19-1651; Rev 1; 5/01

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MAX2360 Evaluation Kit

General Description

The MAX2360 evaluation kit (EV kit) simplifies testing of the MAX2360/MAX2362/MAX2364. The EV kit provides 50Ω SMA connectors for all RF inputs and outputs. A varactor-based tank circuit is provided for the on-chip voltage-controlled oscillator (VCO) and can be tuned by a potentiometer or external voltage, or phase locked with an on-chip PLL. I/Q baseband inputs come standard with BNC connectors.

The EV kit allows evaluation of the MAX2360/MAX2362/MAX2364s' variable-gain amplifier (VGA), I/Q IF modulator, IF VGA, RF upconverter, dual-band IF VCOs, dual synthesizer, 3-wire programming interface, and power-management features.

The MAX2360 EV kit also allows evaluation of the single-band MAX2362/MAX2364, as they are subsets of the MAX2360.

Features

♦ **SPI™/QSPI™/MICROWIRE™ Compatible**
♦ **Differential and Single-Ended Baseband Inputs**
♦ **Single-Supply Operation**
♦ **50Ω SMA Connectors on All RF Ports**
♦ **BNC Connectors for Baseband Inputs**
♦ **Low-Power Shutdown Mode**
♦ **PC Control Software Available at www.maxim-ic.com**

Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX2360EVKIT	-40°C to +85°C	48 TQFP

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	3pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG030B050 or Taiyo Yuden EVK105CH030JW
C2, C16, C20, C31, C39, C40, C57, C60, C64, C67, C68, C76, C78, C80	14	100pF ±5% ceramic capacitors (0402) Murata GRM36COG101J050 or Taiyo Yuden UMK105CH101JW
C3, C41	2	33pF ±5% ceramic capacitors (0402) Murata GRM36COG330J050 or Taiyo Yuden UMK105CH330JW
C4, C8, C11, C15, C17, C18, C32–C35, C55, C75	12	0.01µF ±10% ceramic caps (0402) Murata GRM36X7R103K016 or Taiyo Yuden EMK105BJ103KV
C5, C13, C14, C26, C27, C65, C66	0	Not installed
C6	1	2.4pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG2R4B050 or Taiyo Yuden EVK105CH2R4JW
C7, C10, C19, C43, C52, C63	6	1000pF ±10% ceramic caps (0402) Murata GRM36X7R102K50 or Taiyo Yuden UMK105B102KW
C9, C21, C94	3	1µF ±10% ceramic capacitors (0805) Murata GRM40X7R105K010 or Taiyo Yuden LMK212BJ105KG

DESIGNATION	QTY	DESCRIPTION
C12	1	4.3pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG4R3B050 or Taiyo Yuden EVK105CH4R3JW
C22, C23	2	18pF ±5% ceramic capacitors (0402) Murata GRM36COG180J050 or Taiyo Yuden UMK105CH180JW
C24, C25	2	12pF ±5% ceramic capacitors (0402) Murata GRM36COG120J050 or Taiyo Yuden UMK105CH120JW
C28, C29, C37	3	0.033µF ±10% ceramic caps (0402) Murata GRM36X7R333K010 or Taiyo Yuden LMK105BJ333KV
C30, C36	2	3300pF ±10% ceramic caps (0402) Murata GRM36X7R332K050 or Taiyo Yuden UMK105B332KW
C38, C42, C58, C79, C88, C89, C91, C92, C93, C95, C96, C97	12	0.1µF ±10% ceramic capacitors (0402) Murata GRM36X5R104K010 or Taiyo Yuden LMK105BJ104KV
C44, C45, C46	3	15pF ±5% ceramic capacitors (0402) Murata GRM36COG150J050 or Taiyo Yuden UMK105CH150JW
C47, C50	2	9.1pF ±0.25pF ceramic caps (0402) Murata GRM36COG9R1C050
C48	1	7pF ±0.5pF ceramic capacitor (0402) Murata GRM36COG070D50 or Taiyo Yuden UMK105CH070DW

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MICROWIRE is a trademark of National Semiconductor Corp.

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For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at

Evaluates: MAX2360/MAX2362/MAX2364

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C49	1	2.7pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG2R7B050 or Taiyo Yuden EVK105CH2R7JW
C51	1	1.5pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG1R5B050 or Taiyo Yuden EVK105CH1R5BW
C53, C54	2	10pF ±5% ceramic capacitors (0402) Murata GRM36COG100J050 or Taiyo Yuden UMK105CH100JW
C77	1	10µF, 10V tantalum capacitor AVX TAJB106M010
D1, D2	2	Varactor diodes Alpha Industries SMV1255-003
D3	0	Not installed
FL1	1	130.38MHz LC filter Murata LFSH30N32M0130A
GND, GND, RBIAS, VBAT, VGC, VREG	6	Test points Mouser 151-203
I-, Q-	2	BNC jacks (PC mount, female) A/D Electronics 580-002-00
IFINH, IFLO, IFOUTH, LOH, LOL, REF, RFH0, RFH1, RFL	9	SMA connectors (PC edge mount) EFJohnson 142-0701-801
JP1	1	20-pin header (2x10), 0.1in centers
JP2	1	5-pin header, 0.1in centers
JU1–JU4 , JU6–JU10, JU12	10	2-pin headers
L1	1	8.7nH ±5% inductor (0603) Coilcraft 0603CS-8N7XJBC
L2, L3	2	100nH ±5% inductors (0603) Coilcraft 0603CS-R10XJBC
L4	1	10nH ±5% inductor (0603) Coilcraft 0603CS-10NXJBC
L5, L16, L19	3	220nH ±5% inductors (0603) Coilcraft 0603CS-R22XJBC
L6	1	2.2nH ±0.3nH inductor (0402) Murata LQG10A2N2S00
L9	1	39nH ±5% inductor (0603) Coilcraft 0603CS-39NXJBC
L10, L11	2	22nH ±5% inductors (0603) Coilcraft 0603CS-22NXJBC

DESIGNATION	QTY	DESCRIPTION
Q1	0	Not installed
R1, R2, R7, R47	4	47kΩ ±5% resistors (0402)
R3	1	51kΩ ±5% resistor (0402)
R4, R5, R20, R29, R30, R46	6	1kΩ ±5% resistors (0402)
R6, R8, R14, R16, R76	5	0Ω resistors (0402)
R9–R12, R15, R17, R18, R19, R33, R37, R39, R65, R70–R73, R75, R77	0	Not installed (open)
R31, R32, R35, R36, R40, R64	6	10kΩ ±5% resistors (0402)
R38, R60, R61, R62, R67	0	Not installed (shorted with PC trace)
R41, R66	2	10kΩ ±10% multiturn potentiometers
R43, R54, R56	3	100Ω ±5% resistors (0402)
R53, R57	2	150Ω ±5% resistors (0402)
R74	1	16.2kΩ ±1% resistor (0603)
T2, T3	2	Balun transformers (B5F type) TOKO 458DB-1011
T5, T6	2	Balun transformers Coilcraft TTWB2010
U1	1	MAX2360ECM (48-pin TQFP)
U2	0	Not installed
V1	1	1750MHz VCO Murata MQE-925-1750
V2	1	967MHz VCO Murata MQE-917-967
None	8	Shunts for JU3, JU4, JU6–JU10, JU12
None	1	MAX2360 PC board
None	1	MAX2360/MAX2362/MAX2364 data sheet
None	1	MAX2360 EV kit data sheet
None	1	INTF2300 board
None	1	MAX2360 EV kit software

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Component Suppliers

SUPPLIER	PHONE	FAX
Alpha Industries	617-935-5150	617-933-2359
AVX	803-946-0690	803-626-3123
Coilcraft	847-639-6400	847-639-1469
EFJohnson	402-474-4800	402-474-4858
Murata	949-852-2001	949-852-2002
Taiyo Yuden	408-573-4150	408-573-4159
Toko	708-297-0070	708-699-1194

Note: *Please indicate that you are using the MAX2360 when contacting these component suppliers.*

Quick Start

The MAX2360 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section.

Test Equipment Required

This section lists the recommended test equipment to verify the operation of the MAX2360. It is intended as a guide only, and substitutions may be possible.

- One RF signal generator capable of delivering -7dBm of output power in the 10MHz to 50MHz frequency range (HP 8648A or equivalent) for the PLL reference frequency
- An RF spectrum analyzer with optional CDMA personality (Rohde & Schwarz FSEA20 or equivalent)
- A power supply that can provide 250mA at +3.0V
- Low-noise power supply (HP 6236B or equivalent), or voltage regulator
- Optionally, an additional voltage source for external control of VGA functions
- I/Q arbitrary waveform generator or CDMA generator (HP E4433B or equivalent)
- PC (486DX33 or better) with Win95® or Win98® operating system and an available parallel port
- INTF2300 interface board (supplied with EV kit)

Connections and Setup

This section provides step-by-step instructions for getting the EV kit up and running in cellular and PCS CDMA modes.

Win95 and Win98 are registered trademarks of Microsoft Corp.

Cellular CDMA Mode

Perform the following steps to evaluate the MAX2360 in the cellular CDMA mode:

1) Verify shunts JU4, JU6–JU10, and JU12 are in place. Connect the cellular VCO module side of JU2 to the low-noise power supply or a regulator. This is to prevent excessive supply pushing, which degrades the ACPR of narrow-band modulation such as IS-136, even though the ACPR of CDMA-modulated signals is not affected.

2) Connect the INTF2300 interface cable as shown in Figure 7. **Note:** Pin 1 of the interface cable corresponds to the red wire. Pin 1 is designated in silkscreen on each of the PC boards.

3) Download the serial-interface control software at www.maxim-ic.com/techsupport/other/htm and install on a PC with a parallel port.

4) Connect a +2.85V power supply to the V_{BAT} and V_{REG} terminals. The INTF2300 board derives its power from the MAX2360 EV kit.

5) Connect a function generator to the REF port, configured for a sine wave with a frequency of 19.68MHz and an amplitude of -13dBm.

6) Connect a CDMA baseband signal generator to the I and Q ports using a BNC connector. Configure the output for 200mV$_{RMS}$. The EV kit includes transformers at the I and Q inputs that do not pass signals below 50kHz. For evaluation of digital mode with low-frequency content, bypass the transformer as described in the *Detailed Description*.

7) Install and run Maxim CDMA control software. Software is also available on the Web at www.maxim-ic.com. On the IC selection form, click on the MAX2360 control button.

8) With the MAX2360 control screen active, click on the cellular CDMA preset located at the left of the screen.

9) Click on the Send Data button for each of the control registers located at the right of the screen. There are seven registers that need to be downloaded to the IC. The Lock LED on the screen should be red, indicating lock.

10) Set the VGA control to 2.5VDC by rotating potentiometer R66. Optionally, an external VGA control voltage may be used by removing jumper JU4 and applying a DC voltage to header VGC. Current consumption is about 150mA. This includes the RF VCO and the potentiometers.

11) Connect RFL to the spectrum analyzer. Configure a

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spectrum analyzer to measure ACPR for reverse-channel CDMA. Set the center frequency to 836MHz with a +10dBm reference level.

12) The output power should be about 7dBm after accounting for cable and connector loss. The ACPR at ±885kHz offset should be -54dBc, and the ACPR at ±1.98MHz offset should be -70dBc.

Low-Band PCS CDMA Mode

Perform the following steps to evaluate the MAX2360 in the PCS CDMA mode:

1) Connect the PCS VCO module side of JU3 to the low-noise power supply or a regulator.

2) With the MAX2360 control screen active, click on the PCS Low preset located at the left of the screen.

3) Click on the Send Data buttons for each of the control registers located at the right of the screen. There are seven registers that need to be downloaded to the IC. The Lock LED on the screen should be red, indicating lock.

4) Set the VGA control to 2.55VDC by rotating potentiometer R66. Optionally, an external VGA control voltage may be used by removing jumper JU4 and applying a DC voltage to header VGC. Current consumption is about 150mA. This includes the RF VCO and the potentiometer.

5) Connect the RFH1 port to the spectrum analyzer. Configure a spectrum analyzer to measure ACPR for reverse-channel CDMA. Set the center frequency to 1880.38 MHz with a +10dBm reference level.

6) The output power should be about 7dBm after accounting for cable and connector loss. The ACPR at ±1.25MHz offset should be -54dBc.

Adjustments and Control

VGA Adjust

The MAX2360 EV kit is configured with a 10kΩ trim potentiometer for setting and adjusting the VGA gain. By removing the two-pin shunt JU4, an external supply can be used by directly connecting to header VGC. The VGC voltage is filtered on the EV kit to minimize undesired amplitude modulation.

Optional VCO External Adjust

The MAX2360 EV kit is configured with a 10kΩ trim potentiometer for setting and adjusting the VCO tune voltage. Apply a two-pin shunt to JU1. Stuff a 0Ω resistor for R33, and remove R38 to break the loop and remove the charge-pump output. The VCO voltage must be clean to minimize undesired frequency modulation.

Interface Control

The interface port is designed to use a 20-pin ribbon cable (Figure 8); 10 pins are signal lines, and the other 10 pins are digital grounds. Pin 1 of the interface cable is red. Pin 1 is also designated in silk screen on each of the PC boards.

$\overline{IDLE}$

A logic low on the $\overline{IDLE}$ pin shuts down everything except the RF PLL and associated registers.

$\overline{TXGATE}$

A logic low on the $\overline{TXGATE}$ pin shuts down everything except the RF PLL, IF PLL, IF VCO, serial bus, and registers. This mode is used for gated transmission.

$\overline{SHDN}$

A logic low on the $\overline{SHDN}$ pin powers down the entire device, including registers and the serial interface.

Detailed Description

The following section covers the EV kit's circuit blocks in detail (refer to the MAX2360/MAX2362/MAX2364 data sheet for additional information).

I/Q Inputs

The I/Q ports are high-impedance differential baseband inputs. They require a DC bias level of 1/2 V_{CC} with 6µA of current drive. For convenience, the MAX2360 EV kit provides a transformer that provides a single-ended to differential conversion and provides bias for the I/Q inputs. The transformer makes it easy to interface with single-ended test equipment, but due to its low-frequency cutoff of 50kHz, does not allow full evaluation of the MAX2360. To evaluate the part over its full bandwidth, use shielded twisted-pair transmission line to connect a differential signal source to the differential pads provided on the EV kit. Stuff R10, R12, R15, and R17 with 0Ω resistors and remove R6, R8, R14, and R16 when using the differential pads.

Programming Interface

The programming interface is provided by the INTF2300 interface board. The interface board buffers and level shifts logic levels from the PC to the MAX2360 EV kit (refer to the INTF2300 documentation). These logic signals control the logic pins as well as the MAX2360 serial interface.

IFLO

The IFLO output port provides an output signal that is either the IF VCO frequency or the VCO frequency divided by 2, depending on the setting of the BUF_DIV control bit. It can be disabled by setting the BUF_EN bit to 0 in the OPCTRL register.

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TANK BYP

The tank bypass port is provided to drive the high-band tank with an external LO source. The VCO_BYP bit should be set to 1 to enable this port. Stuff C24 and C25 with AC-coupling capacitors; R70 and R75 with 0Ω resistors; and remove L10, C12, R35, and R36.

REF

REF provides the reference frequency for the RF and IF PLL. The REF port is AC-coupled. Make sure the reference signal has low phase noise.

LOH

LOH is the high-band RF LO input port and is optimized for PCS frequency. The EV kit is shipped with this port disconnected. To use this port with an external signal source, disconnect the PCS VCO by removing C39 and placing it at location C66.

LOL

LOL is the low-band RF LO input port and is optimized for cellular frequency. The EV kit is shipped with this port disconnected. To use this port with an external signal source, disconnect the cellular VCO by removing C40 and placing it at location C65.

RFH1

RFH1 is the PCS high-band PA driver output. This port is active in PCS high mode. Refer to Table 6 in the MAX2360/MAX2362/MAX2364 data sheet for the mode description.

RFL

RFL is the cellular band PA driver output. This port is active in PCS high mode. Refer to Table 6 in the MAX2360/MAX2362/MAX2364 data sheet for the mode description.

RFH0

RFH0 is the PCS low-band PA driver output. This port is active in PCS high mode. Refer to Table 6 in the MAX2360/MAX2362/MAX2364 data sheet for the mode description.

IFINH

IFINH is the high-band IF input port. For convenience, a matching network and balun have been provided to transform the 400Ω differential port to a 50Ω SMA connector. It is matched for 130MHz broadband operation. C43 is an AC-coupling capacitor, while balun T2 performs a 4-to-1 impedance transformation from 50Ω to 200Ω, as well as single-ended to differential conversion. C54, C53, and L5 are a series differential shunt match from 200Ω to 400Ω. Capacitor C51 partially resonates with inductor L5 to increase the effective inductance.

Table 1. Jumpers

JUMPER	ASSOCIATED FUNCTIONAL BLOCK
JU1	IF VCO pot (for open-loop operation)
JU2	External cellular VCO
JU3	External PCS VCO
JU4	VGC jumper. Shorted VGC provided by on-board potentiometer. Open VGC provided by external source.
JU5	RF charge-pump output (optional)
JU6	PA predrivers V_{CC}
JU7	RF mixer V_{CC}
JU8	IF modulator V_{CC}
JU9	Digital V_{CC}
JU10	IF charge pump V_{CC}
JU11	Shutdown pin (optional)
JU12	RF VCO supply

IFOUTH

IFOUTH is the high-band IF output port. It is matched for 130MHz broadband operation. C52 is an AC-coupling capacitor, while balun T3 performs a 4-to-1 impedance transformation from 50Ω to 200Ω as well as single-ended to differential conversion. C47, C50, and L2, L3 are a series shunt match from 200Ω to 600Ω. Capacitor C49 partially resonates with inductors L2 and L3 to increase the effective inductance.

IFINL and IFOUTL

For cascade evaluation, an on-board filter is connected between IFOUTL and IFINL. Select these ports by programming IFSEL to zero.

VBAT/VREG

VBAT supplies V_{CC} to the PA driver circuitry. This may be an unregulated battery voltage. The PA drivers are open collector.

VREG supplies V_{CC} to the RF mixer, IF modulator, digital circuitry, and VCOs. There are optional pads for a MAX8868EUK29 2.84V, 5-pin SOT23, low-dropout (LDO) regulator. Jumpers are provided to enable current measurement to each functional block of the IC (Table 1).

RBIAS

When resistor R73 is stuffed (typically $16k\Omega$), a bias voltage may be applied to the RBIAS header to adjust the PA driver bias current. Internal to the IC, pin 12 is set to 1.18V by a bandgap reference. Output linearity or efficiency may be improved by adjusting PA driver current.

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Layout Considerations

The MAX2360 EV kit can serve as a guide for your board layout. Keep PC board trace lengths as short as possible to minimize parasitics. Also, keep decoupling capacitors as close to the IC as possible with a direct connection to the ground plane.

PC Board Construction

The MAX2360 EV kit PC board uses a 14mil-wide trace for 50Ω transmission line. The PC board has an 8mil-layer profile on FR4 with a dielectric of 4.5 and a trace to coplanar ground-plane spacing of 15mil.

INTF2300 SPI Interface Board

The INTF2300 interface board is used to interface 3-wire SPI protocol from a PC's parallel port to a device under test. This board will level translate 5V logic from the PC to V_{CC} of the device under test (typically this will be 3.3V logic). The INTF2300 also provides buffering and EMI filtering. Its absolute maximum supply voltage is 4.6V, limited by the breakdown of the buffer IC. The recommended operating supply voltage range is +2.7V to +3.6V. For operations above +3.6V, jumper JU1 may be removed and an external supply voltage of +3.6V may be applied between VCC (pin 2) and GND (pin 1) (Figure 8).

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Evaluates: MAX2360/MAX2362/MAX2364

Figure 1. MAX2360 EV Kit Schematic
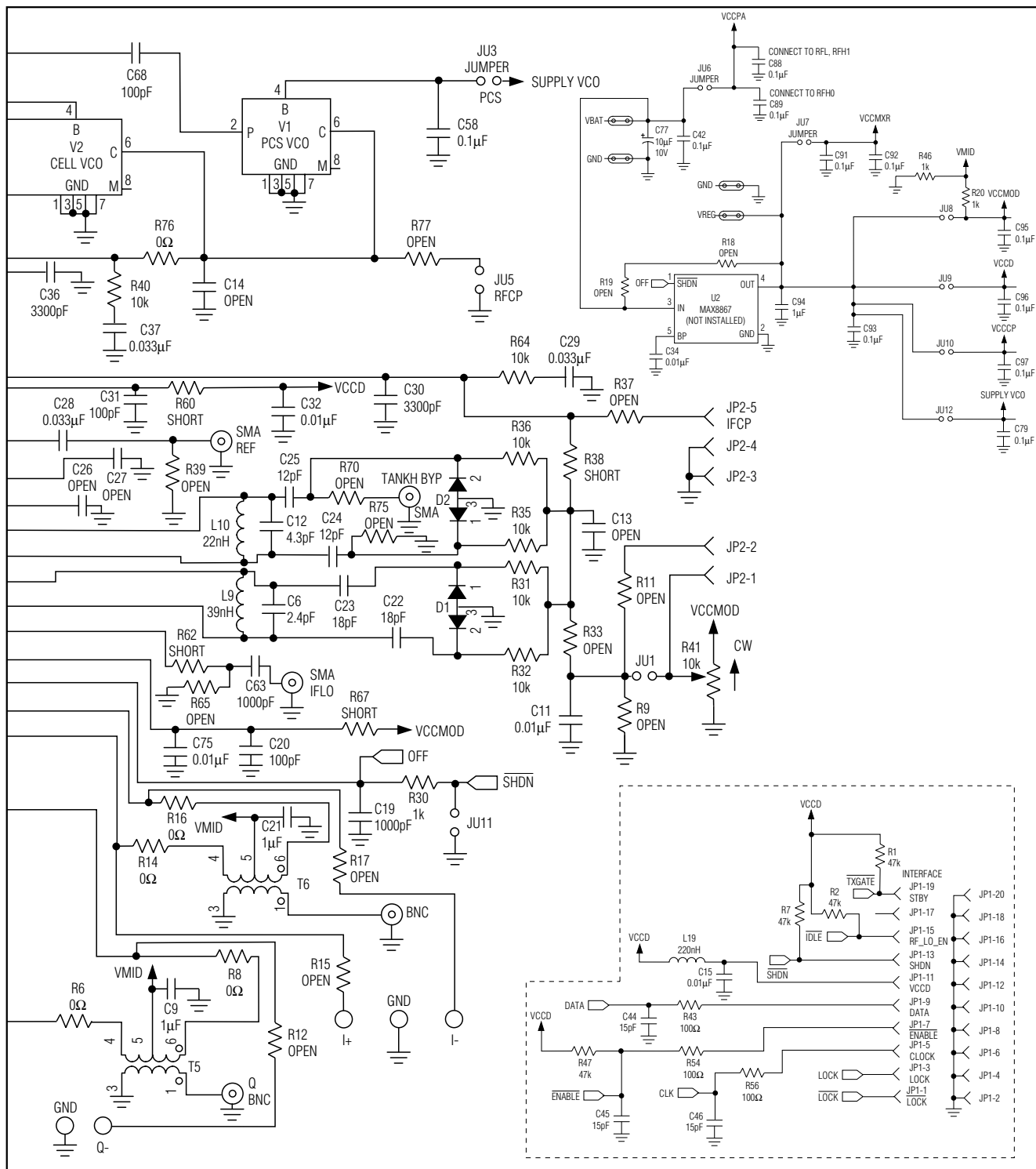
Figure 1. MAX2360 EV Kit Schematic (continued)

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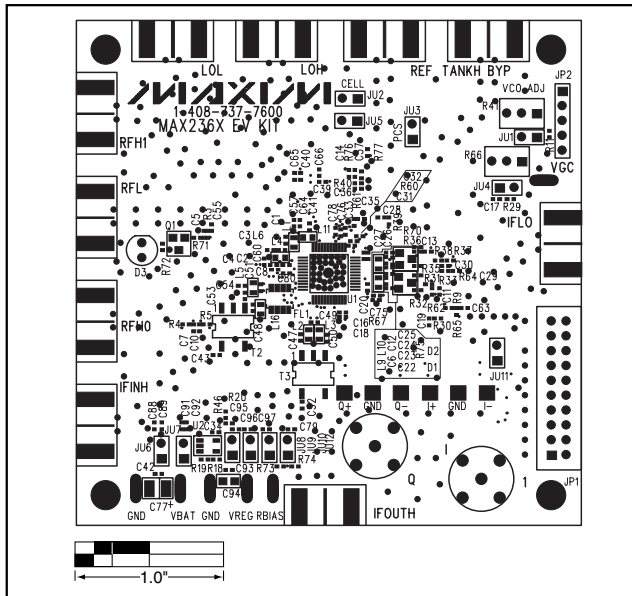*Evaluates: MAX2360/MAX2362/MAX2364*

Figure 2. MAX2360 EV Kit Component Placement Guide—
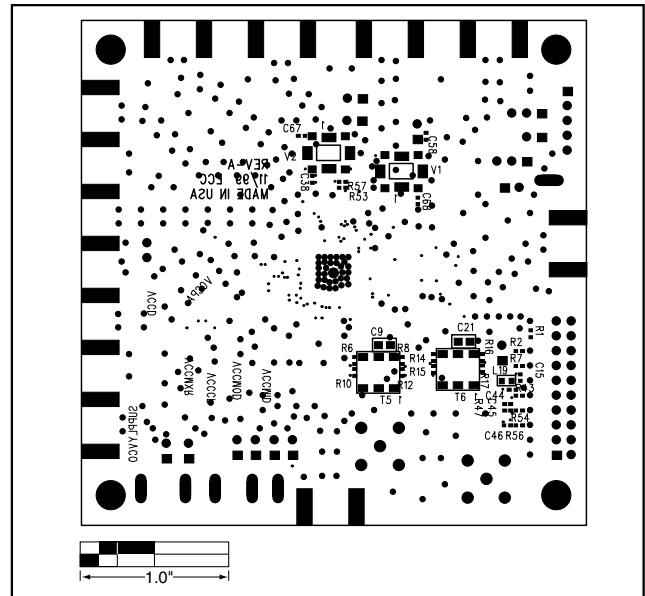Component Side

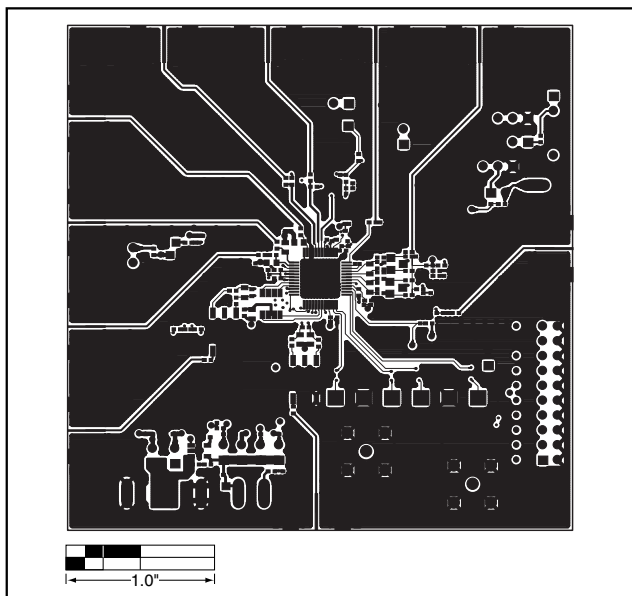Figure 3. MAX2360 EV Kit Component Placement Guide—
Solder Side

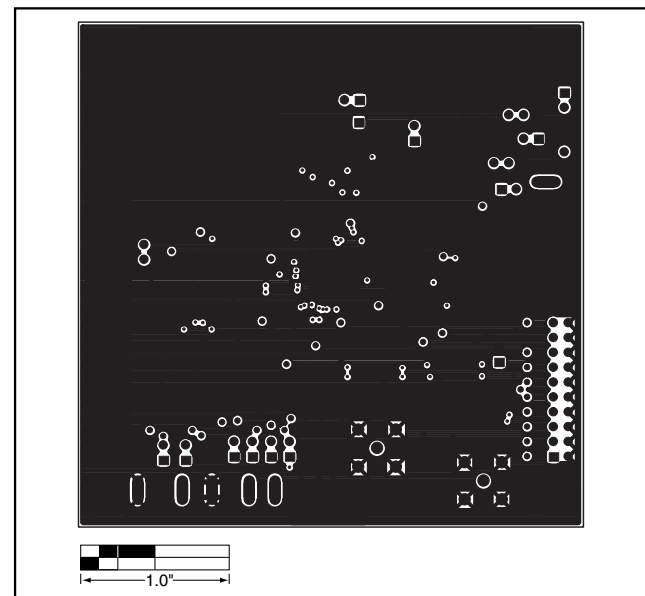Figure 4. MAX2360 EV Kit PC Board Layout—Component Side

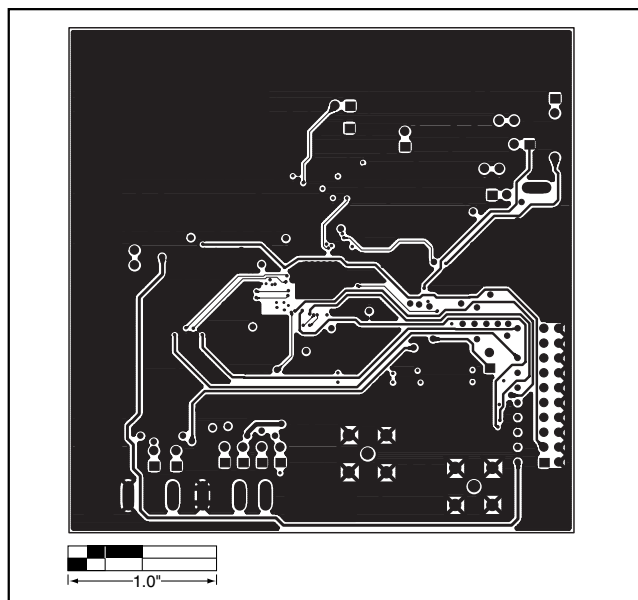Figure 5. MAX2360 EV Kit PC Board Layout—Ground Plane

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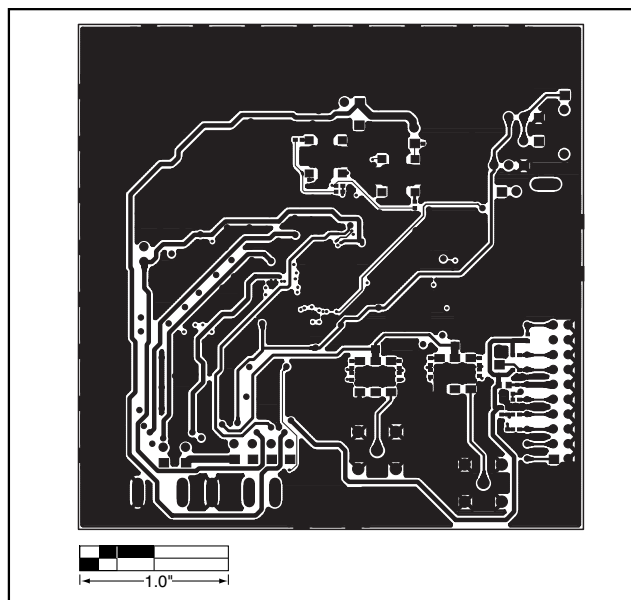Figure 6. MAX2360 EV Kit PC Board Layout—Inner Layer

Figure 7. MAX2360 EV Kit PC Board Layout—Solder Side

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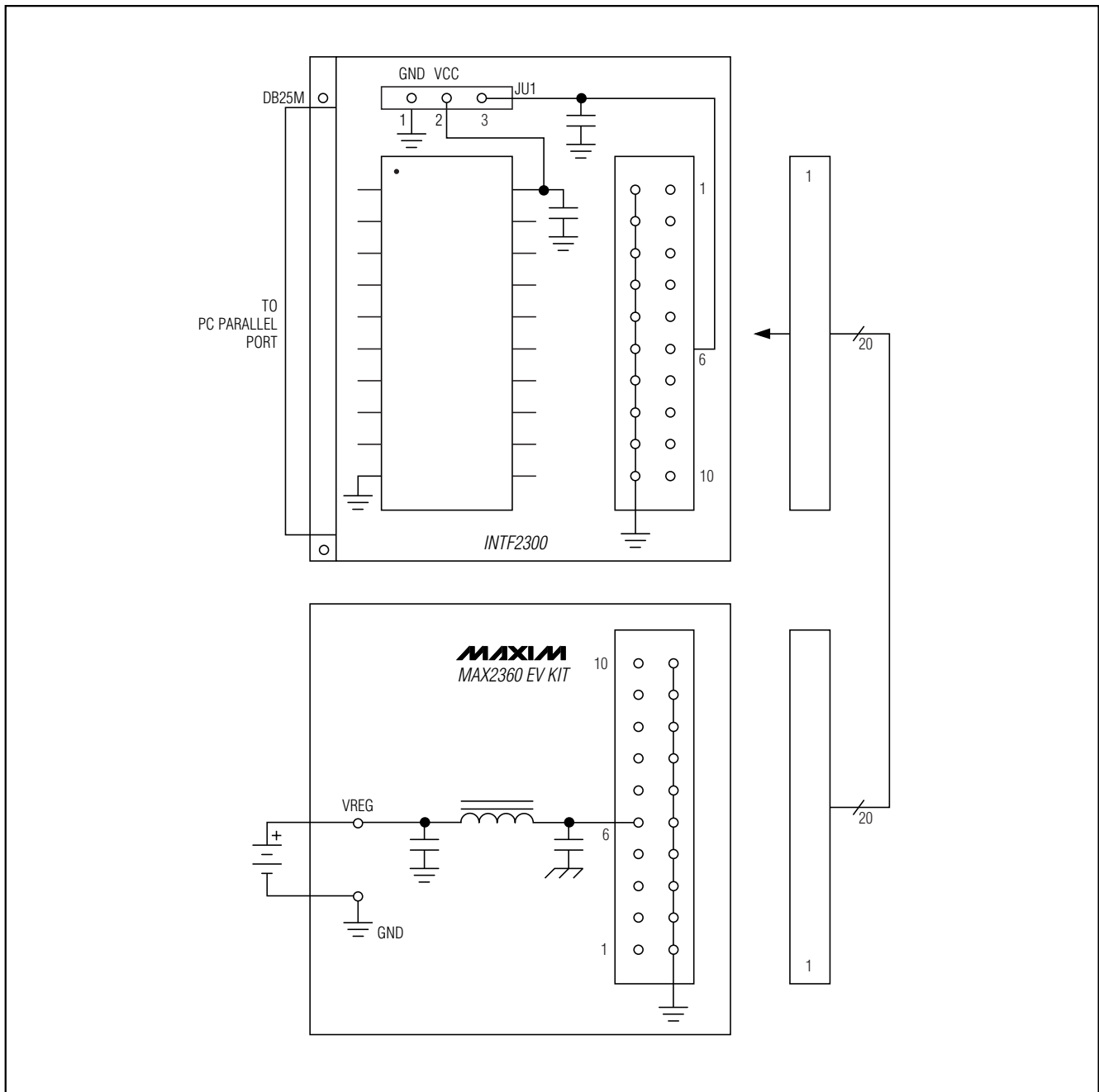
Evaluates: MAX2360/MAX2362/MAX2364

Figure 8. INTF2300 with MAX2360 EV Kit Providing Filtered Supply