



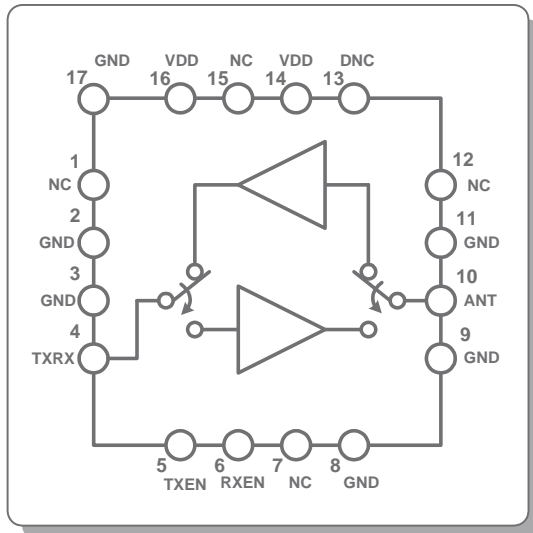
RFX2401C Single-Chip CMOS RFeIC with PA, LNA, Antenna Switch and Combined Tx/Rx Transceiver Port

Eval Board Test Summary & Technical Notes

RFX2401C RFeIC Key Features and Benefits



(3x3x0.55mm
16L QFN)



RFX2401C Differentiating Features

- Integration of PA, LNA, Tx-Rx Switching Circuitry, Associated Matching Network and Harmonic Filter all into a Single-Chip, Single-Die pure CMOS Solution
- Greatly Reduced and Simplified Tx/Rx Control
- Low Voltage Battery Operation down to 2.7V
- Digital Logic with 1.2V Turn-On Voltage
- No Vref Regulator for Biasing
- Common Tx/Rx Port Saves Additional SPDT
- Requires Minimal External Components
- Small, Ultra-Thin 3.0mmx3.0mmx0.55mm 16L QFN Package

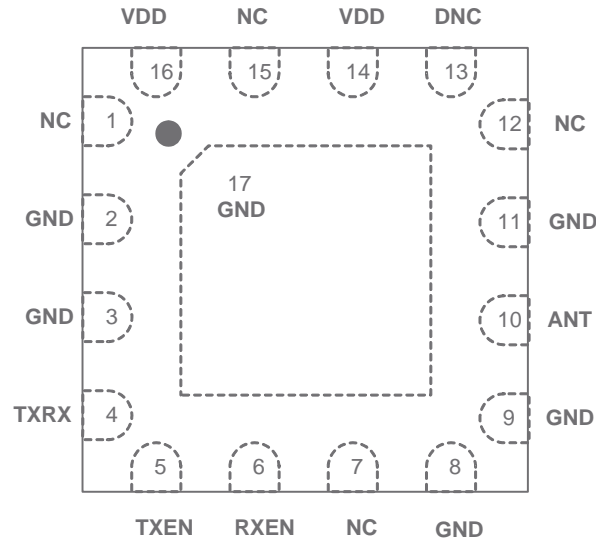
APPLICATIONS

- 802.15.4 ZigBee Extended Range Devices
- ZigBee Smart Power
- ZigBee Home Area Network
- RF4CE Remote Control
- Wireless Sensor Networks
- Other 2.4GHz ISM Band Systems

RFX2401C Customer Benefits

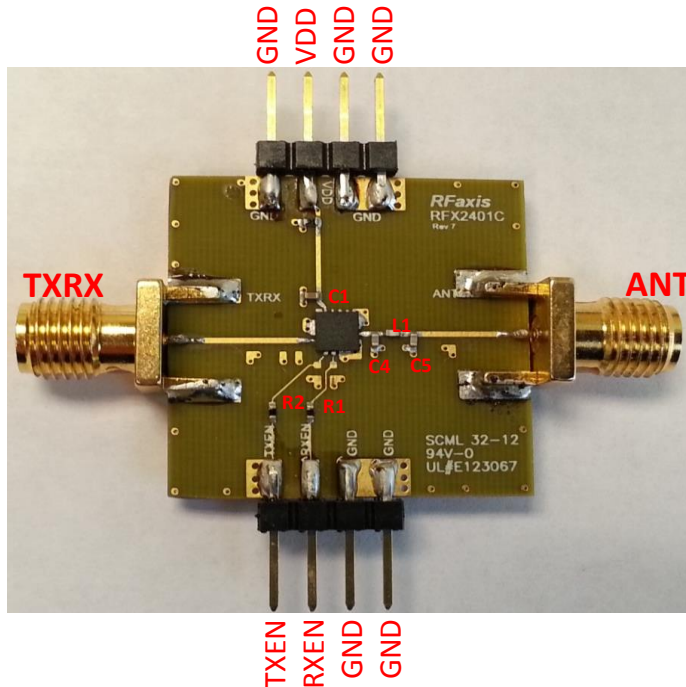
- Greatly Simplified, 50 Ohm “Plug & Play” PCB Implementation
- Small Form-Factor and Quick Design Cycle
- Simplest Approach to Improve Link Performance including Range and Receiver Sensitivity
- Very Low BOM Cost and Competitive Price

RFX2401C Pin Out and Pin Description



(Top "See-Through" View)

Pin Number	Pin Name	Description
1, 7, 12, 15	NC	Not Connected; May be floated or connected to GND
4	TXRX	RF signal to / from the Transceiver; DC shorted to GND
5	TXEN	CMOS Input to Control TX Enable
6	RXEN	CMOS Input to Control RX Enable
10	ANT	RF Signal from the PA or RF Signal Applied to the LNA; DC Shorted to GND
2, 3, 8, 9, 11, 17	GND	Ground – Must be connected to Ground in the Application Circuit
13	DNC	Reserved – Do Not Connect in the Application Circuit
14	VDD	Alternative Voltage Supply Pin, internally connected to Pin 16, no connection needed
16	VDD	Voltage Supply Connection



Eval PCB Information:

- 4-Layer Stack, 10mil/40mil/10mil
- FR4 with $\epsilon_r=4.5$, $\tan \delta = 0.02$ (Typ)
- TX, RX, ANT trace losses are $\sim 0.2\text{dB}$ @ 2.4GHz – 2.5GHz
- Results in following slides are referenced to device pins with the trace loss de-embedded
- VDD should be on before applying ctrl signals

Recommended BOM:

For VDD decoupling:

- C1=1uF

For Harmonic Filtering only (not required otherwise):

- C4=C5=2pF
- L1=1.5nH only TDK part# MLG1005S1N5S or 1.8nH ACX part # HI1005-1C1N8SMT

For Control Line:

- R1 = 1K Ω
- R2 = 1K Ω

R1 and R2 are for evaluation purpose only, not needed in application schematic

DC Bias & Tx/Rx Logic Control:

VDD=3.3V nominal (1.8~3.6V operational)

For Transmit Mode (TX):

- TXEN=High (>1.2V)
- RXEN= Don't Care

For Receive Mode (RX):

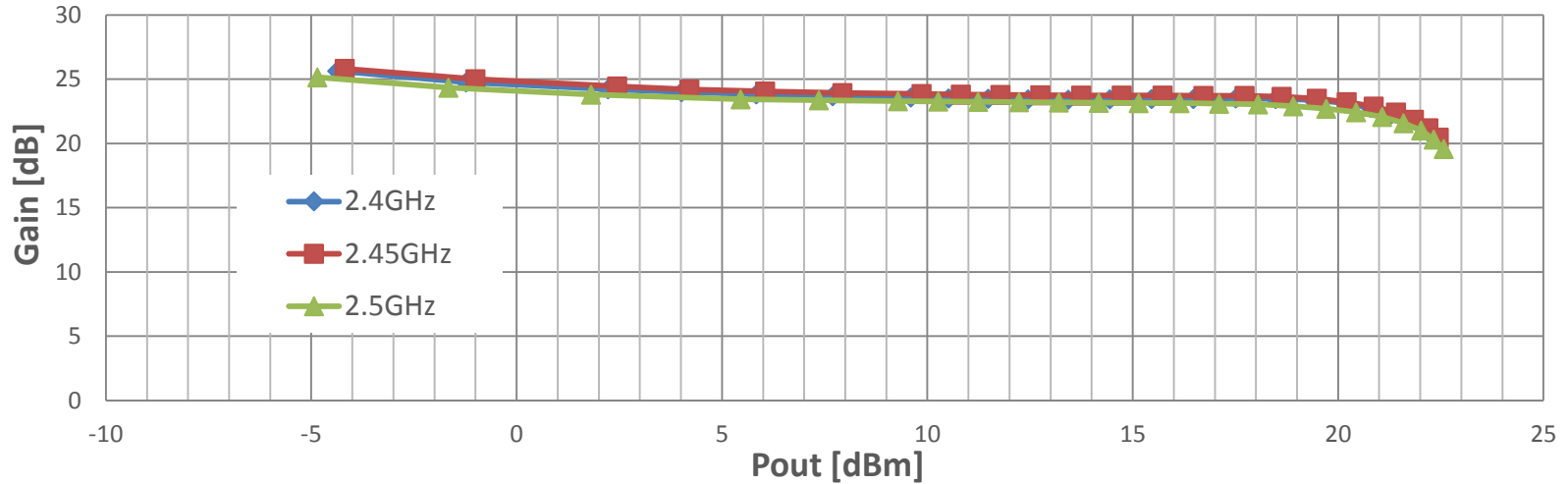
- RXEN=High(>1.2V)
- TXEN=Low (<0.3V)

Control Logic Truth Table

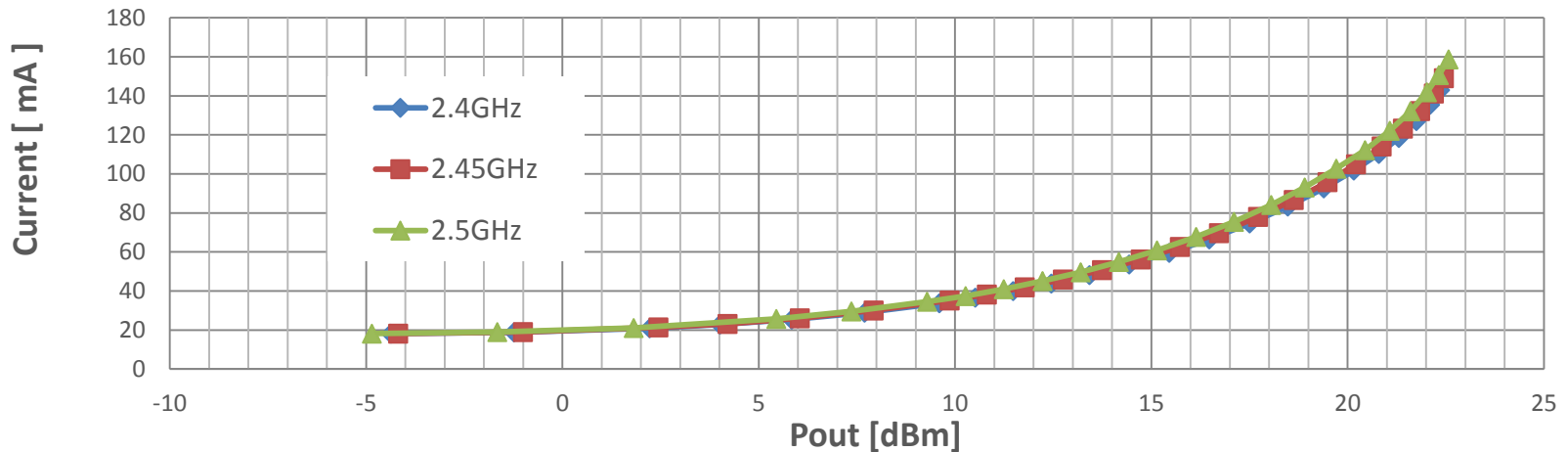
TXEN	RXEN	Operating Conditions
1	X	TX Active
0	1	RX Active
0	0	Chip is Shut-down

RFX2401C Tx CW Gain and Current vs. Pout & Frequency without External Harmonic Filter (VDD=3.3V)

TX Gain vs. Pout



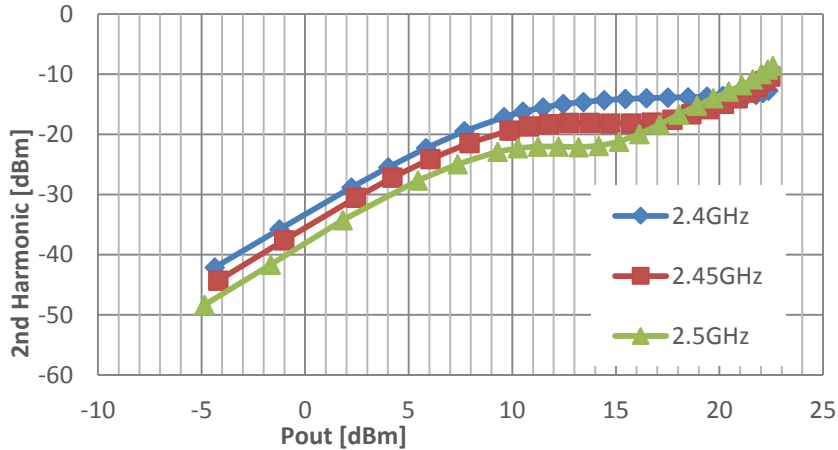
Current vs. Pout



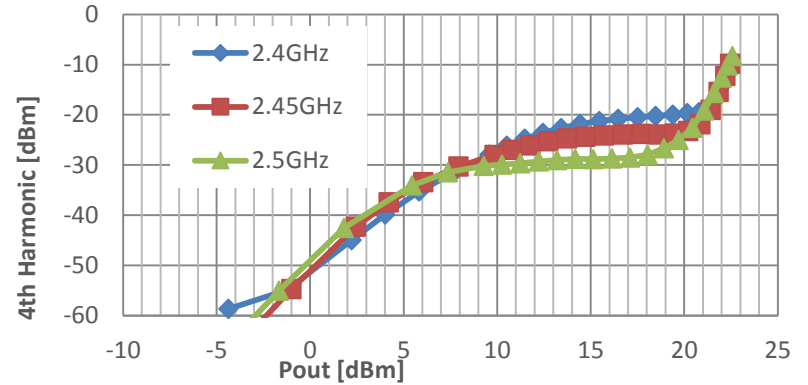
Note: Output power measured at antenna, without external harmonic filter.

RFX2401C Tx Harmonics vs Pout & Frequency Without External Harmonic Filter (VDD=3.3V)

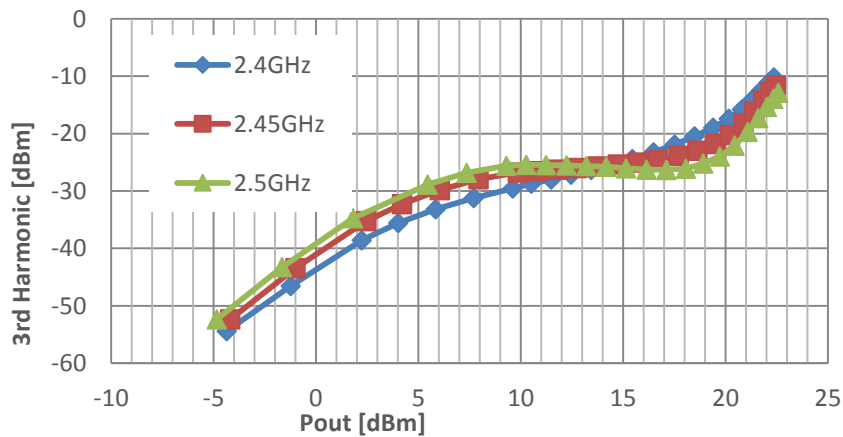
2nd Harmonic vs. Pout



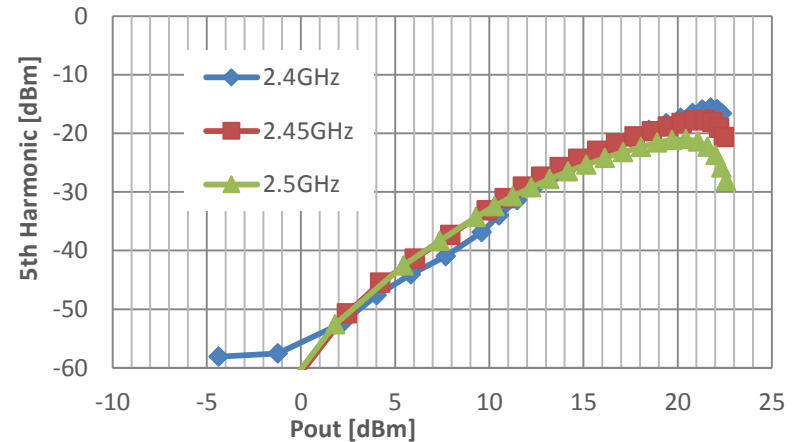
4th Harmonic vs. Pout



3rd Harmonic vs. Pout

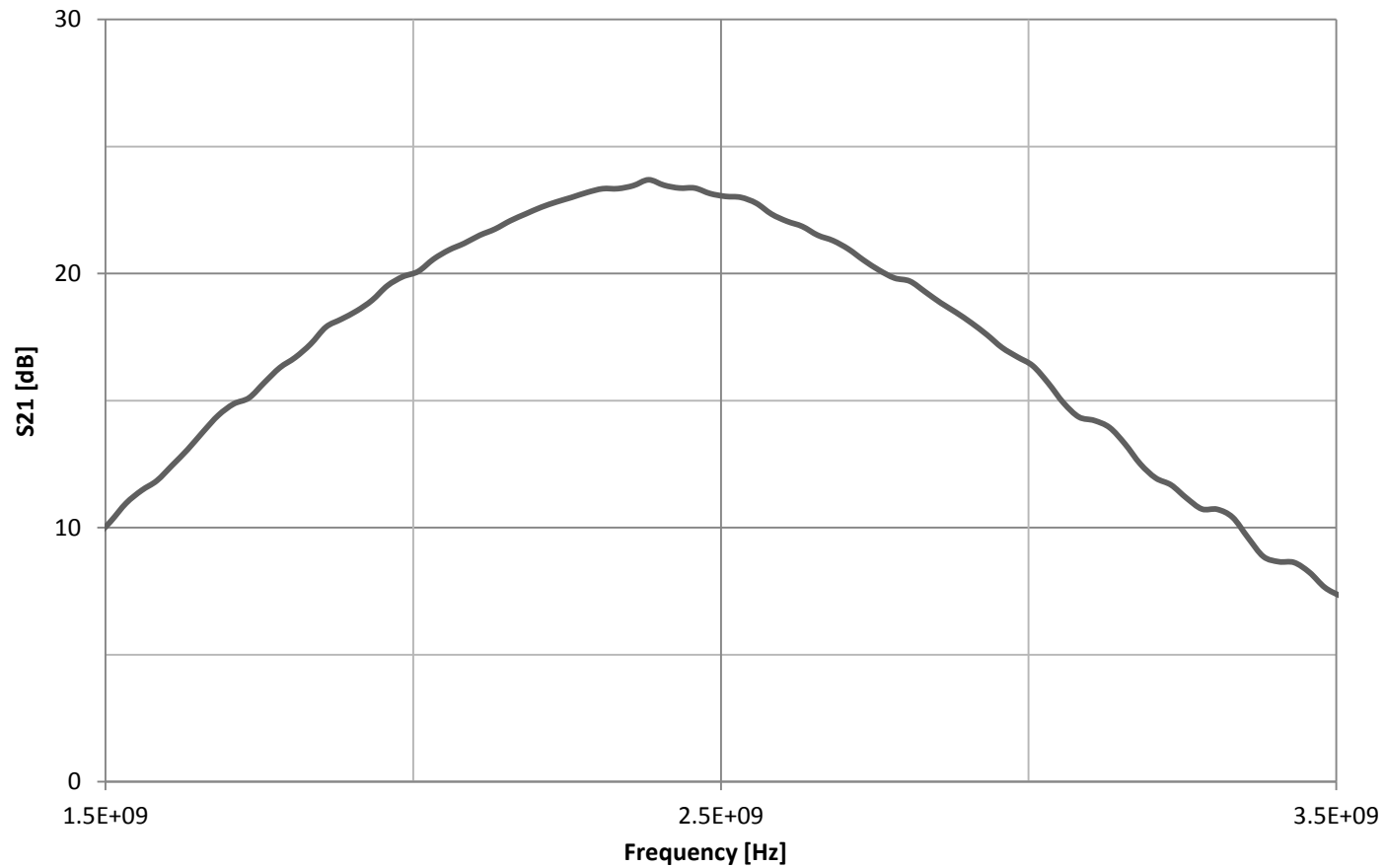


5th Harmonic vs. Pout

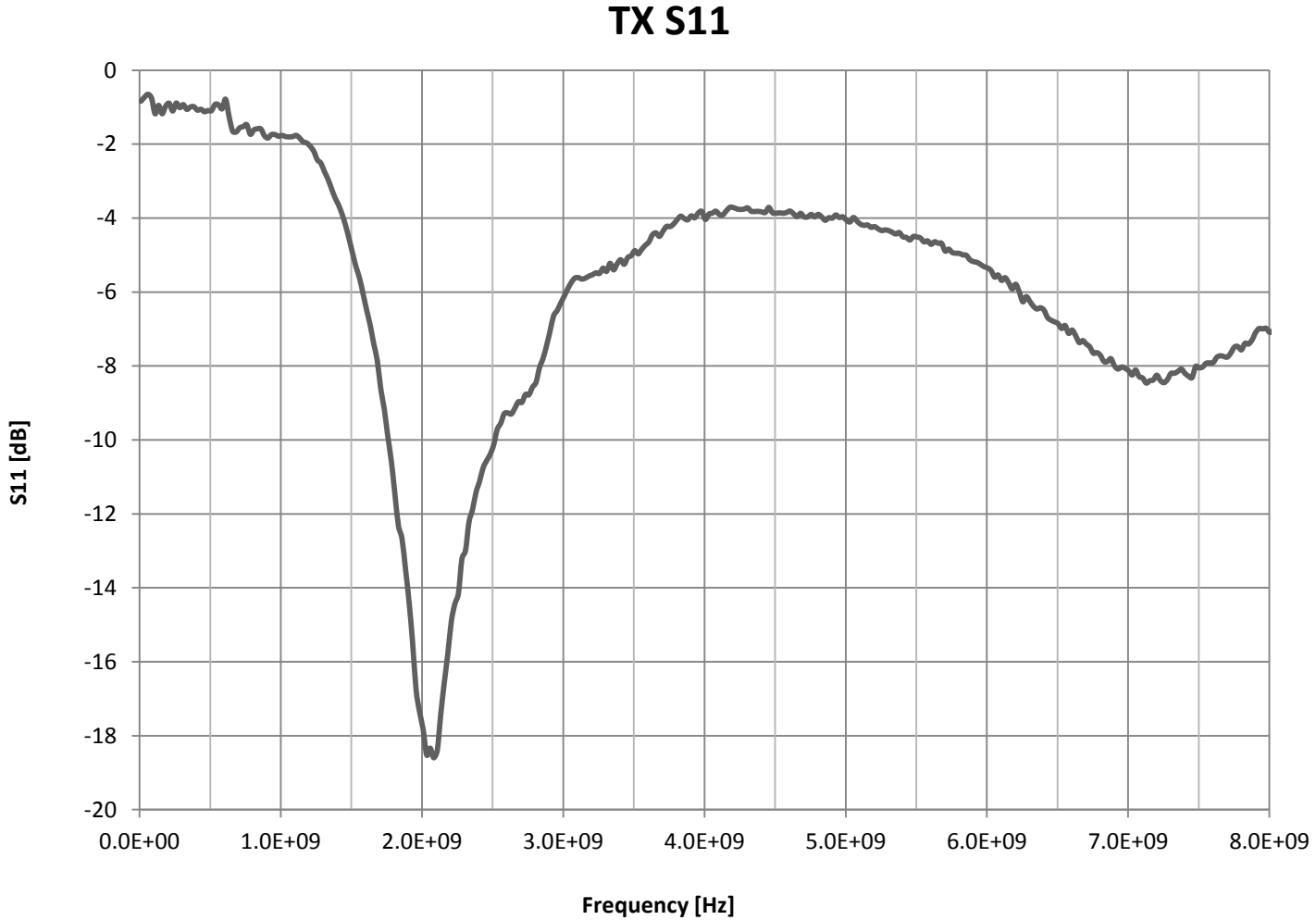


RFX2401C Tx Small-Signal Gain Without External Harmonic Filter (VDD=3.3V)

TX S21

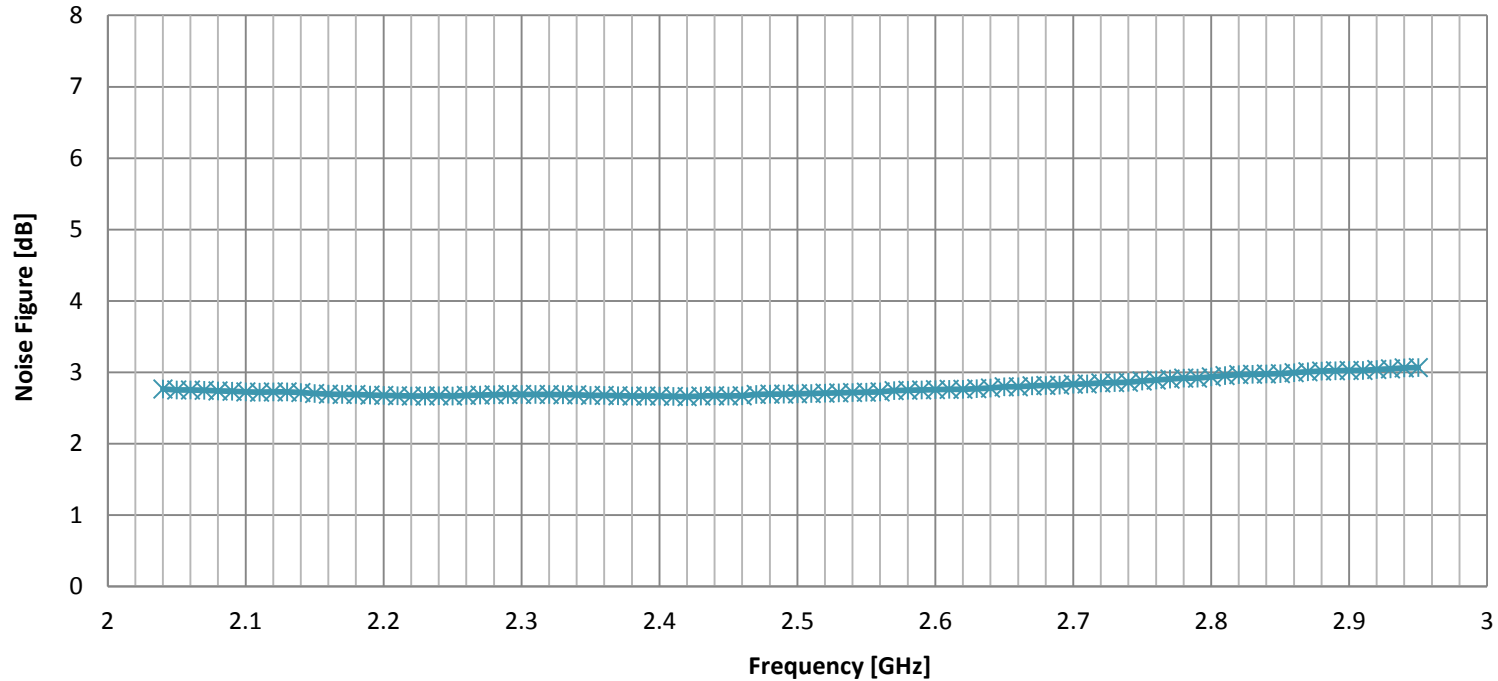


RFX2401C Tx S11 without External Harmonic Filter (VDD=3.3V)



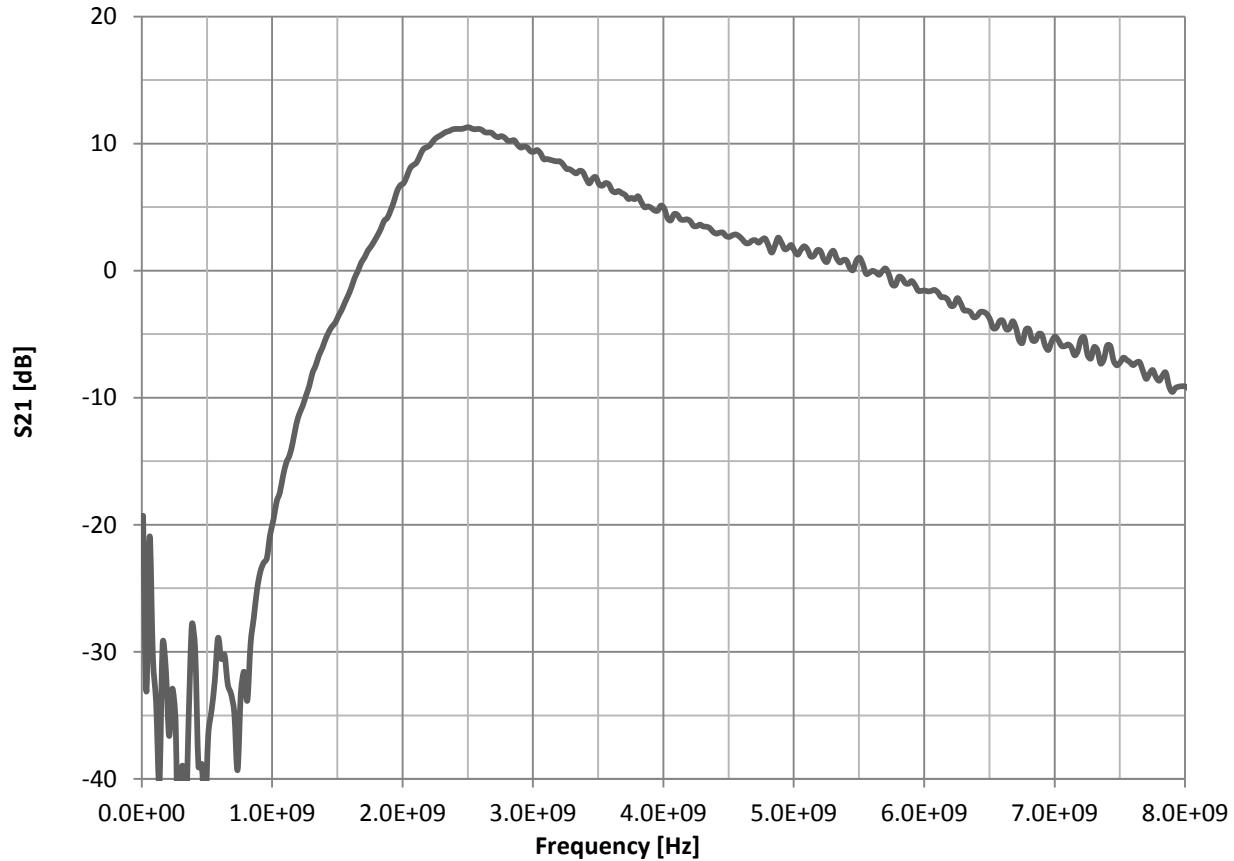
RFX2401C Rx Noise Figure Without External Harmonic Filter (VDD=3.3V)

RX Noise Figure vs. Frequency



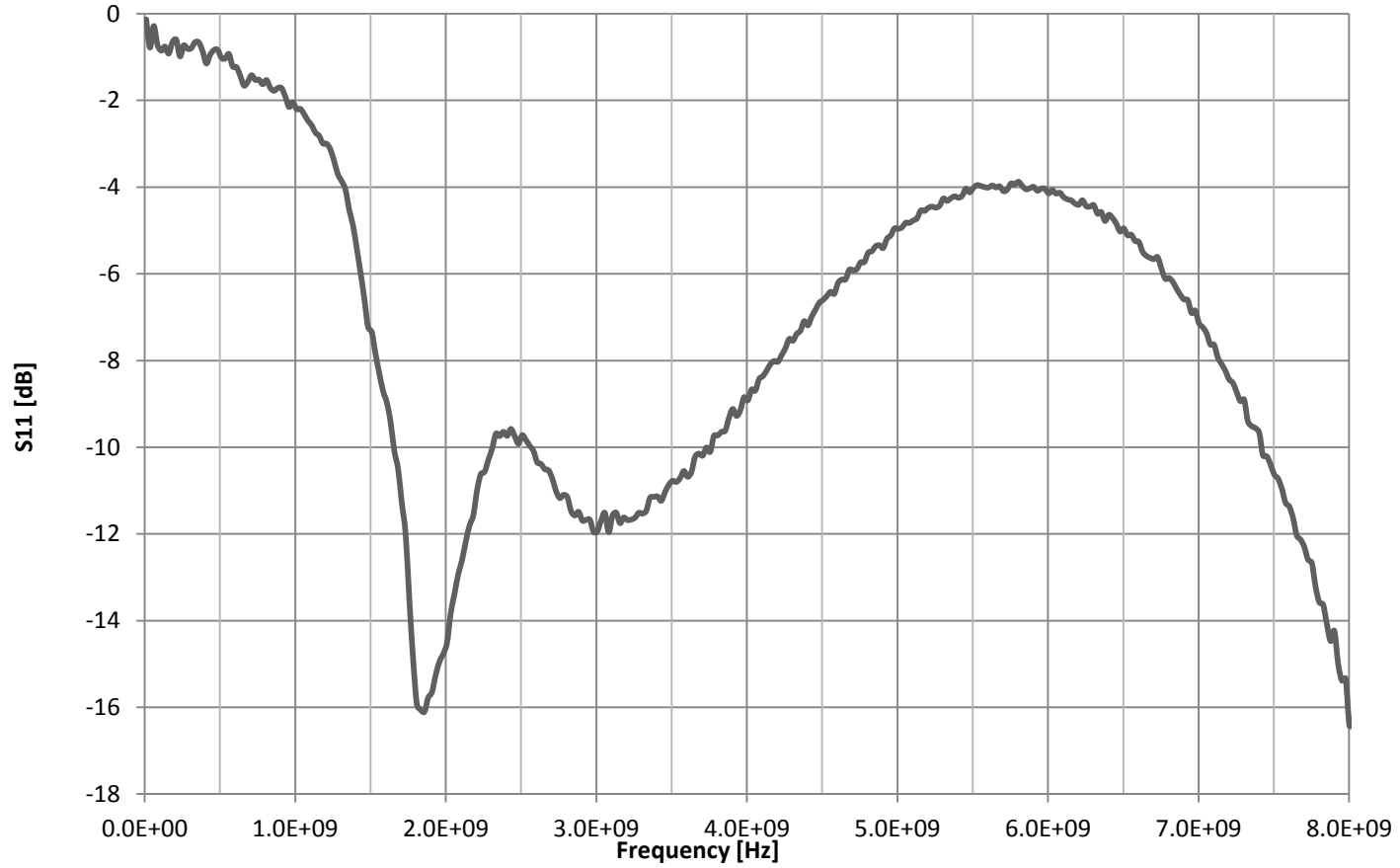
RFX2401C Rx Small-Signal Gain Without External Harmonic Filter (VDD=3.3V)

RX S21



RFX2401C Rx Without External Harmonic Filter (VDD=3.3V)

RX S11



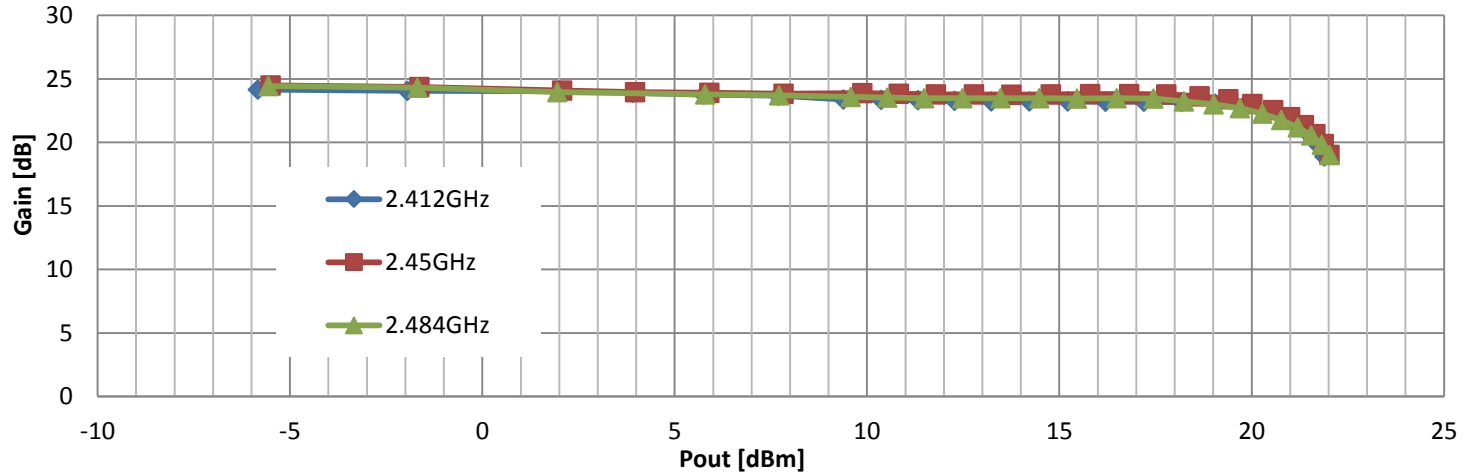
RFX2401C

With External Harmonic Filter

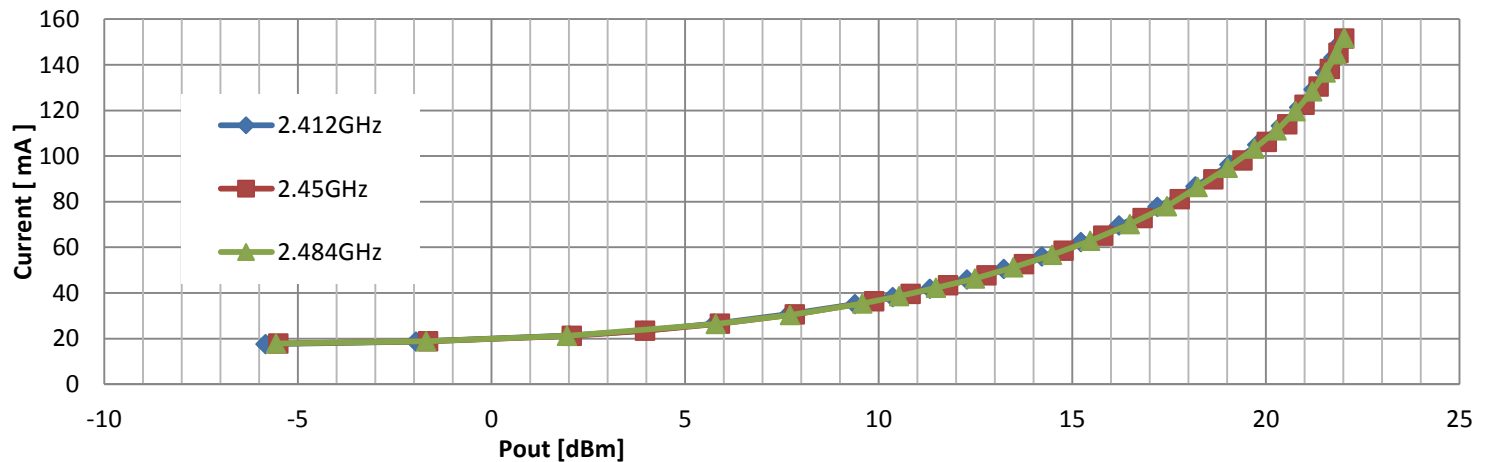
Eval Board Test Summary & Technical Notes

RFX2401C Tx CW Gain and Current vs. Pout & Frequency With External Harmonic Filter (VDD=3.3V)

Gain vs. Pout



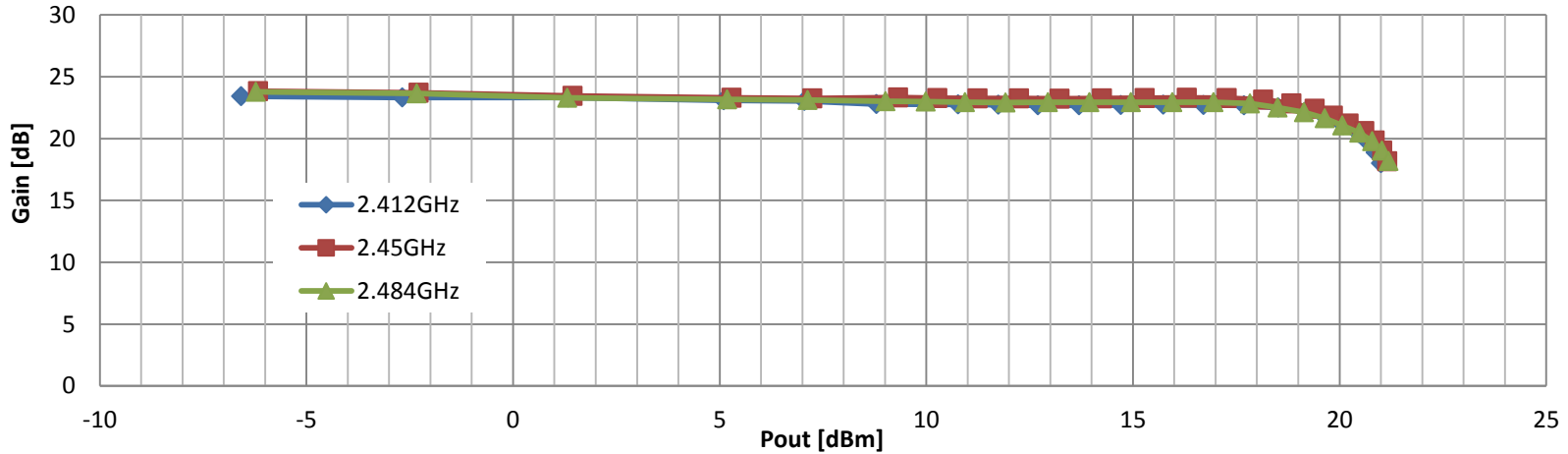
Current vs. Pout



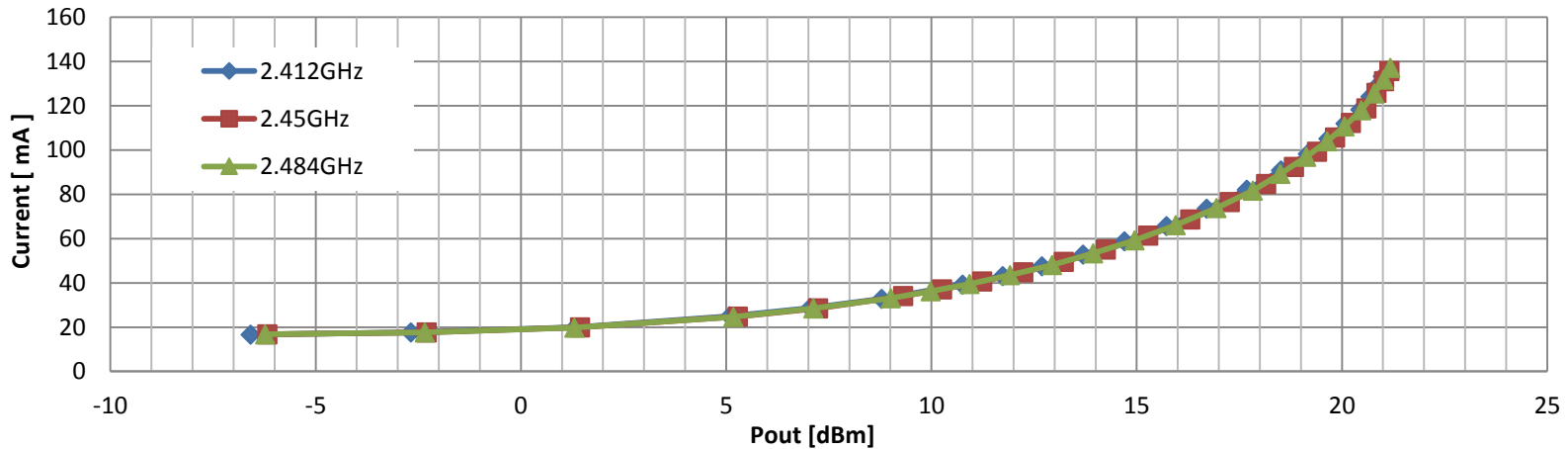
Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

RFX2401C Tx CW Gain and Current vs. Pout & Frequency With External Harmonic Filter (VDD=3.0V)

Gain vs. Pout



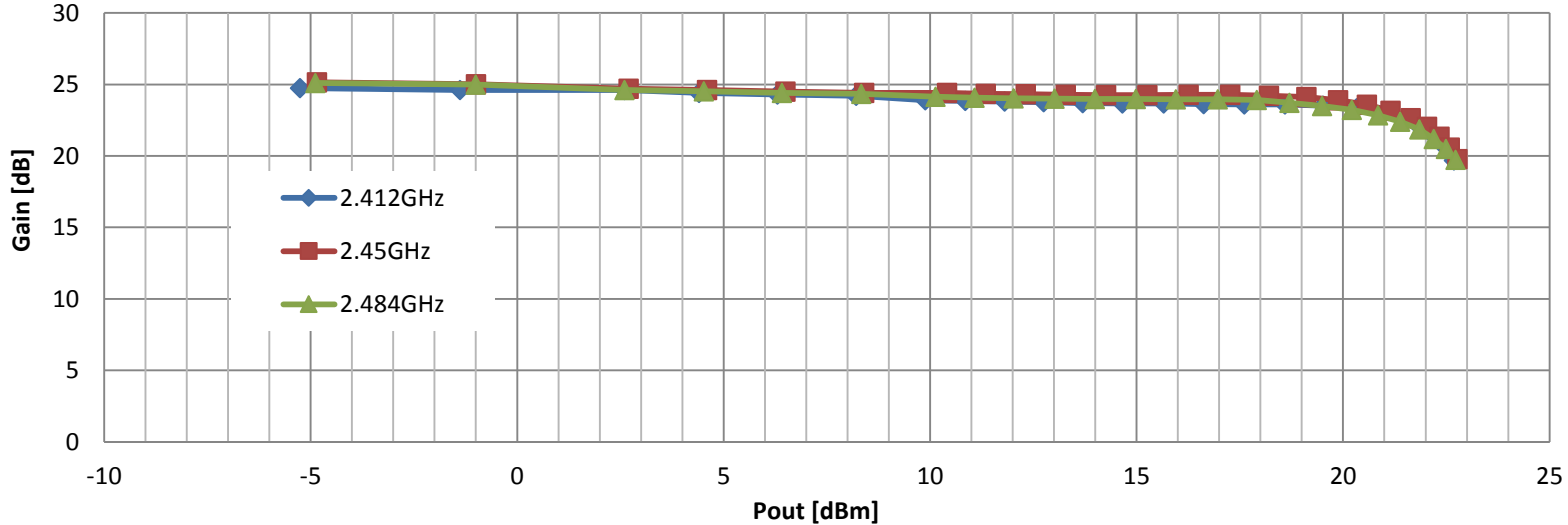
Current vs. Pout



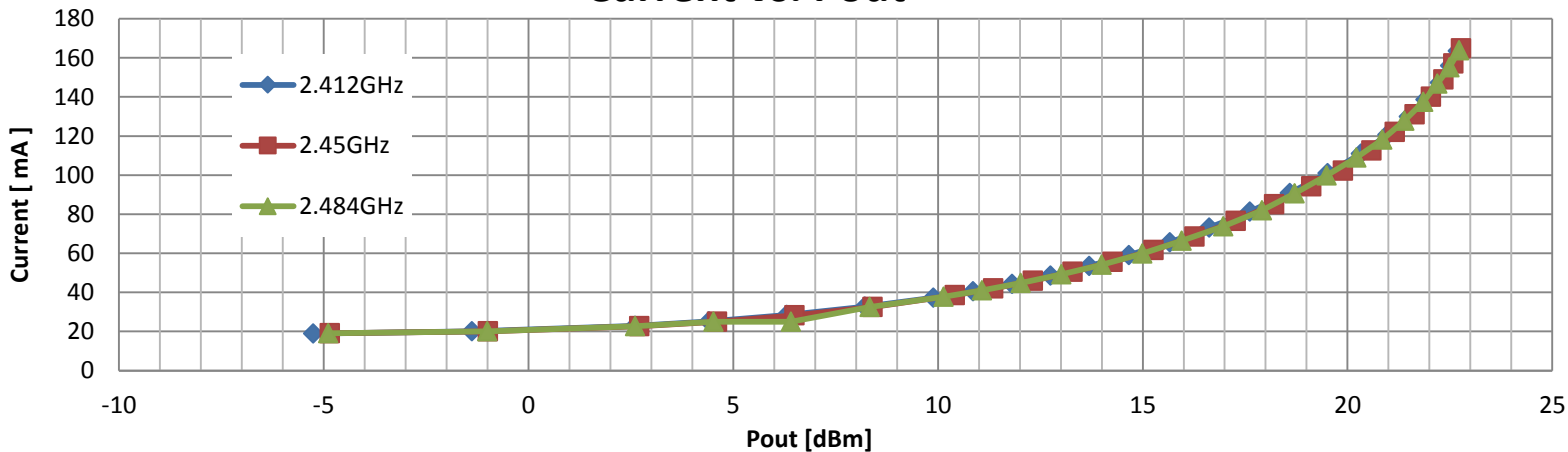
Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

RFX2401C Tx CW Gain and Current vs. Pout & Frequency With External Harmonic Filter (VDD=3.6V)

Gain vs. Pout



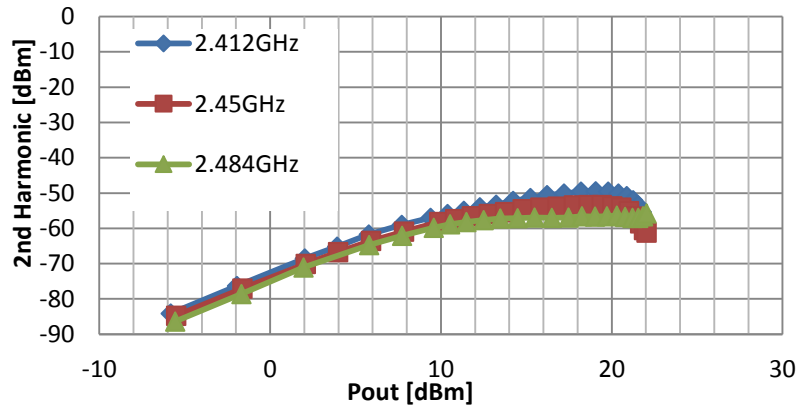
Current vs. Pout



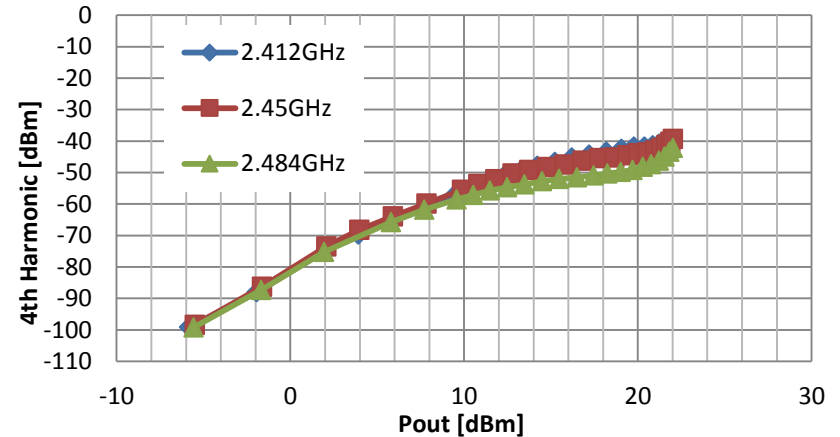
Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

RFX2401C Tx Harmonics vs Pout & Frequency With External Harmonic Filter (VDD=3.3V)

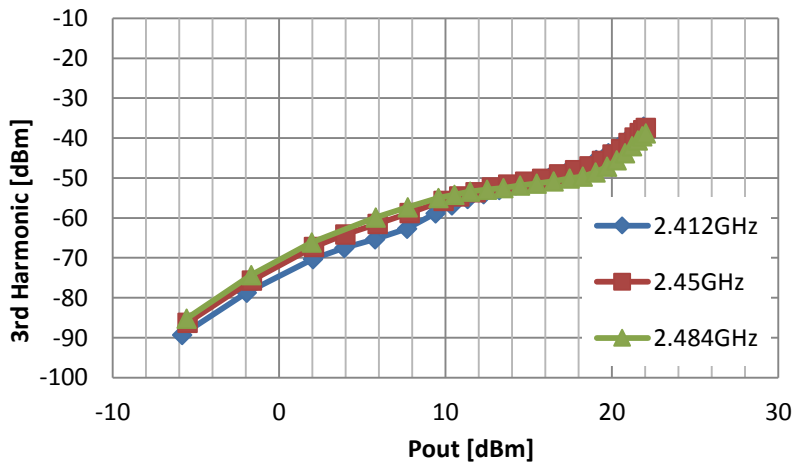
2nd Harmonic vs. Pout



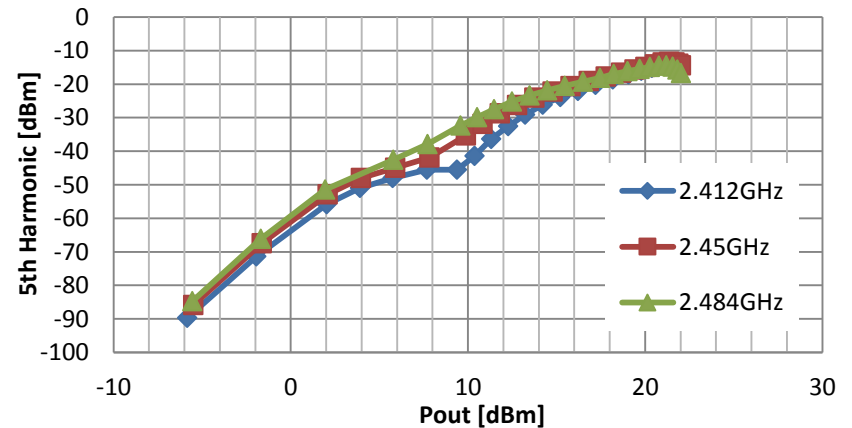
4th Harmonic vs. Pout



3rd Harmonic vs. Pout

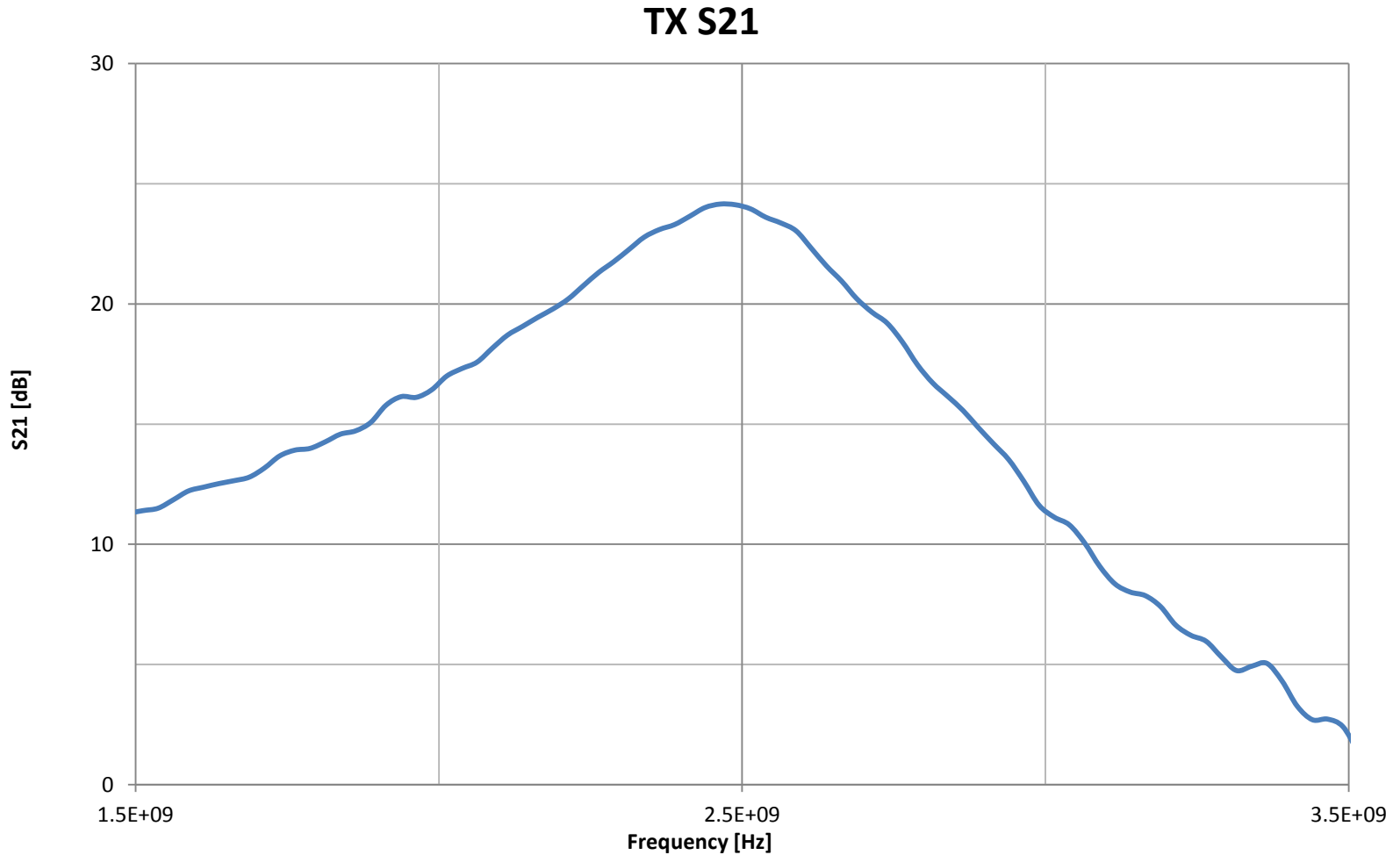


5th Harmonic vs. Pout



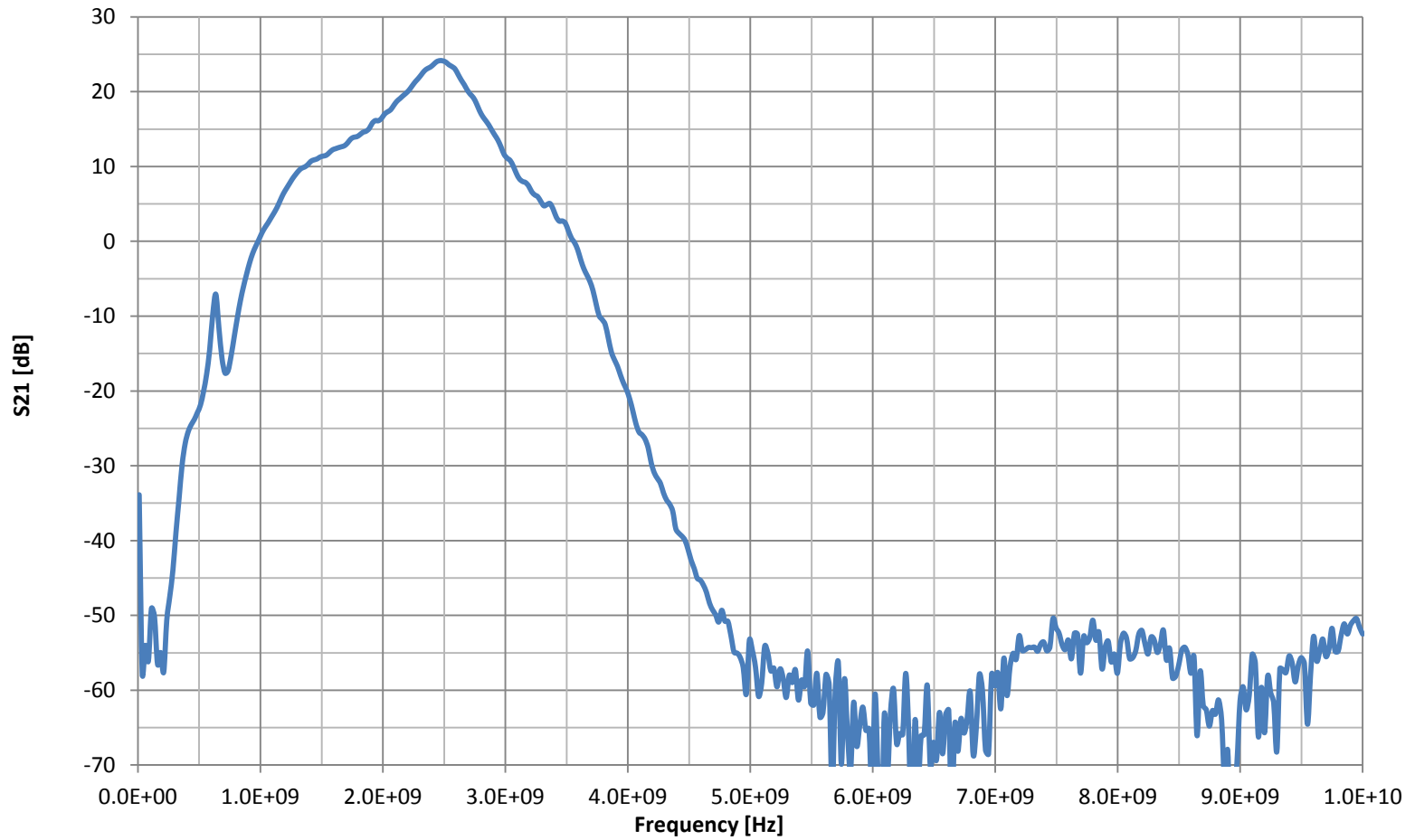
Note: RFX2401C can achieve FCC harmonic compliance with only one simple pi-filter.

RFX2401C Tx Small-Signal Gain (S21) With External Harmonic Filter (VDD=3.3V)



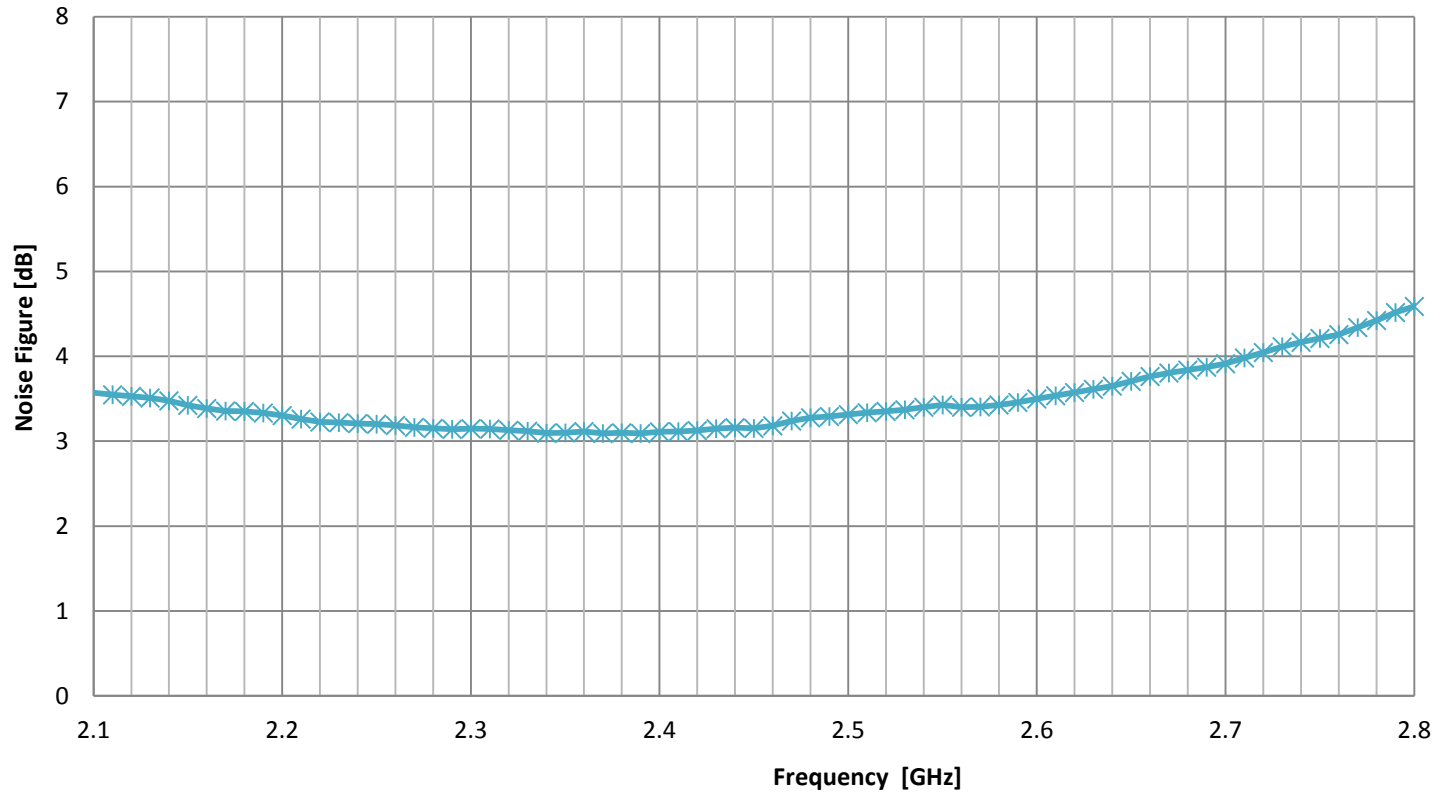
RFX2401C Tx Wideband Small-Signal Gain With External Harmonic Filter (VDD=3.3V)

TX S21



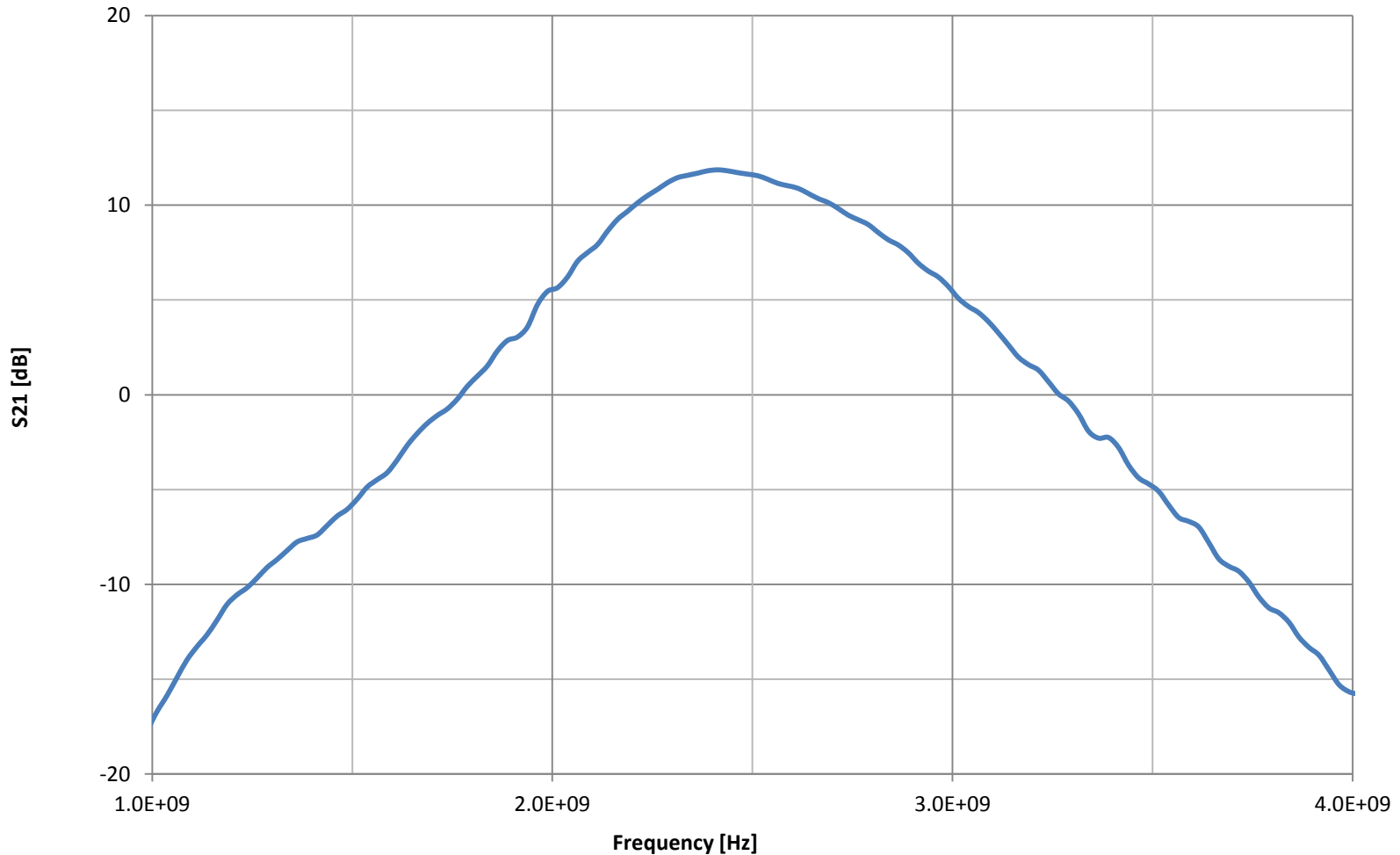
RFX2401C Rx Noise Figure With External Harmonic Filter (VDD=3.3V)

RX Noise Figure vs. Frequency



RFX2401C Rx Small-Signal Gain With External Harmonic Filter (VDD=3.3V)

RX S21



RFX2401C Application Schematic & BOM

Typical Application Schematic

Recommended BOM:

For VDD Decoupling

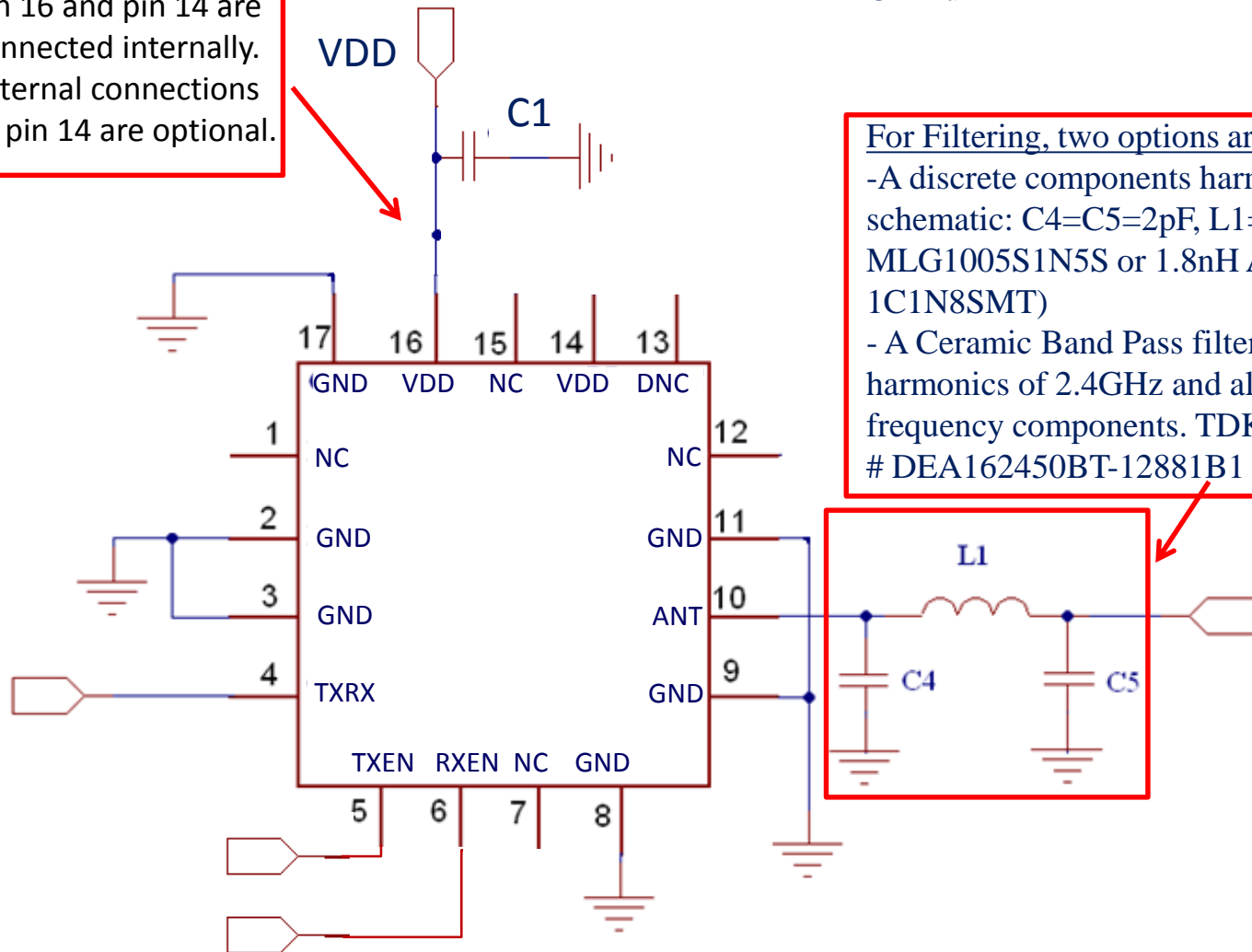
C1=1uF

For Filtering, two options are presented:

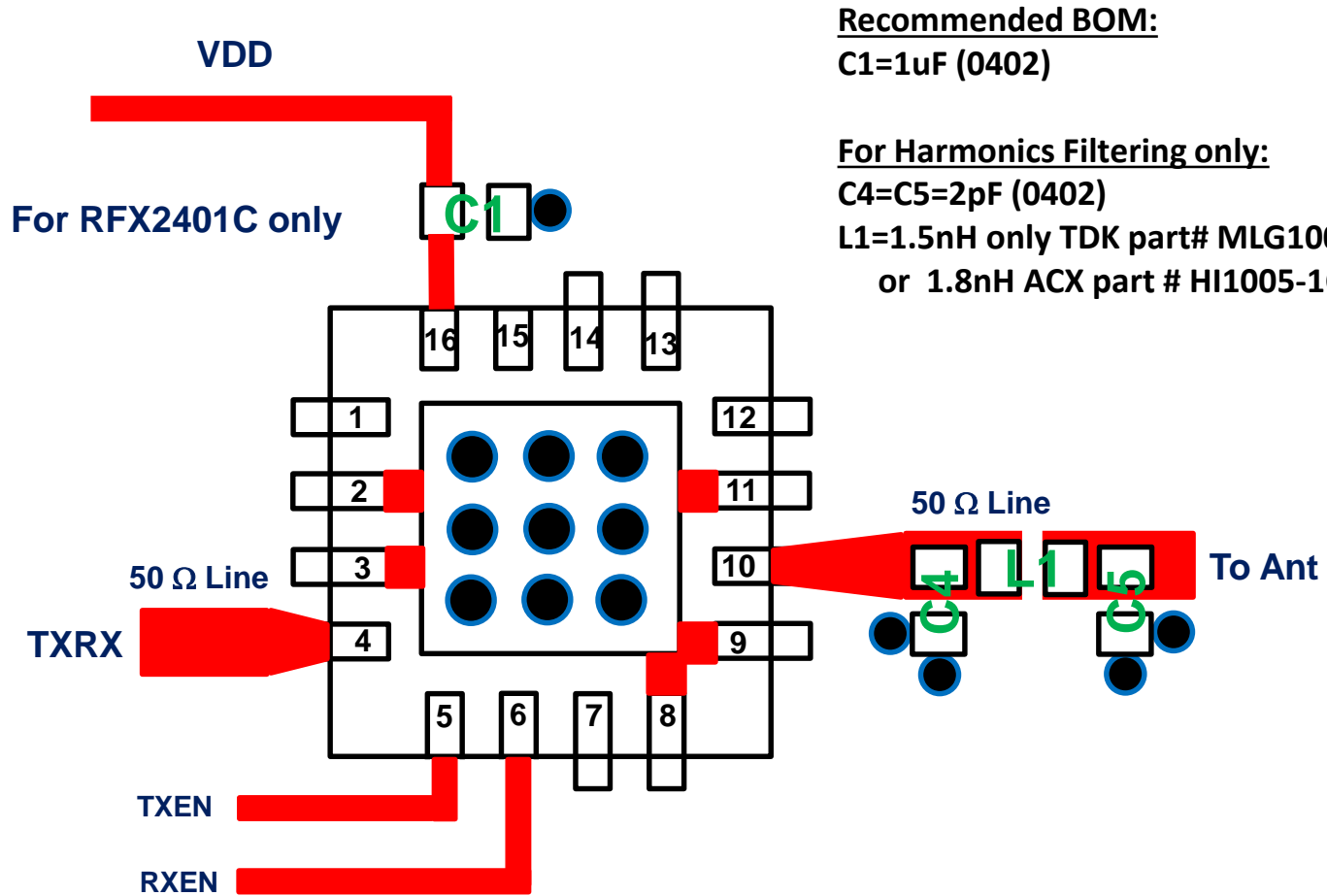
-A discrete components harmonic as shown in the schematic: C4=C5=2pF, L1=1.5nH (TDK part# MLG1005S1N5S or 1.8nH ACX part # HI1005-1C1N8SMT)

- A Ceramic Band Pass filter: This will filter the harmonics of 2.4GHz and also suppress low frequency components. TDK Band pass filter part # DEA162450BT-12881B1 is recommended

Pin 16 and pin 14 are connected internally. External connections to pin 14 are optional.



RFX2401C PCB Layout Recommendation



Recommended BOM:

C1=1uF (0402)

For Harmonics Filtering only:

C4=C5=2pF (0402)

L1=1.5nH only TDK part# MLG1005S1N5S

or 1.8nH ACX part # HI1005-1C1N8SMT

Notes:

- Tie all unused pins to center ground paddle
- For best RF performance please place 9 vias under the center ground paddle
- Place vias immediately next to each shunt cap (C1,C4, C5) if possible
- Pin 14 is an alternative supply pin and can be left open