

# MAXIM

## MAX2740 Evaluation Kit

### General Description

The MAX2740 evaluation kit (EV kit) simplifies testing of the MAX2740 GPS receiver. This kit allows evaluation of the device's LNA, mixers, variable gain amplifier (VGA), fixed gain amplifier, voltage-controlled oscillator (VCO), and synthesizer.

The EV kit provides 50Ω SMA connectors for all signal inputs and outputs. A varactor-based tank circuit is provided for the on-chip VCO and is phase locked with the on-chip phase-locked loop (PLL).

### Features

- ◆ Differential Baseband Outputs
- ◆ +2.7V to +3.3V Single-Supply Operation
- ◆ SMA Connectors on All Signal Ports

### Ordering Information

PART	TEMP.RANGE	IC PACKAGE
MAX2740EVKIT	-40°C to +85°C	48 TQFP-EP*

\*Exposed Paddle

### Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	10μF ±10% tantalum capacitor AVX TAJC106K016R
C2, C10, C14, C18, C20, C21, C32, C33, C35, C36, C37, C38, C43	12	1000pF ±10% ceramic capacitors (0402) Murata GRM36X7R102K050A
C3	1	12pF ±5% ceramic capacitor (0402) Murata GRM36COG120J050A
C4, C8, C16, C22–C31,	13	0.015μF ±10% ceramic capacitors (0402) Murata GRMX5R153K016A
C5, C7, C13, C15, C17, C19, C39	7	100pF ±5% ceramic capacitors (0402) Murata GRM36COG101J050A
C6	1	7pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG070B050A
C9, C12, C41, C45, C46, C47	6	Leave sites open

DESIGNATION	QTY	DESCRIPTION
C40	1	2.7pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG2R7B050A
C42	1	3pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG030B050A
C44	1	2pF ±0.1pF ceramic capacitor (0402) Murata GRM36COG020B050A
D1	1	BBY 51-03W Siemens tuning diode
R2	1	100Ω variable resistor Bourns 3796W Digi-Key
R3, R4	2	100Ω ±5% resistors (0402)
R5, R8	2	12.1kΩ ±1% resistors (0402)
R6, R7, R9, R10	4	2.74kΩ ±1% resistors (0402)
R11, R12	2	1.21kΩ ±1% resistors (0402)
R13–R18	6	2kΩ ±1% resistors (0402)
R19	1	453Ω ±1% resistor (0402)
R20	1	15kΩ ±1% resistor (0402)
L1, L2, L5	3	220nH inductors Toko LL1608-FSR22J
L8, L9	2	8.2nH inductors Toko LL1608-FH8N2K
L3	1	Leave site open
L10	1	1.8nH inductor Murata LQP10A1N8B00
L11, L12	2	0Ω resistors (0603)

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## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U1	1	MAX2740ECM 48-pin TQFP-EP*
U2	1	MAX4122EUK SOT23-5
J3–J22	20	SMA connectors (PC mount) Johnson 142-0701-201 or Digi-Key J500-ND
JU1–JU4, JU7, JU8, JU9	7	2-pin headers
VCC, GND	2	Test points Digi-Key 5000K-ND
—	1	MAX2740 EV kit circuit board, Rev. B
—	1	MAX2740 data sheet

\*Note: U1 has an exposed paddle that requires it to be solder attached to the circuit board to ensure proper functionality of the part.

## Component Suppliers

SUPPLIER	PHONE	FAX
AVX	803-946-0690	803-626-3123
Coilcraft	847-639-6400	847-639-1469
Digi-Key	218-681-6674	218-681-3380
Infineon	408-501-6000	408-501-2424
Murata	949-852-2001	949-852-2002
Toko	708-297-0070	708-699-1194

Note: Please indicate that you are using the MAX2740 when contacting these component suppliers.

## Quick Start

The MAX2740 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section. Table 1 lists the test equipment recommended to verify MAX2740 operation. This list is intended as a guide only; substitutions may be possible. Figure 1 shows the MAX2740 EV kit schematic.

### Connections and Setup

The customer has the option of closing the PLL loop or externally driving the LO. The PLL loop is closed on the assembled EV kit. To externally drive the LO, remove L10 and place C9. A 1440MHz, -10dBm signal is required at the TANK SMA connector. Perform the following steps to evaluate the MAX2740:

- 1) Verify that jumpers JU1, JU2, and JU7, JU8, JU9 are in place.

Table 1. Recommended Test Equipment

EQUIPMENT	DESCRIPTION
RF Signal Generators (2)	One HP 8648C or equivalent and one HP 83712A or equivalent. These should be capable of delivering -70dBm to 0dBm of output power in the 10MHz to 2000MHz frequency range. The HP 8648C is required to test the receive signal path, and the HP 83712A is a low-phase noise source for the reference frequency.
Power Supply	Capable of providing at least 100mA at +2.7V to +3.3V
Spectrum Analyzer	HP 8561E
Balun (2)	M/A Com Anzac 96341
Extra Voltage Source	For external control of VGA functions

- 2) Connect VCC and GND. Set the supply voltage to +3.0V. When the power is turned on, the current should be approximately 55mA.
- 3) For evaluation of the LNA gain, first calibrate the setup for cable losses. Connect the signal generator with 1575.42MHz at -30dBm to LNA\_IN. Connect LNA\_OUT to the spectrum analyzer. The measured power gain will be approximately 16dB.
- 4) Repeat the calibration procedure (step 3) for use on the RF mixer. Connect the 1575.42MHz (-30dBm) signal source to the RFMIX\_IN+. Connect RFMIX\_OUT+ and RFMIX\_OUT- through the balun to the spectrum analyzer. At 135MHz, losses due to the Anzac balun are approximately 0.65dB. The measured power gain should be approximately 22dB. If a balun is unavailable, a single-ended measurement of the output can be taken. Terminate the unused output in 50Ω, and add 3dB to the final output power measurement.
- 5) Repeat the calibration procedure (step 3) for use on the IF mixer. Use the baluns on the input and output to allow a fully differential measurement. Connect IFMIX\_IN+ and IFMIX\_IN- through one balun to the 135.42MHz (-47dBm) signal source. Connect IFMIX\_OUT+ and IFMIX\_OUT- through the second balun to the spectrum analyzer. At 135MHz, losses due to the Anzac balun are approximately 0.65dB, and at 15MHz, the losses are approximately 0.3dB. For gain calculation, the attenuation due to

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the 2kΩ load resistor on each output must be taken into account. The total differential gain calculation, assuming two baluns, is:

$$P_{IN} = P_{IN(MEAS)} - P_{LOSS(BALUN\ AT\ 135MHz)}$$
$$P_{OUT} = P_{OUT(MEAS)} + P_{LOSS(BALUN\ AT\ 15MHz)}$$
$$+ P_{LOSS(LOAD)}$$

where:

$$P_{LOSS(LOAD)} = 20\log\left\{\frac{100}{4100}\right\} = 32.3\text{dB}$$
$$\text{Power\_Gain} = P_{OUT} - P_{IN}$$

The measured power gain should be approximately 36dB.

- 6) To control the VGA gain, connect the second power supply to the nongrounded terminal of jumper JU3, and open jumper JU4. The VGA gain will be evaluated at  $V_{GC} = 0.5V$  and  $2.5V$ . It is important to note that the VGA gain and subsequent FGA gain are voltage-gain measurements. Repeat the calibration procedure as before (step 3). Connect VGA\_IN+ and VGA\_IN- through one balun to the 15.42MHz (-27dBm) signal source. Connect VGA\_OUT+ and VGA\_OUT- through the second balun to the spectrum analyzer. At 15.42MHz, losses due to the Anzac balun are approximately 0.3dB. For gain calculation, the attenuation due to the 2kΩ load resistor on each output must be taken into account. The total differential gain calculation, assuming two baluns, is:

$$P_{IN} = P_{IN(MEAS)} - P_{LOSS(BALUN\ AT\ 15MHz)}$$
$$P_{OUT} = P_{OUT(MEAS)} + P_{LOSS(BALUN\ AT\ 15MHz)}$$
$$+ P_{LOSS(LOAD)}$$

where:

$$P_{LOSS(LOAD)} = 20\log\left\{\frac{100}{4100}\right\} = 32.3\text{dB}$$
$$\text{Voltage\_Gain} = P_{OUT} - P_{IN} - 6\text{dB}$$

The measured voltage gain at  $V_{GC} = 2.5V$  should be approximately 15dB. The gain range should be more than 50dB.

- 7) The FGA procedure will be similar to the VGA, minus the need for the second voltage source. Repeat the calibration procedure as before (step 3). Connect FGA\_IN+ and FGA\_IN- through one balun to the 15.42MHz (-43dBm) signal source. Connect FGA\_OUT+ and FGA\_OUT- through the second balun to the spectrum analyzer. At 15.42MHz, losses due to the Anzac balun are approximately 0.3dB. Calculations are identical to that of the VGA. The measured voltage gain should be approximately 40dB.

## Adjustments and Control

The MAX2740 EV kit is configured with a 100kΩ trim pot for setting and adjusting the VGA gain. To use an external supply, remove the 2-pin series and shunt jumpers (JU3 and JU4). Connect the supply directly to the nongrounded terminal of JU3.

## Detailed Description

The following sections cover the EV kit's circuit blocks in detail. (Refer to the MAX2740 data sheet for additional information.)

### LNA

The LNA is a two-stage amplifier using feedback to set the gain. The circuit requires input and output matching. It is externally biased through the output matching network.

### RF MIXER

The RF mixer is a double-balanced Gilbert cell with local LO drive provided from a low-impedance differential pair. The second RF input is brought out to a separate pin for external decoupling on pin 7. The IF output is delivered through low-output-impedance emitter followers. The input is matched to 50Ω, and the outputs are individually matched to 50Ω (100Ω differential). The mixer is intended to drive a 400Ω SAW filter.

### IF MIXER

The IF mixer is very similar to the RF mixer, except the IF mixer input is fully differential. The emitter follower outputs are intended to drive directly into a high-impedance, differential, 3-pole lowpass filter made up of discrete components.

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## **VGA and FGA**

The inputs and outputs of both circuits are differential. The VGA has a useful gain-control range of >50dB. The FGA was designed to deliver 40dB of differential gain at the second IF frequency of 15.42MHz. In the application, the FGA differential inputs are received from the VGA outputs through a balanced lowpass filter circuit. The FGA's differential output is designed to drive a digitizer with a typical load impedance of 4k $\Omega$  differential.

## **PC Board Layout/Construction**

The MAX2740 EV kit can serve as a board layout guide. 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. The GLSOUT signal must not be routed parallel to the REF input to avoid loss of frequency lock due to coupling between the two signals.

The MAX2740 EV kit PC board uses 14mil-wide traces for 50 $\Omega$  traces. The PC board has an 8mil layer profile to the ground plane on FR4, with a dielectric constant of 4.5, and 75mil trace-to-ground-plane spacing.

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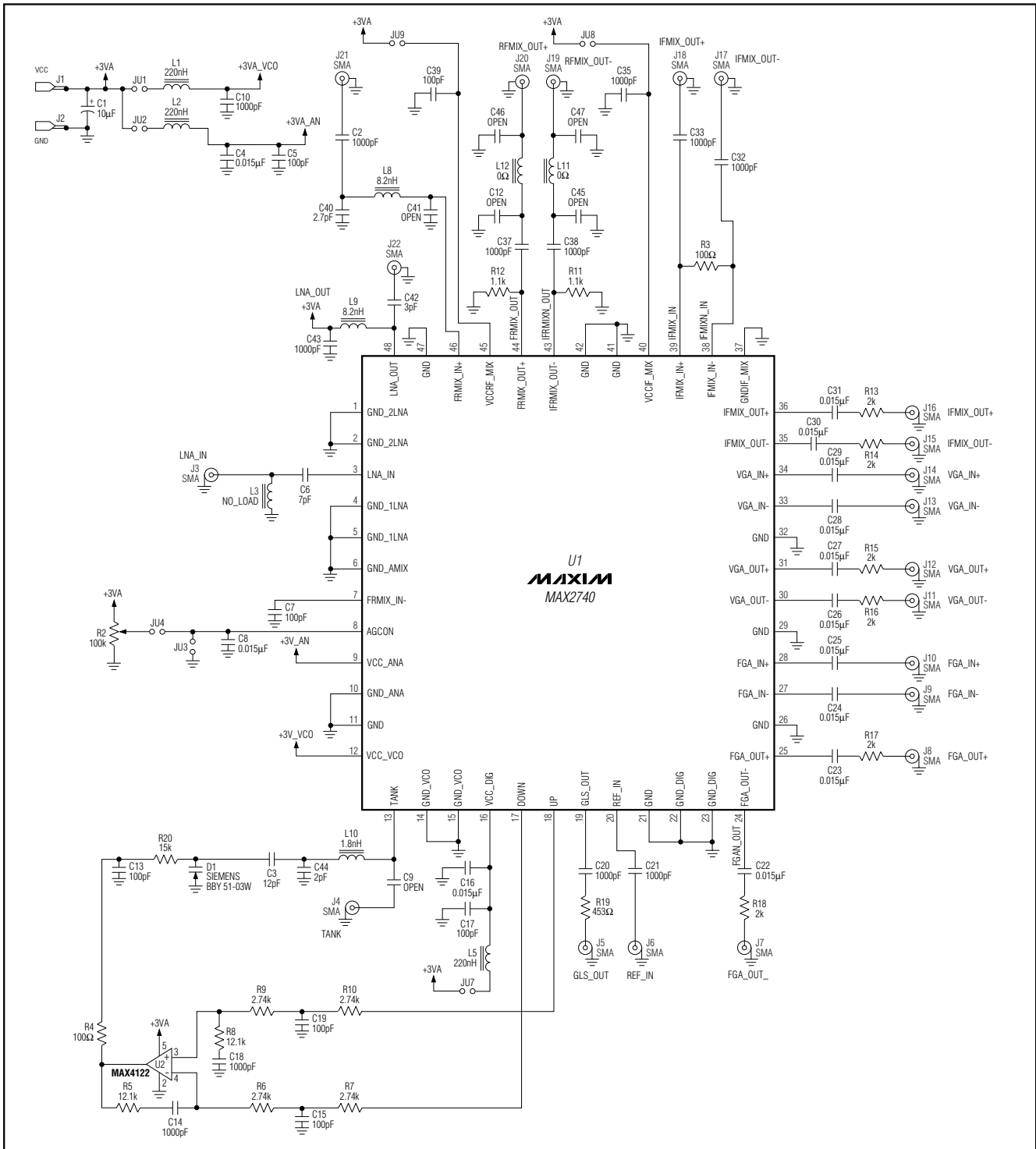


Figure 1. MAX2740 EV Kit Schematic

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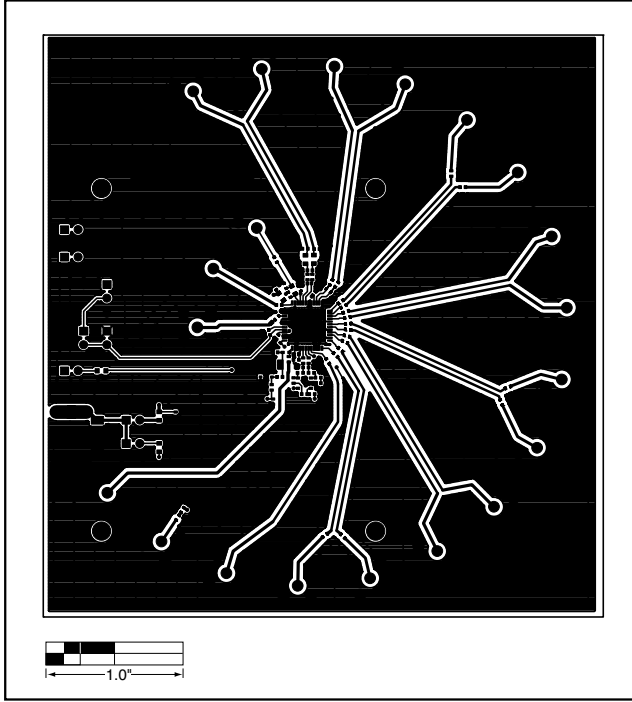


Figure 2. MAX2740 EV Kit PC Board Layout—Component Side

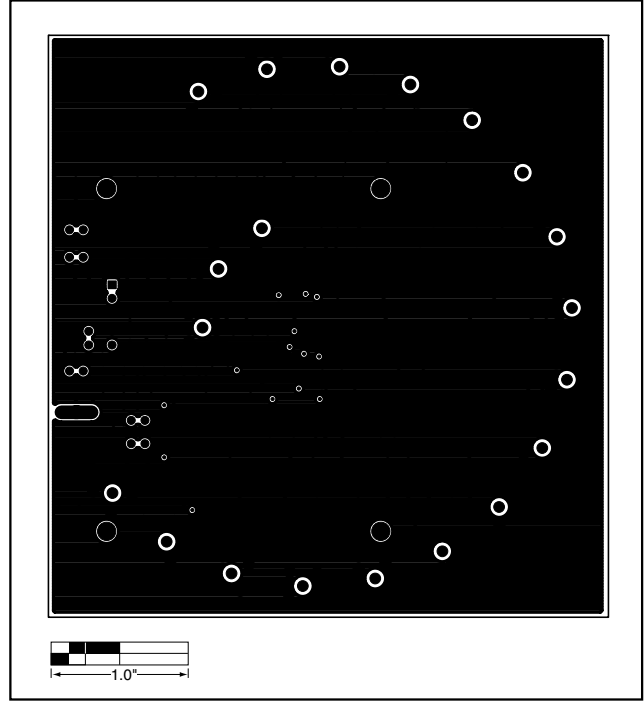


Figure 3. MAX2740 EV Kit PC Board Layout—Ground Plane

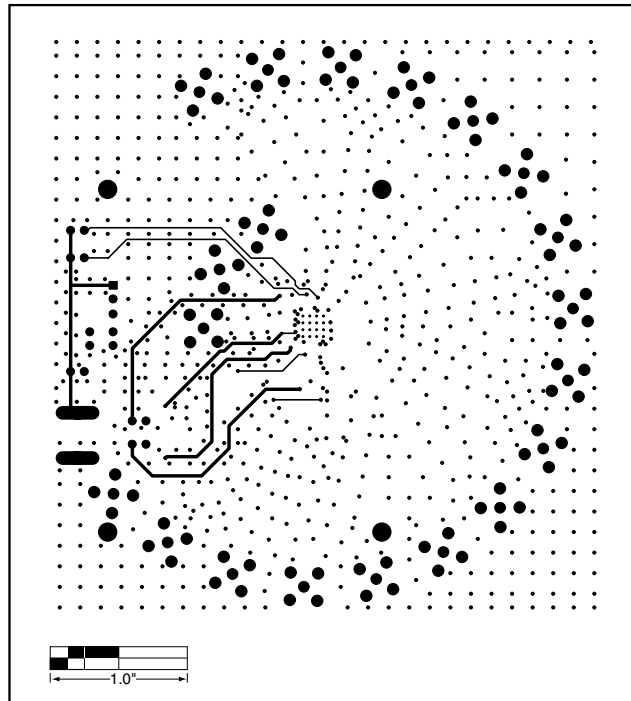


Figure 4. MAX2740 EV Kit PC Board Layout—Power Plane

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NOTES

*Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.*

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