19-1882; Rev 0; 12/00

MAXIM

MAX2700/MAX2701 Evaluation Kits

Evaluate: MAX2700/MAX2701

General Description

The MAX2700/MAX2701 evaluation kits (EV kits) simplify evaluation of the MAX2700/MAX2701 direct down-converter receivers. These kits allow evaluation of the devices' low-noise amplifier (LNA), I/Q demodulator, and variable gain amplifiers (VGAs). Figure 1 shows the MAX2700/MAX2701 EV kits schematic. The EV kits provide 50Ω SMA connectors for all RF input and output signals, and BNC connectors for all baseband input and output signals.

Features

- ♦ **Easy Evaluation of MAX2700/MAX2701**
- ♦ **+2.7V to +3.3V Single-Supply Operation**
- ♦ **RF Ports Matched to 1960MHz (MAX2700)**
- ♦ **RF Ports Matched to 2400MHz (MAX2701)**
- ♦ **SMA Connectors for All RF Signal Ports**
- ♦ **BNC Connectors for All Baseband Signal Ports**
- ♦ **Low-Power Shutdown Mode**

Ordering Information

PART	TEMP.RANGE	IC PACKAGE
MAX2700EVKIT	-40°C to +85°C	48 TQFP-EP
MAX2701EVKIT	-40°C to +85°C	48 TQFP-EP

MAX2700 Component List

DESIGNATION	QTY	DESCRIPTION
C1, C17, C18, C19, C21, C22, C23, C30, C31, C32, C36, C37, C38	13	0.1µF 10% ceramic capacitors (0603) Murata GRM39X7R104K016A
C2, C10, C11, C25, C43, C46	6	68pF 5% ceramic capacitors (0402) Murata GRM36COG680J050A
C3, C6, C7, C45	4	1000pF 10% ceramic capacitors (0402) Murata GRM36X7R102K050A
C4, C50	2	2.0pF ±0.1pF ceramic capacitors Murata GRM36COG020B050A
C5	1	0Ω resistor (0603)
C8, C14, C33	3	100pF 5% ceramic capacitors (0402) Murata GRM36COG101J050A
C9, C16, C34	3	0.01µF 10% ceramic capacitors (0402) Murata GRM36X7R103K016A
C12, C26, C27, C40	4	22pF 5% ceramic capacitors (0402) Murata GRM36COG220J050A
C13, C41, C42, C47, C48	5	Not installed
C15, C20, C35, C39	4	0.056µF 10% ceramic capacitors (0603) Murata GRM39X7R563K016A
C24, C29	2	0.56µF 10% ceramic capacitors (0805) Murata GRM40X7R564K016A
C28	1	Not installed
C44	1	10µF tantalum capacitor ±10% 16V min AVX TAJC106K016
C49	1	5pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG050B050A
R1, R12, R15, R26, R32, R40, R45	7	0Ω resistors (0805)
R2, R5, R6, R11	4	100Ω ±5% resistors (0402)
R3, R4, R7, R8, R9, R10	6	0Ω resistors (0402)
R13, R14, R19, R20, R33, R34, R38, R39,	8	1kΩ ±5% resistors (0402)

MAX2700/MAX2701 Evaluation Kits

MAX2700 Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R16, R22, R30, R36	4	1.1kΩ ±5% resistors (0402)
R17, R21, R31, R37	4	3.6kΩ ±5% resistors (0402)
R18, R23, R29, R35	4	820Ω ±5% resistors (0402)
R24, R25, R27, R28, R41, R42, R43, R44	8	51Ω ±5% resistors (0402)
T1	1	Balun transformer Murata LDB15C500A1900
Z1	1	4.7nH inductor Toko LL1608-FH4N7J
Z4	1	6pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG060B050A
L2	1	Not installed
L3	1	1.5nH inductor Toko LL1608-FH1N5S
L4	1	5.6nH inductor Toko LL1005-FH5N6S

DESIGNATION	QTY	DESCRIPTION
L5, L6	2	3.9nH inductors Toko LL1608-FH3N9J
L7	1	0Ω resistor (0603)
U1	1	MAX2700ECM 48-pin TQFP-EP **NOTE:** U1 has an exposed paddle which needs to be solder-attached to the circuit board to ensure proper functionality of the part.
J3, J6, J12, J18	4	SMA PC-mount connectors Johnson 142-0701-201 or Digi-Key J500-ND
J7–J11, J13–J17	10	BNC connectors A/D Electronics 580-002-00
VCC, GND	2	Test points, Digi-Key 5000K-ND
J1, TP1	2	1×2 headers (0.1in centers) Digi-Key S1012-36-ND
J2, J4, J5	3	1×3 headers (0.1in centers) Digi-Key S1012-36-ND
J2, J4, J5	3	Shunts, Digi-Key S9000-ND
—	1	MAX2700/2701 evaluation kit circuit board, rev. E

MAX2701 Component List

DESIGNATION	QTY	DESCRIPTION
C1, C17, C18,C19, C21, C22, C23, C30, C31, C32, C36, C37, C38	13	0.1µF 10% ceramic capacitors (0603) Murata GRM39X7R104K016A
C2, C10, C11, C25, C43, C46	6	68pF 5% ceramic capacitors (0402) Murata GRM36COG680J050A
C3, C6, C7, C45	4	1000pF 10% ceramic capacitors (0402) Murata GRM36X7R102K050A
C4, C50	2	1.5pF ±0.1pF ceramic capacitors Murata GRM36COG1R5B050A
C5	1	10pF ±0.1pF ceramic capacitor (0603) Murata GRM39COG100B050A

DESIGNATION	QTY	DESCRIPTION
C8, C14, C33	3	100pF 5% ceramic capacitors (0402) Murata GRM36COG101J050A
C9, C16, C34	3	0.01µF 10% ceramic capacitors (0402) Murata GRM36X7R103K016A
C12, C26, C27, C40	4	22pF 5% ceramic capacitors (0402) Murata GRM36COG220J050A
C13	1	2pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG020B050A
C15, C20, C35, C39	4	0.056µF 10% ceramic capacitors (0603) Murata GRM39X7R563K016A

MAX2701 Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C24, C29	2	0.56µF 10% ceramic capacitors (0805) Murata GRM40X7R564K016A
C28, C41, C42, C47, C48	5	Not installed
C44	1	10µF tantalum capacitor ±10% 16V min AVX TAJC106K016
C49	1	3pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG030B050A
R1, R12, R15, R26, R32, R40, R45	7	0Ω resistors (0805)
R2, R5, R6, R11	4	100Ω ±5% resistors (0402)
R3, R4, R7, R8, R9, R10	6	0Ω resistors (0402)
R13, R14, R19, R20, R33, R34, R38, R39	8	1kΩ 5% resistors (0402)
R16, R22, R30, R36	4	1.1kΩ ±5% resistors (0402)
R17, R21, R31, R37	4	3.6kΩ ±5% resistors (0402)
R18, R23, R29, R35	4	820Ω ±5% resistors (0402)
R24, R25, R27, R28, R41, R42, R43, R44	8	51Ω ±5% resistors (0402)
T1	1	Balun transformer Murata LDB15C500A2400
Z1	1	0.5pF ±0.1pF ceramic capacitor (0603) Murata GRM39COG0R5B050A
Z4	1	1nH inductor Toko LL1005-FH1N0S
L2	1	Not installed
L3, L5, L6	3	2.7nH inductors Toko LL1608-FH2N7S
L4	1	5.6nH inductor Toko LL1005-FH5N6S
L7	1	0Ω resistor (0603)
U1	1	MAX2701ECM 48-pin TQFP-EP **NOTE:** U1 has an exposed paddle which needs to be solder-attached to the circuit board to ensure proper functionality of the part.
J3, J6, J12, J18	4	SMA PC-mount connectors Johnson 142-0701-201 or Digi-Key J500-ND
J7–J11, J13–J17	10	BNC connectors A/D Electronics 580-002-00
VCC, GND	2	Test points, Digi-Key 5000K-ND
J1, TP1	2	1×2 headers (0.1in centers) Digi-Key S1012-36-ND
J2, J4, J5	3	1×3 headers (0.1in centers) Digi-Key S1012-36-ND
J2, J4, J5	3	Shunts, Digi-Key S9000-ND
—	1	MAX2700/MAX2701 evaluation kit circuit board, rev. E

Component Suppliers

SUPPLIER	PHONE	FAX
AVX	803-946-0690	803-626-3123
EFJohnson	402-474-4800	402-474-4858
Kamaya	219-489-1533	219-489-2261
Murata	949-852-2001	949-852-2002
Toko	708-297-0070	708-699-1194

Note: *Please indicate that you are using the MAX2700 or MAX2701 when contacting these component suppliers.*

Table 1. Recommended Test Equipment

EQUIPMENT	DESCRIPTION
RF Signal Generators (2)	HP 8648C or equivalent, capable of delivering -50dBm to -10dBm of output power from 900MHz to 2500MHz
Dual-Channel Oscilloscope	For viewing the demodulator outputs
Power Supply	Capable of providing at least 200mA at +2.7V to +3.3V
Additional Variable Voltage Source	For external control of VGA function
Spectrum Analyzer	HP 8561E or equivalent, covering MAX2700/MAX2701 operating frequency range
Cables (50Ω)	(2) 50Ω cables with SMA connectors
Cables with BNC Connectors	(2) BNC cables to check baseband signals
Ammeter (optional)	For measuring supply current
Noise Figure Meter (optional)	HP 8970B or equivalent, for measuring the noise figure of the LNA and I/Q demodulator
Network Analyzer	HP 8753D or equivalent, for measuring return loss and gain simultaneously

Quick Start

The MAX2700/MAX2701 EV kits are fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section for proper device evaluation.

Connections and Setup

This section provides a step-by-step guide to setting up the MAX2700/MAX2701 EV kits and testing all three major functional blocks: LNA, I/Q demodulator, and VGAs. **Do not turn on the DC power or RF signal generators until all connections are made.**

Low-Noise Amplifier

1) Set the $\overline{SHDN}$ jumper on the EV kit to V_{CC} (HI). This enables the device to operate in the normal mode.
2) Set the GAIN_SET jumper on the EV kit to V_{CC} (HI). This enables the LNA to operate in high-gain mode.
3) Set the $\overline{X2EN}$ jumper on the EV kit to GND (LOW). This enables the VCO doubler.
4) Connect a DC supply preset to +3V (through an ammeter, if desired) to the EV kit's V_{CC} and GND terminals. Do not turn on the supply.
5) Perform a full two-port calibration on a network analyzer at a -30dBm power level.
6) Connect port 1 and port 2 of network analyzer to LNAIN and LNAOUT, respectively.
7) Turn on the DC supply. The supply current should read approximately 165mA for MAX2700 (167mA for MAX2701) if using an ammeter.
8) The network analyzer display should indicate a typical gain of 16.5dB for MAX2700 at 1960MHz (15.5dB for MAX2701at 2400Mhz) after accounting for board losses.
9) The input and output board losses for MAX2700 are 0.25dB and 0.3dB, respectively. The input and output board losses for MAX2701 are 0.3dB and 0.35dB, respectively.
10) Set the GAIN_SET jumper on the EV kit to GND (LOW). This enables the LNA's low-gain-mode operation. Measurements on the network analyzer should indicate a typical gain of -1.75dB for MAX2700 (-2.5dB for MAX2701) after accounting for board losses.
11) Connect the $\overline{SHDN}$ jumper to GND (LOW) to activate the shutdown mode. The supply current should drop to less than 100µA.

I/Q Demodulator

1) Turn off the DC supply.
2) Remove the network analyzer from the LNAIN and LNAOUT connections. The DC supply connections needed for testing the downconverter mixer are the same as in the LNA section.
3) Set jumper J2 ($\overline{X2\_EN}$) to GND (LOW) to enable the LO doubler circuit.
4) Connect an RF signal generator (with output disabled) to the LO SMA connector. Set the frequency to 980MHz for MAX2700 (1200MHz for MAX2701) and the output power to -10dBm. This is the LO signal.
5) Connect another RF signal generator to the RFIN SMA connector (with output disabled). Set the frequency to 1961MHz for MAX2700 (2401MHz for MAX2701) and the output power to -25dBm. This is the RF input signal.

6) Connect the oscilloscope to the MIX_I (for I channel signal) BNC connector. Set the oscilloscope to high-impedance input mode.
7) Turn on the DC supply. Enable the LO signal generator and RF input signal generator outputs.
8) Measure the peak-to-peak amplitude of the 1MHz IF signal on the oscilloscope with a high-impedance probe (V_{OUTp-p}). Voltage gain can be calculated by the following formula:

   Voltage Gain = $20 \log[((V_{OUTp-p}) / (2 \times \sqrt{2})) / V_{IN} (RMS)]$

   $V_{IN} (RMS) = SQRT(50 \times 10^{-3} \times 10^{Pin(dBm)/10})$

   Voltage Gain should be nominally 19.3dB for MAX2700 (18.1dB for MAX2701).

Note: Compensate P_{IN} for input balun loss (1.25dB) and input board loss (0.3dB) and $V_{OUT\ p-p}$ for the voltage divider network at the mixer output.

To check the Q-channel performance of the I/Q demodulator, connect the oscilloscope to MIXQ and repeat the measurements from step 7 of the *I/Q Demodulator* section.

Variable Gain Amplifiers

1) Remove the RF signal generators and oscilloscope from RFIN, LO, and MIXI connections. The DC supply connections needed for testing the VGAs are the same as in the LNA section. Turn off the DC supply while making connections.
2) Connect a variable voltage source, preset to +1.25V, to the VGC input of the EV kit. Do not turn on the supply.
3) Connect an RF signal generator to the BNC connector of input IIN1+ (using appropriate connector adapters). Do not turn on the generator's output. Set the generator for a output frequency of 1MHz at a -40dBm power level.
4) Connect the oscilloscope to the IOUT1 (for I channel signal) BNC connector. Set the oscilloscope to high-impedance-input mode.
5) Turn on the DC supply and the voltage source connected to the VGC input.
6) Measure the peak-to-peak output voltage of the 1MHz signal on the oscilloscope (V_{OUTp-p}), and compute the voltage gain using the equation in the I/Q demodulator section. The voltage gain should be nominally 20dB between IIN1+ (J16) and IOU1 (J15).
7) Connect a jumper across J1.
8) Perform a similar measurement between IIN2+ (J14) and IOUT2 (J13); voltage gain should be 30dB nominal between IIN2+ and IOUT2.

   Note: Compensate P_{IN} for the input network loss and V_{OUTp-p} for the voltage divider network at the amplifier output.
9) The corresponding VGAs in the Q channel (between QIN1+ and QOUT1 and between QIN2+ and QOUT2) can be tested in the same way.

Checking Noise Figure

Noise-figure measurements are sensitive to board and lab setup losses and parasitics. There are many techniques and precautions for measuring a low-noise figure. Detailed explanation of these items goes beyond the scope of this document. For more information on how to perform this level of noise-figure measurement, refer to the noise-figure meter operating manual, as well as to Hewlett Packard application note #57-2, *Noise Figure Measurement Accuracy.*

PC Board Layout Considerations

The MAX2700/MAX2701 EV kits can serve as board layout guides. Keep PC board trace lengths as short as possible to minimize parasitics. Keep decoupling capacitors close to the device, with a low inductance via connection to the ground plane.

Modifying the EV Kit

The MAX2700/MAX2701 EV kits have been optimized for operation at 1960MHz and 2400MHz, respectively. The MAX2700/MAX2701 EV kits can be configured to operate in the 1800MHz to 2100MHz band and the 2100MHz to 2500MHz band, respectively. Use the device parameters listed in the MAX2700/MAX2701 data sheet to determine the proper input and output matching components at other frequencies.

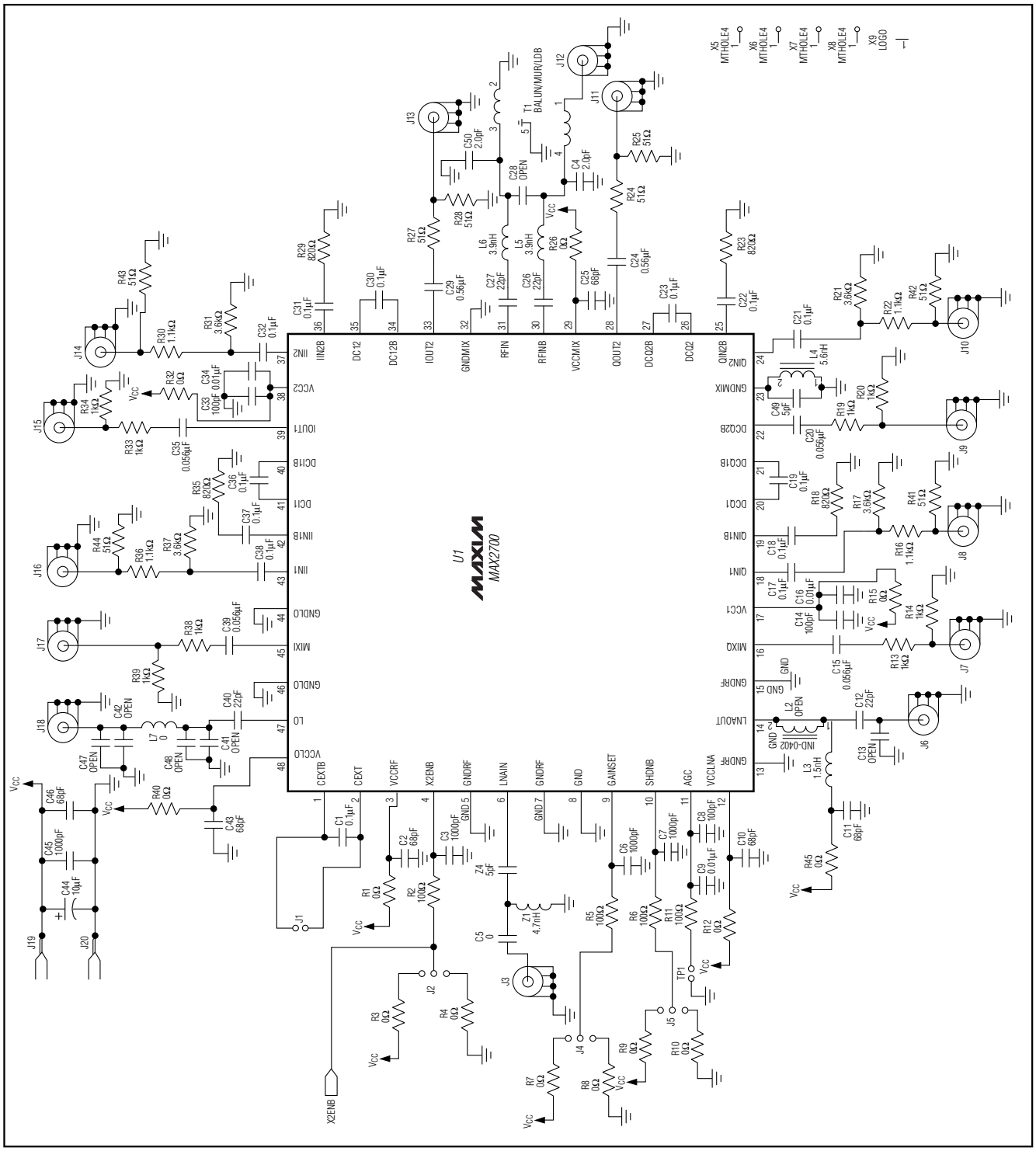

Figure 1a. MAX2700 EV Kit Schematic

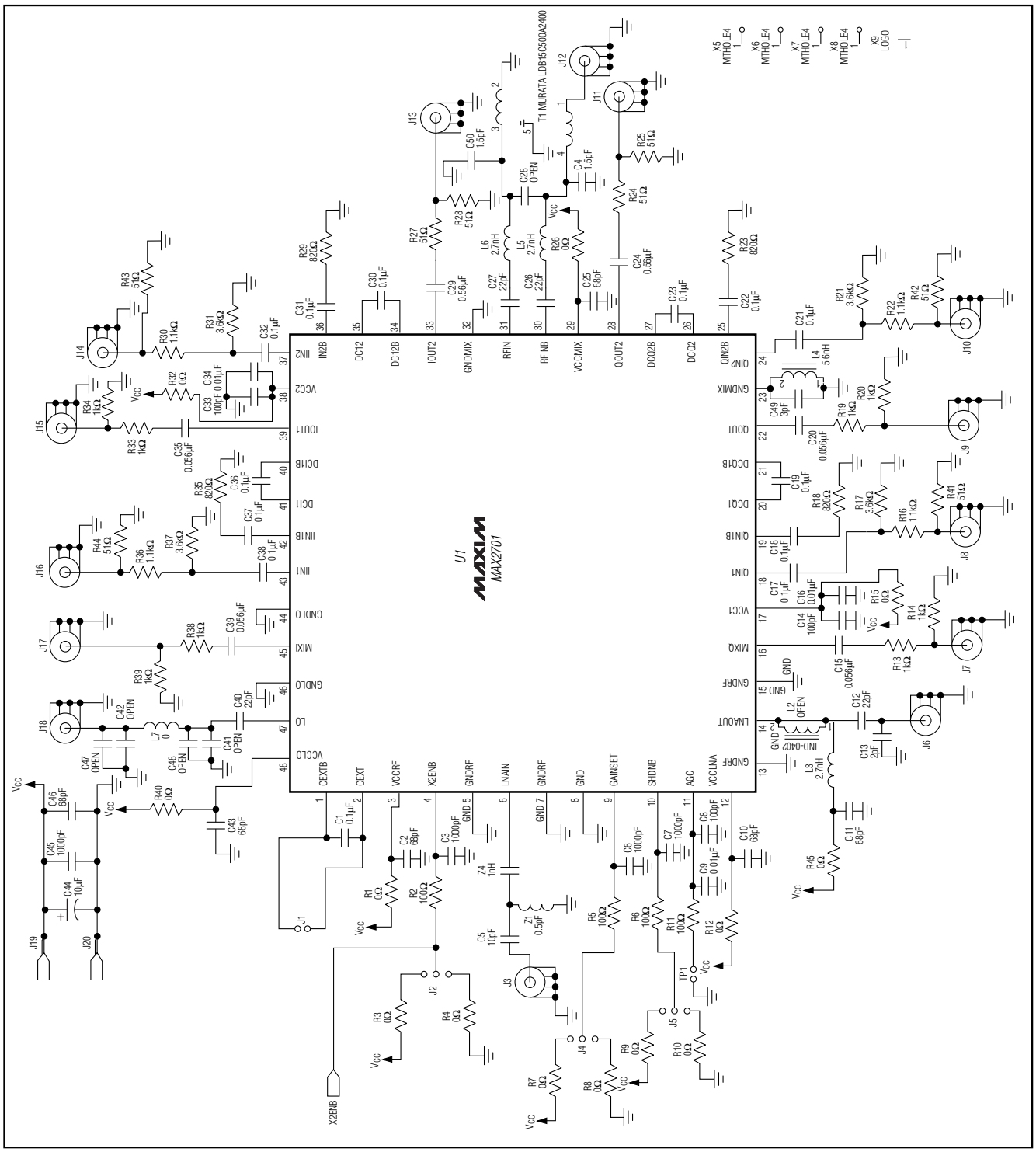

Figure 1b. MAX2701 EV Kit Schematic

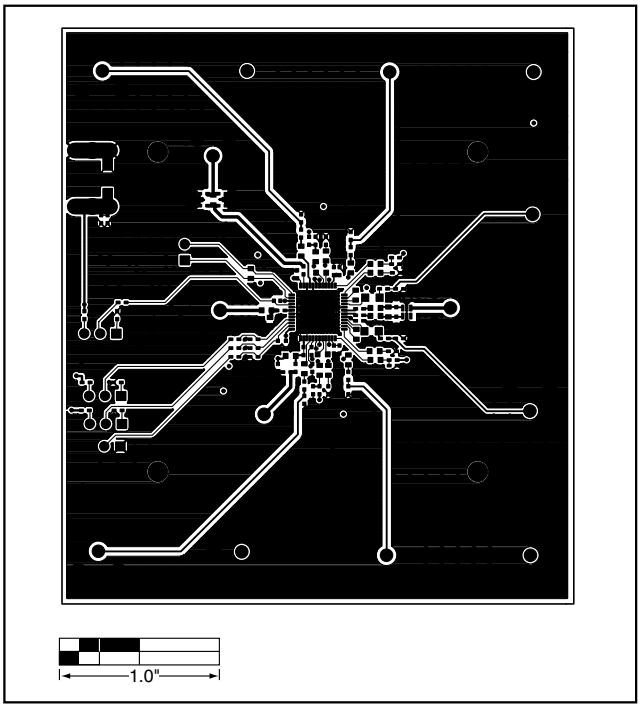

Figure 2. MAX2700/MAX2701 EV Kits PC Board Layout—Component Side

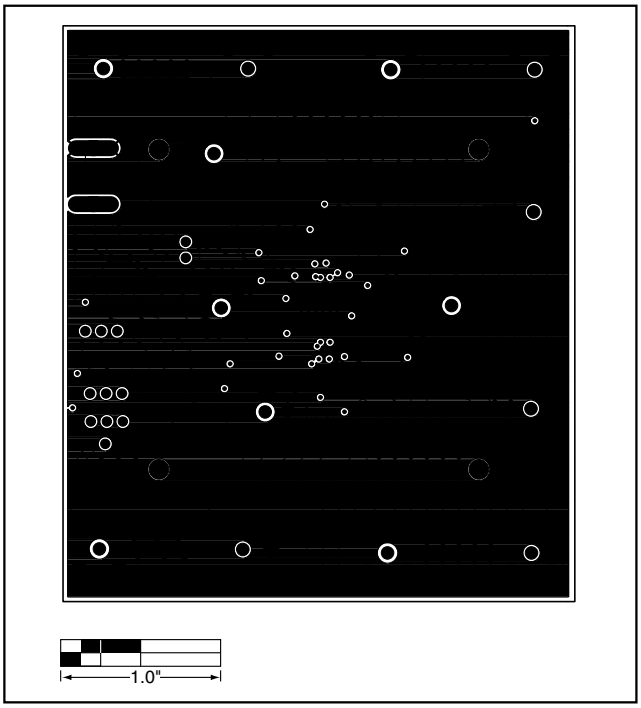

Figure 3. MAX2700/MAX2701 EV Kits PC Board Layout—Ground Plane

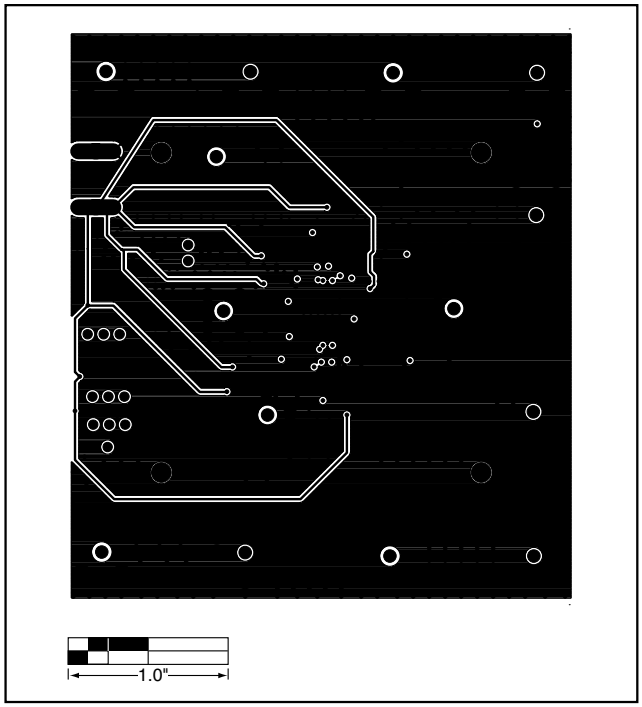

Figure 4. MAX2700/MAX2701 EV Kits PC Board Layout—Power Plane

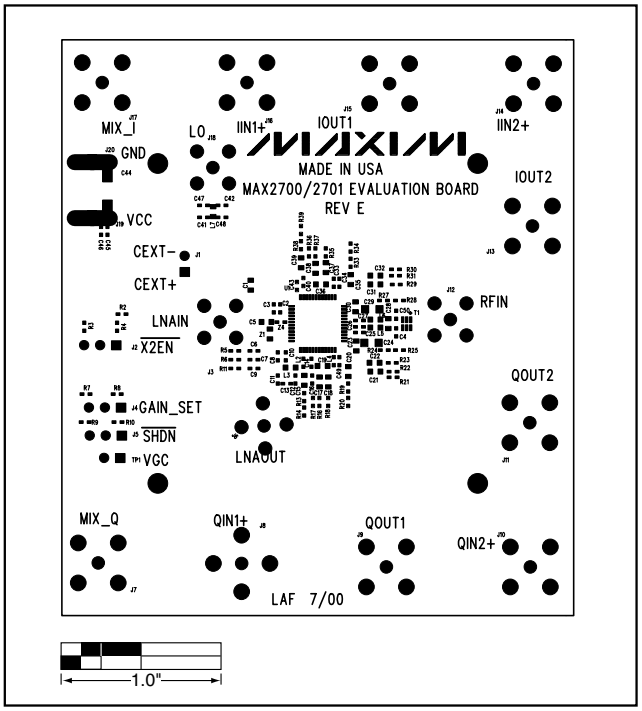

Figure 5. MAX2700/MAX2701 EV Kits Component Placement Guide—Top Silkscreen

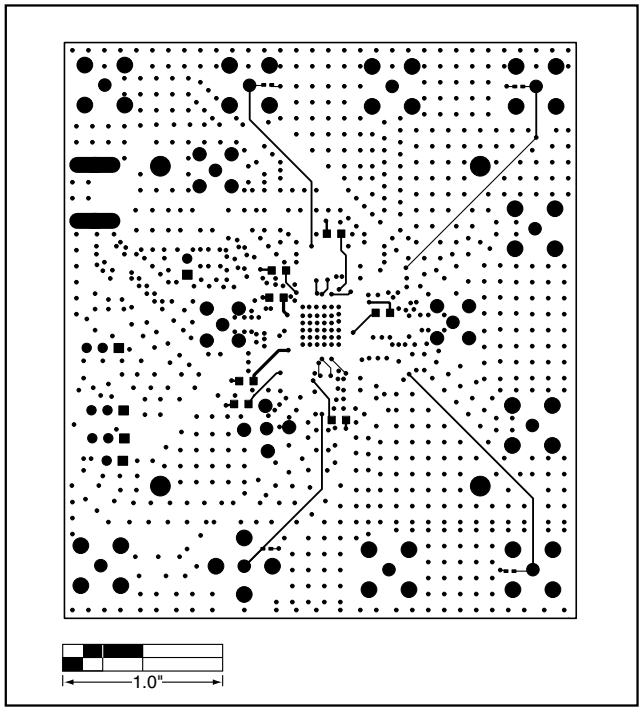

Figure 6. MAX2700/MAX2701 EV Kits PC Board Layout—Solder Side