Dec 26, 2002

The MAX2291 as a WCS 2.3GHz PA with 16-QAM Modulation

The MAX2291 RF PA is capable of operation in the 2.3 to 2.33GHz Wireless Communication Systems band. With some simple component changes the Evaluation Kit can be configured to provide 24dB gain, +23dBm output power, and -49dBc ACPR with 16-QAM modulation. The device is available in a square 2.5mm chip-scale-package.

Additional Information: Wireless Product Line Page
Applications Technical Support

General

The MAX2291 is a radio frequency power amplifier integrated circuit (IC) originally designed for PCS band applications. The device operates from a single, low-voltage supply and is available in a 2.5mm x 2.5mm chip-scale package. Aside from PCS band operation the IC has proven it's versatility in several other application areas to include time division multiple access (TDMA), time division, synchronous code division multiple access (TD-SCDMA), wideband code division multiple access (W-CDMA), and Korean band PCS (person communication system). Initial testing has demonstrated great promise for an additional application at 2.3GHz in the wireless communication system (WCS) band.

Objective

Tune a MAX2291EVKit for use in the 2.3GHz-2.33GHz band with 16-QAM (quadrature amplitude modulation).

Test Setup

The EVKit's input and output are normalized to 50Ω for evaluation by standard lab equipment and 50Ω SMA cables. During testing, a 16-QAM modulated signal was supplied to the EVKit's RFIN port from an Agilent 4433B signal generator. The symbol rate was set to 500ksps. Output power and ACPR (adjacent channel power ratio) were measured with an HP438A power meter and Rhode & Schwarz FSEB Spectrum Analyzer after passing the signal through a directional coupler and power attenuator. See Figure 1 for more setup information.

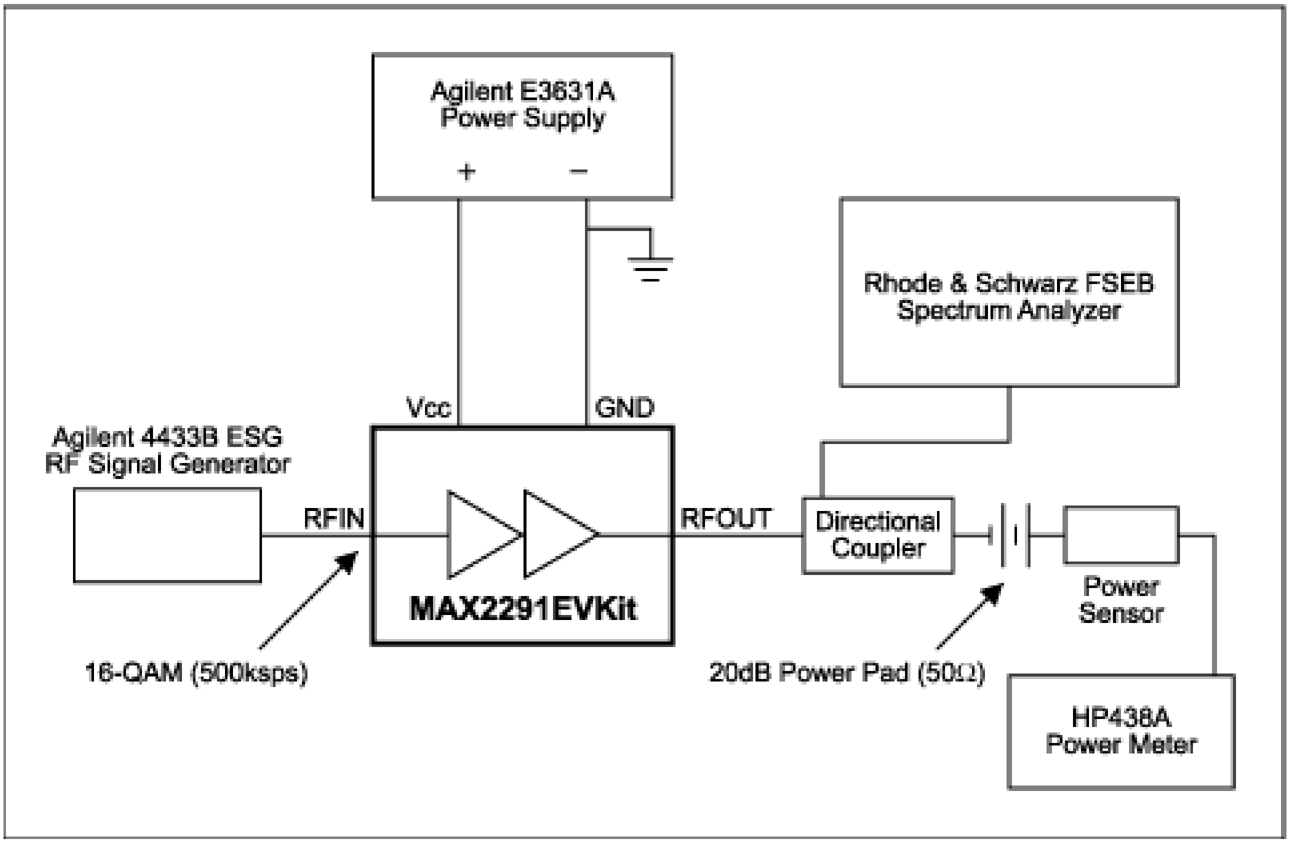

Figure 1.

Results

After tuning a standard EVKit for the desired frequency band, the schematic shown in Figure 2 was generated {see the bill of materials (BOM) below as well}. This arrangement of components provides reasonable performance over the band. Linearity and current consumption are generally inversely related in this regime. Therefore, efficiency can be improved significantly from the data shown depending on linearity requirements of the application. Varying the position of the output shunt capacitor (C90) along the EVKit's micro-strip transmission line alters these characteristics.

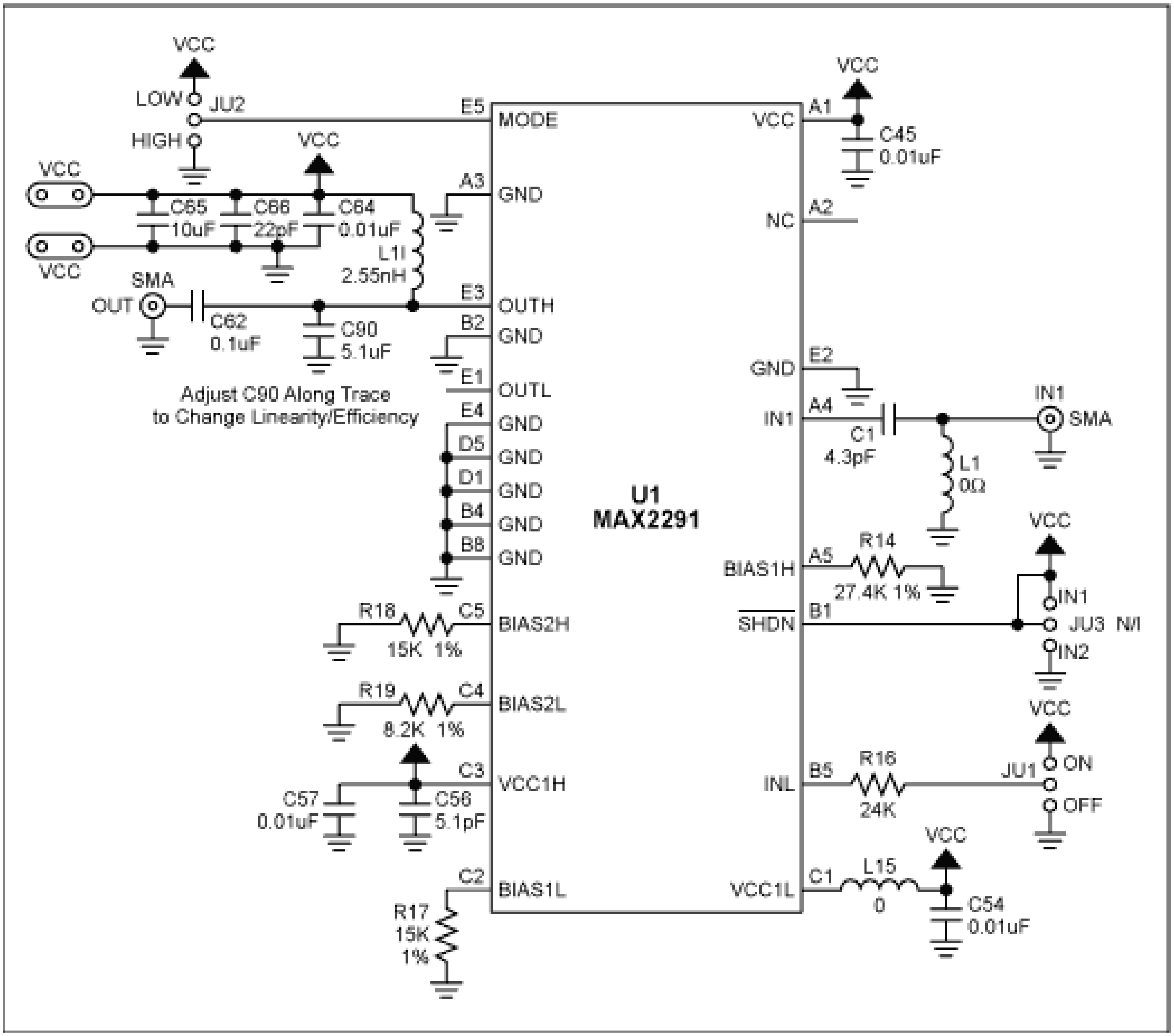

Figure 2. (Pout = +23.5dBm)

Bill of Materials of MAX2291 for 2.3GHz 16QAM Application

Designation	Qty	Description
C90, C56	2	Murata, High Q GJ615 Series, 5.1pF
C45, C54, C57, C64	4	Murata 0.01uF GRM36X7R103K16
C62	1	Murata 0.1uF GRM39X7R102K16
C65	1	10uF 6.3V 100mOhm Taiyo Yuden Ceramic, 1206 case size
C66	1	Murata 22pF GRM36COG220J50
L11	1	Coilcraft, 0906-3, 2.55nH
L15	1	0 Ohm (bus wire)

R14	1	27.4kΩ 1% resistor (0402)
R16	1	24kΩ 5% resistor (0402)
R17, R18	2	15kΩ 1% resistor (0402)
R19	1	8.2kΩ 1% resistor (0402)
U1	1	MAX2291 5x5uCSP
VCCC, GNDC	2	2-Pin Header (0.1" centers)
IN1, OUT	2	0.031" Edge Mount SMA
JU1, JU2	3	3-Pin Header (0.1" centers)

Note: All items omitted are 'not installed' in this application

The data below demonstrates that the MAX2291 is a viable power amplifier solution for 2.3GHz wireless communications systems. The device is capable of providing approximately 24dB of gain and offers design flexibility in the areas of linearity and efficiency, all in a remarkably tiny package.

MAX2291 tuned for 2.3 - 2.33GHz
Modulation = 16QAM
@500Ksps

Vcc (V)	Frequency (MHz)	Gain (dB)	Po (dBm)	Pin (dBm)	ACP1* (dB)	ACP2* (dB)	S11 (dB)	S22 (dB)	Efficiency (%)	IcQ (A)	Icc (A)
3.00	2300	22.92	23.00	0.08	-47.00	-68.00	-11.10	-23.20	23.01	0.163	0.289
3.00	2315	23.84	23.00	-0.84	-47.20	-67.90	-17.40	-15.60	22.62	0.163	0.294
3.00	2330	23.66	23.00	-0.66	-47.00	-68.00	-17.20	-11.70	22.24	0.163	0.299

Vcc (V)	Frequency (MHz)	Gain (dB)	Po (dBm)	Pin (dBm)	ACP1* (dB)	ACP2* (dB)	S11 (dB)	S22 (dB)	Efficiency (%)	IcQ (A)	Icc (A)
3.30	2300	23.18	23.00	-0.18	-49.23	-68.50	-10.60	-24.50	21.14	0.168	0.286
3.30	2315	24.18	23.00	-1.18	-49.30	-68.00	-16.20	-16.50	20.85	0.168	0.290
3.30	2330	24.10	23.00	-1.10	-49.89	-67.90	-17.60	-12.20	20.50	0.168	0.295

Vcc (V)	Frequency (MHz)	Gain (dB)	Po (dBm)	Pin (dBm)	ACP1* (dB)	ACP2* (dB)	S11 (dB)	S22 (dB)	Efficiency (%)	IcQ (A)	Icc (A)
3.60	2300	23.54	23.00	-0.54	-49.70	-69.40	-10.00	-24.90	19.52	0.172	0.284
3.60	2315	24.58	23.00	-1.58	-49.66	-68.80	-15.20	-17.50	19.24	0.172	0.288
3.60	2330	24.56	23.00	-1.56	-50.70	-68.90	-17.70	-12.73	18.98	0.172	0.292

*ACP1 measured in a 30KHz BW, at 625KHz offset
ACP2 measured in a 30KHz BW, at 1.28KHz offset

Measurement of EVM (error vector magnitude) was accomplished by replacing the spectrum analyzer with an Agilent 89441A Vector Signal Analyzer. The EVM plot can be seen in Figure 3, which shows the output at +23.5 dBm. The EVM of the input signal was measured at 1.8%, and the plot shows 2.47% for a total PA contribution of around 1.7% EVM.

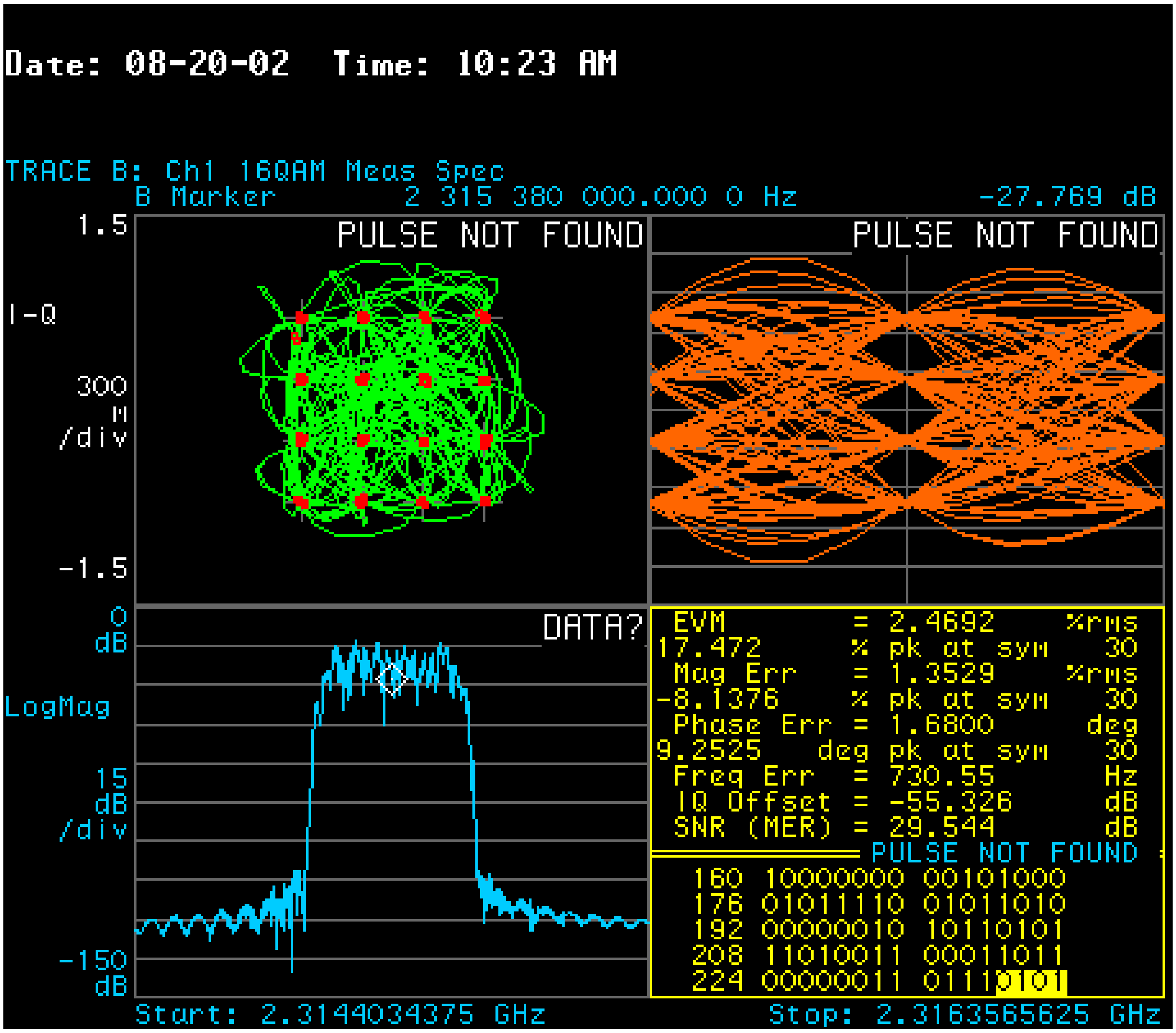

Figure 3. EVM plot