19-1715; Rev 0; 4/00

MAXIM

MAX2720/MAX2721 Evaluation Kits

Evaluate: MAX2720/MAX2721

General Description

The MAX2720/MAX2721 evaluation kits (EV kits) simplify evaluation of the MAX2720/MAX2721 direct I/Q modulator with variable gain amplifier (VGA) and power amplifier (PA) driver. The MAX2720 is optimized for RF frequencies between 1700MHz and 2100MHz, while the MAX2721 is optimized for RF frequencies between 2100MHz and 2500MHz. The EV kits are fully assembled and tested, allowing simple evaluation of all device functions. All signal ports utilize SMA connectors, providing a convenient interface to RF test equipment.

Features

- **Easy MAX2720/MAX2721 Evaluation**
- **All Critical Peripheral Components Included**
- **SMA Input and Output Signal Connectors**
- **RF Ports Matched to 1900MHz (MAX2720)**
- **RF Ports Matched to 2315MHz (MAX2721)**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP. RANGE	IC PACKAGE
MAX2720EVKIT	-40°C to +85°C	20 TSSOP-EP*
MAX2721EVKIT	-40°C to +85°C	20 TSSOP-EP*

*Exposed paddle

Components Common to MAX2720/MAX2721

DESIGNATION	QTY	DESCRIPTION
C1, C4, C8, C9, C14, C17	6	470pF ±10% ceramic caps (0402) Murata GRM36X7R471K050A
C2	1	2pF ±0.25pF ceramic cap (0402) Murata GRM36COG020C050A
C3, C10, C13	3	1000pF ±10% ceramic caps (0402) Murata GRM36X7R102K050A
C6, C7, C15, C16, C22, C23, C24	7	0.1µF ±10% ceramic caps (0603) Murata GRM39X7R104K016A
C11	1	3.0pF ±0.25pF ceramic cap (0402) Murata GRM36COG030C050A
C18	1	47pF ±5% ceramic cap (0402) Murata GRM36COG470J050A
C19	1	10µF ±10% tantalum capacitor AVX TAJC106K010
C20, C21	0	Not installed
L1	0	Not installed
L2	1	3.9nH ±5% inductor Toko LL1608-FS3N9J
R1, R3	2	100kΩ resistors (0402)
R2	1	10kΩ resistor (0402)

DESIGNATION	QTY	DESCRIPTION
R4	1	20kΩ potentiometer Bournes Digi-Key 3296W-203-ND
R5, R7, R9, R11	4	1.00kΩ ±1% resistors (0603)
R6, R8, R10, R45	4	49.9Ω ±1% resistors (0603)
J1, J3, J4, J5, J7, J8	6	SMA edge-mount connectors EFJohnson 142-0701-801
J2, J6	0	Not installed
J10, J11, J12	3	Test points
JU2	0	Not installed
JU4, JU5	2	1x3-pin headers (0.1in center)
JU6	1	1x2-pin header (0.1in center)
None	3	Shunts (JU4, JU5, JU6)
None	1	MAX2720/MAX2721 PC board
None	1	MAX2720/MAX2721 EV kit data sheet
None	1	MAX2720/MAX2721 data sheet

MAX2720 EV Kit Specific Components

DESIGNATION	QTY	DESCRIPTION
C5	1	8.0pF ±0.5pF ceramic cap (0402) Murata GRM36COG080D050A
C12	1	0Ω resistor (0402)
L3	1	1.5nH ±5% inductor Toko LL1608-FS1N5J
L4	1	1pF ±0.25pF ceramic cap (0402) Murata GRM36COG010C050A
U1	1	MAX2720EUP, 20-pin TSSOP-EP

Component Suppliers

SUPPLIER	PHONE	FAX	WEB
AVX	843-448-9411	843-448-1943	www.avxcorp.com
EFJohnson	402-474-4800	402-474-4858	www.efjohnson.com
Murata	800-831-9172	814-238-0490	www.murata.com
Toko	800-pik-toko	708-699-1194	www.tokoam.com

Quick Start

Test Equipment Required

- One low-noise RF-signal generator (50Ω source) capable of delivering at least -10dBm of output power over 1.7GHz to 2.5GHz (HP 8648C, for example)
- One I/Q generator capable of producing two 500kHz sine waves, 90° out of phase with each other, with an amplitude of 300mVp-p (HP 8904A with option 2, for example)
- One dual-channel oscilloscope with a 100MHz minimum bandwidth
- Two low-capacitance (<3.0pF) oscilloscope probes (Tektronix P6201, for example)
- One spectrum analyzer capable of covering the MAX2720/MAX2721 RF frequency range of the HP 8561E, for example
- Two 50Ω BNC-to-SMA cables
- Two 50Ω SMA cables
- One power supply capable of providing a minimum of 150mA of supply current at +3V
- (Optional) Digital multimeters (DMMs) to monitor DC supply voltage and supply current

MAX2721 EV Kit Specific Components

DESIGNATION	QTY	DESCRIPTION
C5	1	6.0pF ±0.5pF ceramic cap (0402) Murata GRM36COG060D050A
C12	1	27pF ±5% ceramic cap (0402) Murata GRM36COG270J050A
L3	1	1.2nH ±5% inductor Toko LL 1608-FS1N2J
L4	1	3.3nH ±5% inductor Toko LL1608-FS3N3J
U1	1	MAX2721EUP, 20-pin TSSOP-EP

- (Optional) A second power supply for varying the gain of the modulator

I/Q Modulator Connections and Setup

1) **DC Power Supply:** Set the power-supply voltage to +3V, and connect it to VCC and GND on the EV kit. If desired, place an ammeter in series with the power supply to measure supply current and a voltmeter in parallel with VCC and GND to measure the supply voltage delivered to the EV kit. Short jumper JU4 to VCC to enable the device. Short jumper JU6 to allow the potentiometer to vary the modulator gain; turn the potentiometer until V_{PC} = 2.5V. If desired, open jumper JU6 and connect to an additional voltage supply to control the modulator gain.
2) **LO Signal Source:** The MAX2720/MAX2721 LO port can be driven at full or half frequency. Connect jumper JU5 ($\overline{X2\ ENB}$) to GND to enable the internal LO frequency doubler, allowing the external LO signal source to operate at half frequency. Set the LO signal source operating frequency to 950MHz (MAX2720) or 1157.5MHz (MAX2721) at an output power of -13dBm.

   Connect jumper JU5 ($\overline{X2\ ENB}$) to VCC to disable the internal LO frequency doubler, and run the external LO source at the fundamental frequency. Set the LO signal source frequency to 1900MHz (MAX2720) or 2315MHz (MAX2721) at an output power of -13dBm. Connect the LO signal generator to the LO port SMA connector using a 50Ω SMA cable.
3) **I/Q Signal Source:** Configure the dual-output function generator for a 500kHz IF frequency, with a 300mVp-p amplitude and a 90° phase difference between channels. Connect a 50Ω cable from the I/Q signal source to the EV kit's I+ and Q+ inputs. The EV kit inputs are terminated with a 50Ω resistor shunted to ground and a 1kΩ resistor in series with

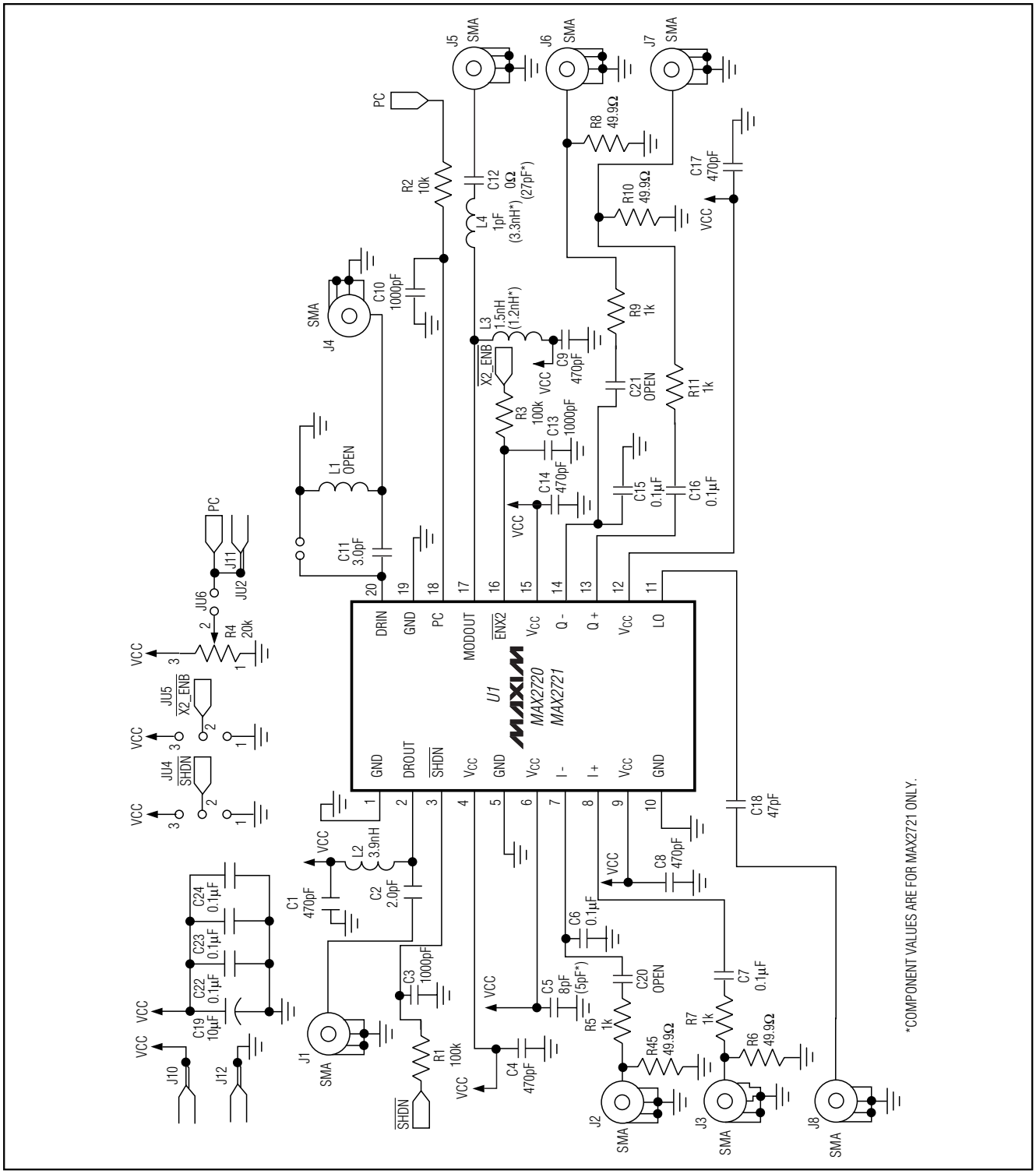

Figure 1. MAX2720/MAX2721 EV Kits Schematic

the baseband input of the MAX2720/MAX2721, which has a 2kΩ (typ) input impedance. This voltage divider results in a 200mVp-p signal applied to the MAX2720/MAX2721s' I+ and Q+ inputs. Use the oscilloscope and its two probes to verify that the amplitude difference between the two signals at the I and Q inputs is at a minimum and the phase difference is 90°.

4) **Spectrum Analyzer:** Connect the spectrum analyzer to the MODOUT SMA connector using a 50Ω SMA cable. Set the spectrum analyzer's center frequency to 1900MHz (MAX2720) or 2315MHz (MAX2721). Set the spectrum analyzer's reference level to 0dBm and the span to 1.2MHz.

I/Q Modulator Analysis

Turn on the power supply and the LO and I/Q signal generators. The ammeter should read approximately 77mA (MAX2720) or 86mA (MAX2721) with the LO doubler enabled, or 72mA (MAX2720) or 81mA (MAX2721) with the LO doubler disabled.

Using the spectrum analyzer, observe the modulator output spectrum. Notice three tones: the carrier, and the lower and upper sidebands 500kHz below and above the carrier. In its peak power setting (V_{PC} = 2.5V), the desired sideband will have an amplitude of -8.5dBm (MAX2720) or -5.0dBm (MAX2721). The carrier suppression is typically 33dB (MAX2720) or 31dB (MAX2721), while the sideband suppression is typically 40dB (MAX2720) or 35dB (MAX2721). Phase and amplitude differences at the I and Q inputs result in degradation of the carrier and sideband suppression. Be sure to take into account board losses (0.3dB) when calculating the output power of the device.

PA Driver Connections and Setup

1) **DC Power Supply:** Set the power-supply voltage to +3V, and connect it to VCC and GND on the EV kit. If desired, place an ammeter in series with the power supply to measure supply current and a voltmeter in parallel with the VCC and GND connections to measure the supply voltage delivered to the EV kit. Short jumper JU4 to VCC to enable the device.

2) **Spectrum Analyzer:** Connect the spectrum analyzer to the DROUT SMA connector using a 50Ω SMA cable. Set the spectrum analyzer's center frequency to 1900MHz (MAX2720) or 2315MHz (MAX2721). Set the spectrum analyzer's reference level to 10dBm and the span to 1MHz.

3) **RF Signal Source:** Set the signal generator to an output power of -12dBm at a frequency of 1900MHz (MAX2720) or 2315MHz (MAX2721). Connect the signal generator to the DRIN SMA connector using a 50Ω SMA cable.

PA Driver Analysis

Turn on the power supply and RF signal generator. The spectrum analyzer should measure an output power of +1.5dBm (13.5dB gain) for the MAX2720 or -0.5dBm (11.5dB gain) for the MAX2721. Be sure to take into account board losses (0.3dB at the input, 0.3dB at the output) when calculating the output power of the device.

Layout and Bypassing

Good PC board layout is an essential aspect of RF circuit design. The MAX2720/MAX2721 EV board can serve as a guide for layout of your board. Make sure the input traces to the I and Q input pins are of equal length and in the same environment as much as possible to keep the I and Q signals in quadrature for maximum sideband rejection at the modulated output. Keep PC board trace lengths as short as possible to minimize parasitics and losses. Keep bypass capacitors as close to the device as possible with low-inductance connections to the ground plane.

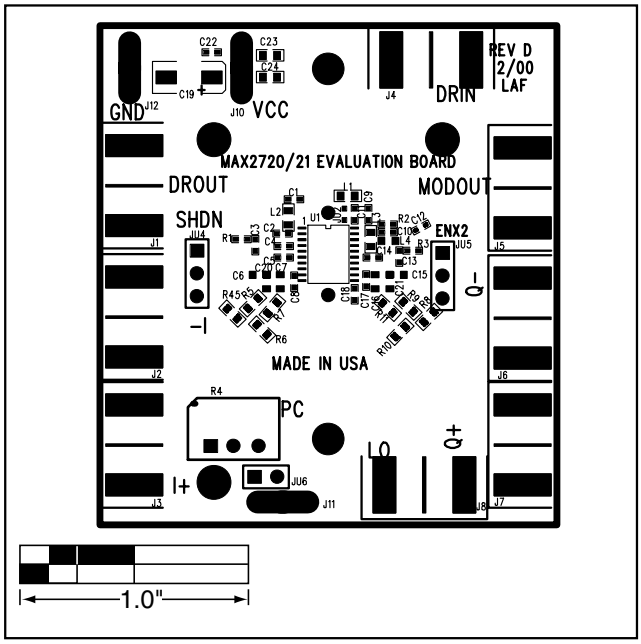

Figure 2. MAX2720/MAX2721 EV Kits PC Board Layout—Component Placement Guide

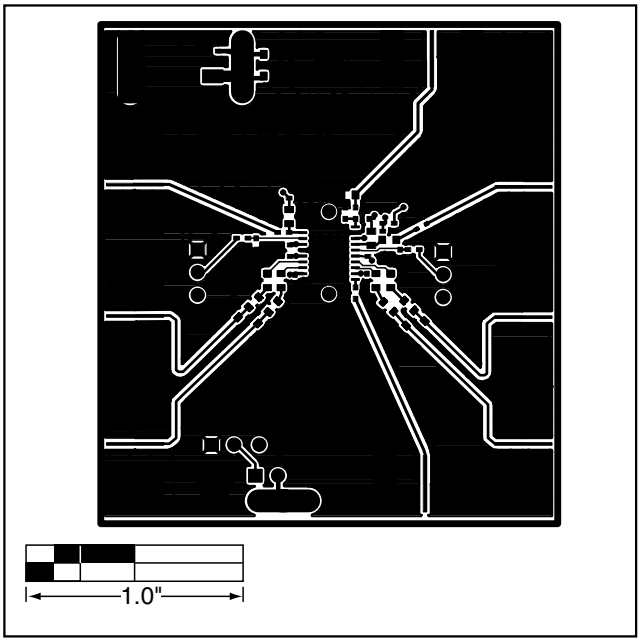

Figure 3. MAX2720/MAX2721 EV Kits PC Board Layout—Component Side (Layer 1, Top)

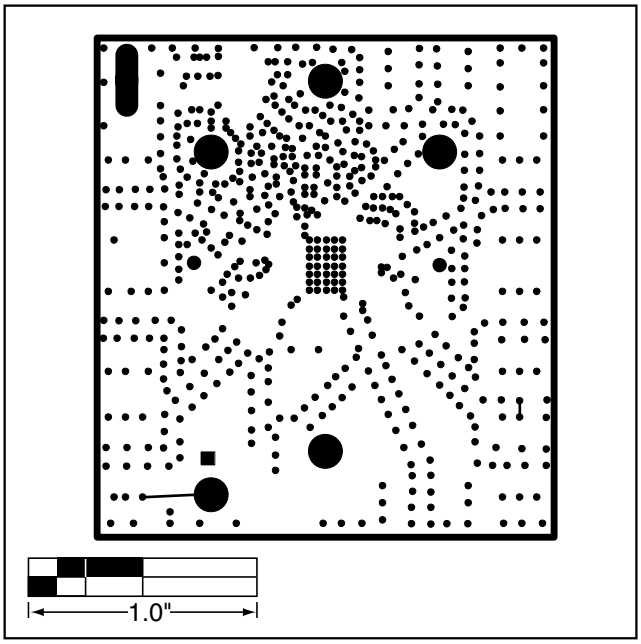

Figure 4. MAX2720/MAX2721 EV Kits PC Board Layout—Ground Plane (Layer 2)

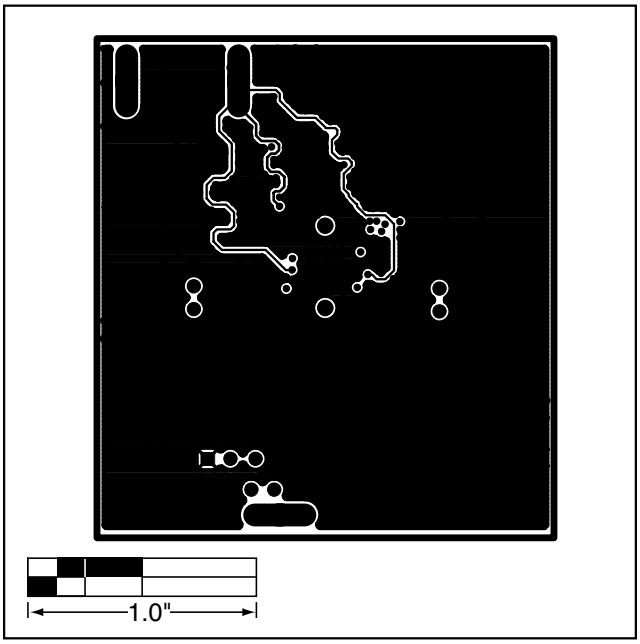

Figure 5. MAX2720/MAX2721 EV Kits PC Board Layout—Power Plane (Layer 3)

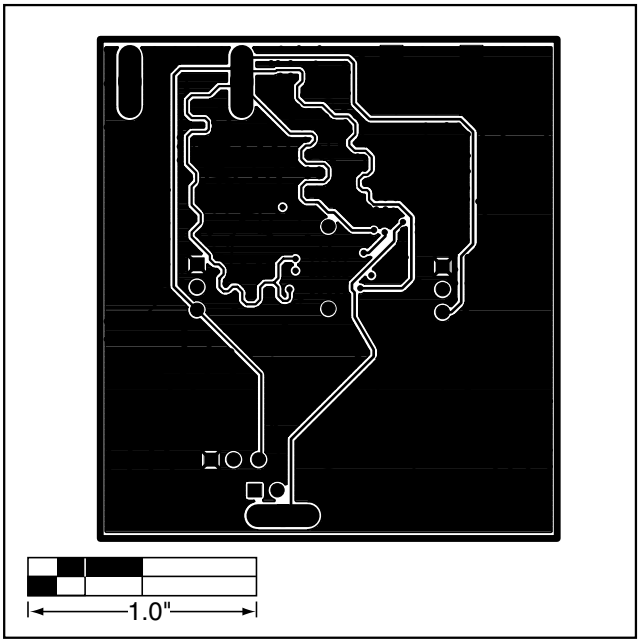

Figure 6. MAX2720/MAX2721 EV Kits PC Board Layout—Power Plane (Layer 4, Bottom)