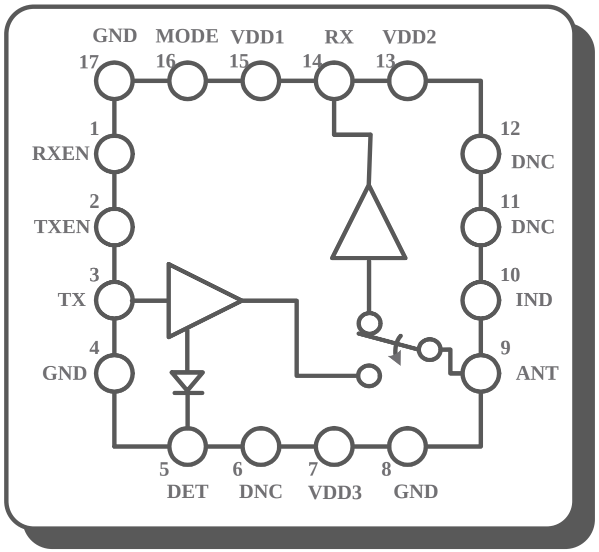
RFX1010 Broadband 700/800/900MHz Single-Chip Half-Watt RFeIC with PA, LNA, and RF Switch

Evaluation Board Test Summary & Technical Notes

RFX1010 Features and Benefits

3x3x0.55mm
16L QFN



APPLICATIONS

- N. America 900MHz ISM Systems
- European 870MHz SRD Systems
- Mobile and Battery Powered ZigBee
- China 780MHz SRD Systems
- Smart Grid/AMR Application

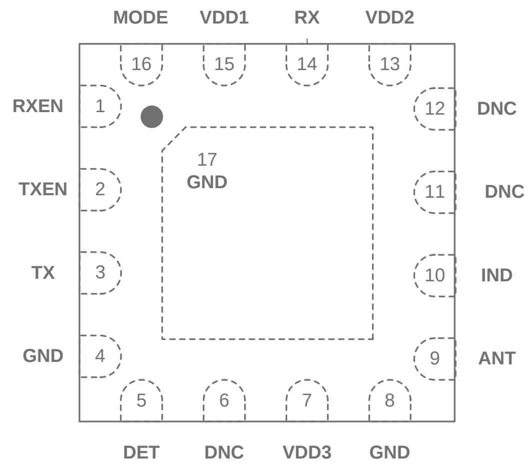
Differentiating Features

- All Key Functions for High Power ISM Including PA, LNA, Tx-Rx Switching Circuitry, Matching, Harmonic Filters and Power Detector Integrated into a Single-Chip Single-Die CMOS Device
- Reduced and Simplified Tx/Rx Control Lines
- Digital Logic with 1.2V Turn-On Voltage
- No Vref Regulator for Biasing
- Minimal External Component Requirements
- Small, Ultra-Thin 3.0mmx3.0mmx0.55mm 16L QFN Package

Customer Benefits

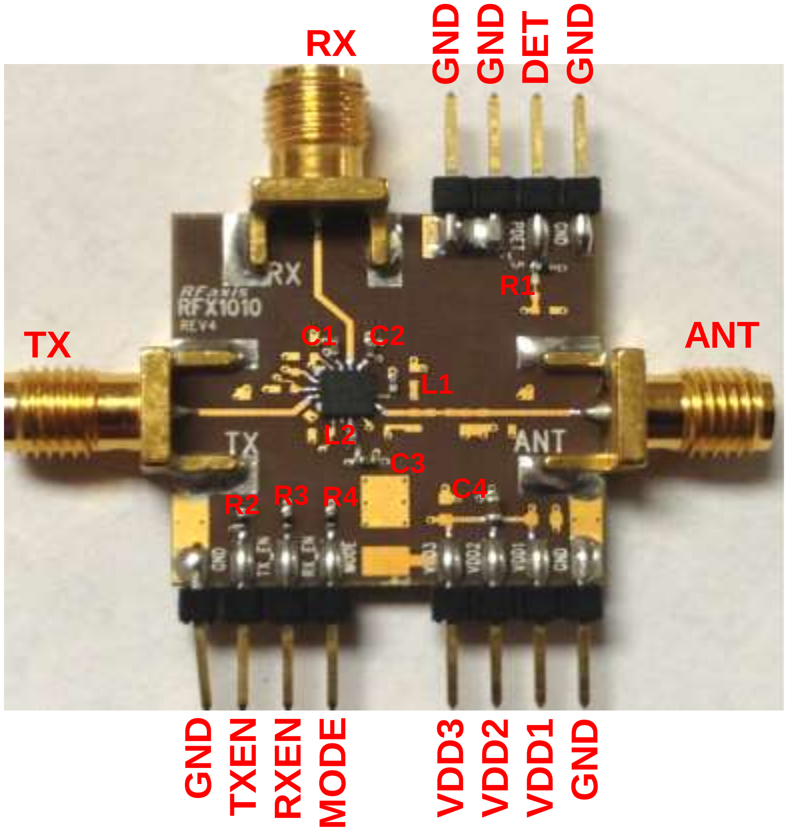
- Simple 50-Ohm "Plug & Play" Implementation onto Customer's PCB
- Reduced Product Design Cycle and TTM
- Enabling Very Small Product Form-Factor
- Available in Bare-Die for Compact SiP Design
- Best-Class RF Performance for both Tx and Rx
- Very Competitive Price & Overall BOM Cost
- Ideal for Long Range Applications

RFX1010 Pin-Out and Pin Description



Pin Number	Pin Name	Description
1	RXEN	CMOS Input to Enable Receive Mode
2	TXEN	CMOS Input to Enable Transmit Mode
3	TX	RF TX Signal from the Transceiver to the PA: DC Shorted to GND
5	DET	Analog Voltage Proportional to the PA Power Output
4, 8, 17	GND	Ground – Must Be Connected to Ground in the Application Circuit
7	VDD3	Voltage Supply Connection for the Power Stage of PA
9	ANT	Common RF Port Connected to the Antenna, DC Shorted to GND
10	IND	Port for Connecting ANT Matching Inductor
6, 11, 12	DNC	Do Not Connect – Must be left floating in the Application Circuit
13	VDD2	Voltage Supply Connection for the LNA
14	RX	RF RX Signal from the LNA to the Transceiver, DC Shorted to GND
15	VDD1	Voltage Supply Connection for the Driver Stage of PA
16	MODE	CMOS Input to Control High Gain/Low Gain for RX

RFX1010 Eval Board, DC Bias and Control Logic



Recommended BOM

Supply Decoupling:
- C1 = C2 = C3 = 10nF
- C4 = 2.2uF
- L2 = 6.2nH

Detector Load:
- R1 = 10Kohm

Antenna Match:
- L1 = 3.3nH

Control Resistor:
- R2, R3 and R4 = 1Kohm (for evaluation purpose only, not needed for application schematic)

-VDD=3.3V Nominal

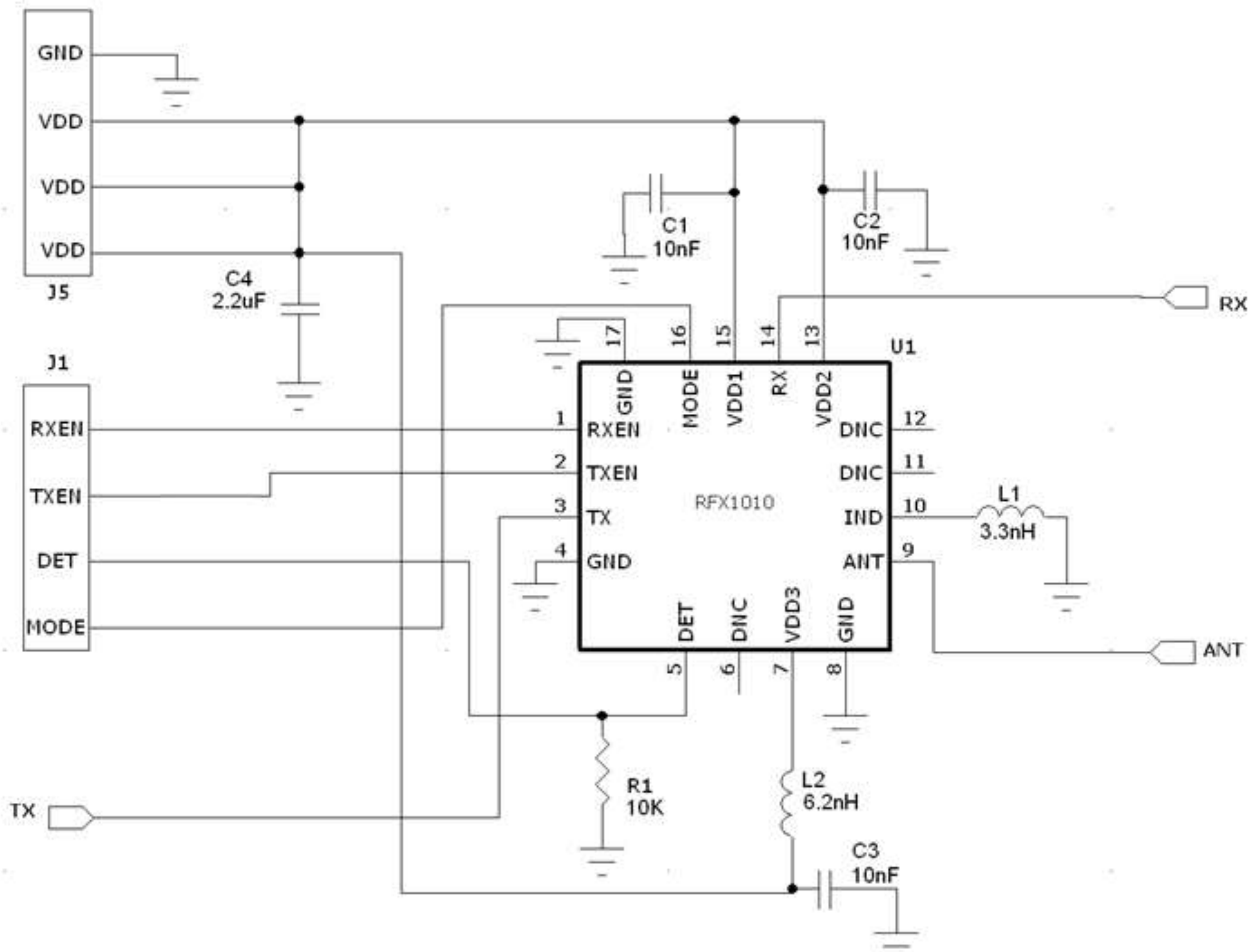
Eval PCB Information:

- 4-Layer Stack, 10mil/40mil/10mil
- FR4 with εr=4.5, tan δ = 0.02 (Typ)
- TX,RX,ANT trace losses are ~0.15dB @ 0.7GHz – 1GHz
- Results in following slides are referenced to device pins with the trace loss de-embedded
- VDD1,2,3 should be on **before** applying ctrl signals

Truth Table for Logic Control

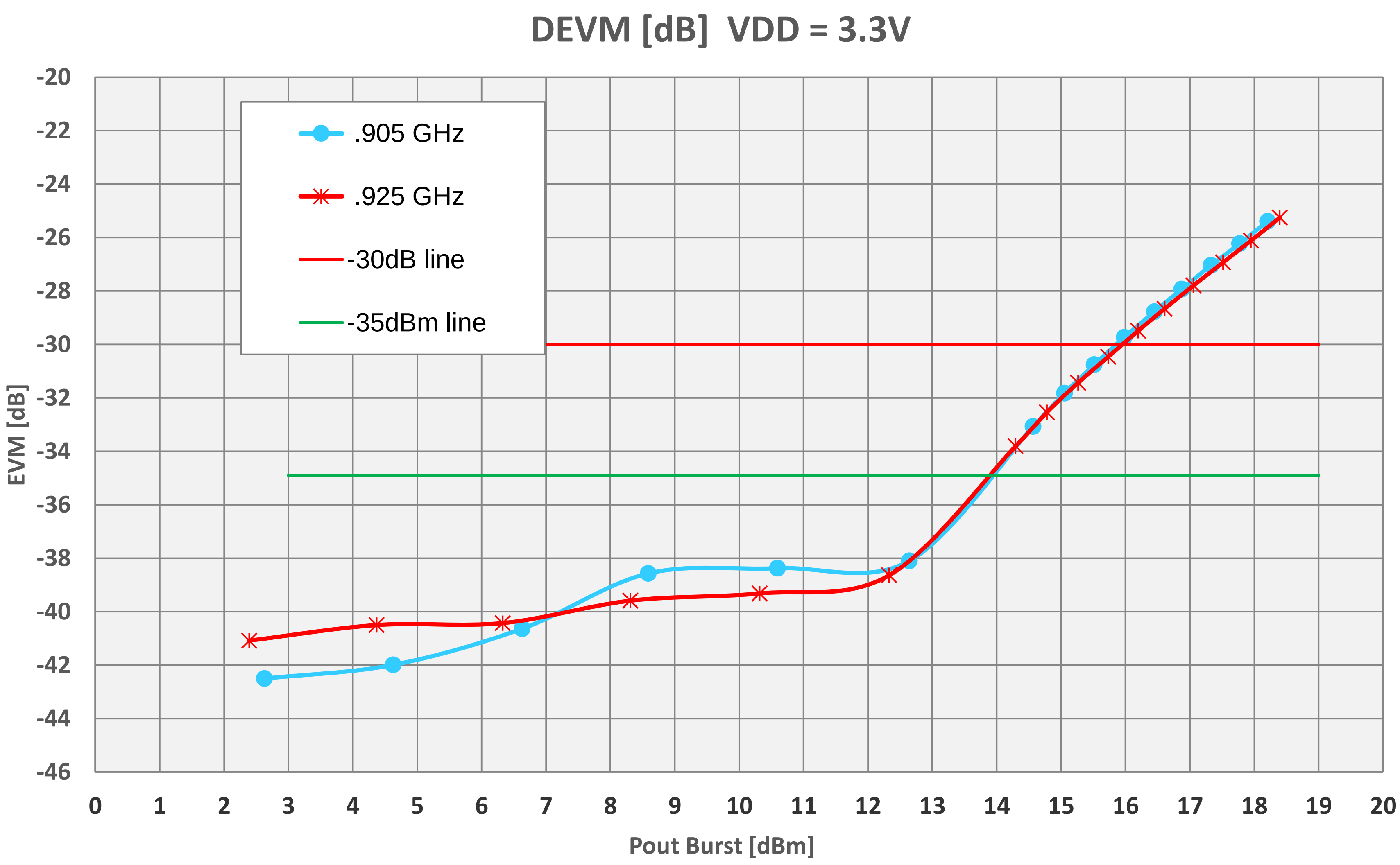
TXEN	RXEN	MODE	Operating Conditions
0	0	X	Shut-down
0	1	0	RX Active, Low Gain Mode
0	1	1	RX Active, High Gain Mode
1	X	X	TX Active

RFX1010 Recommended Application Schematic

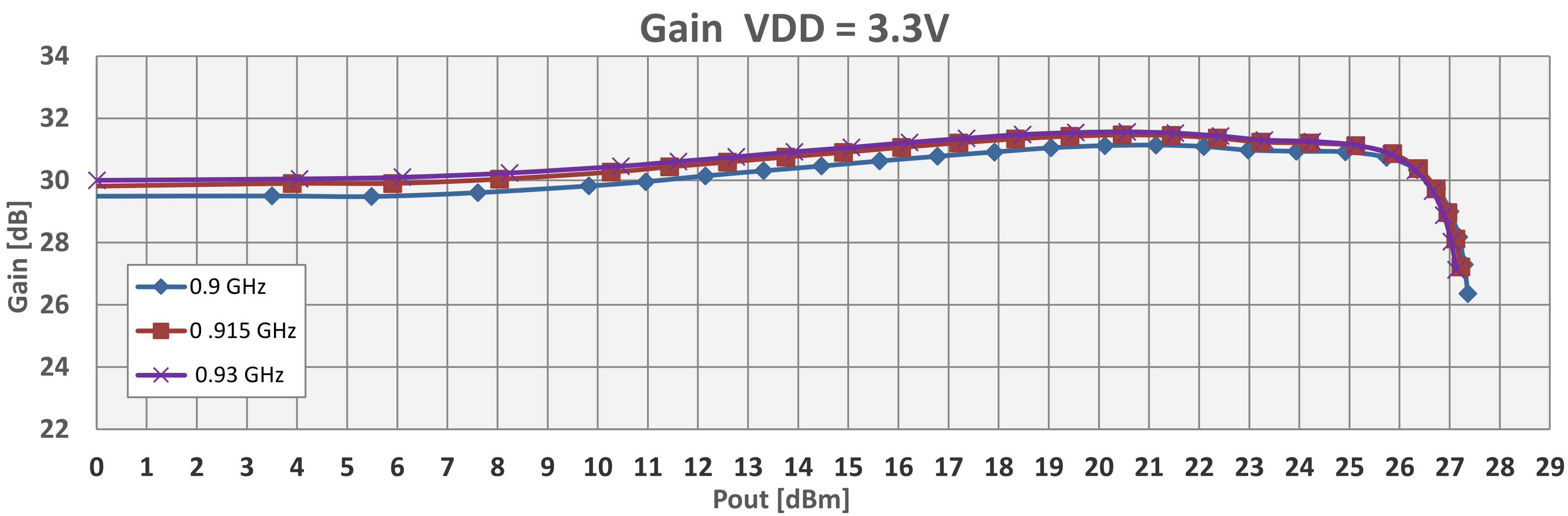


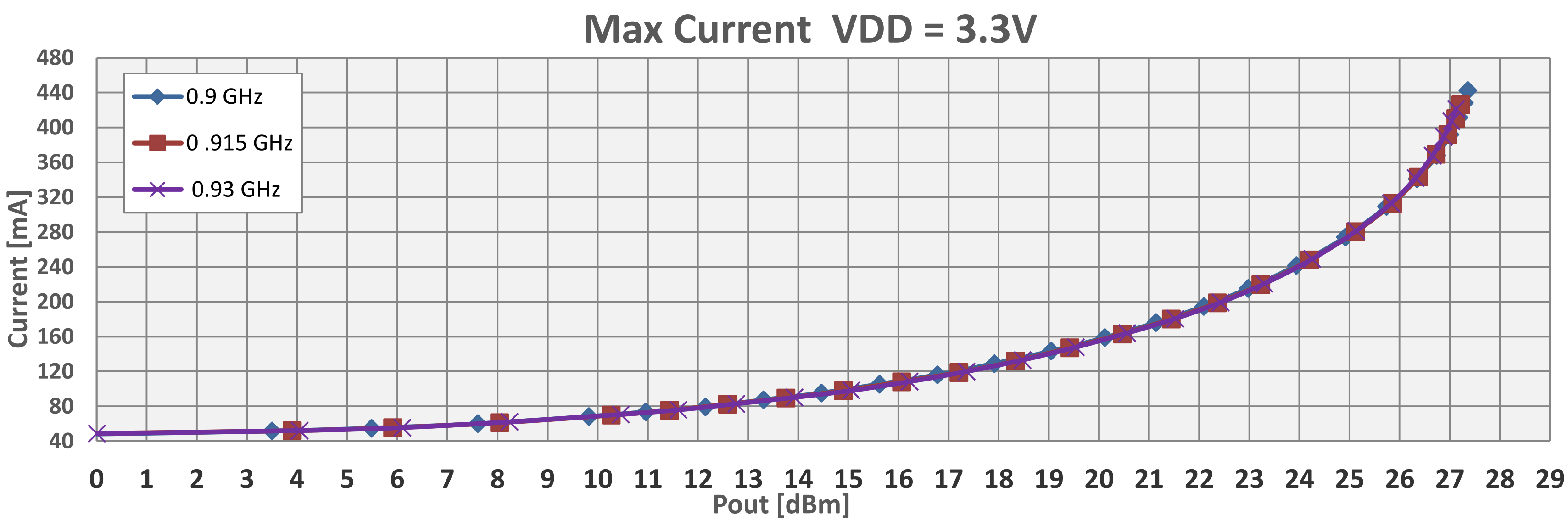
Note: For best harmonic rejection, please connect pin 8 to the center ground paddle in PCB layout.

RFX1010 EVM vs. Output Power
802.11p, VDD = 3.3V

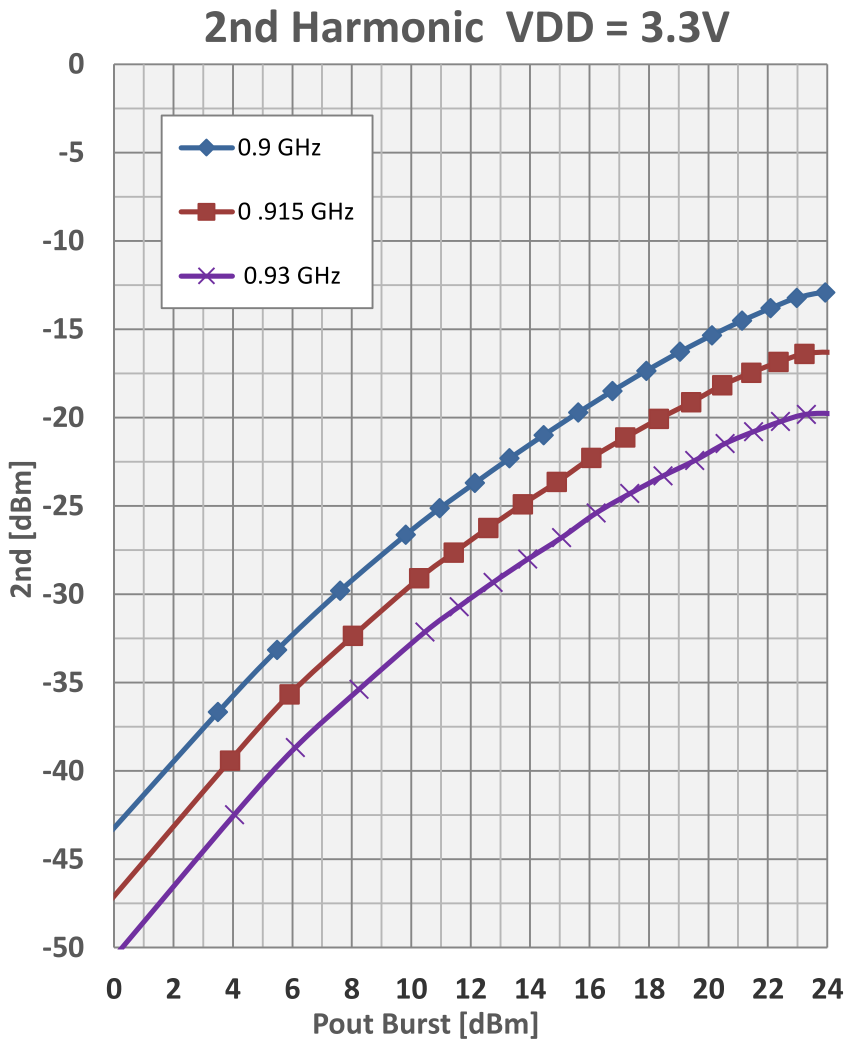


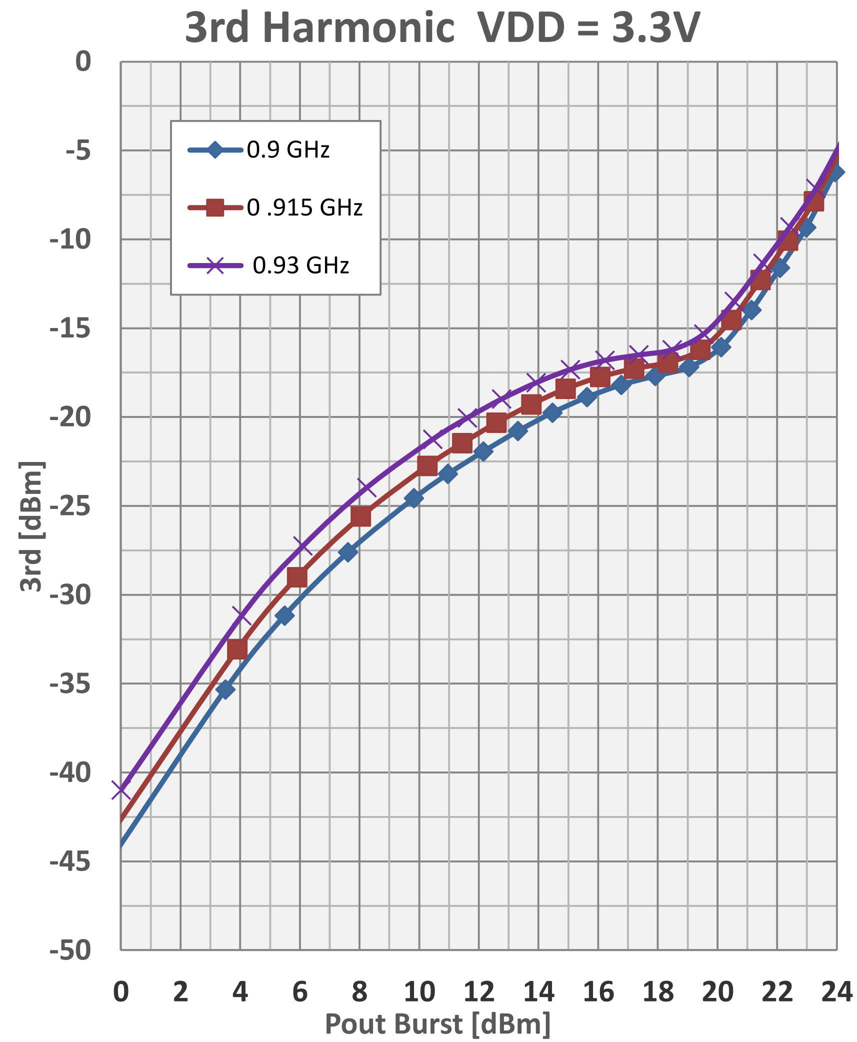
RFX1010 Gain and Current vs. Output Power CW, VDD = 3.3V



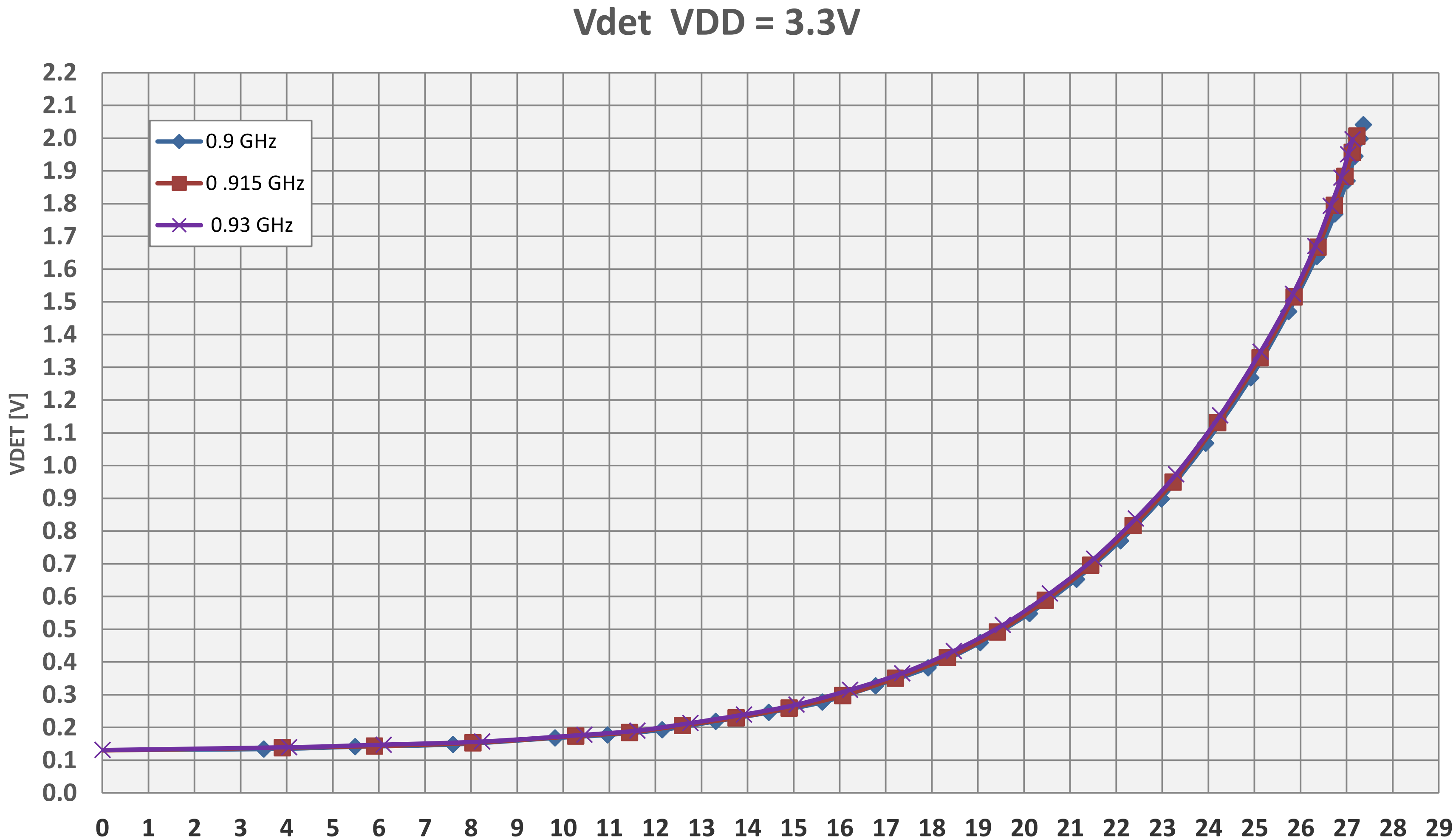


RFX1010 Harmonics vs. Output Power
CW, VDD = 3.3V



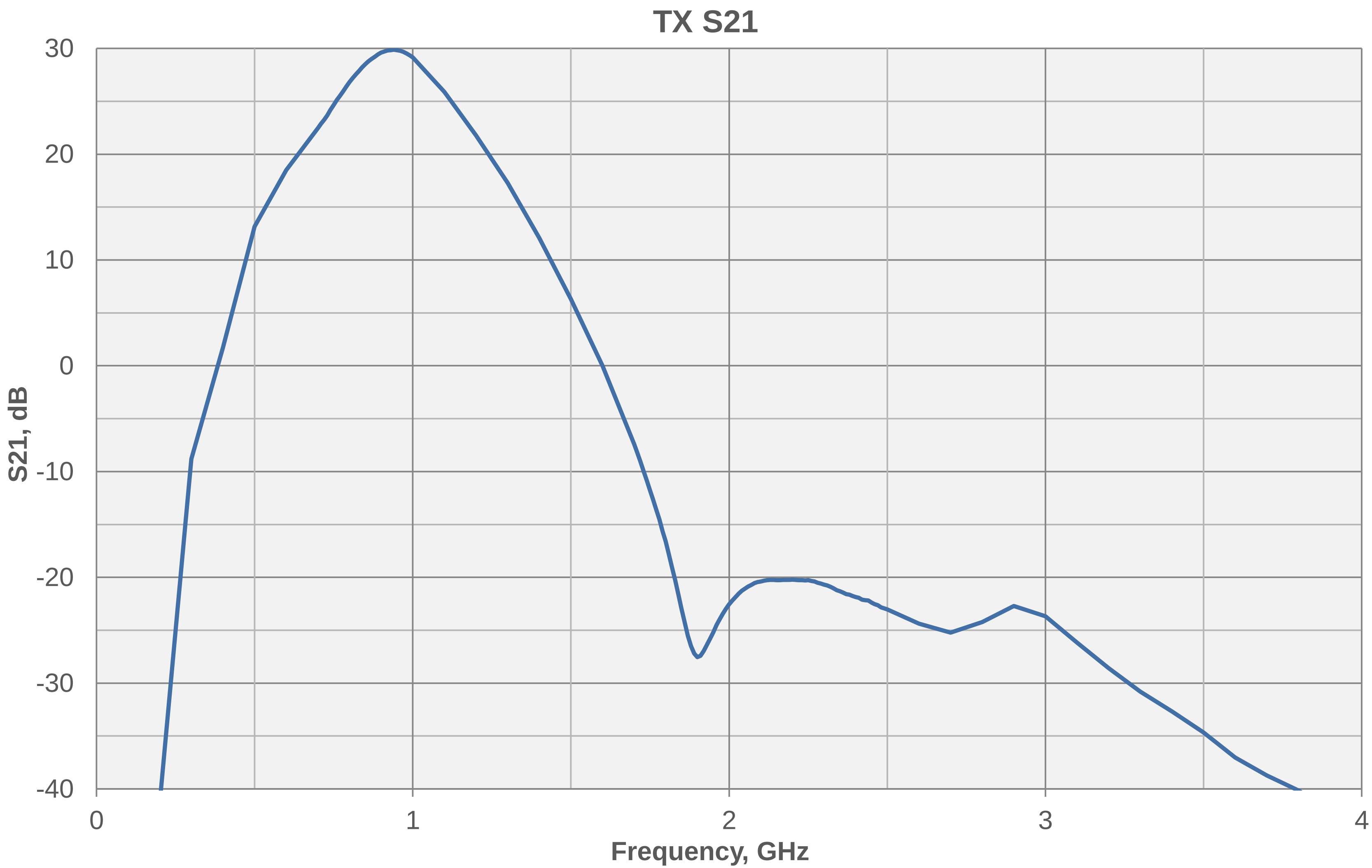


RFX1010 Detector Voltage vs. Output Power
CW, VDD = 3.3V



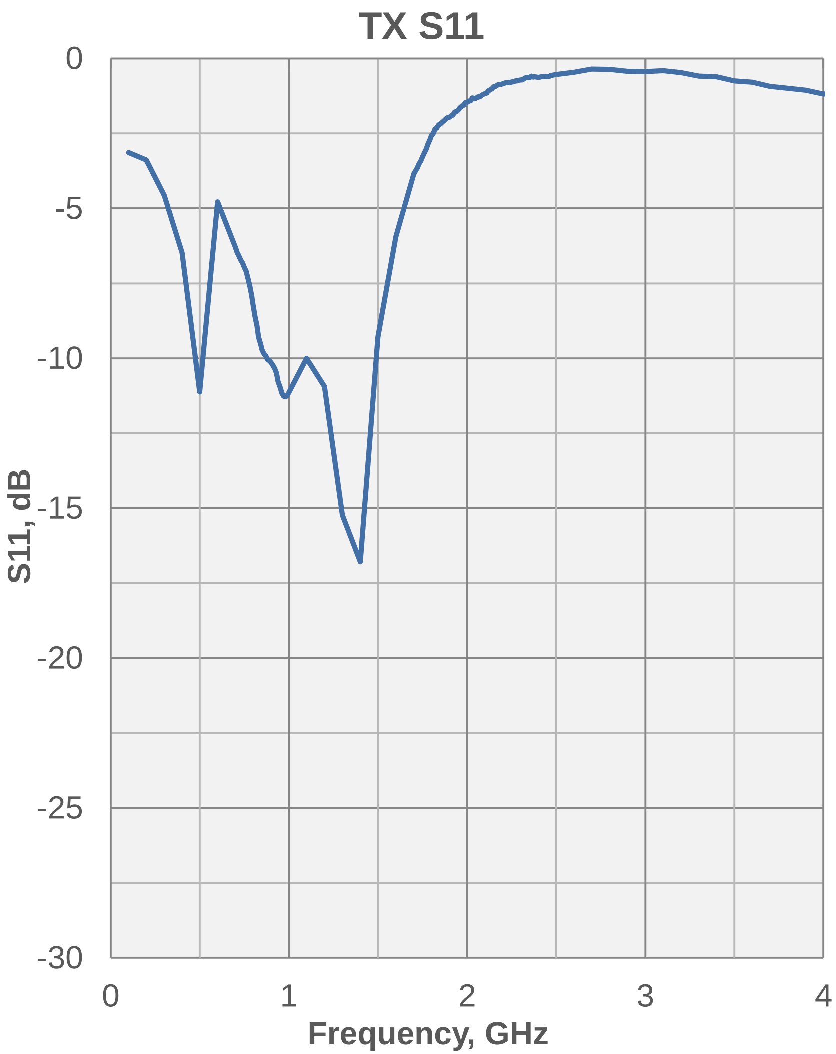
Measured with 10kΩ load. Results will vary with different load resistor values.

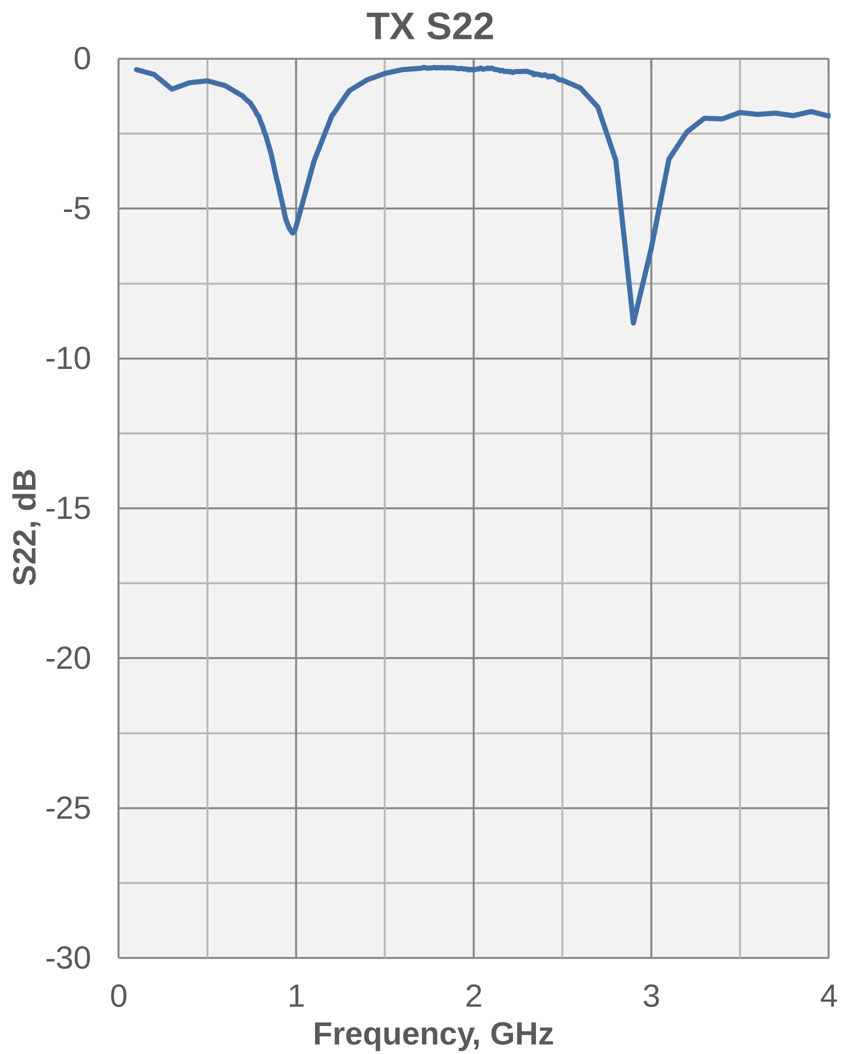
RFX1010 TX S-Parameters
S21, VDD = 3.3V



TXEN=High, RXEN/NODE=Low, Iq=41mA @ VDD=3.3V

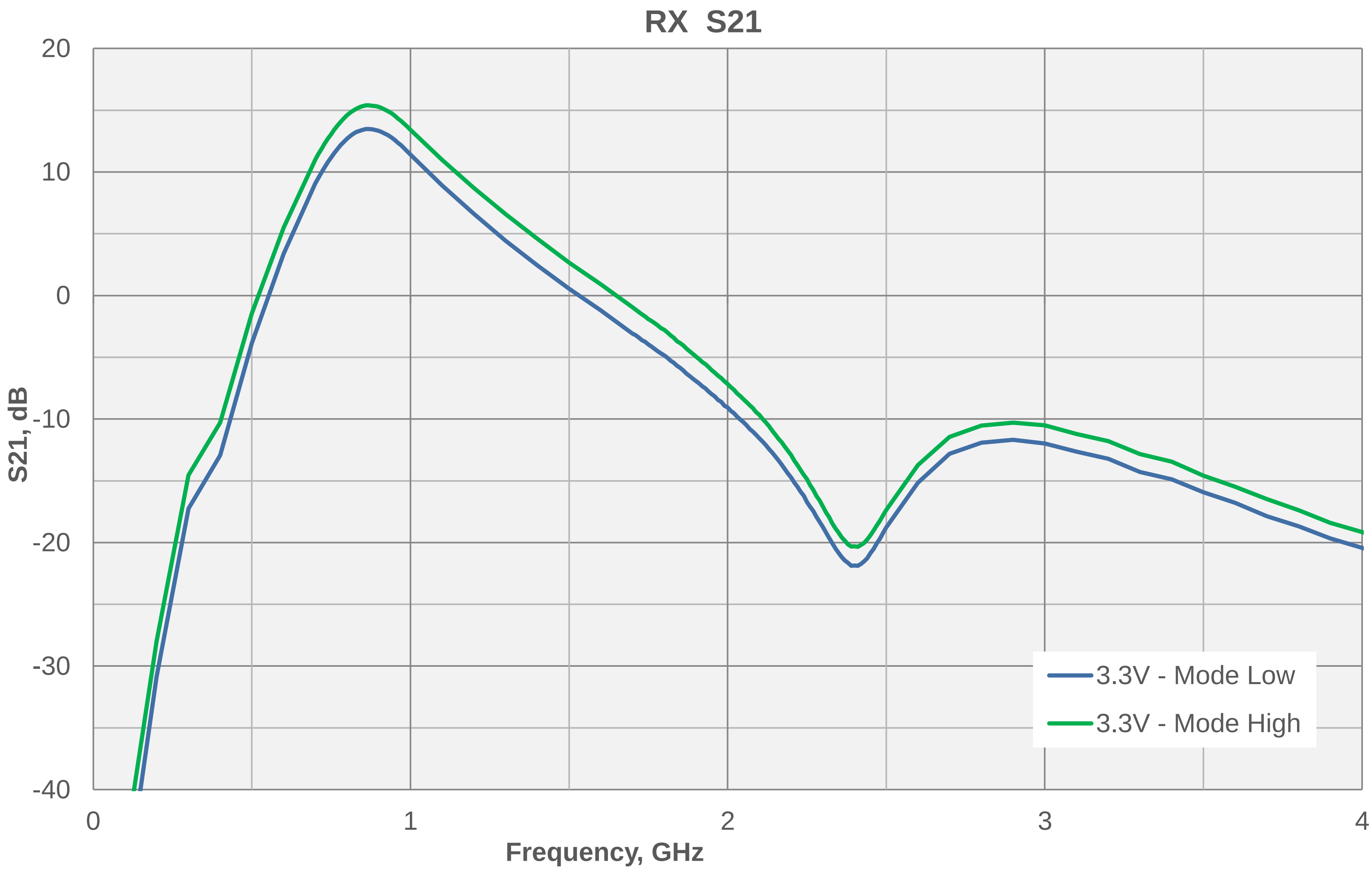
RFX1010 TX S-Parameters
S11 S22, VDD = 3.3V





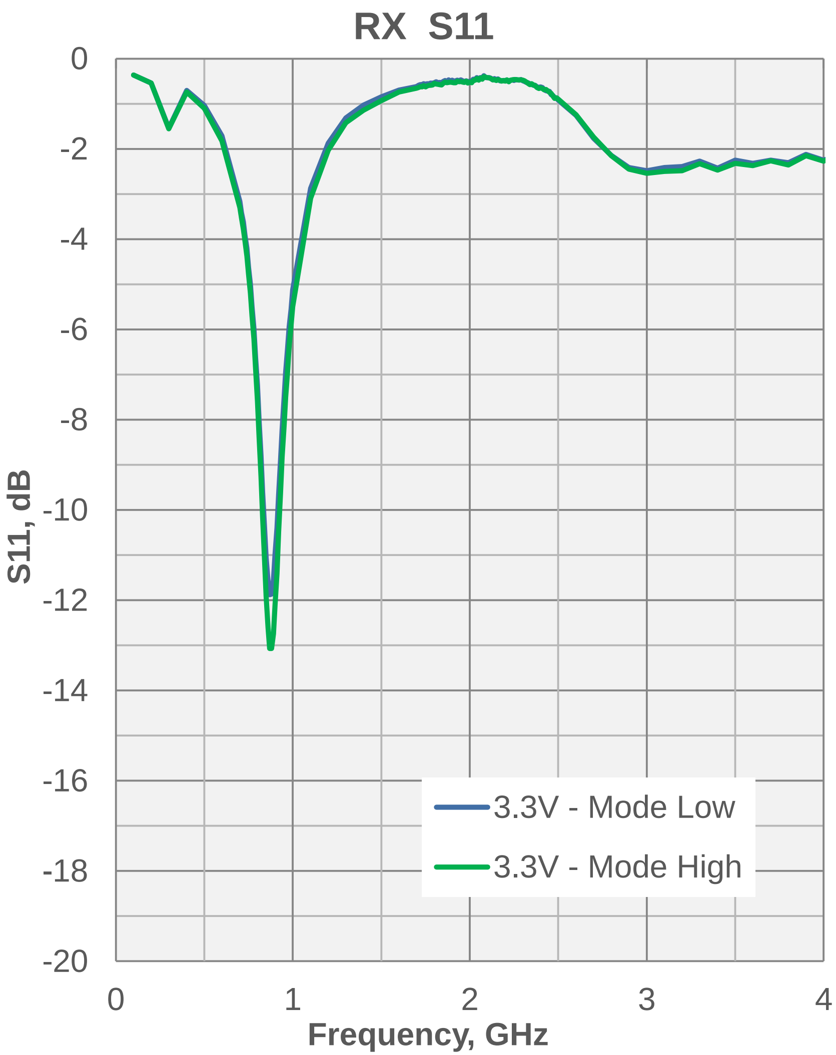
TXEN=High, RXEN/MODE=Low, Iq=41mA @ VDD=3.3V

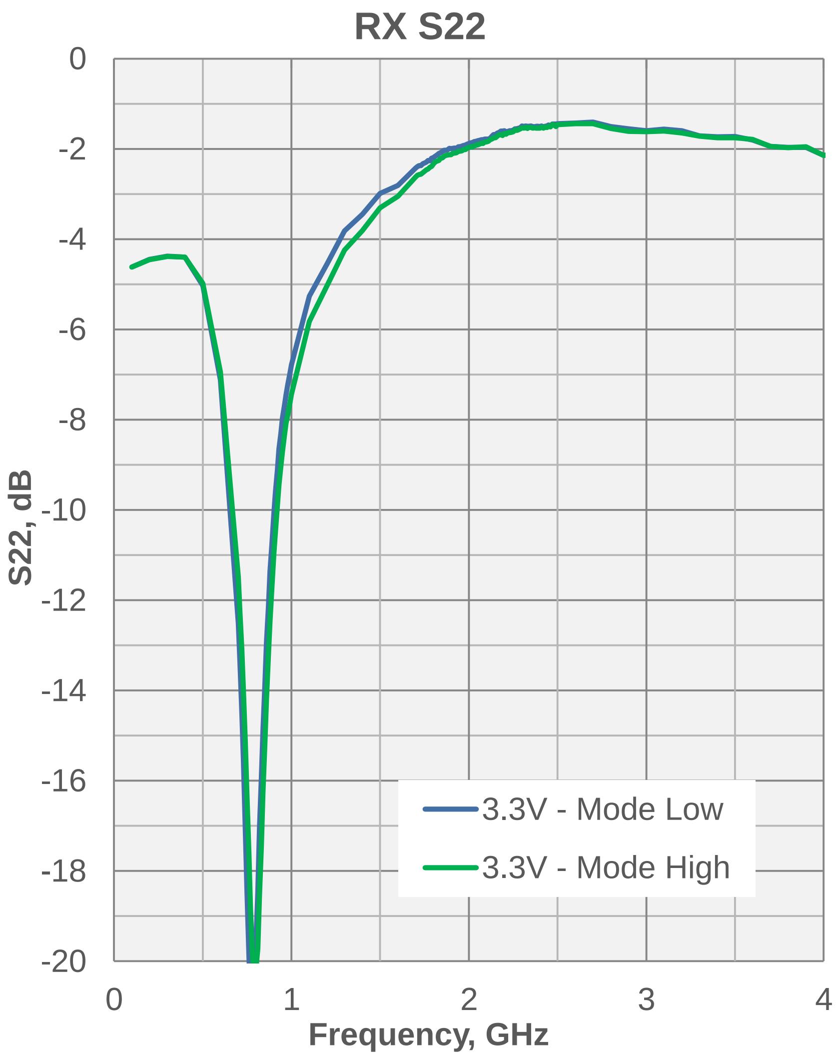
RFX1010 RX S-Parameters
S21, VDD = 3.3V



RXEN=High, TXEN=Low, Iq=10mA @ VDD=3.3V

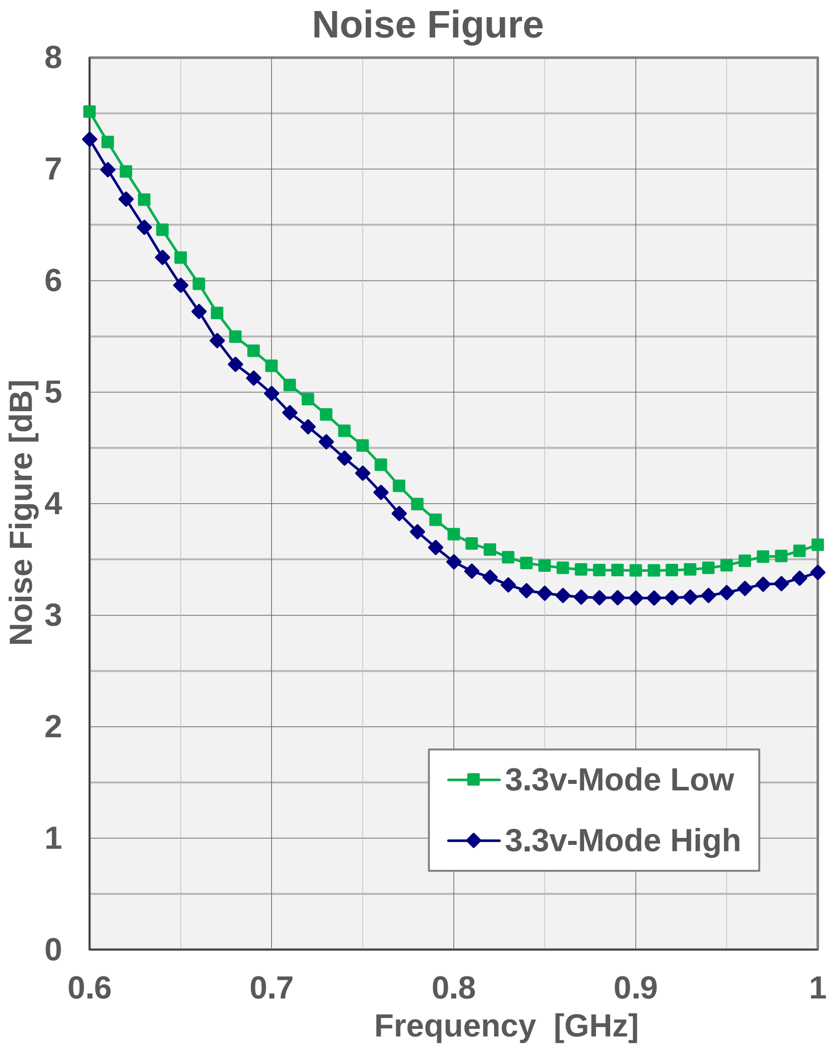
RFX1010 RX S-Parameters
S11 S22, VDD = 3.3V

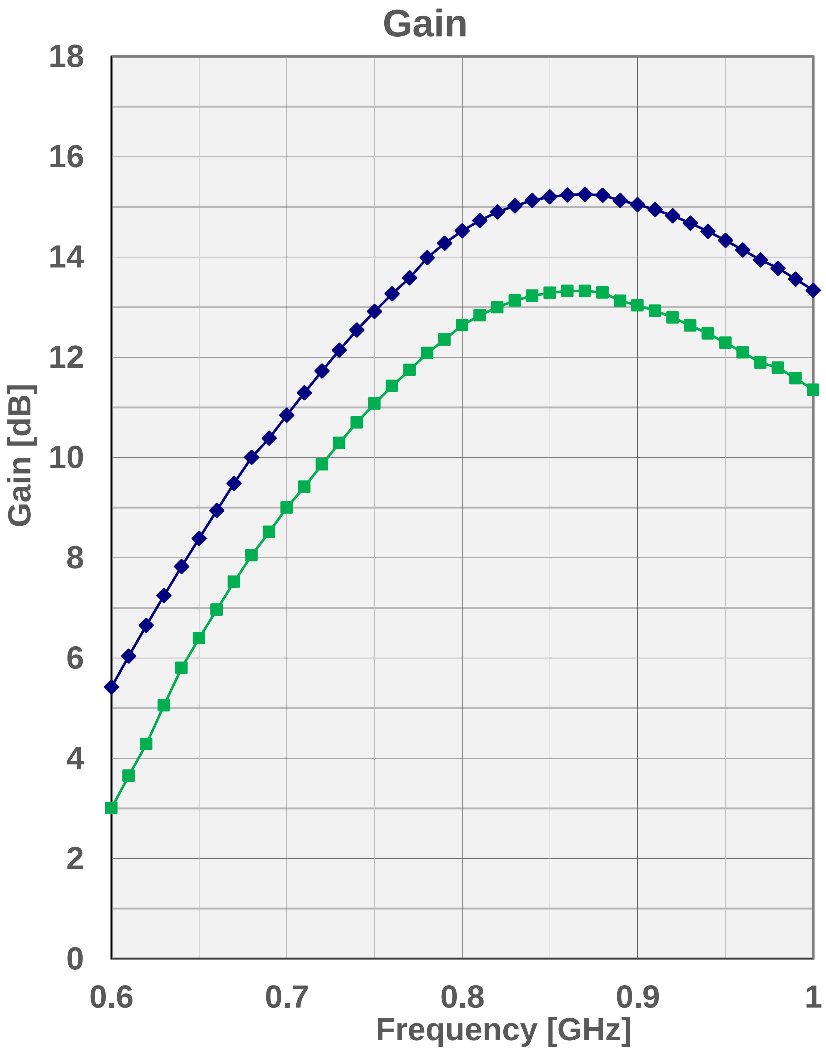




RXEN=High, TXEN=Low, Iq=10mA @ VDD=3.3V

RFX1010 RX Noise Figure and Gain
VDD = 3.3V



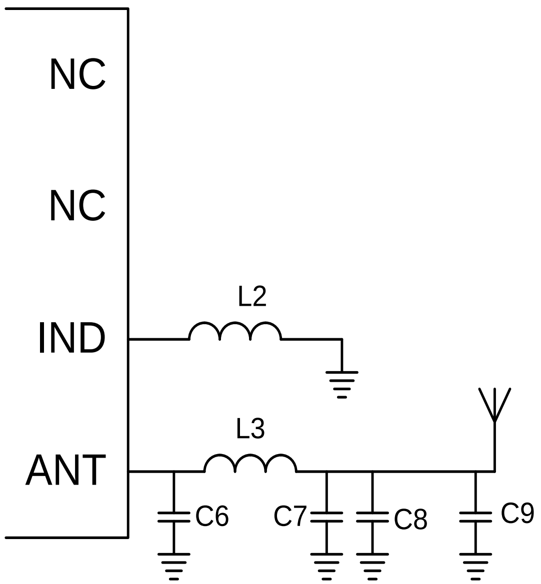


RXEN=High, TXEN=Low, Iq=11mA @ VDD=3.3V

RFX1010
with Harmonic Filter
in 915MHz Band

Evaluation Board Test Summary

RFX1010 Filter Schematic and Preliminary BOM



Prelim BOM with filter for 900MHz:

- **L2=3.3nH, TDK MLG**

Lumped Element Filter:

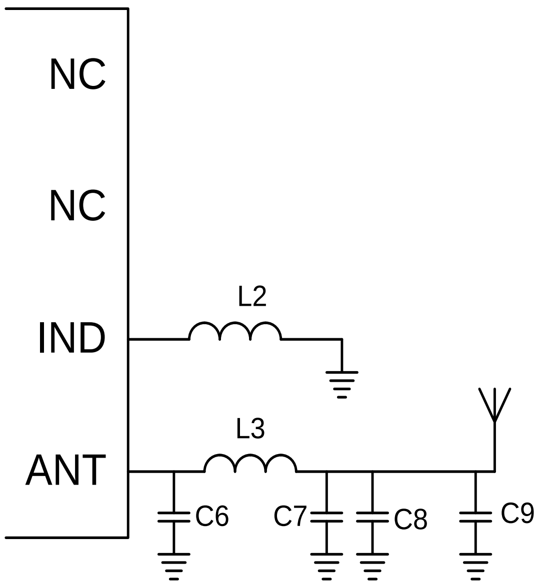
- **C6=5.6pF**
- **C7=3.0pF**
- **C8=1.0pF**
- **C9=1.8pF**
- **L3=6.8nH, TDK MLG**

Eval PCB Information:

- TX,RX,ANT trace losses are ~0.15dB @ 0.7GHz – 1GHz

- Results in following slides have the trace loss de-embedded and filter insertion-loss is not de-embedded

RFX1010 Filter Schematic and Preliminary BOM

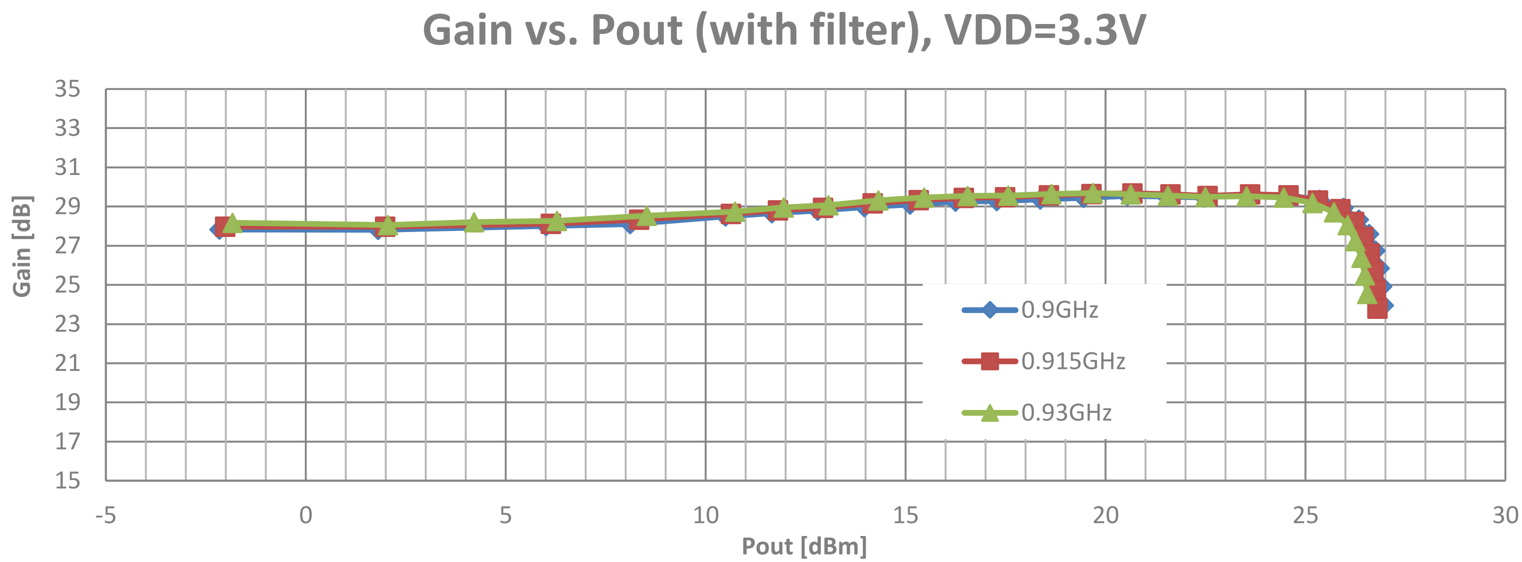


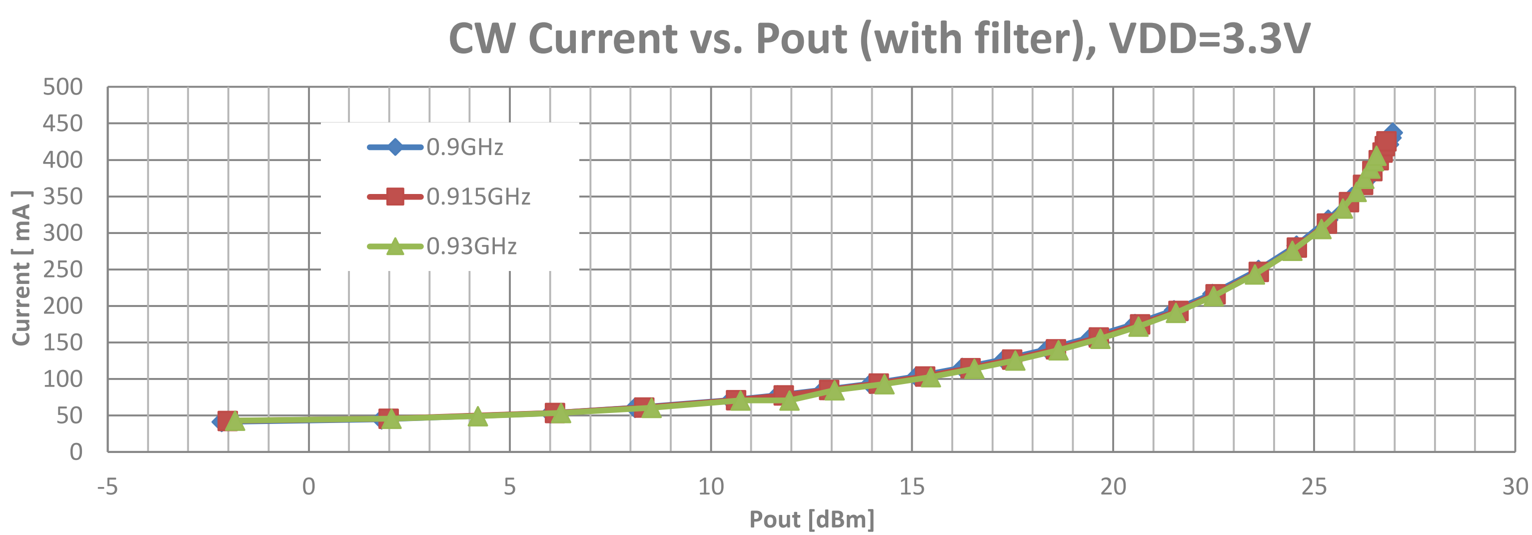
Prelim BOM with filter for 780MHz:
- **L2=12nH, TDK MLGfor high power ZigBee**
- **L2=6.2nH, TDK MLGfor linear WLAN**

Lumped Element Filter:
- **C6=5.1pF**
- **C7=7.5pF**
- **C8=5.1pF**
- **C9=pF**
- **L3=12nH, TDK MLG**
- **L4=12nH, TDK MLG, between C7,C8**

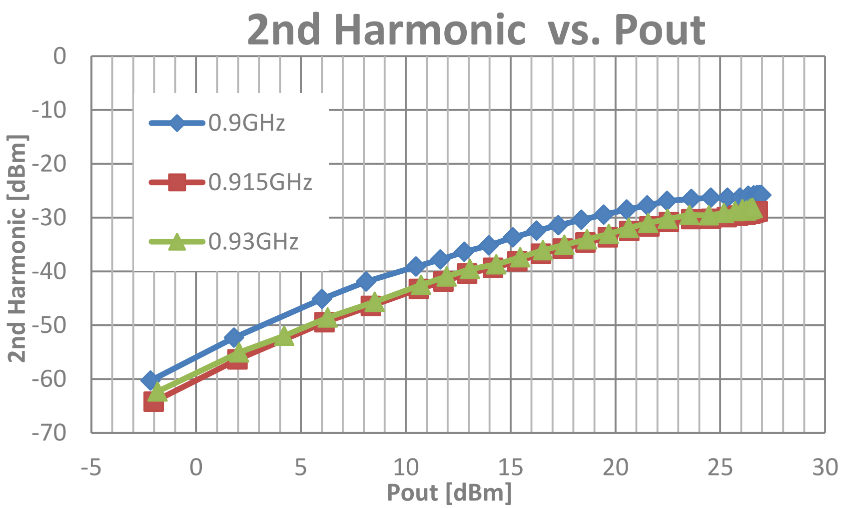
Eval PCB Information:
- **TX,RX,ANT trace losses are ~0.15dB @ 0.7GHz – 1GHz**
- **Results in following slides have the trace loss de-embedded and filter insertion-loss is not de-embedded**

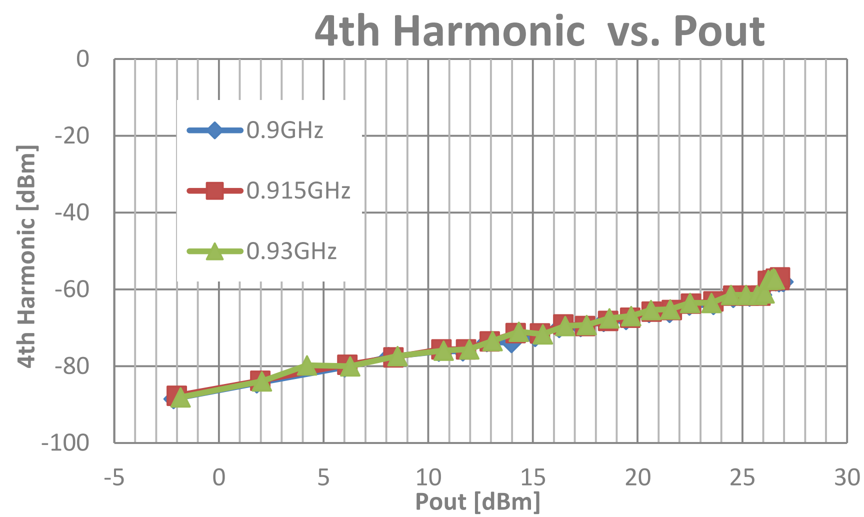
RFX1010 TX Large Signal Gain & Current (VDD=3.3V)

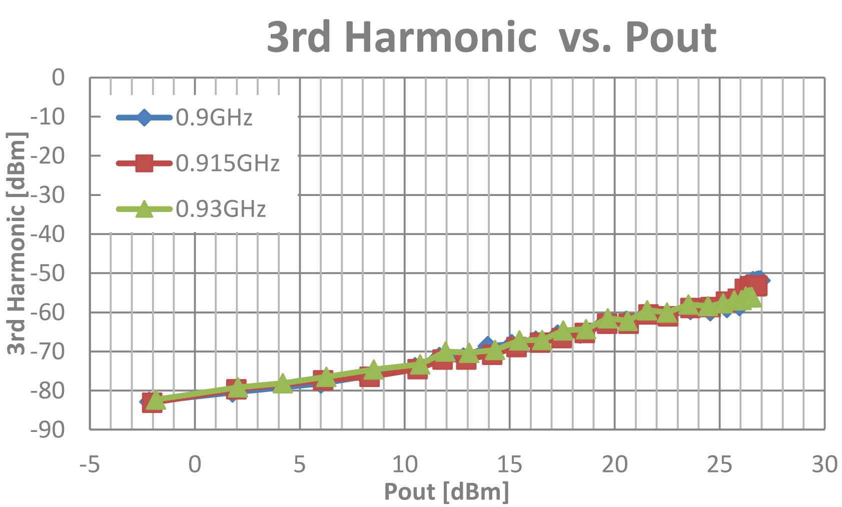


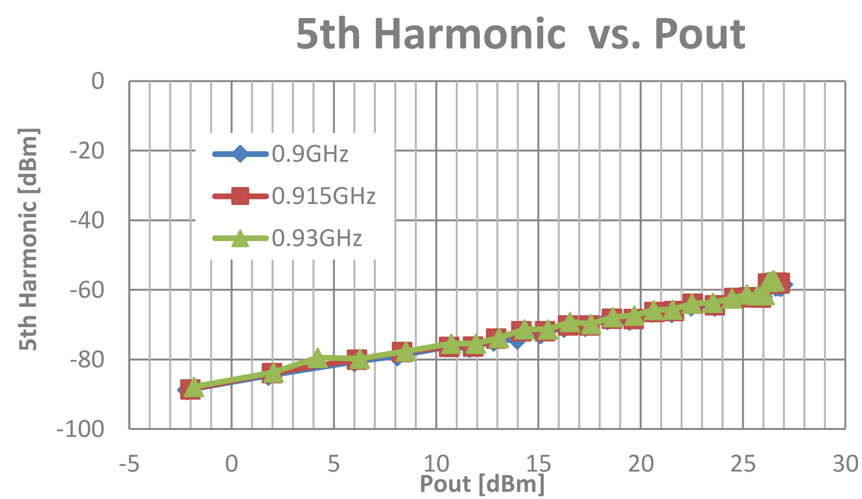


RFX1010 TX Large Signal 2nd , 3rd , 4th and 5th Harmonics (VDD=3.3V)

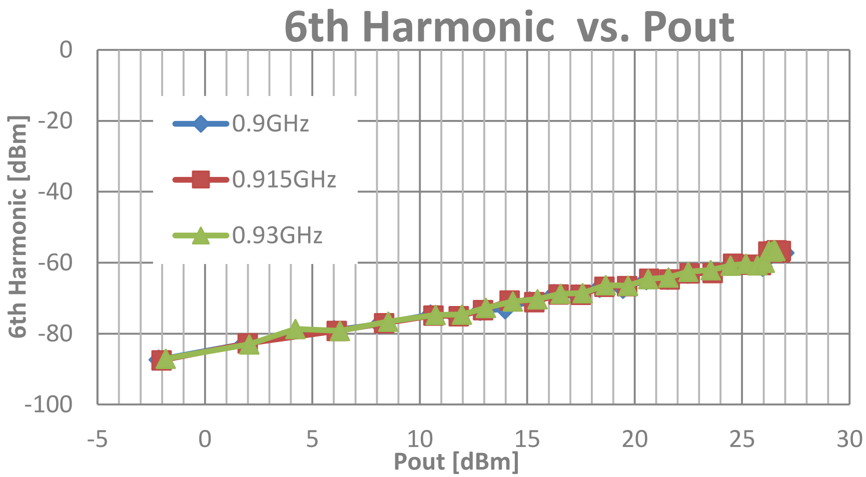


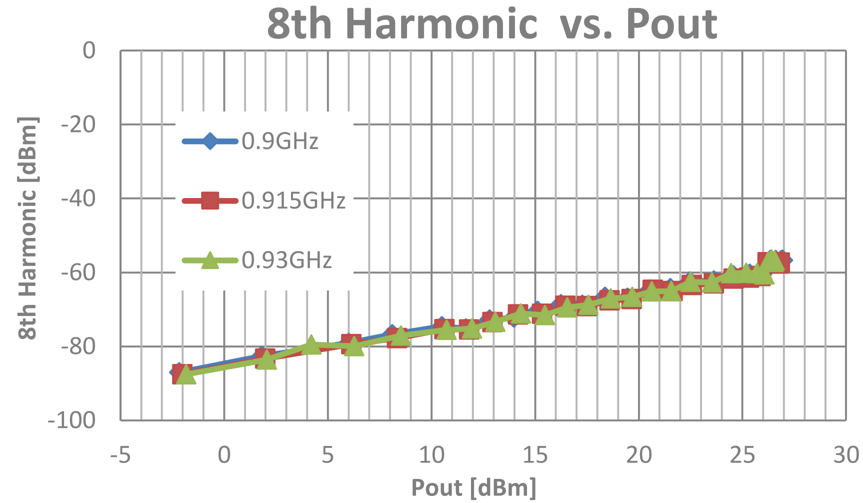


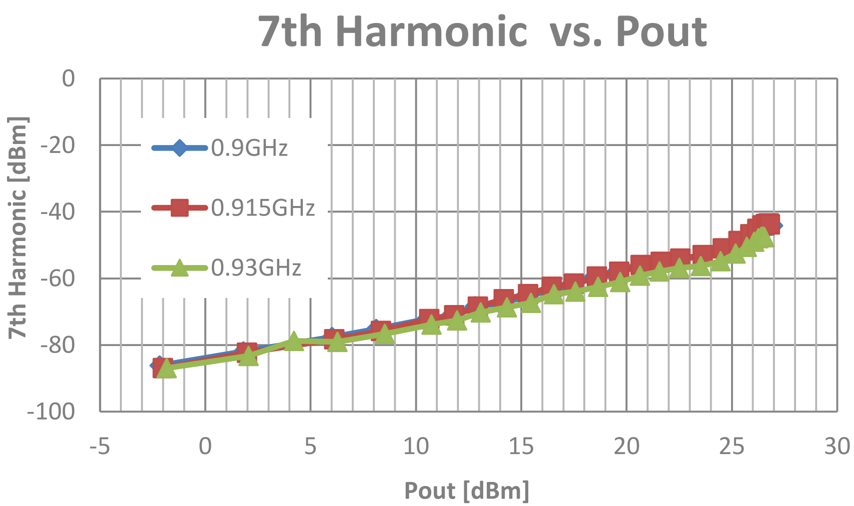


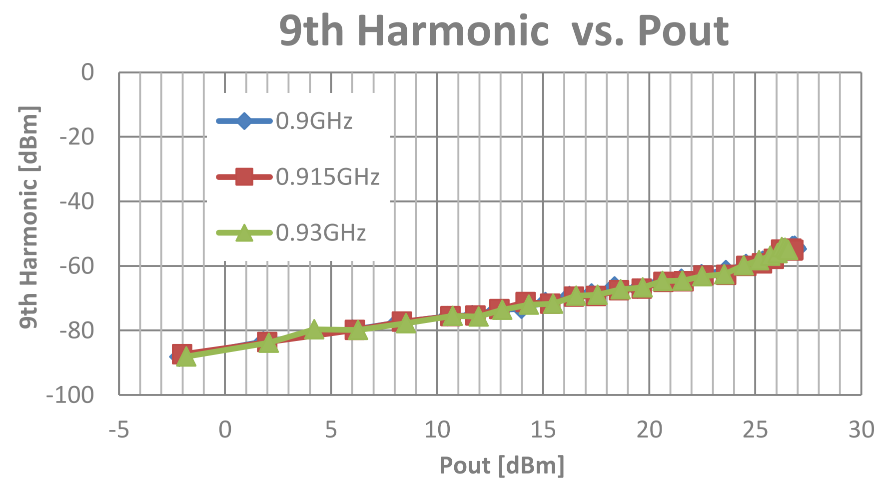


RFX1010 TX Large Signal 6th , 7th , 8th and 9th Harmonics (VDD=3.3V)



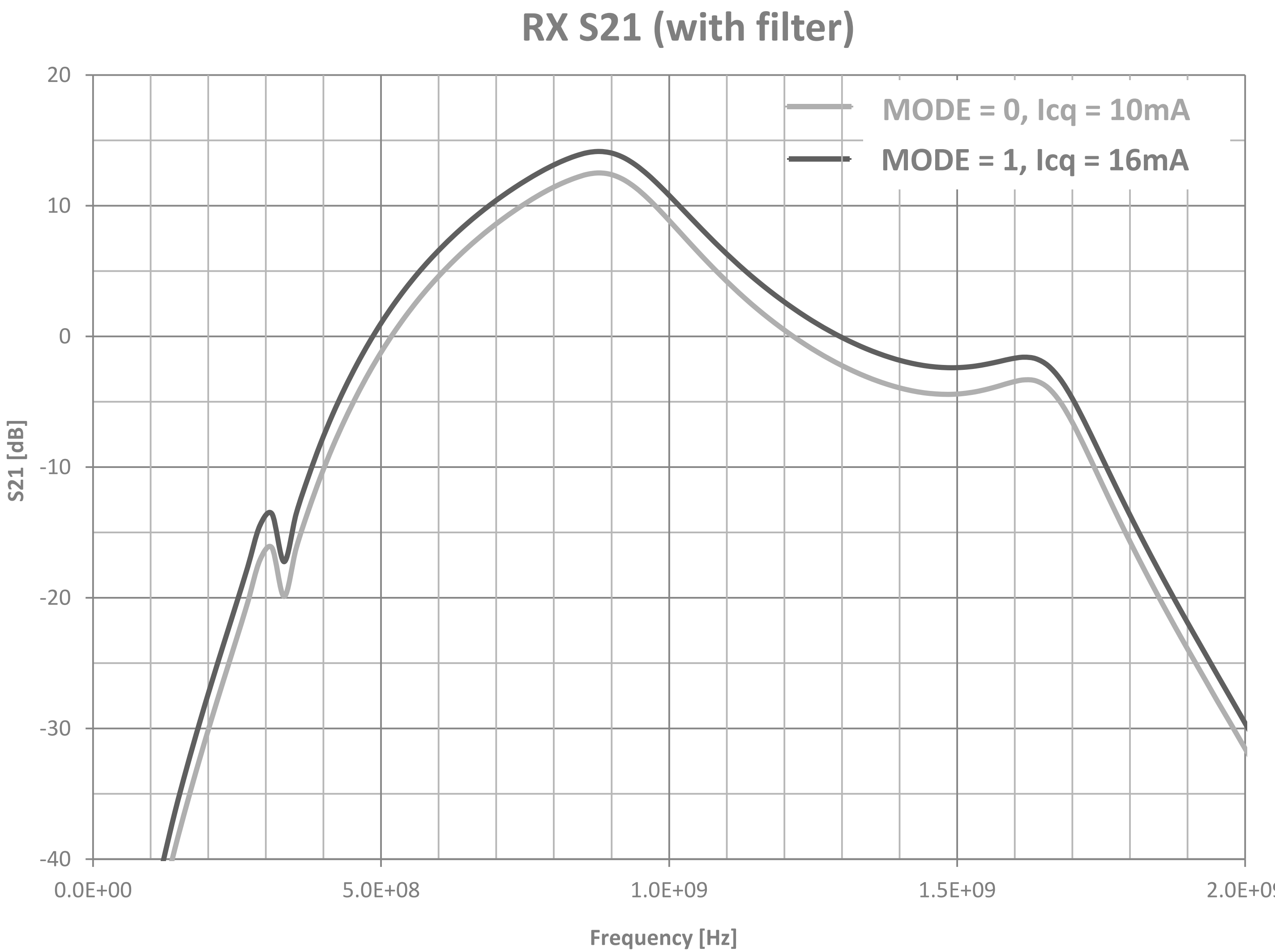






RFX1010 TX Small Signal Gain (VDD=3.3V)

RFX1010 RX Small Signal Gain (VDD=3.3V)



RFX1010 RX Noise Figure (VDD=3.3V)