce stray capacitance and coupling.

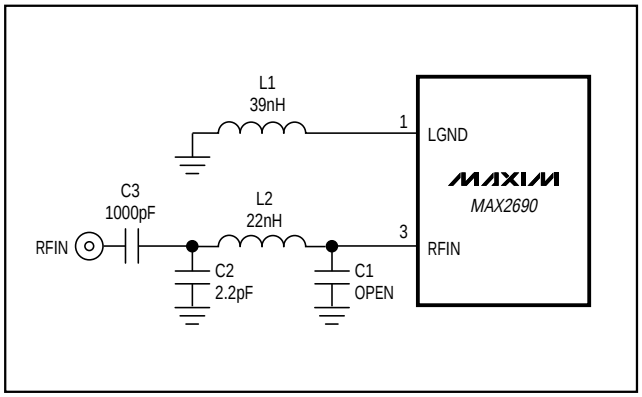

Figure 3. RFIN Match for 900MHz Operation

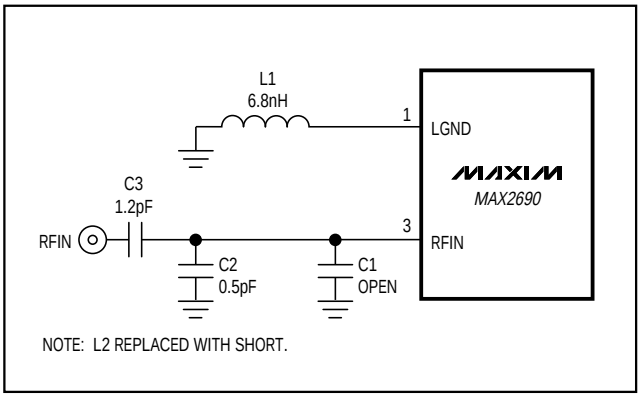

Figure 4. RFIN Match for 2.45GHz Operation

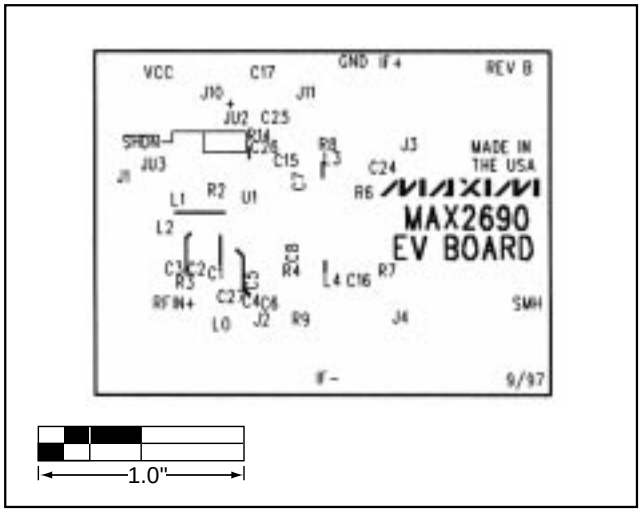

Figure 5. MAX2690 EV Kit PC Board Layout—Component Placement Guide

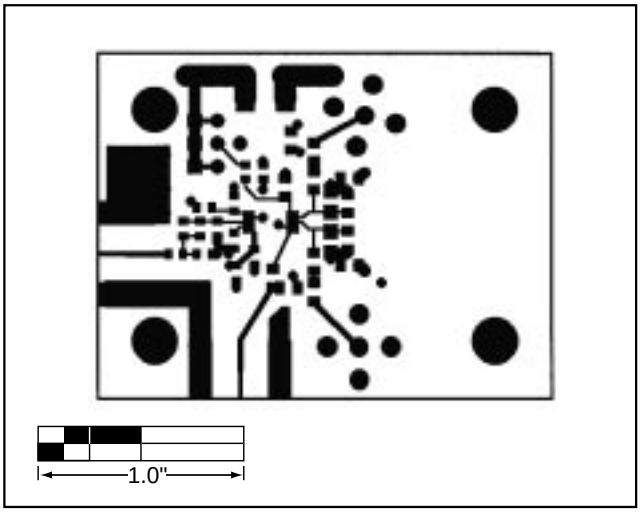

Figure 6. MAX2690 EV Kit PC Board Layout—Component Side

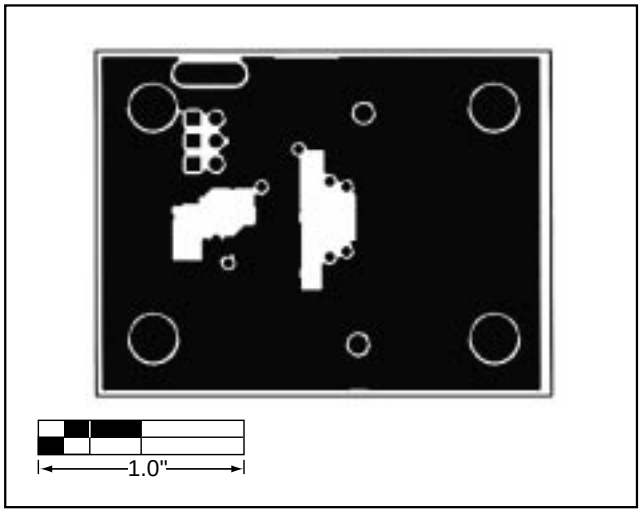

Figure 7. MAX2690 EV Kit PC Board Layout—Ground Plane

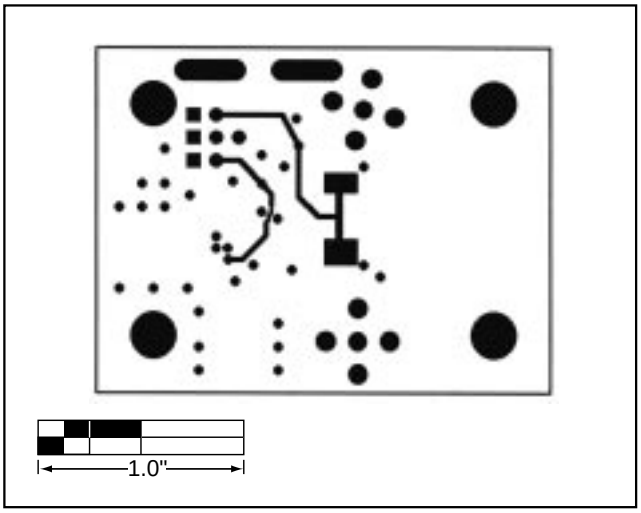

Figure 8. MAX2690 EV Kit PC Board Layout—Power Plane

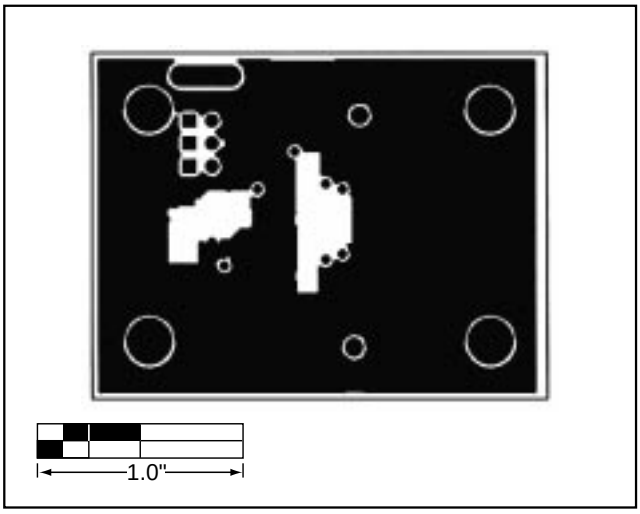

Figure 9. MAX2690 EV Kit PC Board Layout—Solder Side