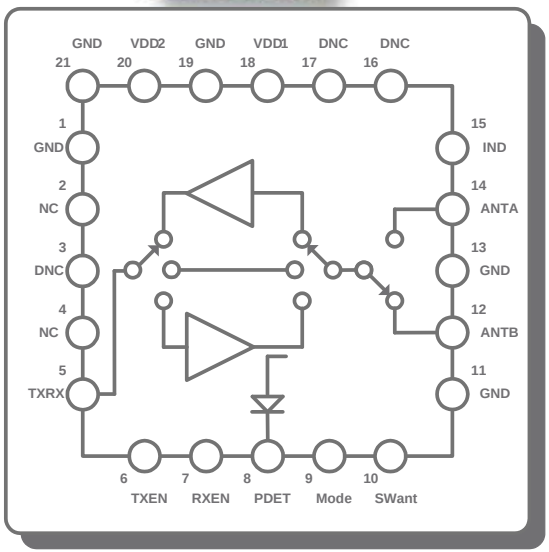
RFX2411 Single-Chip CMOS RFeIC with PA, LNA, Antenna Switch, Combined Tx/Rx Transceiver Port, Input Port to Antenna Ports Bypass Mode, and Diversity Switch

Evaluation Board Results
Summary & Technical Notes

RFX2411 RFeIC Key Features and Benefits

3x3x0.55mm
20L QFN



RFX2411 Differentiating Features

- Integration of PA, LNA, Tx-Rx Switching Circuitry, Associated Matching Network, Harmonic Filter, PA Power Detection Circuit and Diversity switch all in a Single-Chip, Single-Die pure CMOS Solution
- Greatly Reduced and Simplified Tx/Rx Control
- Low Current Mode for ultra low power consumption
- Low Voltage Battery Operation down to 2.0V
- 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 3x3x0.55mm 20L QFN Package

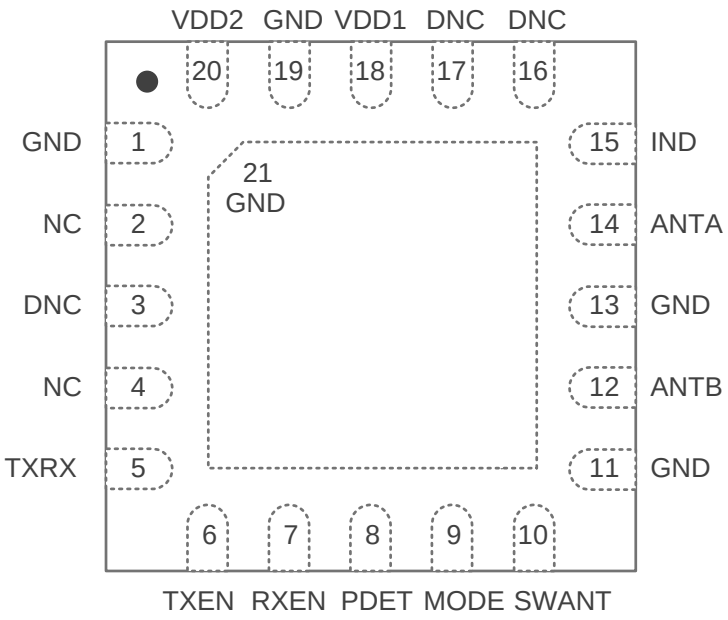
APPLICATIONS

- 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

RFX2411 Customer Benefits

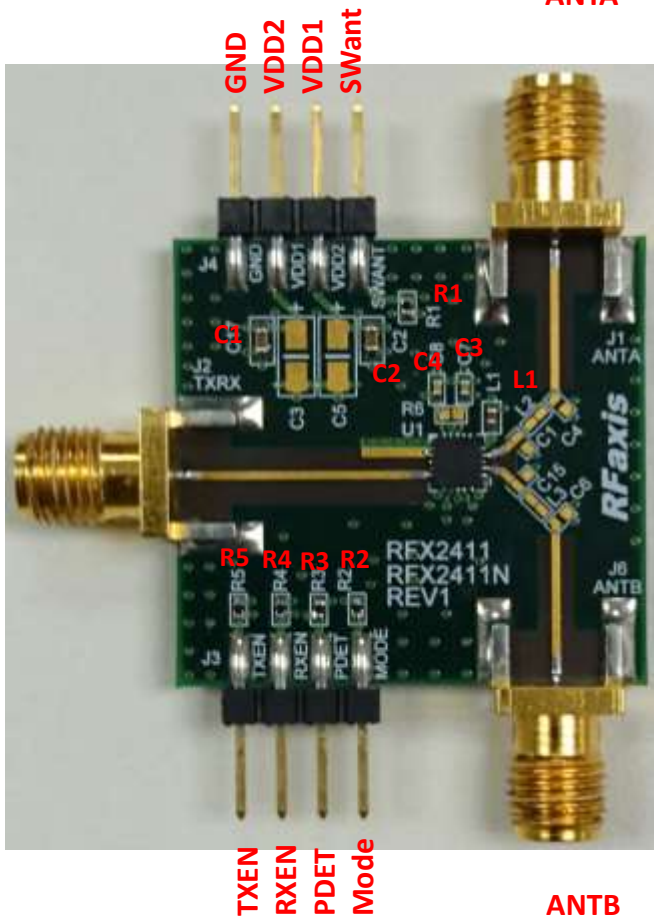
- Greatly Simplified, 50 Ohm “Plug & Play” PCB Implementation
- Small Form-Factor and Quick Design Cycle
- Simplest Approach to Improve Link Performance including Range and Receiver Sensitivity
- Very Low BOM Cost and Competitive Price

RFX2411 Pin Description



Pin Number	Pin Name	Description
1, 11,13, 19, 21	GND	Ground – Must be connected to Ground in the Application Circuit
2, 4	NC	No Internal Connection
5	TXRX	RF signal to/from the Transceiver: DC shorted to GND
6	TXEN	CMOS Input to Control TX Enable
7	RXEN	CMOS Input to Control RX Enable
8	PDET	Analog Voltage Proportional to the PA Power Output
9	MODE	CMOS Input to control mode of operation
10	SWant	CMOS Input to select antenna for diversity
12	ANTB	RF Signal from the PA or RF Signal Applied to the LNA; DC Shorted to GND
14	ANTA	RF Signal from the PA or RF Signal Applied to the LNA; DC Shorted to GND
15	IND	Inductor to GND
3, 16, 17	DNC	Reserved – Do Not Connect in the Application Circuit
18	VDD1	Voltage Supply Connection
20	VDD2	Voltage Supply Connection

RFX2411 Evaluation Board and Preliminary BOM



SWant	Mode of Operation
1	ANTA port enabled
0	ANTB port enabled

For VDD decoupling:
C1, C2=2.2uF
C3, C4=220pF

Detector Loading:
R3 = 10Kohm

Digital Control Protection:
R1 = R2 = R4 = R5 = 1Kohm (Recommended for control lines with voltage that may approach Vdd levels).

For Harmonic Suppression:
L1=1.2nH (Inductor value may need to be optimized in final application circuit since it is layout dependent)
Additional filtering may be required for compliance depending on system configuration and application.

Eval PCB Information:
- 4-Layer Stack, 10mil/40mil/10mil
- FR4 with εr=4.5, tan δ = 0.02 (typ.)
- All trace losses have been de-embedded from the following Measurements.

Control Logic Truth Table

TXEN	RXEN	MODE	Mode of Operation
0	0	0	Shutdown Mode
0	0	1	Bypass Mode
1	X	0	Low Idq TX Mode
1	X	1	High Idq TX Mode
0	1	0	Low Noise Figure Receive Mode
0	1	1	Low Current Receive Mode

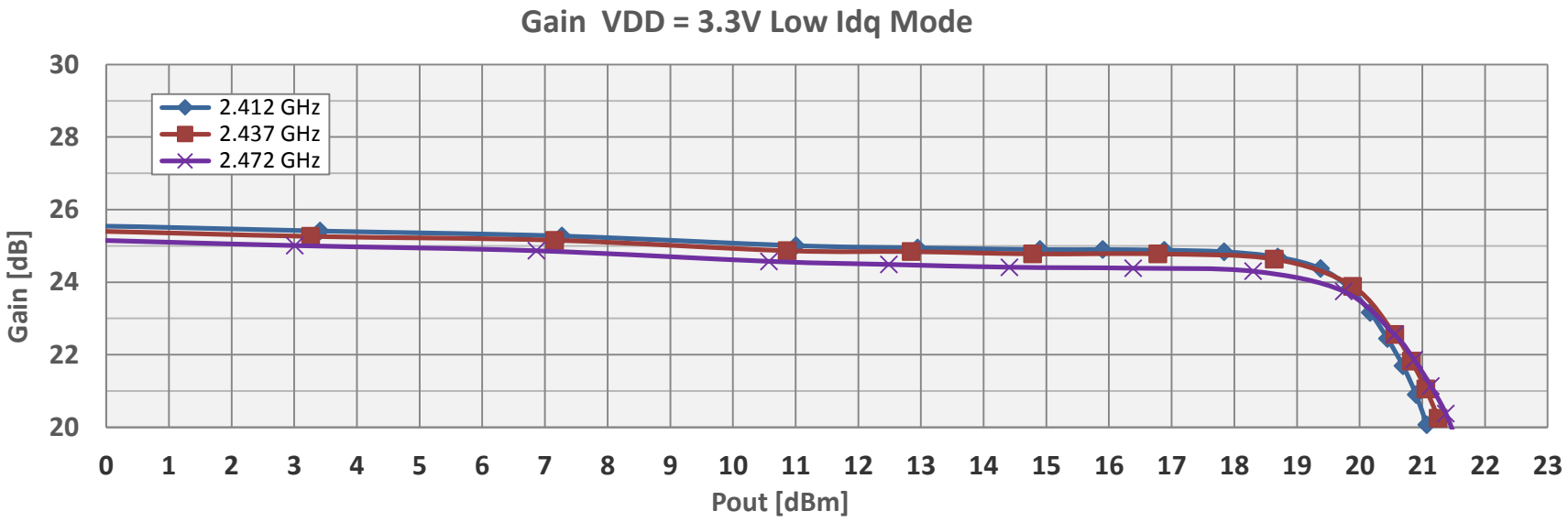
Note: “1” denotes high voltage state (> 1.2V) at Control Pins
“0” denotes low voltage state (< 0.3V) at Control Pins

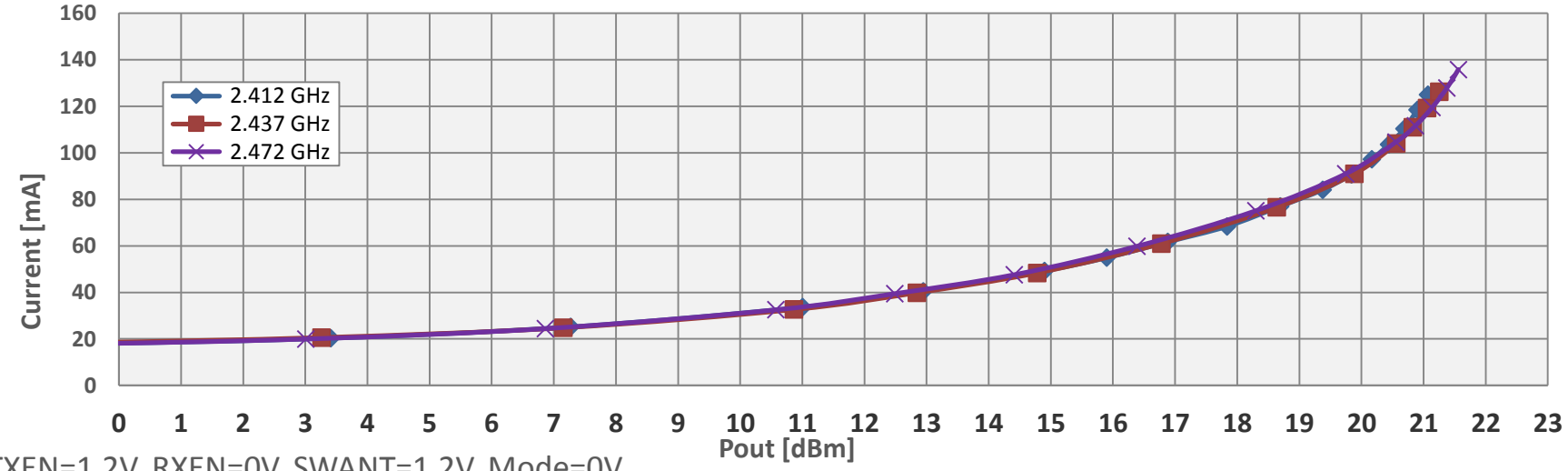
EVB Signal Loss De-Embedding

RF Signal	Loss
ANT	.22 dB
TX	.22 dB
RX	.22 dB

Total EVB Loss Includes the Trace and Connector

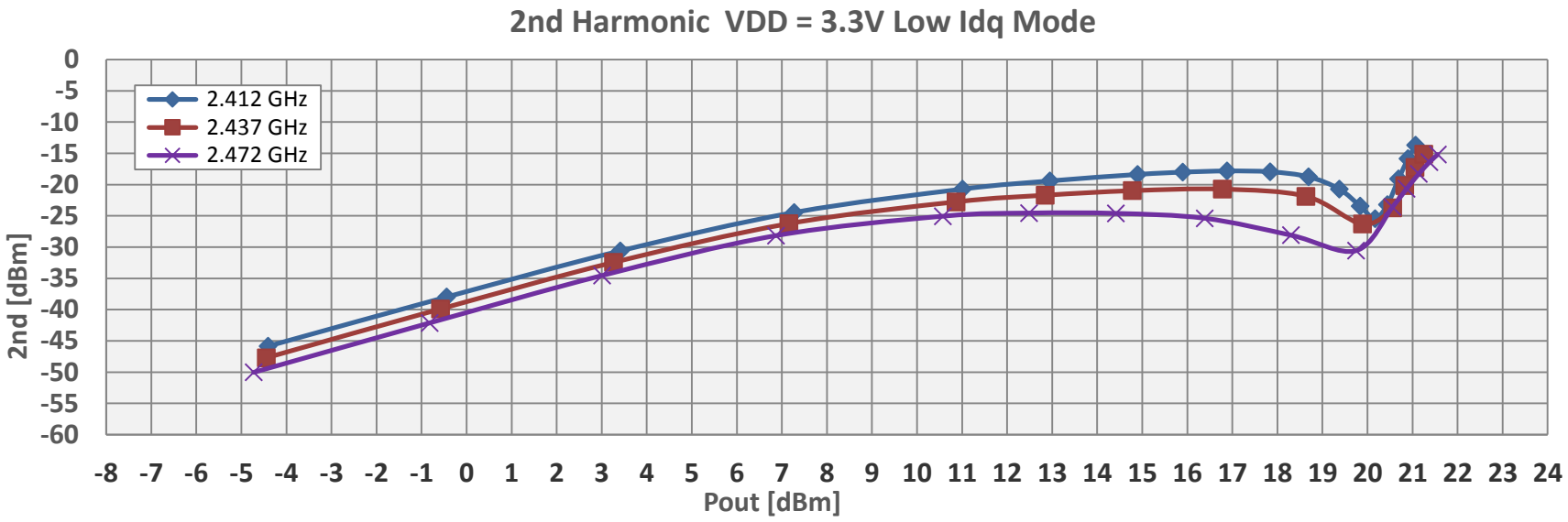
TX Large Signal Gain & Current vs. Pout Across Frequency
Antenna A, Low Idq Mode, CW Signal

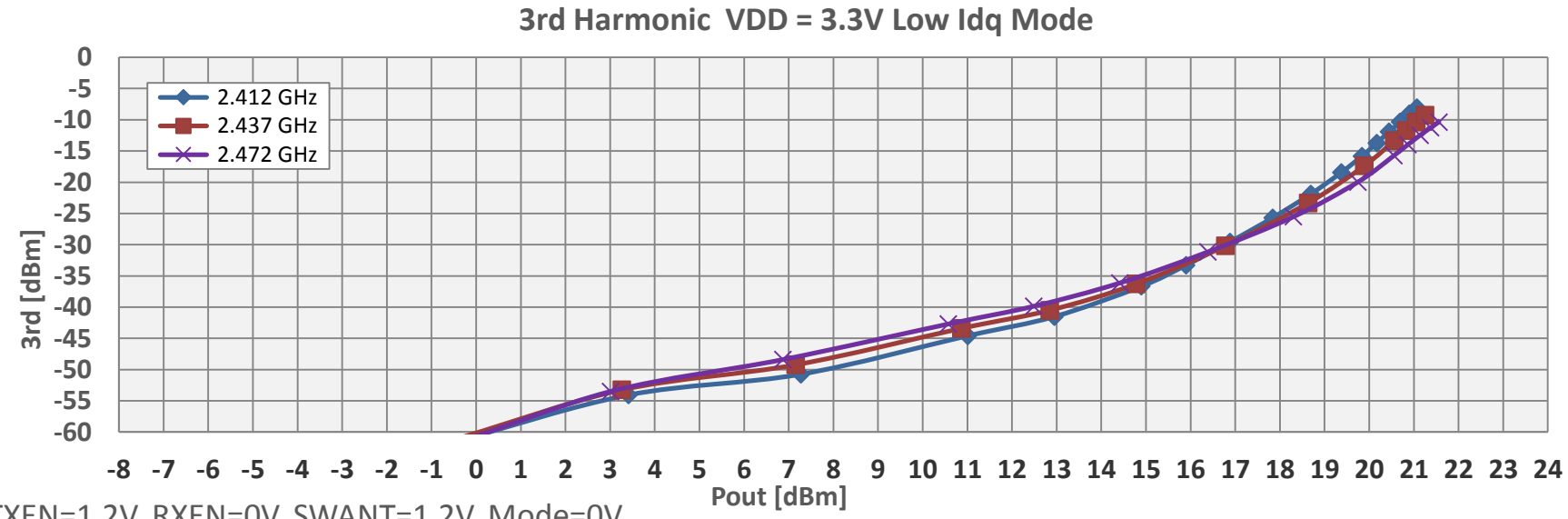




TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

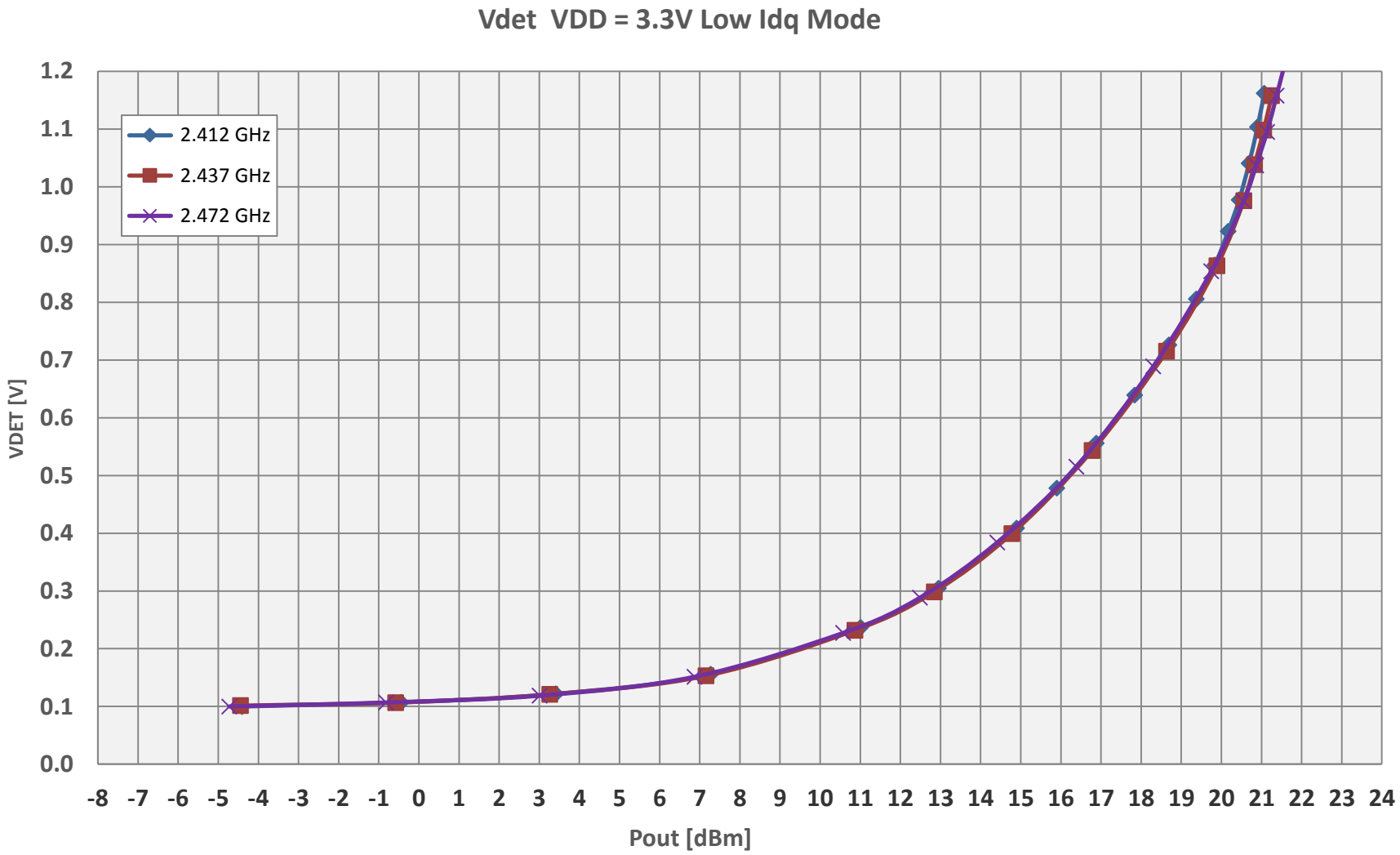
TX Large Signal 2nd and 3rd Harmonic Across Frequency
Antenna A, Low Idq Mode, CW Signal





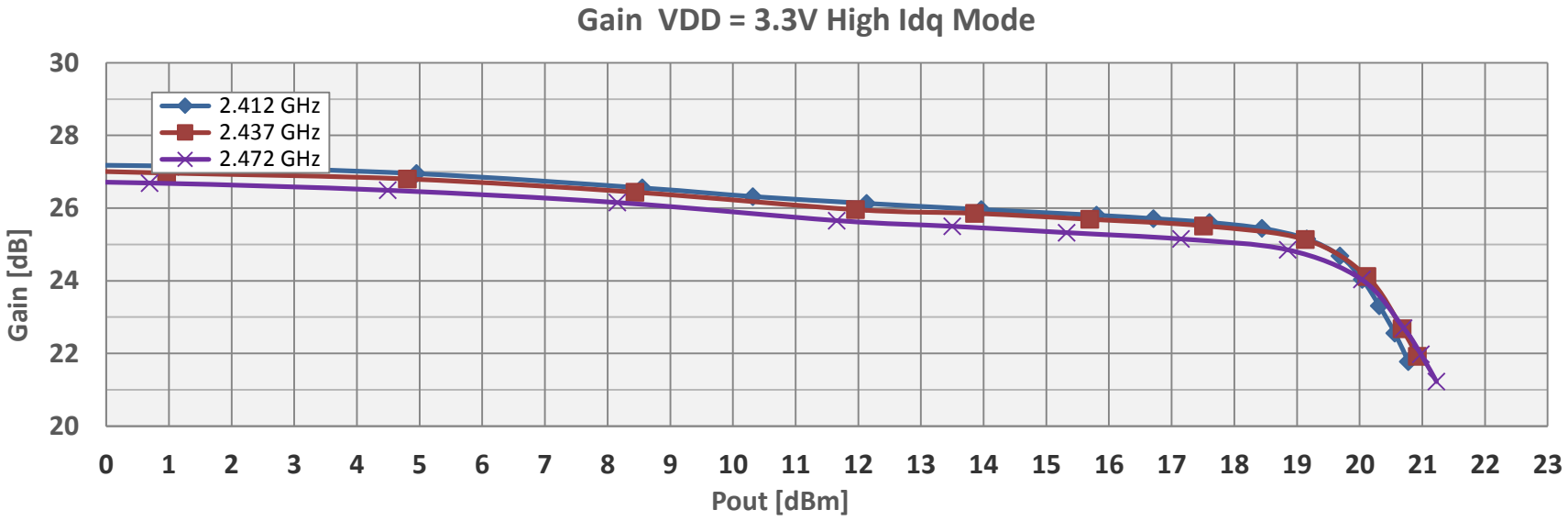
TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

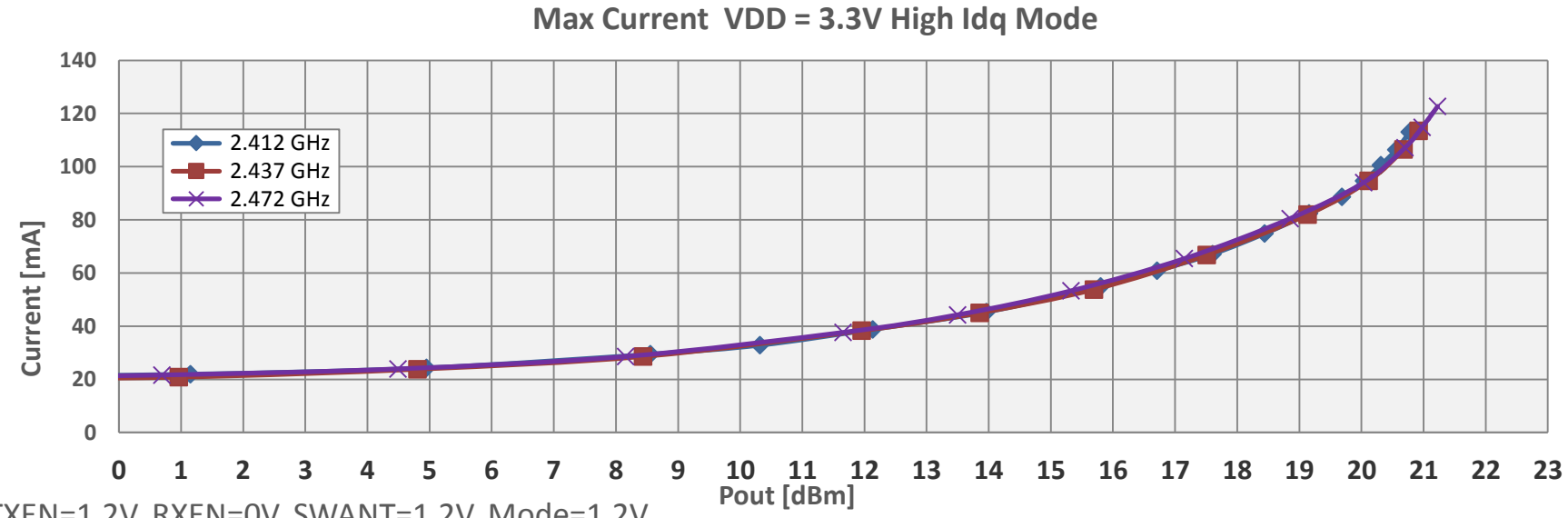
TX Large Signal Detector Voltage vs. Pout Across Frequency
Antenna A, Low Idq Mode, CW Signal



TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

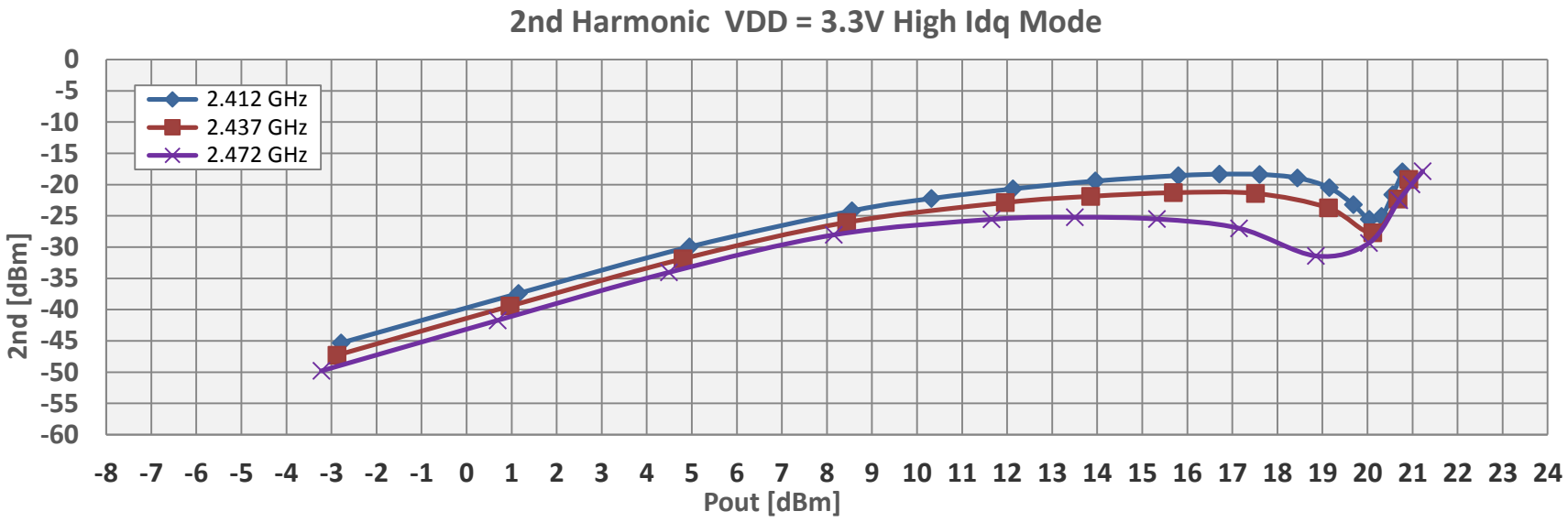
TX Large Signal Gain & Current vs. Pout Across Frequency
Antenna A, High Idq Mode, CW Signal

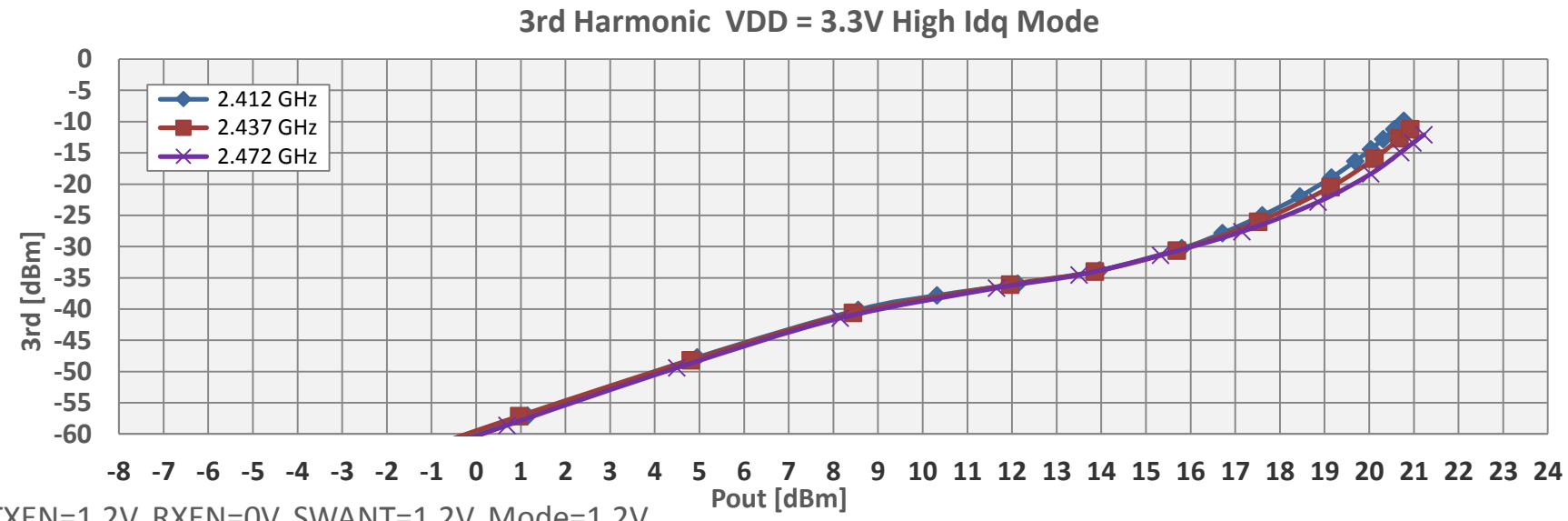




TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

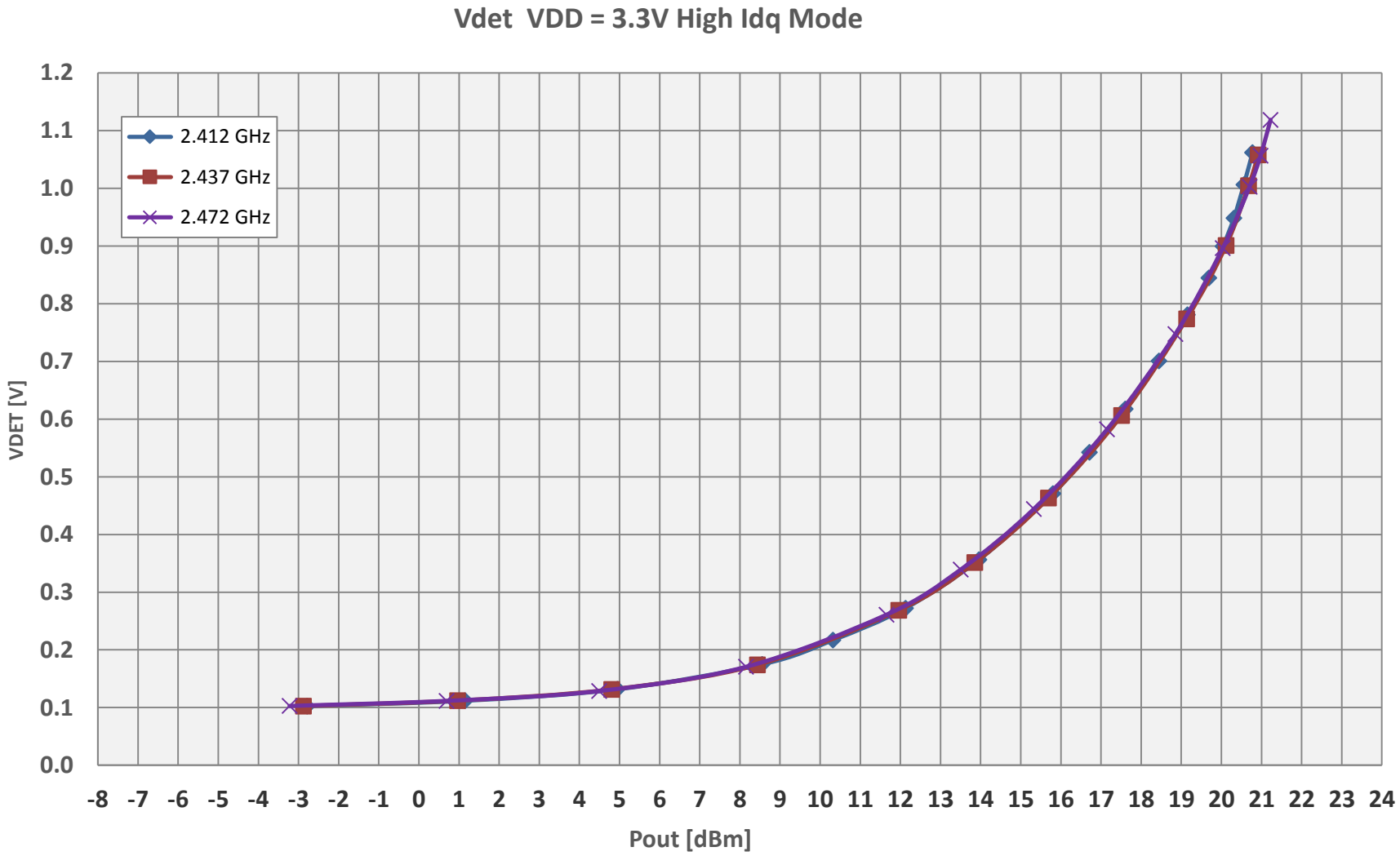
TX Large Signal 2nd and 3rd Harmonic Across Frequency Antenna A, High Idq Mode, CW Signal





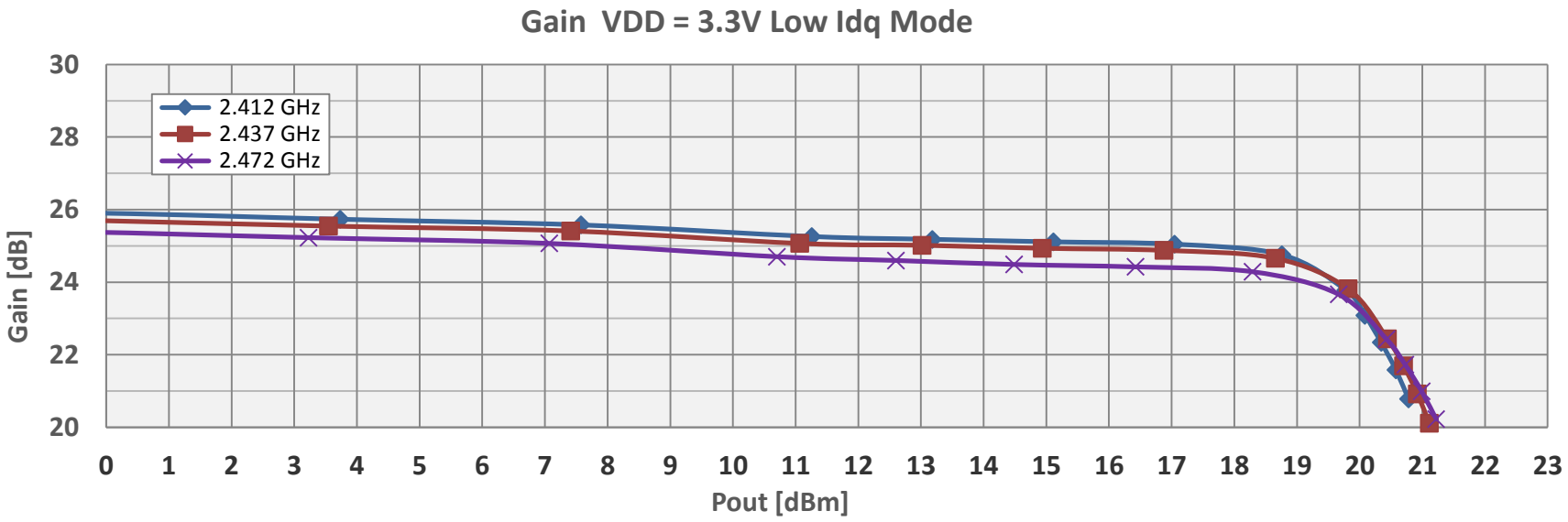
TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

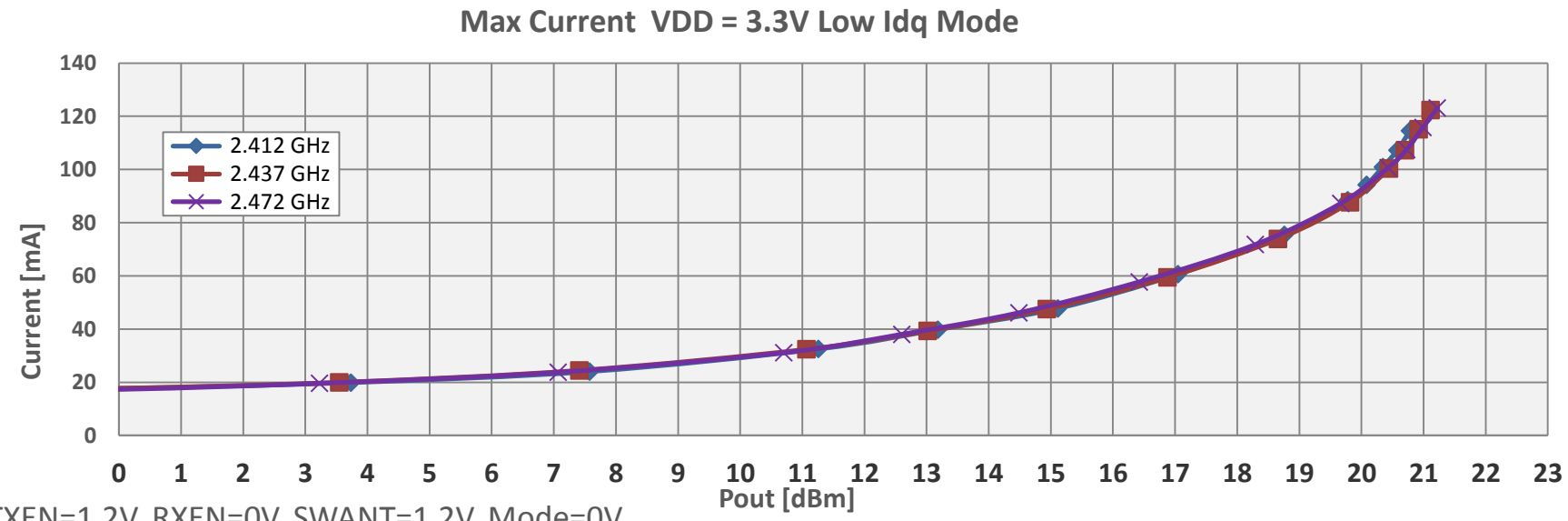
TX Large Signal Detector Voltage vs. Pout Across Frequency
Antenna A, High Idq Mode, CW Signal



TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

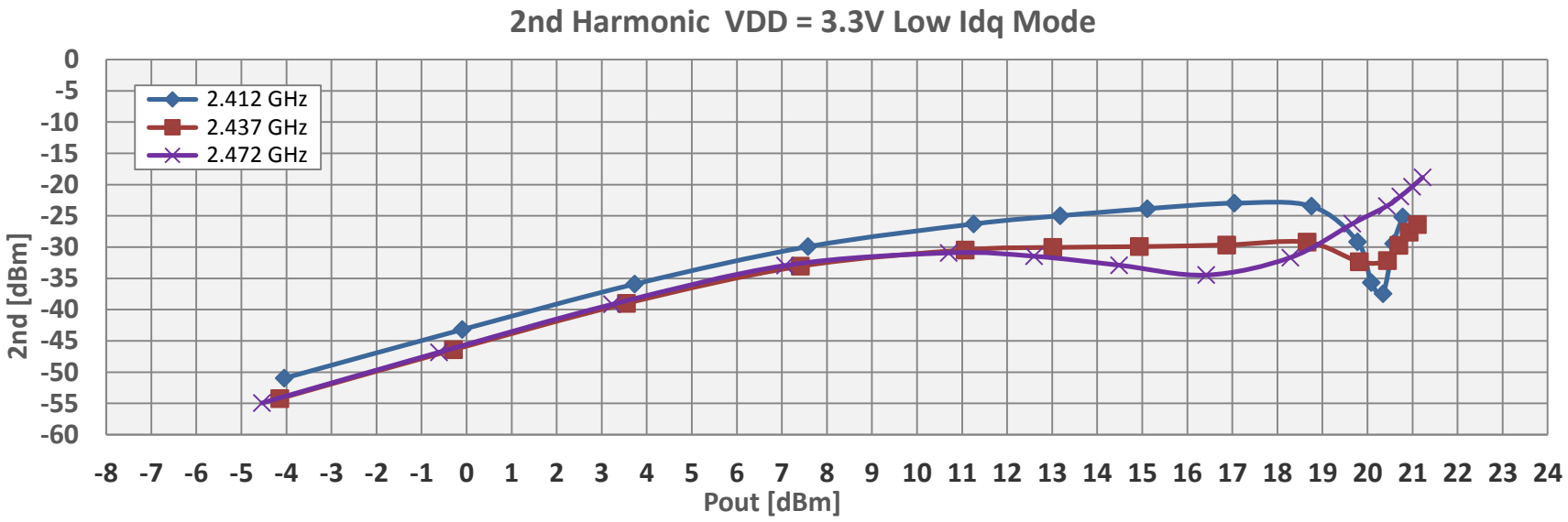
TX Large Signal Gain & Current vs. Pout Across Frequency
Antenna B, Low Idq Mode, CW Signal

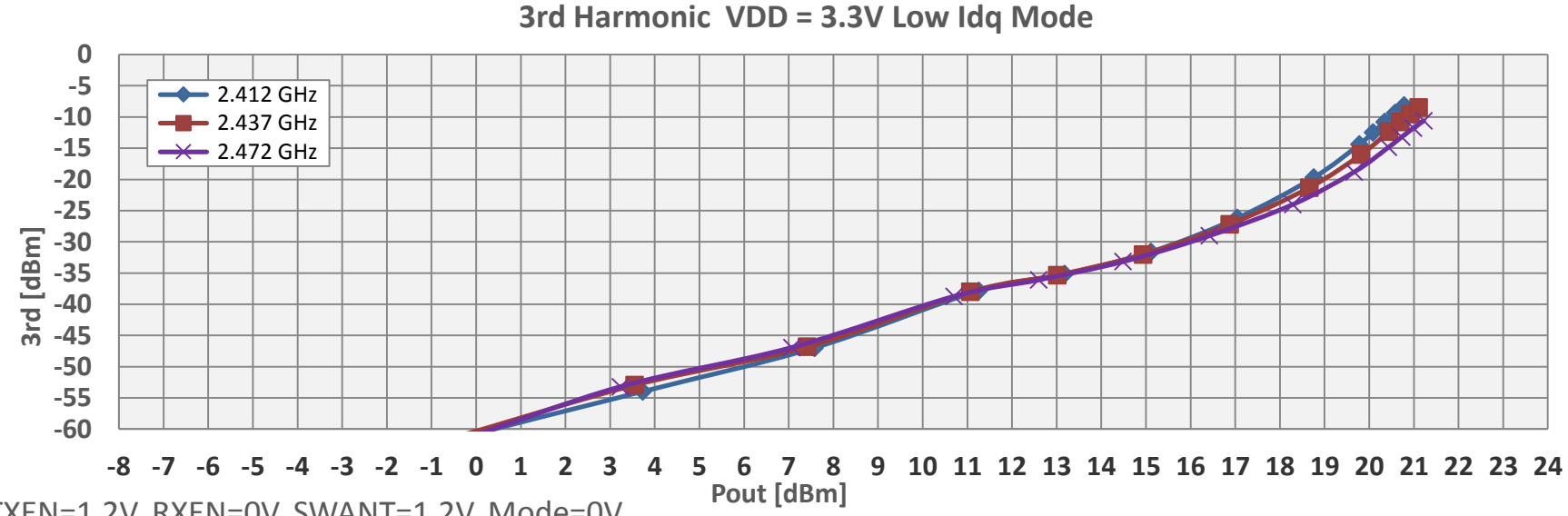




TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

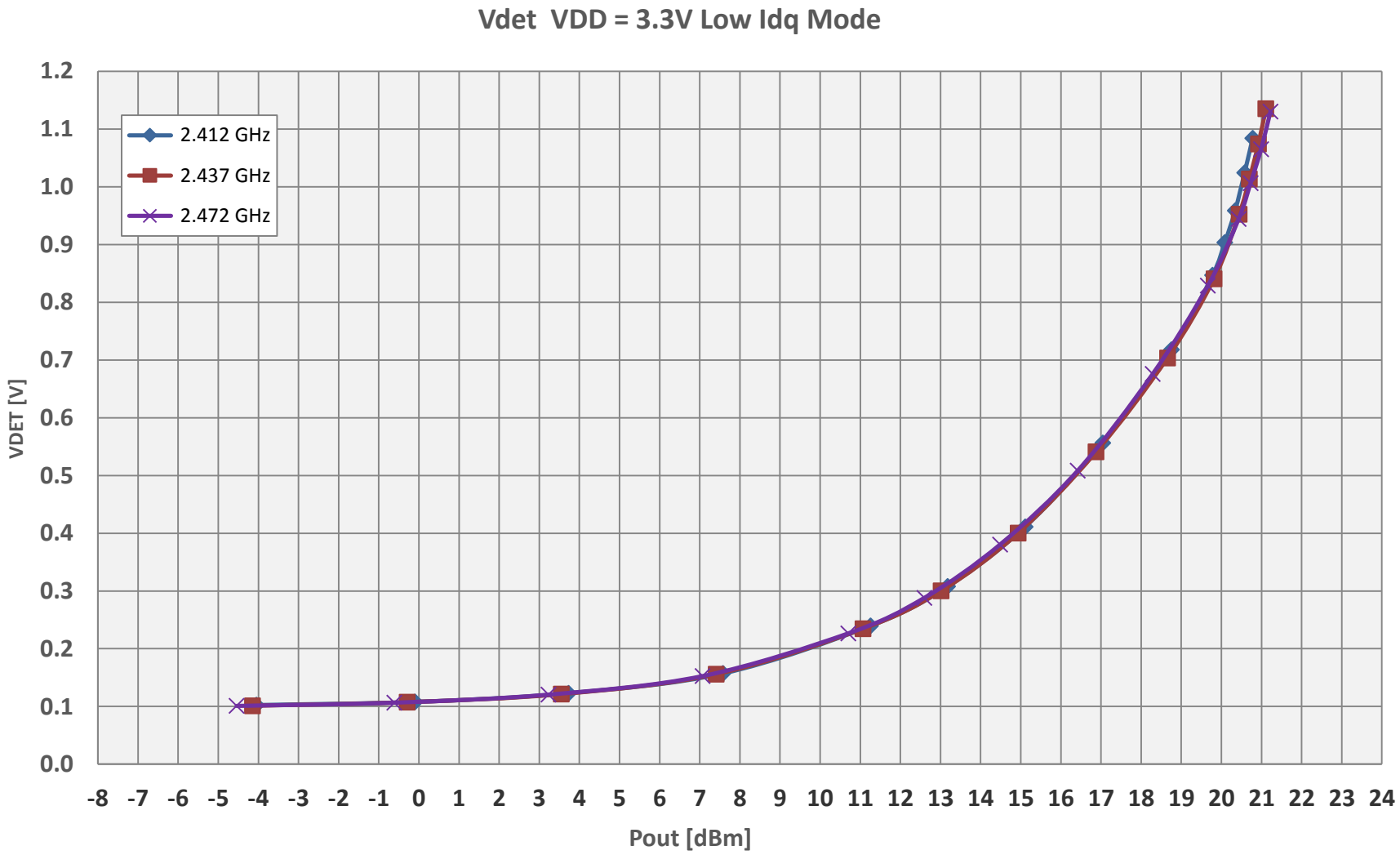
TX Large Signal 2nd and 3rd Harmonic Across Frequency
Antenna B, Low Idq Mode, CW Signal





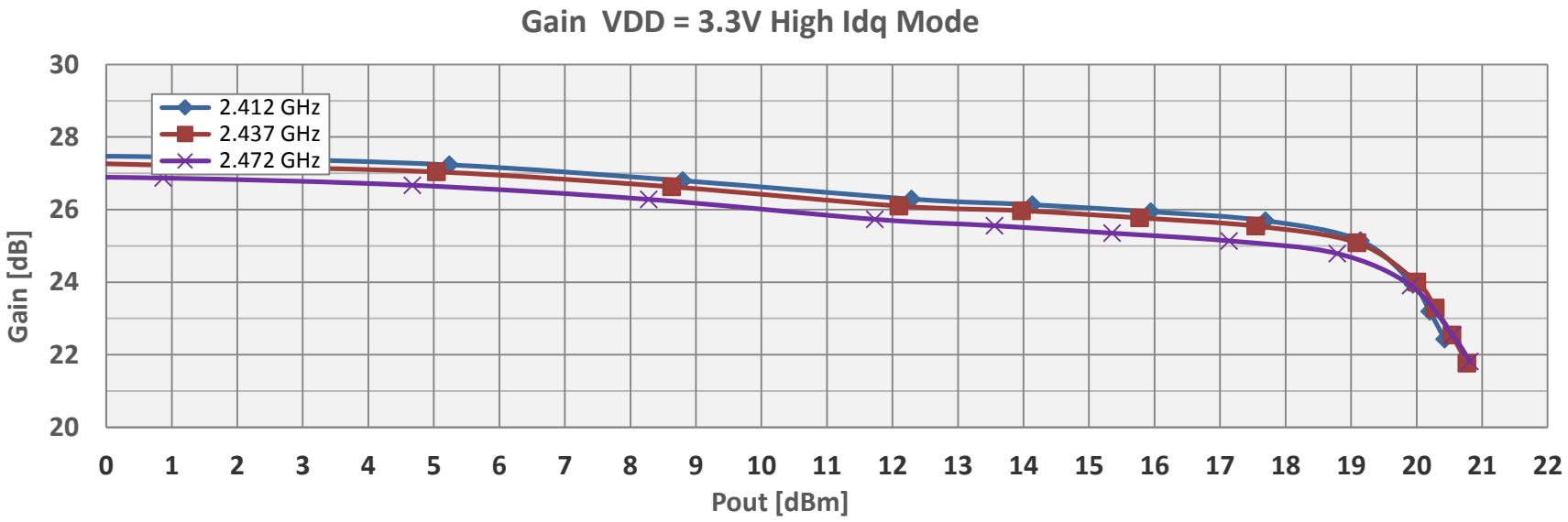
TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

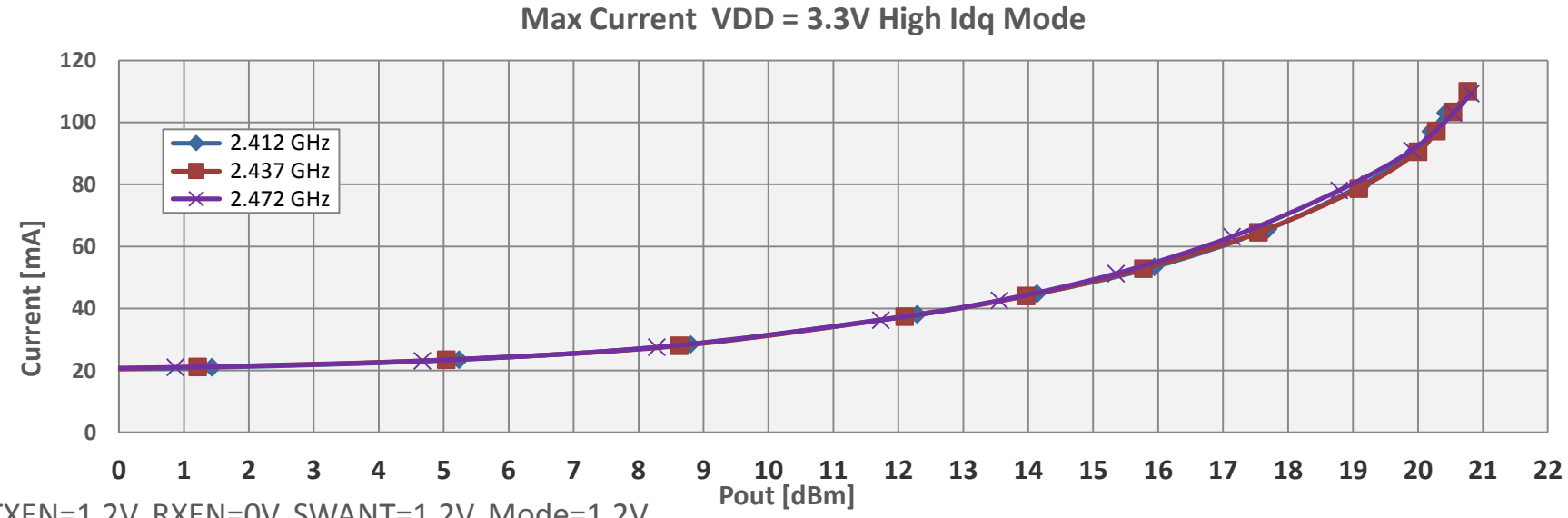
TX Large Signal Detector Voltage vs. Pout Across Frequency
Antenna B, Low Idq Mode, CW Signal



TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=0V

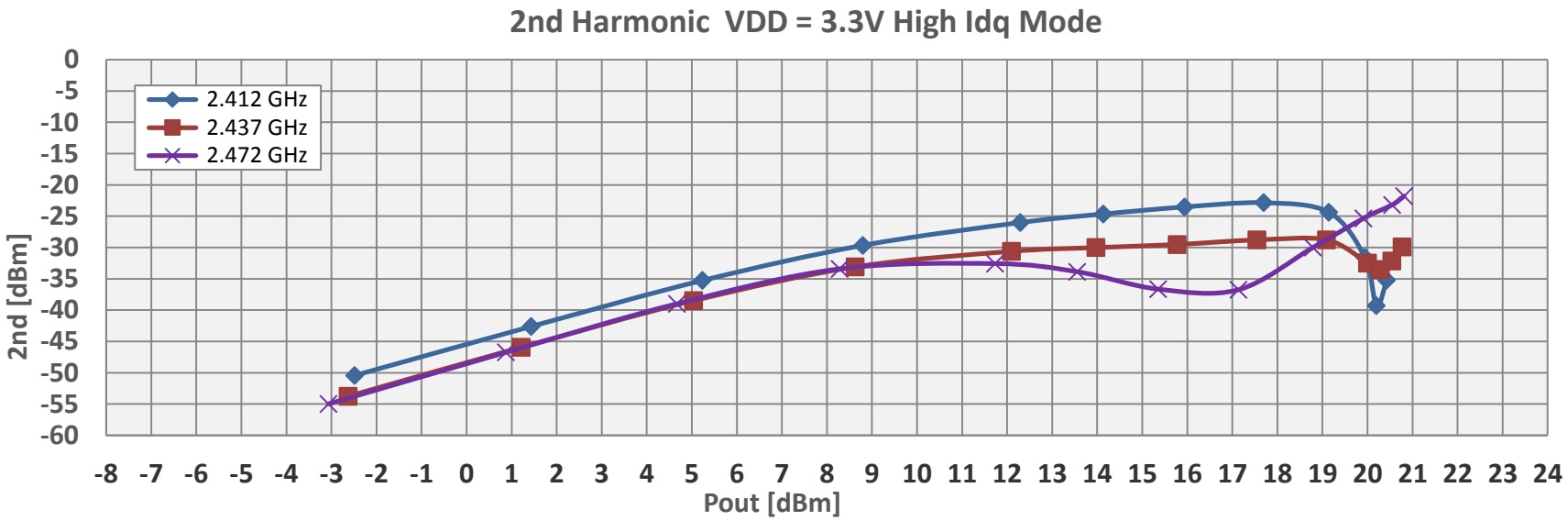
TX Large Signal Gain & Current vs. Pout Across Frequency
Antenna B, High Idq Mode, CW Signal

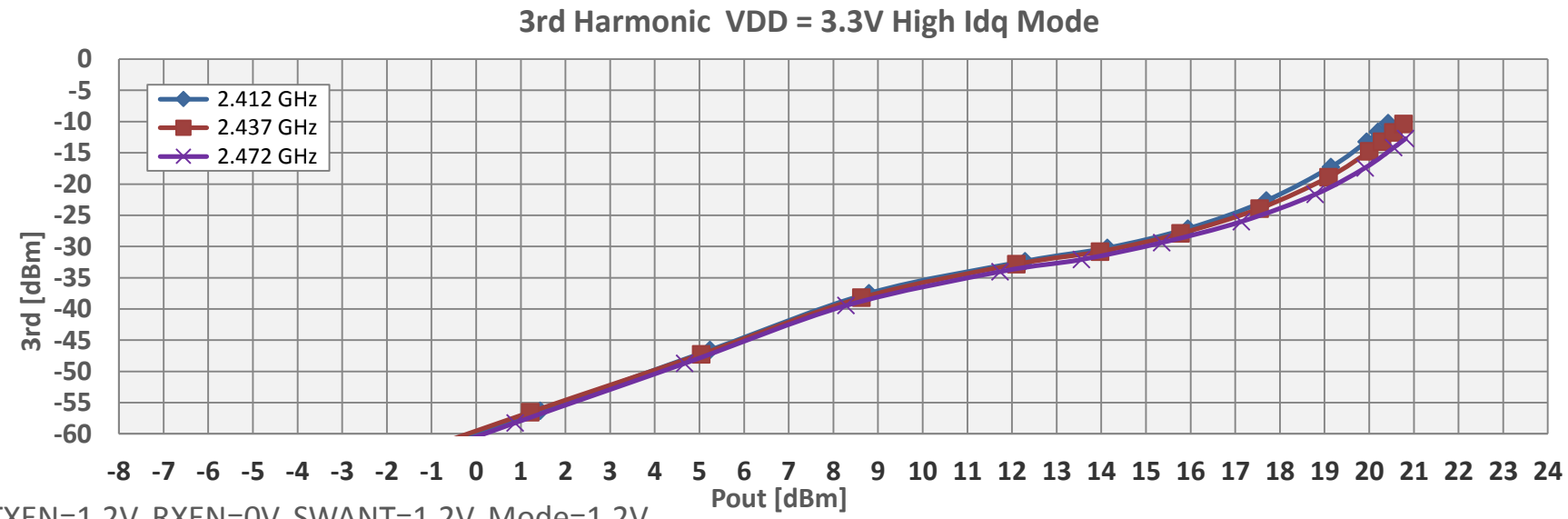




TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

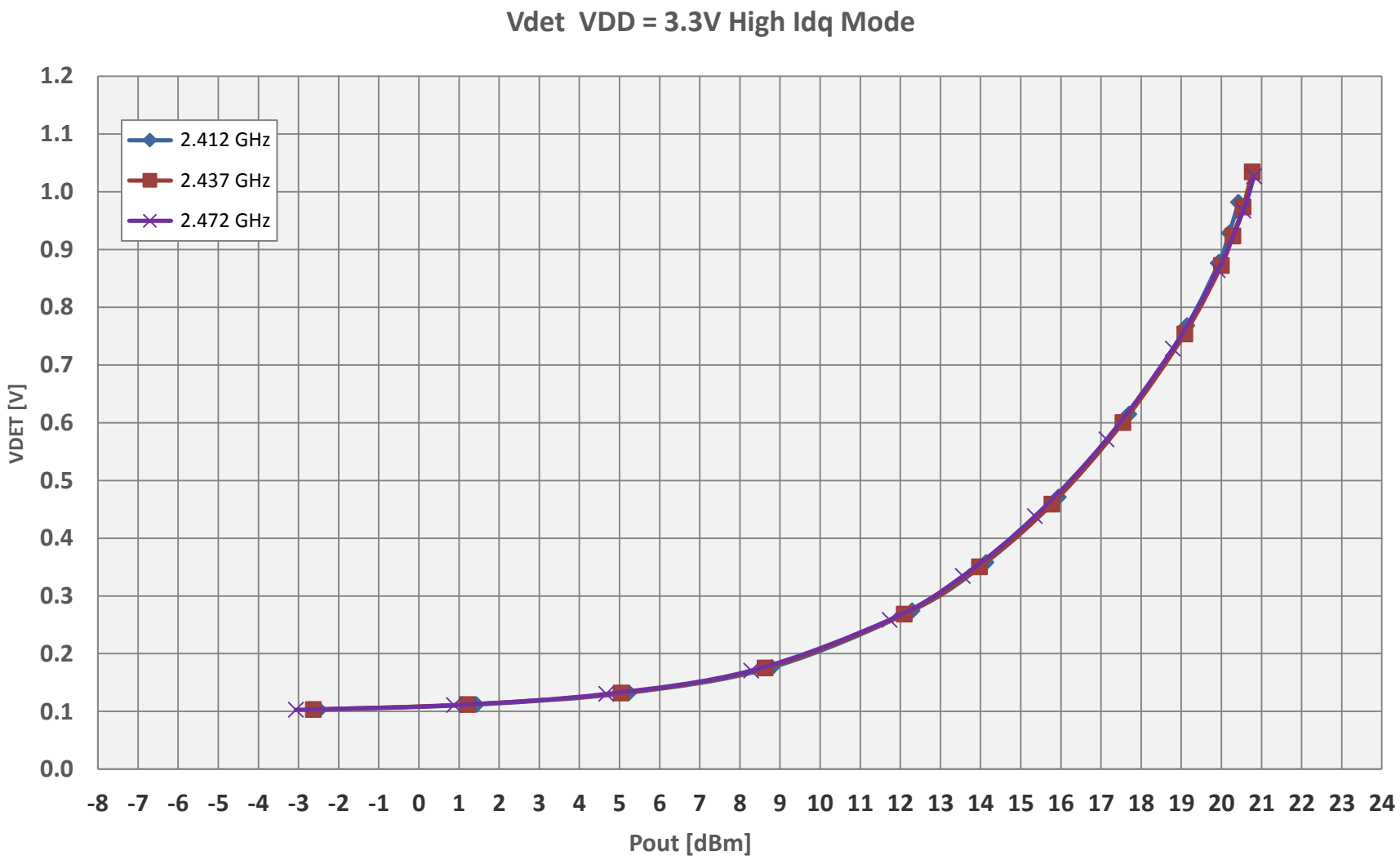
TX Large Signal 2nd and 3rd Harmonic Across Frequency Antenna B, High Idq Mode, CW Signal





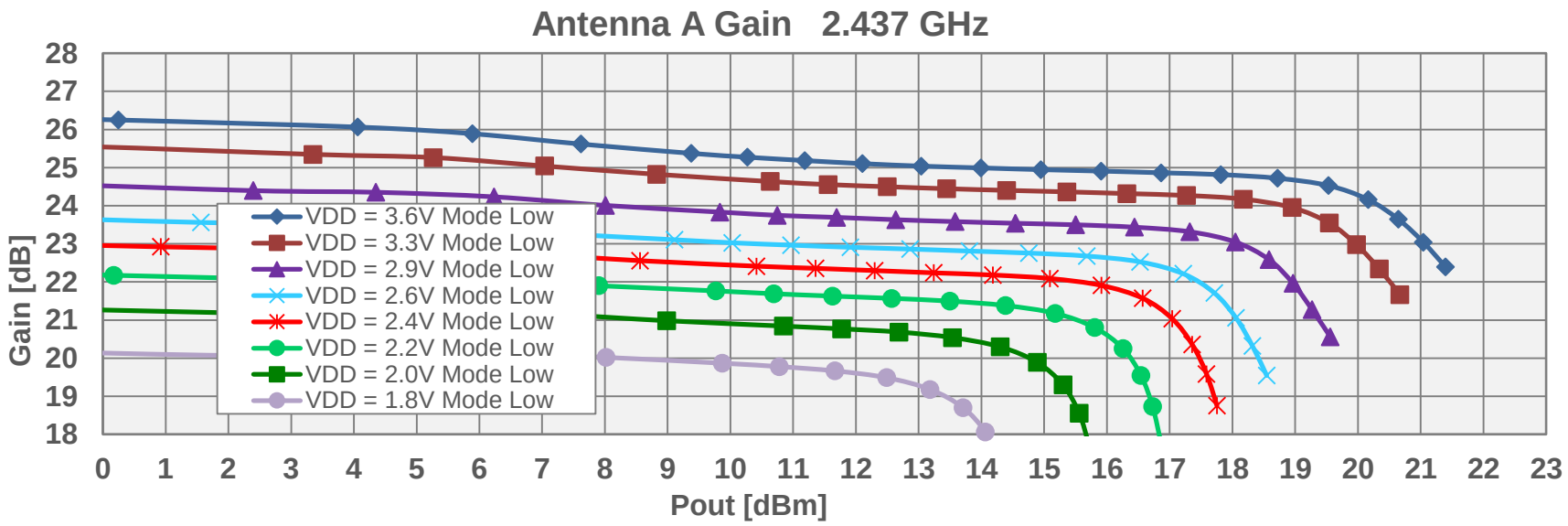
TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

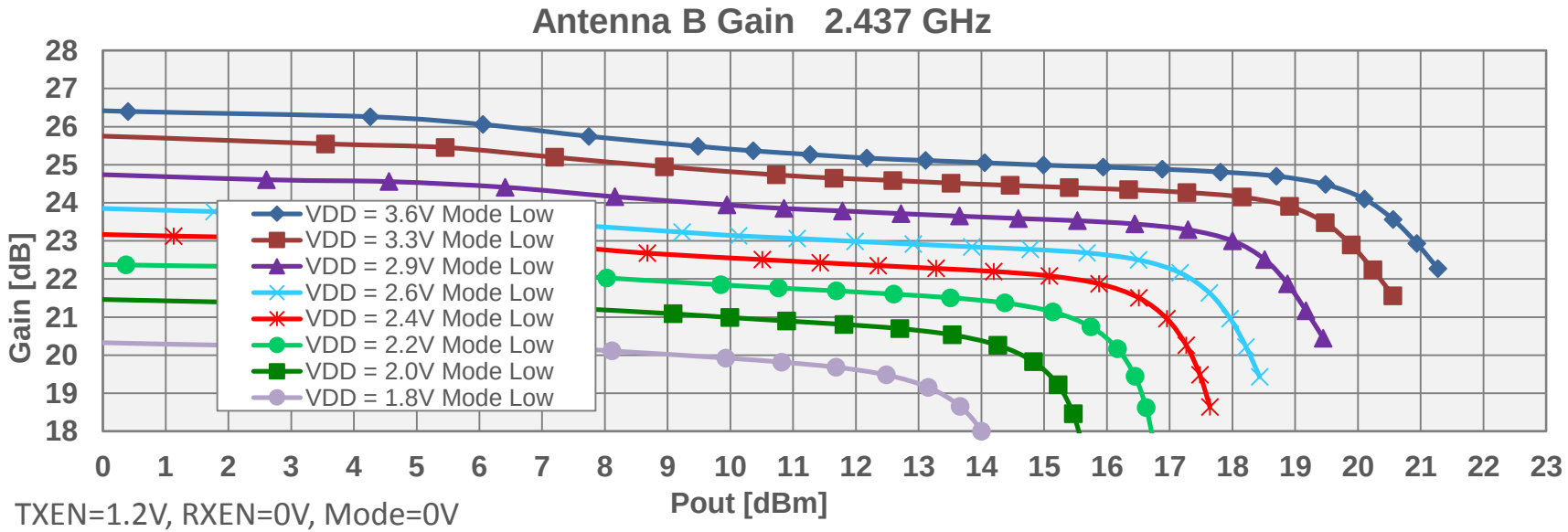
TX Large Signal Detector Voltage vs. Pout Across Frequency
Antenna B, High Idq Mode, CW Signal



TXEN=1.2V, RXEN=0V, SWANT=1.2V, Mode=1.2V

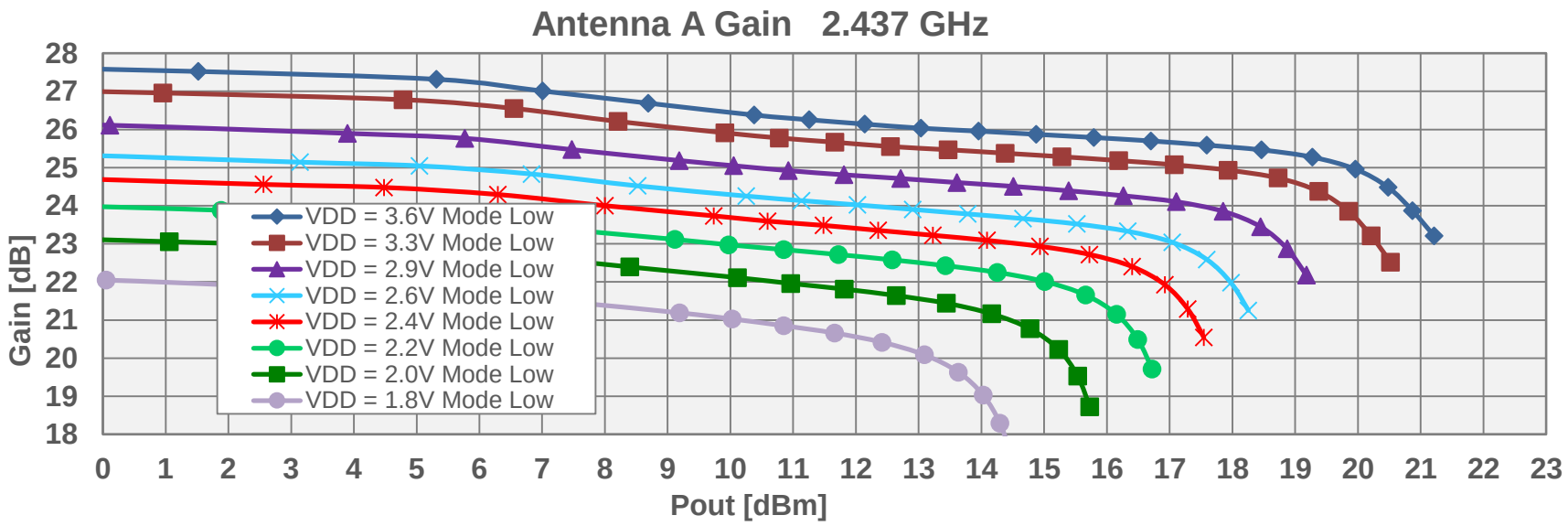
TX Large Signal Gain & Current vs. Pout Across VDD
2.437 GHz, Low Idq Mode, CW Signal

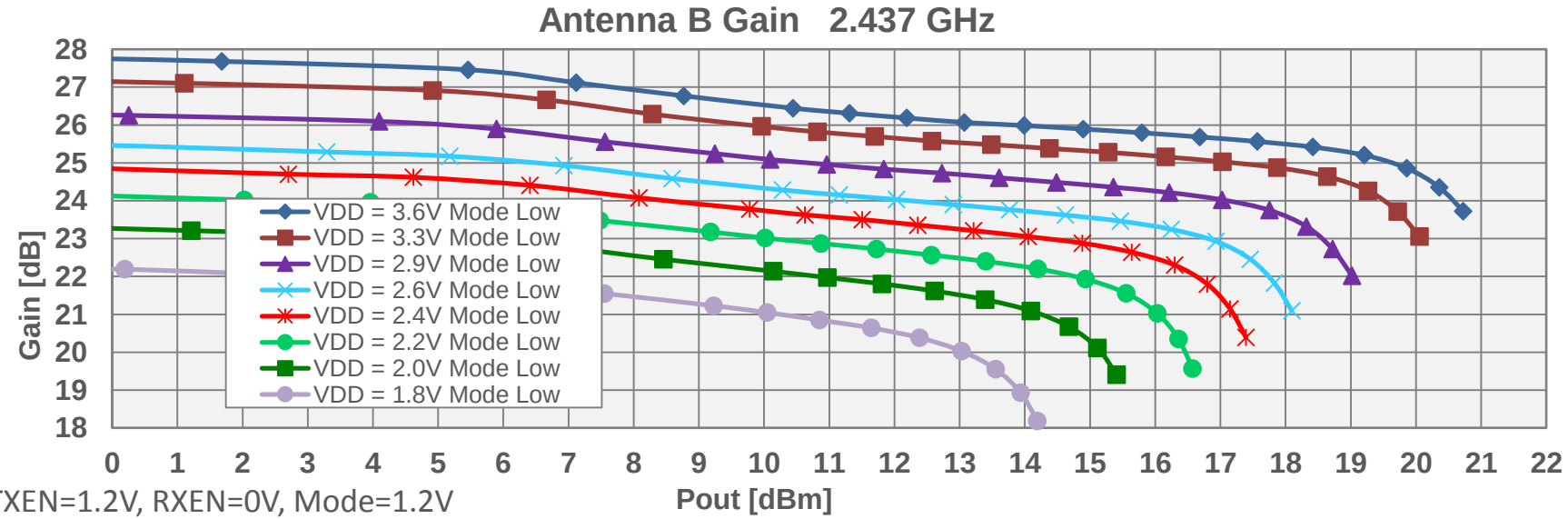




TXEN=1.2V, RXEN=0V, Mode=0V

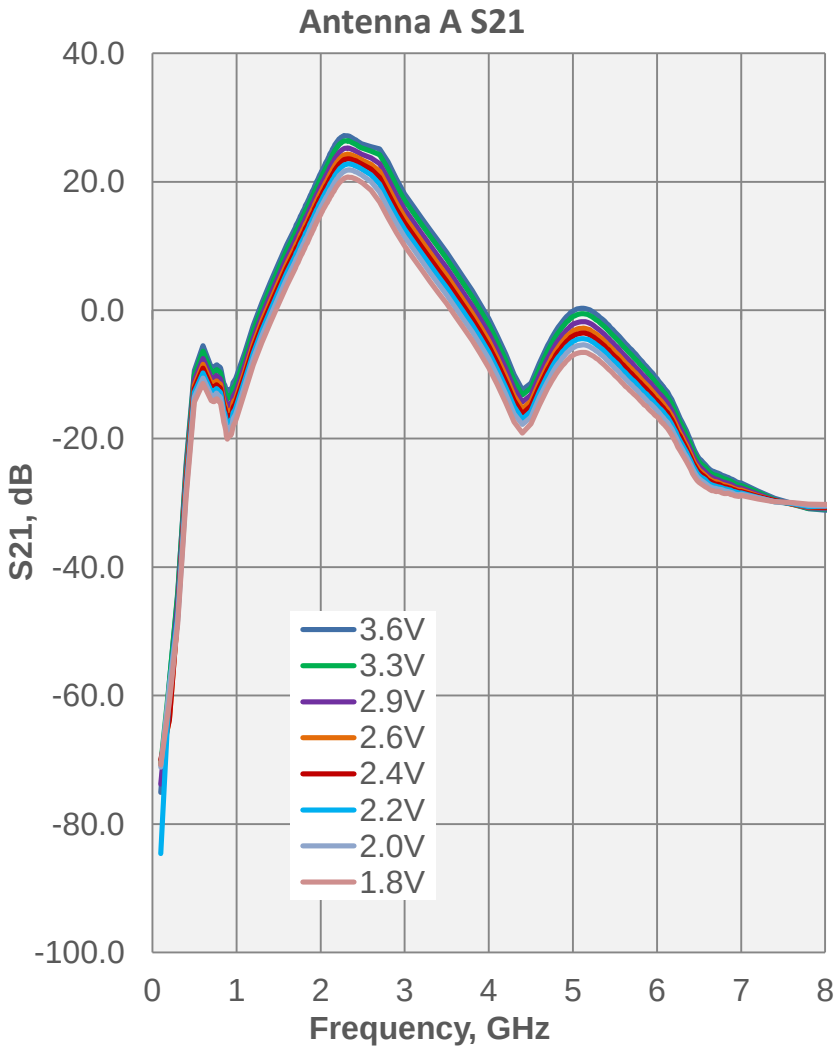
TX Large Signal Gain & Current vs. Pout Across VDD
2.437 GHz, High Idq Mode, CW Signal

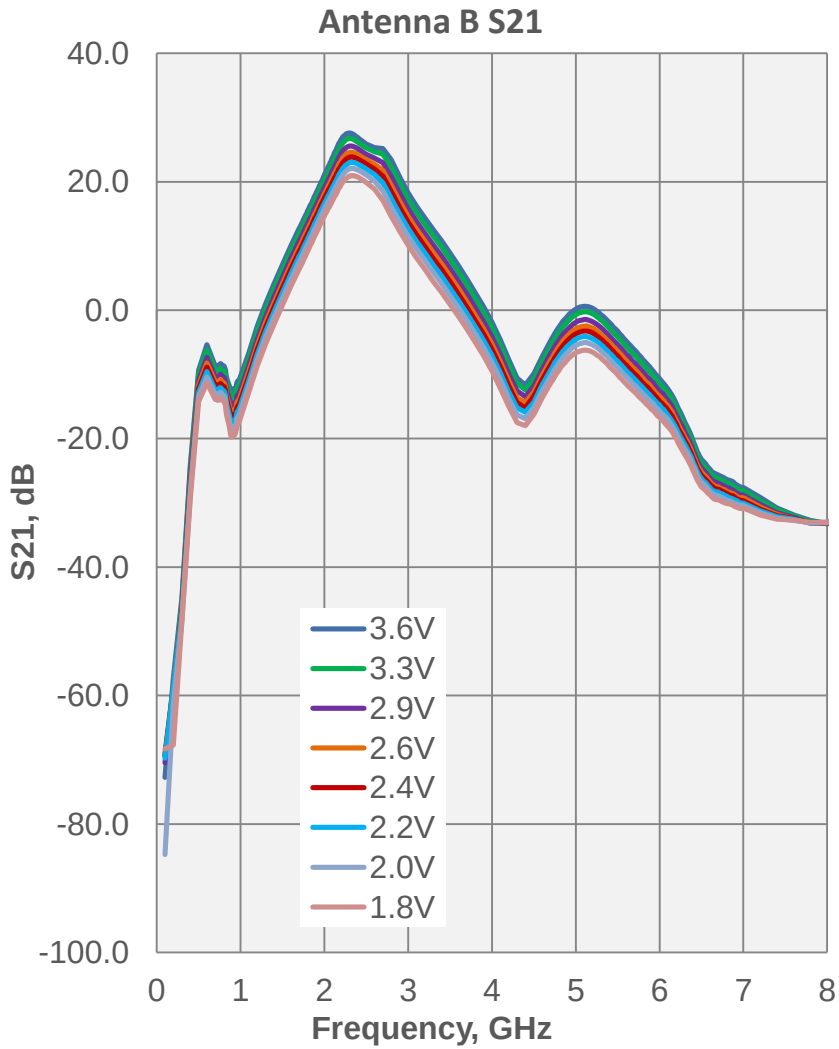




TXEN=1.2V, RXEN=0V, Mode=1.2V

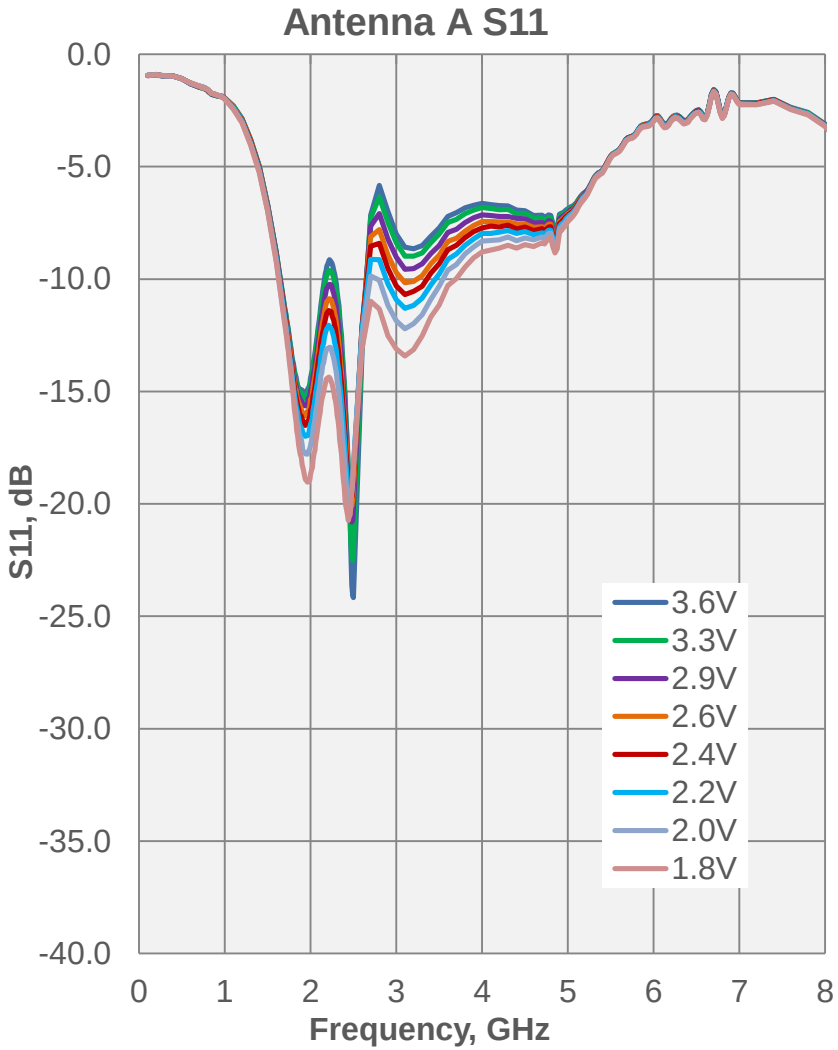
TX S-Parameters Across Voltage
Antenna A and B, Low Idq Mode

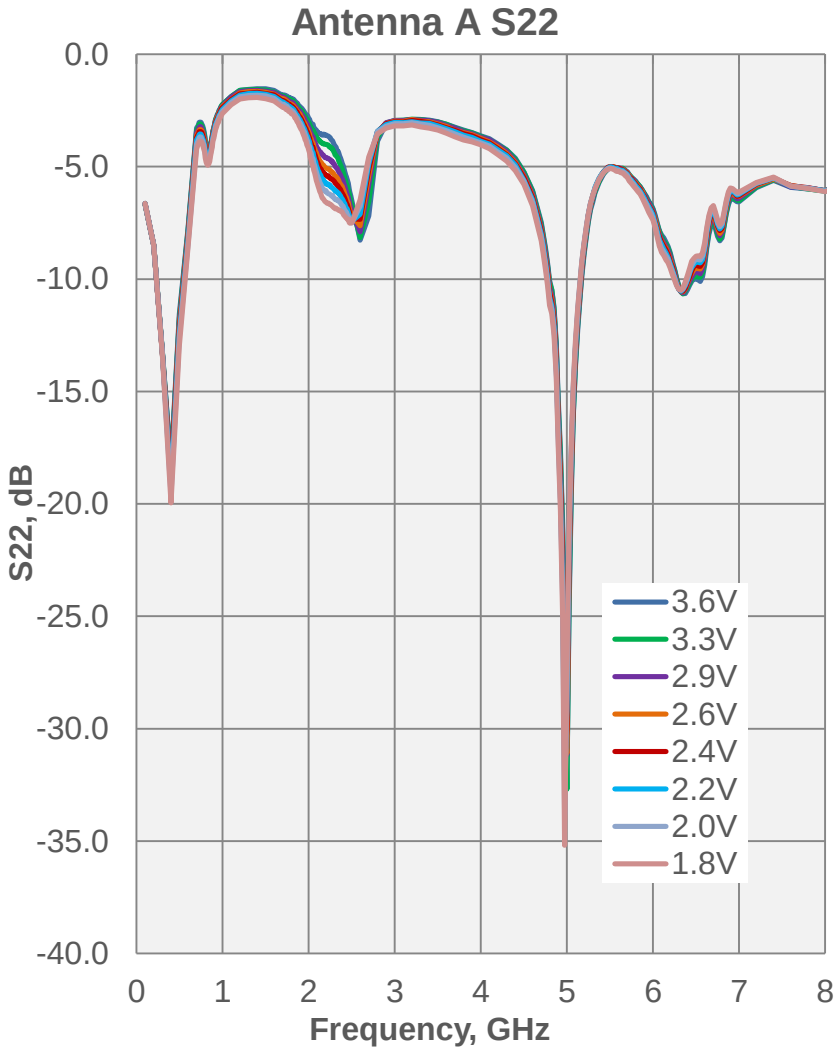




Idq ~ 15mA

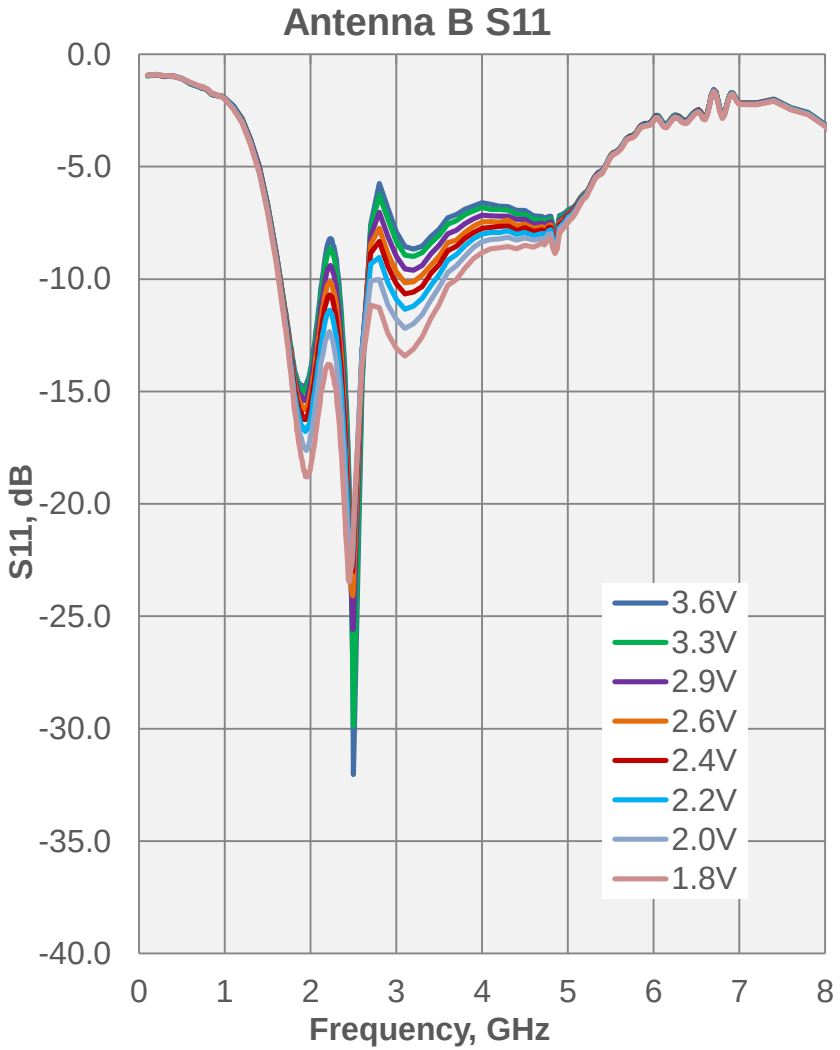
TX S-Parameters Across Voltage
Antenna A S11 and S22, Low Idq Mode

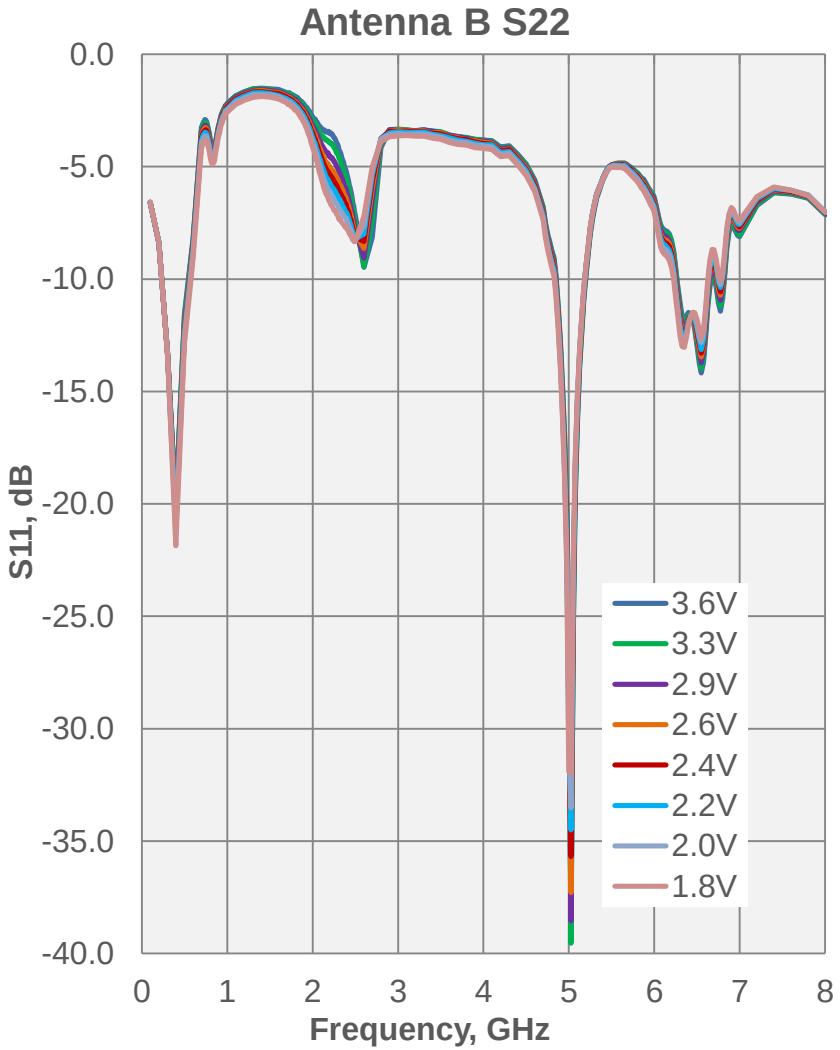




Idq ~ 15mA

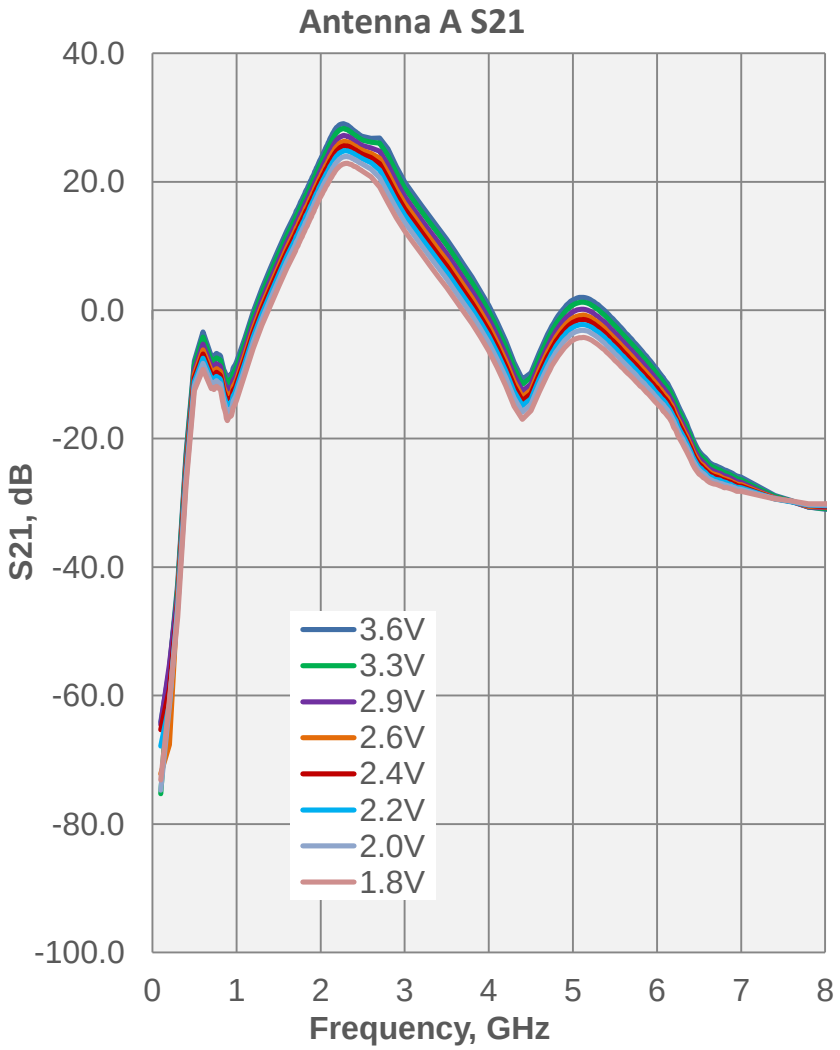
TX S-Parameters Across Voltage
Antenna B S11 and S22, Low Idq Mode

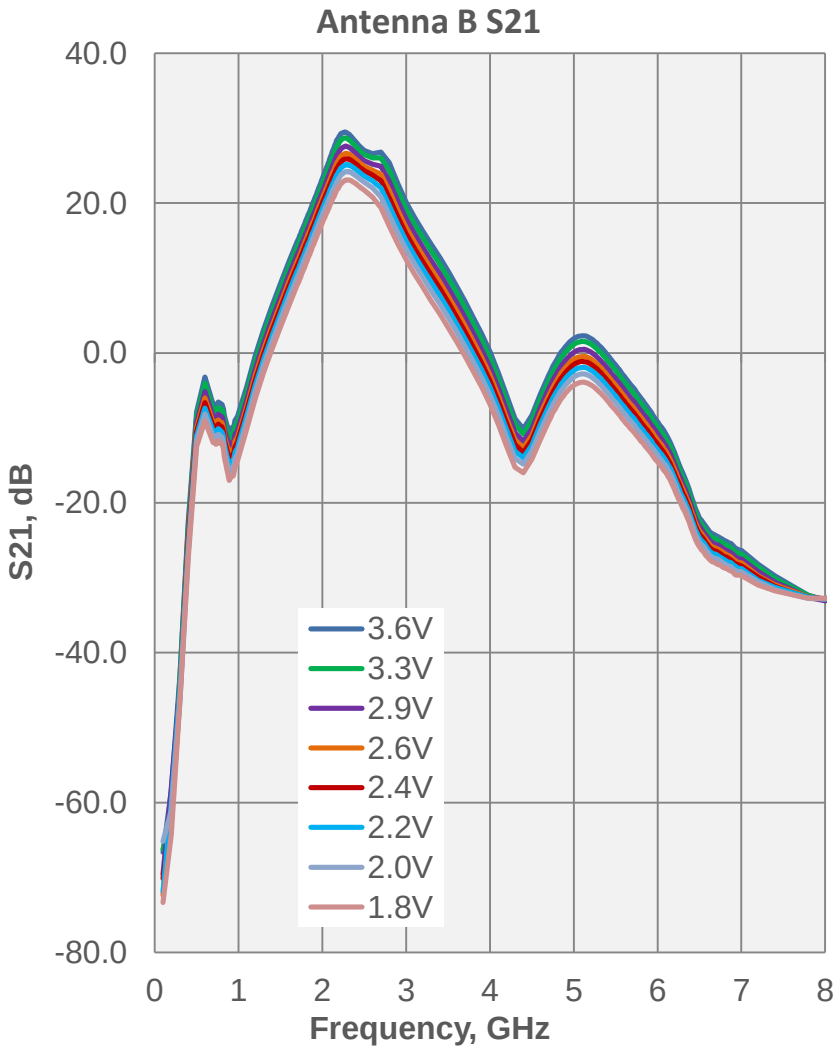




Idq ~ 15mA

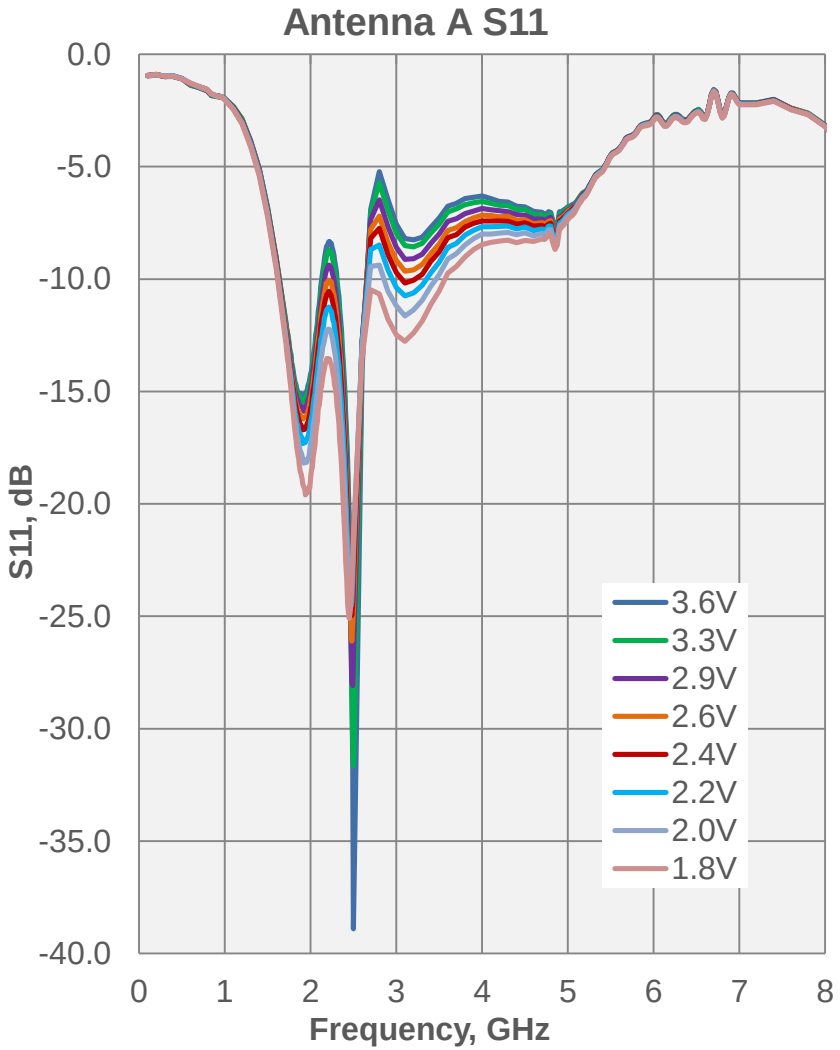
TX S-Parameters Across Voltage
Antenna A and B, High Idq Mode

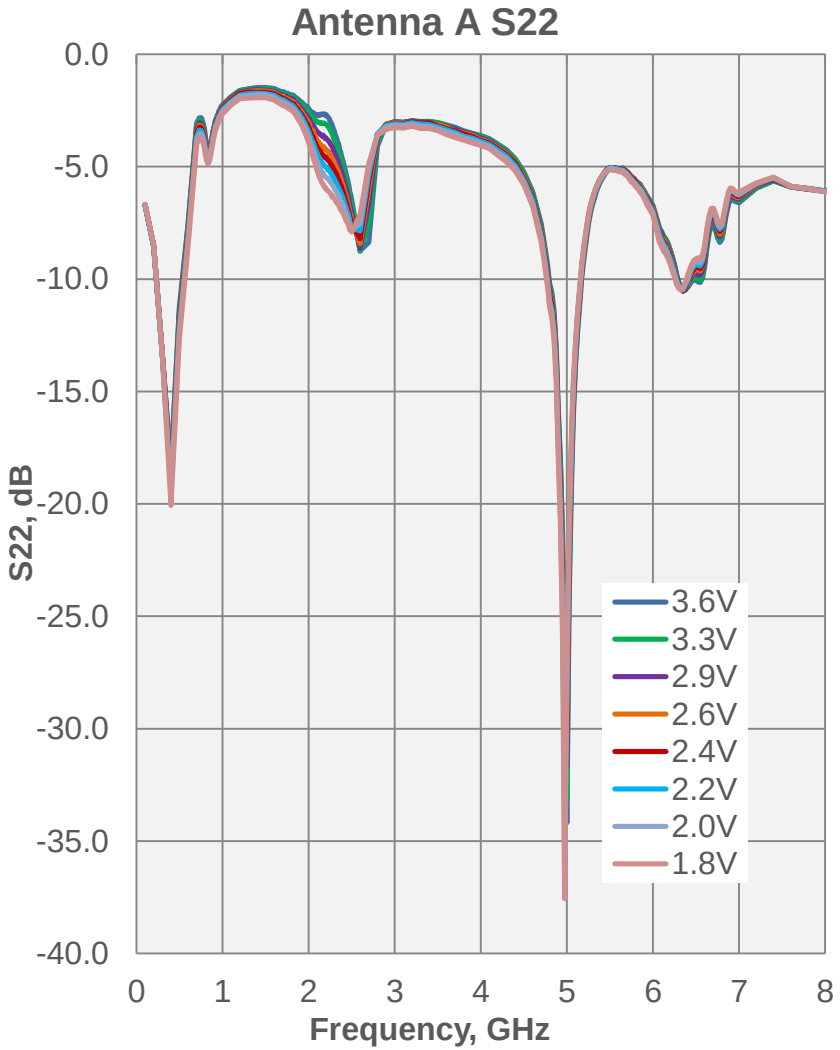




Idq ~ 18mA

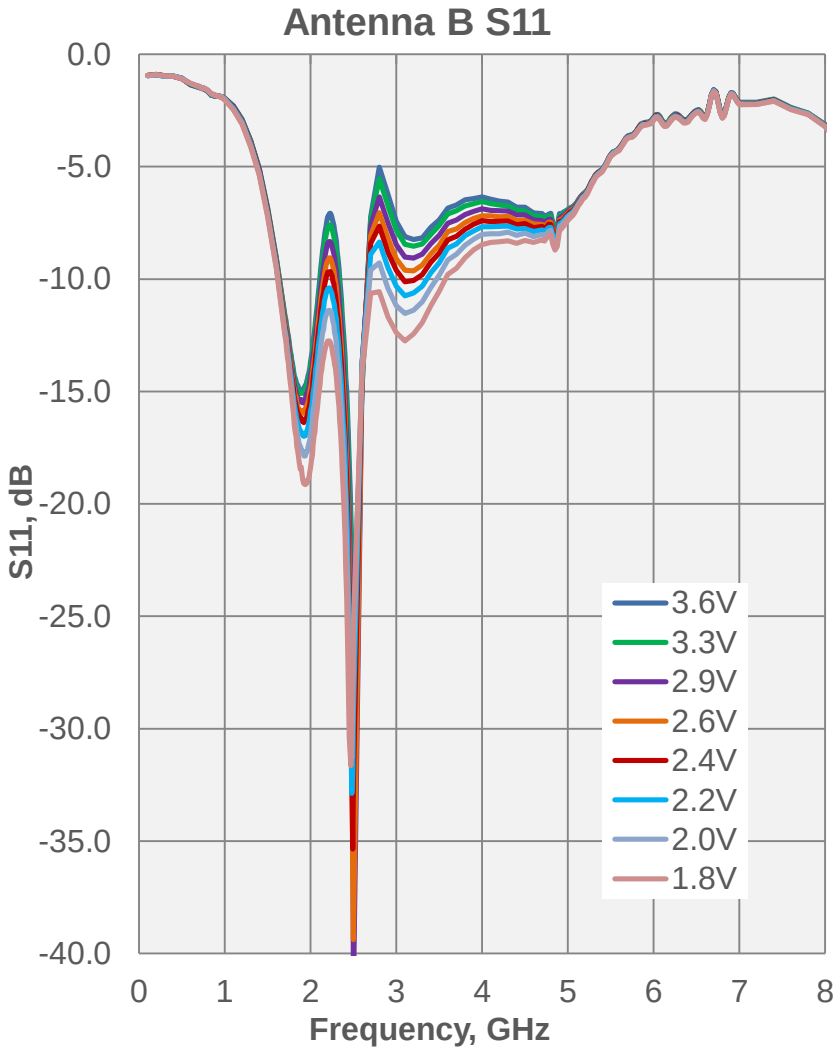
TX S-Parameters Across Voltage
Antenna A S11 and S22, High Idq Mode

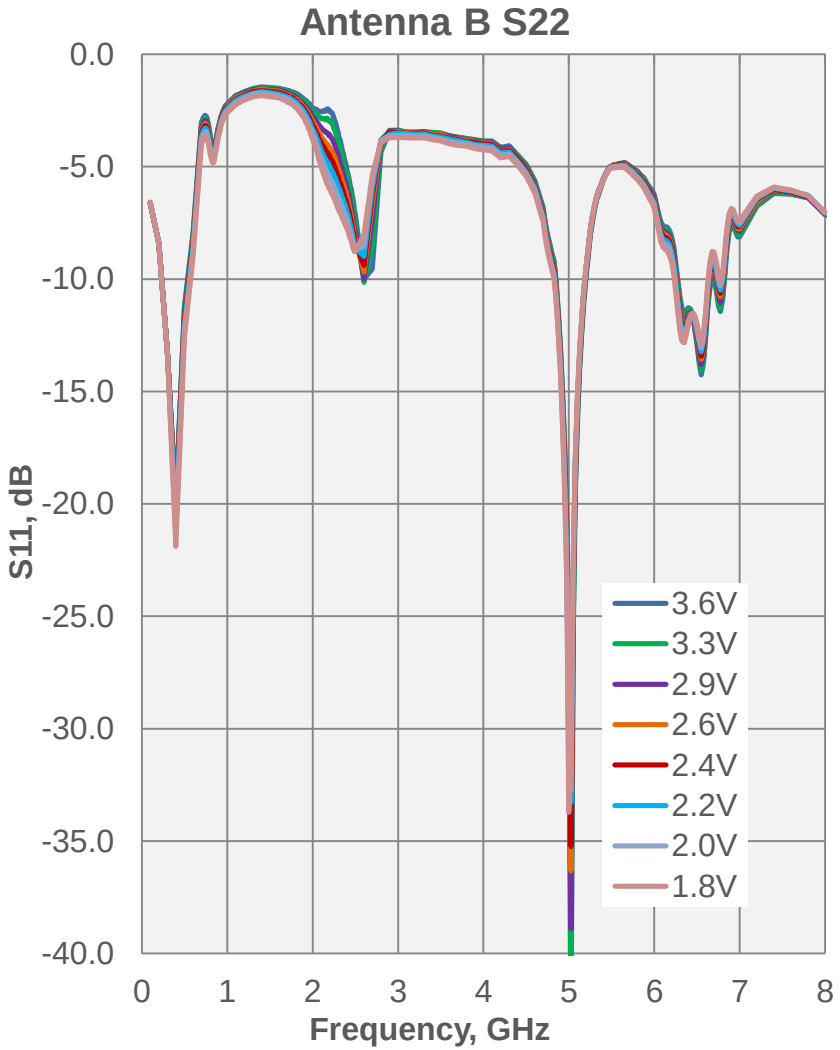




Idq ~ 18mA

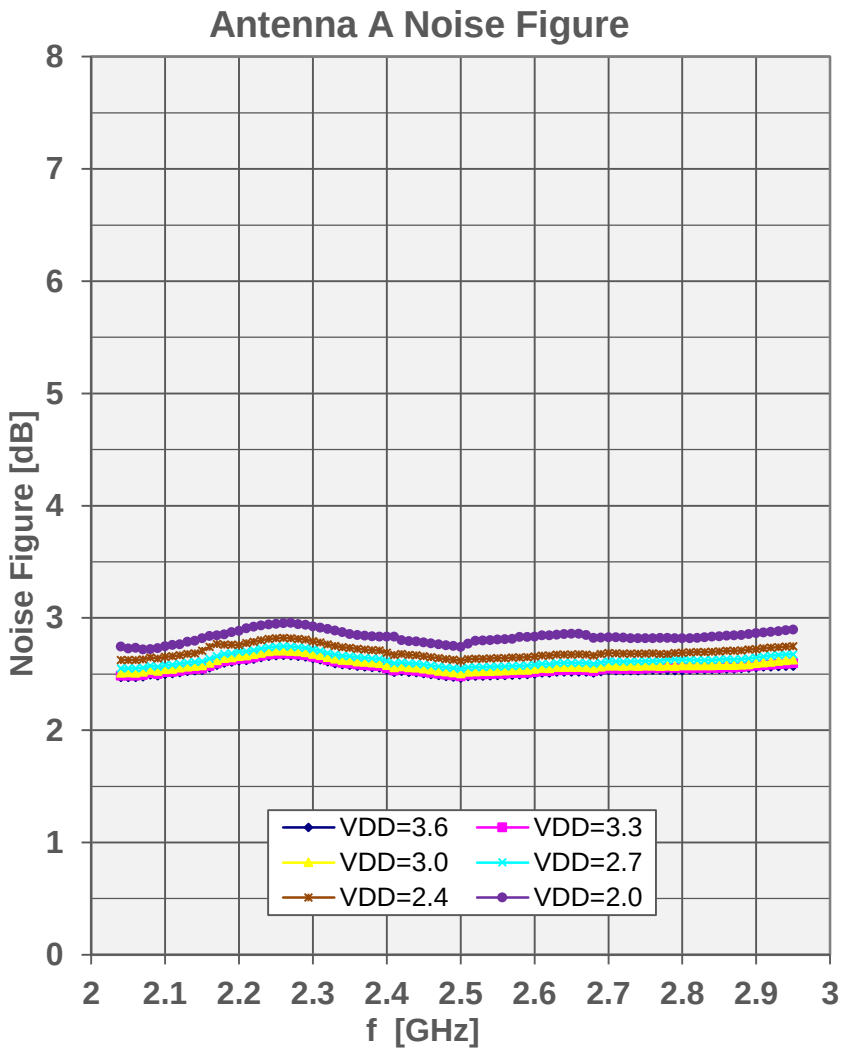
TX S-Parameters Across Voltage
Antenna B S11 and S22, High Idq Mode

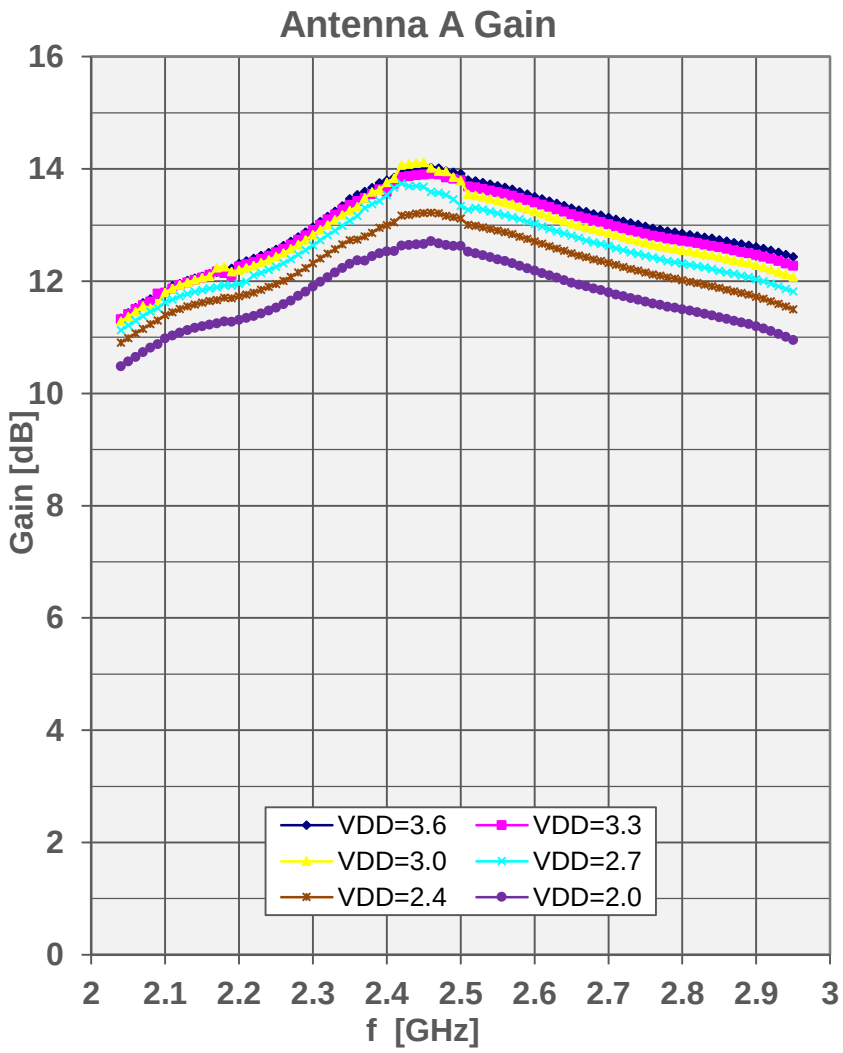




Idq ~ 18mA

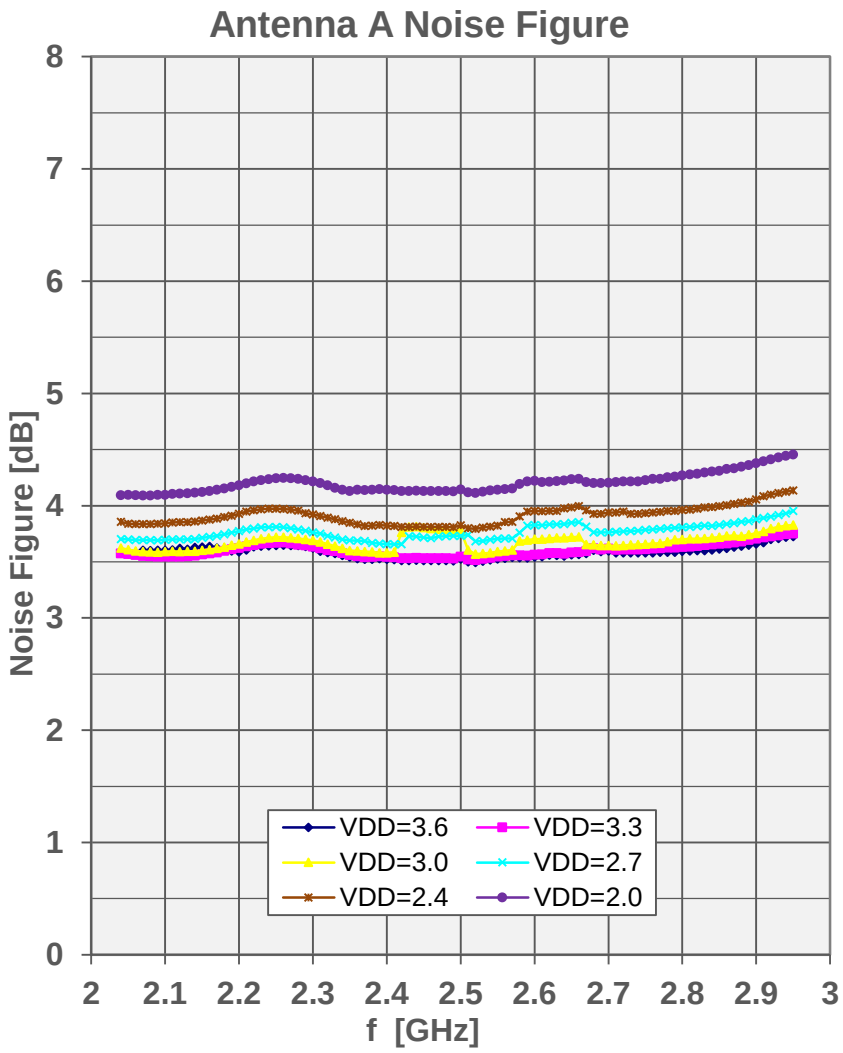
RX Noise Figure and Gain
Antenna A, Low Noise Figure Mode

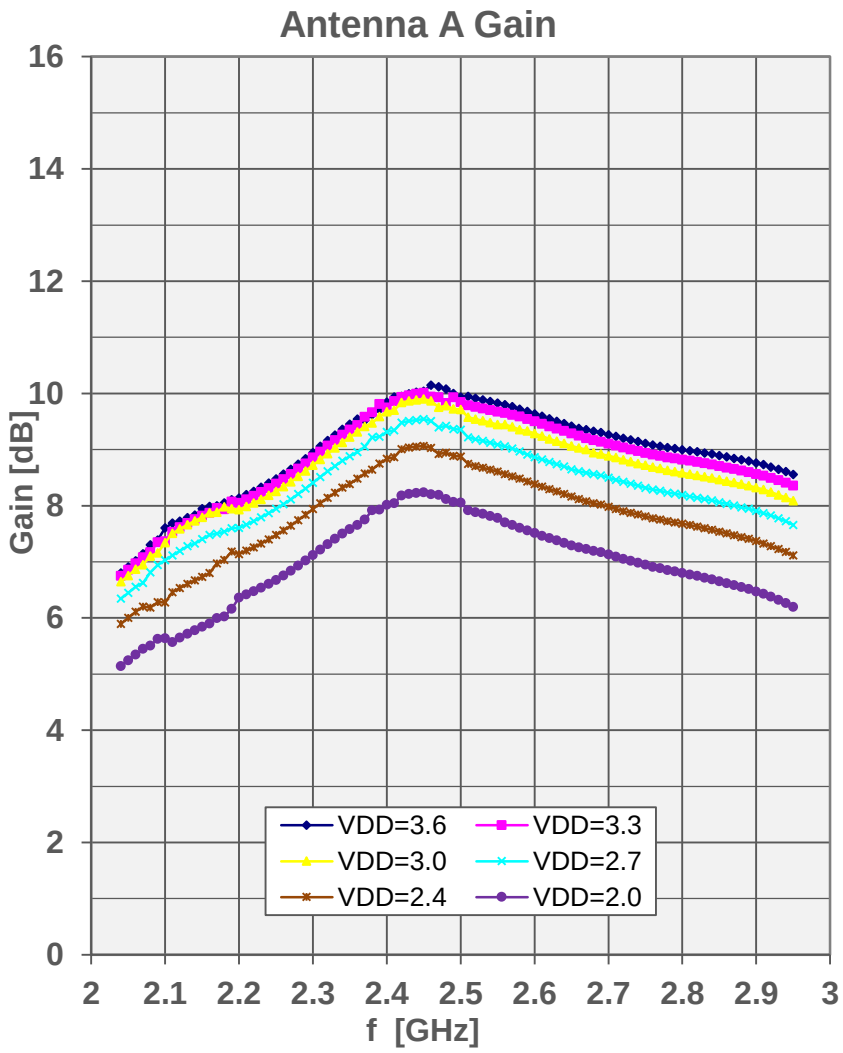




TXEN=0V, RXEN=1.2V, SWANT=1.2V, Mode=0V, Idq= 9 mA

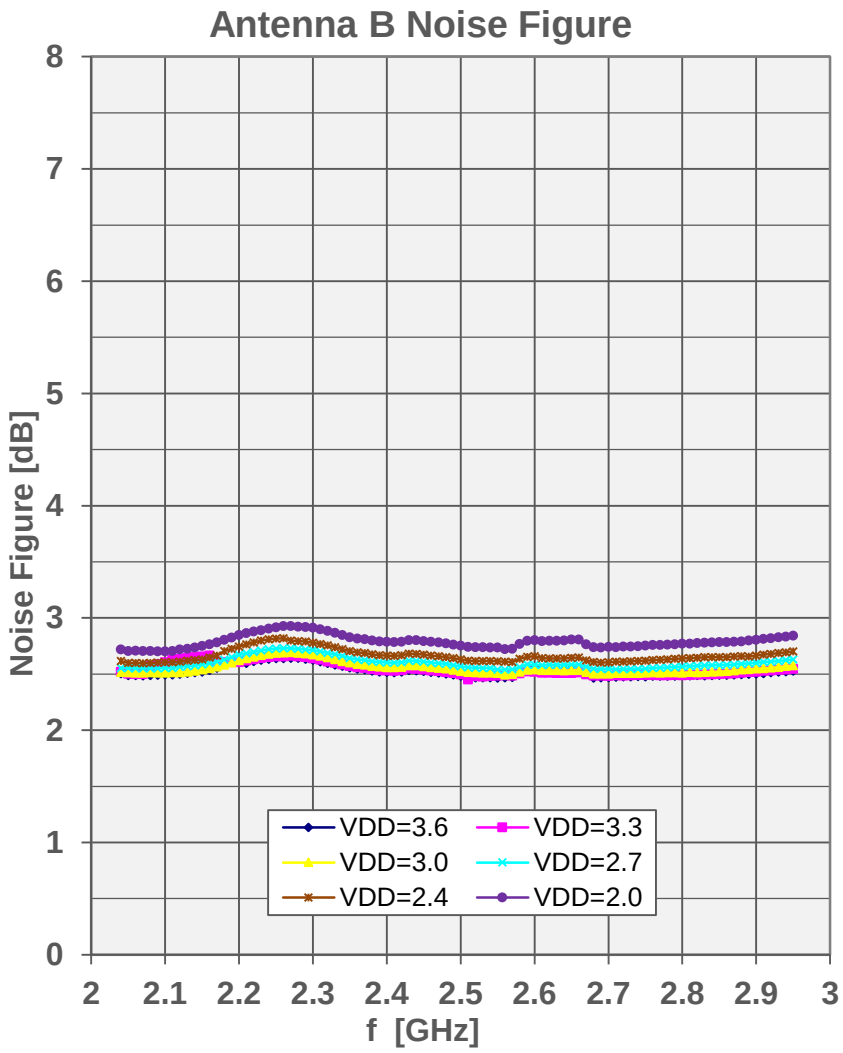
RX Noise Figure and Gain
Antenna A, Low Current Mode

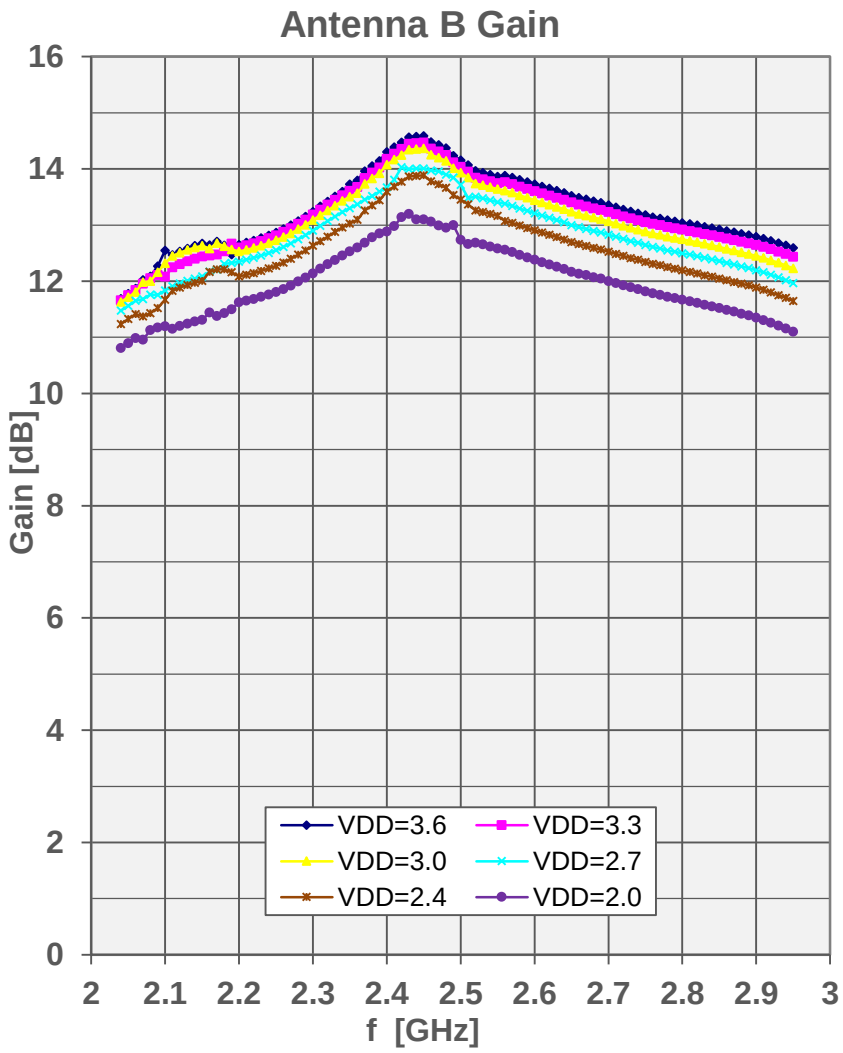




TXEN=0V, RXEN=1.2V, SWANT=1.2V, Mode=1.2V Idq= 3 mA

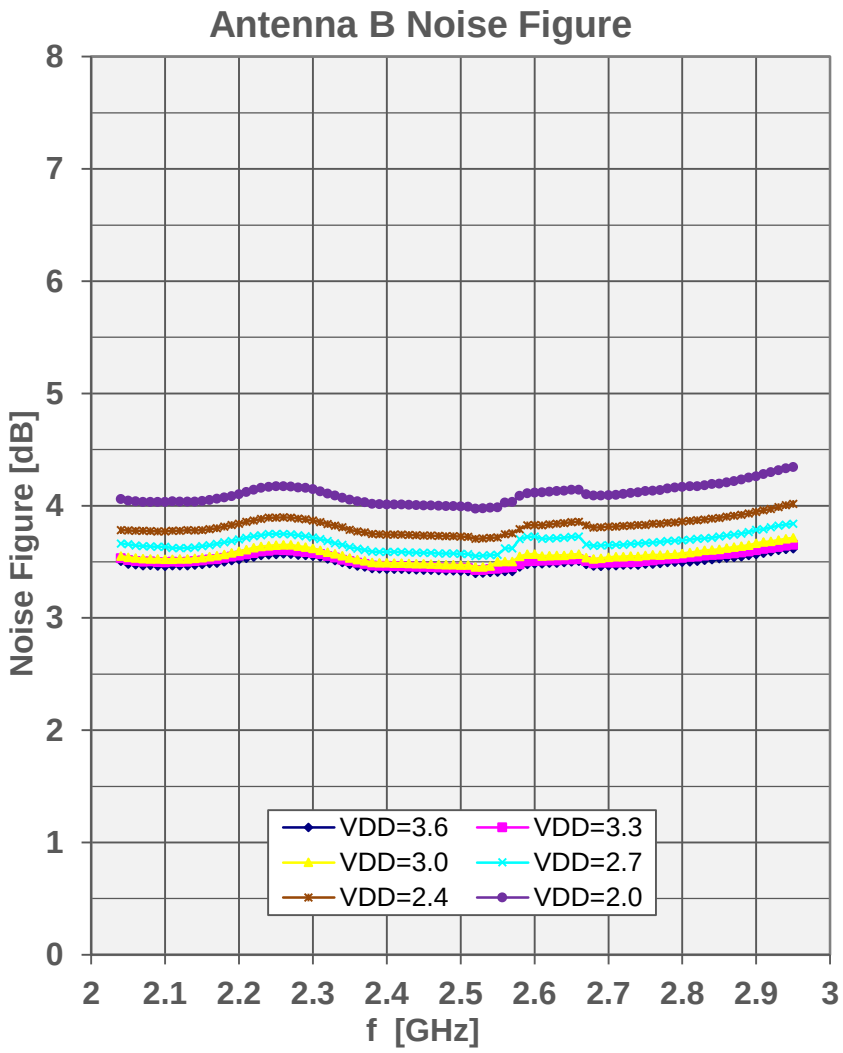
RX Noise Figure and Gain
Antenna B, Low Noise Figure Mode

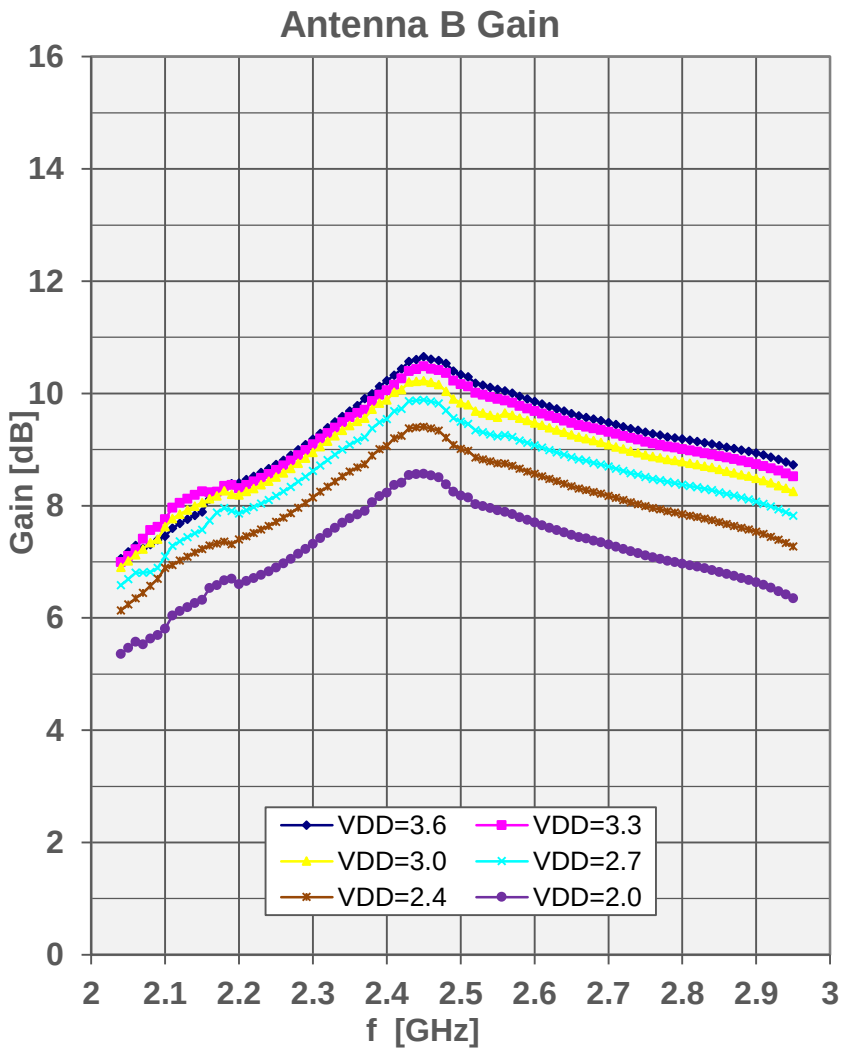




TXEN=0V, RXEN=1.2V, SWANT=1.2V, Mode=0V, Idq= 9 mA

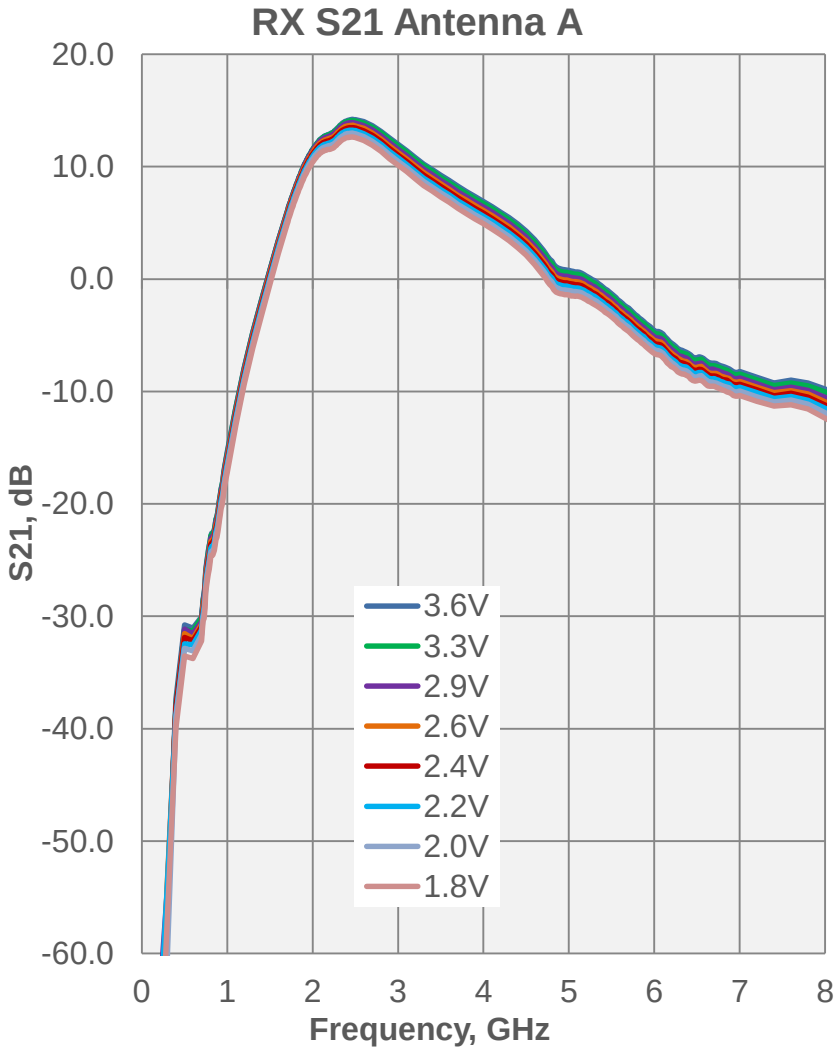
RX Noise Figure and Gain
Antenna A, Low Current Mode

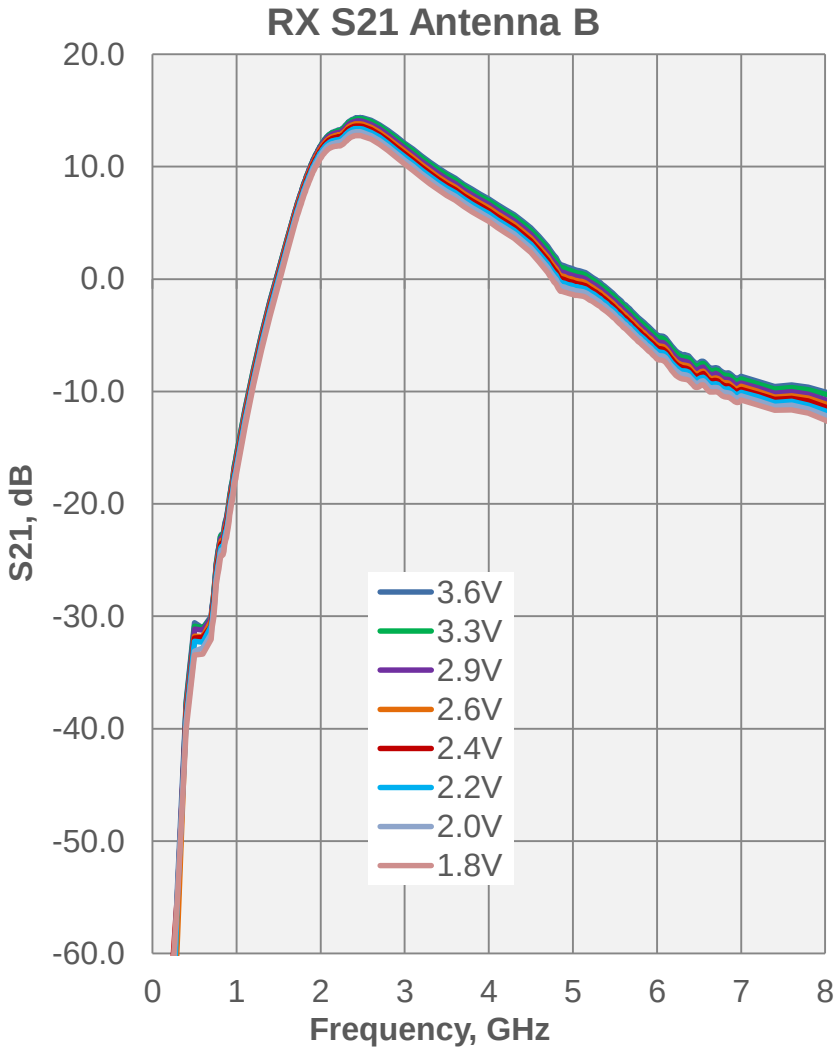




TXEN=0V, RXEN=1.2V, SWANT=1.2V, Mode=1.2V Idq= 3 mA

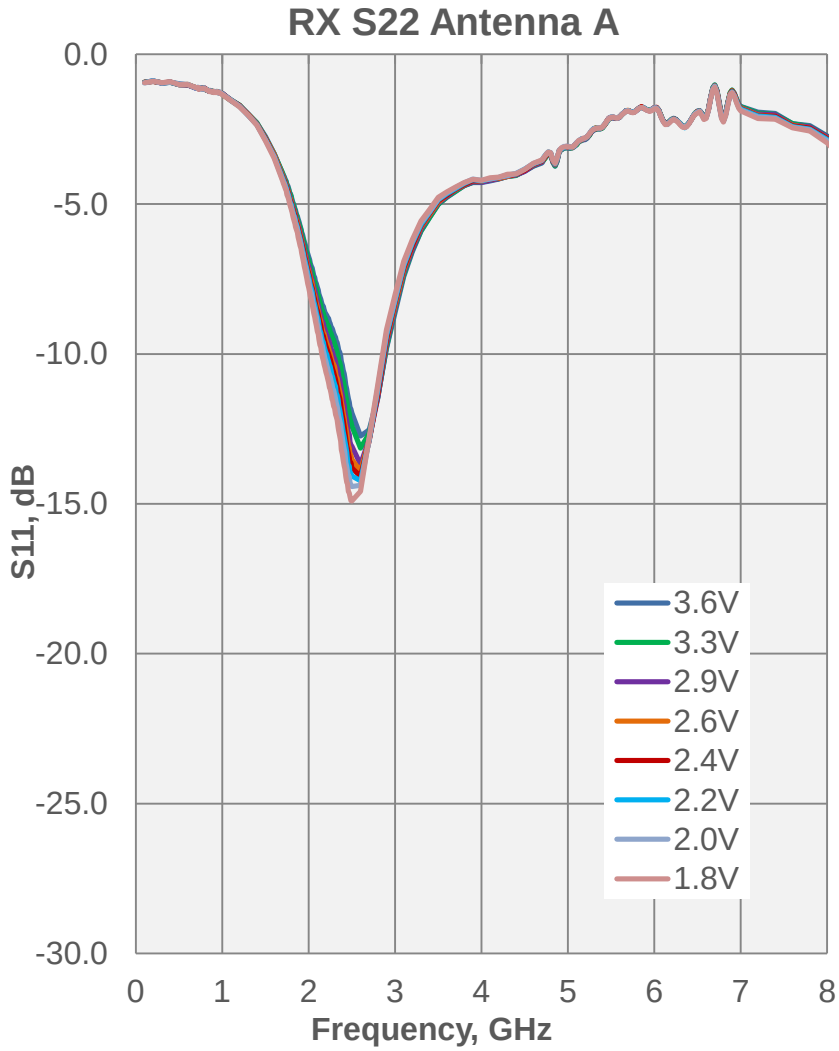
RX S-Parameters Across Voltage
Antenna A and B, Low Noise Figure Mode

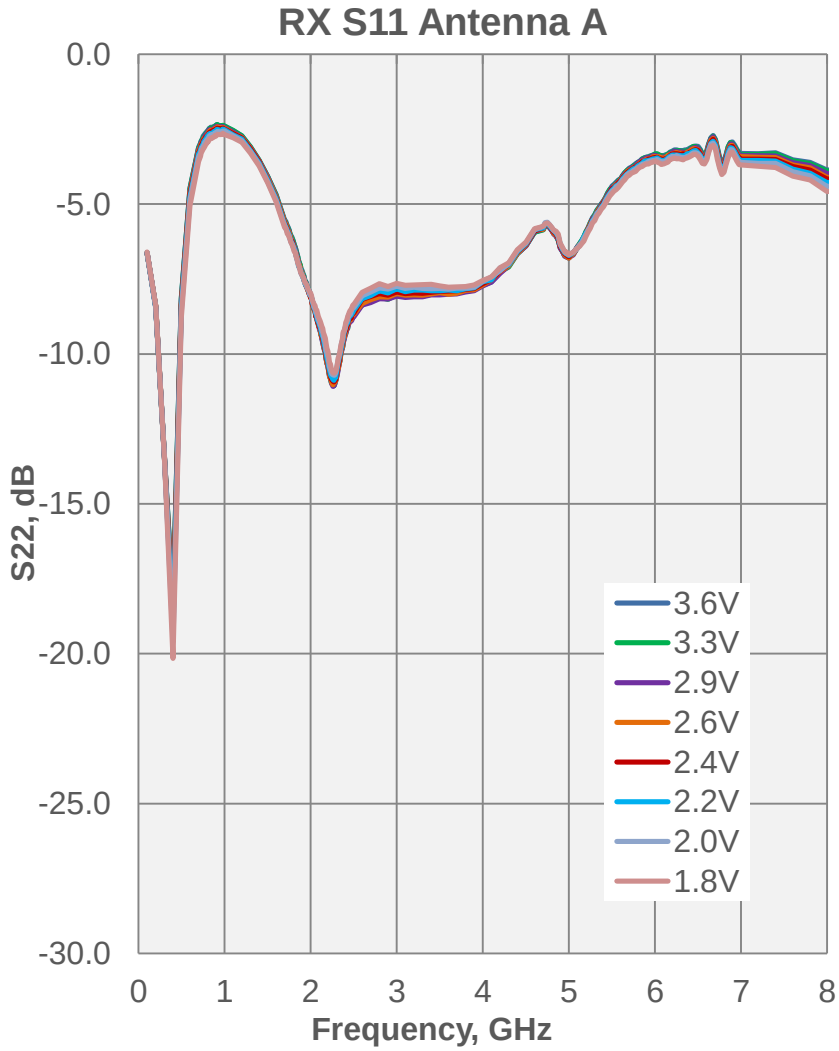




Idq ~ 9mA

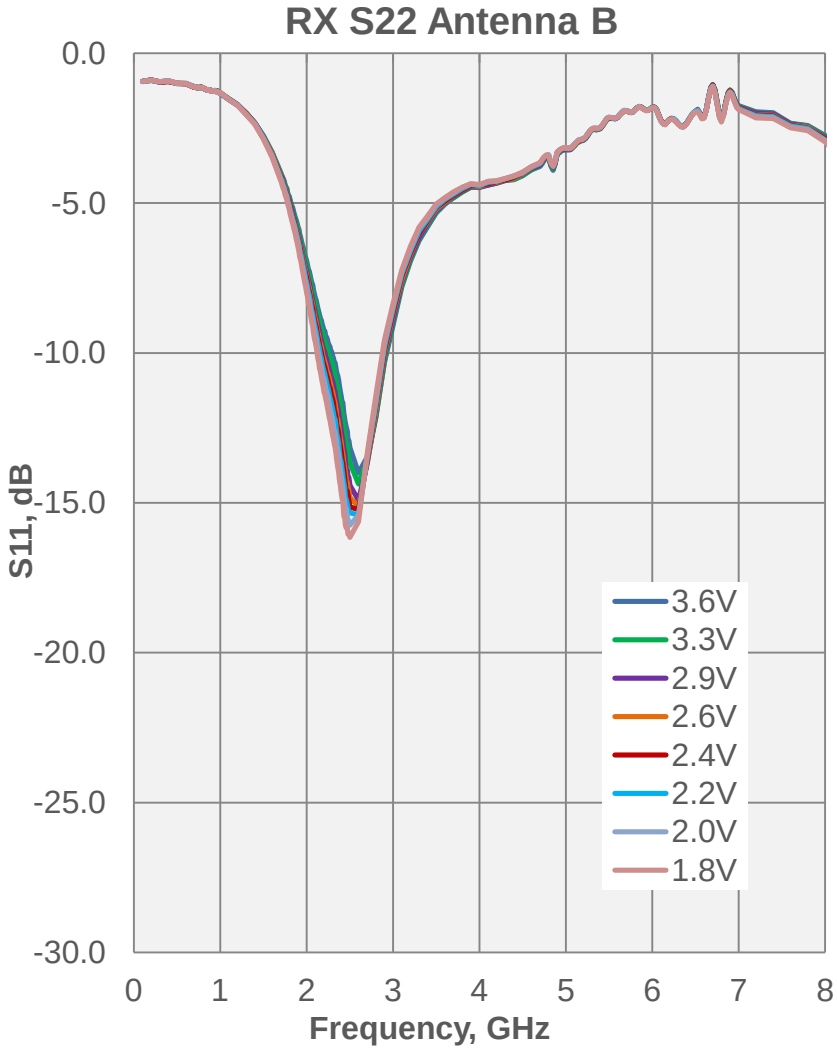
RX S-Parameters Across Voltage
Antenna A S11 and S22, Low Noise Figure Mode

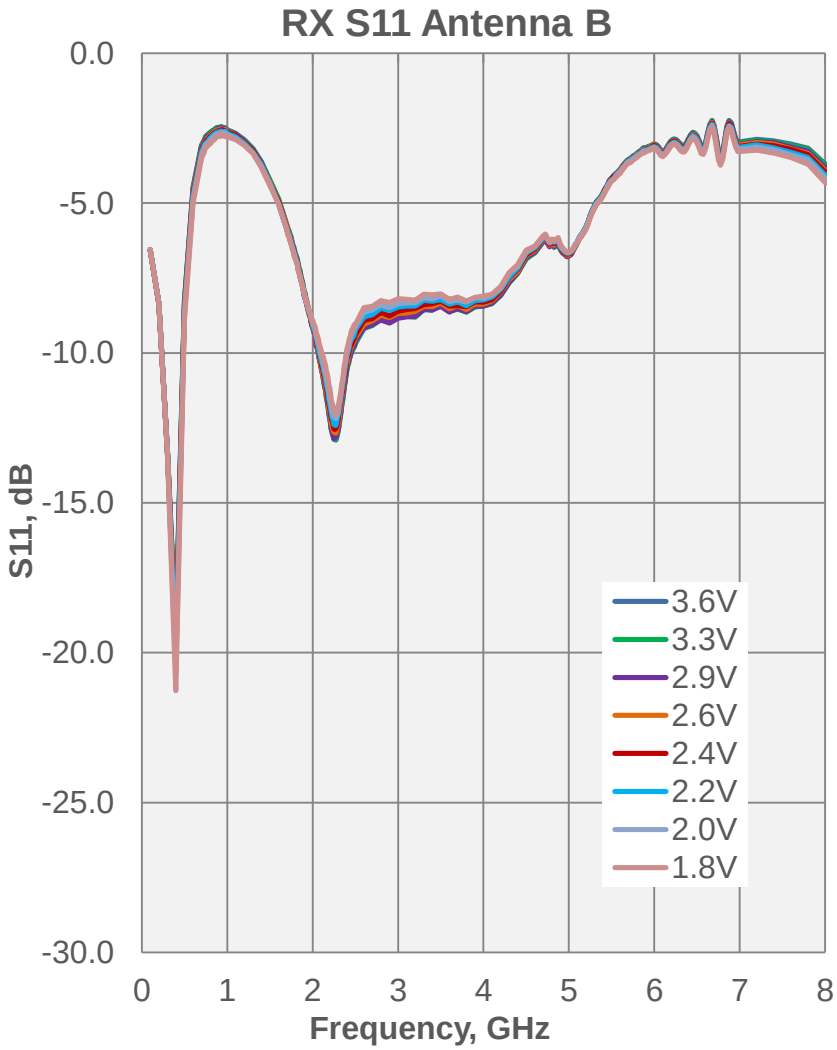




Idq ~ 9mA

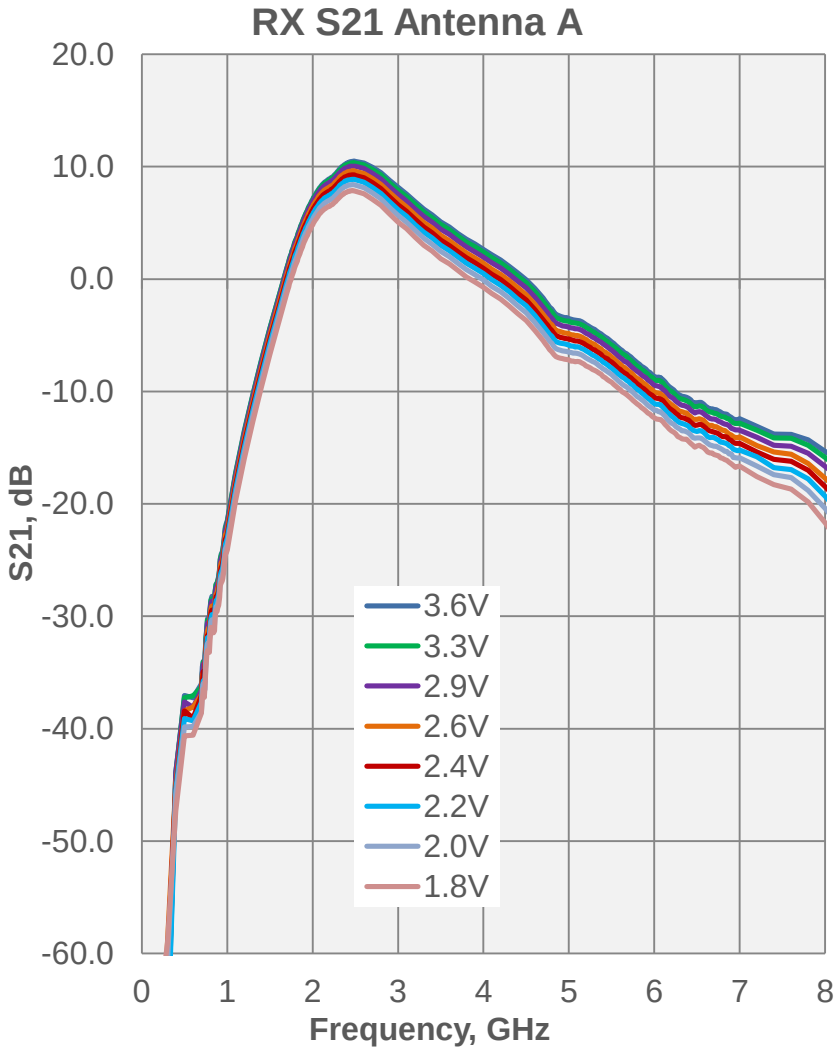
RX S-Parameters Across Voltage
Antenna B S11 and S22, Low Noise Figure Mode

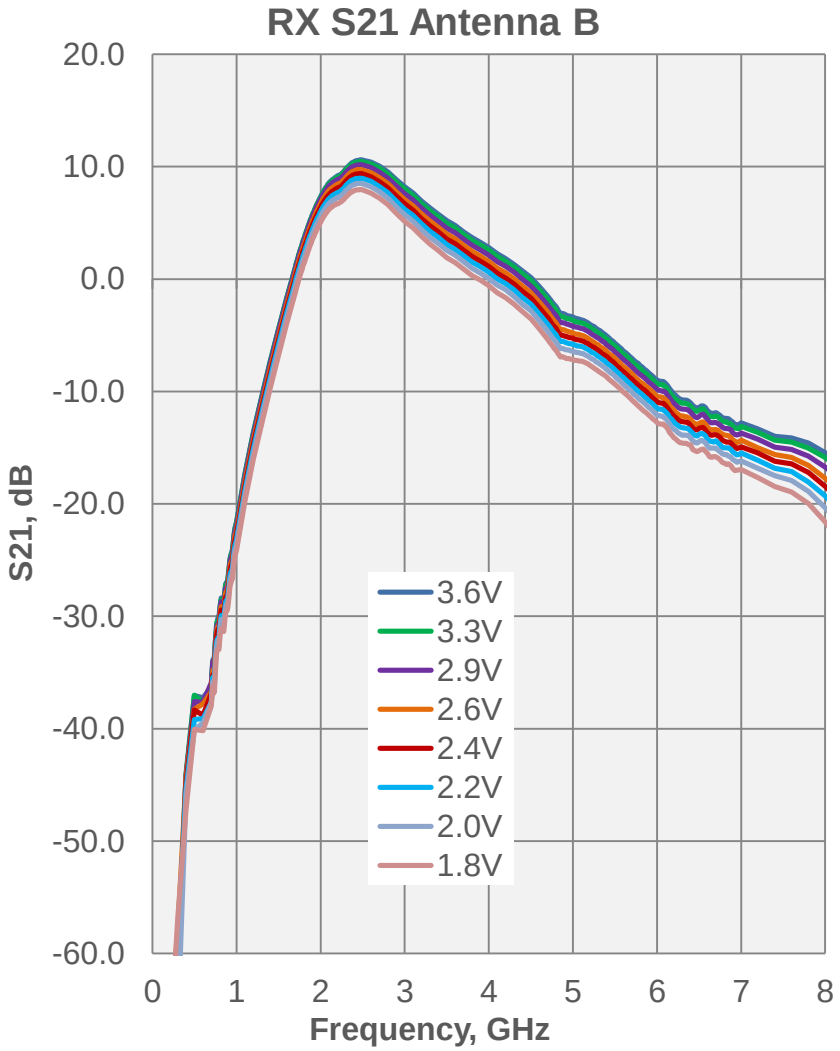




Idq ~ 9mA

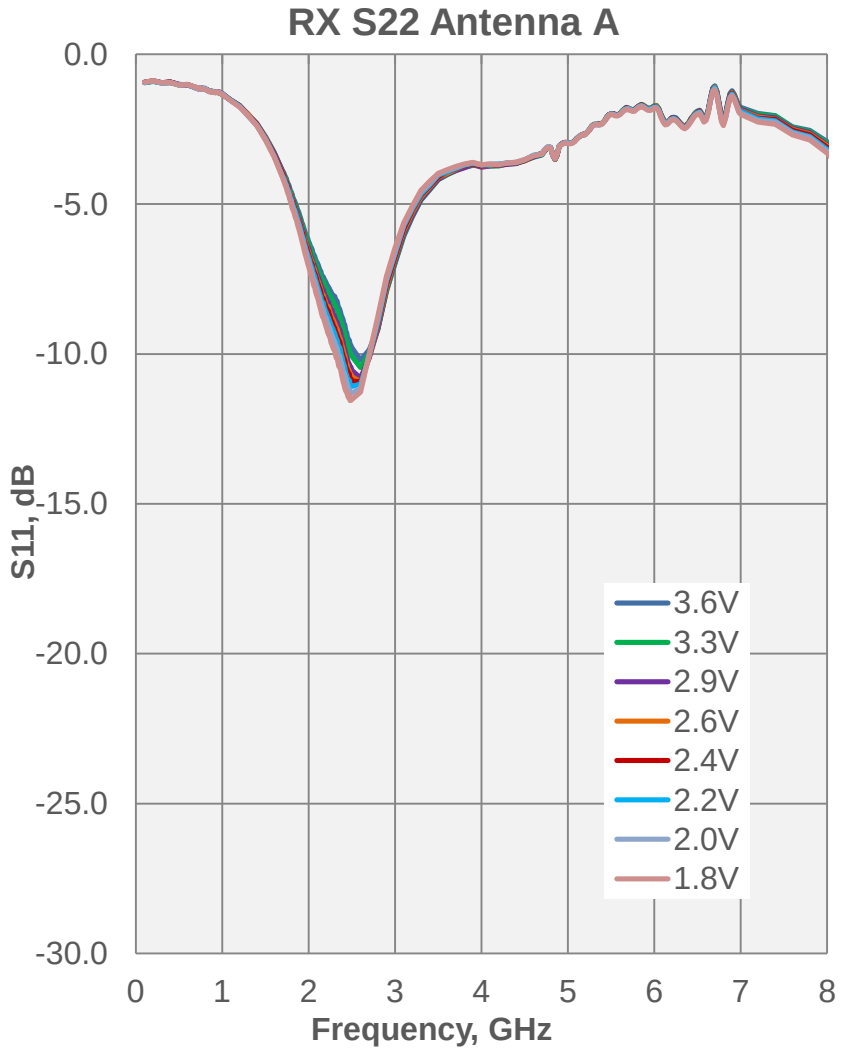
RX S-Parameters Across Voltage
Antenna A and B, Low Current Mode

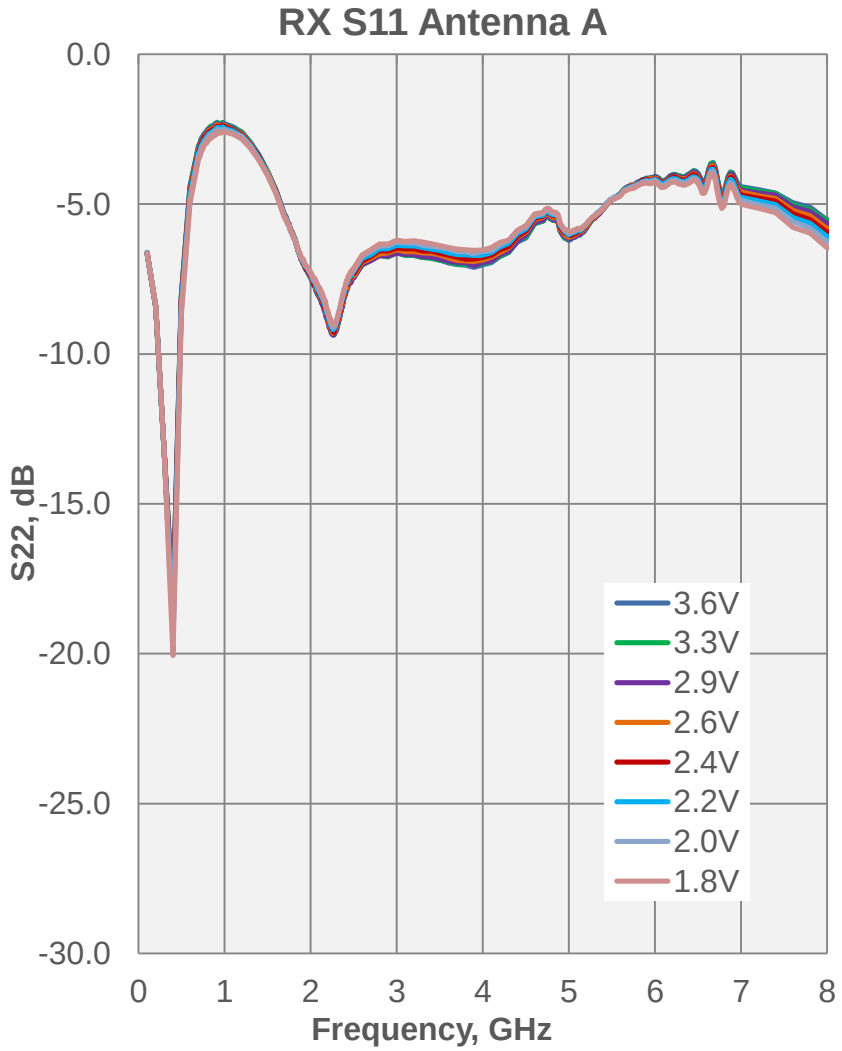




Idq ~ 3mA

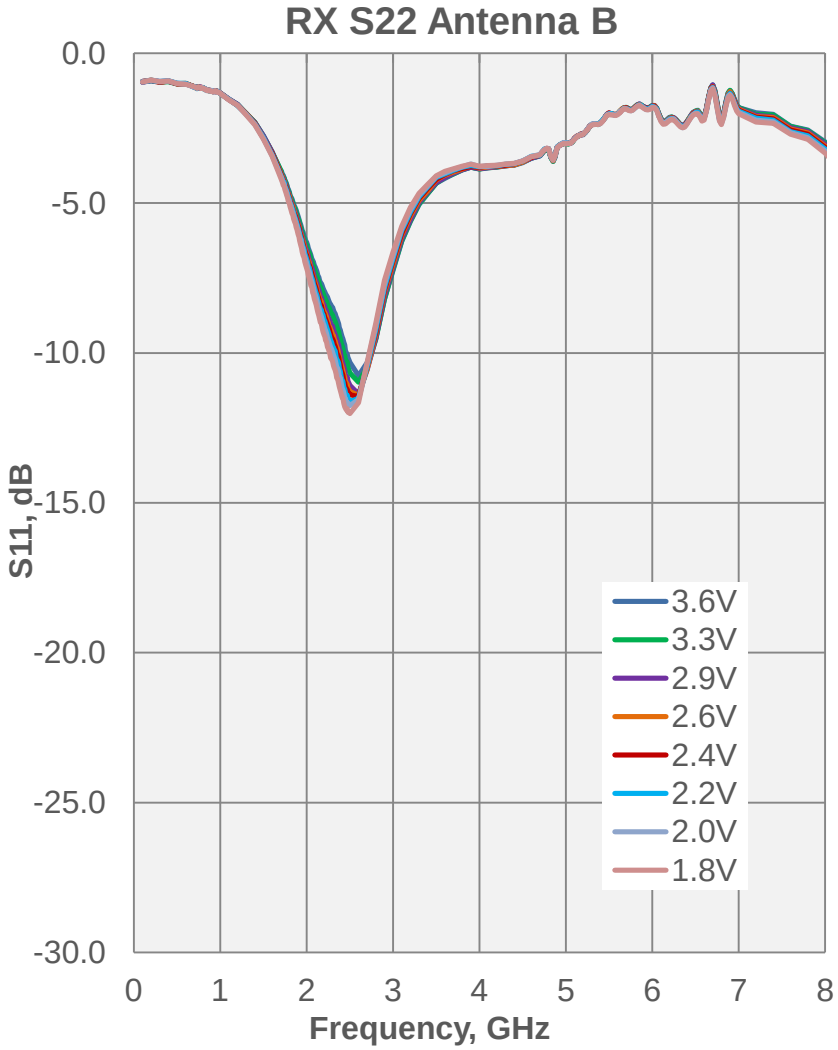
RX S-Parameters Across Voltage
Antenna A S11 and S22, Low Current Mode

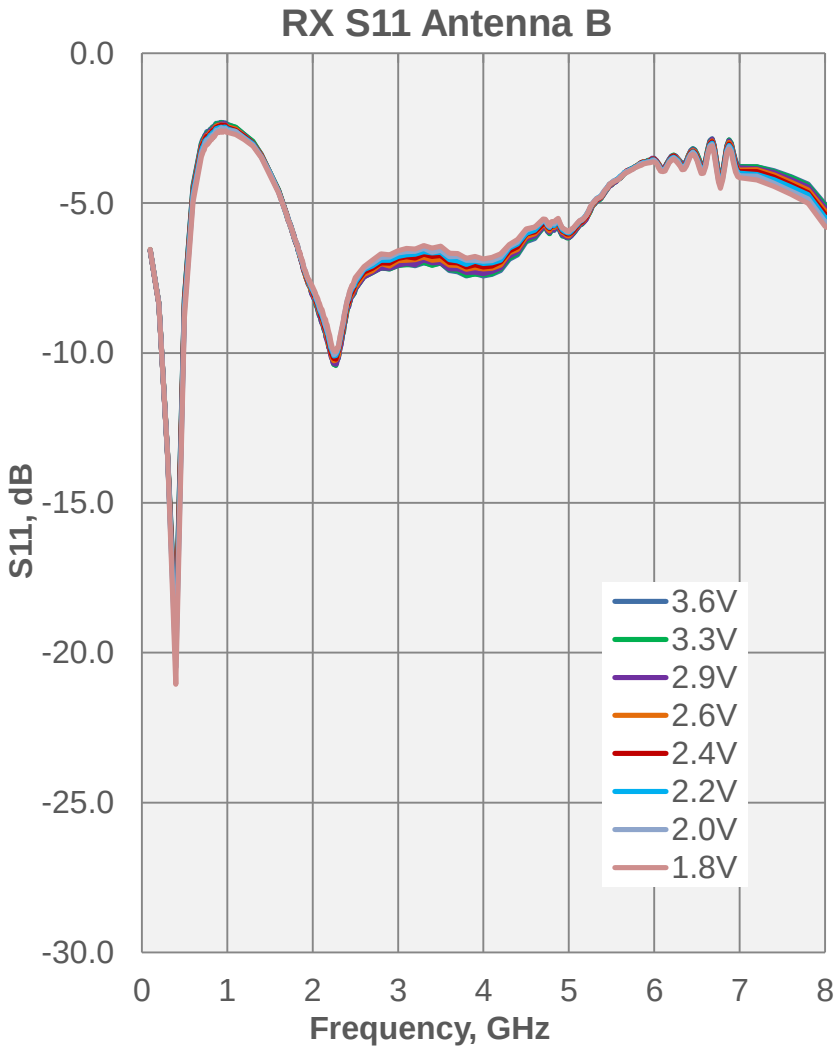




Idq ~ 3mA

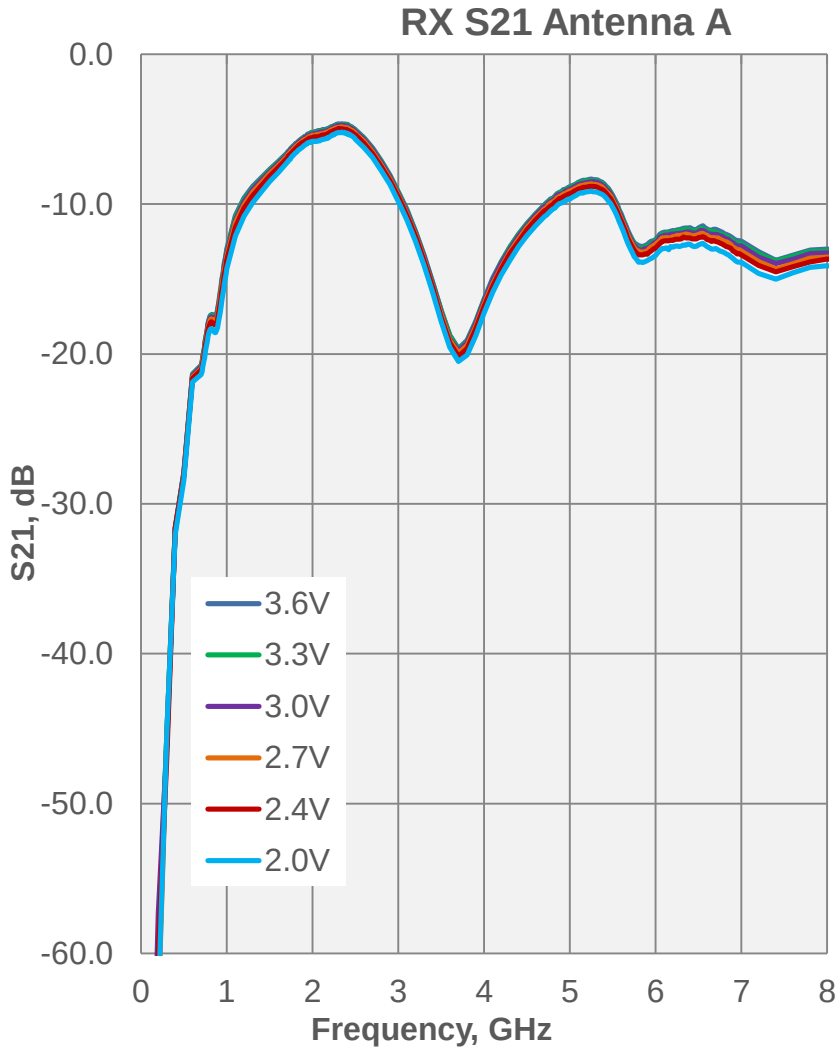
RX S-Parameters Across Voltage
Antenna B S11 and S22, Low Current Mode

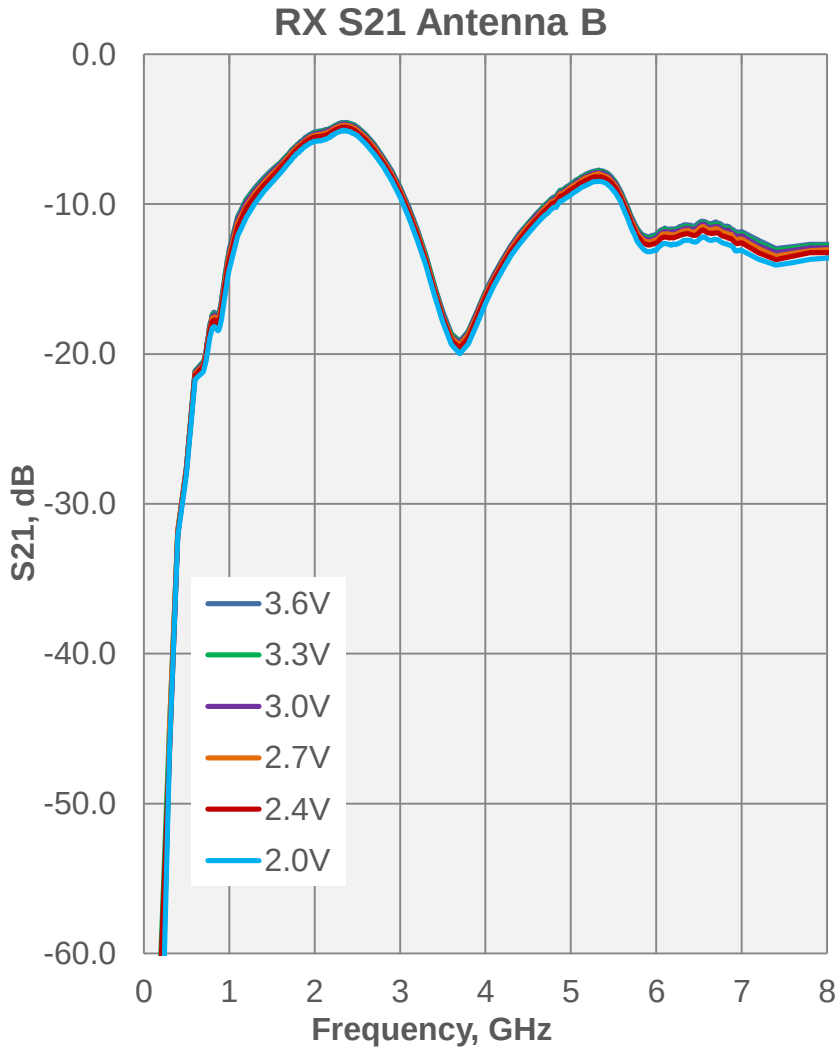




Idq ~ 3mA

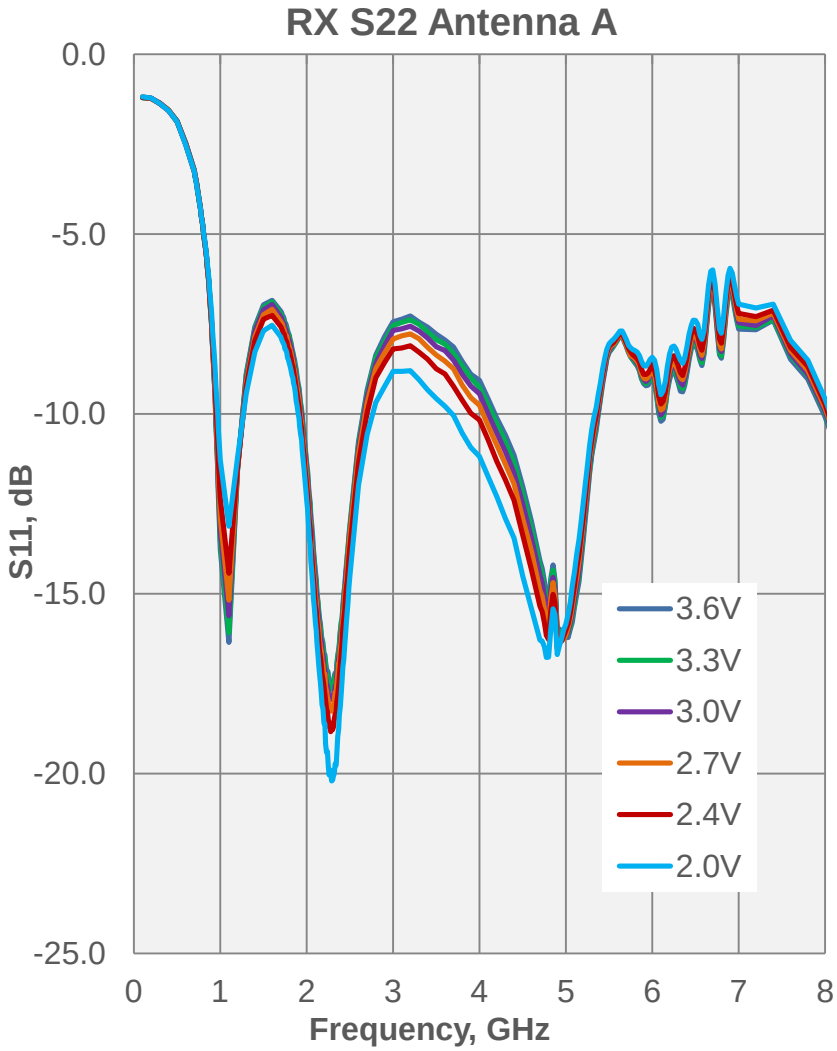
Bypass S-Parameters Across Voltage Antenna A and B

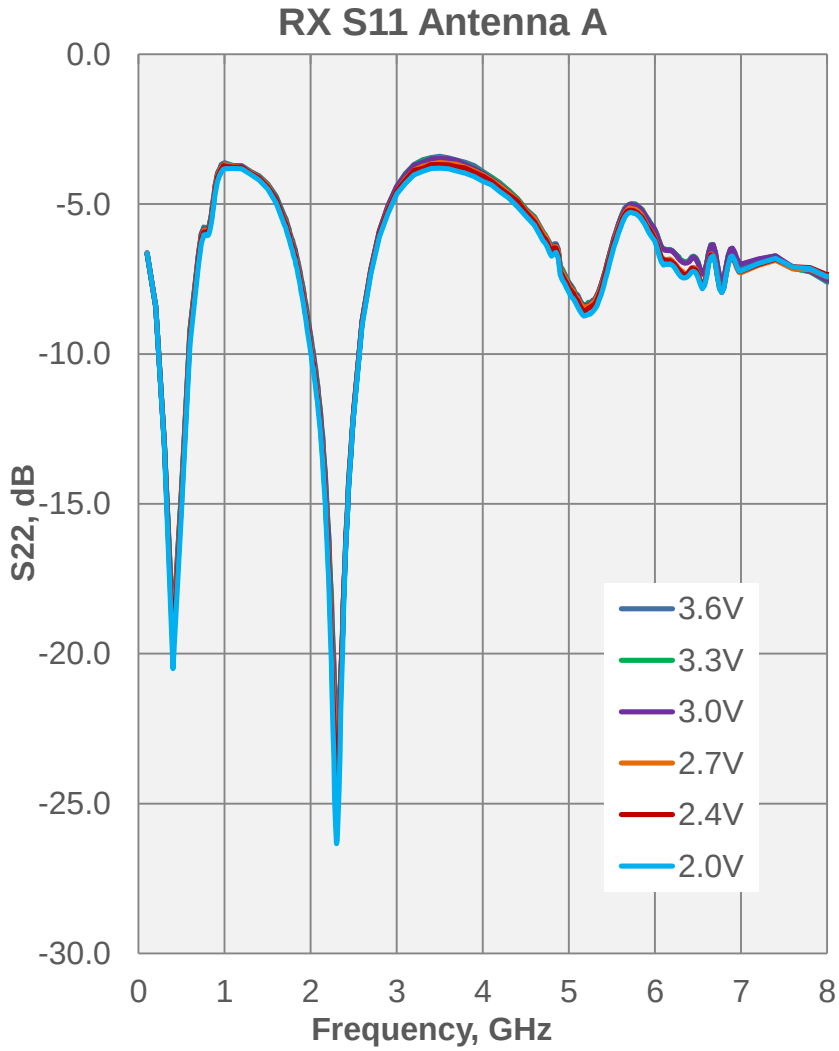




Idq ~ 1uA

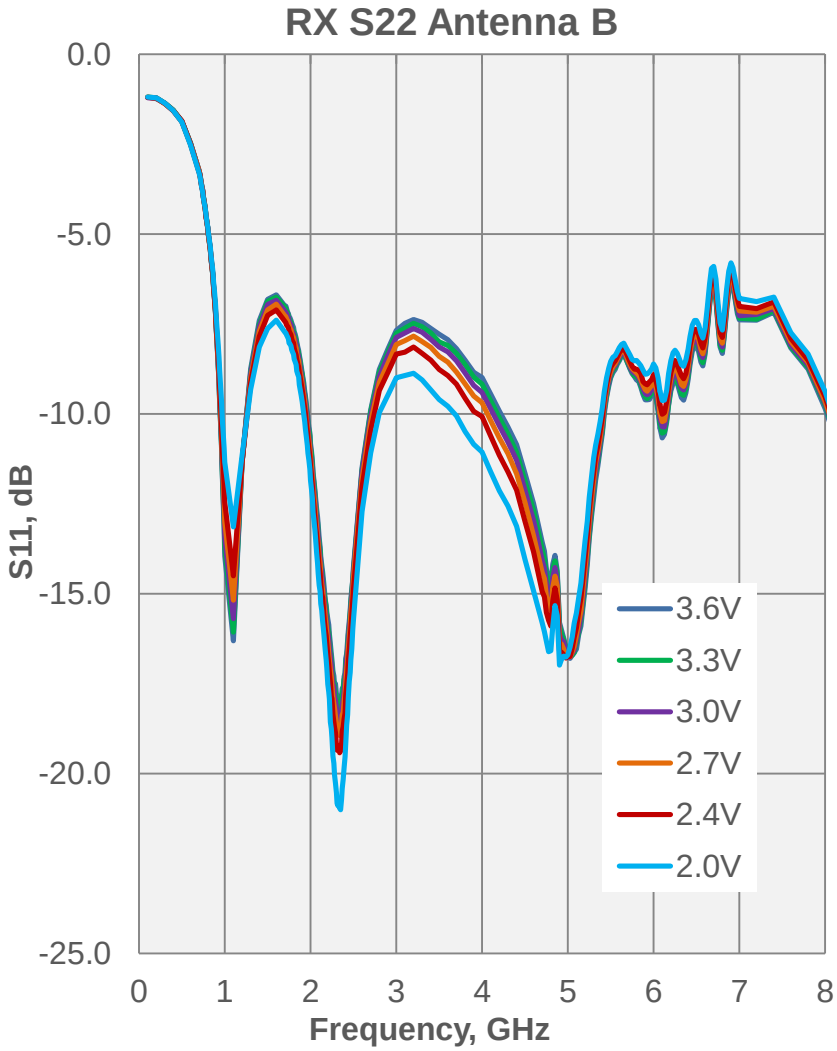
Bypass S-Parameters Across Voltage
Antenna A S11 and S22

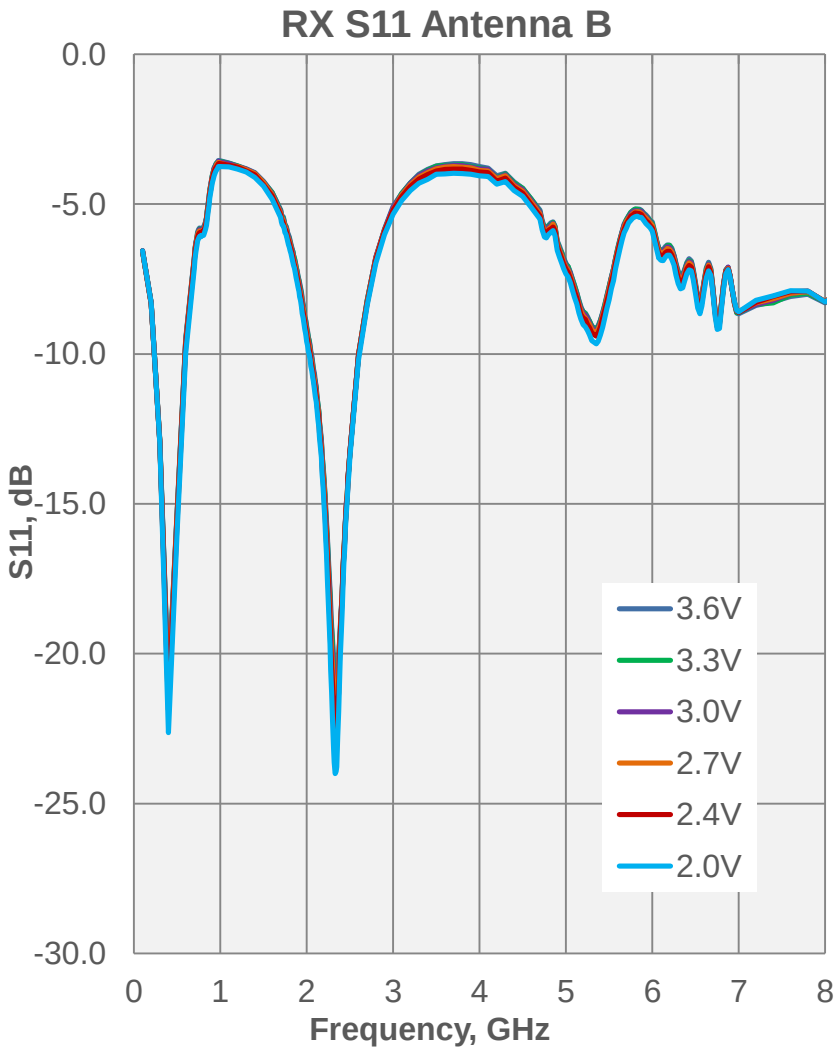




Idq ~ 1uA

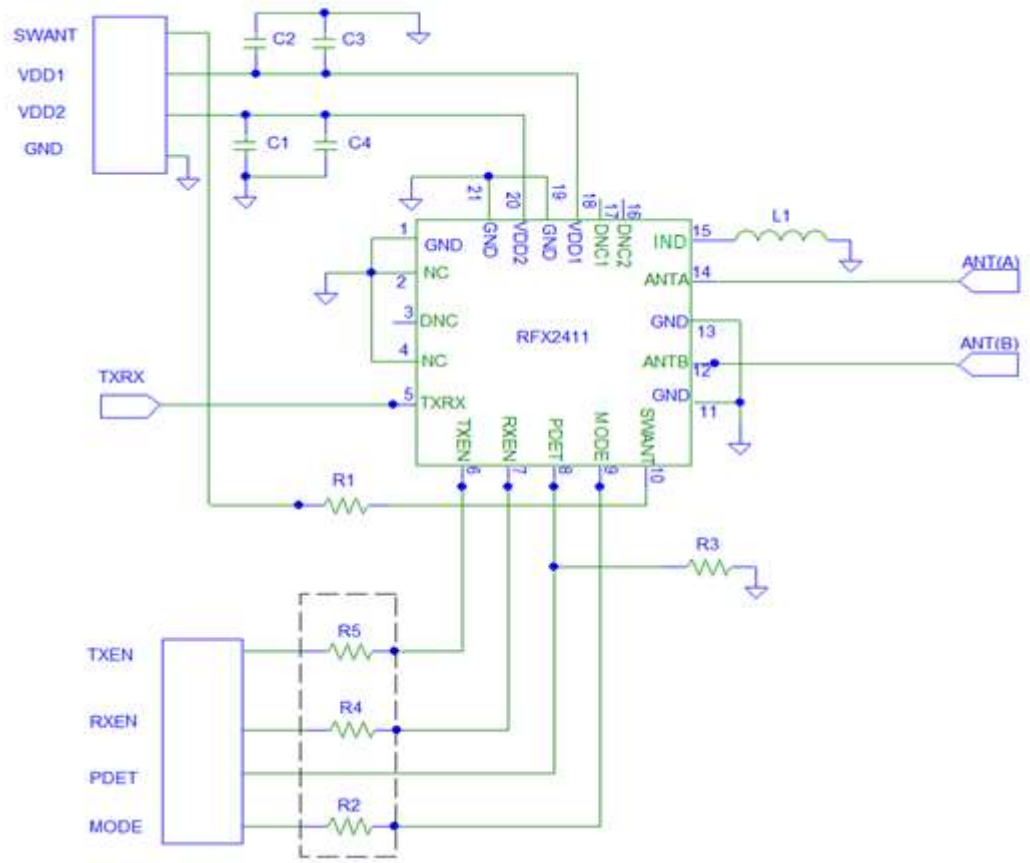
RX S-Parameters Across Voltage
Antenna B S11 and S22





Idq ~ 1uA

RFX2411 Application Schematic



Recommended BOM:

R3=10K
R1=R2=R4=R5=1K
C1=C2=2.2uF
C3=C4=220pF
L1=1.2nH

Notes:
R1, R2, R4, R5 on the control lines are for standalone EVBs, and are recommended in actual system implementation when the control line voltage will approach VDD

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