19-1535; Rev 1; 6/00

MAXIM

MAX2320/21/22/24/26/27 Evaluation Kits

Evaluate: MAX2320/21/22/24/26/27

General Description

The MAX2320/MAX2321/MAX2322/MAX2324/MAX2326/MAX2327 evaluation kits (EV kits) simplify evaluation of these high-linearity, silicon germanium (SiGe), dual-band LNAs/mixers. They enable testing of the devices' RF performance and require no additional support circuitry. The signal inputs and outputs use SMA connectors to simplify the connection of RF test equipment.

The MAX2320/21/22/24/26/27 EV kits are assembled with an associated IC and incorporate input and output matching components optimized for the 869MHz to 894MHz cellular frequency band, 1930MHz to 1990MHz PCS frequency band, 210MHz digital mixer output frequency, and 110MHz FM mixer output frequency. All matching components may be changed to work at other frequencies within the bands specified in the MAX2320/21/22/24/26/27 data sheet.

Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX2320EVKIT	-40°C to +85°C	20 TSSOP-EP*
MAX2321EVKIT	-40°C to +85°C	20 TSSOP-EP
MAX2322EVKIT	-40°C to +85°C	20 TSSOP-EP
MAX2324EVKIT	-40°C to +85°C	20 TSSOP-EP
MAX2326EVKIT	-40°C to +85°C	20 TSSOP-EP
MAX2327EVKIT	-40°C to +85°C	20 TSSOP-EP

**EP = Exposed paddle*

Component Suppliers

SUPPLIER	PHONE	FAX	URL
AVX	803-946-0690	803-626-3123	www.avxcorp.com
Coilcraft	847-639-6400	803-639-1469	www.coilcraft.com
EFJohnson	402-474-4800	402-474-4858	www.efjohnson.com
Kamaya	219-489-1533	219-489-2261	www.kamaya.com
Murata Electronics	800-831-9172	814-238-0490	www.murata.com
Sprague	603-224-1961	603-224-1430	www.vishay.com
Toko	408-432-8281	408-943-9790	www.toko.com

Features

- ♦ **50Ω SMA Ports for Easy Testing**
- ♦ **+2.7V to +3.6V Single-Supply Operation**
- ♦ **All Critical Matching Components Included**
- ♦ **Fully Assembled and Tested**

MAX2320/21/26/27 EV Kits Component List

DESIGNATION	QTY	DESCRIPTION
C1, C32	2	1.0pF ±0.1pF ceramic caps (0603) Murata GRM39COG010B50V
C2	1	2.7pF ±0.1pF ceramic cap (0603) Murata GRM39COG2R7B50V
C6, C11, C15, C18, C20, C28	6	100pF ±5% ceramic caps (0603) Murata GRM39COG101J50V
C4, C5, C8, C34	4	6800pF ±5% ceramic caps (0603) Murata GRM39X7R682J50V
C7, C17	2	22pF ±5% ceramic caps (0603) Murata GRM39COG220J50V
C9	1	0.033µF ±10% ceramic cap (0603) Murata GRM39X7R333K50V
C10	1	4.7pF ±0.1pF ceramic cap (0402) Murata GRM36COG4R7B50V
C12	1	10µF ±20%,16V tantalum capacitor AVX TAJB106M016 or Sprague 293D106X0010B
C13, C14, C23	3	3.3pF ±0.1pF ceramic caps (0603) Murata GRM39COG3R3B50V or 3.3pF ±0.25pF ceramic caps (0603) Murata GRM39COG3R3C50V
C16, C19, C21, C22	4	0.01µF ±5% ceramic caps (0603) Murata GRM39X7R103J50V
C24–C27, C29	5	1000pF ±5% ceramic caps (0603) Murata GRM39X7R102J50V
C31	1	1.5pF ±0.1pF ceramic cap (0603) Murata GRM39COG1R5B50V
C35	1	18pF ±5% ceramic cap (0603) Murata GRM39COG1180J50V

MAX2320/21/26/27 EV Kits Component List (continued)

DESIGNATION		QTY	DESCRIPTION
L1		1	1.8nH ±10% inductor (0603) Coilcraft 0603CS-1N8XKBC
L2		1	6.8nH ±5% inductor (0603) Murata LQG11A6N8J00
L3		1	330nH ±5% inductor (1008) Coilcraft 1008CS-331XJBC
L4, L5		2	110nH ±5% inductors (0603) Coilcraft 0603CS-R11XJBC
L6		1	3.85nH ±10% inductor Coilcraft 0906-4-10
L7		1	4.7nH ±0.3nH inductor (0603) Toko LL1608-FH4N7S
L8		1	5.6nH ±0.5nH inductor (0603) Murata LQW1608A5N6D00
L9	MAX2320/ 26/27	—	Not installed
	MAX2321	1	8.2nH ±5% inductor (0603) Murata LQG11A8N2J00
L10		1	1.65nH air core Coilcraft 0906-2
R1	MAX2320/ 26/27	1	20kΩ ±5% resistor (0402) Kamaya RMC16S-203JT
	MAX2327	—	Not installed
R2		1	20kΩ ±5% resistor (0603) Kamaya RMC16-203JT

DESIGNATION		QTY	DESCRIPTION
R3, R4		2	51Ω ±5% resistors (0603) Kamaya RMC16-51RJT
R5		1	2kΩ ±5% resistor (0603) Kamaya RMC16-202JT
R6, R7, R8, R10		4	1kΩ ±5% resistors (0603) Kamaya RMC16-102JT
R9		1	8.2kΩ ±5% resistor (0603) Kamaya RMC16-822JT
R11		1	30Ω ±5% resistor (0603) Kamaya RMC16-30RJT
T1		1	Balun transformer (B5F type) Toko 458DB-1011
LNAINH, LNAOUTH, LNAINL, LNAOUTL, LOLIN, LOHIN, LOOUTH, LOOUTL, FMOUT, CDMAOUT, MIXINL, MIXINH		12	SMA connectors (PC edge mount) EFJohnson 142-0701-801
GND, VCC		2	Test points
JU1–JU4, JU6		5	3-pin headers
JU5, JU8		2	2-pin headers
None		7	Shunts (JU1–JU6, JU8)
U1	MAX2320	1	MAX2320EUP, 20-pin TSSOP-EP
	MAX2321	1	MAX2321EUP, 20-pin TSSOP-EP
	MAX2326	1	MAX2326EUP, 20-pin TSSOP-EP
	MAX2327	1	MAX2327EUP, 20-pin TSSOP-EP

MAX2322 EV Kit Component List

DESIGNATION	QTY	DESCRIPTION
C1, C32	2	1.0pF ±0.1pF ceramic caps (0603) Murata GRM39COG010B50V
C2, C3, C5, C6, C9, C10, C18, C22, C23, C30	—	Not installed
C7, C17	2	22pF ±5% ceramic capacitors (0603) Murata GRM39COG220J50V
C4, C8	20	6800pF ±5% ceramic caps (0603) Murata GRM39X7R082J50V
C9	1	0Ω resistor Kamaya RMC16-0R0JT
C11, C15, C20	3	100pF ±5% ceramic caps (0603) Murata GRM39COG101J50V
C12	1	10µF ±20%, 16V, tantalum capacitor AVX TAJB106M016 or Sprague 293D106X0010B
C13, C14	2	3.3pF ±0.1pF ceramic caps (0603) Murata GRM39COG3R3B50V or 3.3pF ±0.25pF ceramic caps (0603) Murata GRM39COG3R3C50V
C16, C19, C21	3	0.01µF ±5% ceramic caps (0603) Murata GRM39X7R103J50V
C24–C29	6	1000pF ±5% ceramic caps (0603) Murata GRM39X7R102J50V
C31	1	1.5pF ±0.1pF ceramic cap (0603) Murata GRM39COG1R5B50V
C33	1	33pF ±5% ceramic capacitor (0402) Murata GRM36COG330J50V
L1	1	1.8nH ±10% inductor (0603) Coilcraft 0603CS-1N8XKBC
L2, L3, L6, L7, L9	—	Not installed
L4, L5	2	110nH ±5% inductors (0603) Coilcraft 0603CS-R11XJBC

DESIGNATION	QTY	DESCRIPTION
L8	1	5.6nH ±0.5nH inductor (0603) Murata LQW1608A5N6D00
L10	1	1.65nH air core Coilcraft 0906-2
R1	1	20kΩ ±5% resistor (0402) Kamaya RMC16S-203JT
R2	1	20kΩ ±5% resistor (0603) Kamaya RMC16-203JT
R3	1	51Ω ±5% resistor (0603) Kamaya RMC16-51RJT
R4	—	Not installed
R5	1	2kΩ ±5% resistor (0603) Kamaya RMC16-202JT
R6, R7, R8, R10	4	1kΩ ±5% resistors (0603) Kamaya RMC16-102JT
R9	1	8.2kΩ ±5% resistor (0603) Kamaya RMC16-822JT
R11	1	30Ω ±5% resistor (0603) Kamaya RMC16-30RJT
T1	1	Balun transformer (B5F type) Toko 458DB-1011
LNAINH, LNAOUTH, LOHIN, LOOUTH, CDMAOUT, MIXINH	6	SMA connectors (PC edge mount) EFJohnson 142-0701-801
GND, VCC	2	Test points
JU1–JU4, JU6	5	3-pin headers
JU5, JU8	2	2-pin headers
None	7	Shunts (JU1–JU6, JU8)
U1	1	MAX2322EUP, 20-pin TSSOP-EP

MAX2324 EV Kit Component List

DESIGNATION	QTY	DESCRIPTION
C1, C4, C7, C8, C17, C20, C21, C31, C32, C33	—	Not installed
C2	1	2.7pF ±0.1pF ceramic cap (0603) Murata GRM39COG2R7B50V
C6, C11, C15, C18, C28	5	100pF ±5% ceramic caps (0603) Murata GRM39COG101J50V
C5, C30	2	6800pF ±5% ceramic caps (0603) Murata GMR39X7R682J50V
C9	1	0.033µF ±10% ceramic cap (0603) Murata GRM39X7R333K50V
C10	1	4.7pF ±0.1pF ceramic cap (0402) Murata GRM36COG4R7B50V
C12	1	10µF ±20%, 16V, tantalum capacitor AVX TAJB106M016 or Sprague 293D106X0010B
C13, C14, C23	3	3.3pF ±0.1pF ceramic caps (0603) Murata GRM39COG3R3B50V or 3.3pF ±0.25pF ceramic caps (0603) Murata GRM39COG3R3C50V
C16, C19, C22	3	0.01µF ±5% ceramic capacitors (0603) Murata GRM39X7R103J50V
C24–C27, C29	5	1000pF ±5% ceramic capacitors (0603) Murata GRM39X7R102J50V
C35	1	18pF ±5% ceramic capacitor (0603) Murata GRM39COG180J50V
L1, L7, L8, L9	—	Not installed
L2	1	6.8nH ±5% inductor (0603) Murata LQG11A6N8J00
L3	1	330nH ±5% inductor (1008) Coilcraft 1008CS-331XJBC
L4, L5	2	110nH ±5% inductors Coilcraft 0603CS-R11XJBC
L6	1	3.85nH ±10% inductor Coilcraft 0906-4-10
L10	1	4.7nH ±0.3nH inductor (0603) Toko LL1608-FH4N7S
R1	1	20kΩ ±5% resistor (0402) Kamaya RMCS16S-203JT
R2	1	20kΩ ±5% resistor (0603) Kamaya RMC16-203JT
R3	—	Not installed
R4	1	51Ω ±5% resistor (0603) Kamaya RMC16-51RJT
R5	1	2kΩ ±5% resistor (0603) Kamaya RMC16-202JT
R6, R7, R8, R10	4	1kΩ ±5% resistors (0603) Kamaya RMC16-102JT
R9	1	8.2kΩ ±5% resistor (0603) Kamaya RMC16-8252JT
R11	1	30Ω ±5% resistor (0603) Kamaya RMC16-30RJT
T1	1	Balun transformer (B5F type) Toko 458DB-1011
LNAINL, LNAOUTL, LOLIN, LOOUTL, FMOUT, CDMAOUT, MIXINL	7	SMA connectors (PC edge mount) EFJohnson 142-0701-801
GND, VCC	2	Test points
JU1–JU4, JU6	5	3-pin headers
JU5, JU8	2	2-pin headers
None	7	Shunts (JU1–JU6, JU8)
U1	1	MAX2324EUP, 20-pin TSSOP-EP

Quick Start

The MAX2320/21/22/24/26/27 EV kits are fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section for proper device evaluation. Figures 1, 2, and 3 show the schematics. Figures 4 through 9 are component placement guides and PC board layouts.

Test Equipment Required

The adjacent table lists the required test equipment to verify MAX2320/MAX2321/MAX2322/MAX2324/MAX2326/MAX2327 operation. It is intended as a guide only, and some substitutions are possible.

Connections and Setup

This section provides a step-by-step guide to operating the EV kits and testing the devices' functions. Do not turn on DC power or RF signal generators until all connections are made.

Testing the LNA

1) Connect a DC supply set to +2.7V (through an ammeter if desired) to the VCC and GND terminals on the EV kit. If available, set the current limit to 40mA.

2) Install the shunts across jumpers JU5 and JU8. Install the shunt across JU6 to the FMMXR position and across JU4 to the OFF position. See Tables 1–5 for positions of the shunts across JU1, JU2, and JU3 for different modes.

EQUIPMENT	DESCRIPTION
RF Signal Generators	Capable of delivering at least 0dBm of output power up to 2.5GHz (HP 8648C or equivalent)
RF Spectrum Analyzer	Capable of covering the operating frequency range of the devices as well as a few harmonics (HP 8561E, for example)
Power Supply	Capable of up to 100mA at +2.7V to +3.6V
Ammeter	For measuring the supply current (optional)
Network Analyzer	To measure small-signal return loss and gain (optional, HP 8753D, for example)

Table 1. MAX2320/MAX2321/MAX2326 Mode Selection

JU2 SHUNT POSITION	JU1 SHUNT POSITION	JU3 SHUNT POSITION	MODE
CELL	HLIN	HGAIN	Cellular band, high gain, high linearity
CELL	HLIN	LGAIN	Cellular band, low gain, high linearity
CELL	LLIN	HGAIN	Cellular band, high gain, low linearity
CELL	LLIN	LGAIN	Cellular band FM
PCS	HLIN	HGAIN	PCS band, high gain, high linearity
PCS	HLIN	LGAIN	PCS band, low gain, high linearity
PCS	LLIN	HGAIN	PCS band, high gain, low linearity
PCS	LLIN	LGAIN	Shutdown

Table 2. MAX2322 Mode Selection

JU2 SHUNT POSITION*	JU1 SHUNT POSITION	JU3 SHUNT POSITION	MODE
PCS	Don't care	Don't care	Shutdown
CELL	HLIN	HGAIN	PCS band, high gain, high linearity
CELL	HLIN	LGAIN	PCS band, low gain, high linearity
CELL	LLIN	HGAIN	PCS band, high gain, low linearity
CELL	LLIN	LGAIN	Not used

**JU2 is connected to the MAX2322 $\overline{SHDN}$ pin.*

MAX2320/21/22/24/26/27 Evaluation Kits

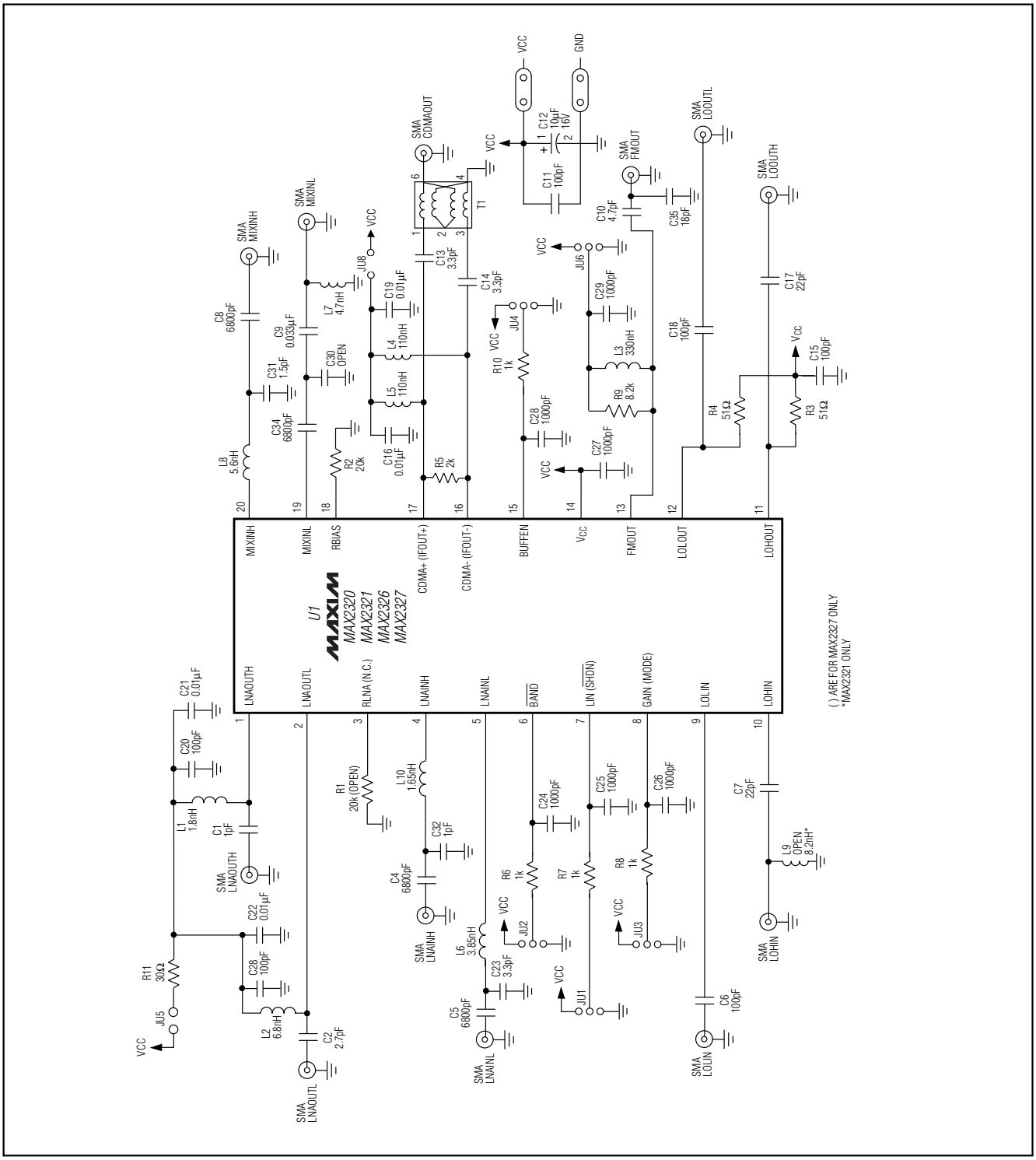

Figure 1. MAX2320/21/26/27 EV Kits Schematic

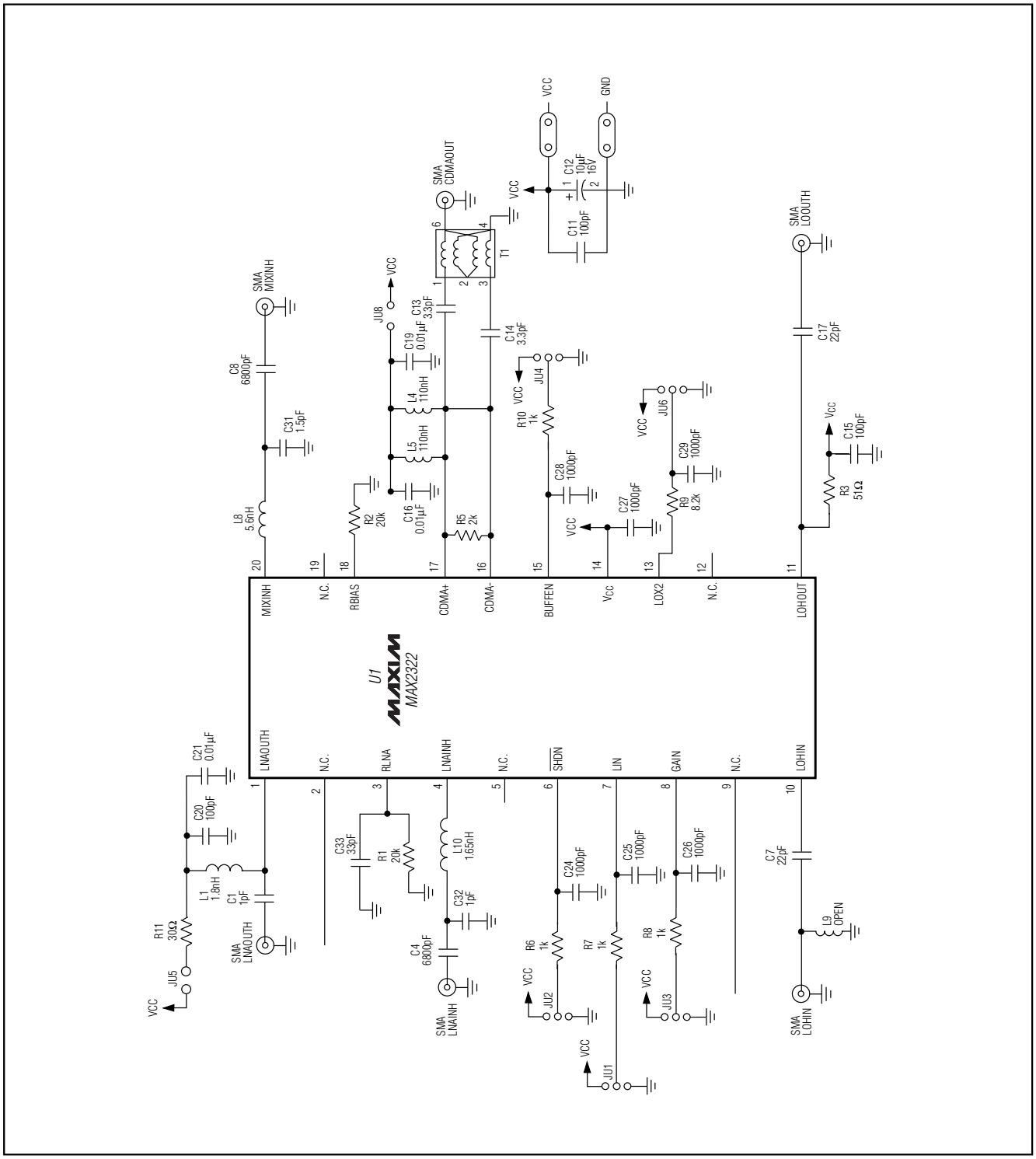

Figure 2. MAX2322 EV Kit Schematic

MAX2320/21/22/24/26/27 Evaluation Kits

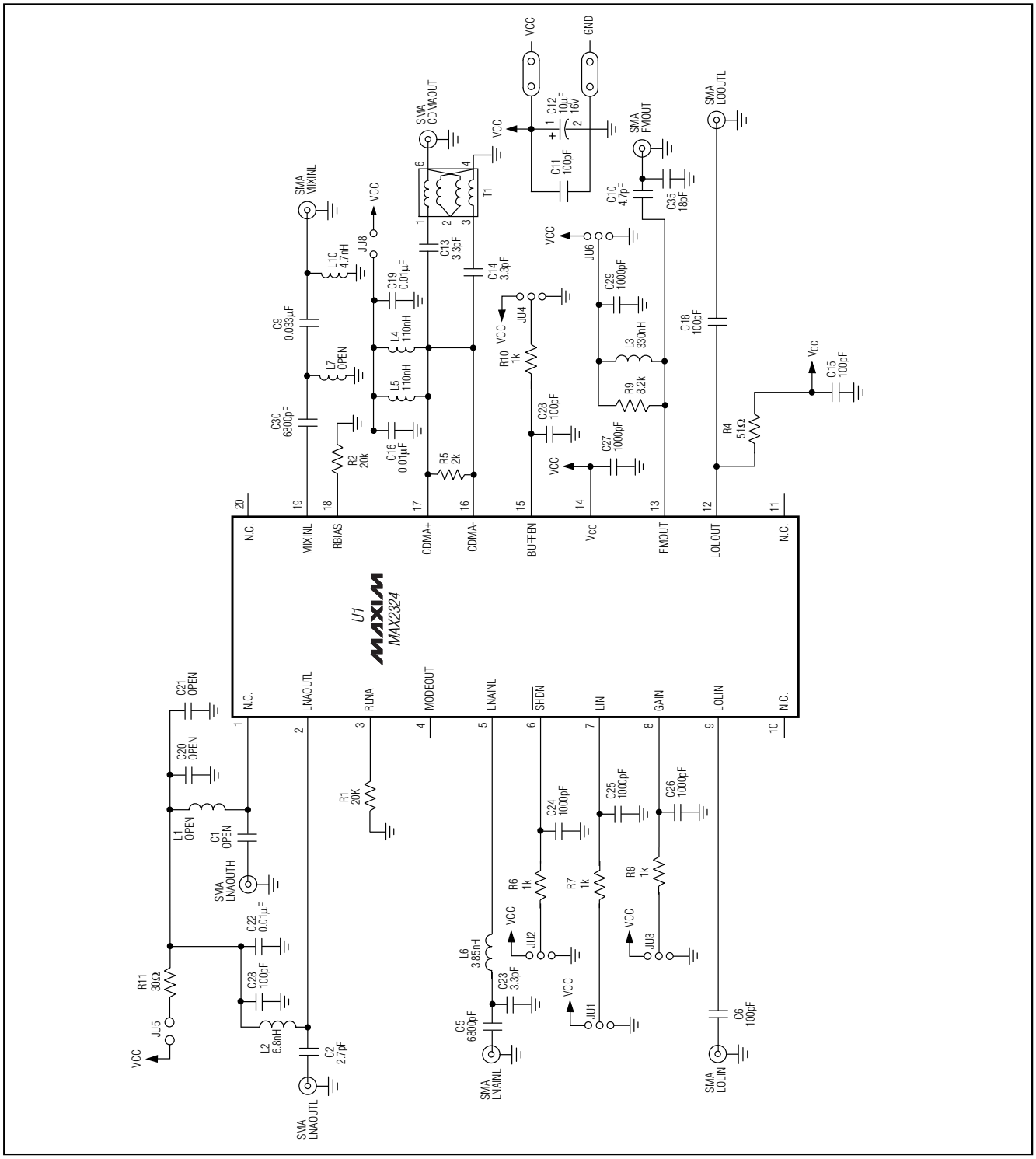

Figure 3. MAX2324 EV Kit Schematic

3) Connect one RF signal generator to the LNAINL (LNAINH) SMA connector for cellular (PCS) band testing. Do not turn on the generator's output. Set the generator for an output frequency of 881MHz (1960MHz) for cellular (PCS) band operation. Set the power level to -25dBm.
4) Connect the spectrum analyzer to the LNAOUTL (LNAOUTH) SMA connector for cellular (PCS) band. Set the center frequency to 881MHz (1960MHz) for cellular (PCS) band, and span to 5MHz.
5) Turn on the RF signal generator. The peak that appears on the spectrum analyzer should have a magnitude of about -11dBm in high-gain and FM modes. In low-gain modes, the magnitude should be about -27dBm. Be sure to account for cable losses (between 0.5dB and 2dB) and circuit board losses (approximately 0.5dB) when computing gain and noise figure.
6) (Optional) Another method for determining gain is by using a network analyzer. This has the advantage of displaying gain over a swept frequency band, in addition to displaying input and output return loss. Refer to the network analyzer manufacturer's user manual for setup details.

Testing the Mixer

1) Connect a DC supply set to +2.7V (through an ammeter if desired) to the VCC and GND terminals on the EV kit. If available, set the current limit to 40mA.
2) Install the shunts across jumpers JU5 and JU8. Install the shunt across JU6 to the FMMXR position (except MAX2322; see Table 5) and across JU4 to OFF. See Tables 1–4 for positions of the shunts across JU1, JU2, and JU3 for different modes.
3) Connect an RF signal generator to the MIXINL (MIXINH) SMA connector for cellular (PCS) band testing. Do not turn on the generator's output. Set the generator for an output frequency of 881MHz (1960MHz) for cellular (PCS). Set the power level to -25dBm.
4) See Table 5, and connect the second RF signal generator to the appropriate LO connector and set the frequency accordingly. Set the power level to -6dBm.
5) In FM mode, connect the spectrum analyzer connector to the FMOUT SMA, set the center frequency to 110MHz, and span to 5MHz. For all other modes, connect the spectrum analyzer connector to the CDMAOUT SMA and set the center frequency to 210MHz and span to 5MHz.

Table 3. MAX2324 Mode Selection

JU2 SHUNT POSITION*	JU1 SHUNT POSITION	JU3 SHUNT POSITION	MODE
PCS	Don't care	Don't care	Shutdown
CELL	HLIN	HGAIN	Cellular band, high gain, high linearity
CELL	HLIN	LGAIN	Cellular band, low gain, high linearity
CELL	LLIN	HGAIN	Cellular band, high gain, low linearity
CELL	LLIN	LGAIN	FM

**JU2 is connected to the MAX2324 $\overline{SHDN}$ pin.*

Table 4. MAX2327 Mode Selection

JU2 SHUNT POSITION	JU1 SHUNT POSITION*	JU3 SHUNT POSITION	MODE
Don't care	LLIN	Don't care	Shutdown
CELL	HLIN	HGAIN	Cellular band, digital mixer output
CELL	HLIN	LGAIN	Cellular band, FM
PCS	HLIN	HGAIN	PCS band, digital mixer output
PCS	HLIN	LGAIN	Not used

**JU1 is connected to the MAX2327 $\overline{SHDN}$ pin.*

Table 5. LO Connector and LO Input Frequency Selection

DEVICE AND BAND OF OPERATION	LO CONNECTOR	LO INPUT FREQUENCY (MHz)
MAX2320/MAX2327 Cellular	LOINL	1091
MAX2320/MAX2327 FM	LOINL	991
MAX2320/MAX2327 PCS	LOINH	1750
MAX2321 Cellular	LOINH	1091
MAX2321 FM	LOINL	991
MAX2321 PCS	LOINH	1085
MAX2322 PCS, JU6 shunt at LOX2N position	LOINH	1750
MAX2322 PCS, JU6 shunt at FMMXR position	LOINH	1085
MAX2324 Cellular	LOINL	1091
MAX2324 FM	LOINL	991
MAX2326 Cellular	LOINH	2182
MAX2326 FM	LOINL	991
MAX2326 PCS	LOINH	2170

6) Turn on both RF signal generators. In FM mode, the spectrum analyzer should read about -15dBm at 110MHz. In all other modes, the peak should be about -13dBm at 210MHz. Be sure to account for cable losses (between 0.5dB and 2dB) and circuit board losses (approximately 0.5dB) when computing gain and noise figure.

Layout

The EV kit PC board can serve as a guide for layout using the MAX2320/21/22/24/26/27.

Keep traces carrying RF signals as short as possible to minimize radiation and insertion loss due to the PC board. Keep the differential mixer output traces together and of equal length to ensure signal amplitude balance. Solder the entire bottom side slug evenly to the board ground plane for best RF performance. Run the input trace to the PCS LNA on the top layer of the PC board avoiding via-induced coupling. Minimize the parallel length of the cellular LNA input trace with the PCS LNA input trace.

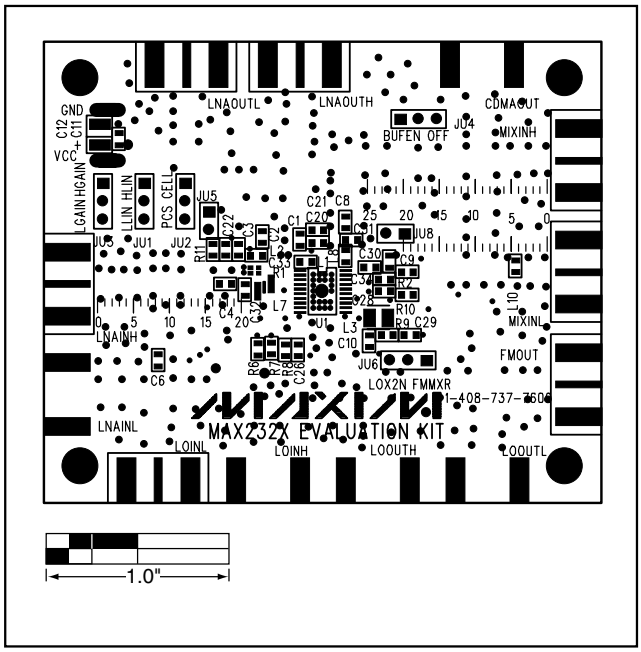

Figure 4. MAX2320/21/22/24/26/27 EV Kits Component Placement Guide—Component Side

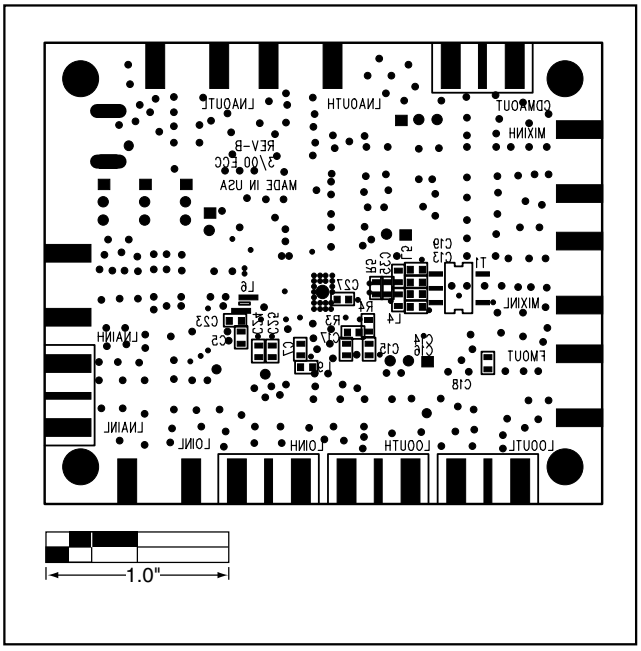

Figure 5. MAX2320/21/22/24/26/27 EV Kits Component Placement Guide—Solder Side

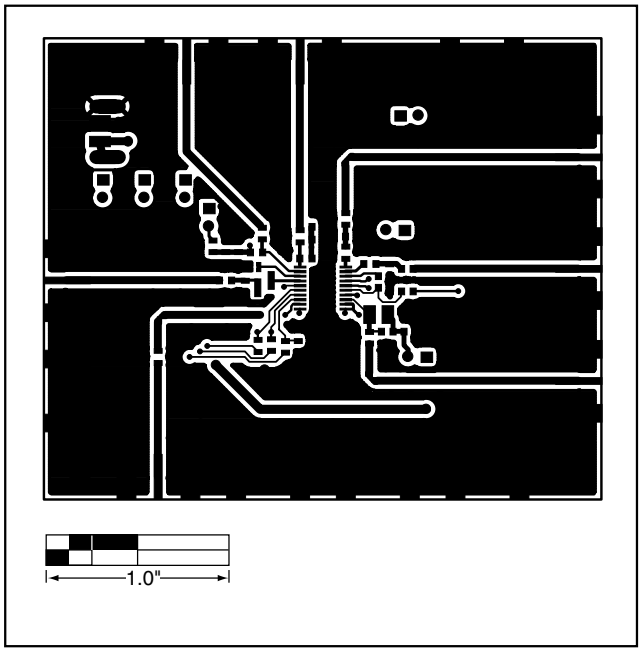

Figure 6. MAX2320/21/22/24/26/27 EV Kits PC Board Layout—Component Side

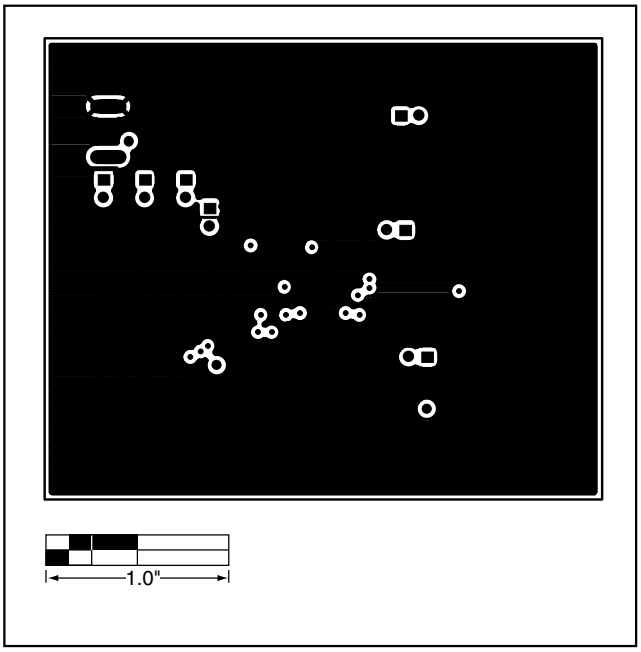

Figure 7. MAX2320/21/22/24/26/27 EV Kits PC Board Layout—Ground Plane 2

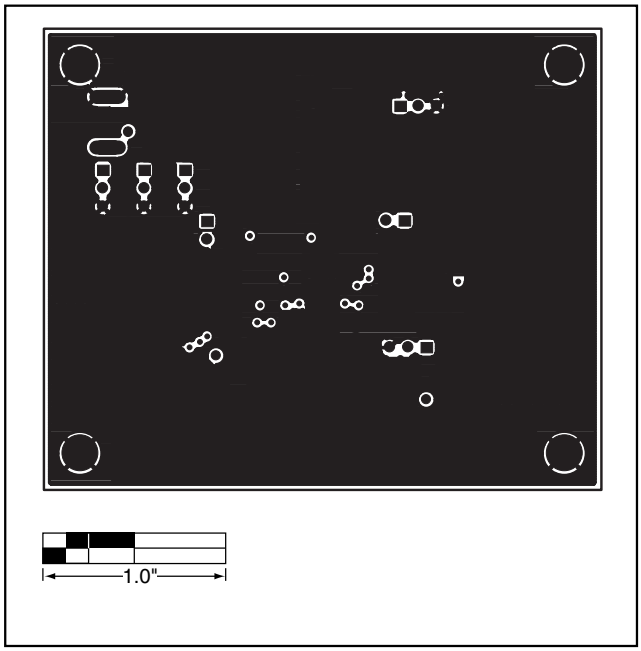

Figure 8. MAX2320/21/22/24/26/27 EV Kits PC Board Layout—Ground Plane 3

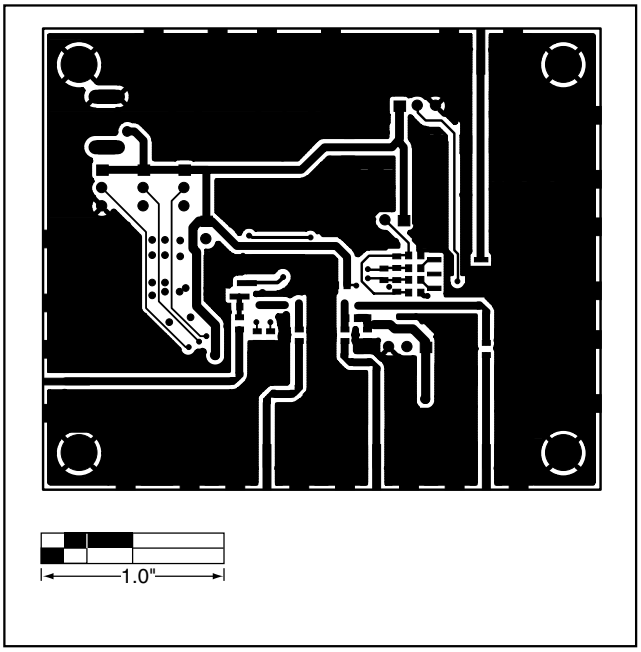

Figure 9. MAX2320/21/22/24/26/27 EV Kits PC Board Layout—Solder Side