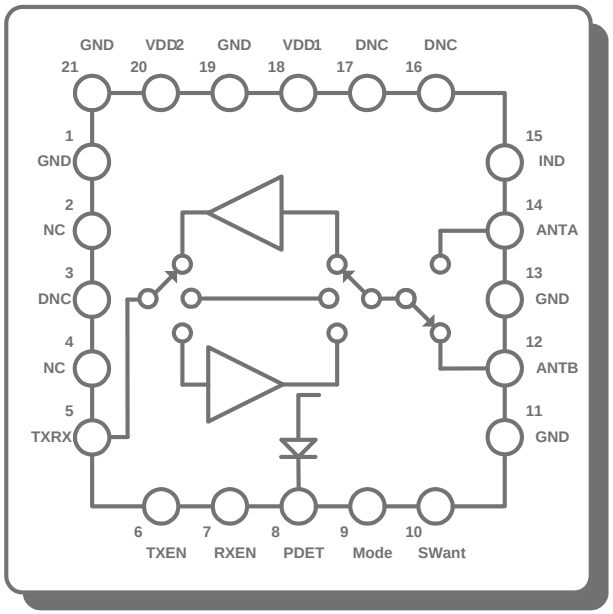
# RFX2411N Single-Chip CMOS RFeIC with PA, LNA, Antenna Switch, Combined TX/RX Transceiver Port, Input Port to Antenna Port Bypass Mode, and Diversity Switch

## Evaluation Board Results
## Summary & Technical Notes

# RFX2411N RFeIC Key Features and Benefits

3x3x0.55mm
20L QFN




## RFX2411N 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 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

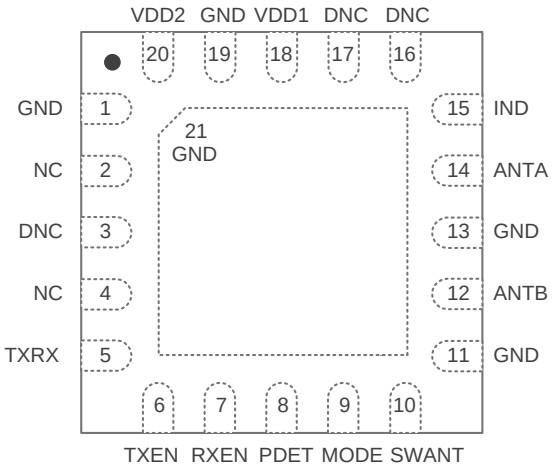
## APPLICATIONS

- 802.15.4 ZigBee Extended Range Devices
- ZigBee Smart Power
- Bluetooth Low Energy
- RF4CE Remote Control
- Wireless Sensor Networks
- Other 2.4GHz ISM Band Systems

## RFX2411N Customer Benefits

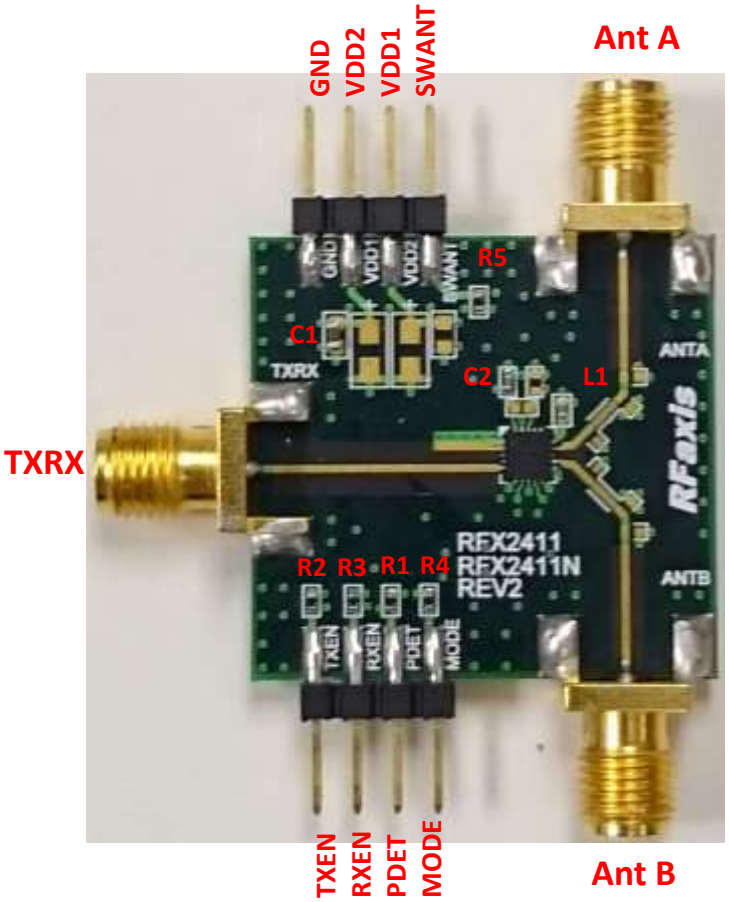
- Greatly Simplified, 50 Ohm “Plug & Play” PCB Implementation
- Small Form-Factor and Quick Design Cycle
- Simplest Approach to Improve Link Performance including Range and Receiver Sensitivity
- Very Low BOM Cost and Competitive Price

# RFX2411N 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 (Internally Connected to Pin 20) |
| 20 | VDD2 | Voltage Supply Connection |

# RFX2411N Evaluation Board and Preliminary BOM




**VDD = 3.3V Nominal; Operational from 3.6V to 1.8V**

**VDD decoupling:**
**C1 =1.0uF**
**C2 =220pF**

**Detector Loading:**
**R1 = 10Kohm**

**Digital Control Protection:**
**R2, R3, R4, R5 = 10Kohm (Recommended for control lines to protect input circuits from over voltage).**
**Control lines TXEN, RXEN, MODE, and SWANT have on-die 1Mohm pull down resistors.**

**For Harmonic Suppression:**
**L1=2.0nH Murata LQP03 Series**
**(Inductor value may need to be optimized in final application circuit for layout dependency)**
**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.)**

## Antenna Selection

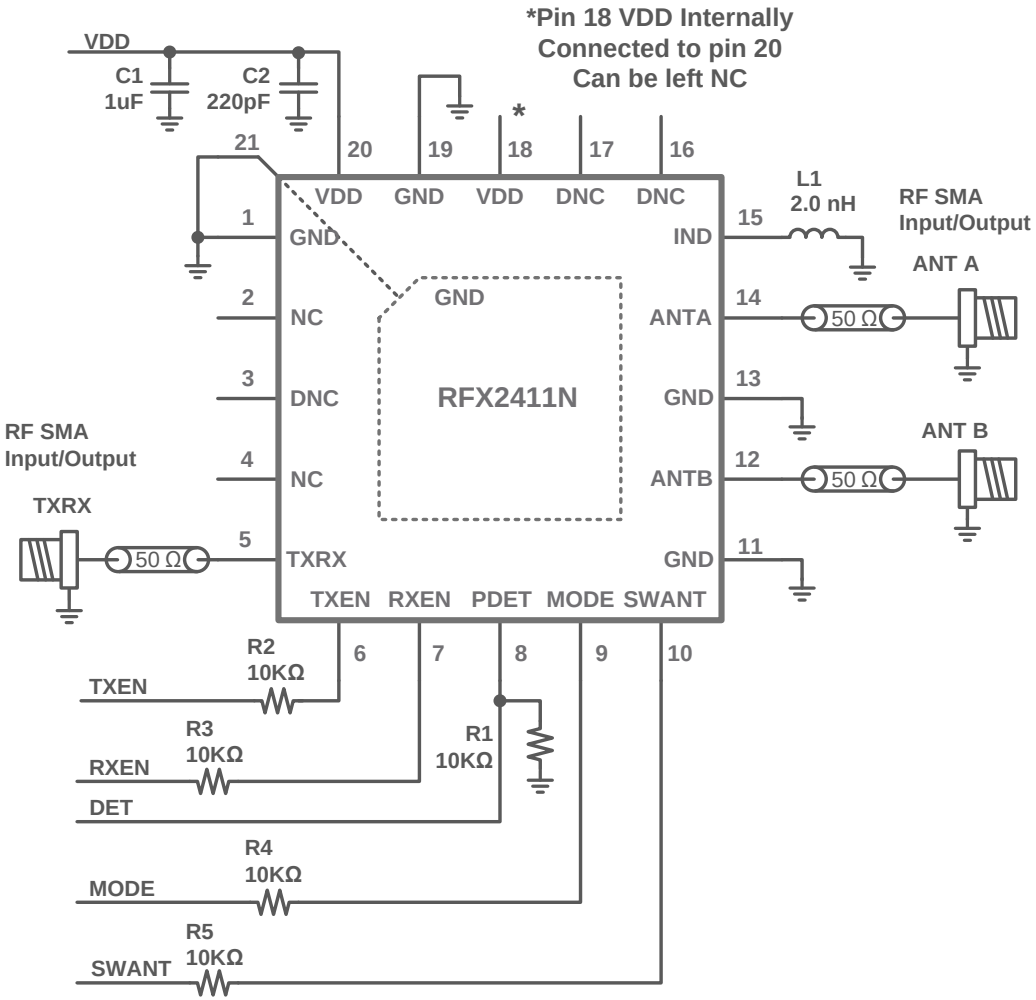
| SWant | Mode of Operation |
|---|---|
| 1 | ANTA port enabled |
| 0 | ANTB port enabled |

## Control Logic Truth Table

| TXEN | RXEN | MODE | Mode of Operation |
|---|---|---|---|
| 0 | 0 | 0 | Shutdown Mode |
| X | X | 1 | Bypass Mode |
| 1 | X | 0 | Transmit Mode |
| 0 | 1 | 0 | Receive Mode |

Note: "1" denotes high voltage state (> 1.2V) at Control Pins
"0" denotes low voltage state (< 0.3V) at Control Pins
"X" denotes do not care: either "1" or "0" can be applied

# RFX2411N Application Test Circuit




## Tested Report BOM:

**R1 – R5=10K**
**C1=1.0uF**
**C2=220pF**
**L1=2.0nH Murata LQP03 Series**

**Notes:**

- **L1 can be optimized for final design configuration**
- **R2, R3, R4, R5 on the control lines are recommended in the system implementation to protect the input circuits from damaging over-voltage spikes**

# RFX2411N Eval Board De-Embedding and Iq Table

## EVB Signal Loss De-Embedding

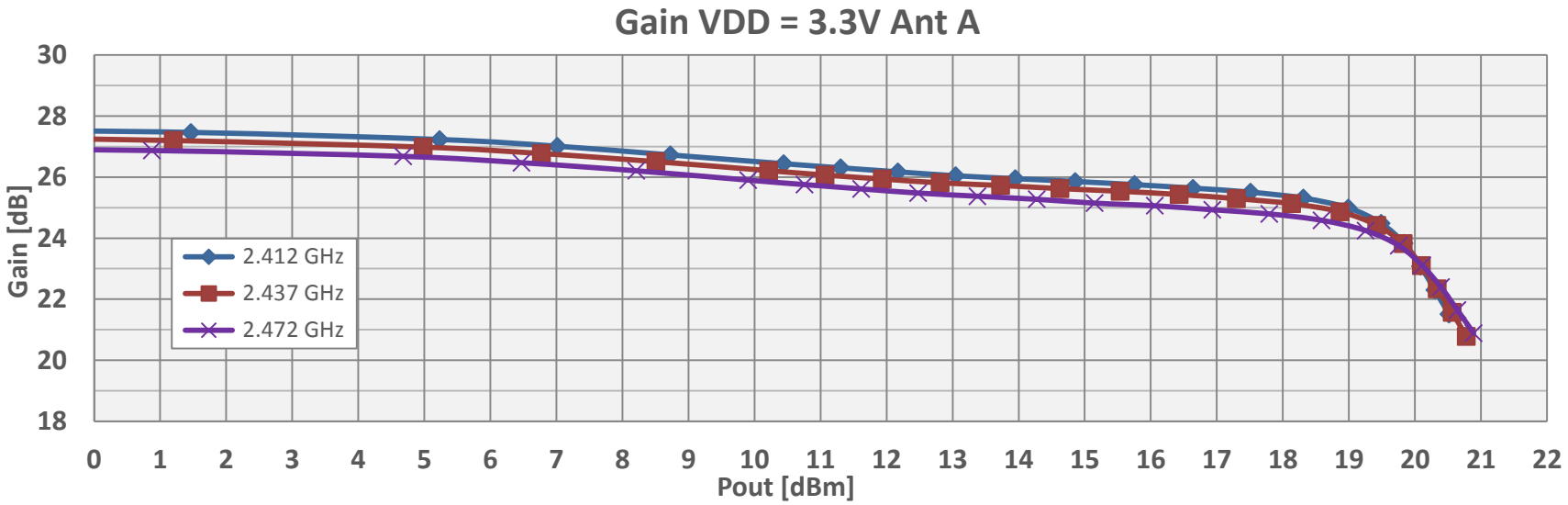
**Total EVB Loss Includes the Trace and Connector**
**All measurements have this loss de-embedded**

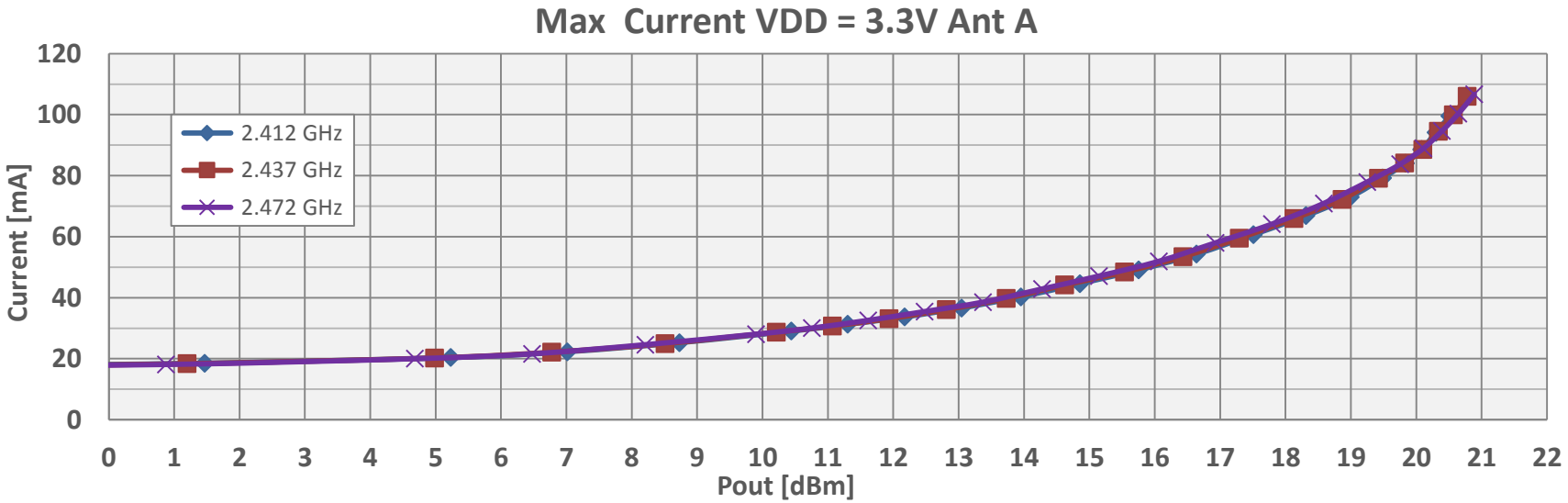
| RF Port | Loss |
|---|---|
| ANT A | .25 dB |
| ANT B | .25 dB |
| TXRX | .25 dB |

## Iq Across VDD

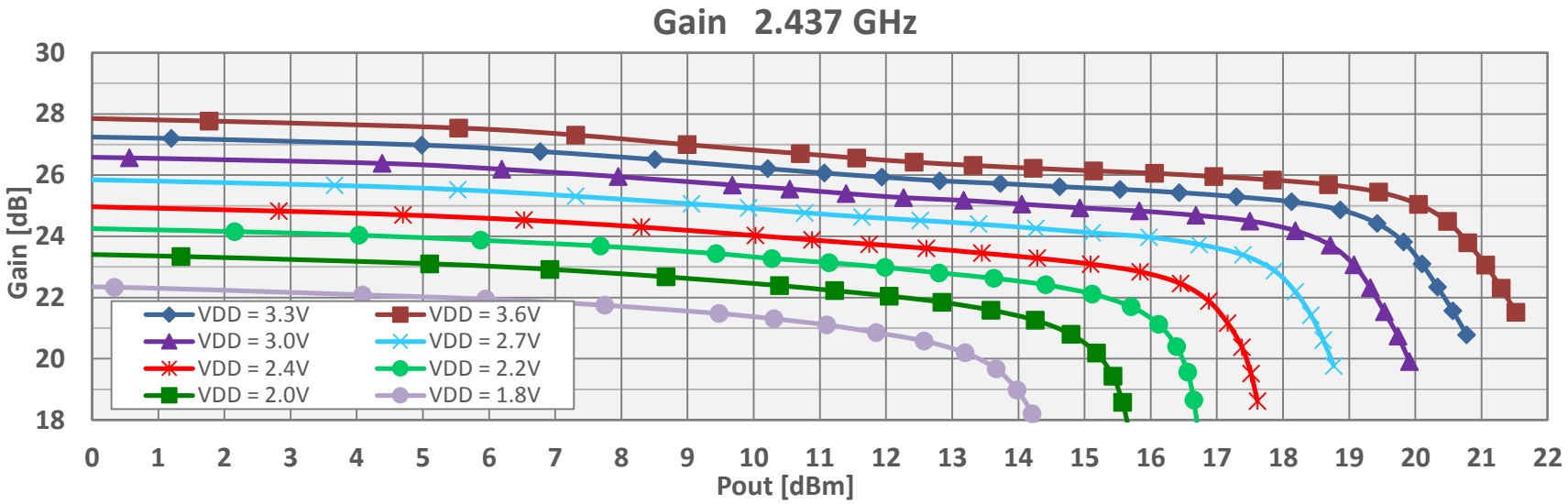
| Mode | 3.6V | 3.3V | 3.0V | 2.7V | 2.4V | 2.2V | 2.0V | 1.8V |
|---|---|---|---|---|---|---|---|---|
| TX | 21 mA | 20 mA | 19 mA | 18 mA | 17 mA | 16 mA | 16 mA | 15 mA |
| RX | 8 mA | 8 mA | 8 mA | 8 mA | 7 mA | 7 mA | 7 mA | 6 mA |
| Bypass | <1uA | <1uA | <1uA | <1uA | <1uA | <1uA | <1uA | <1uA |

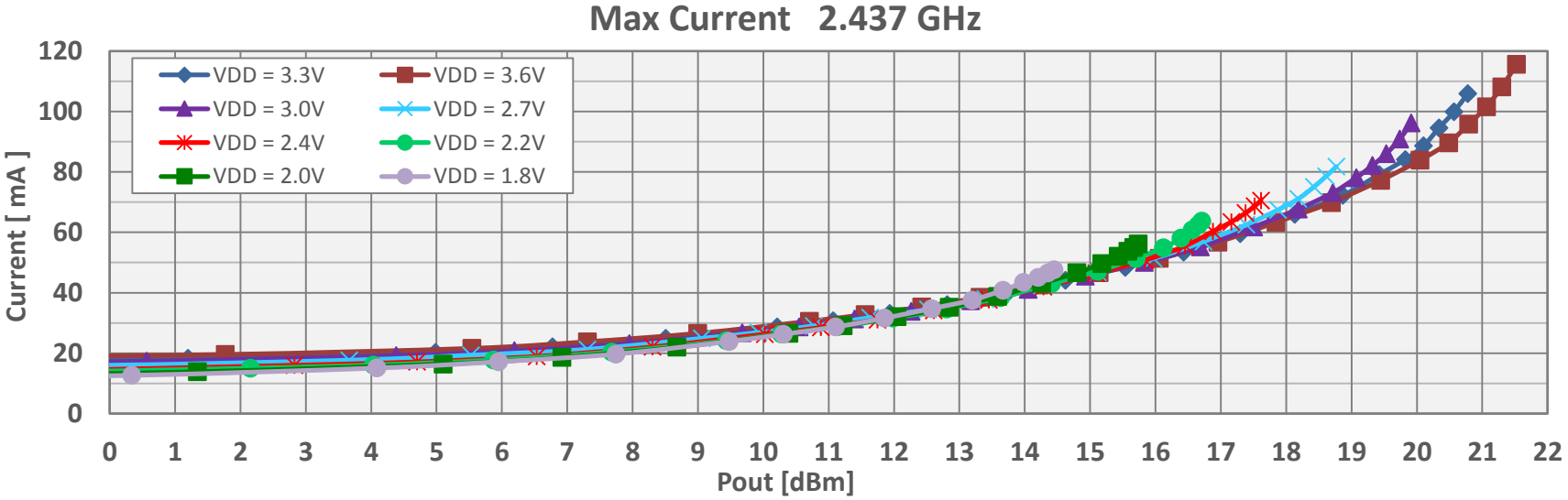
# TX Gain & Current vs. Pout Across Frequency
# Antenna A, CW Signal



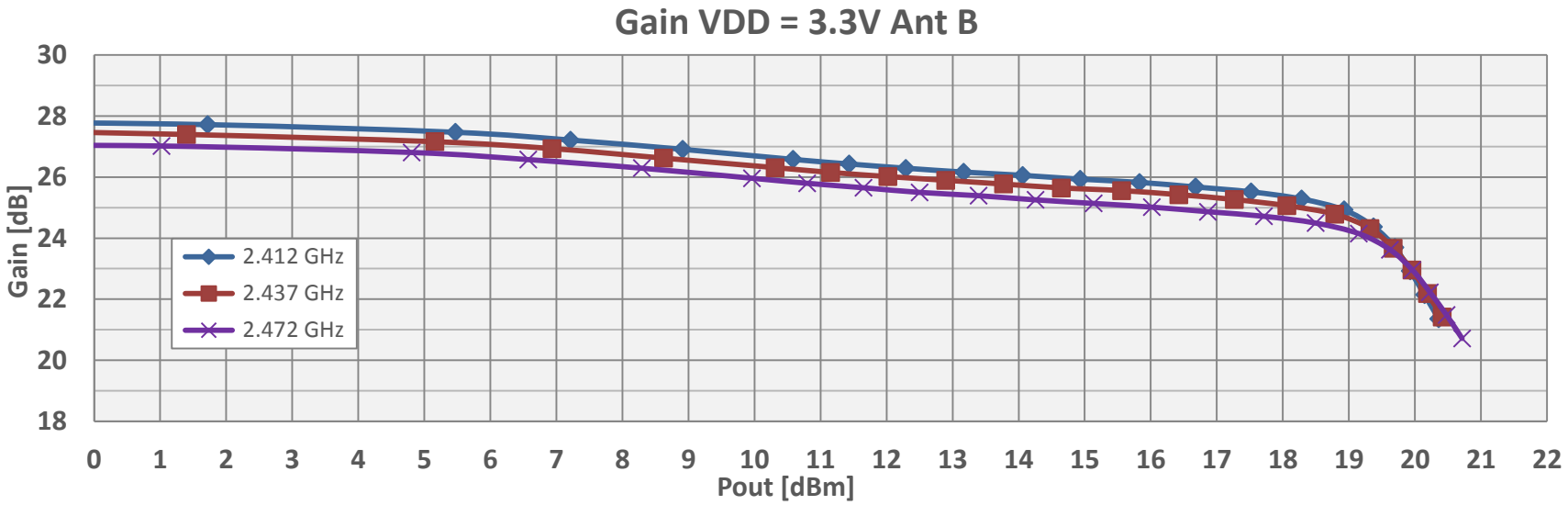



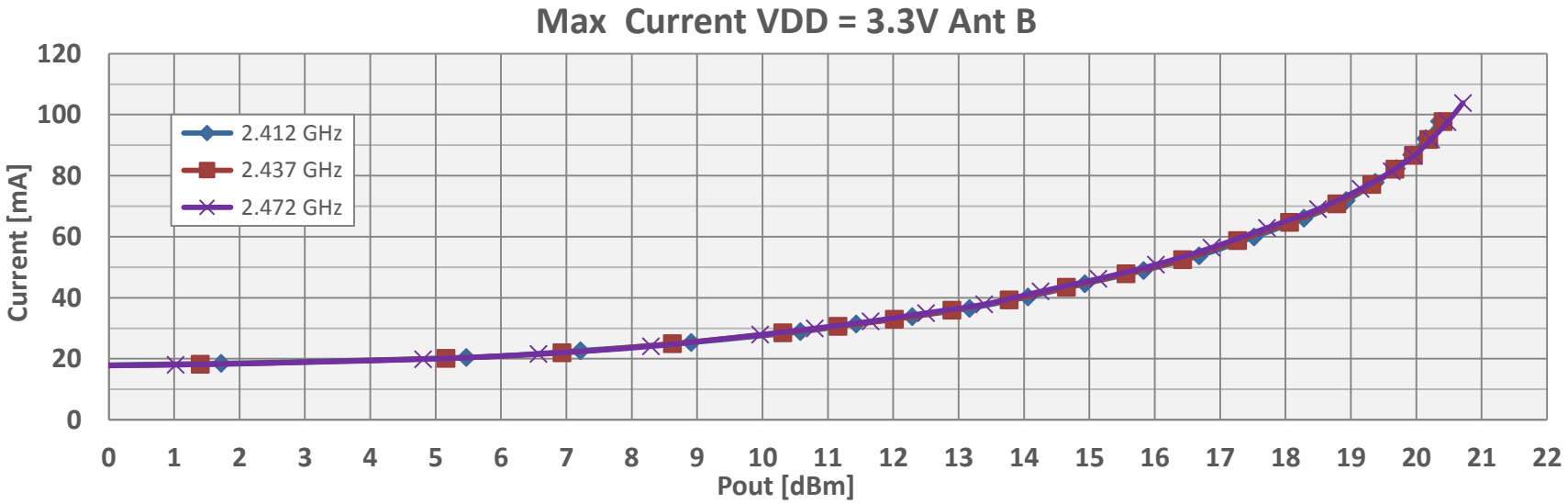
# TX Gain & Current vs. Pout Across Voltage
# 2.437 GHz, Antenna A, CW Signal



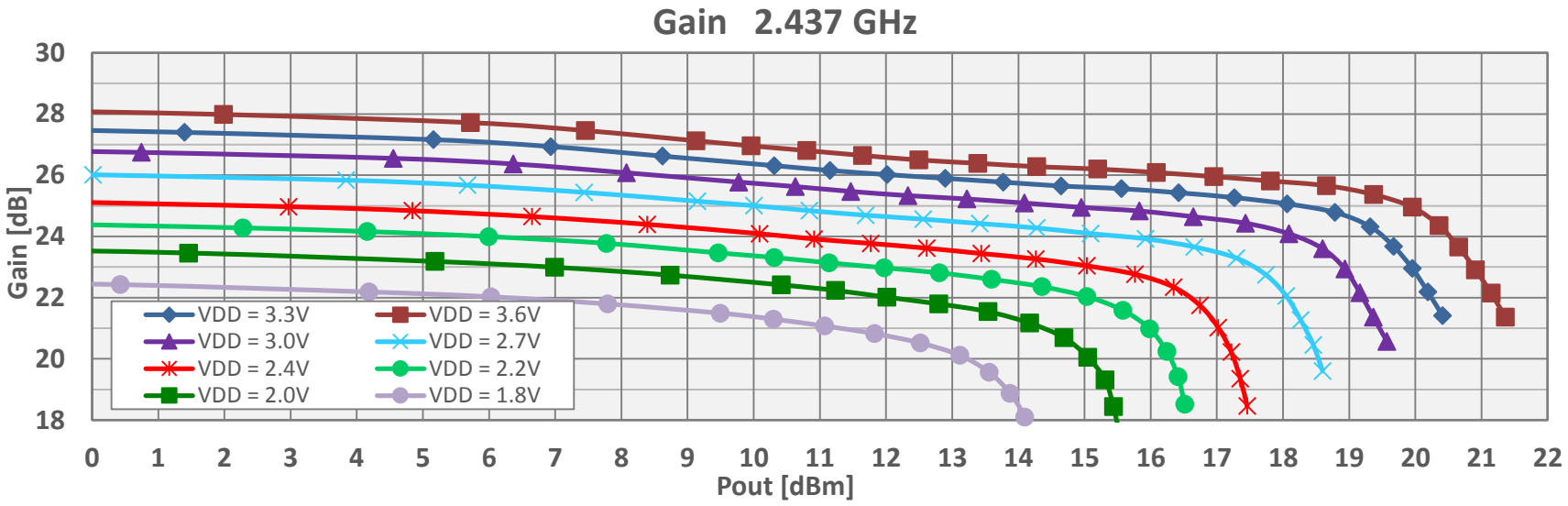



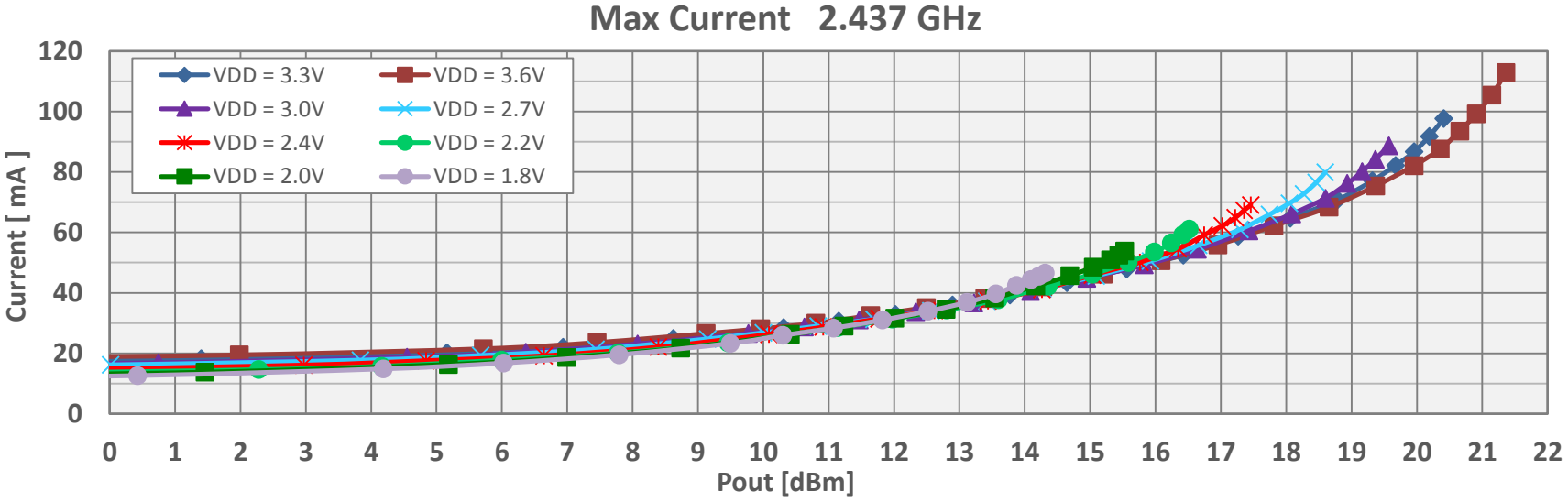
# TX Gain & Current vs. Pout Across Frequency
# Antenna B, CW Signal



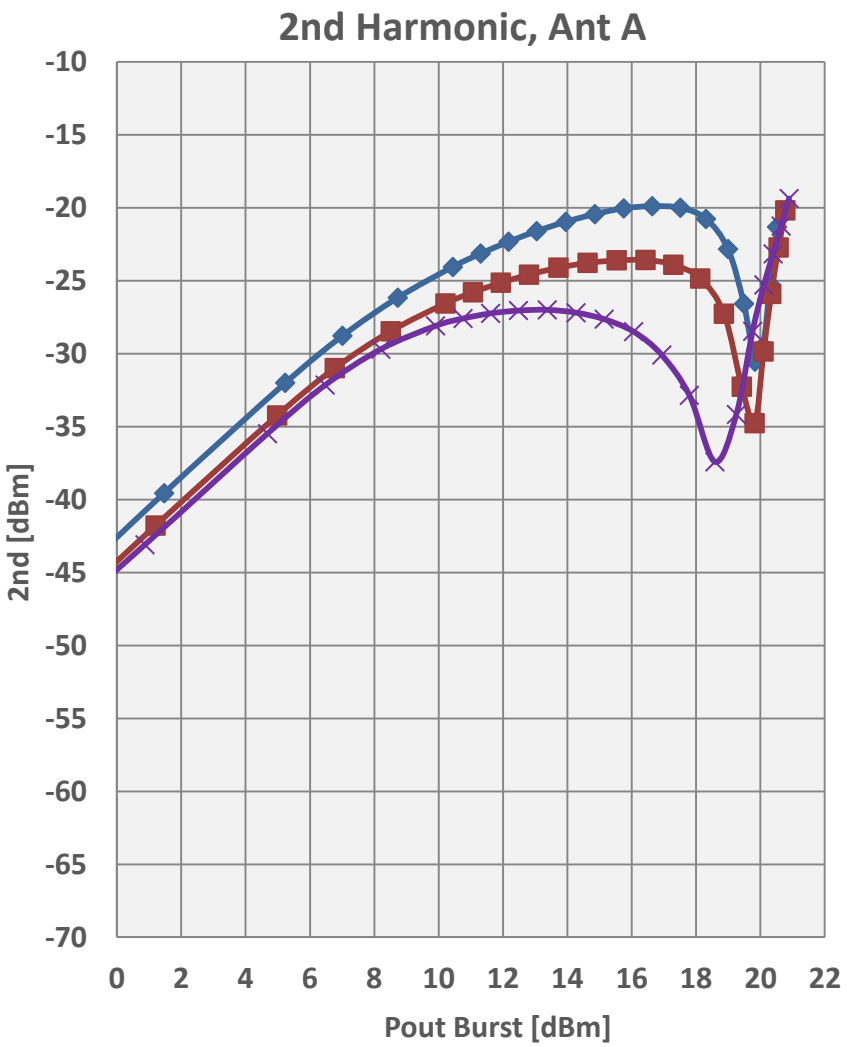



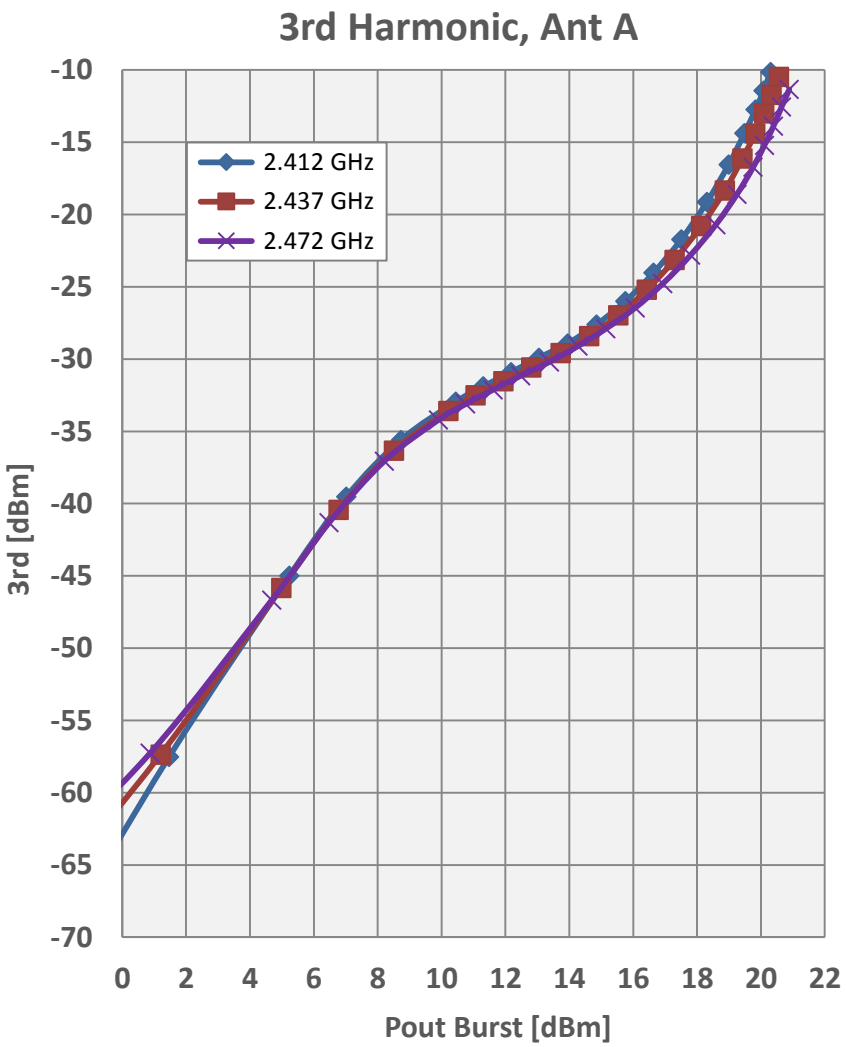
# TX Gain & Current vs. Pout Across Voltage
# 2.437 GHz, Antenna B, CW Signal



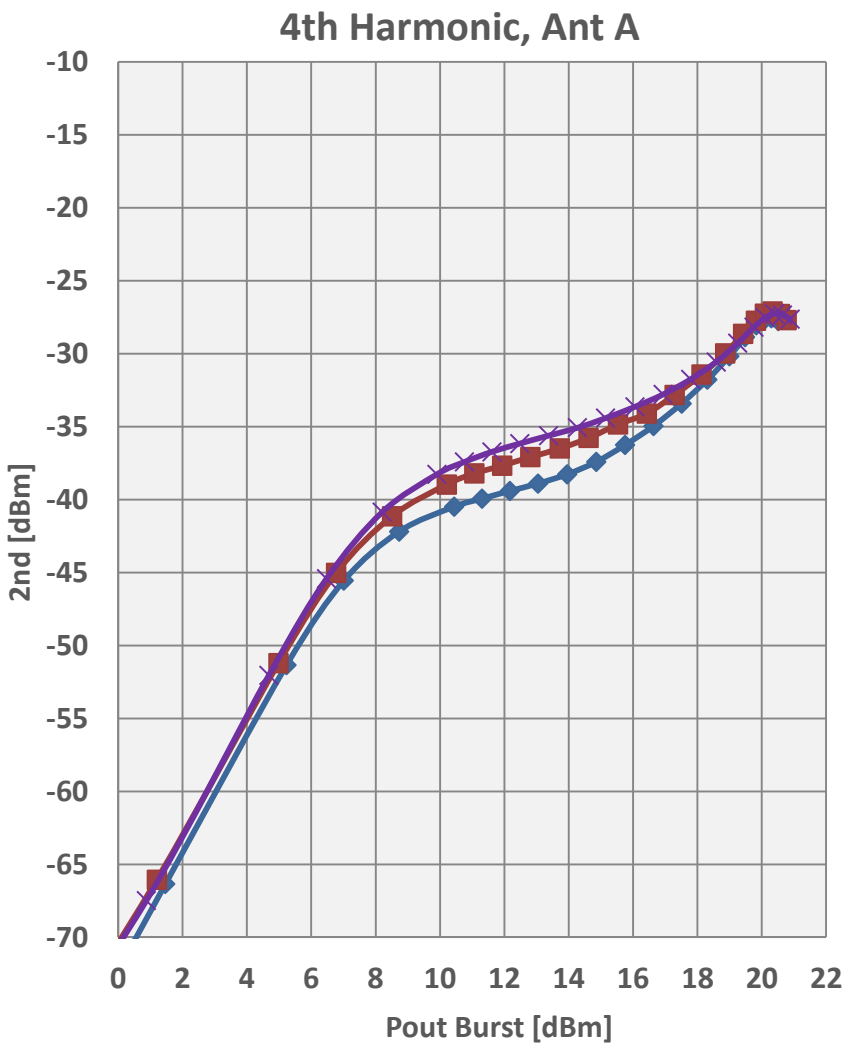



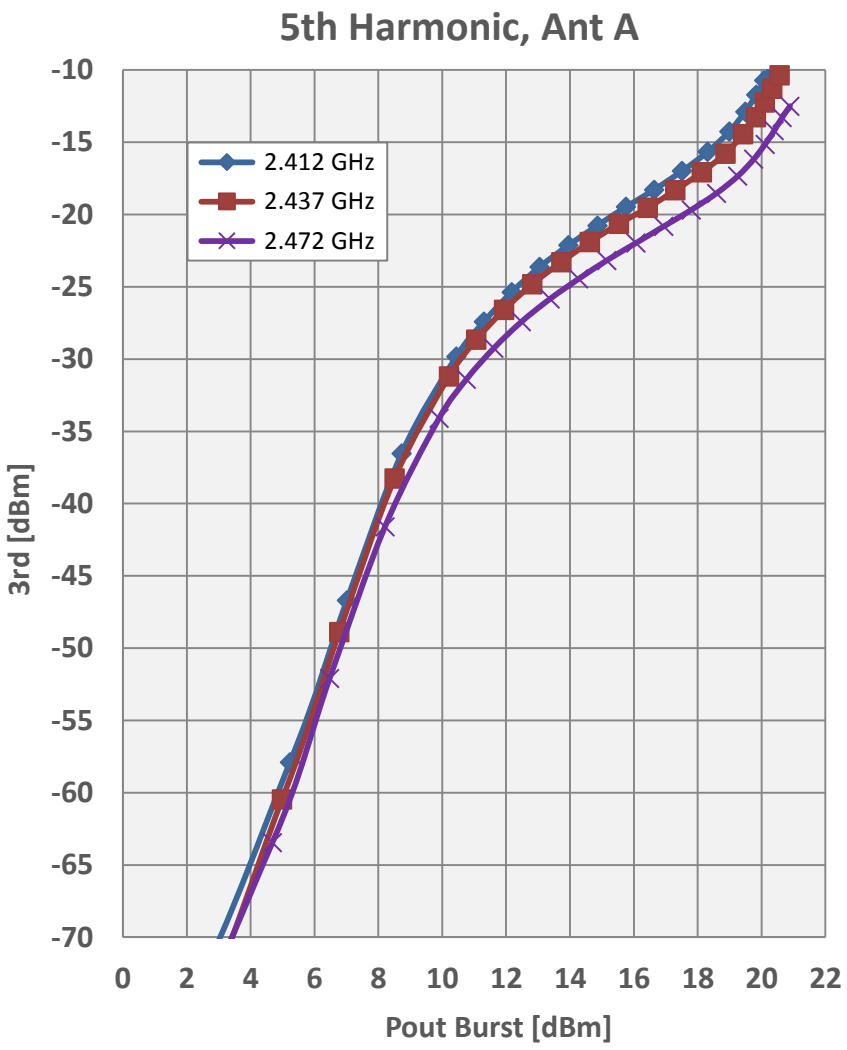
# TX 2nd and 3rd Harmonics vs. Pout Across Frequency
## Antenna A, VDD = 3.3V, CW Signal



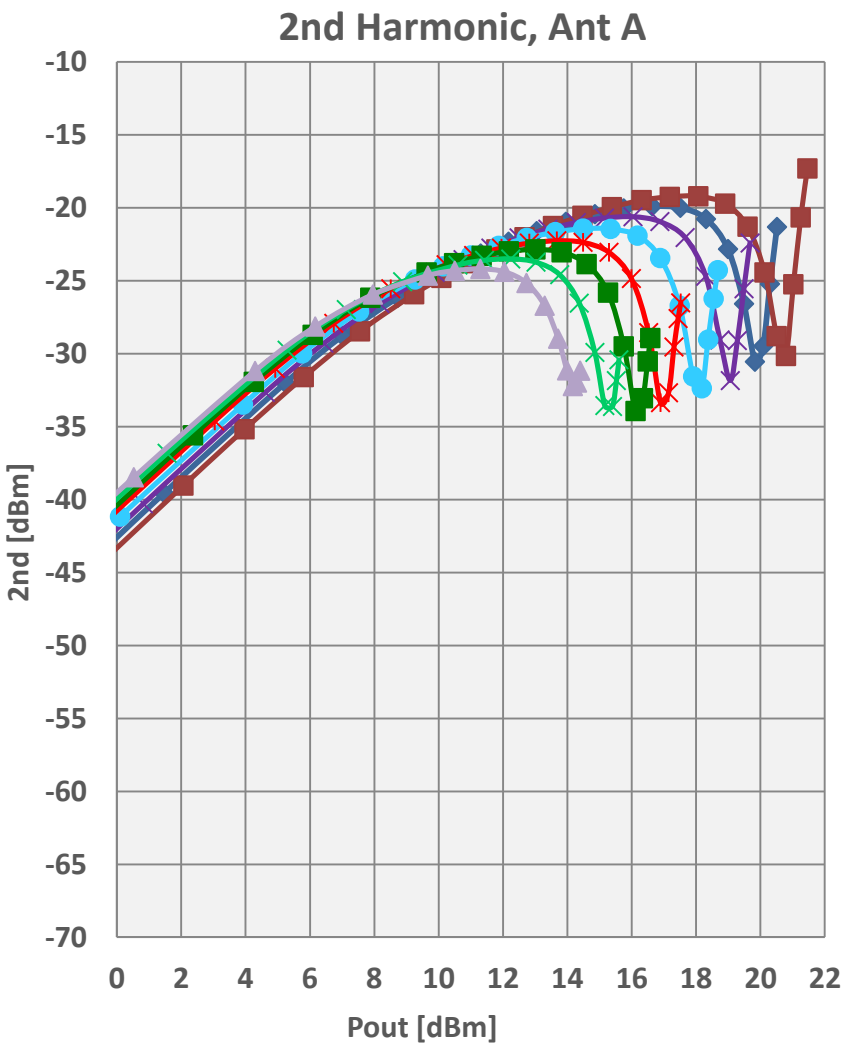



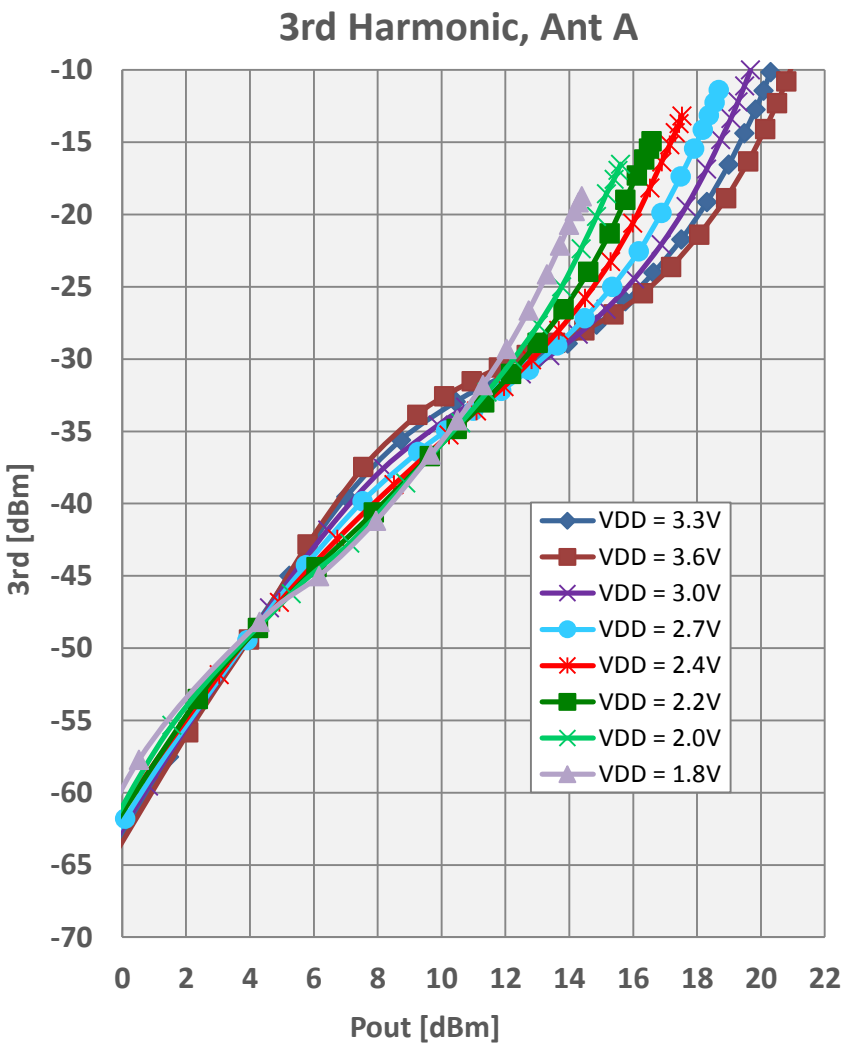
# TX 4th and 5th Harmonics vs. Pout Across Frequency
# Antenna A, VDD = 3.3V, CW Signal



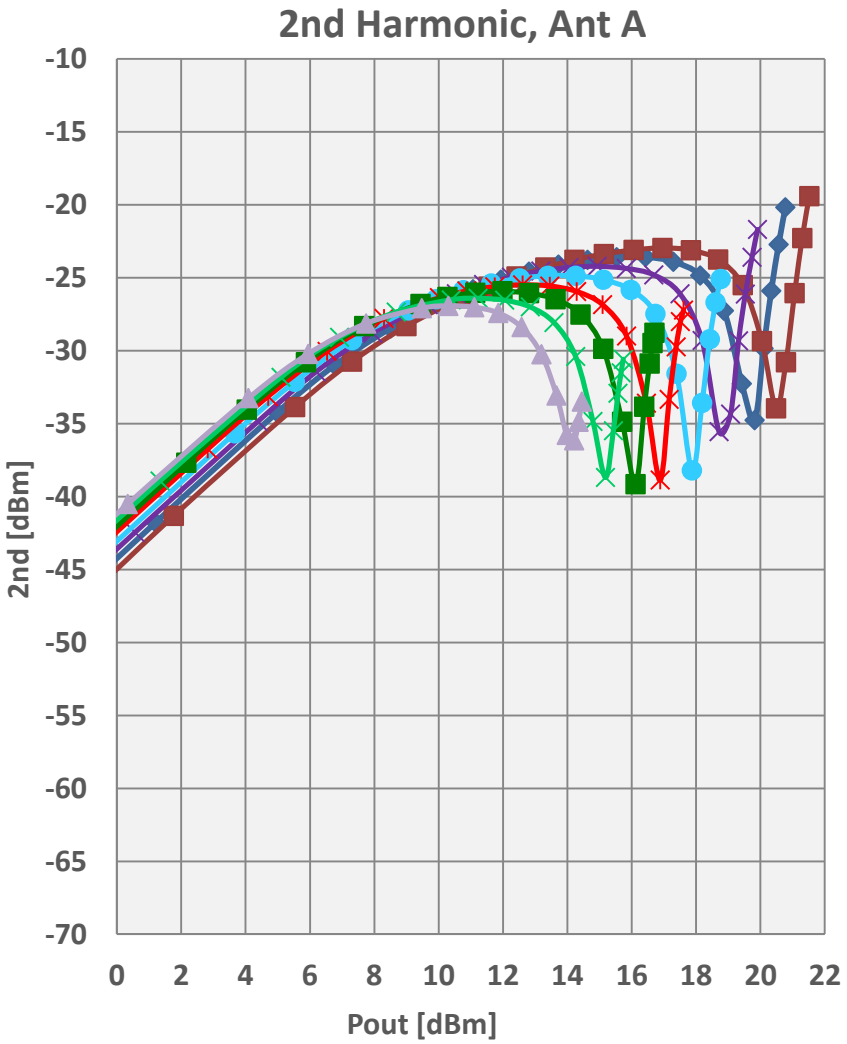



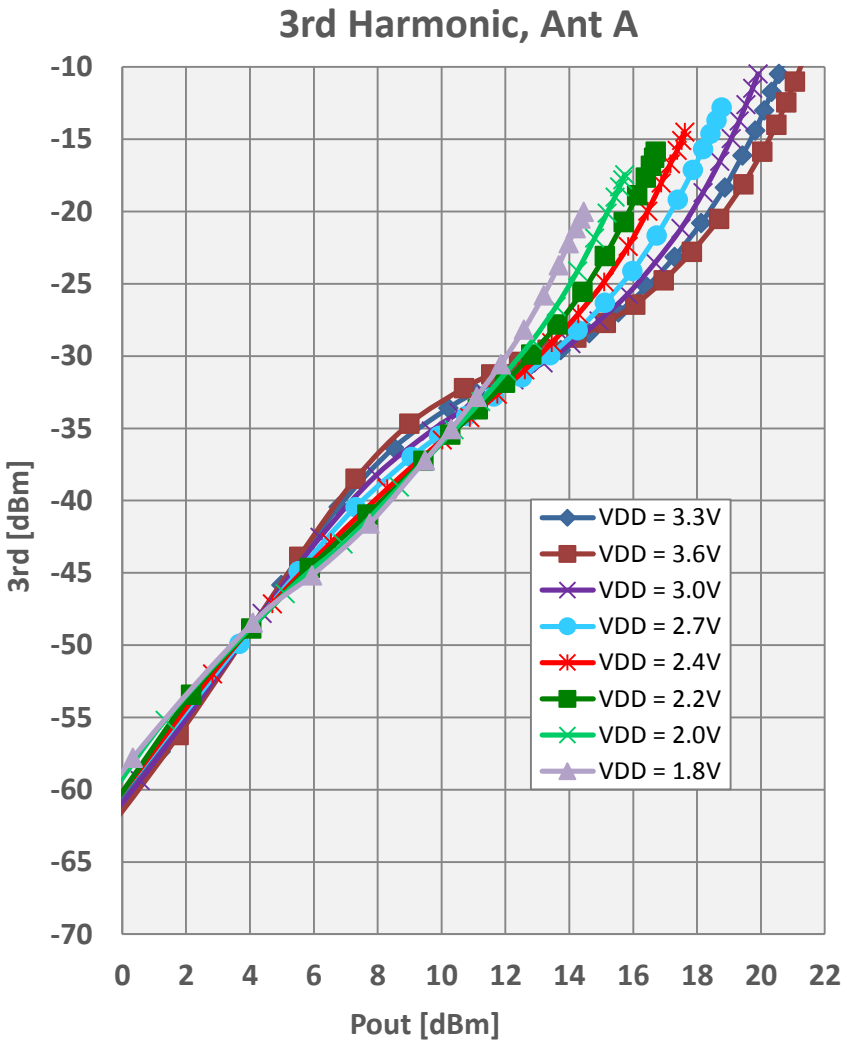
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.412 GHz, Antenna A, CW Signal



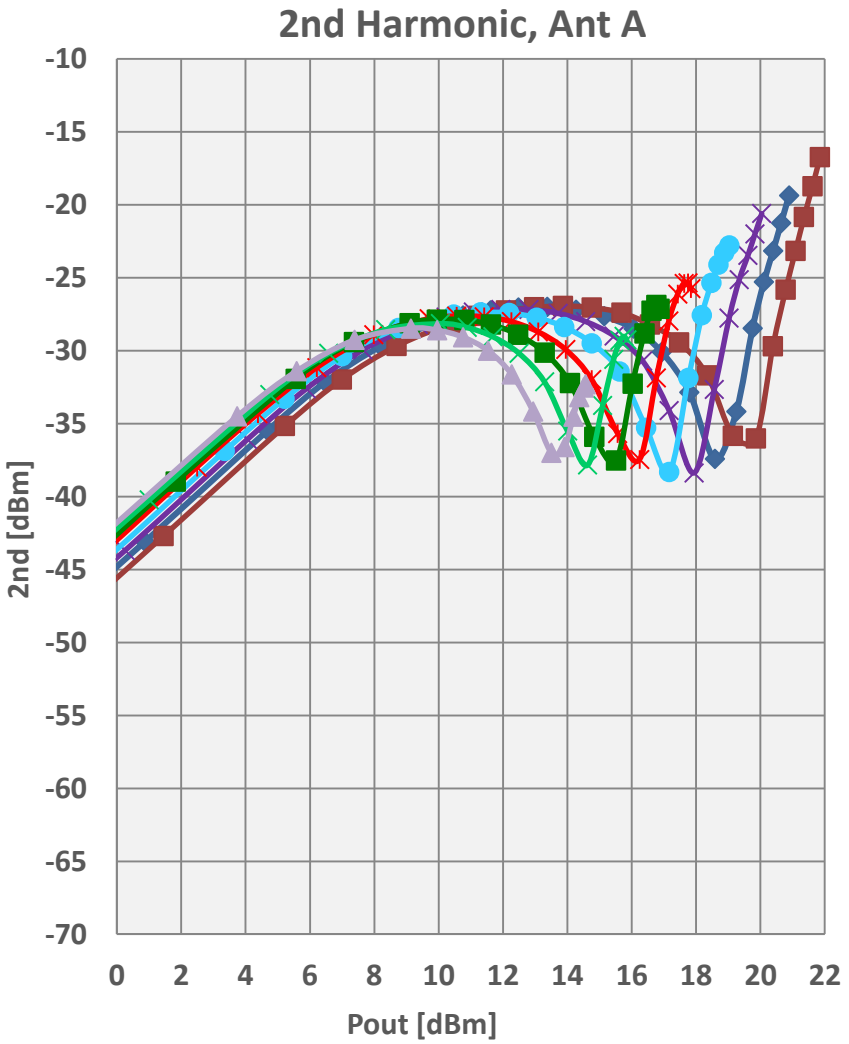



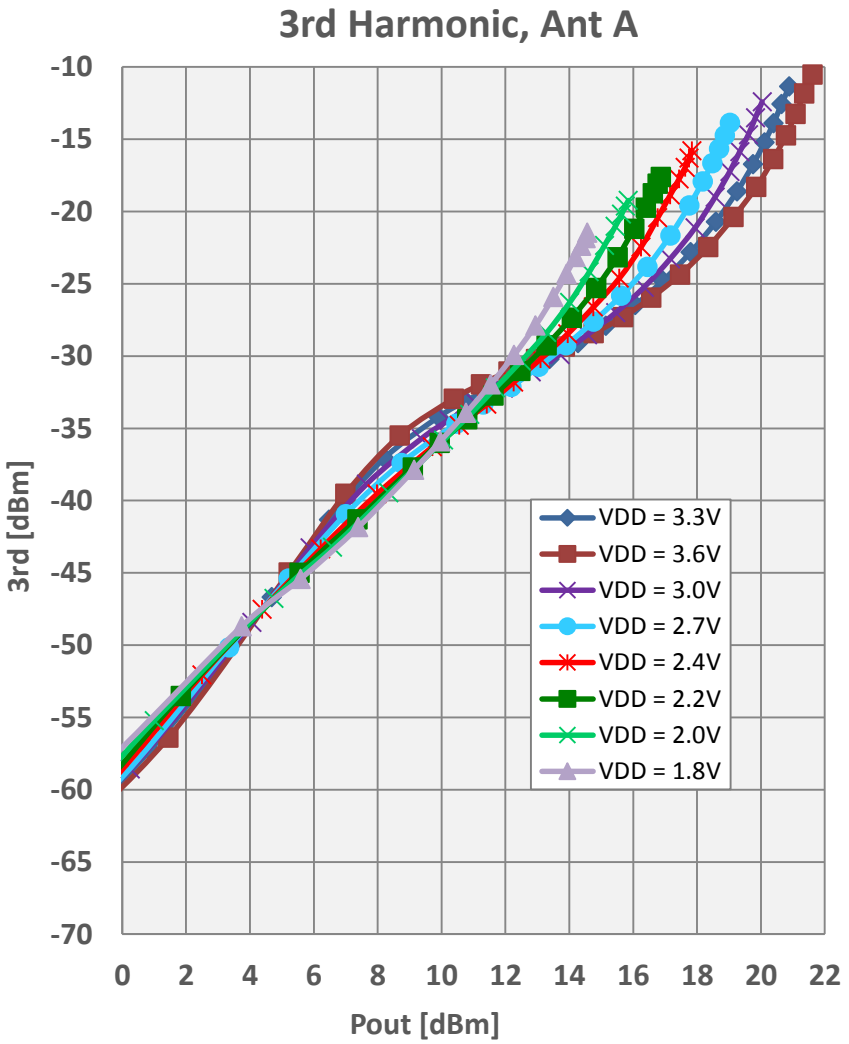
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.437 GHz, Antenna A, CW Signal



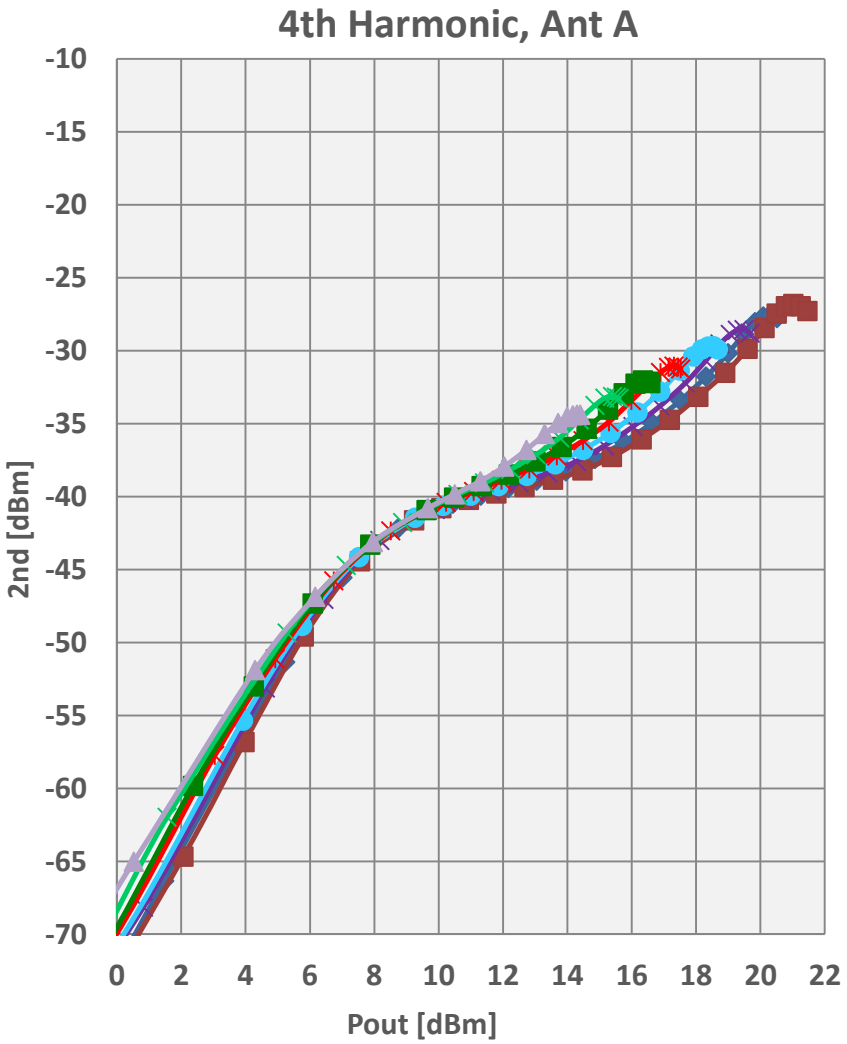



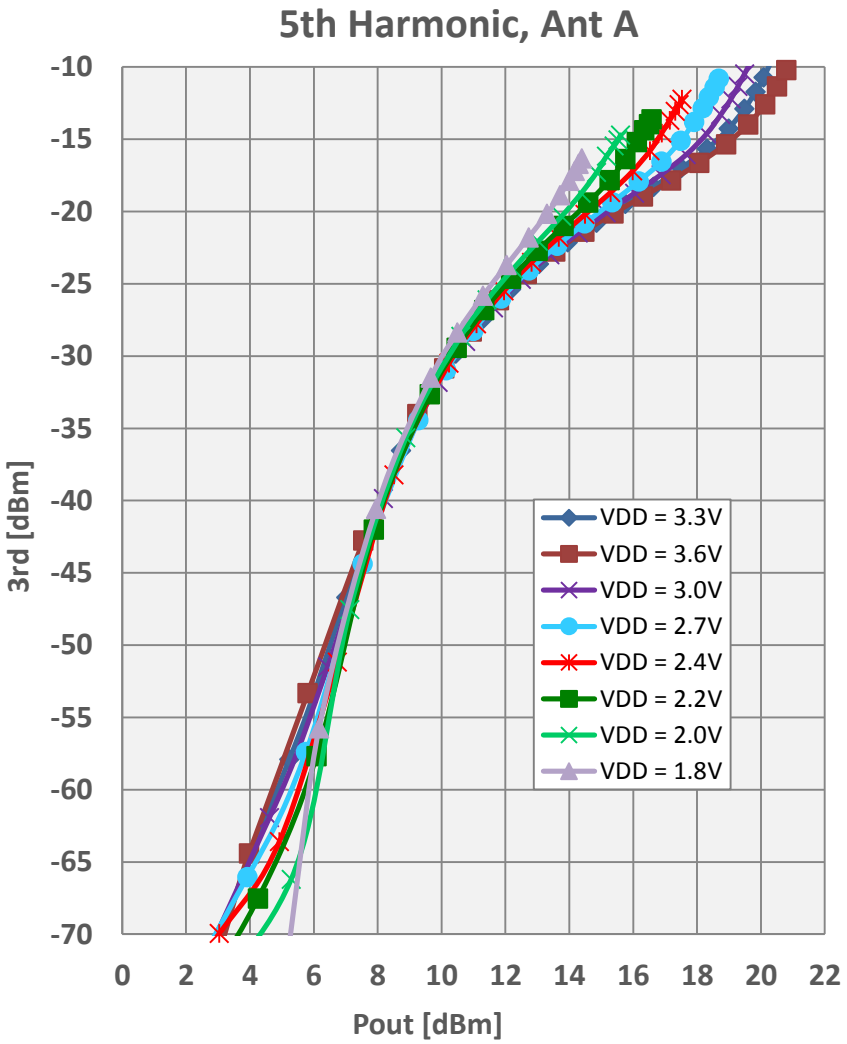
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.472 GHz, Antenna A, CW Signal



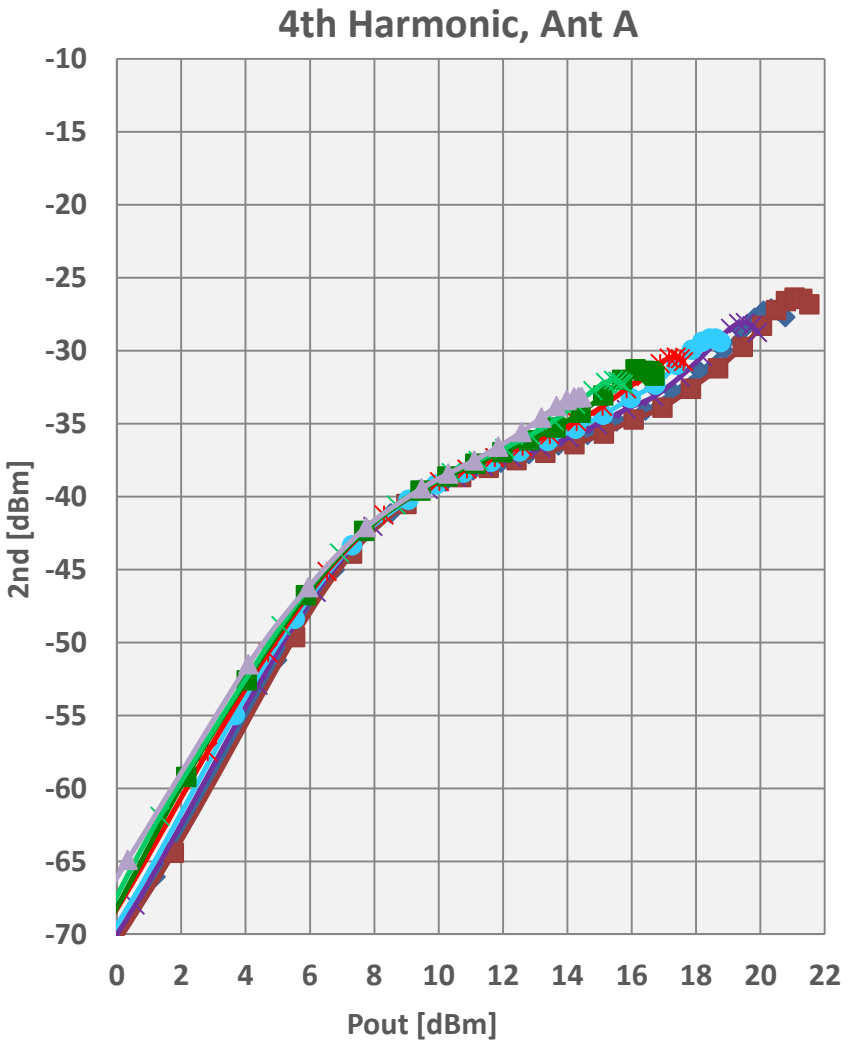



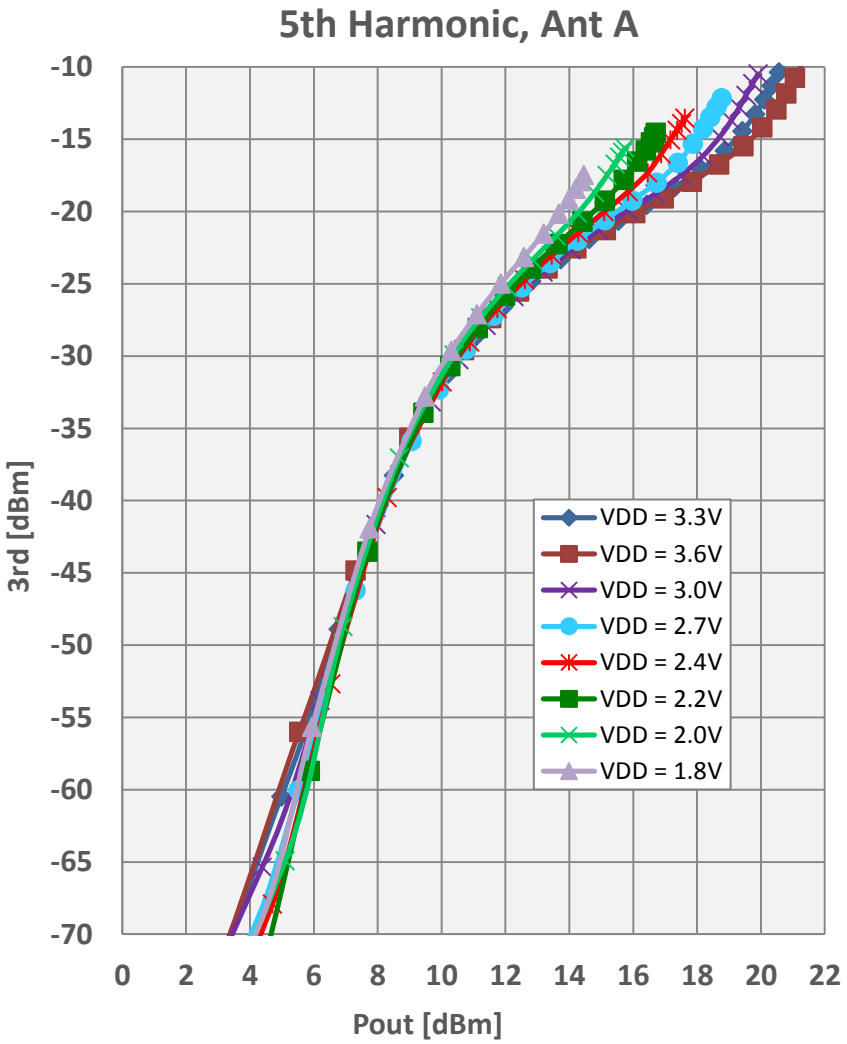
# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.412 GHz, Antenna A, CW Signal



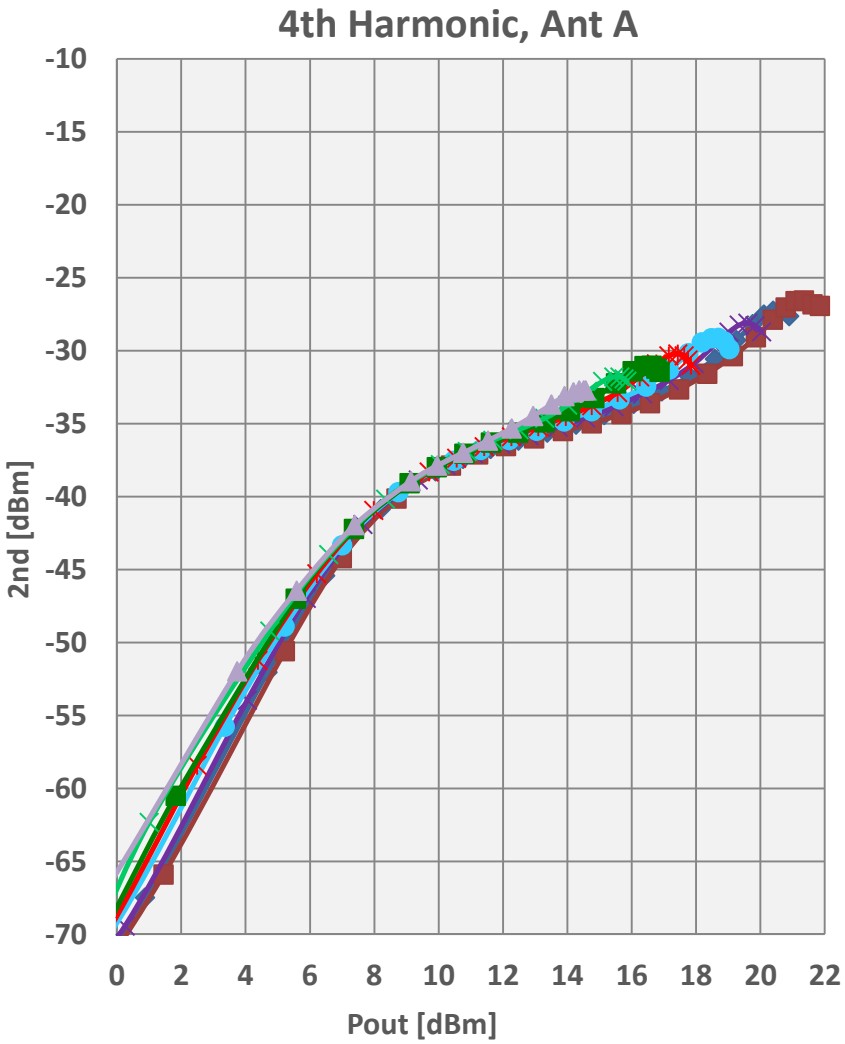



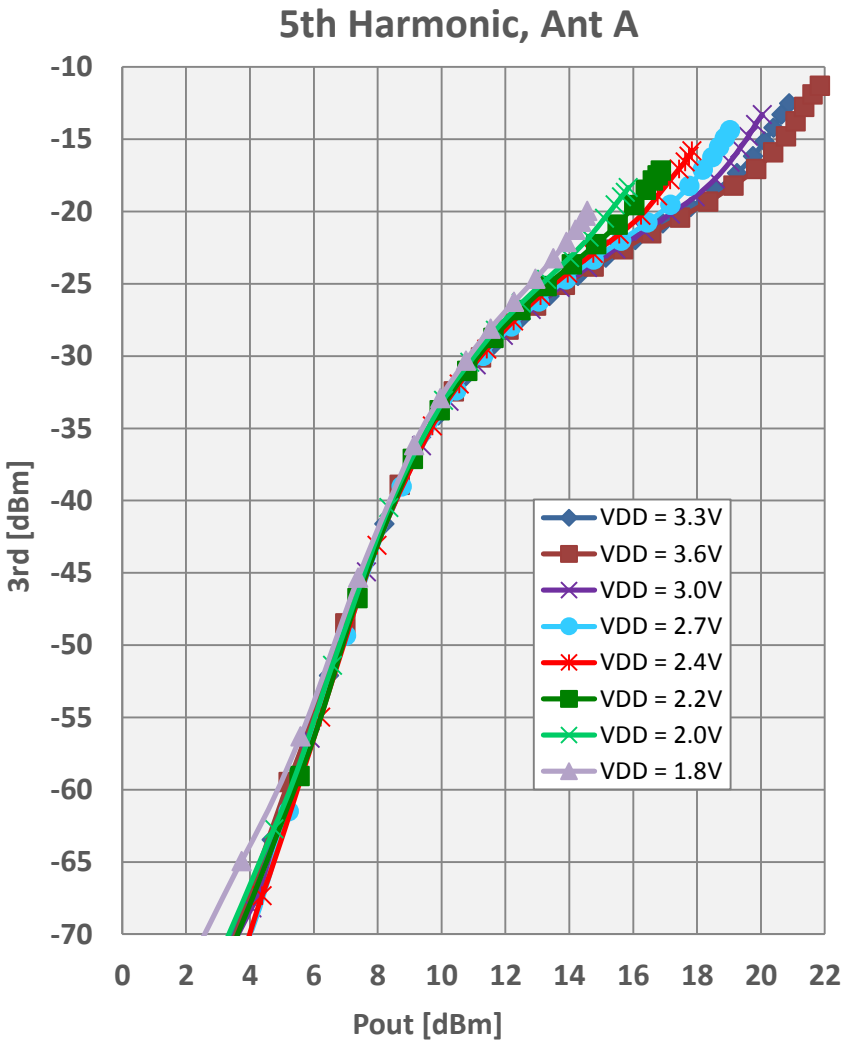
# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.437 GHz, Antenna A, CW Signal



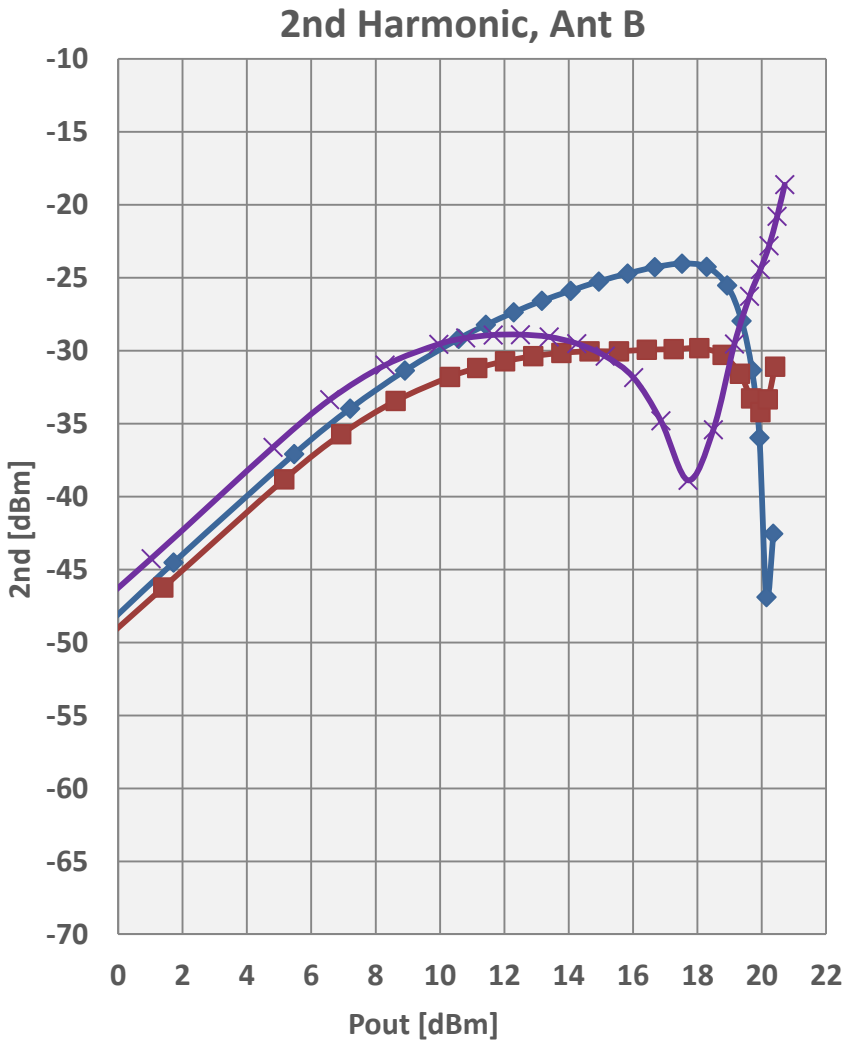



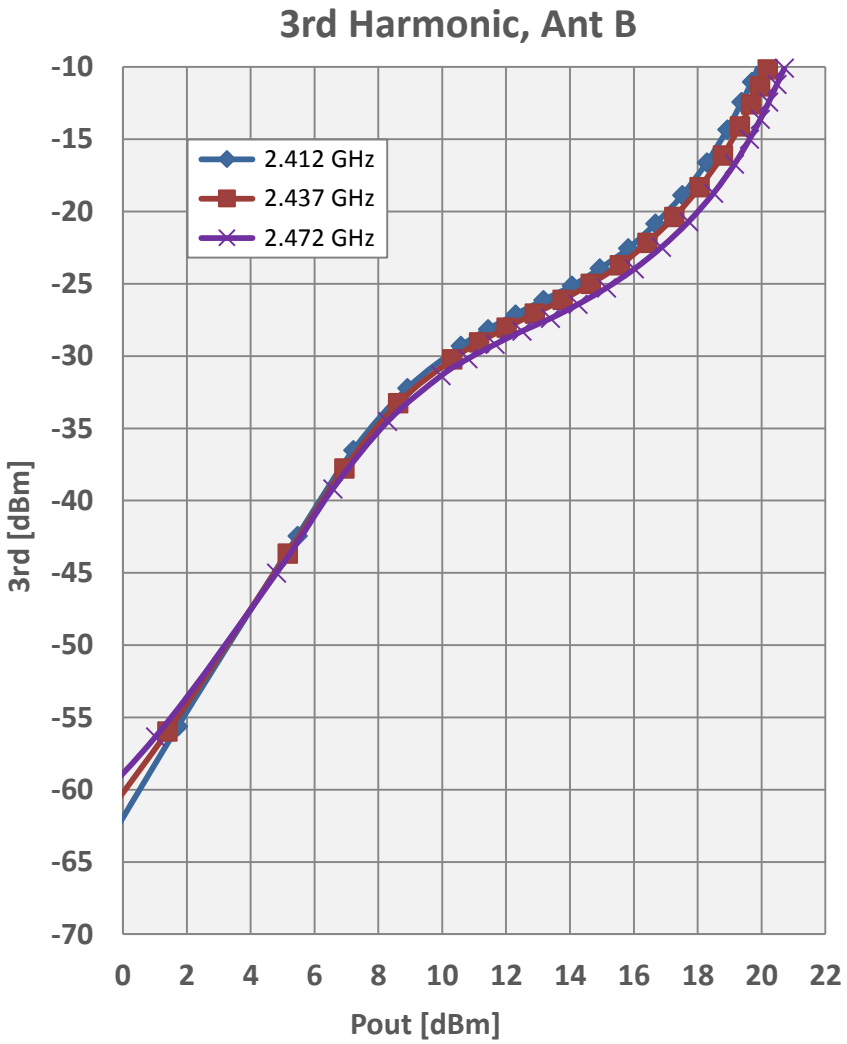
# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.472 GHz, Antenna A, CW Signal



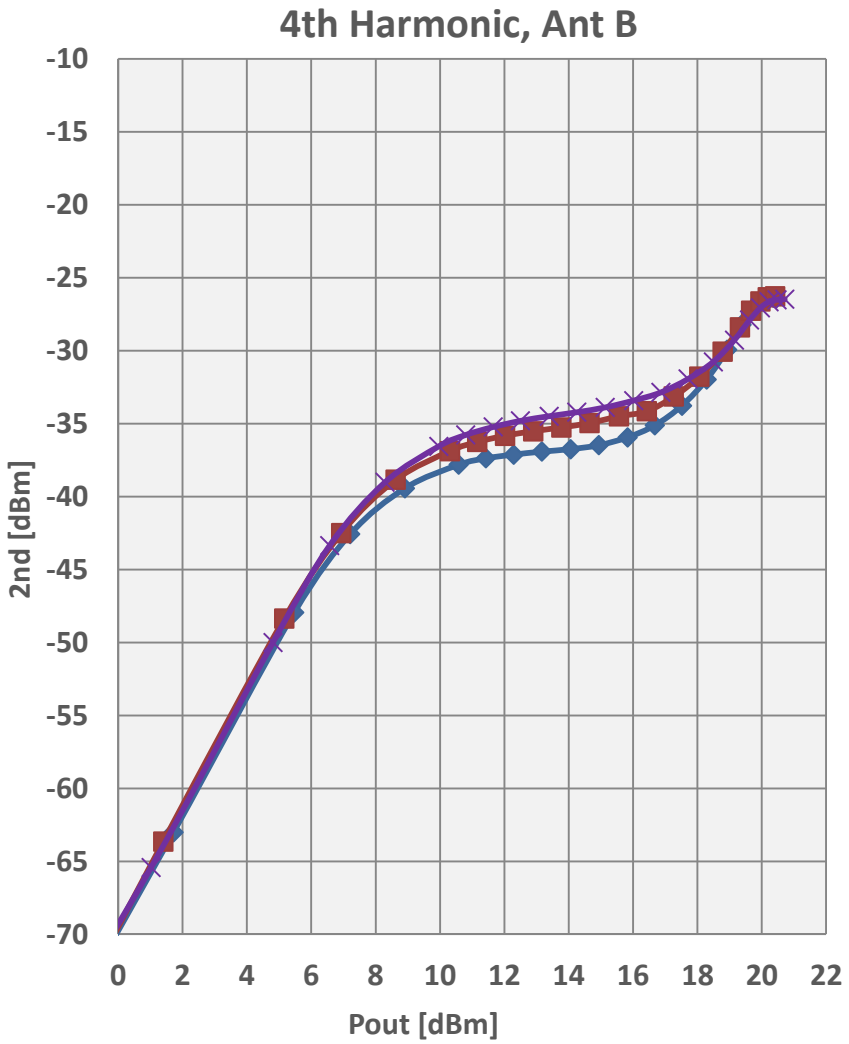



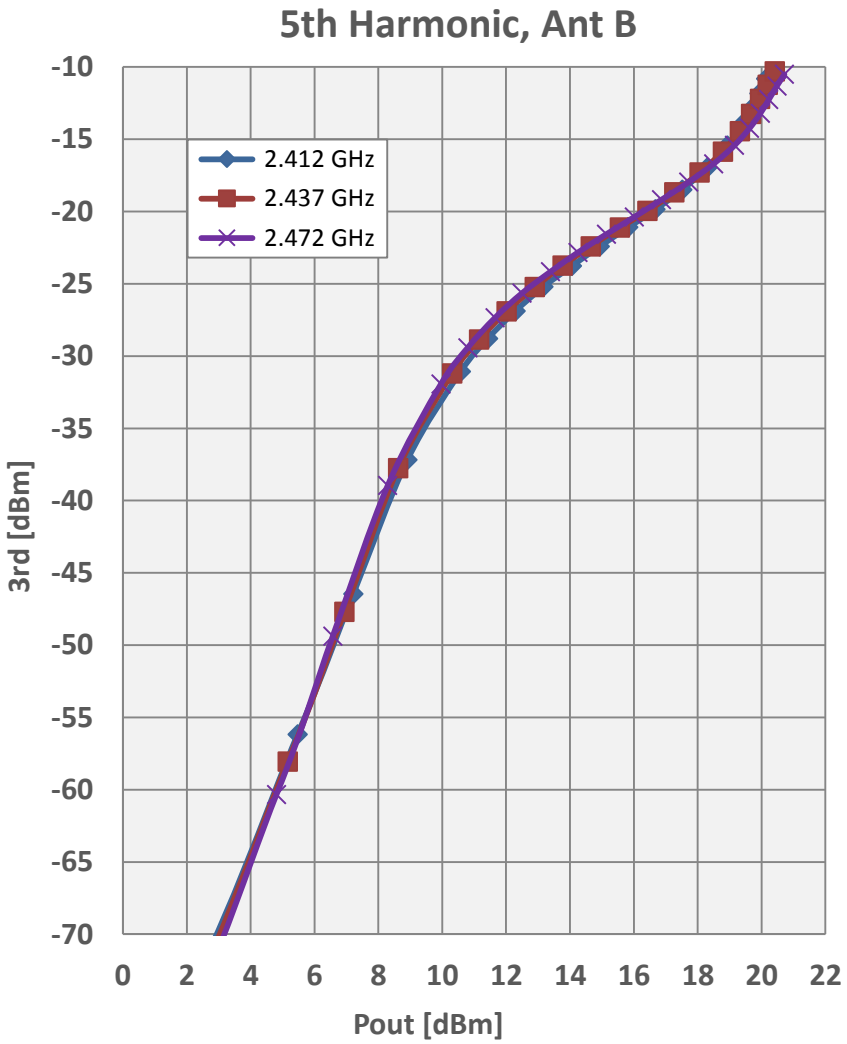
# TX 2nd and 3rd Harmonics vs. Pout Across Frequency
## Antenna B, VDD = 3.3V, CW Signal



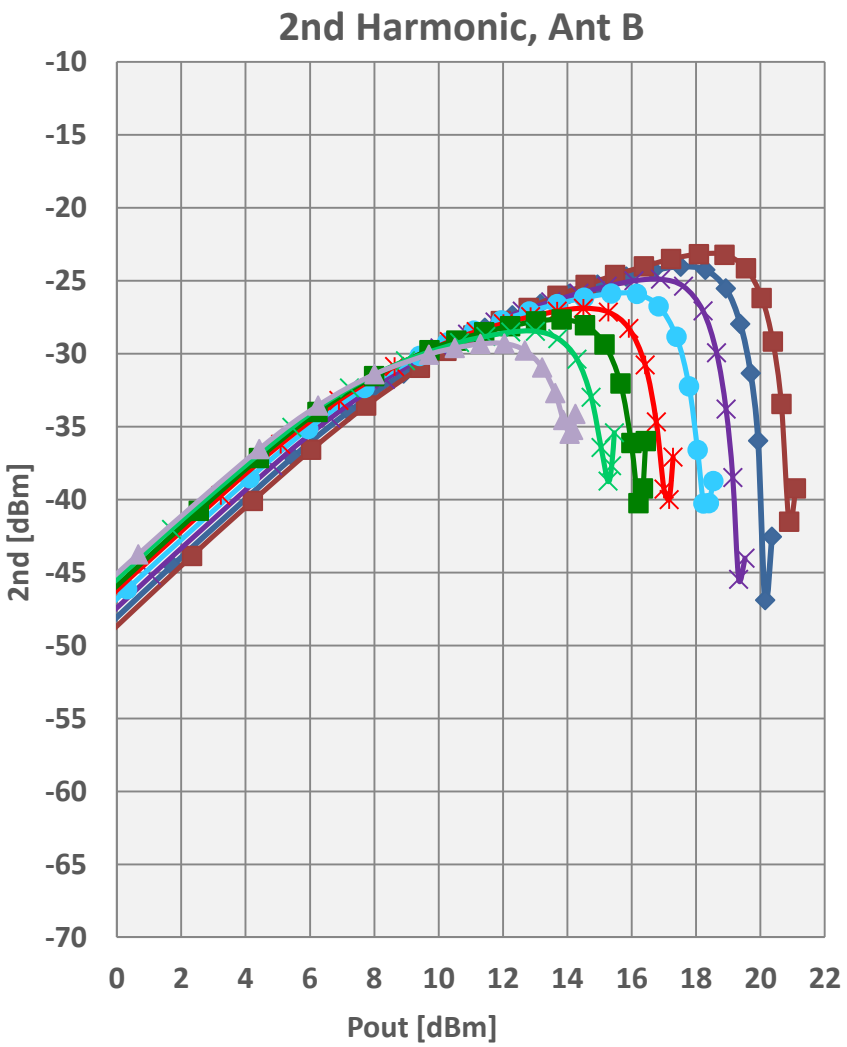



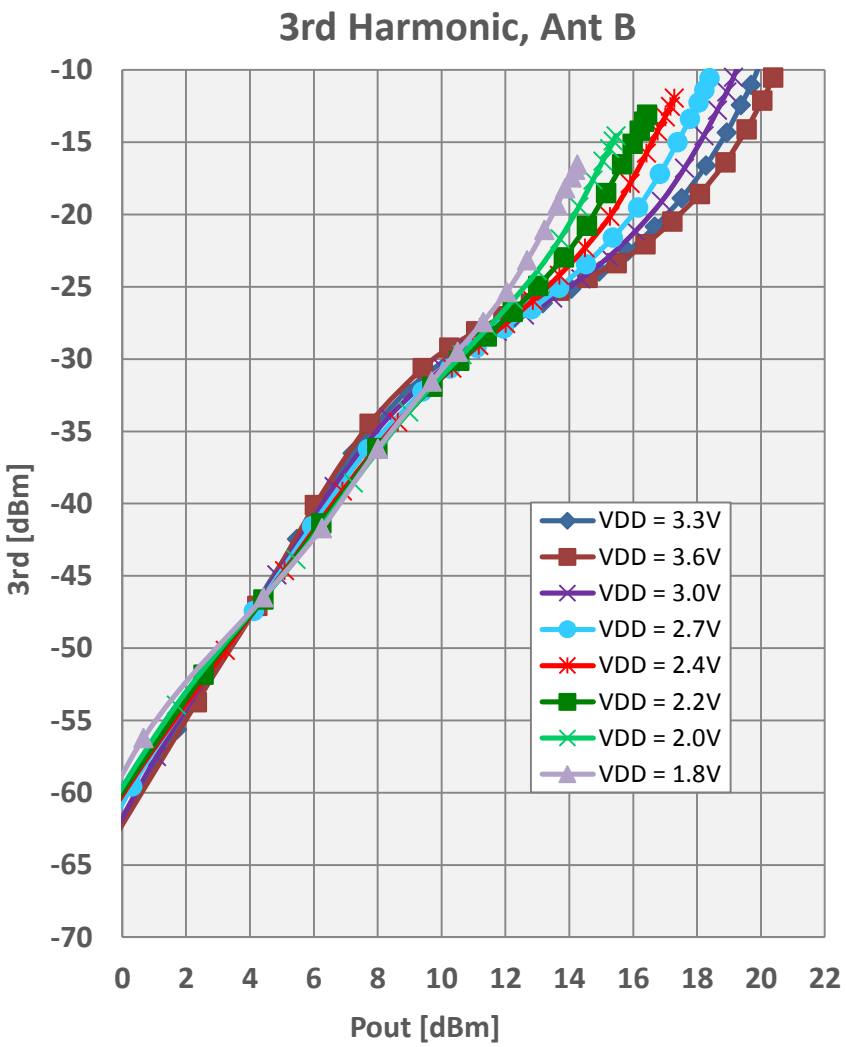
# TX 4th and 5th Harmonics vs. Pout Across Frequency
## Antenna B, VDD = 3.3V, CW Signal



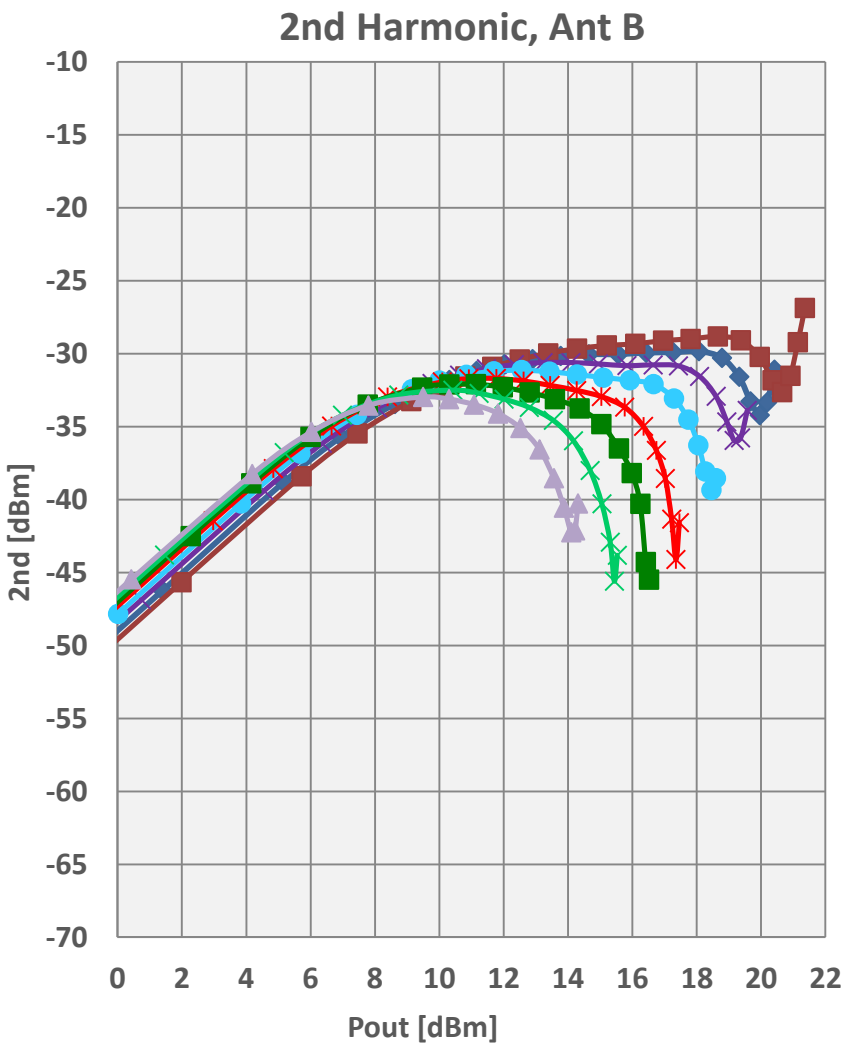



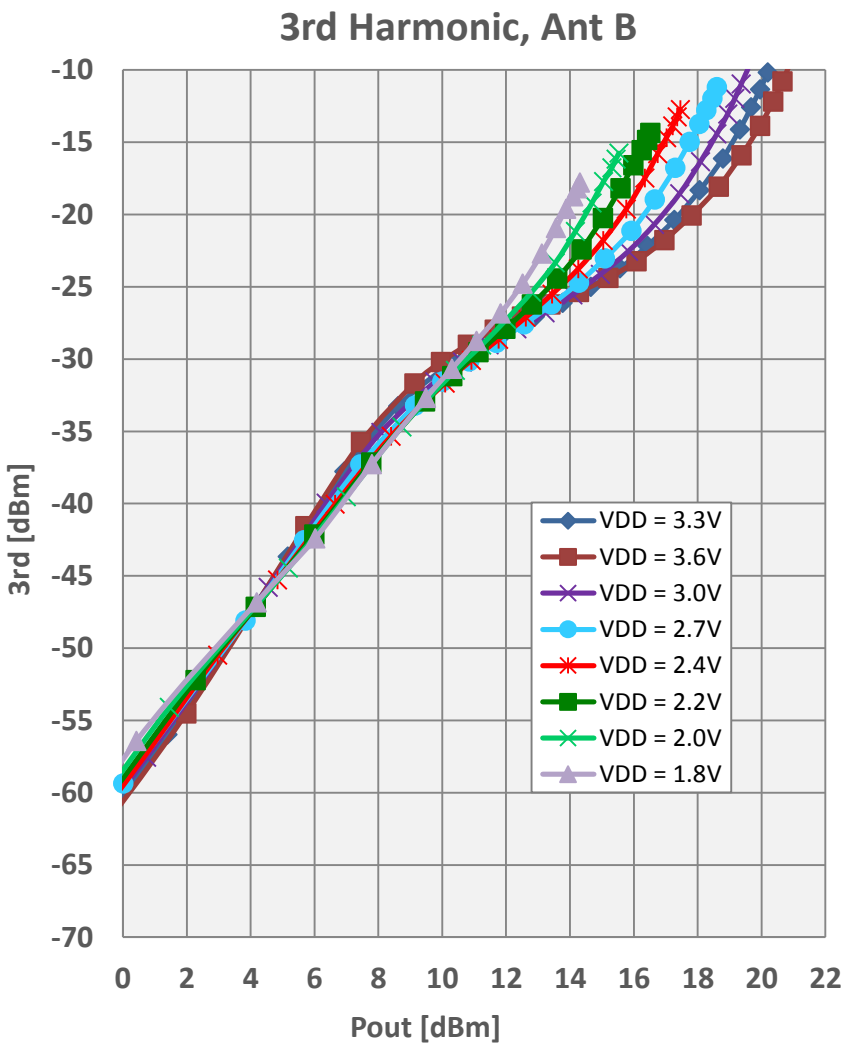
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.412 GHz, Antenna B, CW Signal



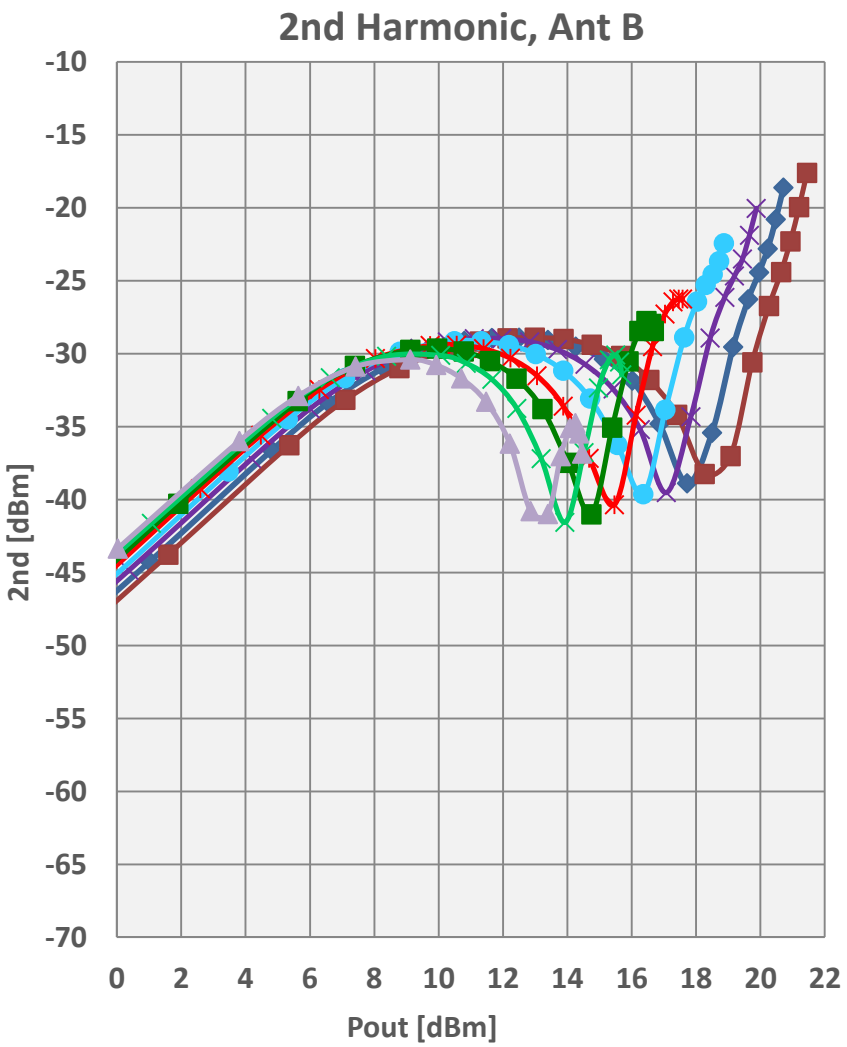



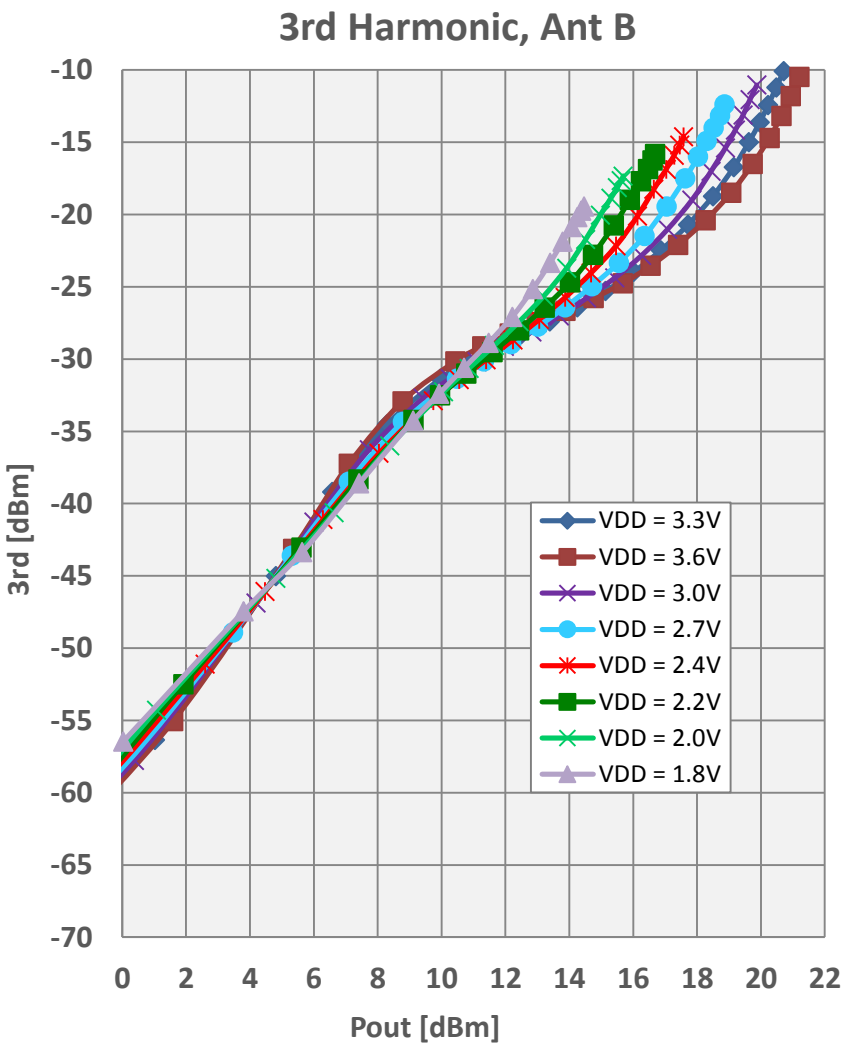
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.437 GHz, Antenna B, CW Signal



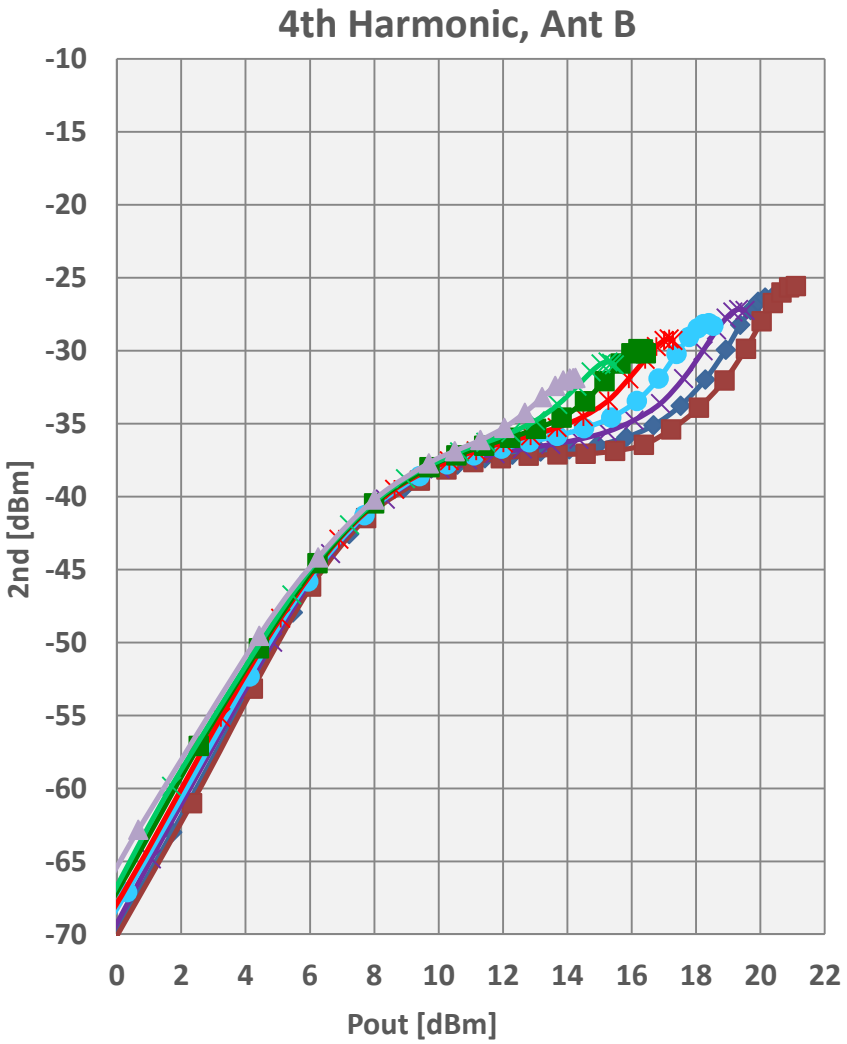



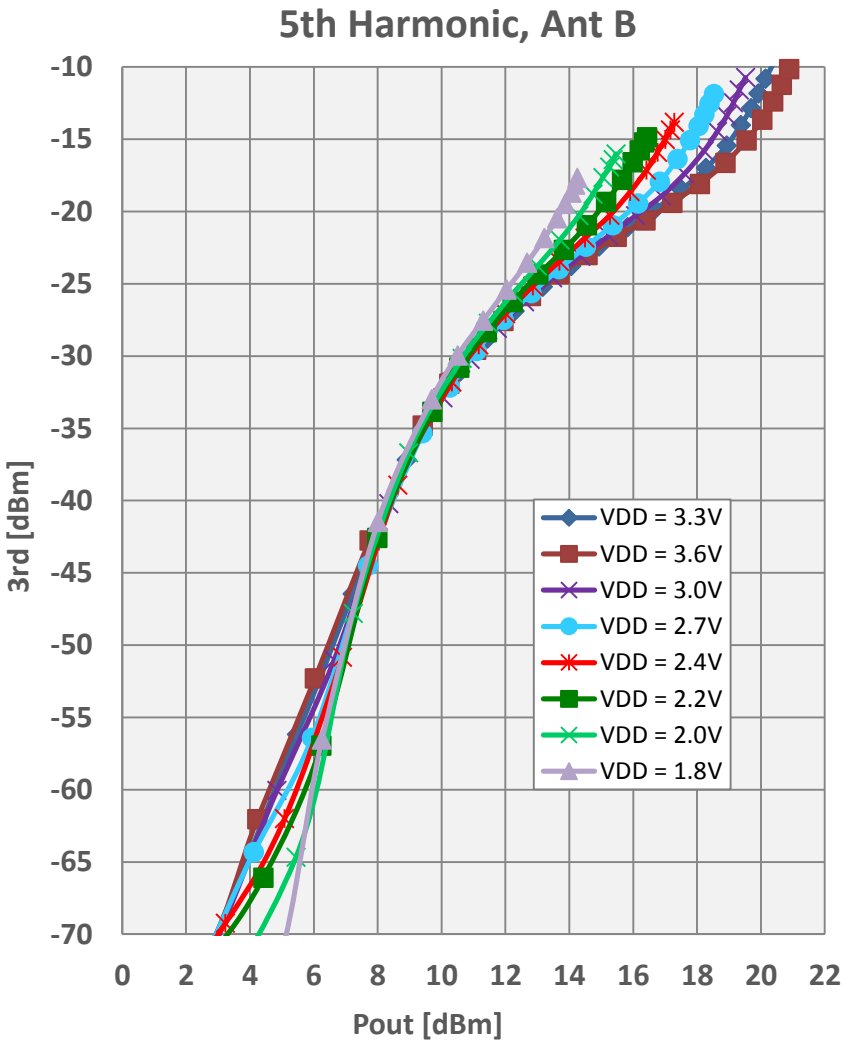
# TX 2nd and 3rd Harmonics vs. Pout Across Voltage
## 2.472 GHz, Antenna B, CW Signal



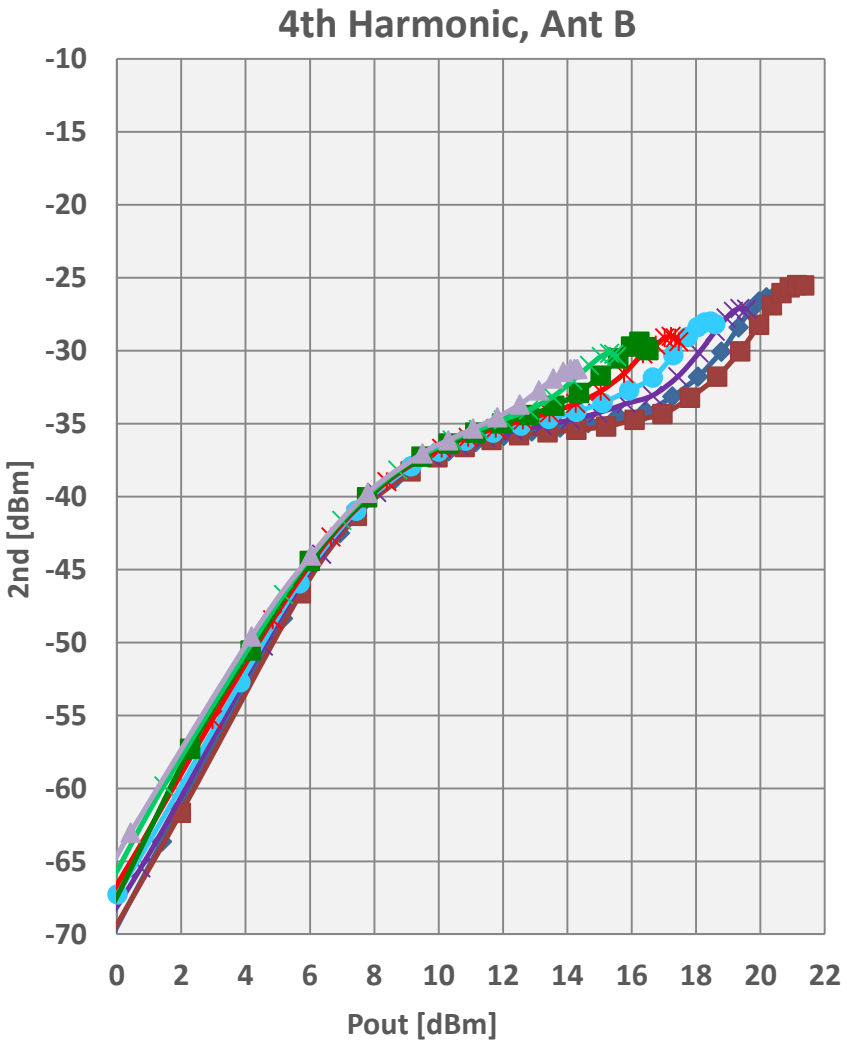



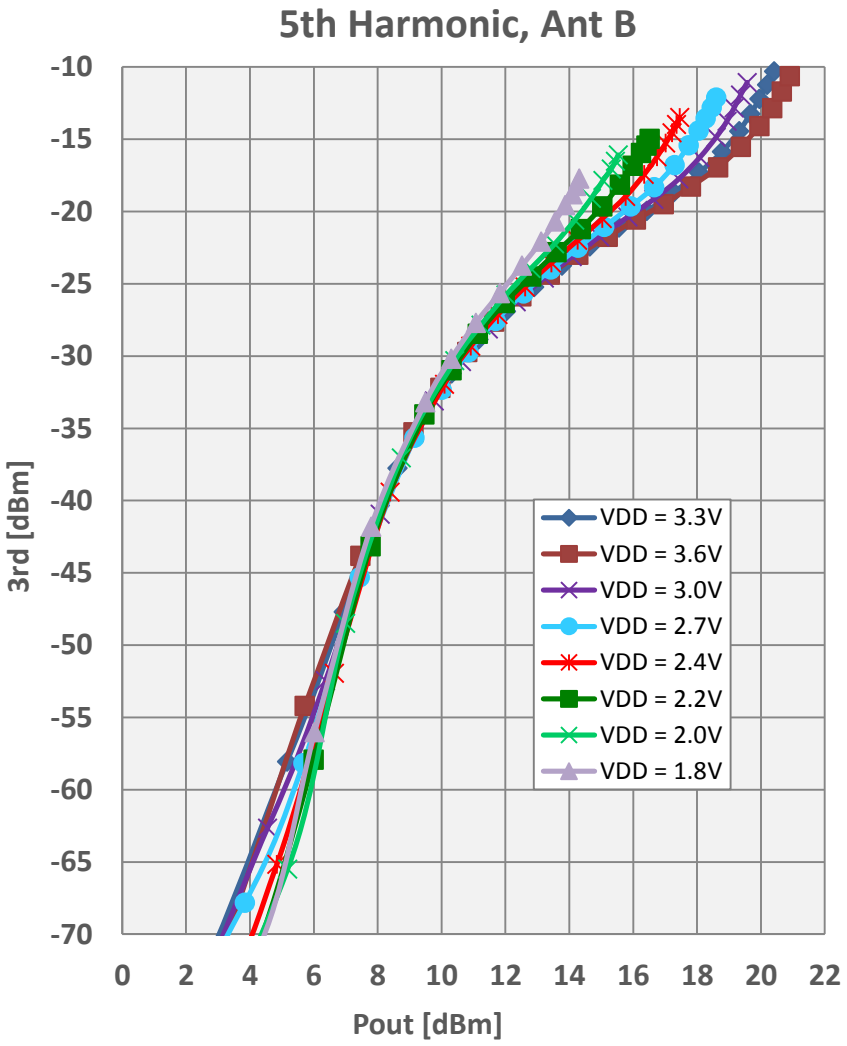
# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.412 GHz, Antenna B, CW Signal



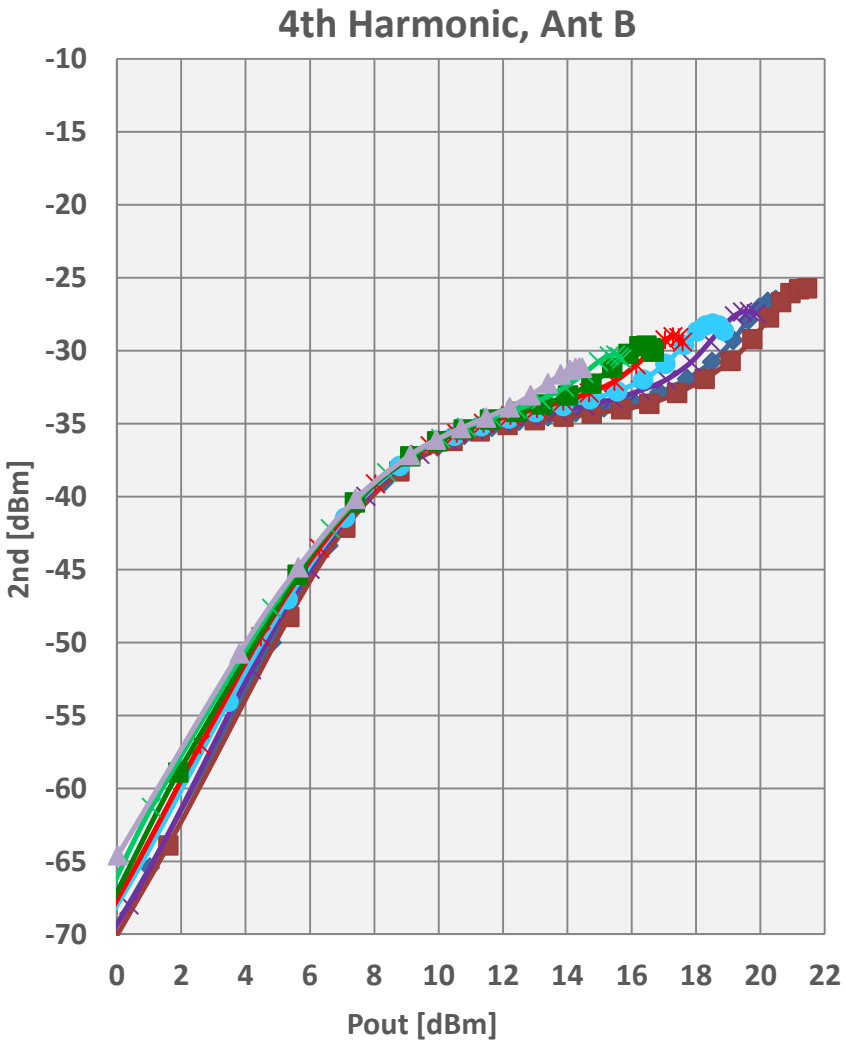



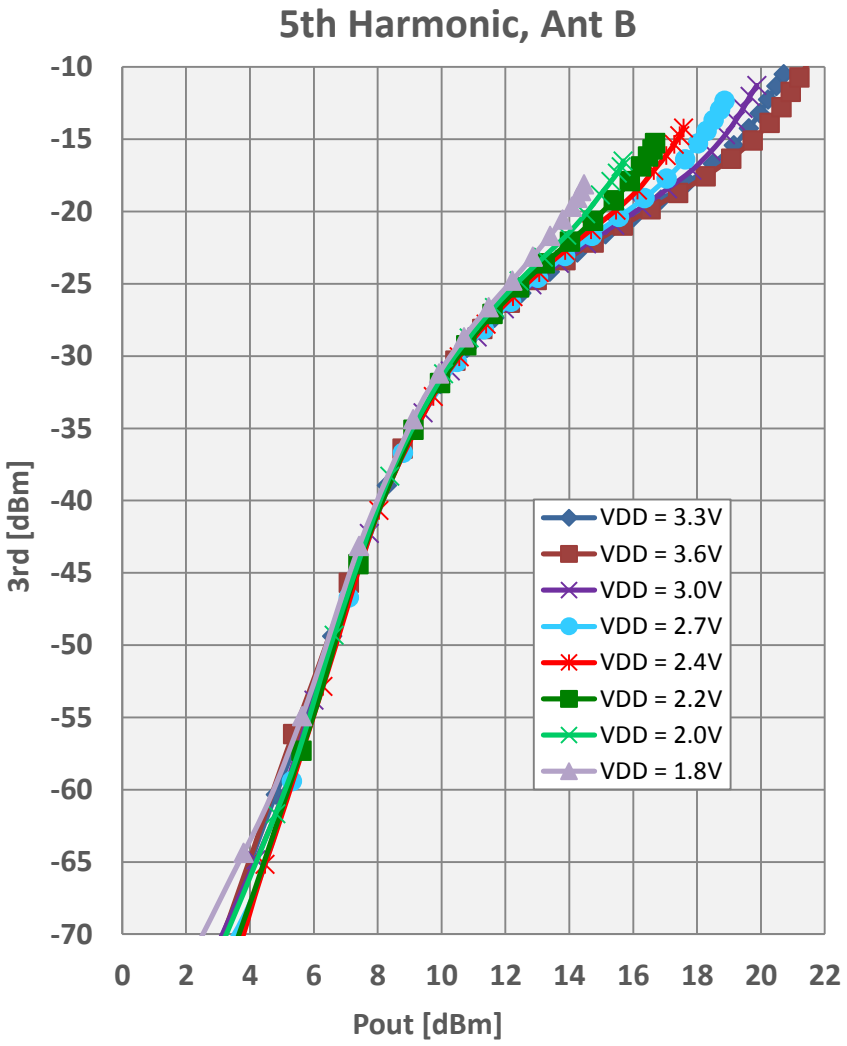
# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.437 GHz, Antenna B, CW Signal



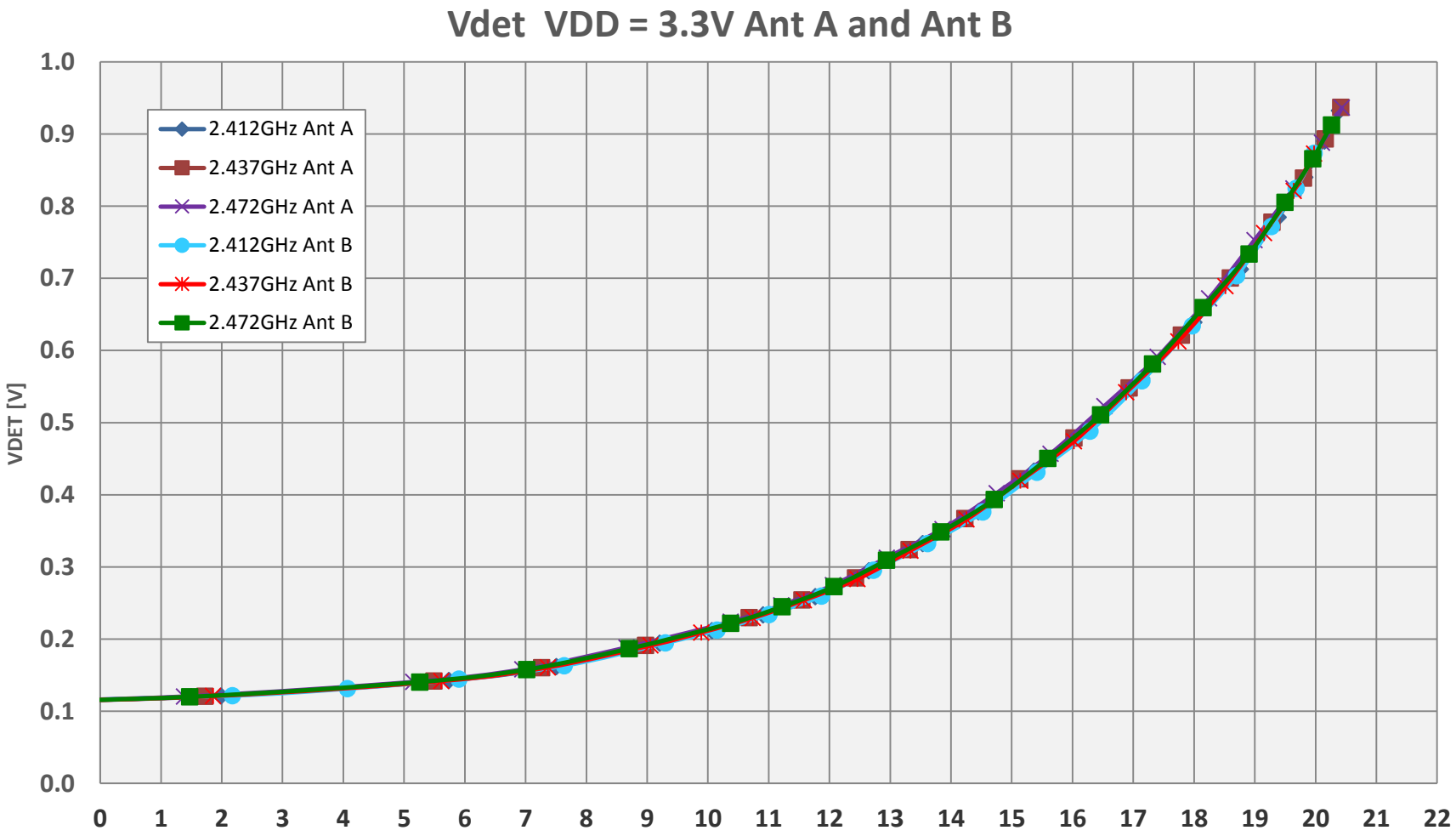



# TX 4th and 5th Harmonics vs. Pout Across Voltage
## 2.472 GHz, Antenna B, CW Signal



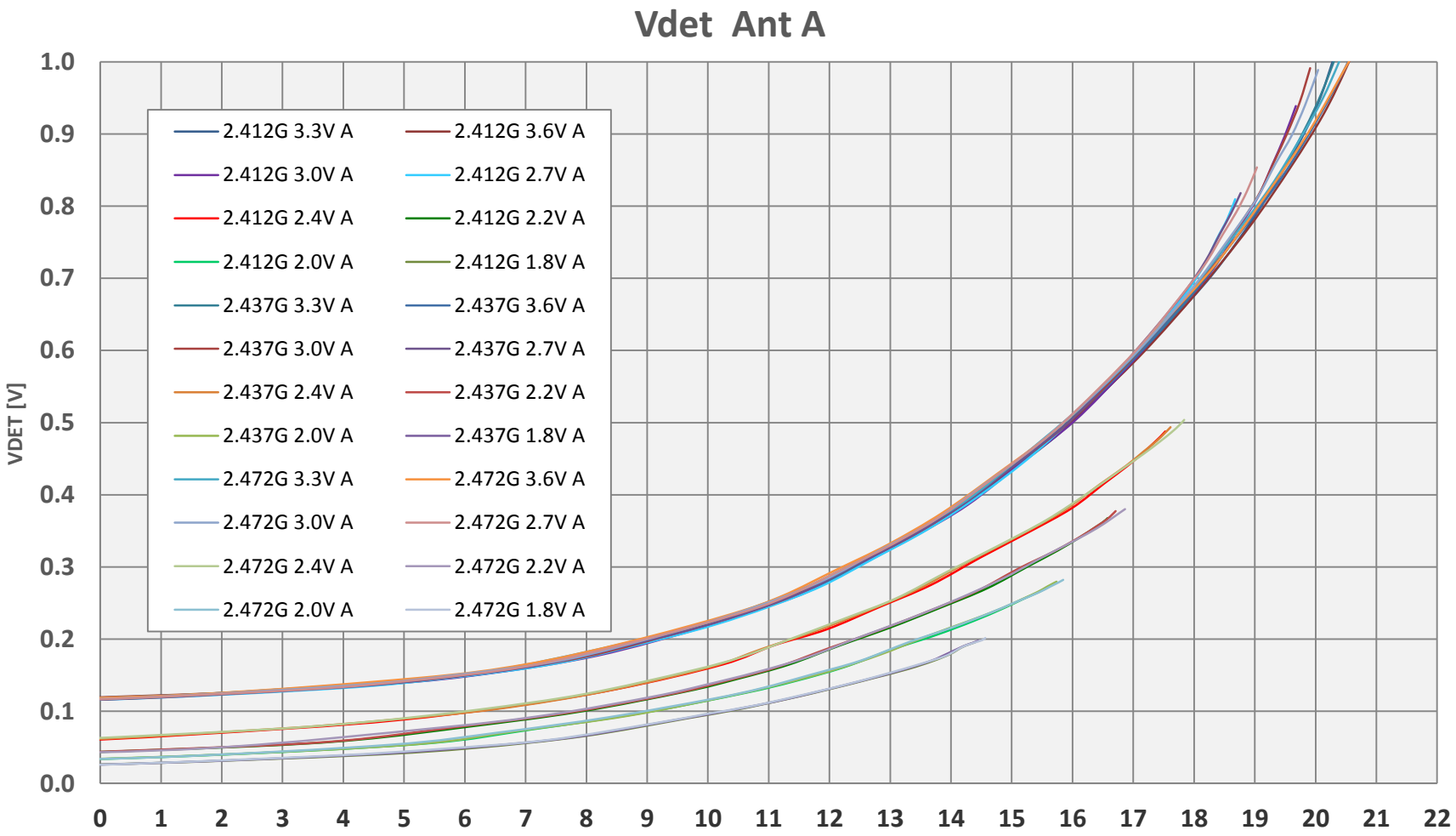



# TX Detector Voltage vs. Pout Across Frequency
# Ant A and Ant B, VDD = 3.3V



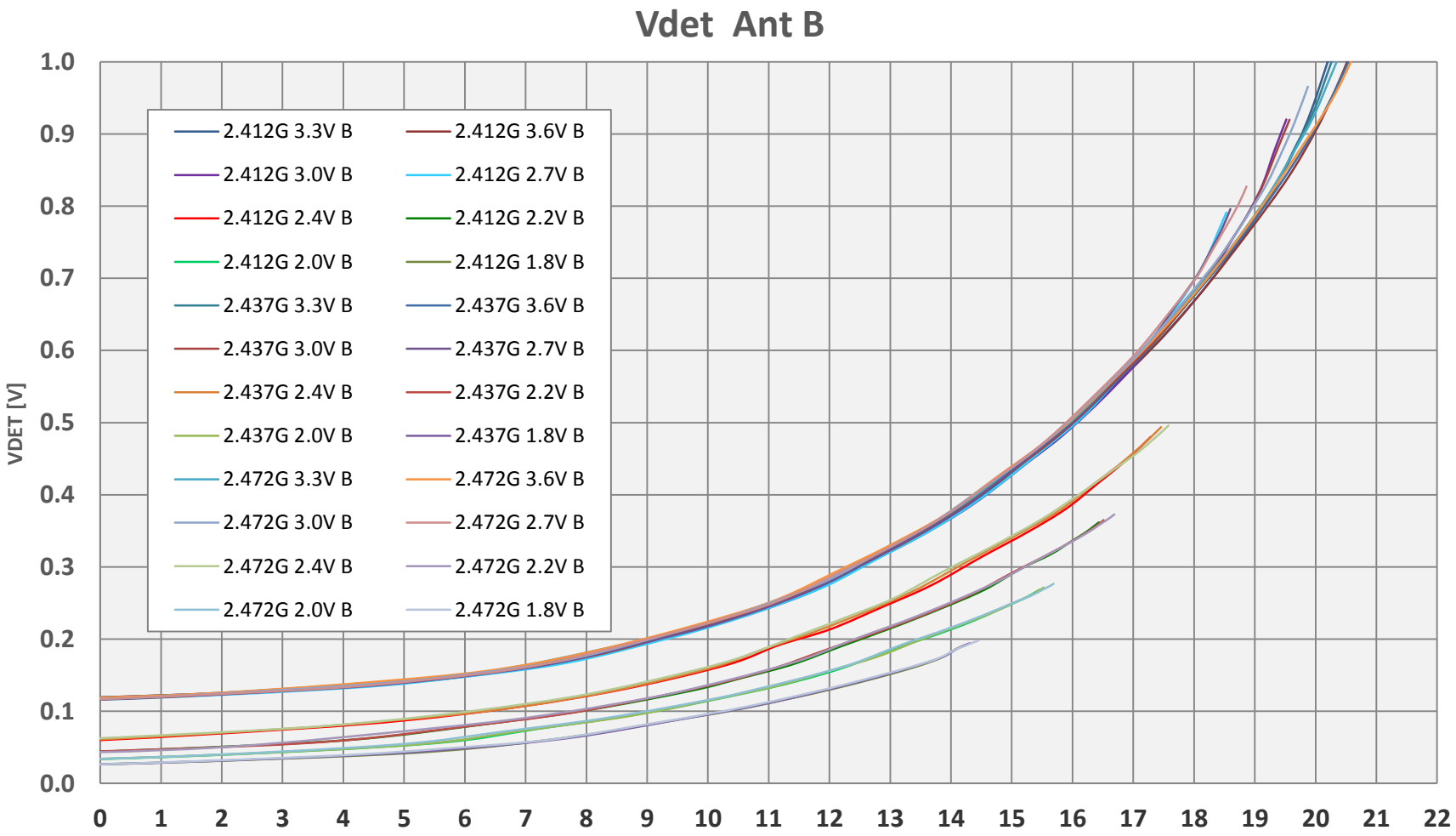

Detector voltage measured with 10kΩ load. Detector Voltage will vary with different resistor values.

# TX Detector Voltage vs. Pout Across Voltage and Frequency Ant A



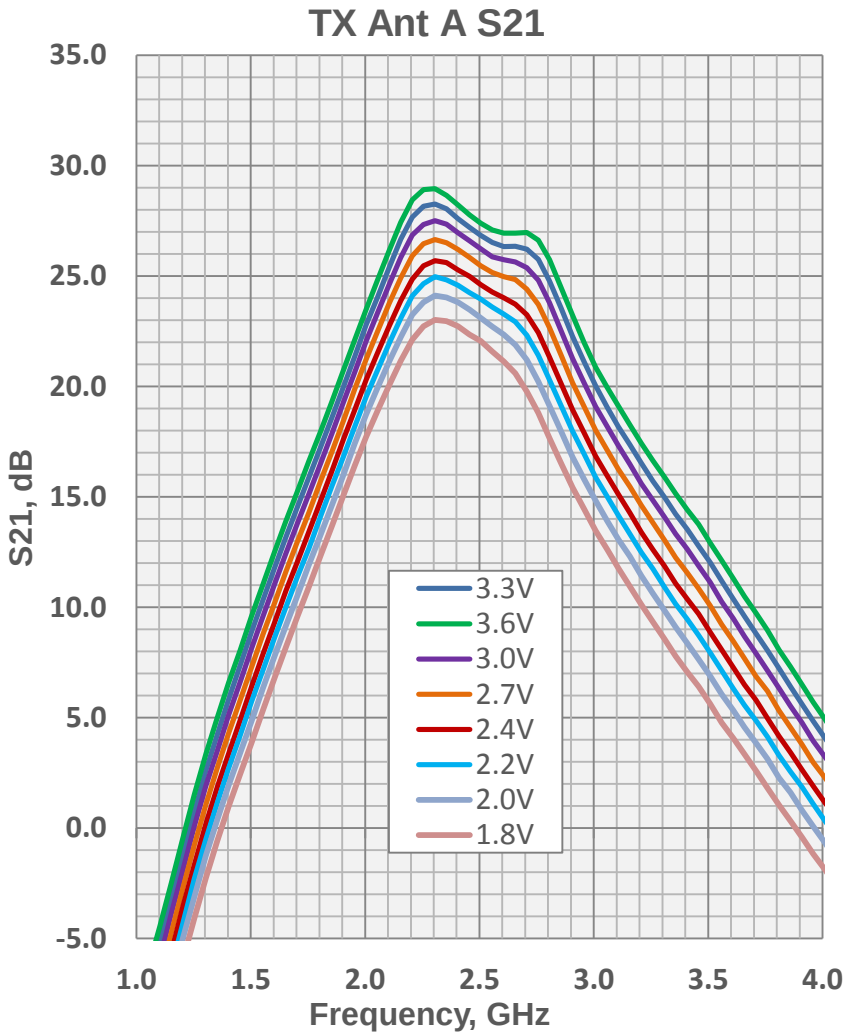

Detector voltage measured with 10kΩ load. Detector Voltage will vary with different resistor values.

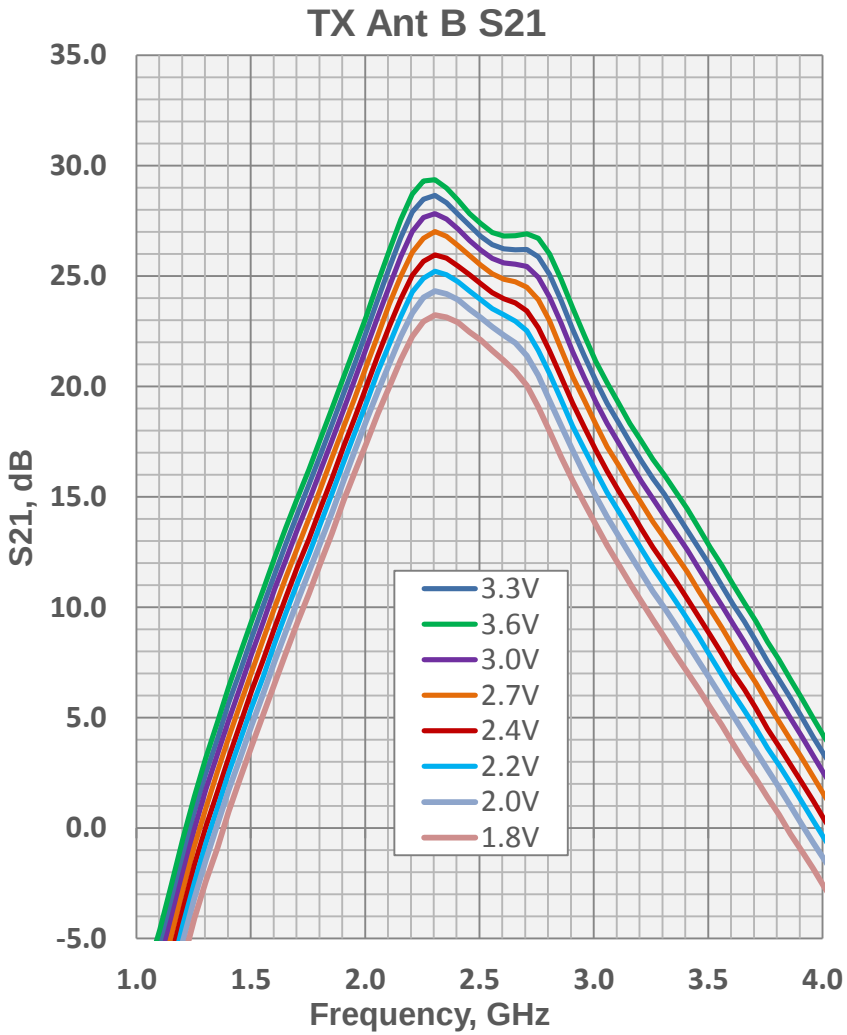
# TX Detector Voltage vs. Pout Across Voltage and Frequency Ant B




Detector voltage measured with 10kΩ load. Detector Voltage will vary with different resistor values.

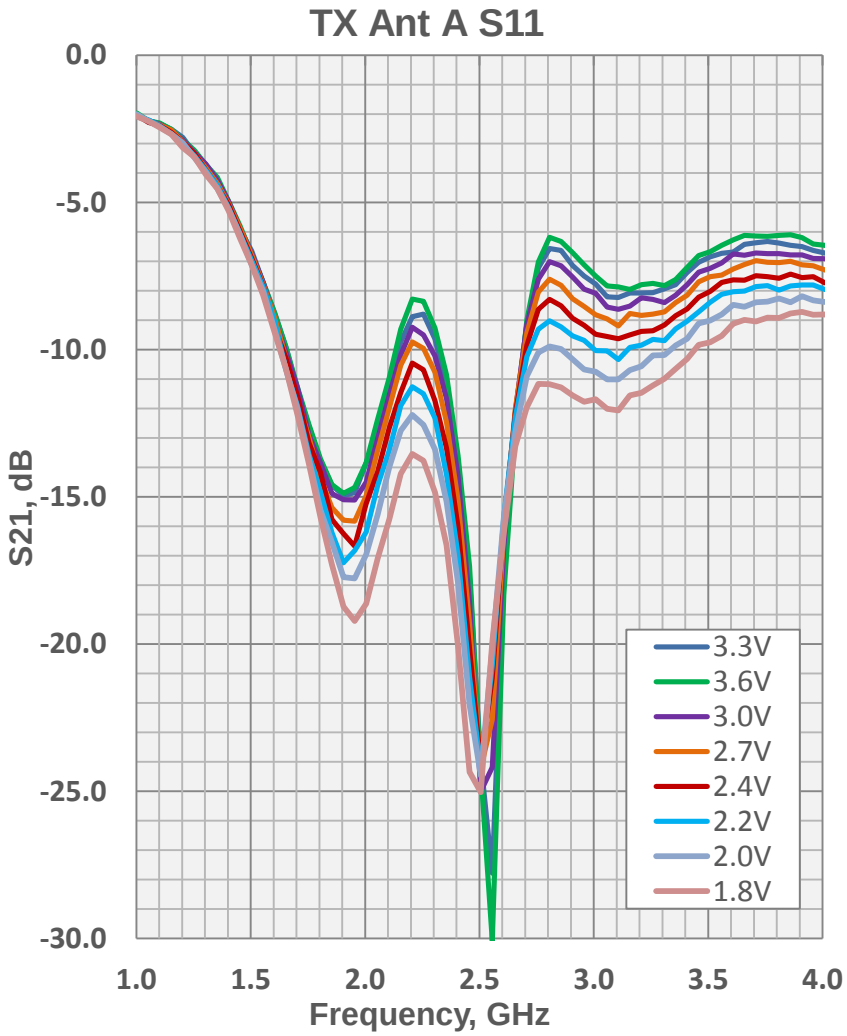
# TX S-Parameter S21 Across Voltage
# Ant A and Ant B

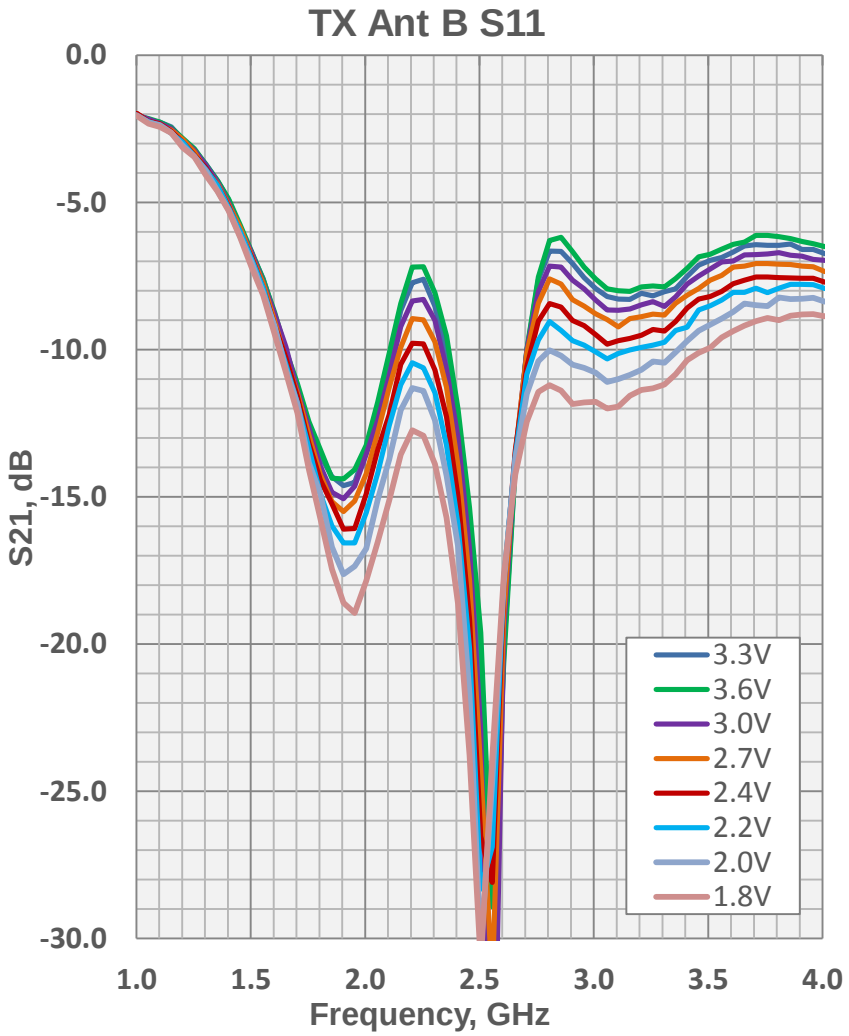



Iq = 20mA @ 3.3V

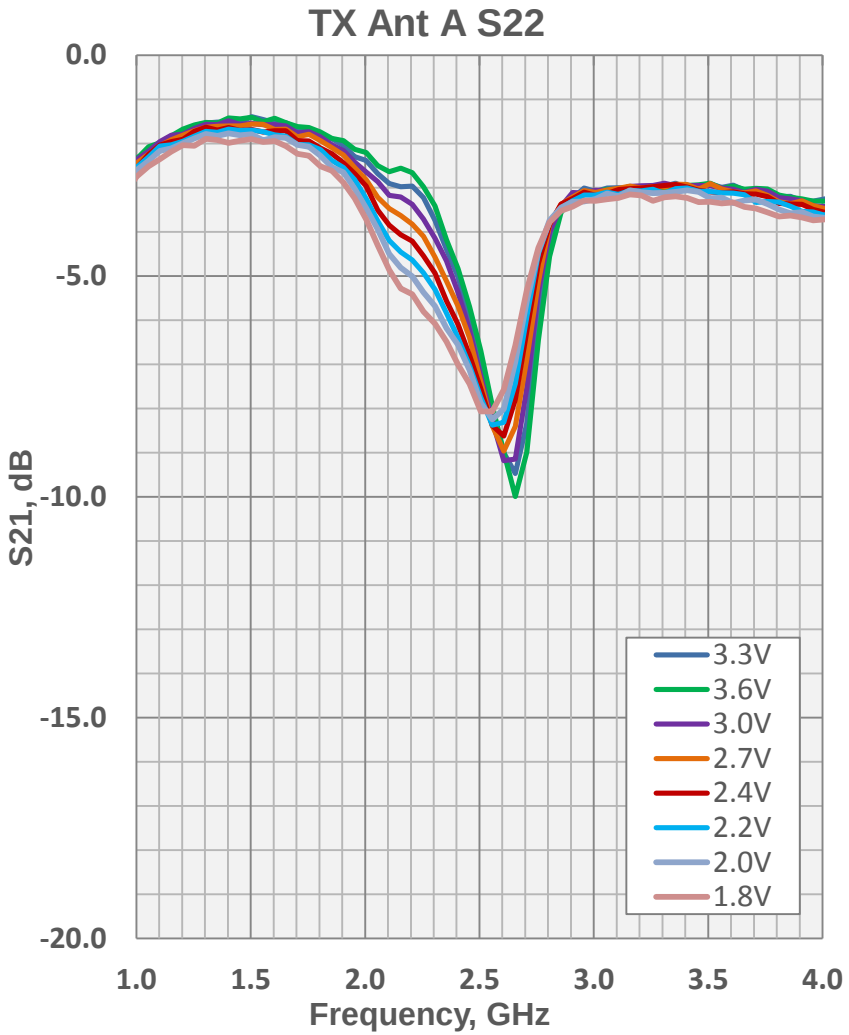
# TX S-Parameter S11 Across Voltage
# Ant A and Ant B

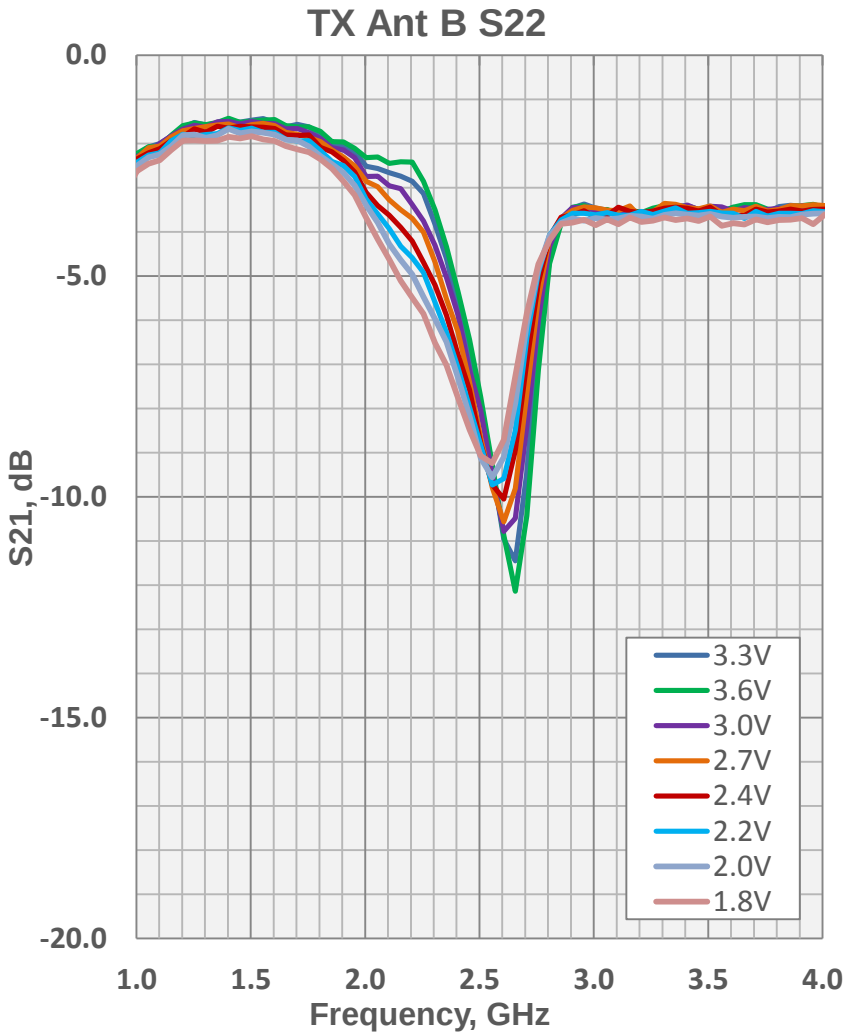



Iq = 20mA @ 3.3V

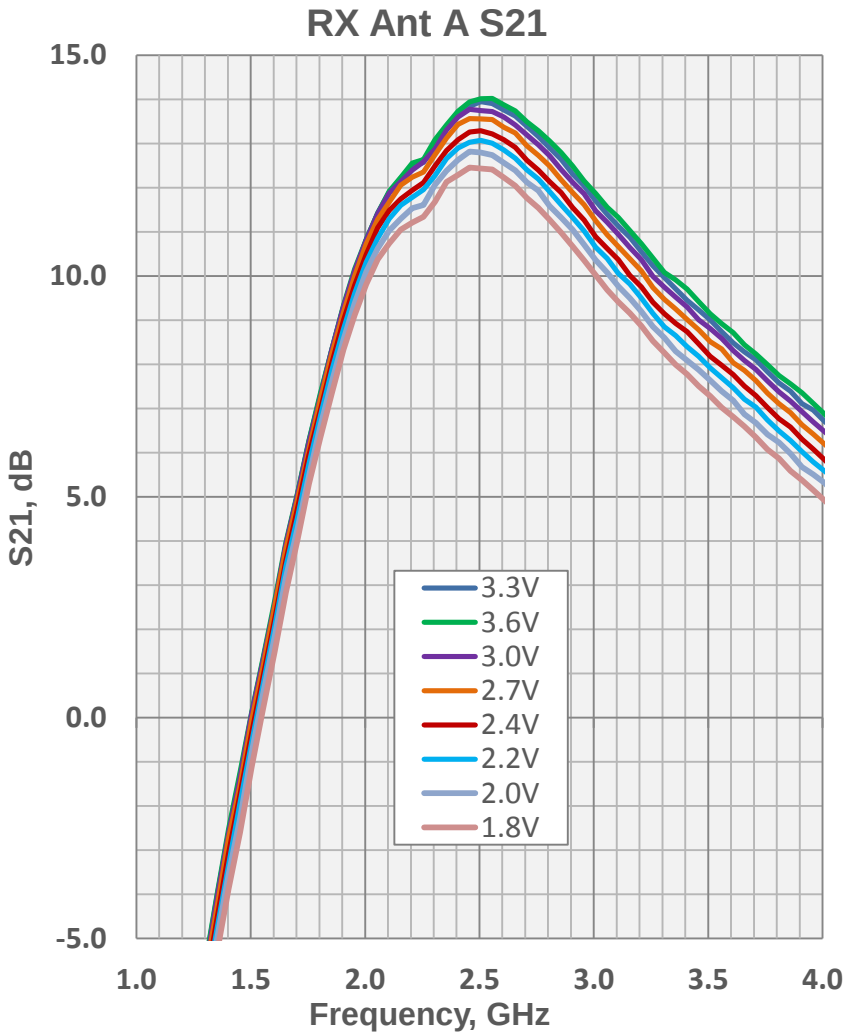
# TX S-Parameter S22 Across Voltage
# Ant A and Ant B

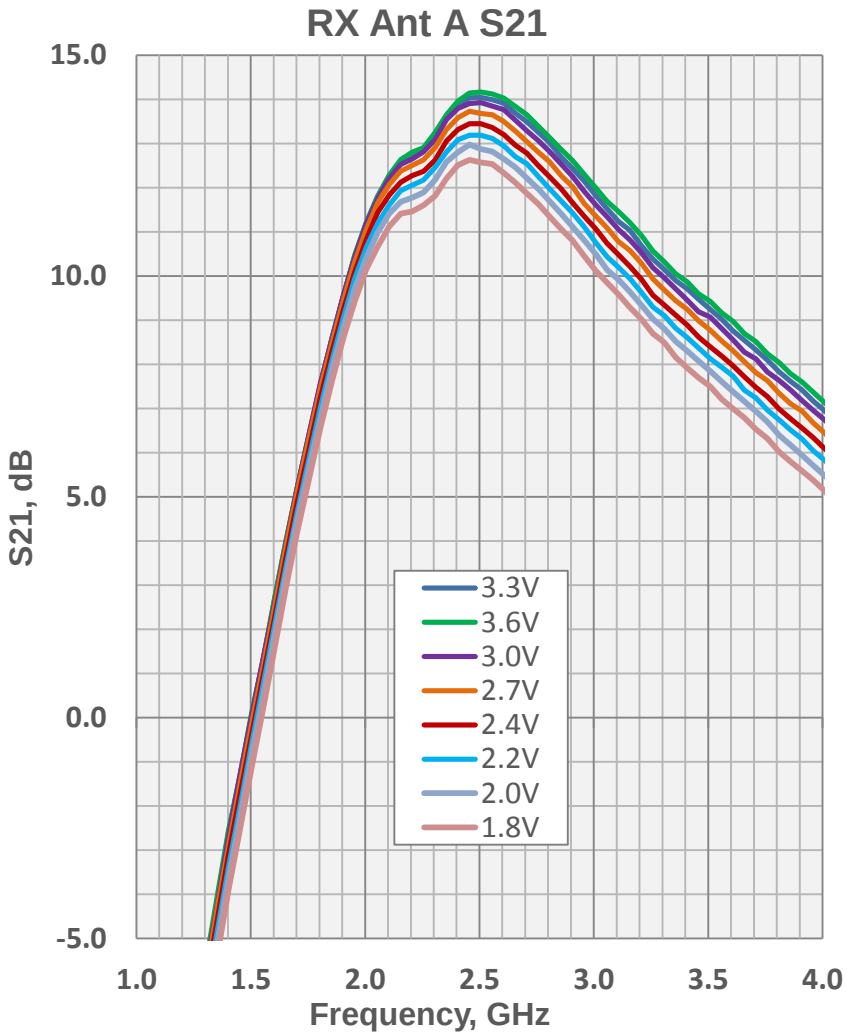



Iq = 20mA @ 3.3V

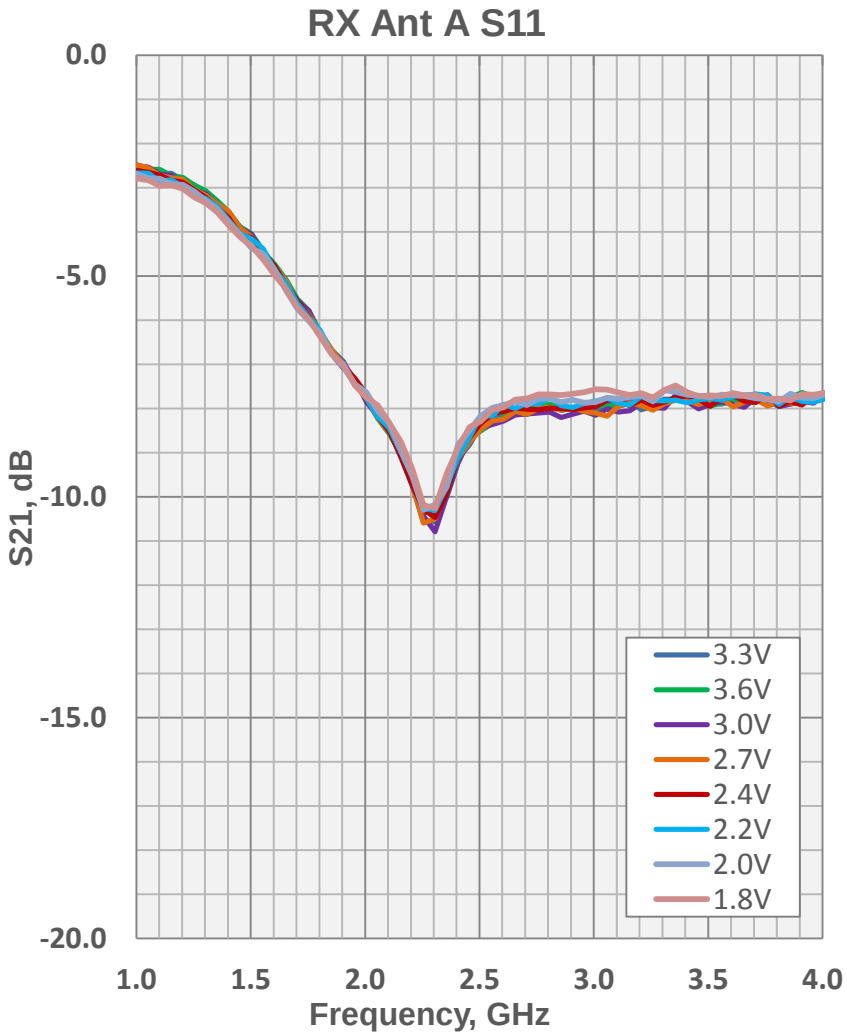
# RX S-Parameter S21 Across Voltage
# Ant A and Ant B

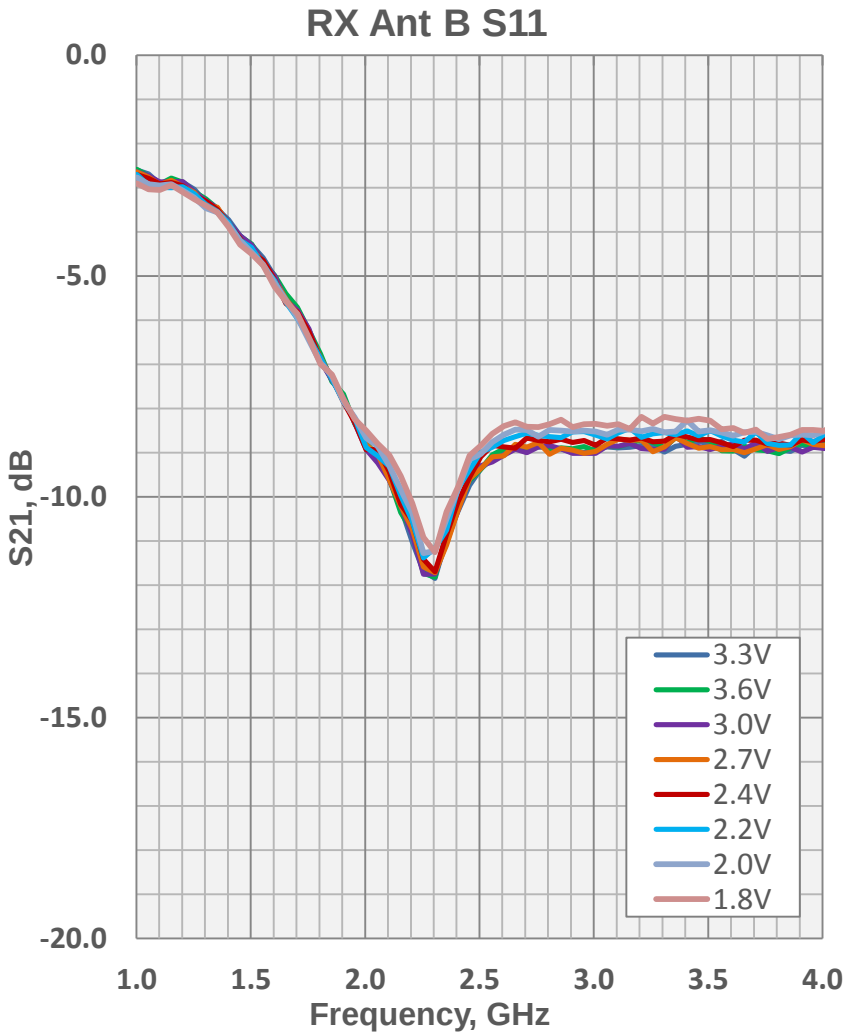



Iq = 8mA @ 3.3V

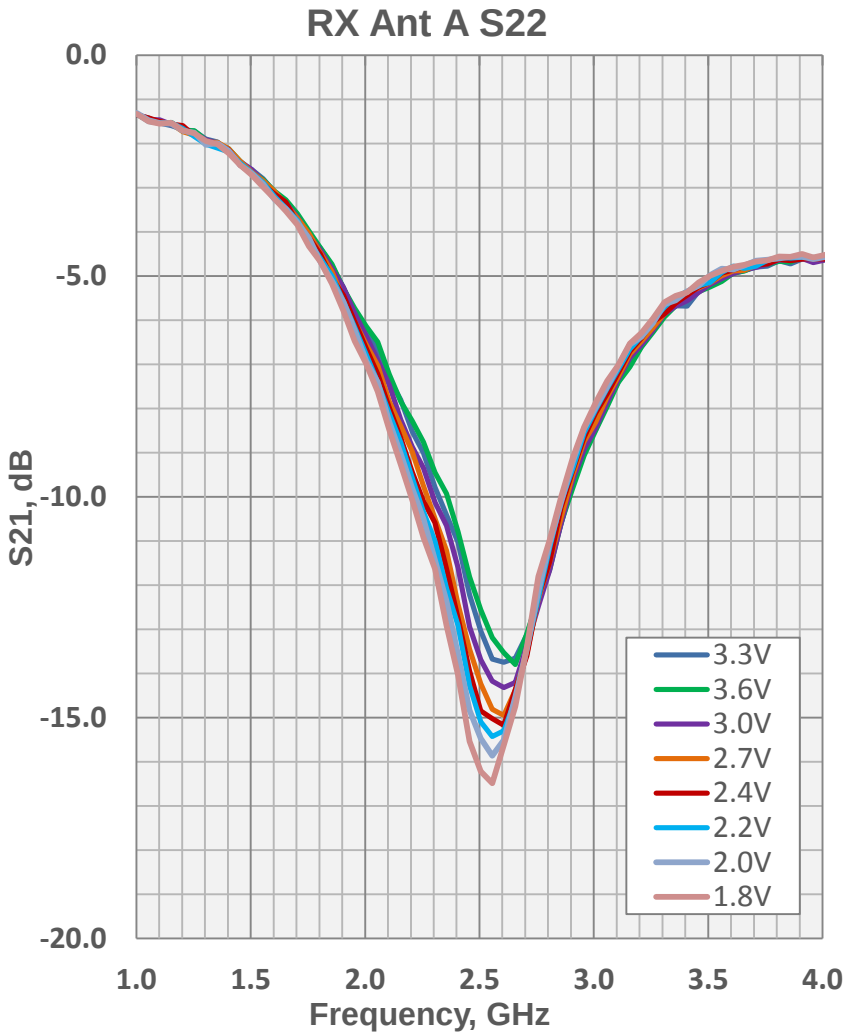
# RX S-Parameter S11 Across Voltage
# Ant A and Ant B

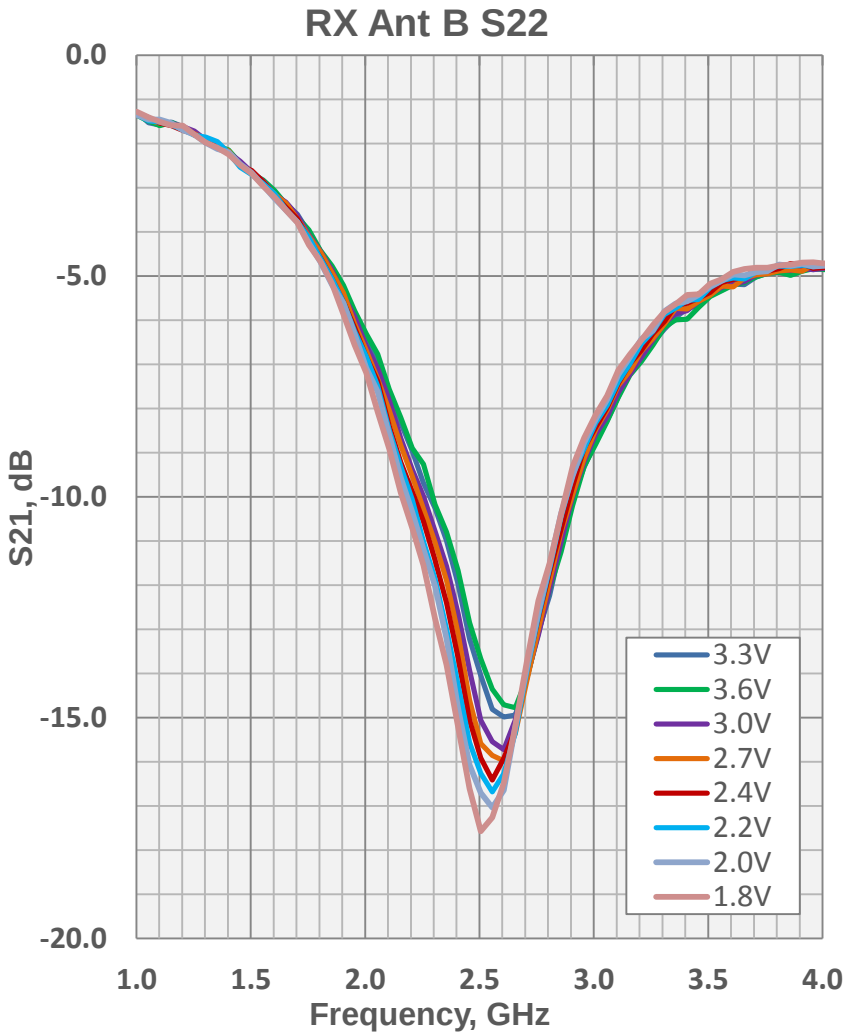



Iq = 8mA @ 3.3V

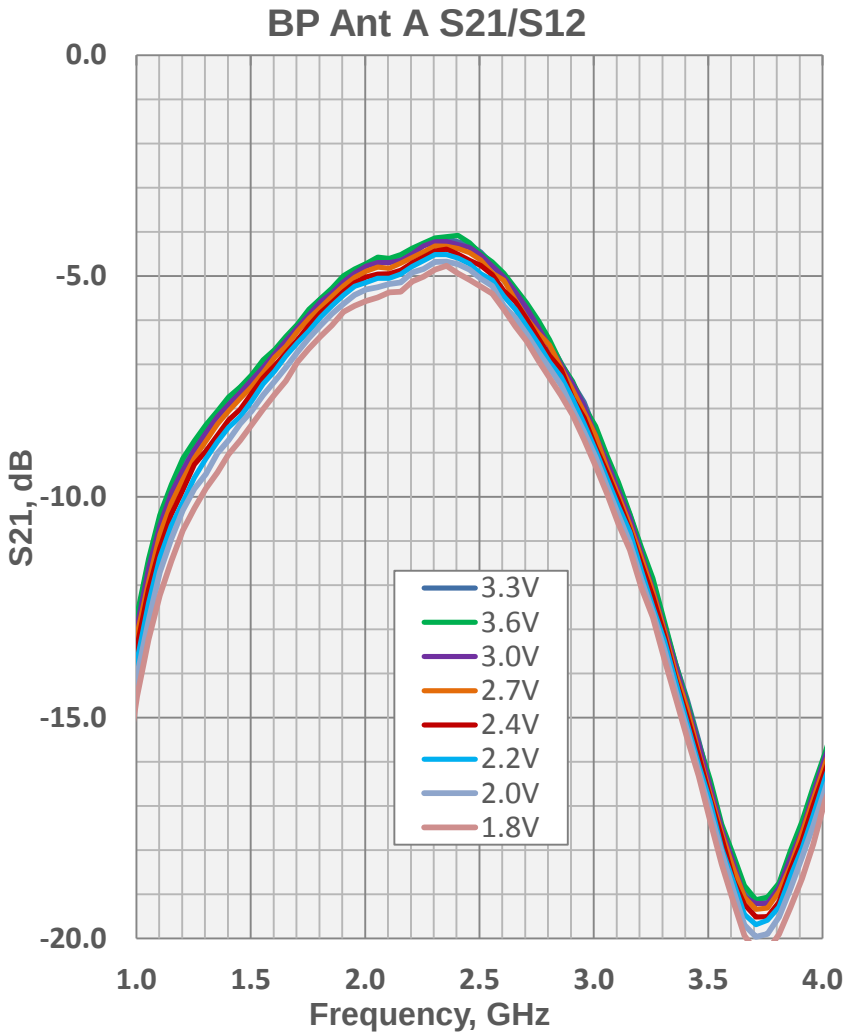
# RX S-Parameter S22 Across Voltage
# Ant A and Ant B

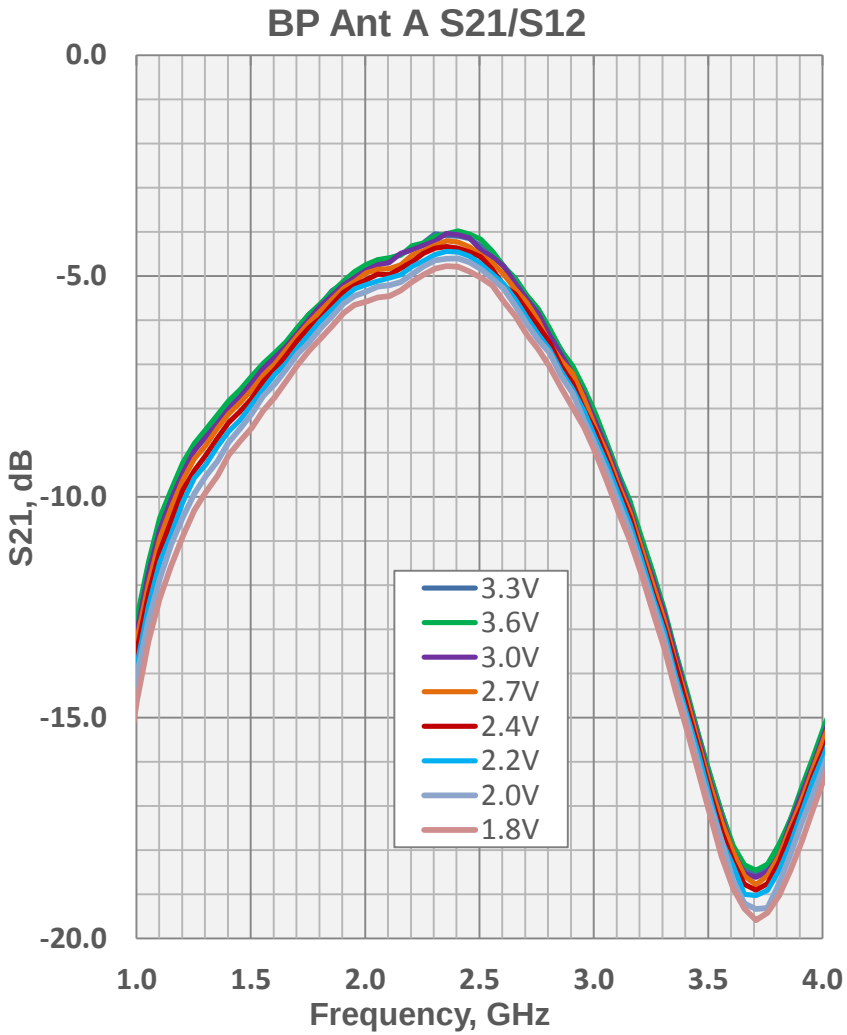



Iq = 8mA @ 3.3V

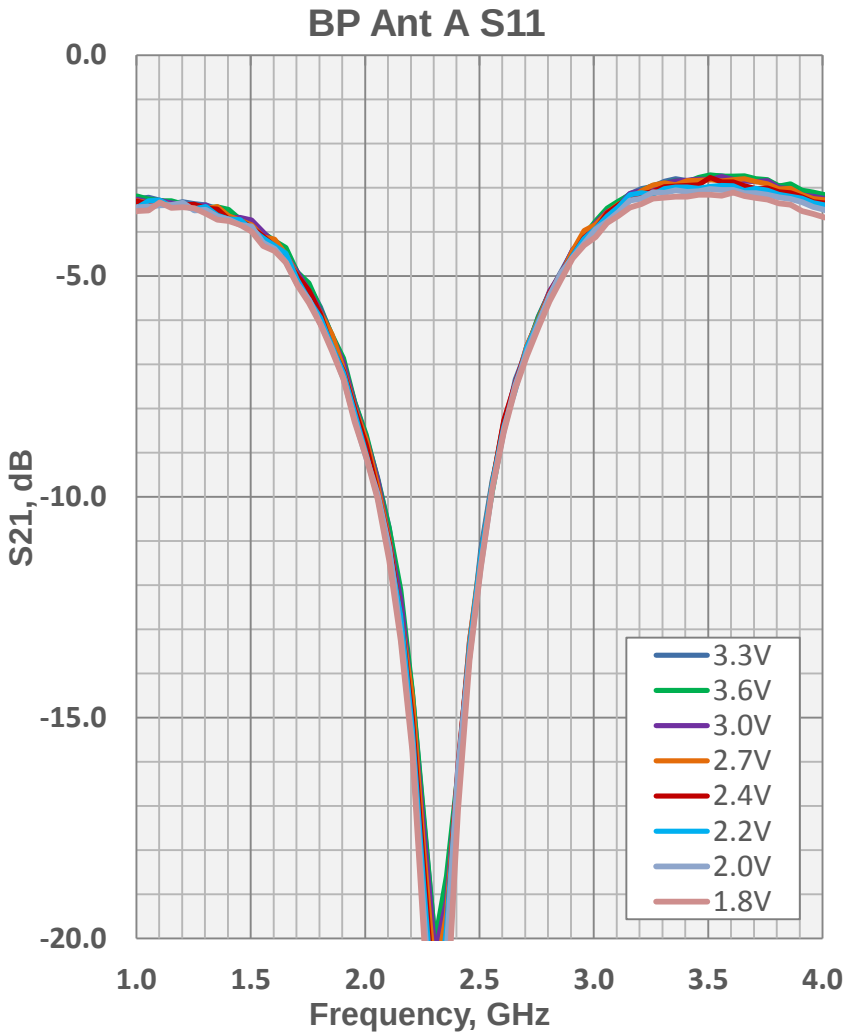
# Bypass S-Parameter S21/S12 Across Voltage Ant A and Ant B

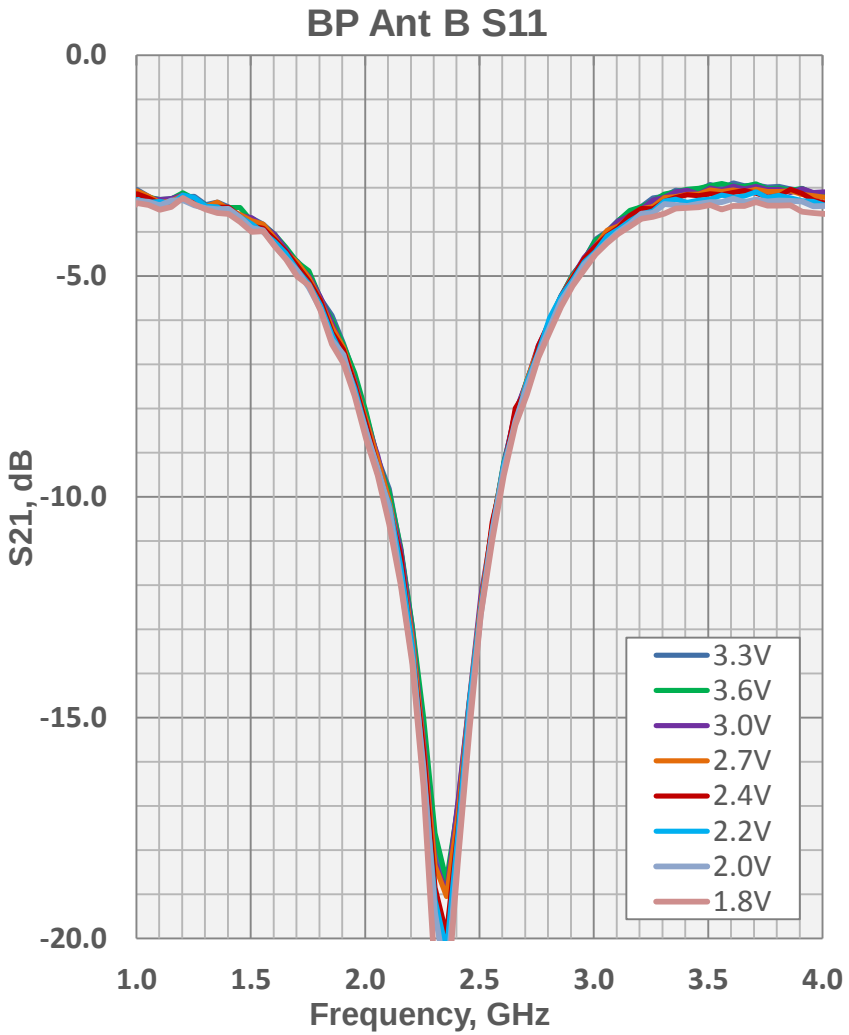



Iq < 1uA @ 3.3V

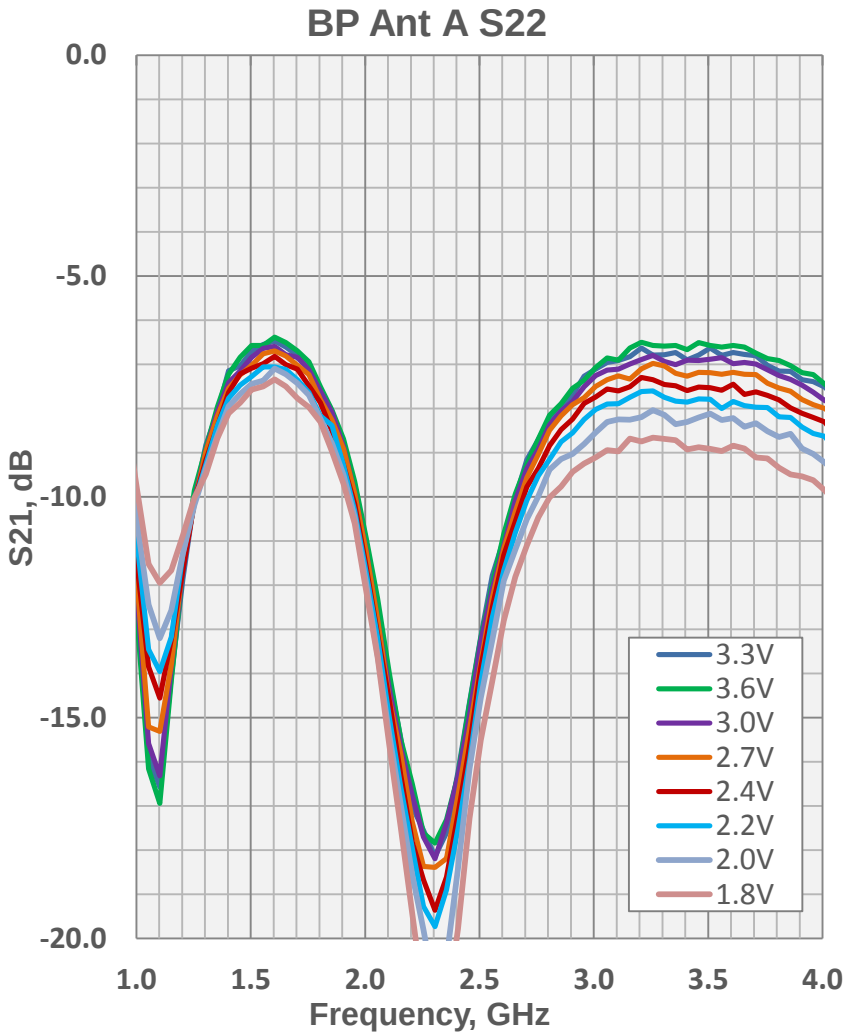
# Bypass S-Parameter S11 Across Voltage Ant A and Ant B

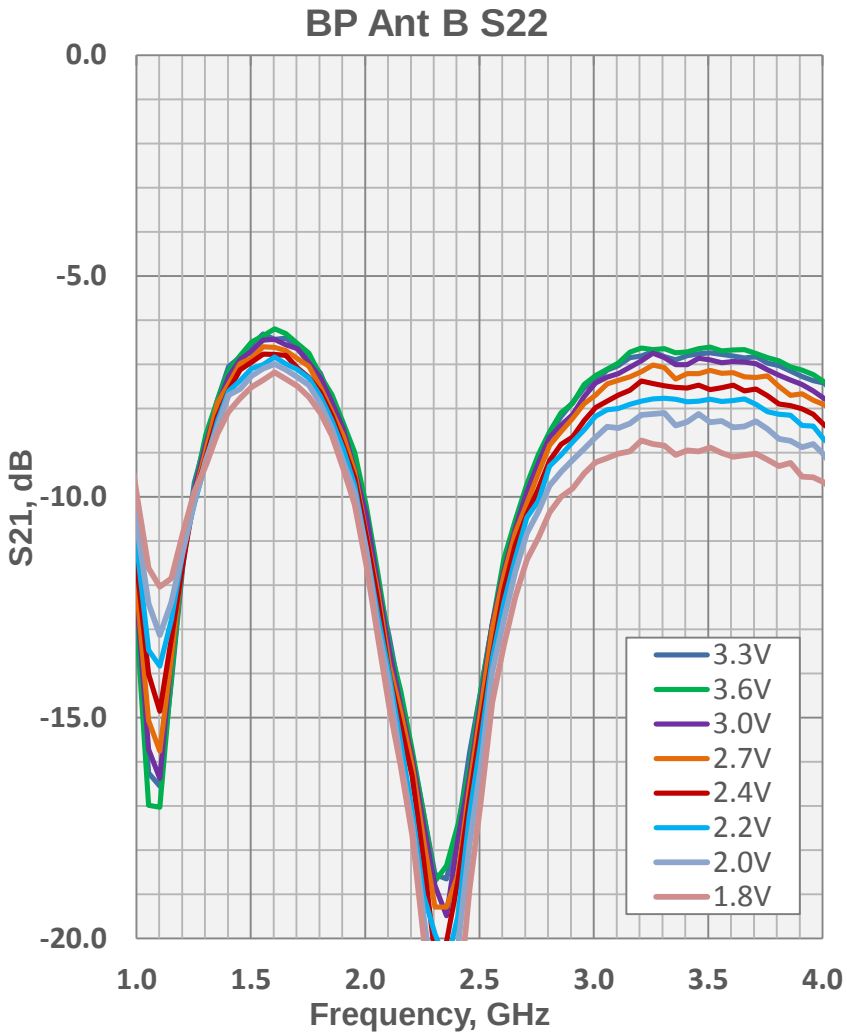



Iq < 1uA @ 3.3V

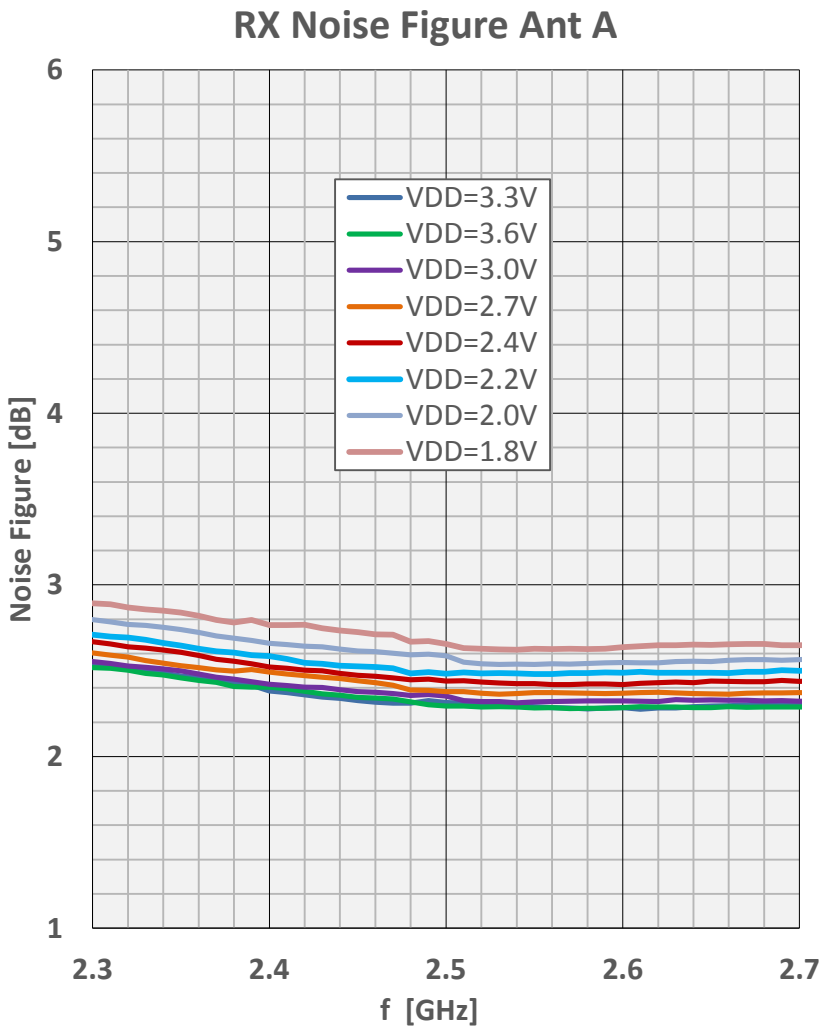
# Bypass S-Parameter S22 Across Voltage
# Ant A and Ant B

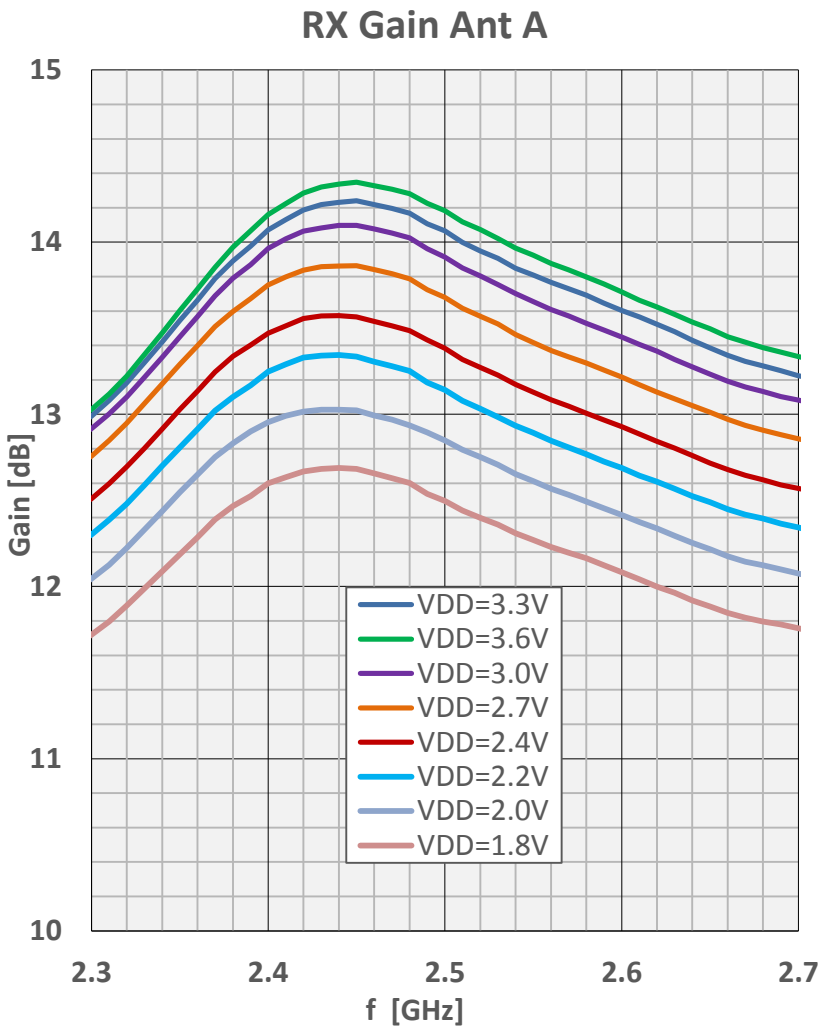



Iq < 1uA @ 3.3V

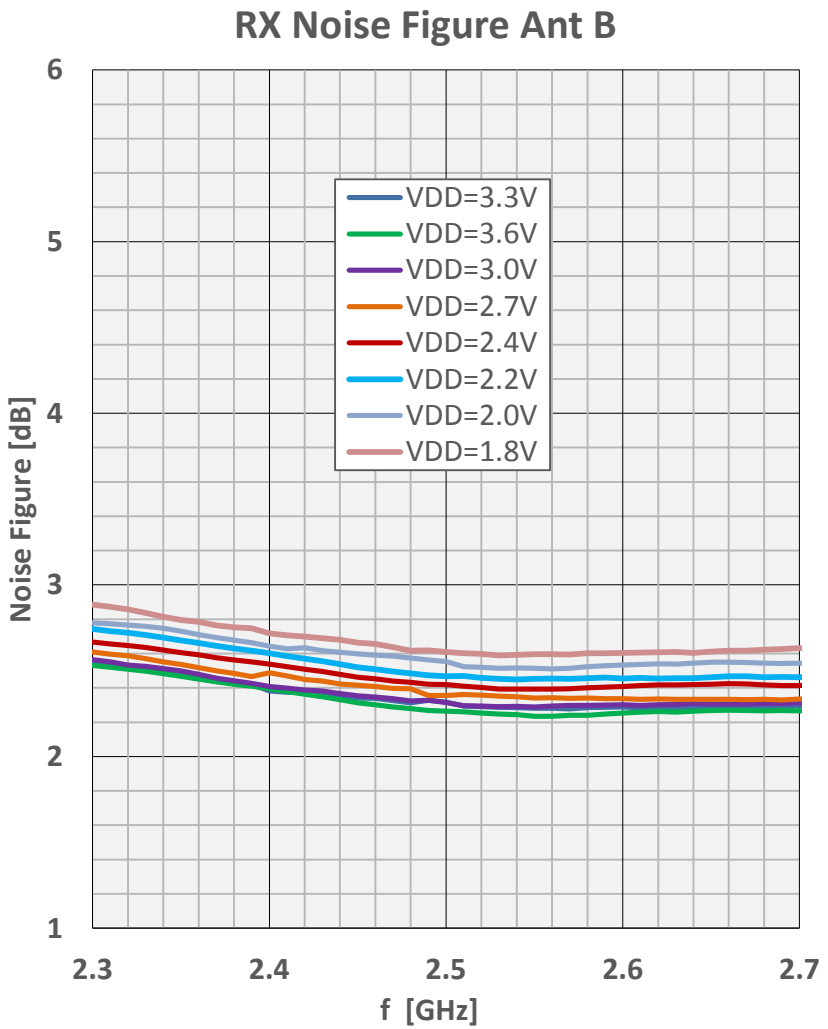
# RX Noise Figure and Gain Across Voltage
# Antenna A

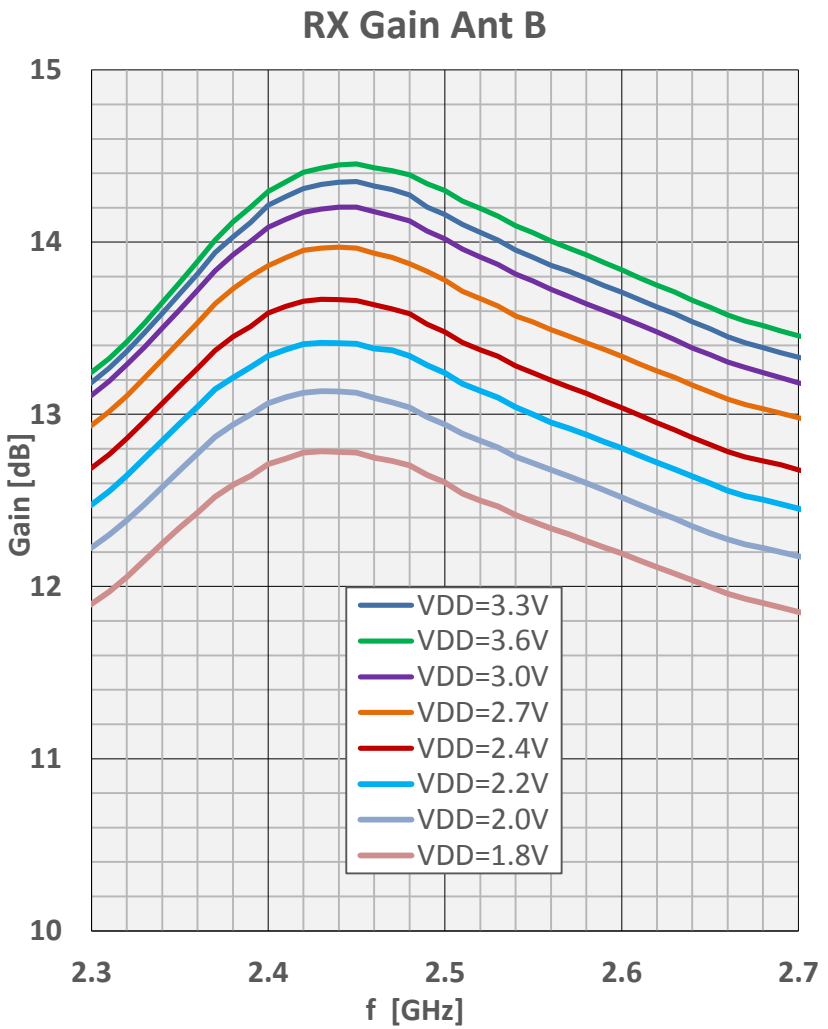



Iq = 8mA @ 3.3V

# RX Noise Figure and Gain Across Voltage
# Antenna B




Iq = 8mA @ 3.3V

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Skyworks:

RFX2411N-EVB