RF2155

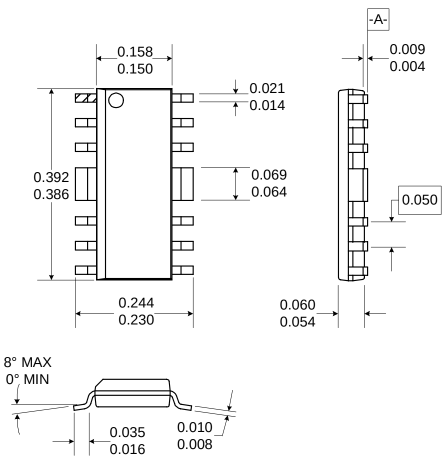
3V PROGRAMMABLE GAIN POWER AMPLIFIER

Typical Applications

- Analog Communication Systems
- 900MHz Spread Spectrum Systems
- 400MHz Industrial Radios
- Driver Stage for Higher Power Applications
- 3V Applications

Product Description

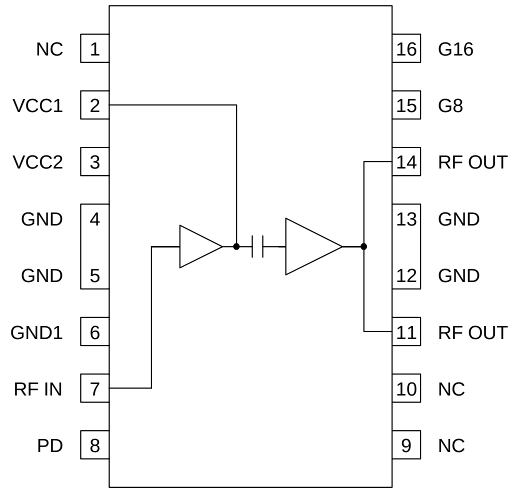
The RF2155 is a 3V medium power programmable gain amplifier IC. The device is manufactured on an advanced Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as the final RF amplifier in analog cellular phone transmitters or ISM applications operating at 915MHz. The device is self-contained with the exception of the output matching network and power supply feed line. A two-bit digital control provides 4 levels of power control, in 8dB steps.



Package Style: Standard Batwing

Optimum Technology Matching® Applied

- ☐ Si BJT
- ☑ GaAs HBT
- ☐ GaAs MESFET
- ☐ Si Bi-CMOS
- ☐ SiGe HBT
- ☐ Si CMOS



Functional Block Diagram

Features

- Single 3V Supply
- 500mW CW Output Power
- 31dB Small Signal Gain
- Up to 60% Efficiency
- Digitally Controlled Output Power
- 430MHz to 930MHz Frequency Range

Ordering Information

RF2155	3V Programmable Gain Power Amplifier
RF2155 PCBA	Fully Assembled Evaluation Board

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +5.5	V_{DC}
Power Down Voltage (V_{PD})	-0.5 to +3.3	V
DC Supply Current	500	mA
Input RF Power	+10	dBm
Output Load VSWR	10:1	
Ambient Operating Temperature	-30 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

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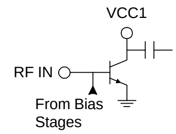
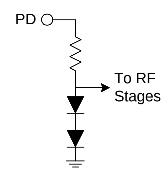
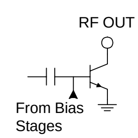
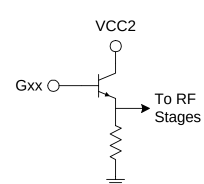
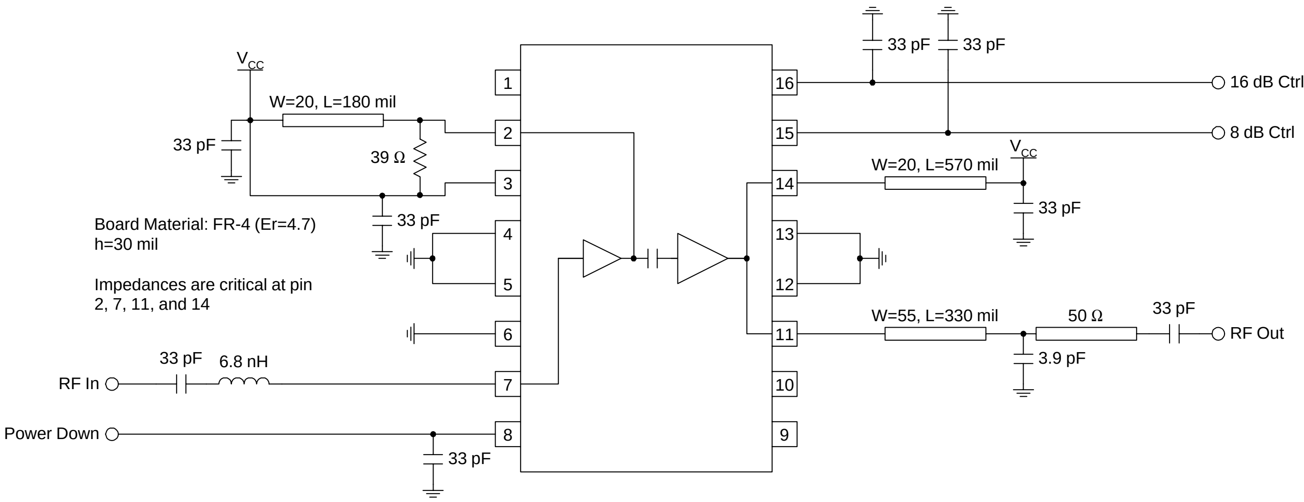
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall					T=25°C, V_{CC}=3.6V, V_{PD}=3.0V, Z_{LOAD}=13Ω, P_{IN}=0dBm, Freq=915MHz
Frequency Range		430 to 930		MHz	
Maximum CW Output Power		450		mW	V_{CC}=3.6V
		300		mW	V_{CC}=3.0V
Small Signal Gain		31		dB	
Second Harmonic		-30		dBc	Without external second harmonic trap
Third Harmonic		-40		dBc	
Fourth Harmonic		-36		dBc	
Input VSWR		2:1			All gain settings
CW Efficiency	50	56		%	G16=“high”, G8=“high”, P_{IN}=0dBm
Output Load VSWR	6:1				Spurious<-60dBc
Power Control					
Power Down “ON”	2.7	2.8	3.0	V	Voltage supplied to the input
Power Down “OFF”	0	0.5	0.8	V	Voltage supplied to the input
PD Input Current		3.7	5.0	mA	Only in “ON” state
G16, G8 “ON”	2.2	2.5	3.0	V	Voltage supplied to the input
G16, G8 “OFF”	0	0.3	0.5	V	Voltage supplied to the input
G16, G8 Input Current	0.8	1.0	1.6	mA	Only in “ON” state
Output Power	+25.5	+26.5	+28.0	dBm	G16=“high”, G8=“high”, P_{IN}=0dBm
	+16.0	+18.5	+21.0	dBm	G16=“high”, G8=“low”, P_{IN}=0dBm
	+8.0	+10.5	+13.0	dBm	G16=“low”, G8=“high”, P_{IN}=0dBm
	-1.0	+1.5	+4.0	dBm	G16=“low”, G8=“low”, P_{IN}=0dBm
Turn On/Off Time			100	ns	
Power Supply					
Power Supply Voltage		3.6		V	Specifications
	3.0		5.0	V	Operating limits
Power Supply Current		225	300	mA	G16=“high”, G8=“high”, P_{IN}=0dBm
		90	115	mA	G16=“high”, G8=“low”, P_{IN}=0dBm
		37	55	mA	G16=“low”, G8=“high”, P_{IN}=0dBm
		25	35	mA	G16=“low”, G8=“low”, P_{IN}=0dBm
	20	50	110	mA	G16=“high”, G8=“high”, No RF In
		1	10	µA	G16=“low”, G8=“low”, PD=“low”

Pin	Function	Description	Interface Schematic
1	NC	Not internally connected.	
2	VCC1	Positive supply for the first stage (driver) amplifier. This is an unmatched transistor collector output. This pin should see an inductive path to AC ground (V_{CC} with a UHF bypassing capacitor). This inductance can be achieved with a short, thin microstrip line (approximately equivalent to 0.4nH). At lower frequencies, the inductance value should be larger (longer microstrip line) and V_{CC} should be bypassed with a larger bypass capacitor. This inductance forms a matching network with the amplifier stages, setting the amplifier's frequency of maximum gain. An additional 1µF bypass capacitor in parallel with the UHF bypass capacitor is also recommended, but placement of this component is not as critical. A resistor of 39Ω from this pin to pin 3 is necessary to ensure stability under extreme output VSWR conditions.	
3	VCC2	Positive supply for the bias circuits. This pin should be bypassed with a single UHF capacitor, placed as close as possible to the package.	
4	GND	Ground connection. Keep traces physically short and connect immediately to the ground plane for best performance.	
5	GND	Same as pin 4.	
6	GND1	Ground return for the first stage; this should be connected to a via very close to the device.	
7	RF IN	Amplifier RF input. This is a 50Ω RF input port to the amplifier. To improve the input match over all four gain control settings, an input inductor of 6.8nH should be added. The amplifier does not contain internal DC blocking and, therefore, should be externally DC blocked before connecting to any device which has DC present or which contains a DC path to ground. A series UHF capacitor is recommended for the DC blocking.	See pin 2.
8	PD	Power down control voltage. When this pin is at 0V, the device will be in power down mode, dissipating minimum DC power. When this pin is at 3V the device will be in full power mode delivering maximum available gain and output power capability. This pin should not, in any circumstance, be higher than 3.3V. This pin should also have an external UHF and HF bypassing capacitor.	
9	NC	Not internally connected.	
10	NC	Not internally connected.	
11	RF OUT	Amplifier RF output. This is an unmatched collector output of the final amplifier transistor. It is internally connected to pins 11 and 14 to provide low series inductance and flexibility in output matching. Bias for the final power amplifier output transistor must also be provided through one of these pins. Typically, pin 14 is used to supply bias. A transmission line of approximately 500mils length, followed by a bypass capacitor, is adequate. This pin can also be used to create a second harmonic trap. A UHF and large tantalum (1µF) capacitor should be placed on the power supply side of the bias inductor. Pin 11 should be used for the RF output with a matching network that presents the optimum load impedance to the PA for maximum power and efficiency, as well as providing DC blocking at the output.	
12	GND	Same as pin 4.	
13	GND	Same as pin 4.	
14	RF OUT	Same as pin 11.	
15	G8	RF output power gain control 8dB bit (see specification table for logic). The control voltage at this pin should never exceed 3.3V and a logic high should be at least 2.7V. This pin should also have an external UHF bypassing capacitor.	

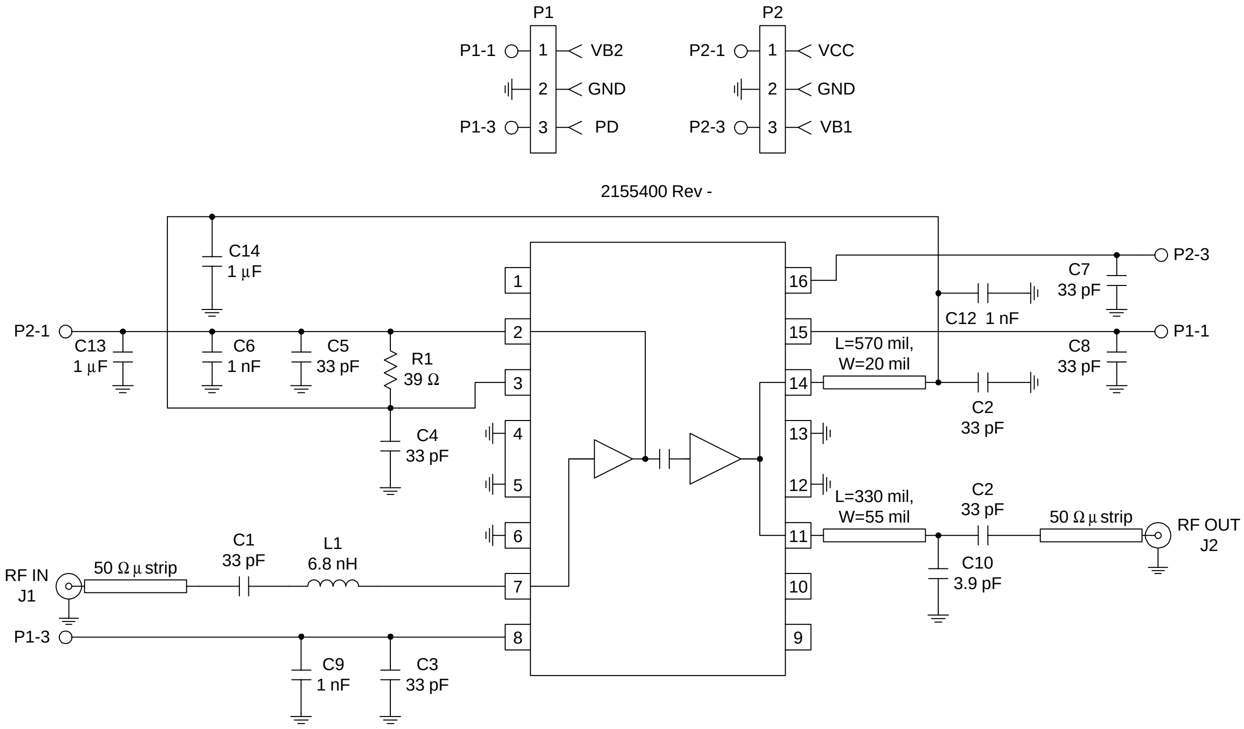
Pin	Function	Description	Interface Schematic
16	G16	RF output power gain control 16dB bit (see specification table for logic). The control voltage at this pin should never exceed 3.3V and a logic high should be at least 2.7V. This pin should also have an external UHF bypassing capacitor.	Same as pin 15.

Application Schematic
915 MHz

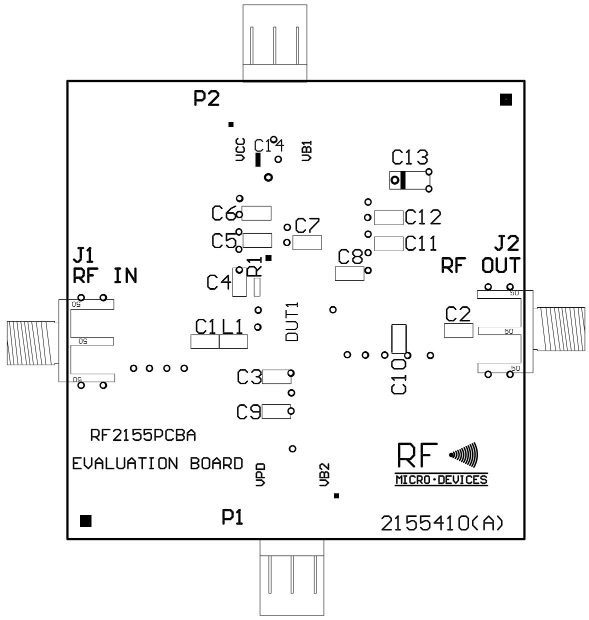


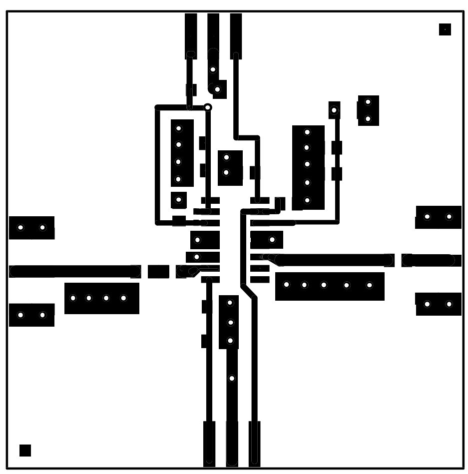
Evaluation Board Schematic

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

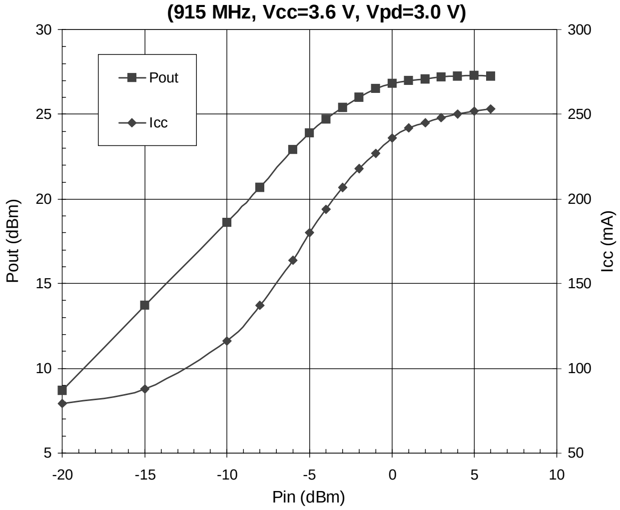


Evaluation Board Layout
Board Size 2.0” x 2.0”

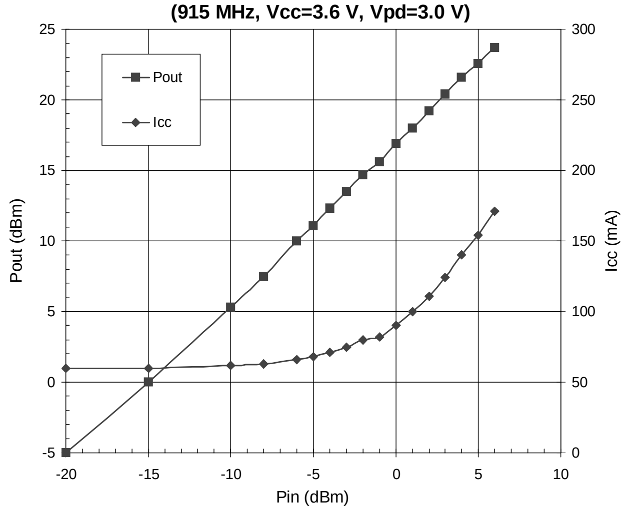




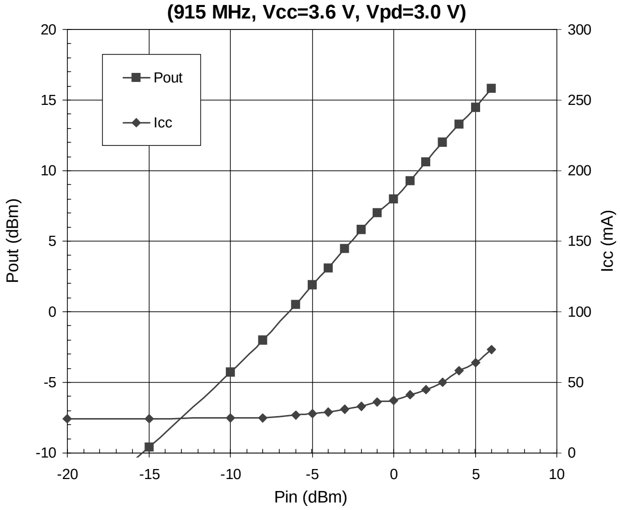
Pout and Icc vs. Pin, State 11
(915 MHz, Vcc=3.6 V, Vpd=3.0 V)



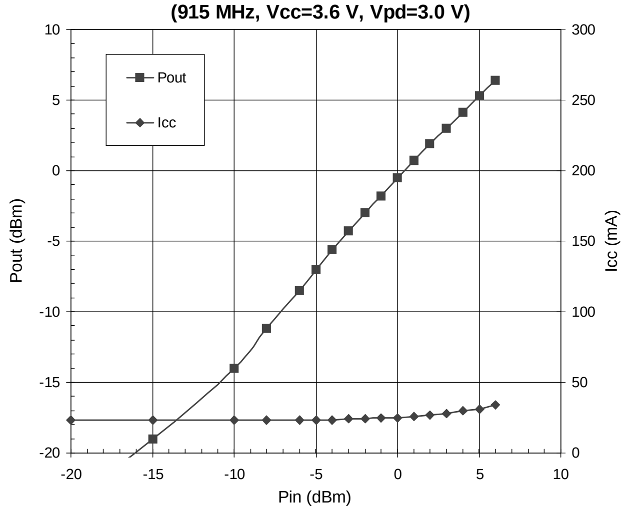
Pout and Icc vs. Pin, State 10
(915 MHz, Vcc=3.6 V, Vpd=3.0 V)



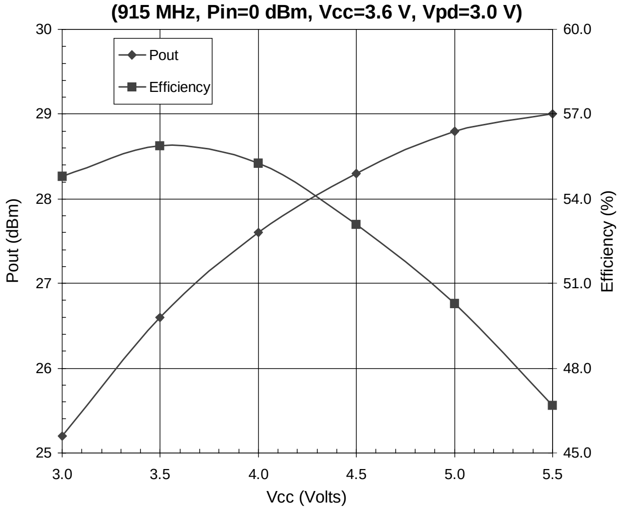
Pout and Icc vs. Pin, State 01
(915 MHz, Vcc=3.6 V, Vpd=3.0 V)



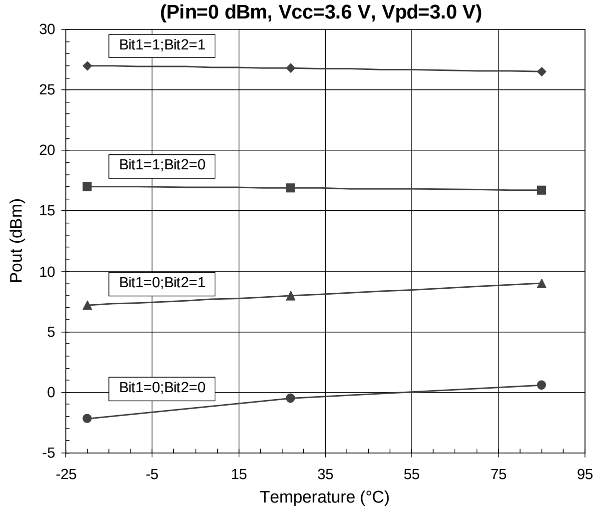
Pout and Icc vs. Pin, State 01
(915 MHz, Vcc=3.6 V, Vpd=3.0 V)

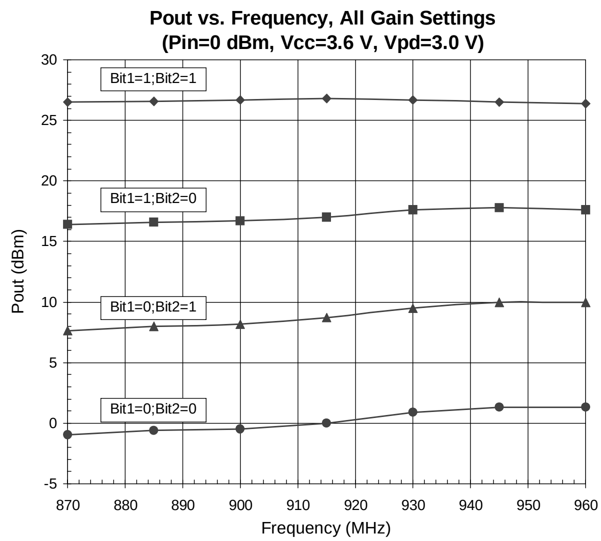


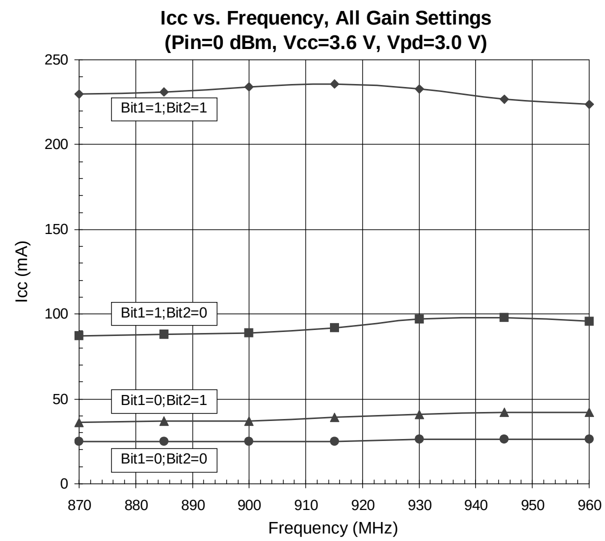
Pout and Efficiency vs. Vcc, Full Gain
(915 MHz, Pin=0 dBm, Vcc=3.6 V, Vpd=3.0 V)



Pout vs. Temperature, All Gain Settings
(Pin=0 dBm, Vcc=3.6 V, Vpd=3.0 V)




Pout vs. Frequency, All Gain Settings
(Pin=0 dBm, Vcc=3.6 V, Vpd=3.0 V)
Bit1=1;Bit2=1
Bit1=1;Bit2=0
Bit1=0;Bit2=1
Bit1=0;Bit2=0
Pout (dBm)
Frequency (MHz)
30
25
20
15
10
5
0
-5
870
880
890
900
910
920
930
940
950
960


Icc vs. Frequency, All Gain Settings
(Pin=0 dBm, Vcc=3.6 V, Vpd=3.0 V)
Bit1=1;Bit2=1
Bit1=1;Bit2=0
Bit1=0;Bit2=1
Bit1=0;Bit2=0
Icc (mA)
Frequency (MHz)
250
200
150
100
50
0
870
880
890
900
910
920
930
940
950
960