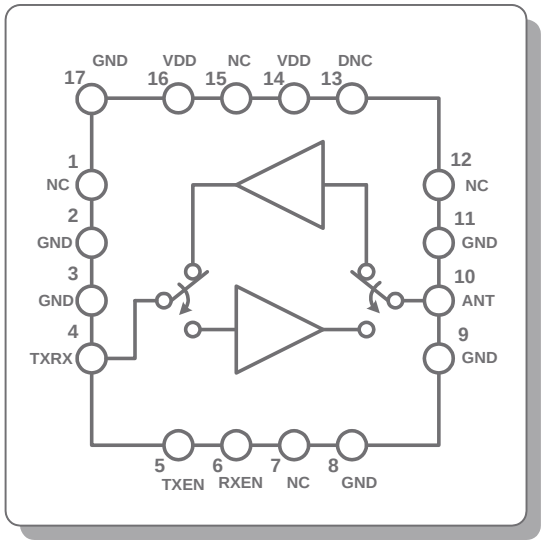
RFX2401C Single-Chip CMOS RFeIC with PA, LNA, Antenna Switch and Combined TX/RX Transceiver Port

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

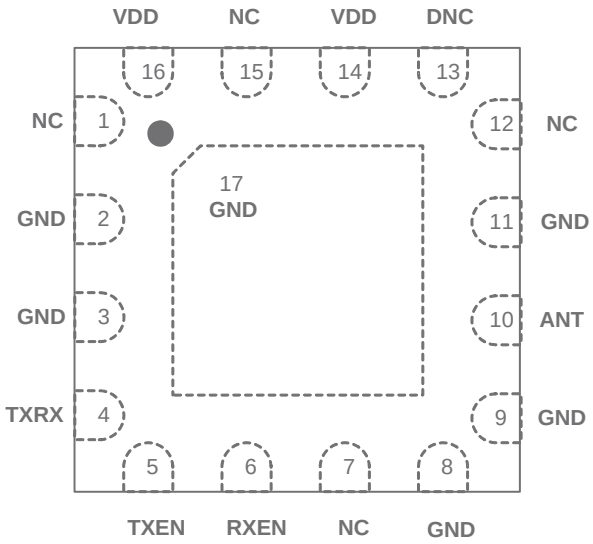
APPLICATIONS

- 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

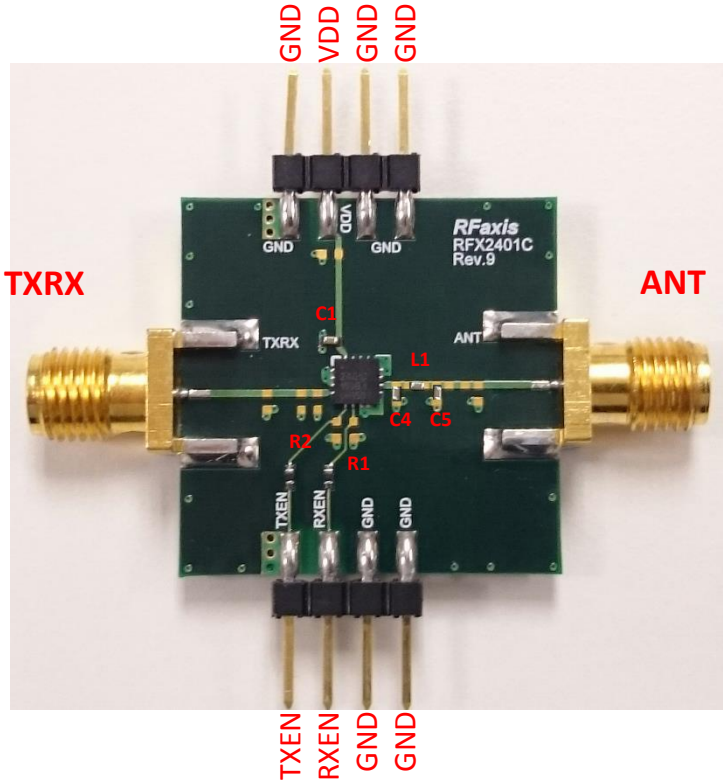
RFX2401C Pin Out and Pin Description



(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

RFX2401C Eval Board and Recommended BOM



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 ~0.2dB @ 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 = 1KΩ
- R2 = 1KΩ

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):

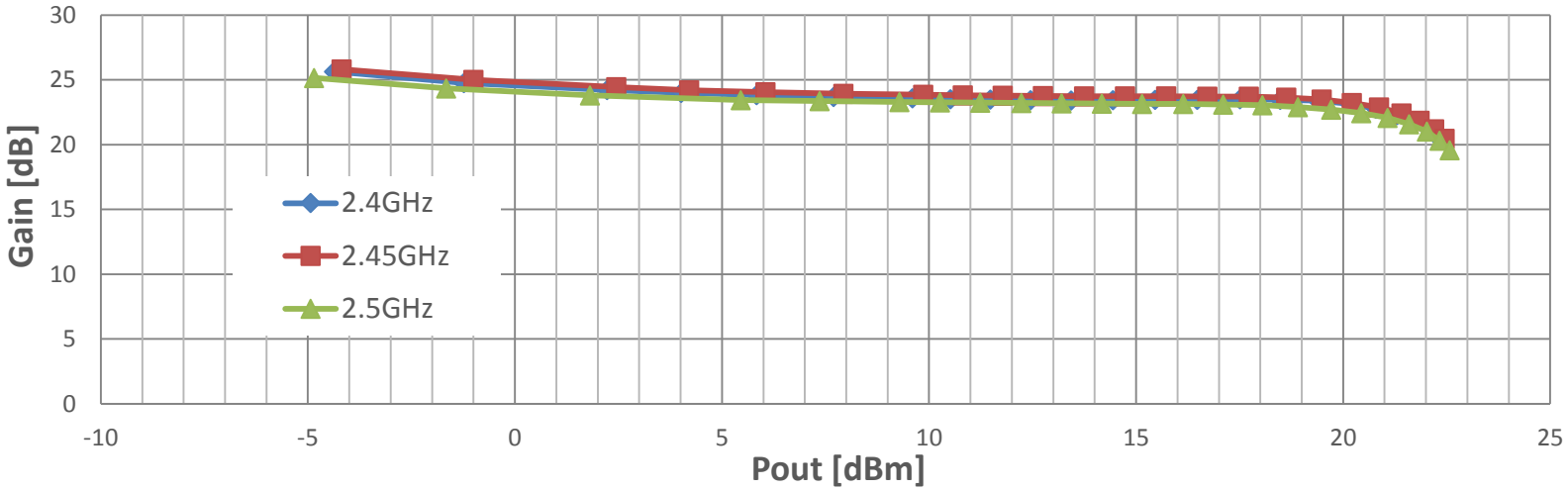
- RXEN=High(>1.2V)
- TXEN=Low (<0.3V)

Control Logic Truth Table

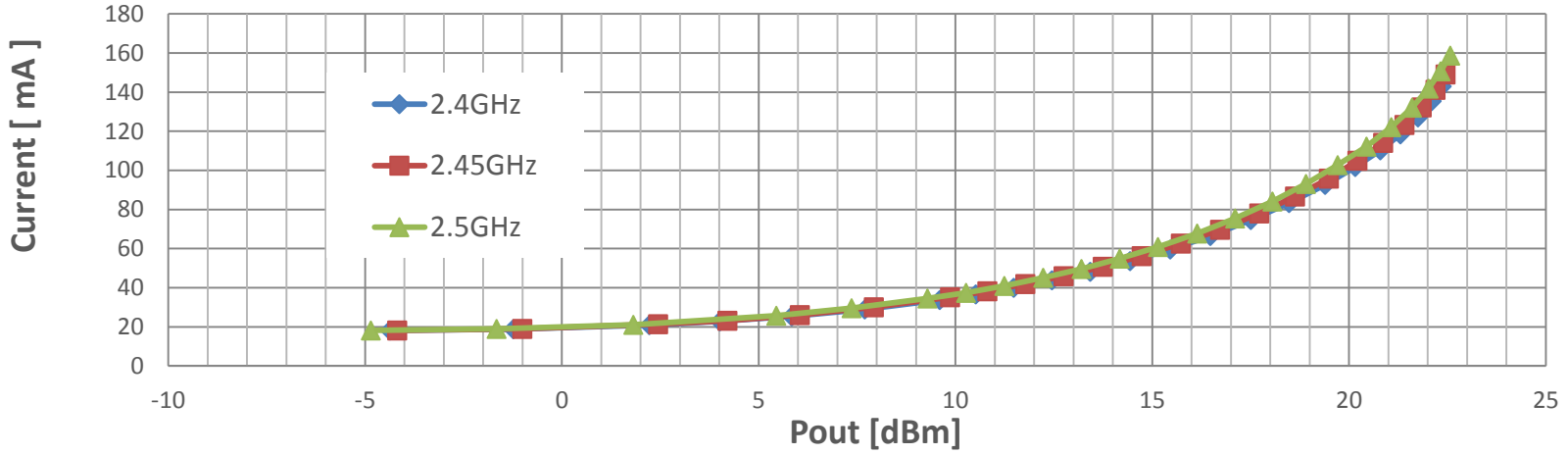
TXEN	RXEN	Operating Conditions
1	X	TX Active
0	1	RX Active
0	0	Chip is Shut-down

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

TX Gain vs. Pout

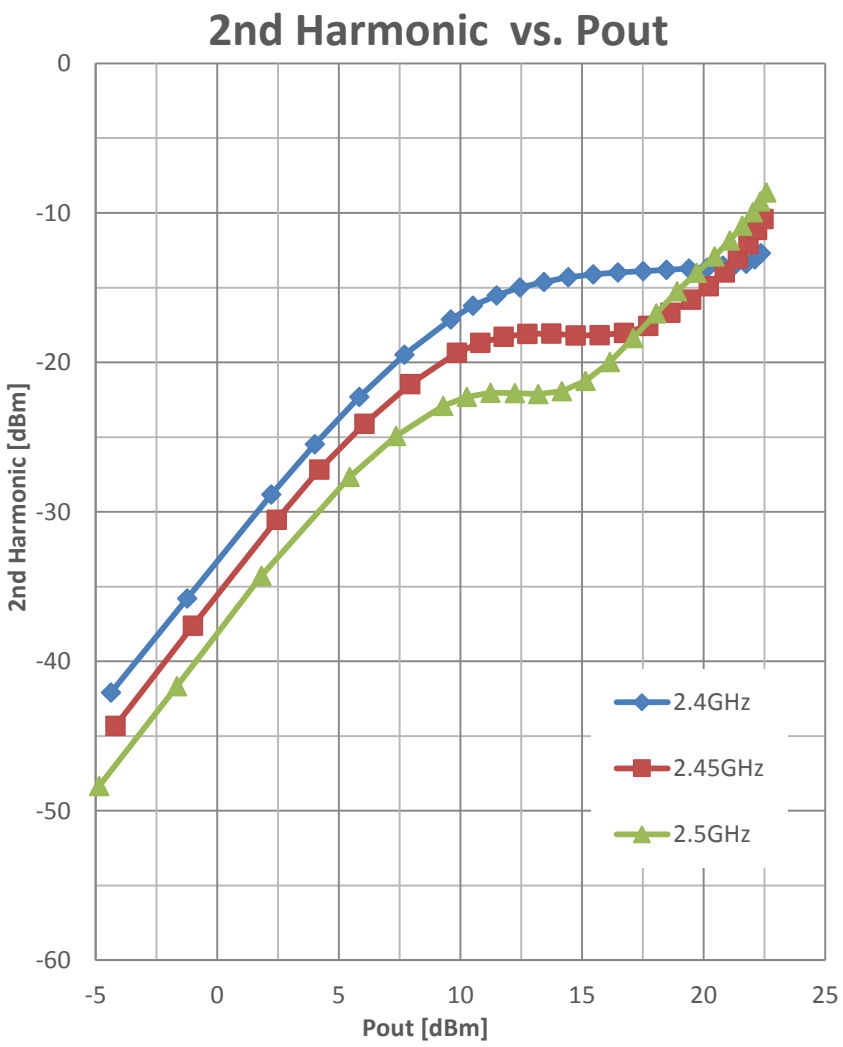


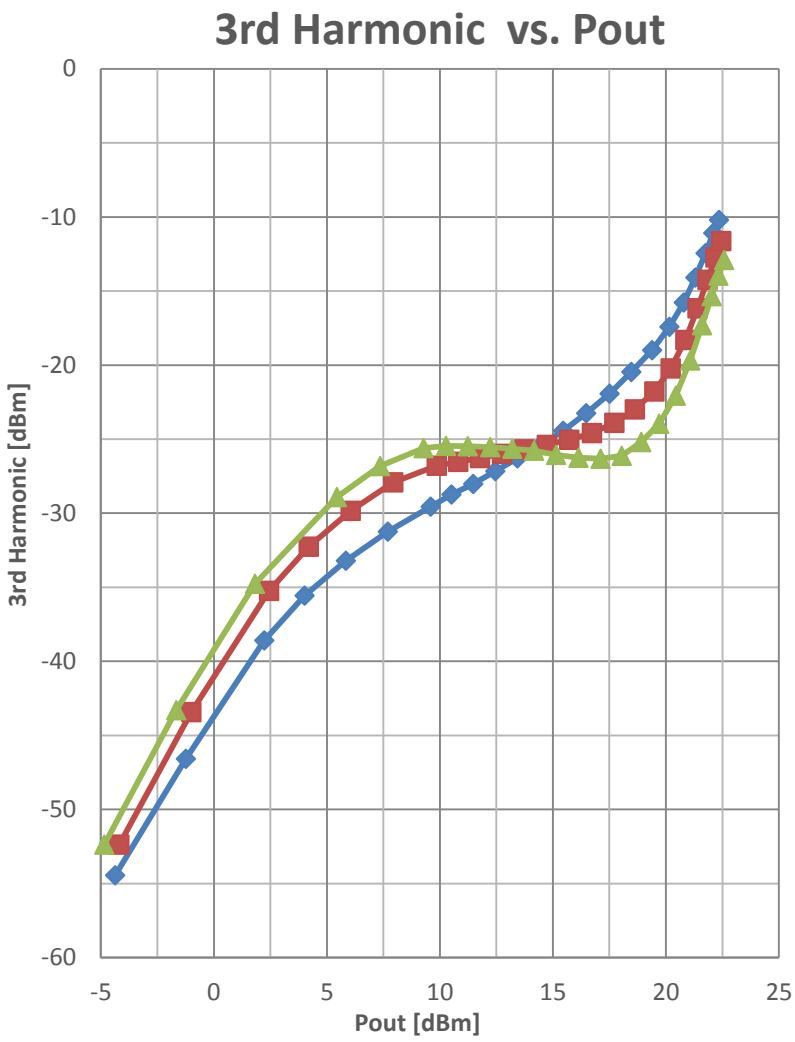
Current vs. Pout



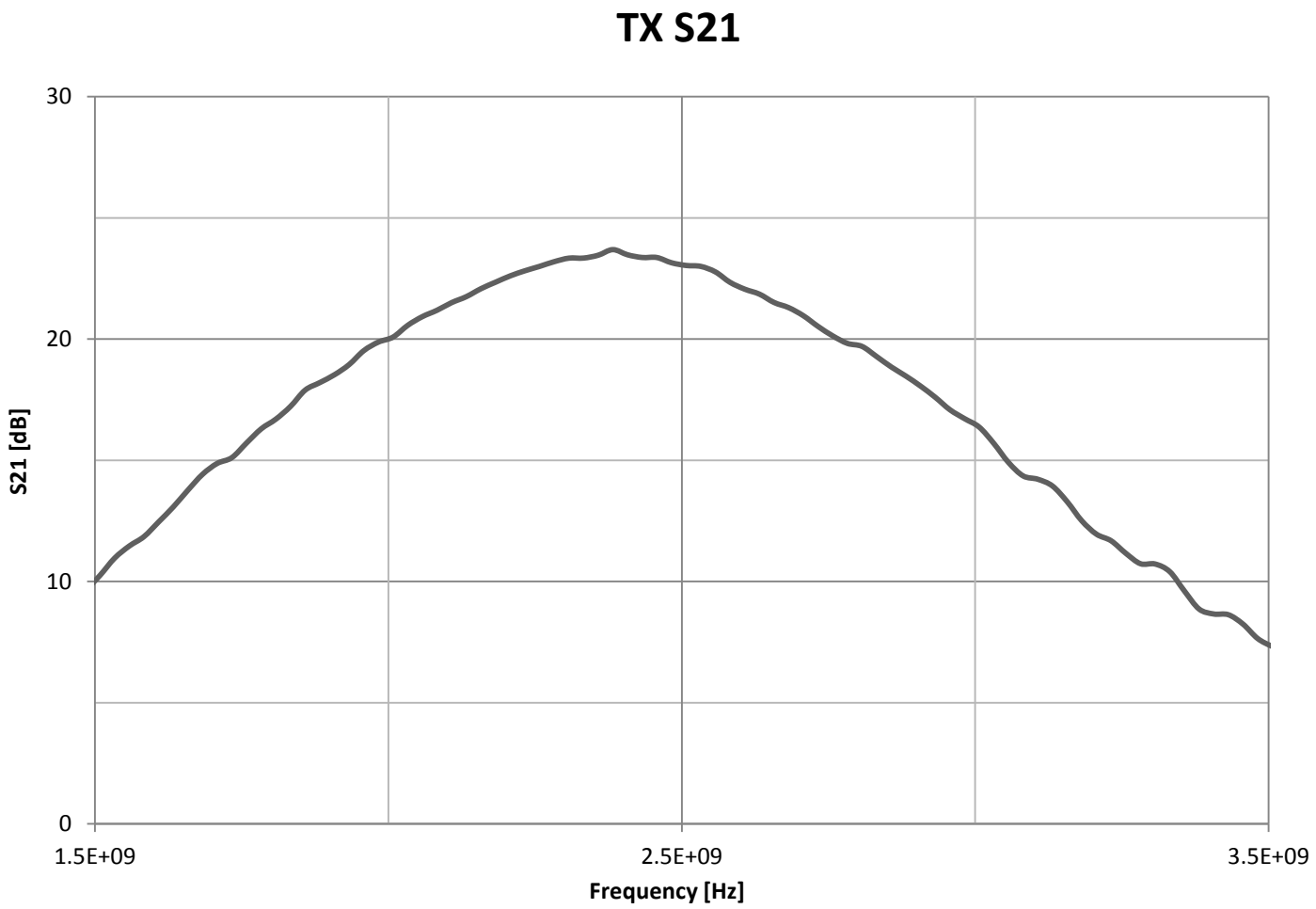
Note: Output power measured at antenna, without external harmonic filter.

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

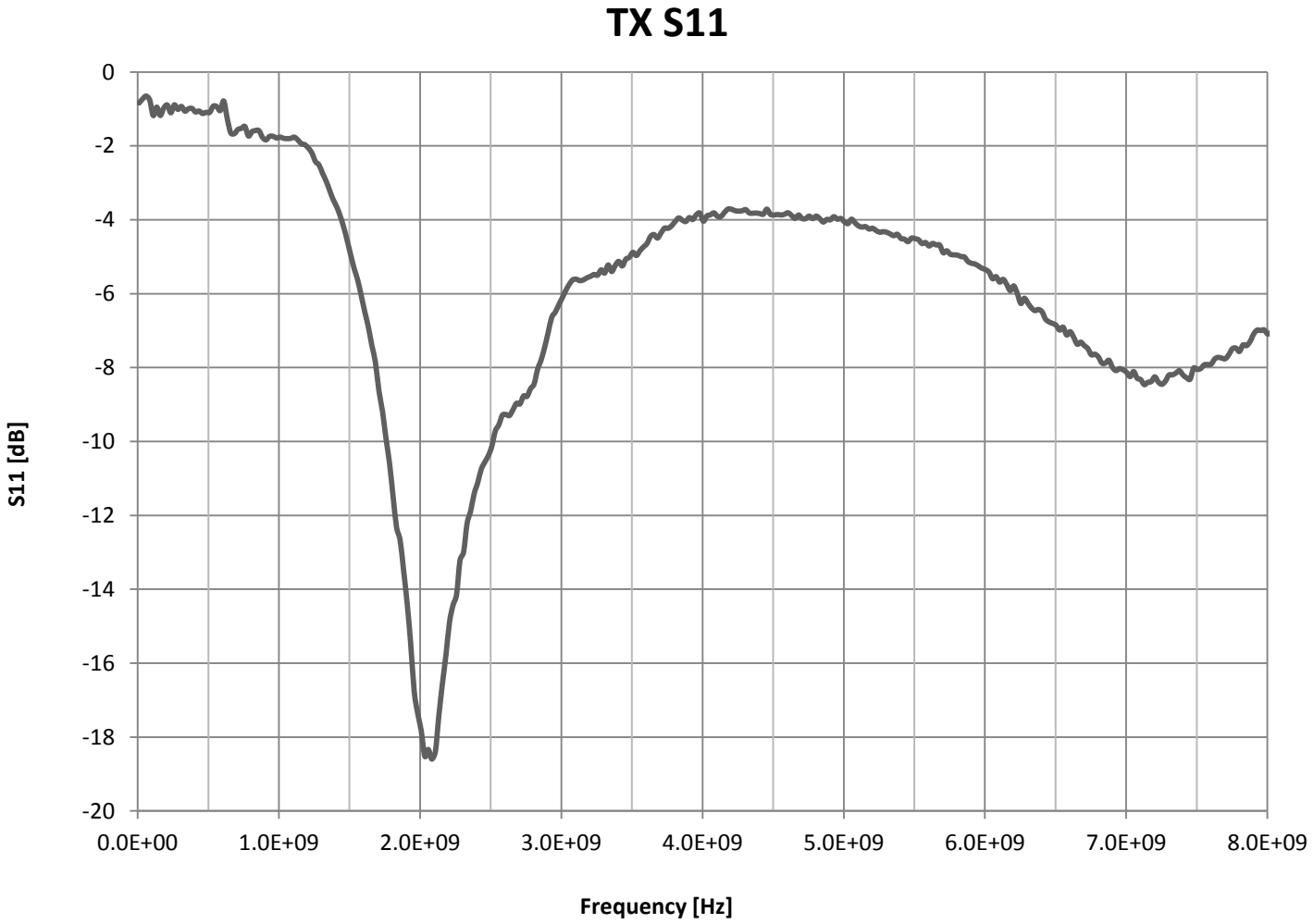




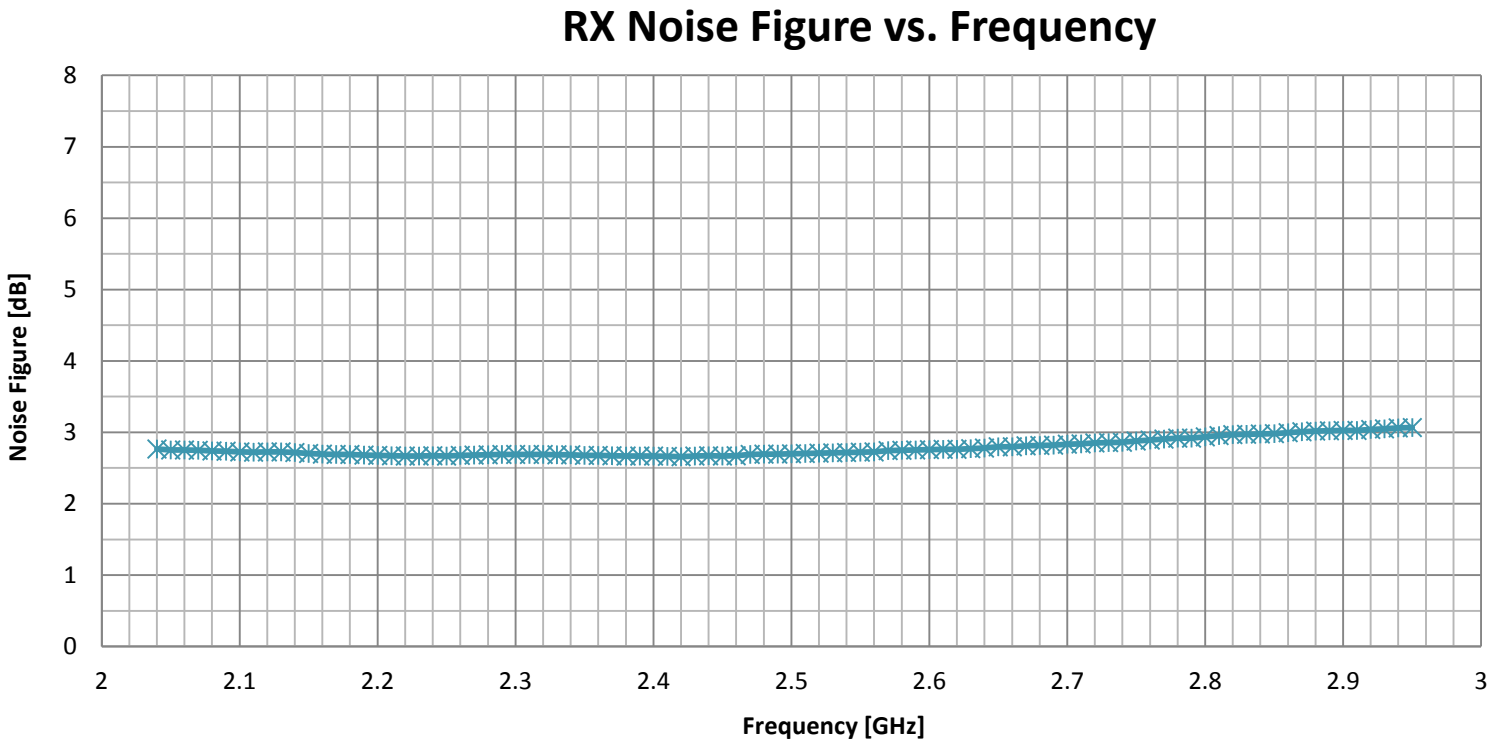
RFX2401C TX Small-Signal Gain Without External Harmonic Filter (VDD=3.3V)



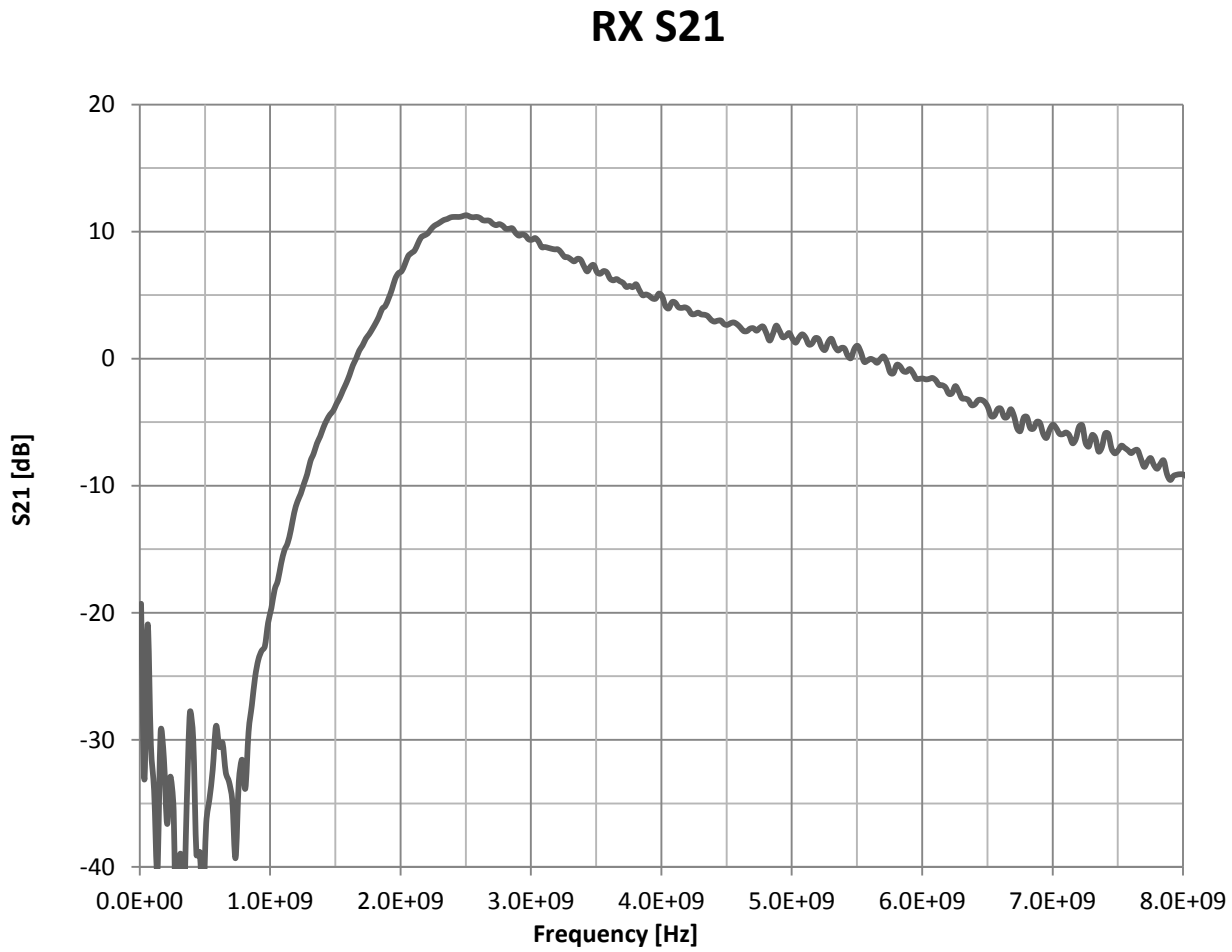
RFX2401C TX S11 without External Harmonic Filter (VDD=3.3V)



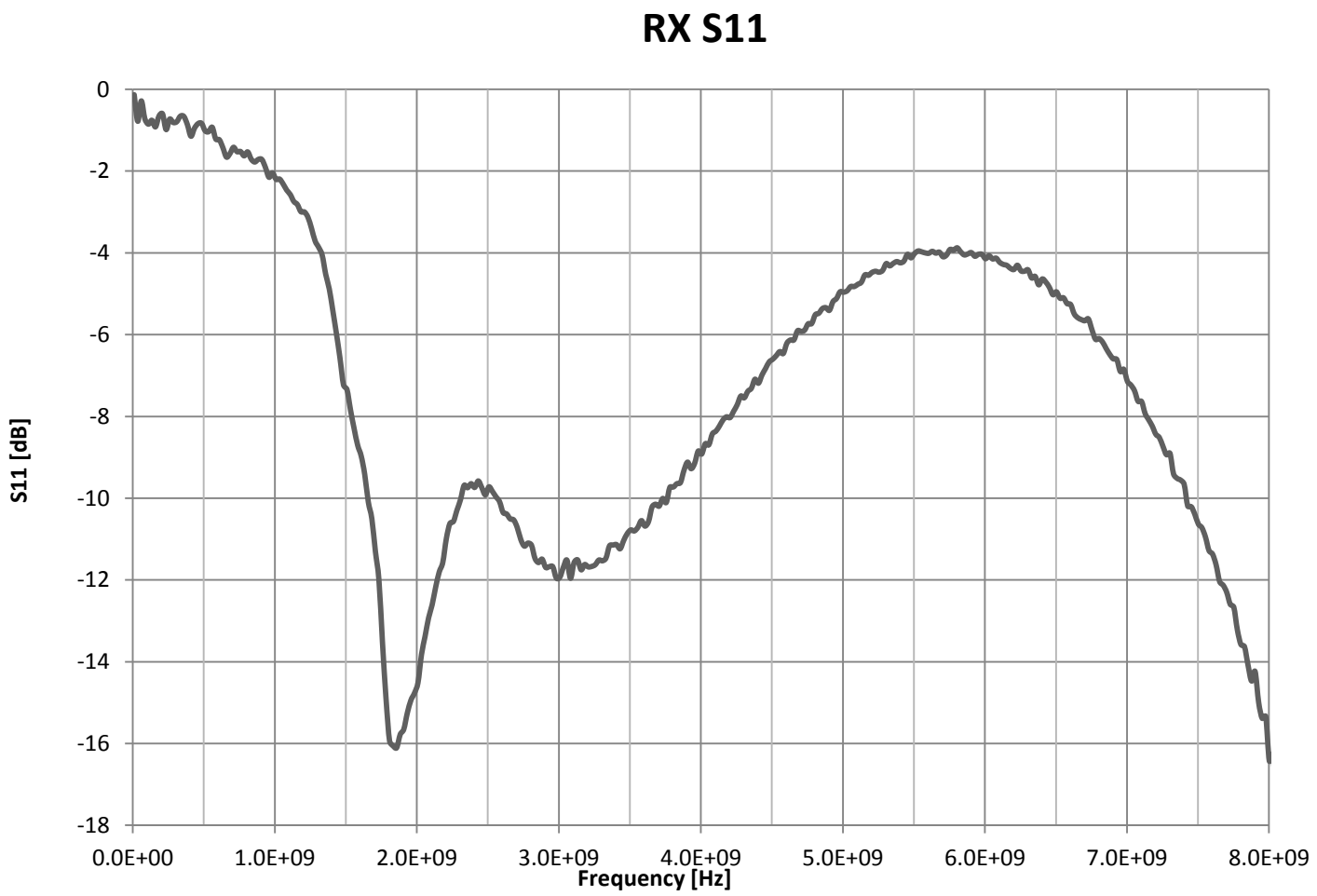
RFX2401C RX Noise Figure Without External Harmonic Filter (VDD=3.3V)



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



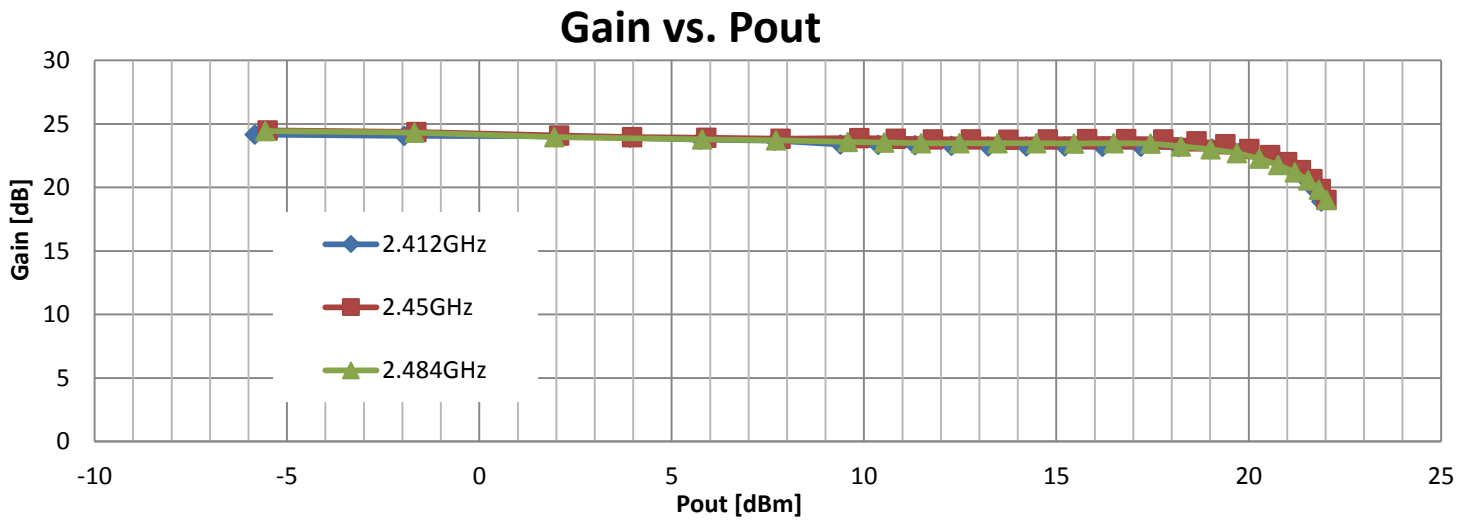
RFX2401C RX Without External Harmonic Filter (VDD=3.3V)

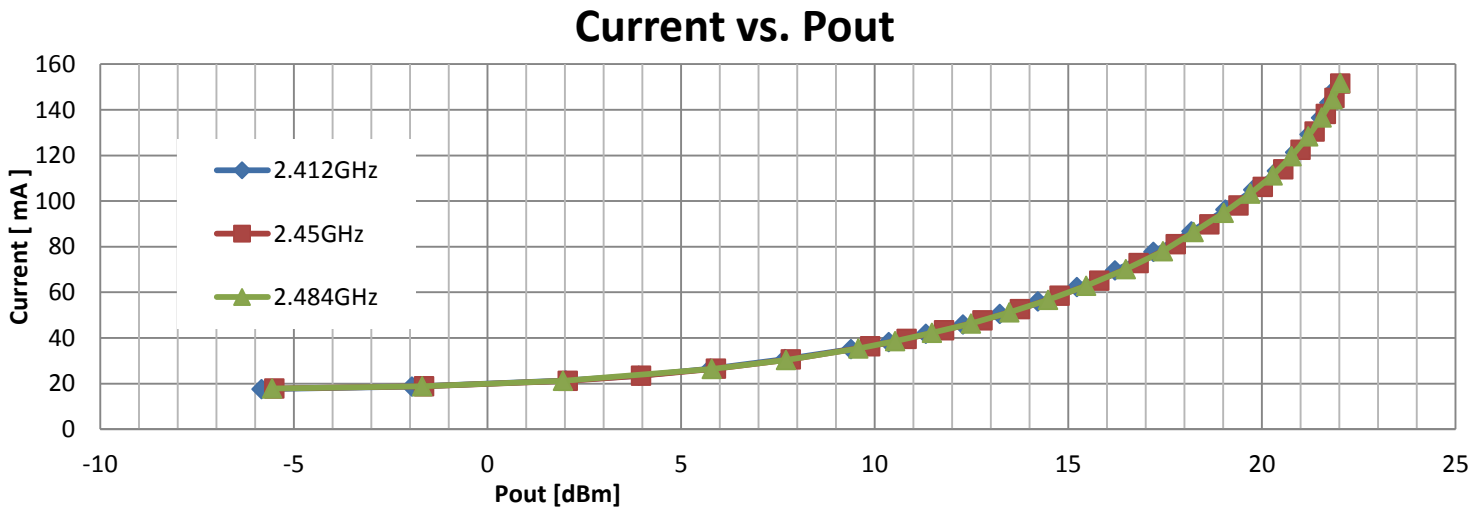


RFX2401C
With External Harmonic Filter

Eval Board Test Summary & Technical Notes

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

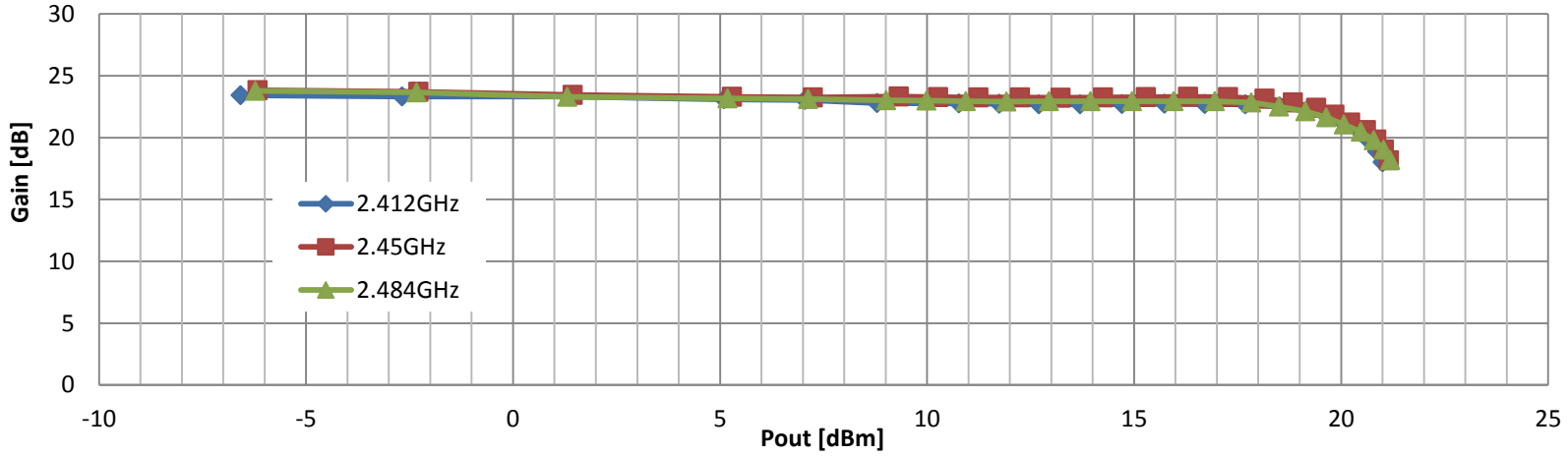




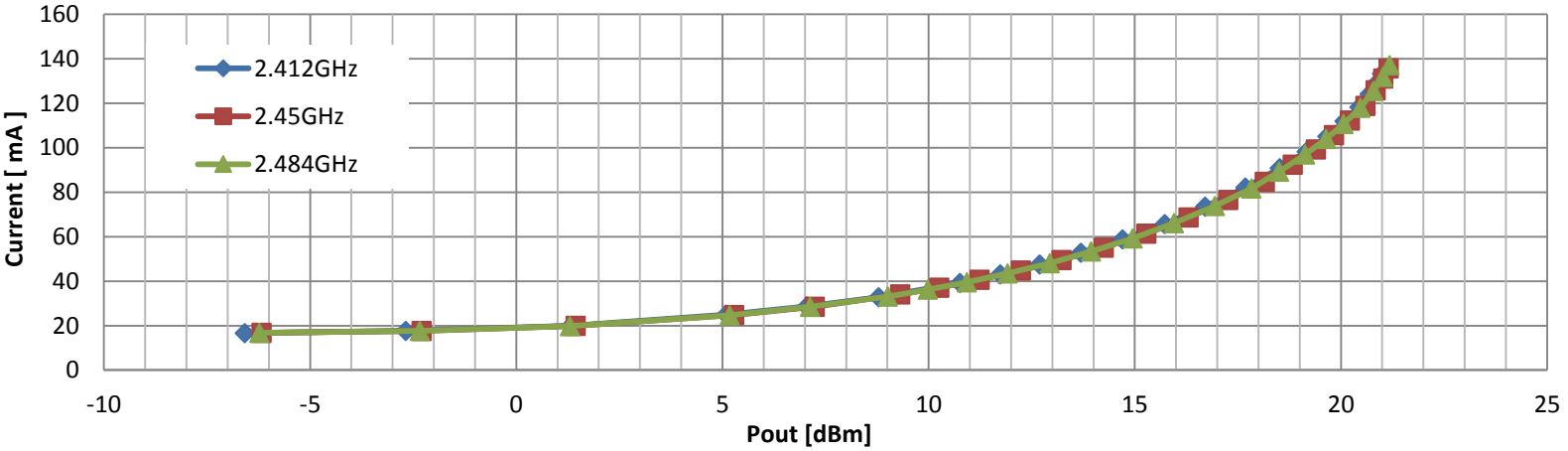
Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

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

Gain vs. Pout

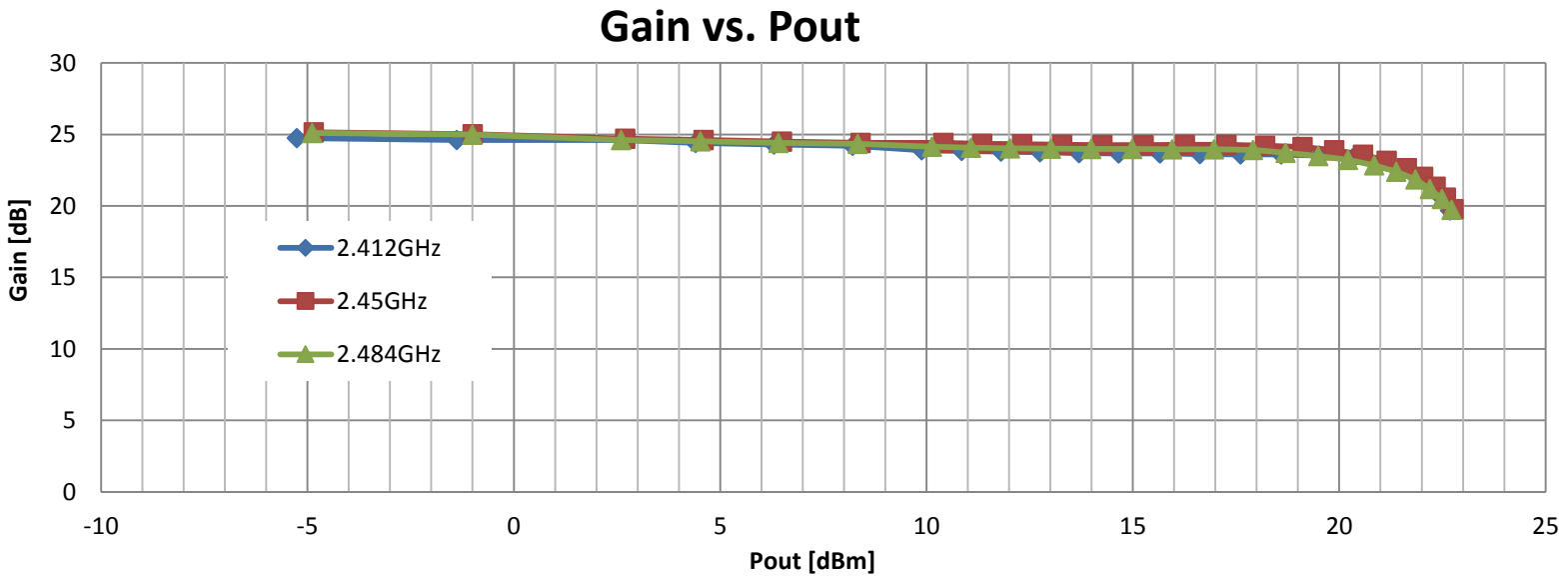


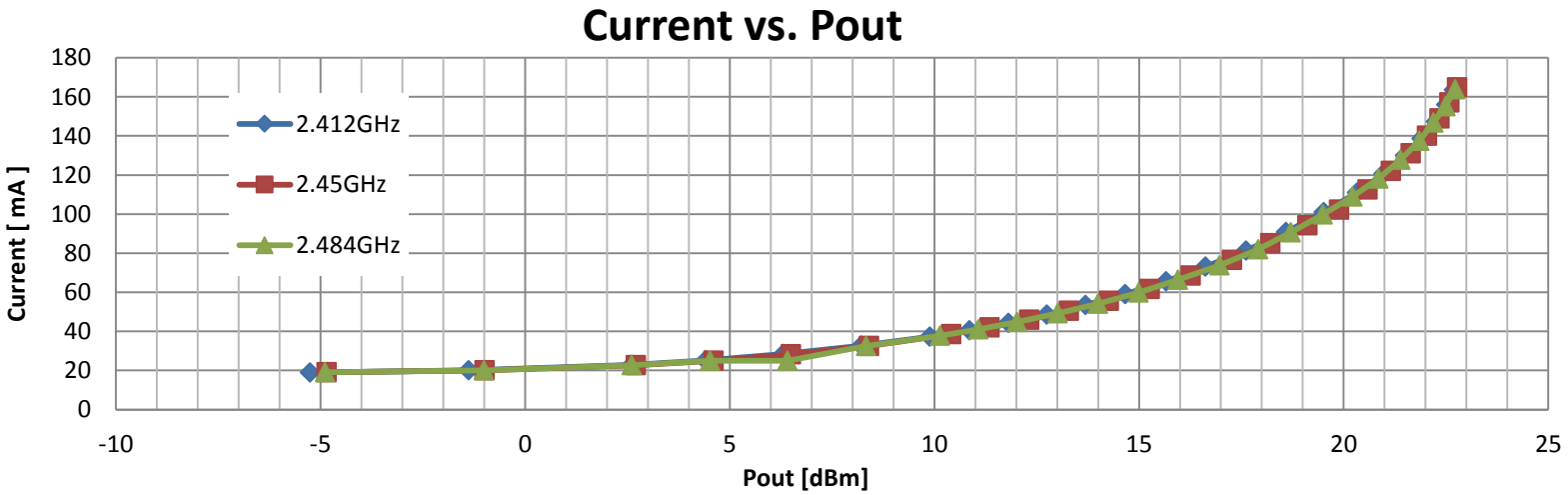
Current vs. Pout



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

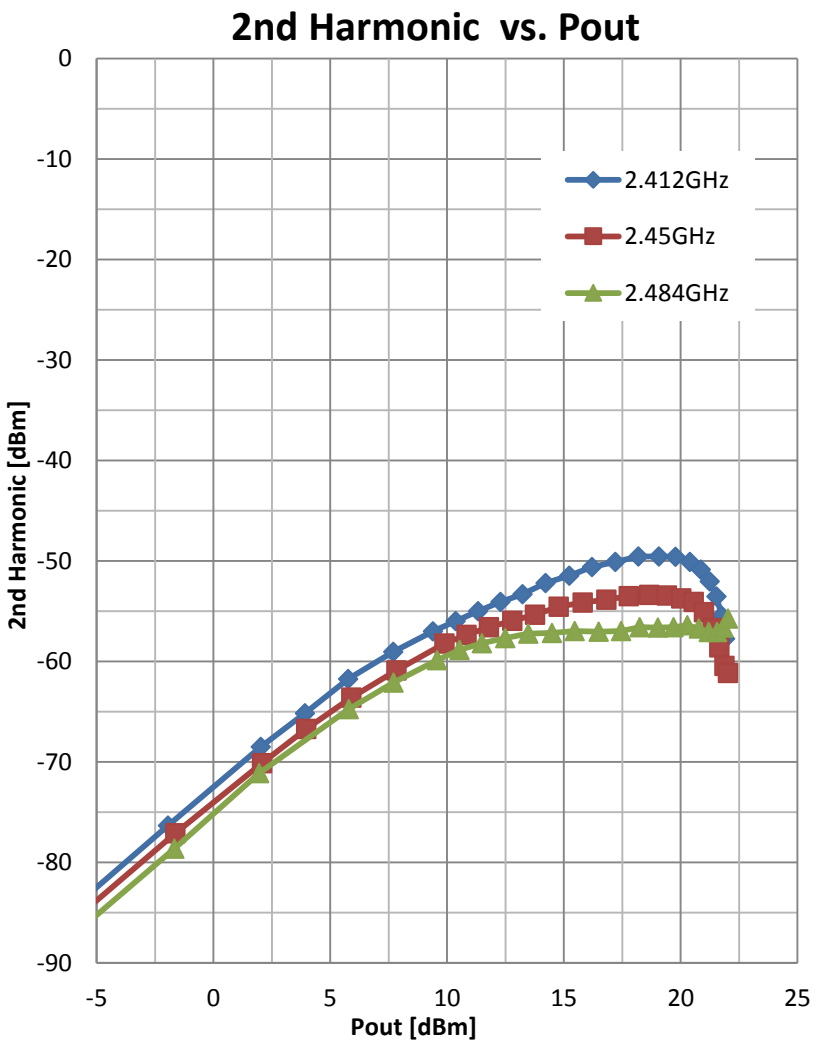
RFX2401C TX CW Gain and Current vs. Pout & Frequency With External Harmonic Filter (VDD=3.6V)

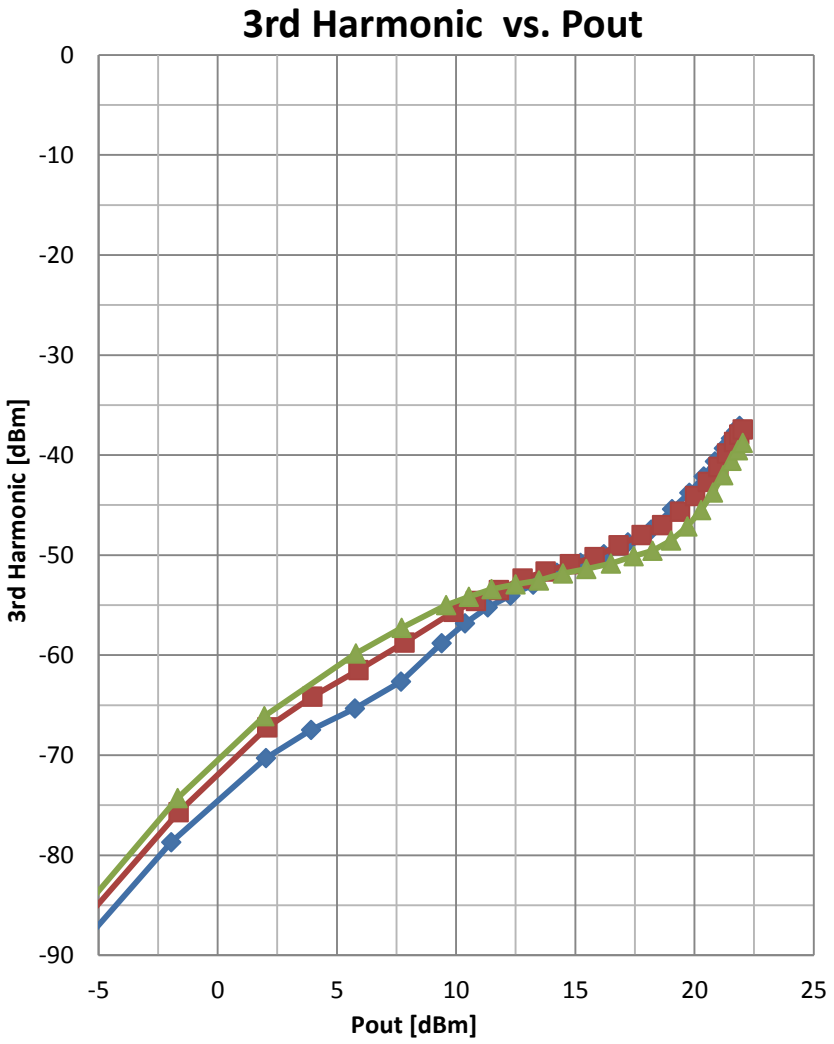




Note: Output power measured at antenna, after the harmonic filter which has ~0.5dB insertion loss.

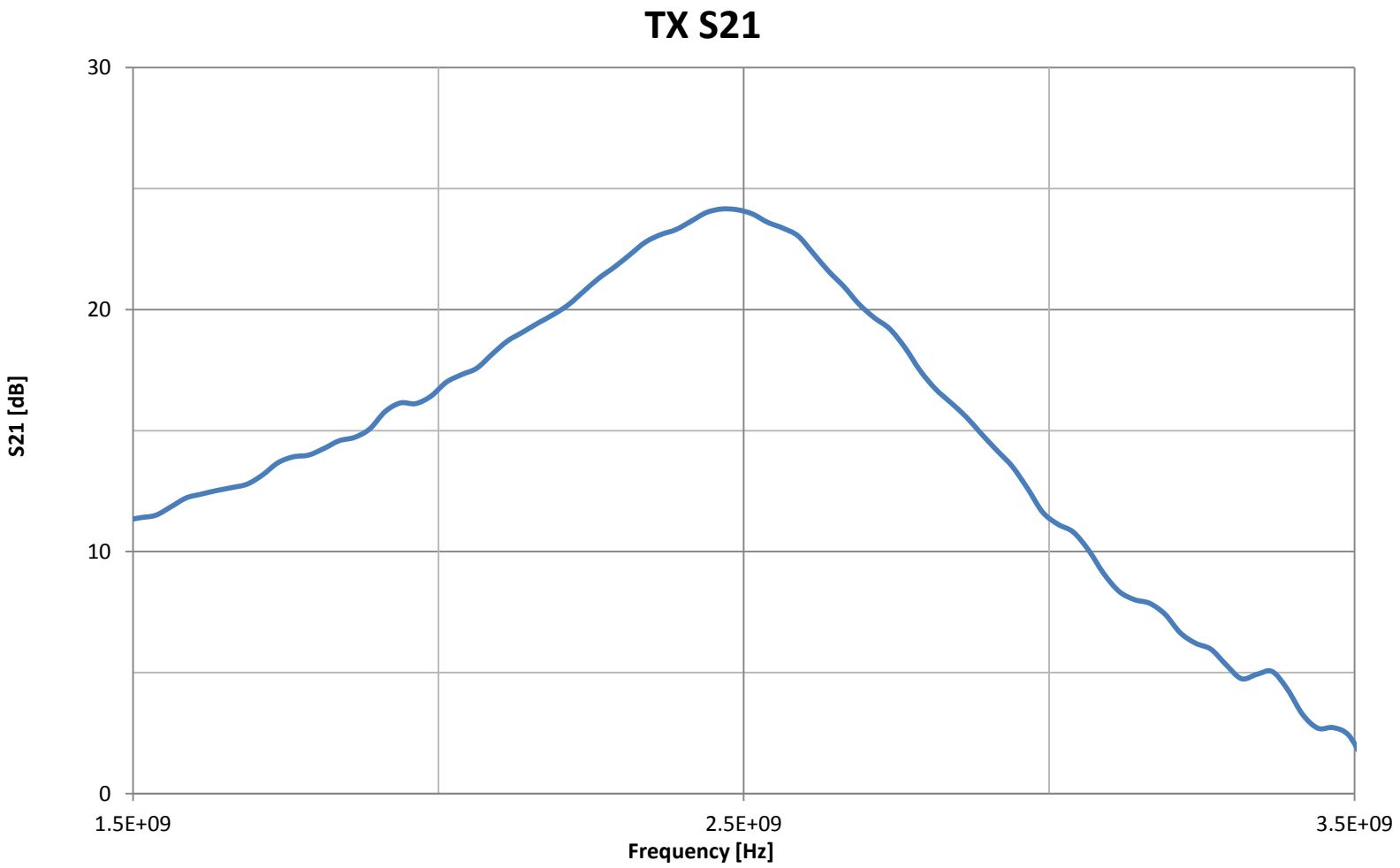
RFX2401C TX Harmonics vs. Pout & Frequency With External Harmonic Filter (VDD=3.3V)



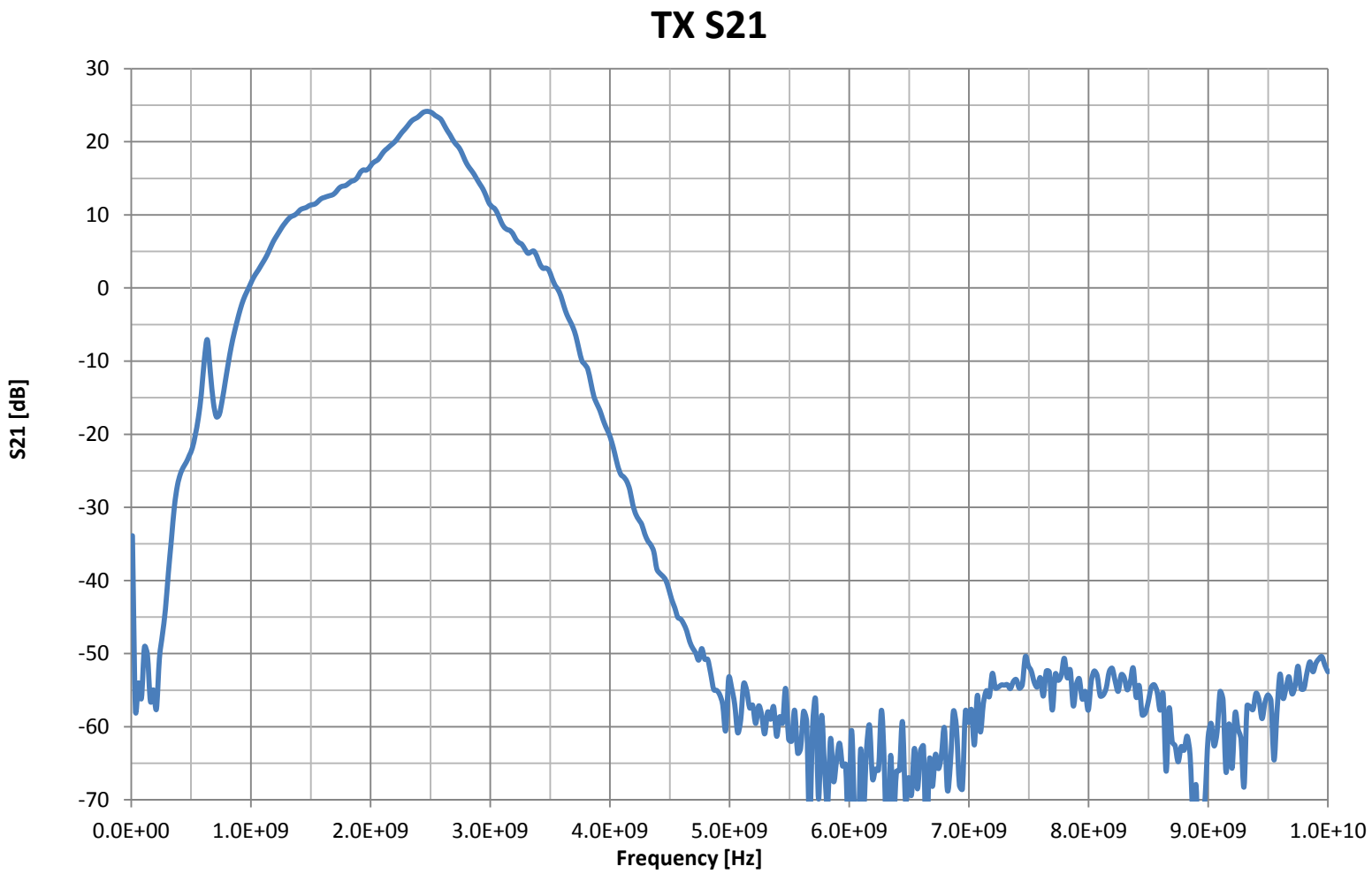


Note: RFX2401C can achieve FCC harmonic compliance with only one simple pi-filter.

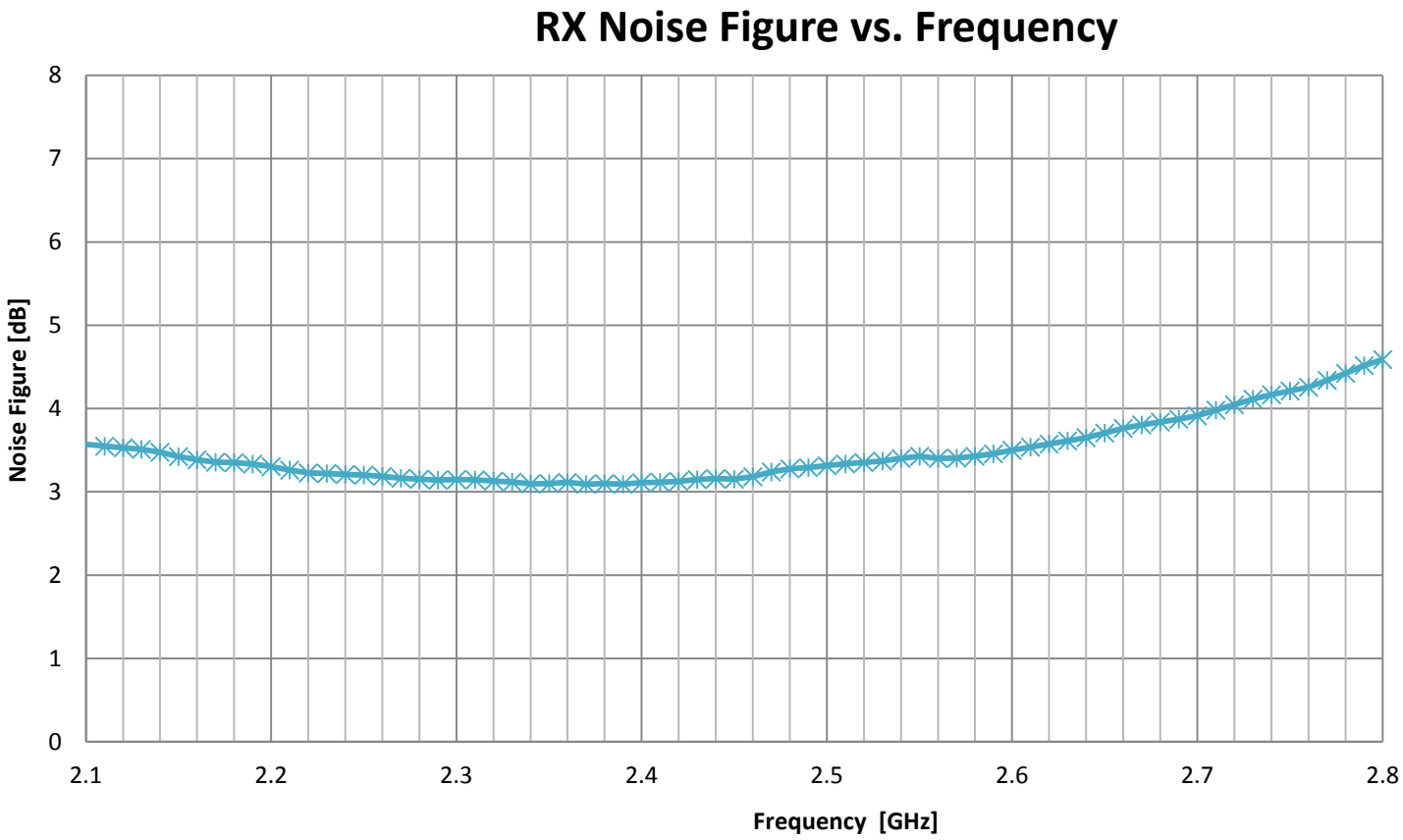
RFX2401C TX Small-Signal Gain (S21) With External Harmonic Filter (VDD=3.3V)



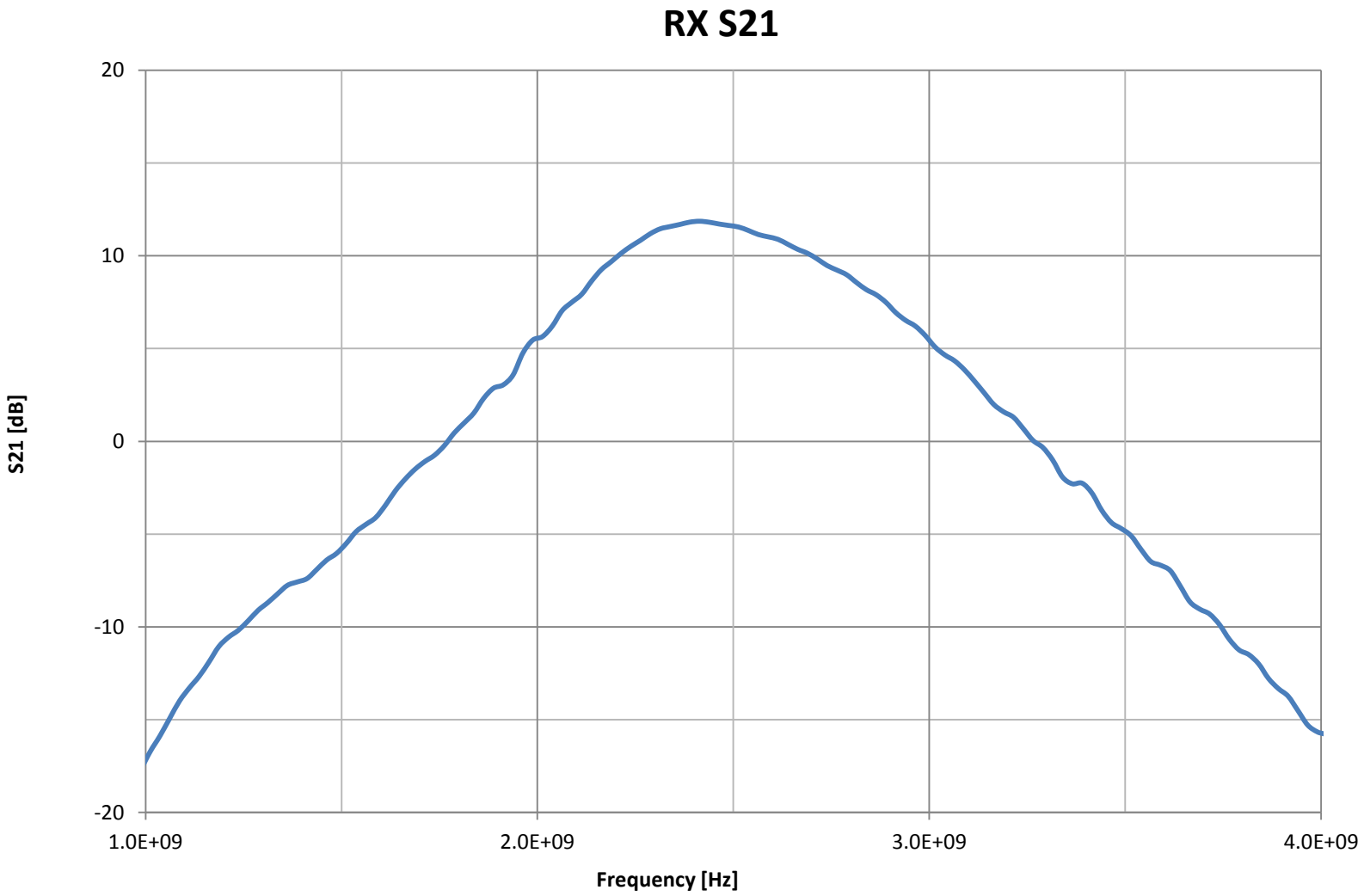
RFX2401C TX Wideband Small-Signal Gain With External Harmonic Filter (VDD=3.3V)



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

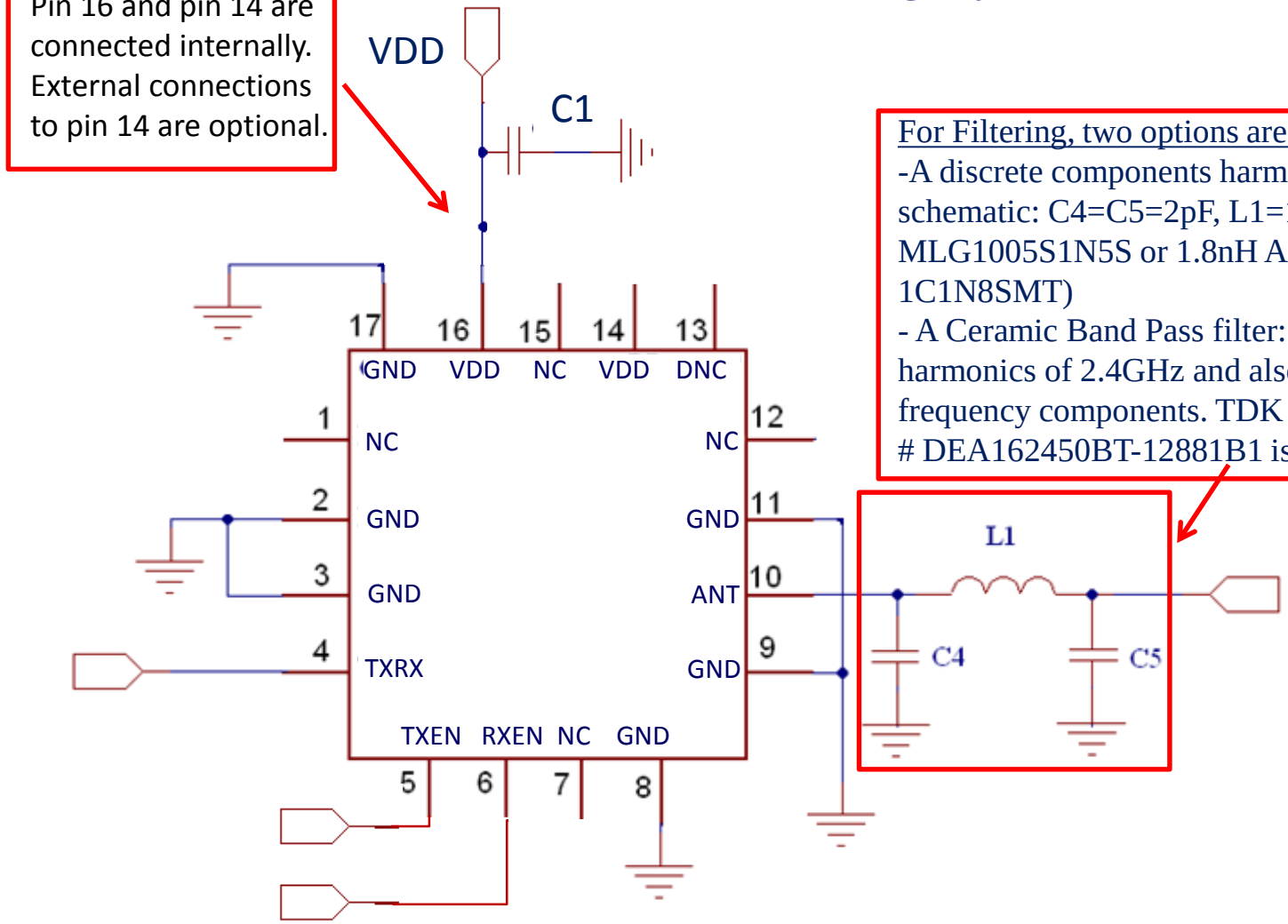


RFX2401C RX Small-Signal Gain With External Harmonic Filter (VDD=3.3V)



RFX2401C Application Schematic & BOM

Typical Application Schematic



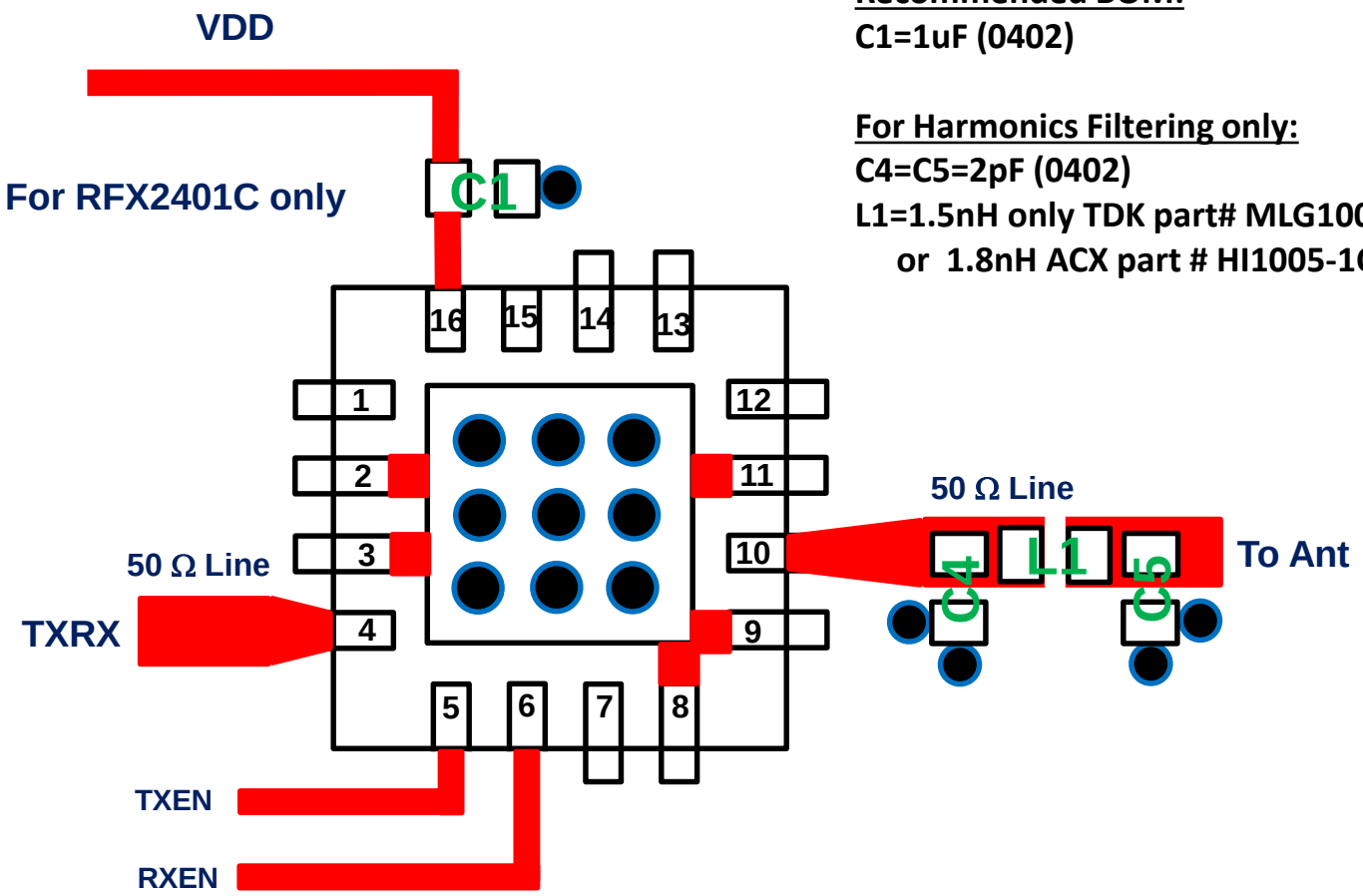
Pin 16 and pin 14 are connected internally. External connections to pin 14 are optional.

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

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