RF MICRO·DEVICES

RF2942

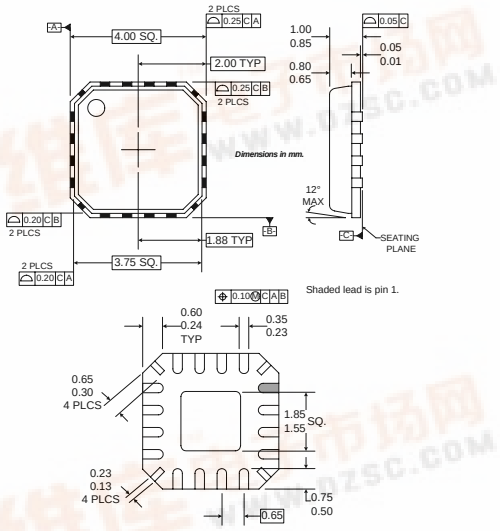
UHF QUADRATURE MODULATOR AND TRANSMITTER

Typical Applications

- 915MHz ISM Band Products
- Digital Communications
- Quadrature Modulation
- Portable Battery-Powered Equipment

Product Description

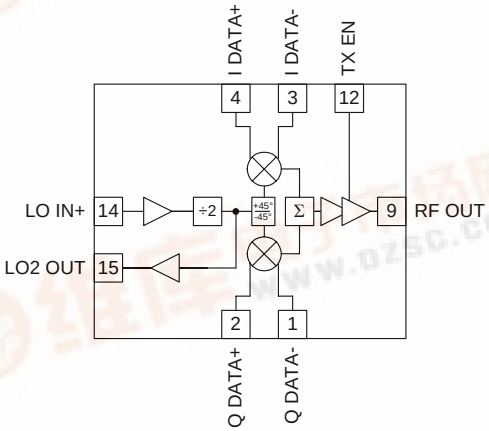
The RF2942 is an integrated power amplifier and quadrature modulator IC. The quadrature modulator is driven with a single-ended local oscillator (LO) source. The quadrature phase generation of the LO is accomplished using an internal passive network tuned for twice the operating frequency. The LO frequency is at twice the RF frequency to avoid interfering with an external synthesizer.



Package Style: QFN, 16-Pin, 4x4

Optimum Technology Matching® Applied

- ☐ Si BJT
- ☐ Si Bi-CMOS
- ☐ InGaP/HBT
- ☐ GaAs HBT
- ☐ SiGe HBT
- ☐ GaN HEMT
- ☐ GaAs MESFET
- ☐ Si CMOS
- ☑ SiGe Bi-CMOS



Functional Block Diagram

Features

- 2.0V to 3.6V Power Supply
- 902MHz to 928MHz Frequency Range
- 200mW Output Power
- Low LO Input Level
- Low Broadband Noise Floor
- Small Footprint

Ordering Information

RF2942	UHF Quadrature Modulator and Transmitter
RF2942 PCBA	Fully Assembled Evaluation Board

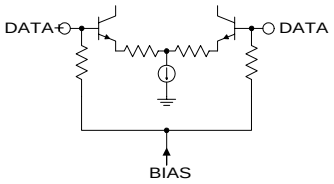
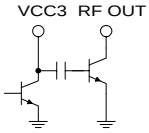
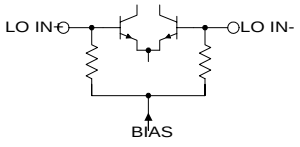
RF Micro Devices, Inc.
7628 Thorndike Road
Greensboro, NC 27409, USA
Tel (336) 664 1233
Fax (336) 664 0454
http://www.rfmd.com

Absolute Maximum Ratings

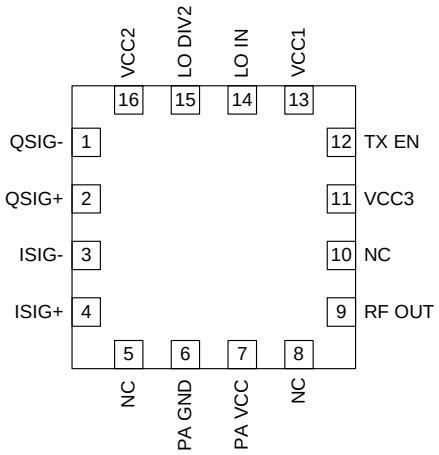
Parameter	Rating	Unit
Supply Voltage	-0.5 to +3.6	V_{DC}
Power Down Voltage (V_{PD})	V_{CC}+0.4	V_{DC}
Input LO and RF Levels	+6	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Power Supply					
Voltage		2.8		V	Specifications
	2.0		3.6	V	Operating limits
Current	170	225	260	mA	
	10		24	mA	TXEN=0.0V
Carrier Input (LO IN)					T=25°C, V_{CC}=2.8V
Frequency Range		1800 to 1860		MHz	
Power Level	-15	-6		dBm	
Input Impedance		50		Ω	1830MHz
Modulation Input					
Frequency Range	DC	2	10	MHz	50Ω source, I,Q=400mV_{p-p}
Modulation for P_{OUT} Power (I & Q)		400		mV_{P-P}	Differential
Quadrature Phase Error		±2	±5	°	
I/Q Amplitude Imbalance		0.2		dB	
Input Impedance		≥10		kΩ	
RF Output					T=25°C, V_{CC}=2.8V, LO power=-6dBm, SSB, I/Q=400mV_{P-P} sine wave, 500kHz
Power Output		23		dBm	V_{CC}=3.0V
	21	22	27	dBm	V_{CC}=2.8V
Second Harmonic Output	-20	-25		dBc	
Third Harmonic Output	-35	-45		dBc	
Sideband Suppression	-25	-40		dBc	
Carrier Suppression	-25			dBc	Modulation DC offset can be externally adjusted for optimum suppression. Carrier suppression is then typically better than 40dB.
Broadband Noise Floor		-90		dBm/Hz	

Pin	Function	Description	Interface Schematic
1	QSIG-	Reference voltage for the I and Q mixer. This voltage should be the same as the DC voltage supplied to the I and Q SIG pin. To obtain a carrier suppression of better than 40dB it may be tuned ±0.15V (relative to the I and Q SIG DC voltage). Without tuning, the carrier suppression will typically be better than 25dB. The input impedance of this pin is typically >10 kΩ.	
2	QSIG+	Same as pin 1, except complementary input.	See pin 1.
3	ISIG-	Same as pin 4, except complementary input.	See pin 1.
4	ISIG+	This pin is used to supply V_{CC} to the modulator circuits. A RF bypass capacitor should be connected directly to this and ground. Baseband input to the I mixer. A DC bias of approximately 1.2V is present at this pin.A DC blocking capacitor is needed if the signal has a different DC level. Maximum output power is obtained when the input signal has a peak to peak amplitude of 1V. The input impedance of this pin is about 3 kΩ. The SIG- and SIG+ inputs are interchangeable. If swapping the I SIG+ and I SIG- pins, the Q SIG+ and Q SIG- also need to be swapped to maintain the correct phase. The SIG+ and SIG- pins may be driven differentially for BPSK to increase conversion gain.	See pin 1.
5	N/C	No connection.	
6	GND		
7	PA VCC	Voltage supply for PA driver.	
8	N/C	No connection.	
9	RF OUT	Power Amp output, open collector output.	
10	N/C	No connection.	
11	VCC3	Voltage supply for PA buffer.	
12	TX EN	TX enabled when >2.0V. When TX EN is held low, only the LO buffer, LO divider and LO divider buffer are left on. To power all of the circuitry down, TX EN and VCC1 must be held low.	
13	VCC1	Voltage supply for LO buffer and divider.	
14	LO IN	The LO input level should be greater than -15dBm for proper operation.	
15	LO/2 OUT	LO divide-by-2 output.	
16	VCC2	Voltage supply for mixers.	

Pin Out


VCC2
LO DIV2
LO IN
VCC1
16
15
14
13
QSIG- 1
QSIG+ 2
ISIG- 3
ISIG+ 4
12 TX EN
11 VCC3
10 NC
9 RF OUT
5
6
7
8
NC
PA GND
PA VCC
NC

Theory of Operation

Modulator

The modulator is a direct conversion double balanced quadrature mixer architecture. The local oscillator signal is buffered then split with internal phase shifters that are optimized for twice the operating frequency. The LO buffer provides isolation from load changes that may occur as the power amplifier section is turned on and off. In addition, the LO buffer may be left on when the transmit section is turned off to prevent load pulling of the external oscillator, by holding TX EN low and leaving the bias on VCC1.

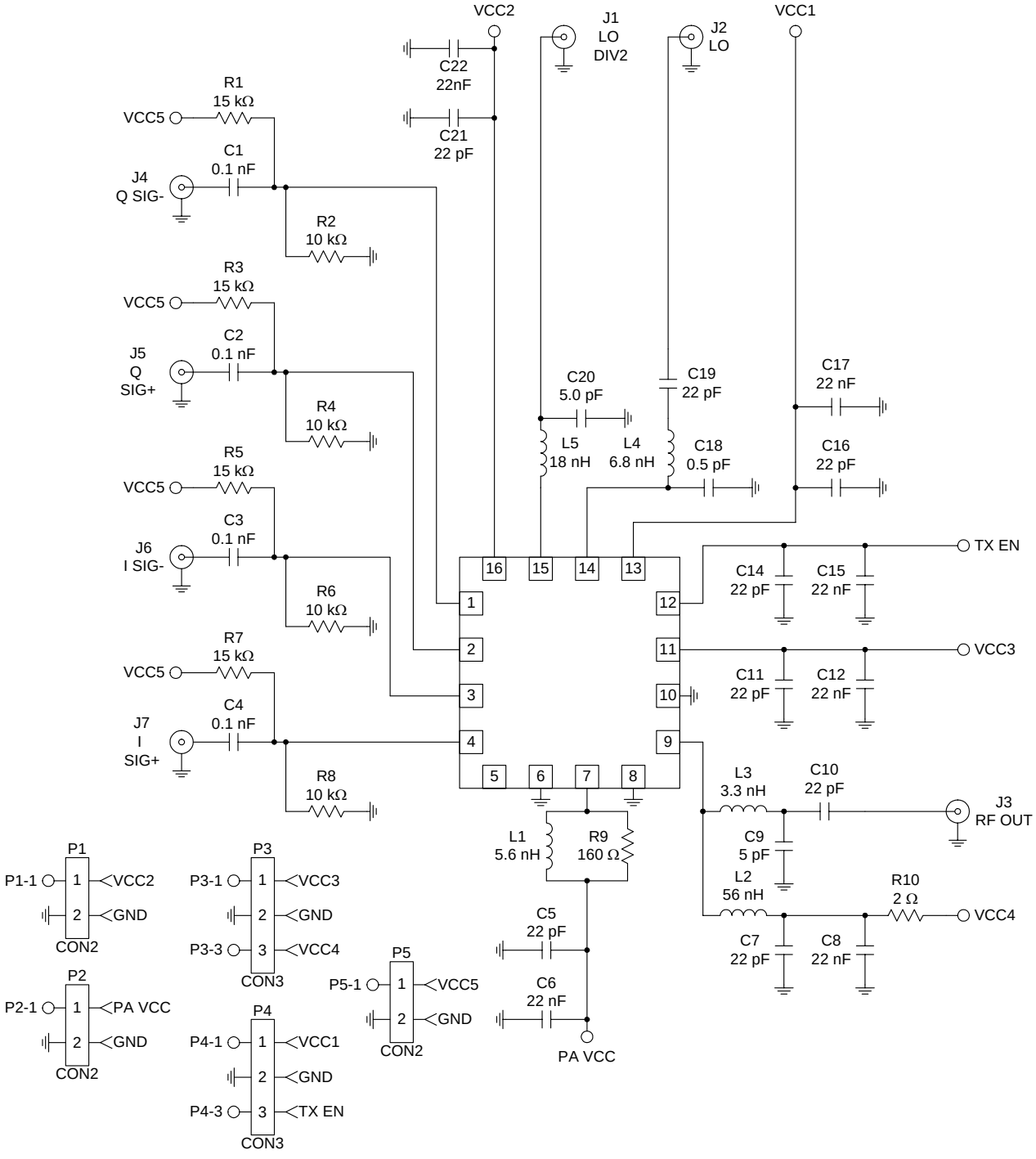
The baseband I and Q pins are connected to the internal mixer bias, therefore it is recommended that the modulation signal be DC-blocked if a similar external reference voltage cannot be provided. The baseband drive may be either single-ended with the complementary input AC-grounded with a capacitor or driven differentially.

Power Amplifier

The power amplifier requires matching on the output (RF OUT) and the interstage transistor (PA VCC).

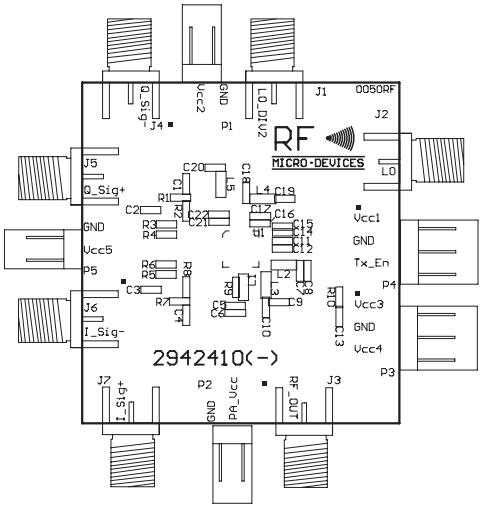
Evaluation Board Schematic - 915MHz

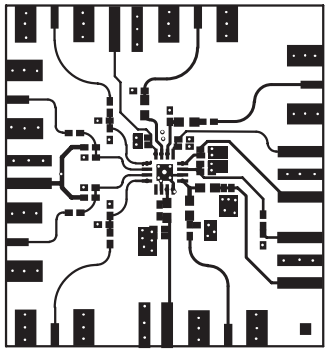
(Download Bill of Materials from www.rfmd.com).

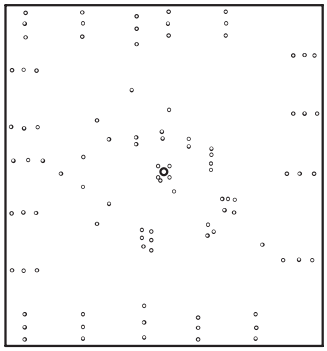


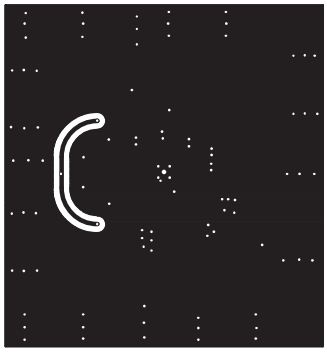
Evaluation Board Layout
Board Size 1.4” x 1.5”

Board Thickness 0.032”, Board Material FR-4, Multi-Layer







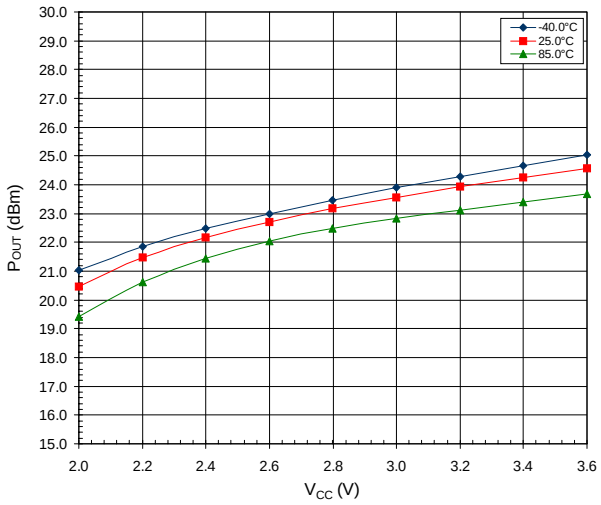


Graphs

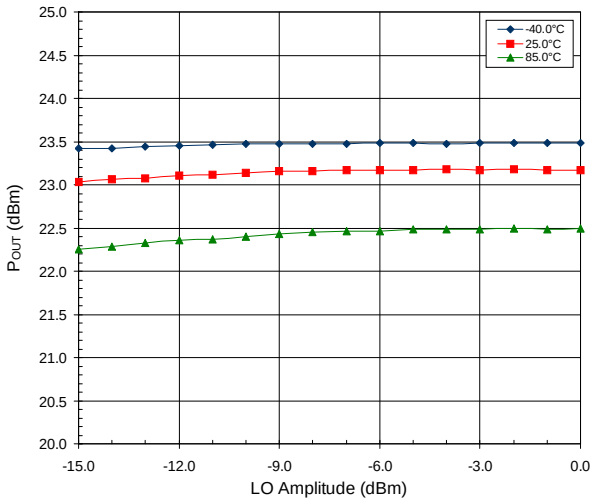
Unless swept, the conditions for the subsequent graphs are as follows. All cable losses accounted for in measurements.

VCC=2.8V	I/Q Frequency=1MHz
LO Frequency=1830MHz	I/Q Amplitude=400mV$_{P-P}$
LO Amplitude=-6dBm	I/Q Phase=90°

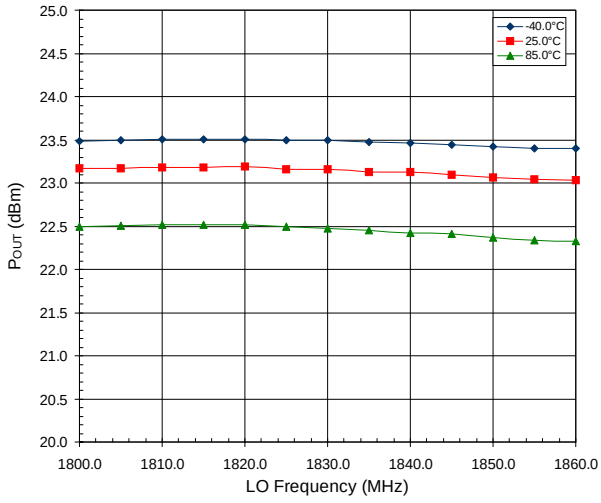
P_{OUT} versus V_{CC} Over Temperature



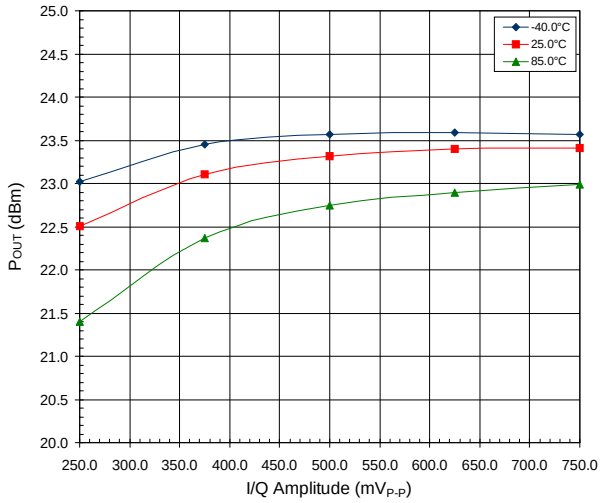
P_{OUT} versus LO Amplitude Over Temperature



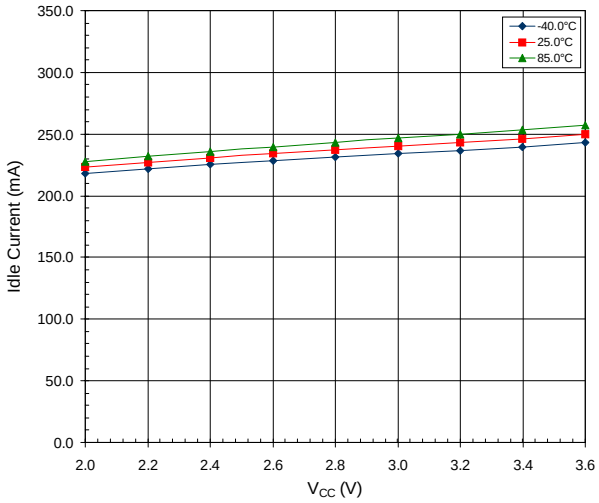
P_{OUT} versus LO Frequency Over Temperature



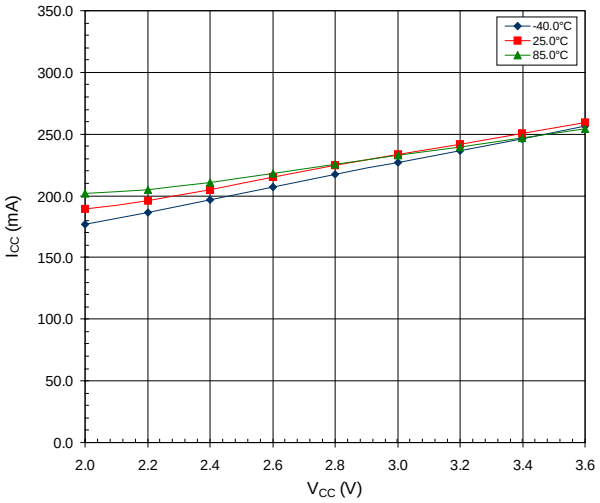
P_{OUT} versus I/Q Amplitude Over Temperature



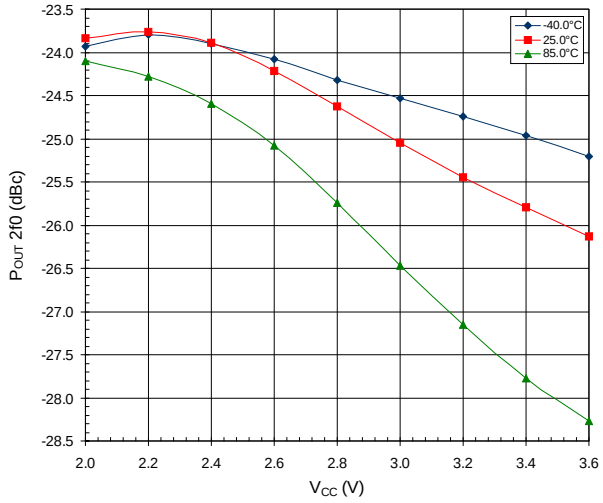
Idle Current versus V_{CC} Over Temperature



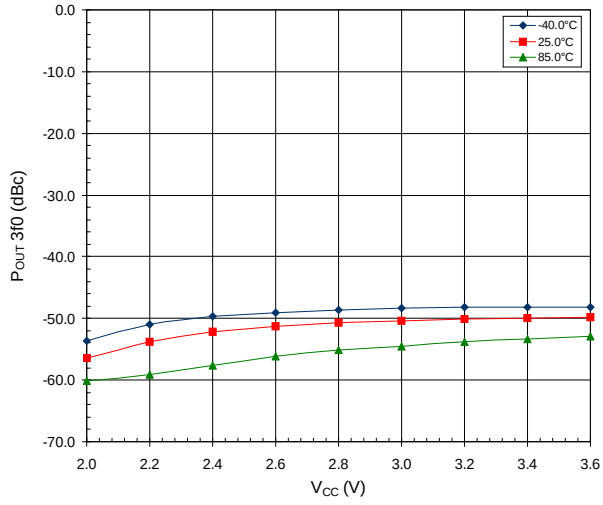
I_{CC} versus V_{CC} Over Temperature



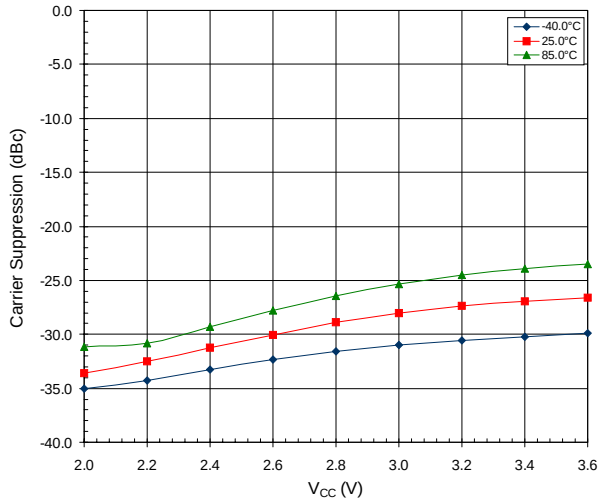
P_{OUT} 2f0 versus V_{CC} Over Temperature



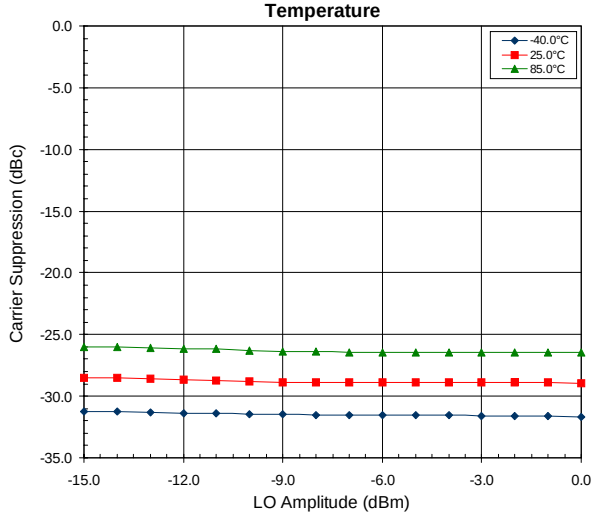
P_{OUT} 3f0 versus V_{CC} Over Temperature



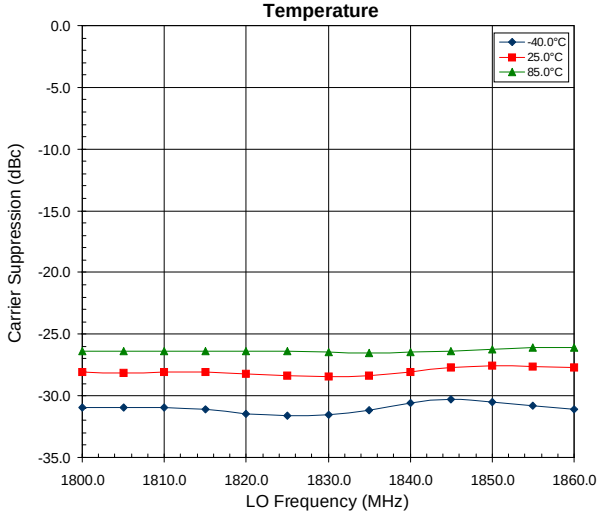
Carrier Suppression versus V_{CC} Over Temperature



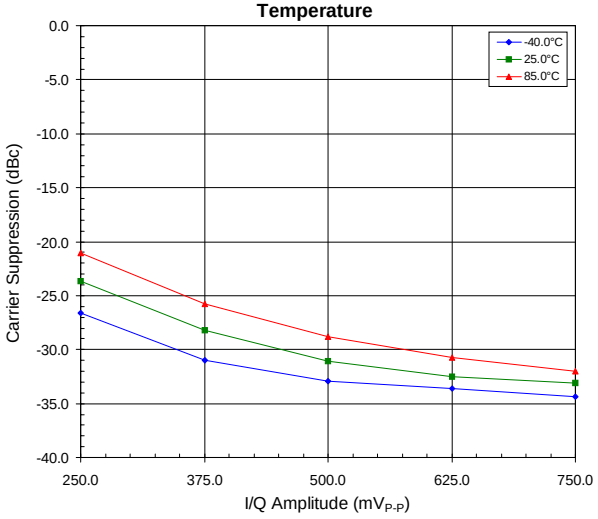
Carrier Suppression versus LO Amplitude Over Temperature



Carrier Suppression versus LO Frequency Over Temperature



Carrier Suppression versus I/Q Amplitude Over Temperature



Carrier Suppression versus I/Q Phase Over Temperature

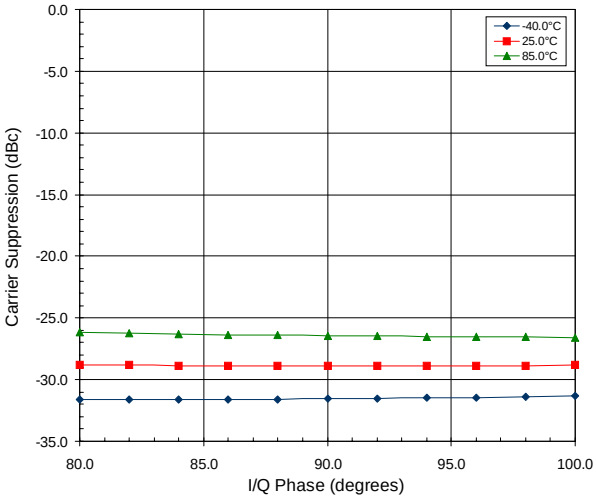


Image Suppression versus V_{CC} Over Temperature

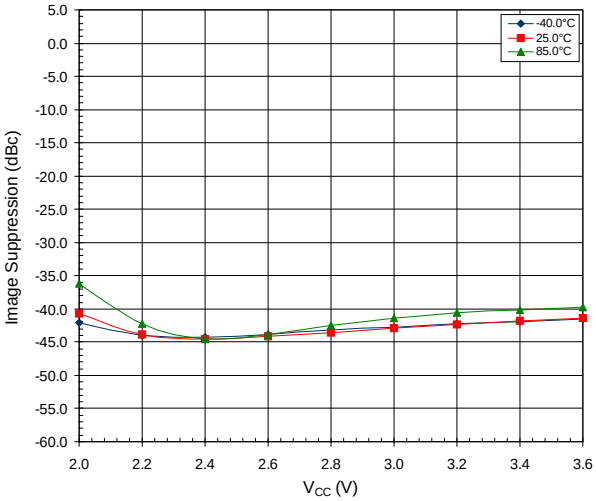


Image Suppression versus LO Amplitude Over Temperature

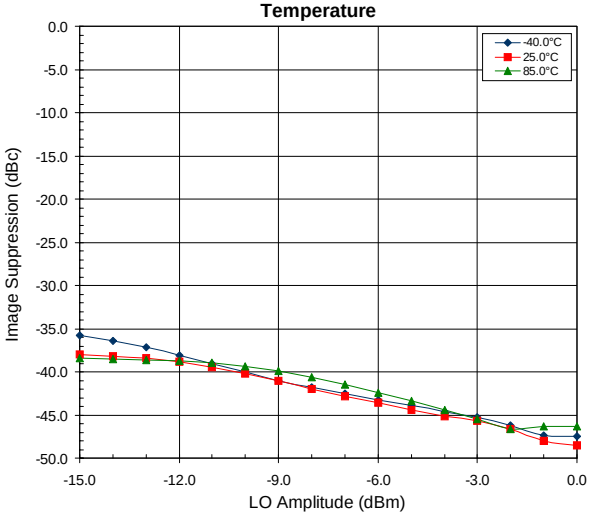


Image Suppression versus LO Frequency Over Temperature

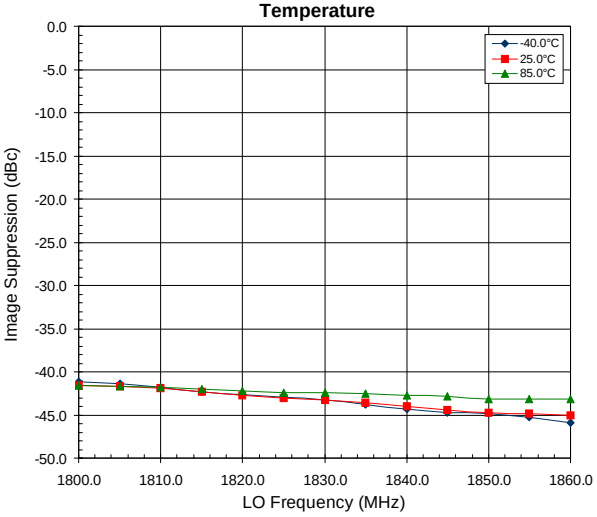


Image Suppression versus I/Q Amplitude Over Temperature

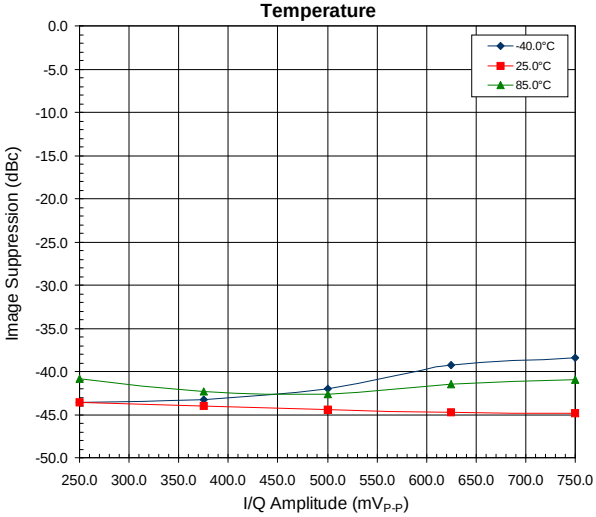
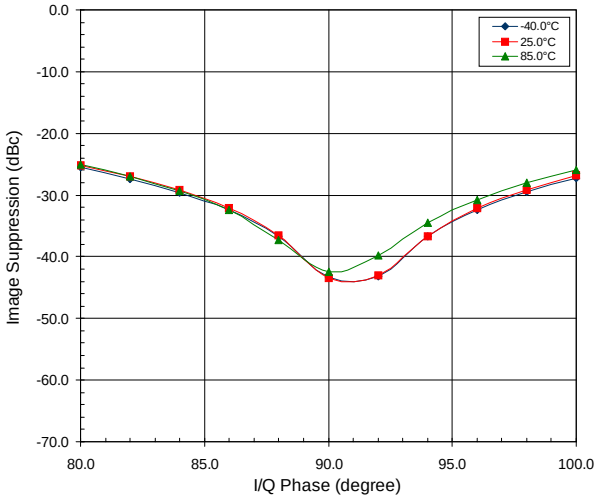
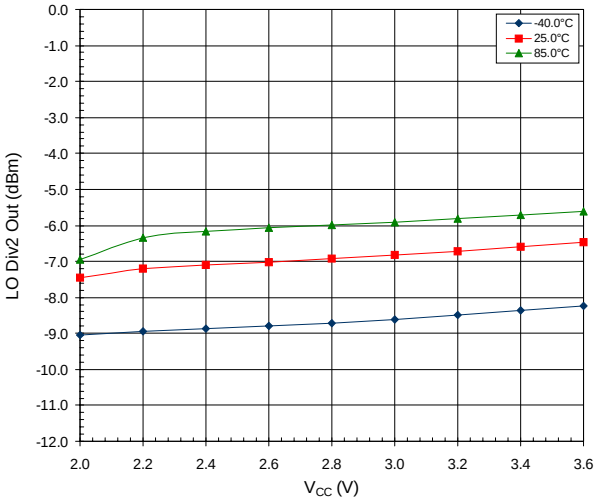


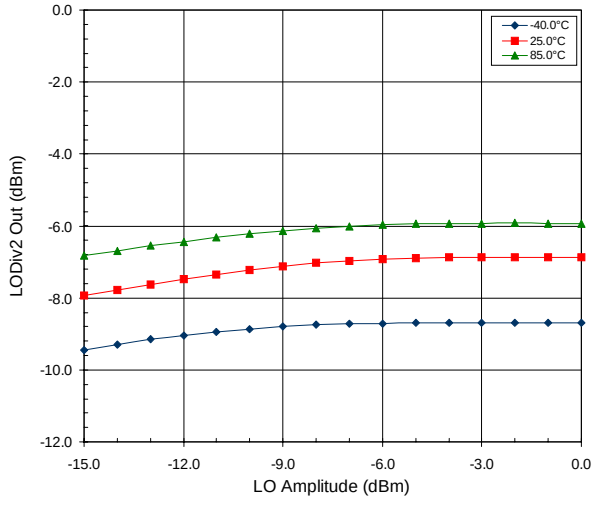
Image Suppression versus I/Q Phase Over Temperature



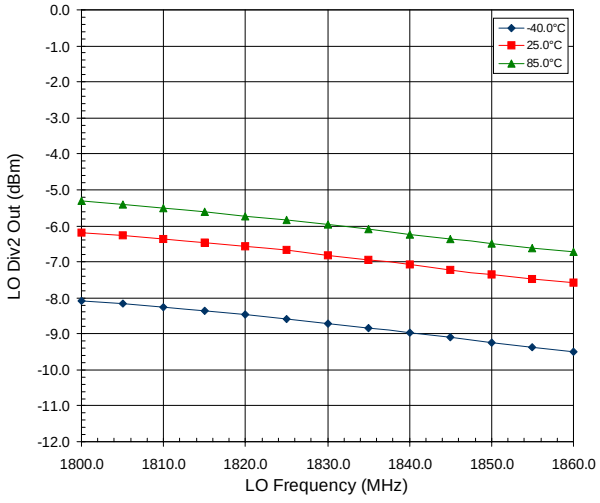
LODiv2 Out versus V_{CC} Over Temperature



LODiv2 Out versus LO Amplitude Over Temperature



LODiv2 Out versus LO Frequency Over Temperature



LODiv2 Out versus I/Q Amplitude Over Temperature