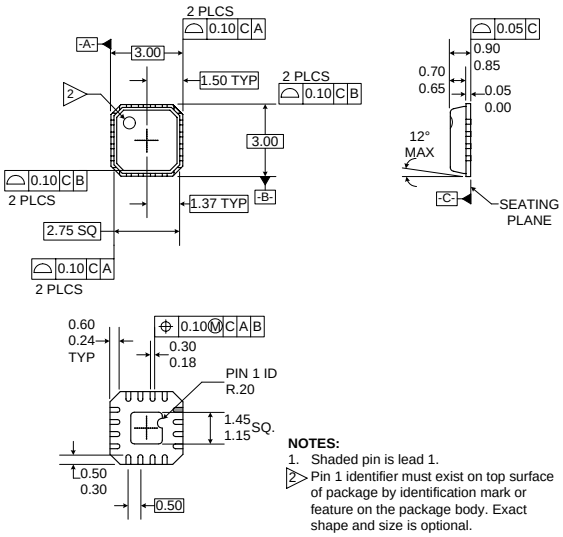
# TRI-BAND LOW NOISE AMPLIFIER

## Typical Applications

- Tri-Band EGSM/DCS/PCS Handsets
- Dual-Band EGSM/DCS Handsets

## Product Description

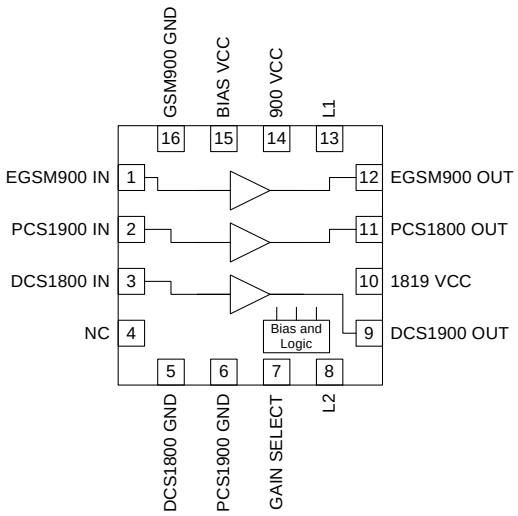
The RF2417 is a highly-integrated, low-power and low-cost tri-band LNA for EGSM-based multi-band handset applications. All input and output ports include on-chip matching, thus minimizing external components. The device supports the worldwide EGSM and DCS bands and the North American PCS band. A 20dB gain reduction mode is provided. Three mode-control pins control gain and band selection. Unused functions are powered down for the lowest power consumption. The RF2417 is packaged in a 3mmx3mm, 16-pin leadless chip carrier, and is manufactured in the Silicon Germanium (SiGe HBT) process technology.




**Package Style: QFN, 16-Pin, 3x3**

### Optimum Technology Matching® Applied

- ☐ Si BJT
- ☐ Si Bi-CMOS
- ☐ InGaP/HBT
- ☐ GaAs HBT
- ☐ SiGe HBT
- ☐ GaN HEMT
- ☐ GaAs MESFET
- ☐ Si CMOS
- ☑ SiGe Bi-CMOS




**Functional Block Diagram**

## Features

- On-Chip Matching
- Gain Reduction Mode
- 2.7V Supply Voltage
- Low Noise Figure
- Supports Tri-Band Applications

### Ordering Information

| | |
|---|---|
| RF2417 | Tri-Band Low Noise Amplifier |
| RF2417 PCBA | Fully Assembled Evaluation Board |

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## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| Supply Voltage | -0.5 to +5.0 | $V_{DC}$ |
| Input RF Power | +6 | dBm |
| Operating Ambient Temperature | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |

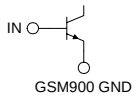
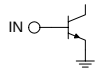
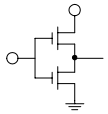
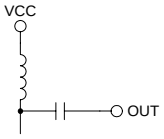
**Caution!** ESD sensitive device.



| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **EGSM900 MHz Mode** | | | | | |
| **LNA Parameters** | | | | | $T_{AMBIENT}$=25°C, $V_{CC}$=2.7V to 2.86V |
| Frequency Range ($f_{IN}$) | 925 | | 960 | MHz | L1=0; L2=1 |
| Input Impedance ($Z_I$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Output Impedance ($Z_O$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Noise Figure (NF) | | 1.6 | 1.7 | dB | High Gain; GS=1 |
| | | | 6 | dB | Low Gain; GS=0 |
| Gain ($G_{TYP}$) | 17 | 18 | 19 | dB | High Gain; GS=1 |
| Gain Variation Over Temperature Range ($G_{TEMP}$) | | | 0.5 | dB | -40°C to +85°C |
| Gain Variation Over Frequency Band ($G_{FREQ}$) | | | ±0.75 | dB | |
| Low Gain ($G_{LOW}$) | -6 | -3 | | dB | Low Gain; GS=0 |
| Input IP3 | -5 | | | dBm | High Gain; GS=1 |
| | 15 | | | dBm | Low Gain; GS=0 |
| Input 1dB Compression Point ($ICP_{1dB}$) | -22 | -20 | | dBm | High Gain; GS=1 |
| | -15 | | | dBm | Low Gain; GS=0 |
| Isolation | | 22 | | dB | $RF_{OUT}$ to $RF_{IN}$ |
| Turn-On Settling Time | | | 10 | uS | |
| Rise and Fall Time ($t_r t_f$) | | | 10 | uS | |
| **Power Supply Parameters** | | | | | |
| Supply Voltage ($V_{CC}$) | 2.7 | | 3.3 | V | |
| Current Consumption ($I_{CC}$) | | 5.0 | 6.0 | mA | High Gain@25°C; GS=1 |
| | | | 0.5 | mA | Low Gain@25°C; GS=0 |
| Standby Current ($I_{CC}$) | | | 10 | uA | L1=0; L2=0 |

| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **DCS1800MHz Mode** | | | | | |
| **LNA Parameters** | | | | | $T_{AMBIENT}$=25°C, $V_{CC}$=2.7V to 2.86V |
| Frequency Range ($f_{IN}$) | 1805 | | 1880 | MHz | L1=1; L2=0 |
| Input Impedance ($Z_I$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Output Impedance ($Z_O$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Noise Figure (NF) | | | 1.9 | dB | High Gain; GS=1 |
| | | | 6 | dB | Low Gain; GS=0 |
| Gain ($G_{TYP}$) | 17 | 19 | 20 | dB | High Gain; GS=1 |
| Gain Variation Over Temperature Range ($G_{TEMP}$) | | | ±1.0 | dB | -40°C to +85°C |
| Gain Variation Over Frequency Band ($G_{FREQ}$) | | | 0.5 | dB | |
| Low Gain ($G_{LOW}$) | -7 | -5 | -3 | dB | Low Gain; GS=0 |
| Input IP3 | -5 | | | dBm | High Gain; GS=1 |
| | 15 | | | dBm | Low Gain; GS=0 |
| Input 1dB Compression Point ($ICP_{1dB}$) | -20 | -18 | | dBm | High Gain; GS=1 |
| | -15 | | | dBm | Low Gain; GS=0 |
| Isolation | | 33 | | dB | $RF_{OUT}$ to $RF_{IN}$ |
| Turn-On Settling Time | | | 10 | uS | |
| Rise and Fall Time ($t_r$,$t_f$) | | | 10 | uS | |
| **Power Supply Parameters** | | | | | |
| Supply Voltage ($V_{CC}$) | 2.7 | | 3.3 | V | |
| Current Consumption ($I_{CC}$) | | 5.5 | 7.0 | mA | High Gain@25°C; GS=1 |
| | | | 0.5 | mA | Low Gain@25°C; GS=0 |
| Standby Current ($I_{CC}$) | | | 10 | uA | L1=0; L2=0 |

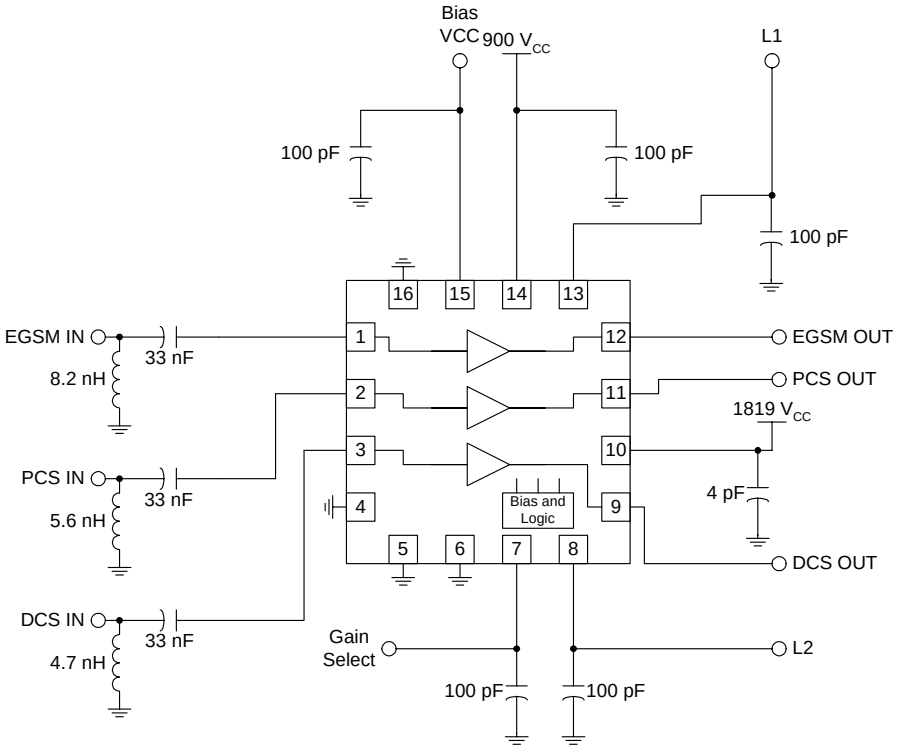
| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **PCS1900MHz Mode** | | | | | |
| **LNA Parameters** | | | | | $T_{AMBIENT}$=25°C, $V_{CC}$=2.7V to 2.86V |
| Frequency Range ($f_{IN}$) | 1930 | | 1990 | MHz | L1=1; L2=1 |
| Input Impedance ($Z_I$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Output Impedance ($Z_O$) | | 50 | | Ω | High Gain; GS=1 |
| | | 50 | | Ω | Low Gain; GS=0 |
| Noise Figure (NF) | | 1.9 | 2.0 | dB | High Gain; GS=1 |
| | | | 6 | dB | Low Gain; GS=0 |
| Gain ($G_{TYP}$) | 16 | 17 | 19 | dB | High Gain; GS=1 |
| Gain Variation Over Temperature Range ($G_{TEMP}$) | | | ±1.25 | dB | -40°C to +85°C |
| Gain Variation Over Frequency Band ($G_{FREQ}$) | | | 1.0 | dB | |
| Low Gain ($G_{LOW}$) | -7 | -5 | -3 | dB | Low Gain; GS=0 |
| Input IP3 | -3 | | | dBm | High Gain; GS=1 |
| | 15 | | | dBm | Low Gain; GS=0 |
| Input 1dB Compression Point ($ICP_{1dB}$) | -20 | -18 | | dBm | High Gain; GS=1 |
| | -15 | | | dBm | Low Gain; GS=0 |
| Isolation | | 35 | | dB | $RF_{OUT}$ to $RF_{IN}$ |
| Turn-On Settling Time | | | 10 | uS | |
| Rise and Fall Time ($t_r$,$t_f$) | | | 10 | uS | |
| **Logic Levels** | | | | | |
| Input Low | | | 0.5 | V | |
| Input High | 2 | | | V | |
| Input Current | | 10 | 100 | uA | |
| Input Impedance | | 40 | | kΩ | |
| **Power Supply Parameters** | | | | | |
| Supply Voltage ($V_{CC}$) | 2.7 | | 3.3 | V | |
| Current Consumption ($I_{CC}$) | | 5.5 | 7.0 | mA | High Gain@25°C; GS=1 |
| | | | 0.5 | mA | Low Gain@25°C; GS=0 |
| Standby Current ($I_{CC}$) | | | 10 | uA | L1=0; L2=0 |

| Pin | Function | Description | Interface Schematic |
|---|---|---|---|
| 1 | EGSM900 IN | EGSM 900MHz LNA input. Requires DC blocking cap. |   |
| 2 | PCS1900 IN | PCS 1900MHz LNA input. Requires DC blocking cap. |   |
| 3 | DCS1800 IN | DCS 1800MHz LNA input. Requires DC blocking cap. | See pin 2. |
| 4 | NC | Connect to die flag. | |
| 5 | DCS1800 GND | DCS 1800MHz LNA ground connect to die flag. | |
| 6 | PCS1900 GND | PCS 1900MHz LNA ground connect to die flag. | |
| 7 | Gain Select | Gain select pin. Requires AC-coupling capacitor to ground (Logic 1: High Gain; Logic 0: Low Gain) |  |
| 8 | L2 | Logic pin 2. Requires AC-coupling capacitor to ground. | See pin 7. |
| 9 | DCS1800 OUT | DCS 1800MHz output. Internally matched to 50Ω. |   |
| 10 | 1819 VCC | DCS 1800MHz/PCS 1900MHz supply pin. This requires immediate AC-coupling to ground. | |
| 11 | PCS1900 OUT | PCS 1900MHz output. Internally matched to 50Ω. | See pin 9. |
| 12 | EGSM900 OUT | EGSM 900MHz output. Internally matched to 50Ω. | See pin 9. |
| 13 | L1 | Logic pin 1. Requires AC-coupling capacitor to ground. | See pin 7. |
| 14 | 900 VCC | EGSM 900MHz supply pin. This requires immediate AC-coupling to ground. | |
| 15 | Bias VCC | Bias supply. Requires AC-coupling capacitor to ground. | |
| 16 | EGSM900 GND | EGSM 900MHz ground. | |

**Logic Control**

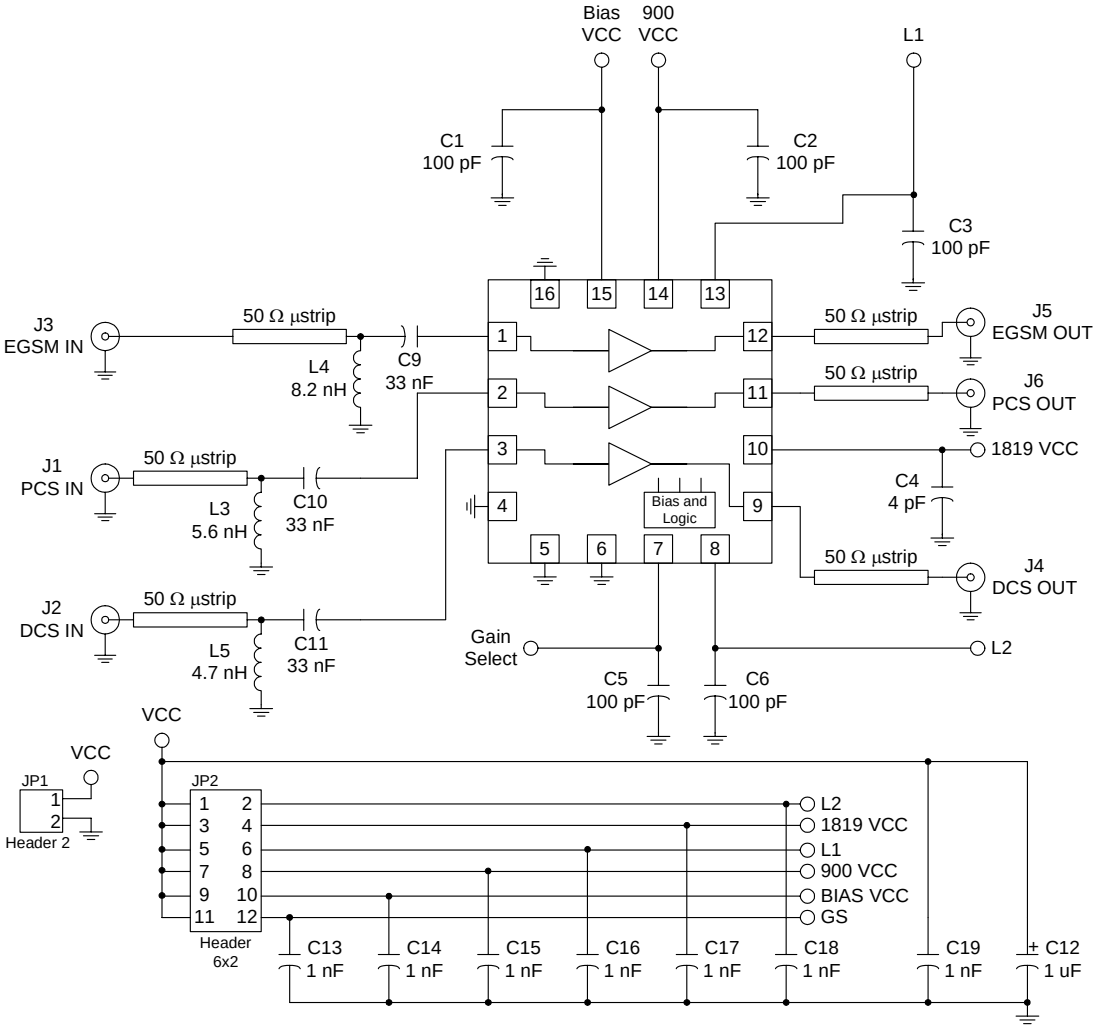
| Mode | | L1 | L2 | GS |
|---|---|---|---|---|
| Standby | | 0 | 0 | X |
| EGSM900 | High Gain | 0 | 1 | 1 |
| | Low Gain | 0 | 1 | 0 |
| DCS1800 | High Gain | 1 | 0 | 1 |
| | Low Gain | 1 | 0 | 0 |
| PCS1900 | High Gain | 1 | 1 | 1 |
| | Low Gain | 1 | 1 | 0 |

# Application Schematic



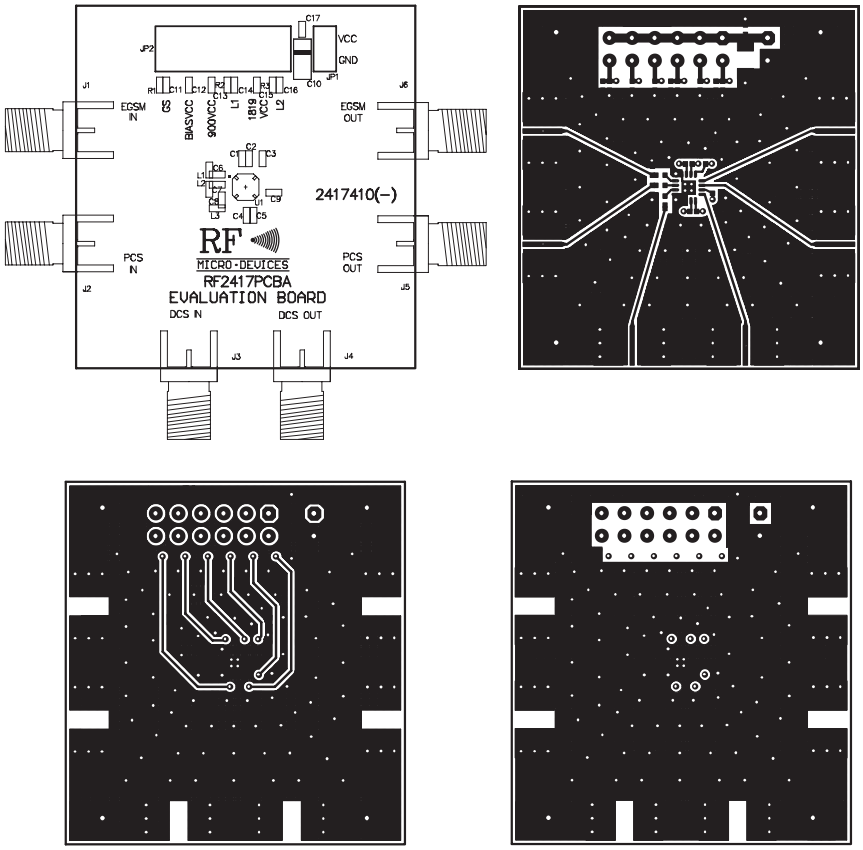
# Evaluation Board Schematic

(Download Bill of Materials from www.rfmd.com.)

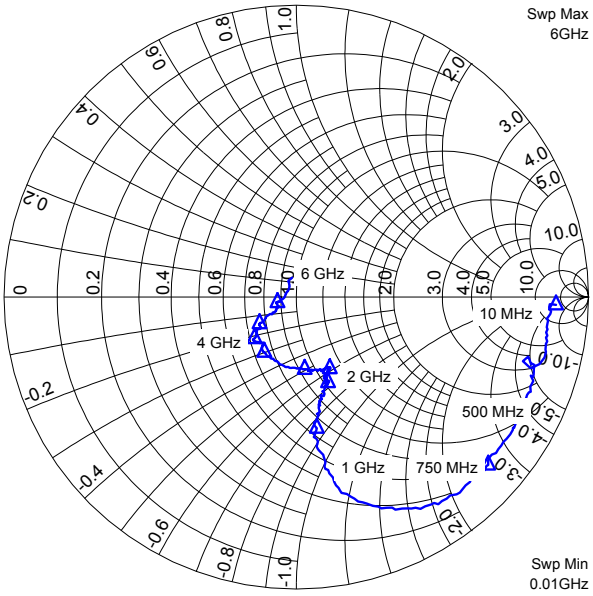


# Evaluation Board Layout
# Board Size 1.5" x 1.6"

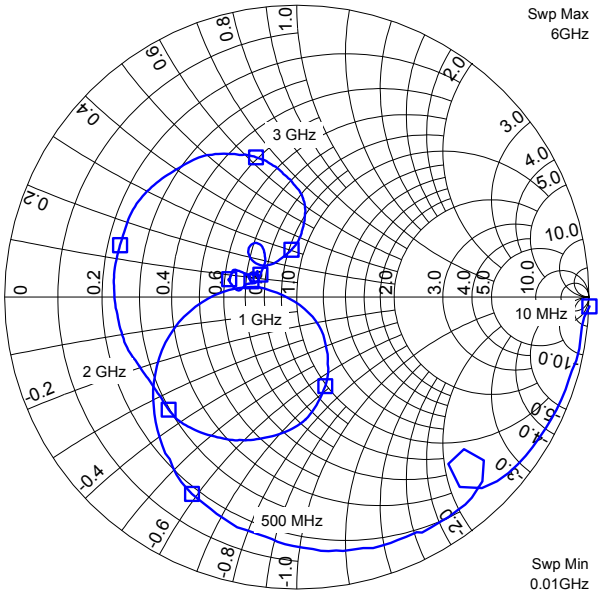
Board Thickness 0.58”, Board Material FR-4, Multi-Layer



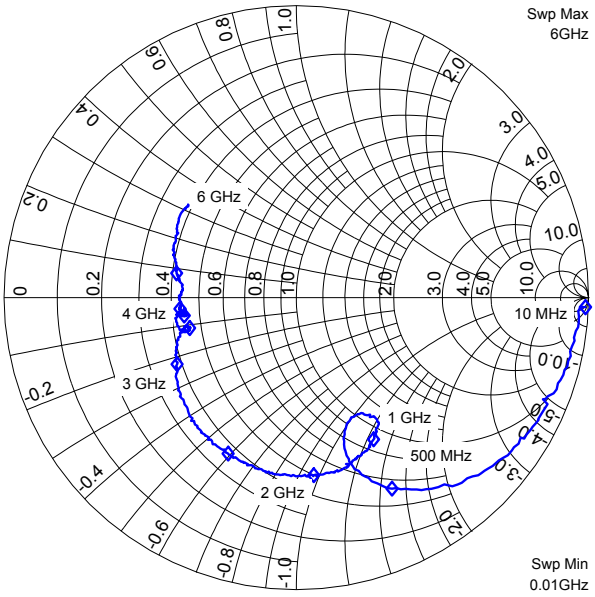
### EGSM High Gain Mode Input Impedance (S11)



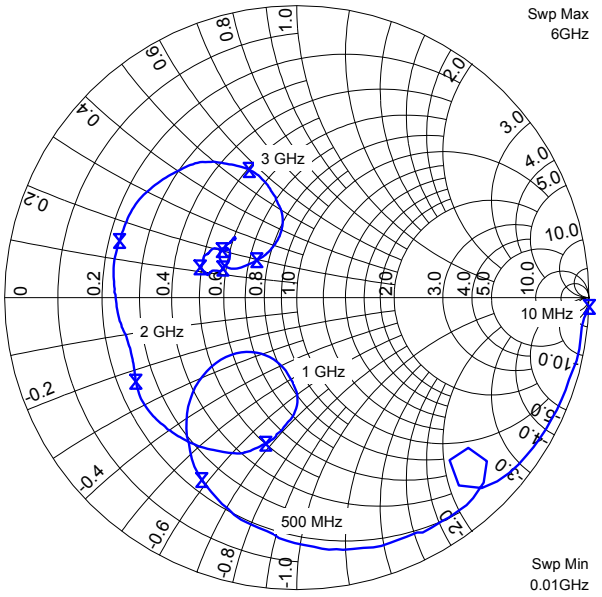

### EGSM High Gain Mode Output Impedance (S22)



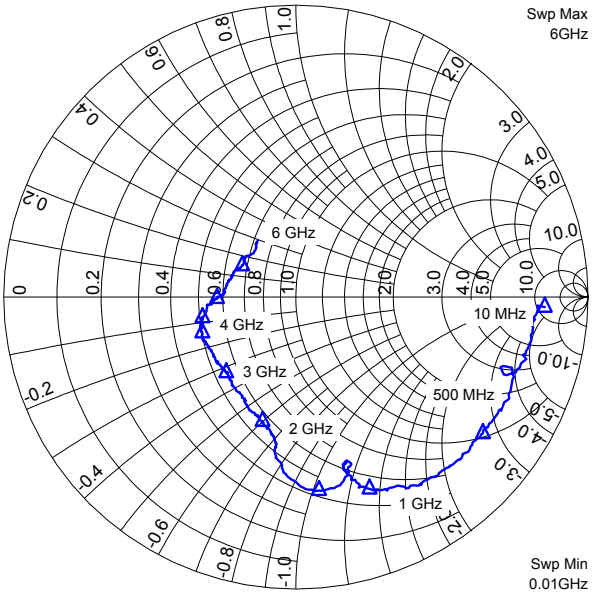

### EGSM Bypass Mode Input Impedance (S11)



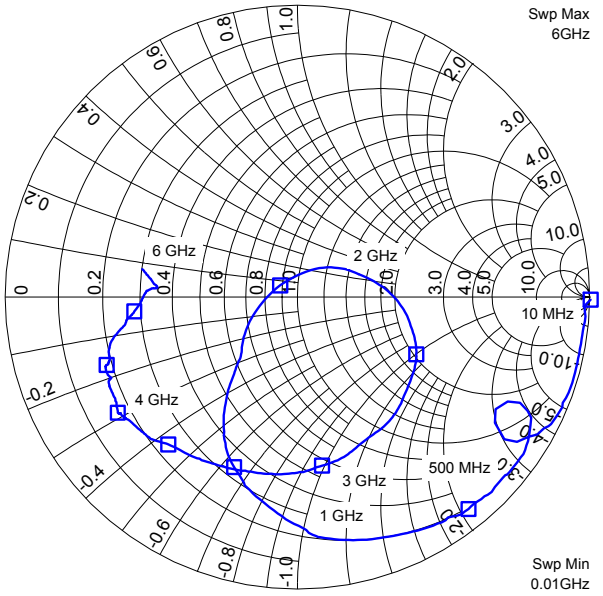

### EGSM Bypass Mode Output Impedance (S22)



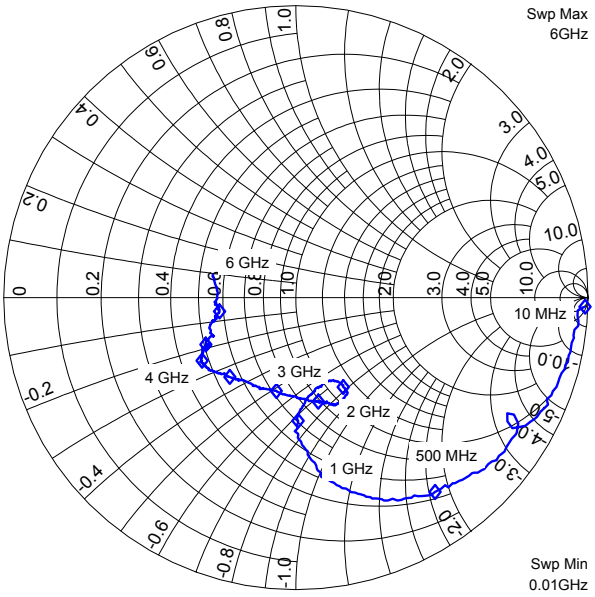
### DCS High Gain Mode Input Impedance (S11)



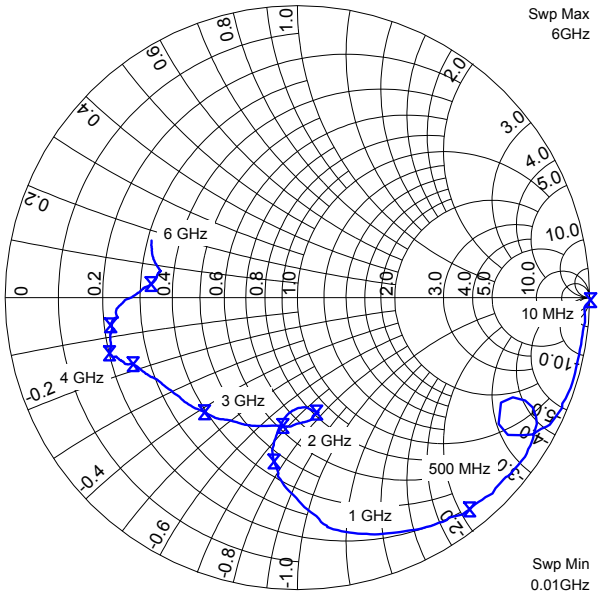

### DCS High Gain Mode Output Impedance (S22)



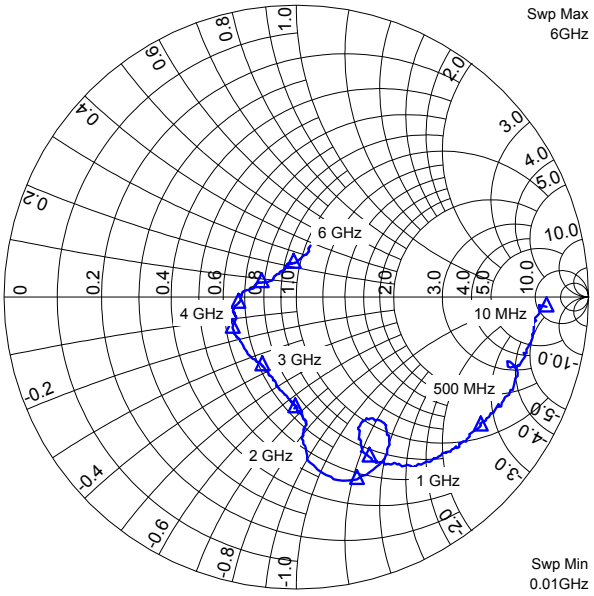

### DCS Bypass Mode Input Impedance (S11)



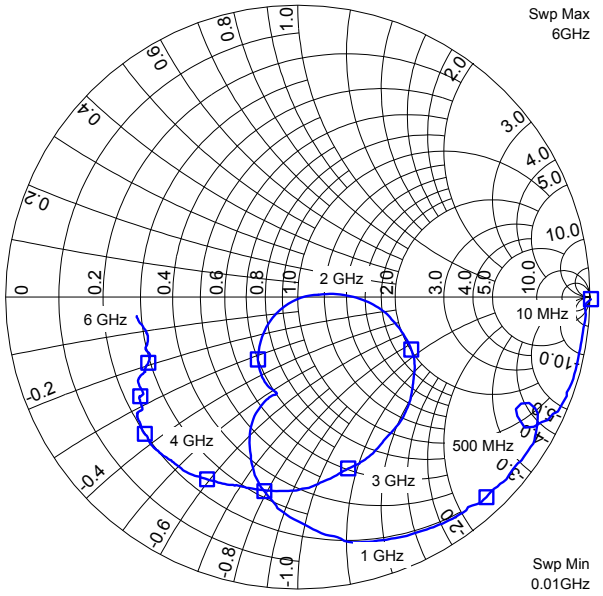

### DCS Bypass Mode Output Impedance (S22)



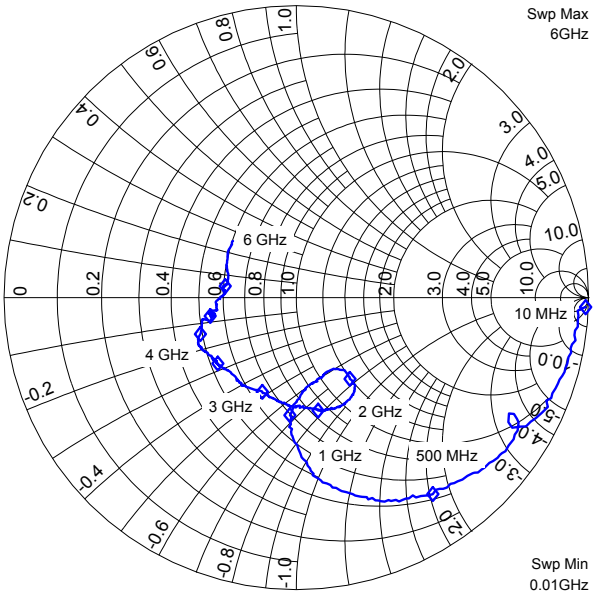
**PCS High Gain Mode Input Impedance (S11)**



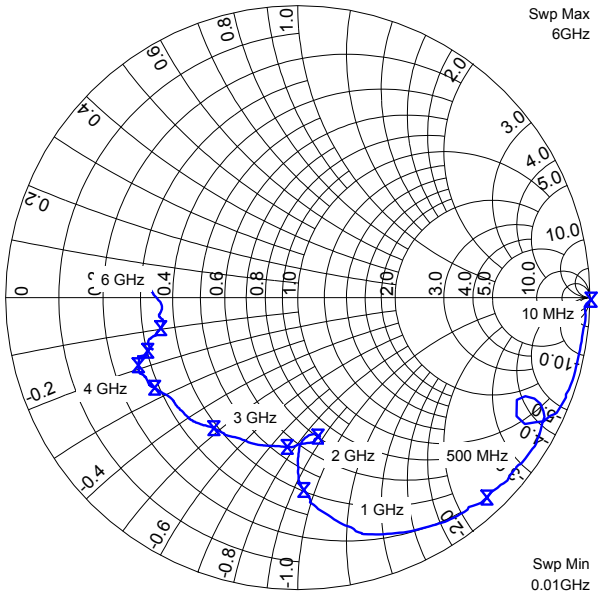

**PCS High Gain Mode Output Impedance (S22)**




**PCS Bypass Mode Input Impedance (S11)**




**PCS Bypass Mode Output Impedance (S22)**

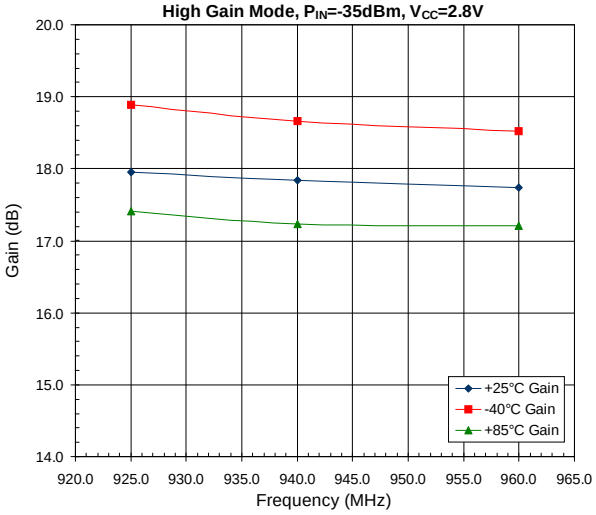



**NOTES:**

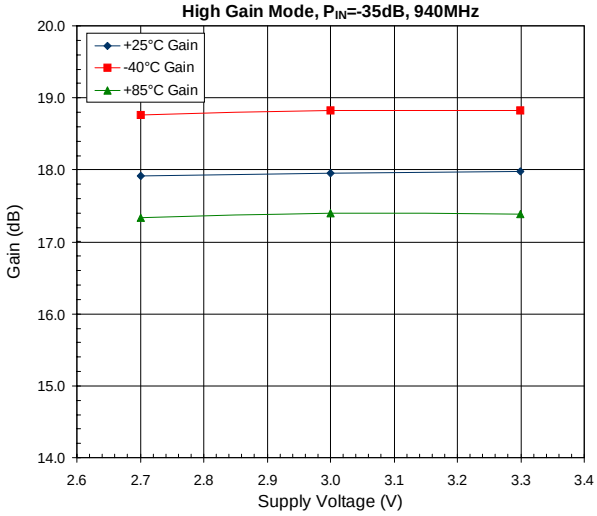
1. All plots shown were taken at $V_{CC}$=2.8V and room ambient temperature.

2. All S11 and S22 plots shown were taken from an RF2417 assembled on a 2417310 evaluation board. The data was extracted without the external input or output tuning components in place and the reference points at the RF IN and RFOUT pins of the device.

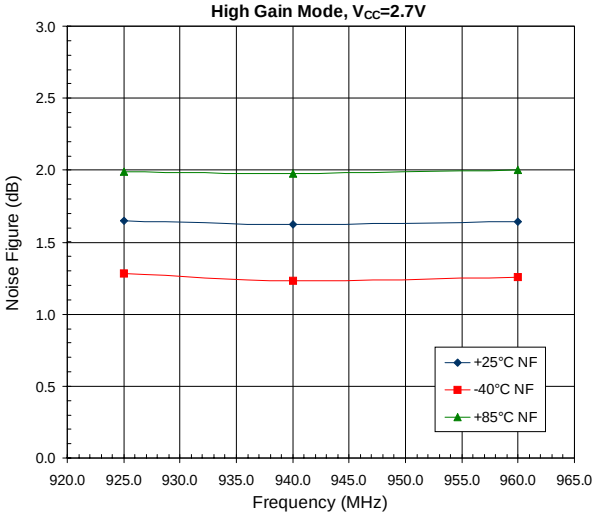
**EGSM Gain versus Frequency**
**High Gain Mode, $P_{IN}$=-35dBm, $V_{CC}$=2.8V**



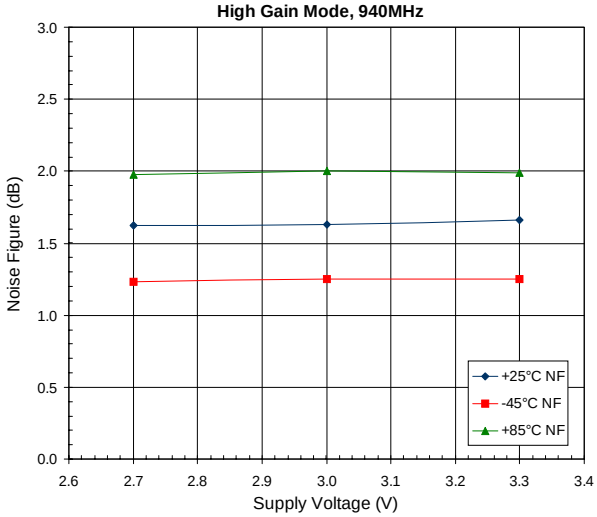

**EGSM Gain versus Supply Voltage**
**High Gain Mode, $P_{IN}$=-35dB, 940MHz**



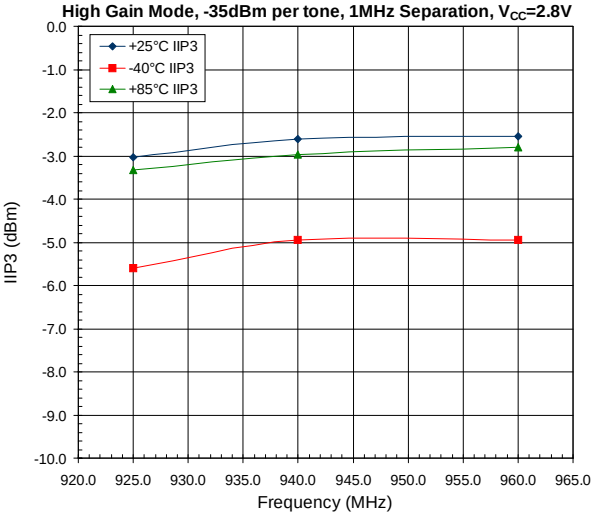

**EGSM Noise Figure versus Frequency**
**High Gain Mode, $V_{CC}$=2.7V**



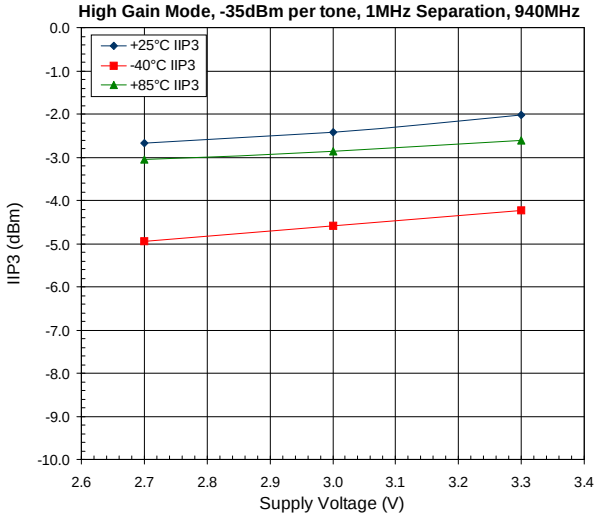

**EGSM Noise Figure versus Supply Voltage**
**High Gain Mode, 940MHz**




**EGSM Input IP3 versus Frequency**
**High Gain Mode, -35dBm per tone, 1MHz Separation, $V_{CC}$=2.8V**

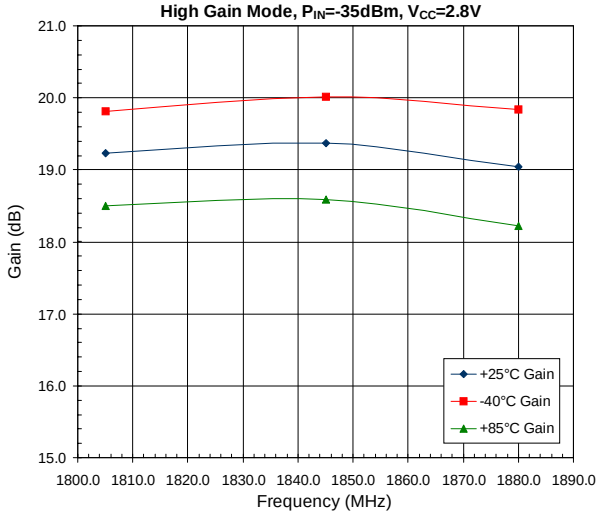



**EGSM Input IP3 versus Supply Voltage**
**High Gain Mode, -35dBm per tone, 1MHz Separation, 940MHz**



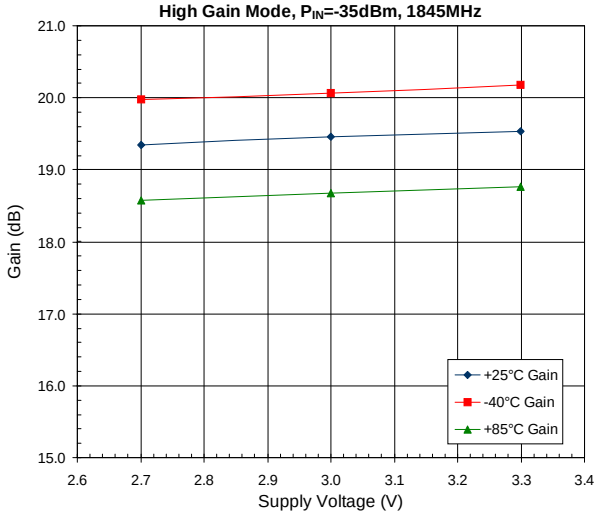
**DCS Gain versus Frequency**

**High Gain Mode, $P_{IN}$=-35dBm, $V_{CC}$=2.8V**



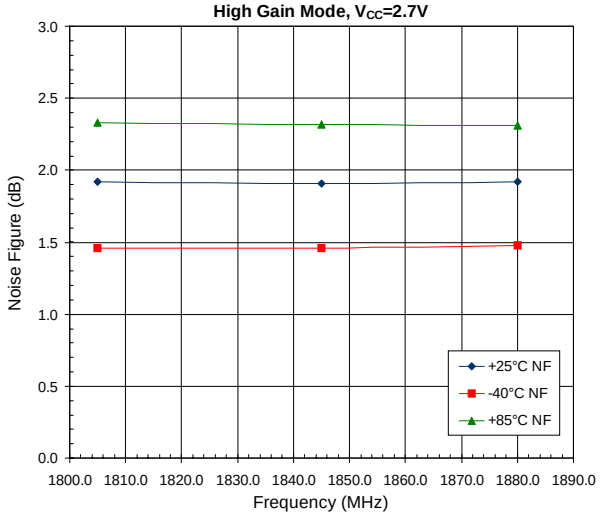

**DCS Gain versus Supply Voltage**

**High Gain Mode, $P_{IN}$=-35dBm, 1845MHz**



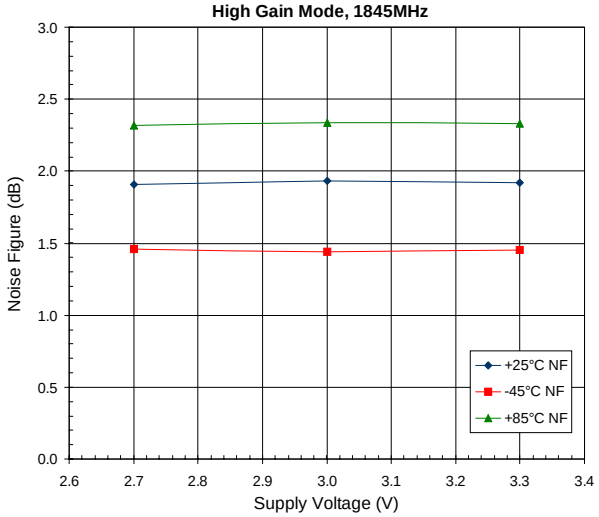

**DCS Noise Figure versus Frequency**

**High Gain Mode, $V_{CC}$=2.7V**



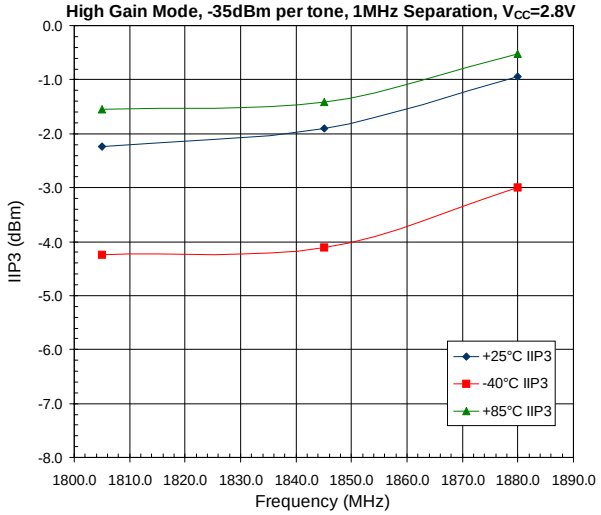

**DCS Noise Figure versus Supply Voltage**

**High Gain Mode, 1845MHz**



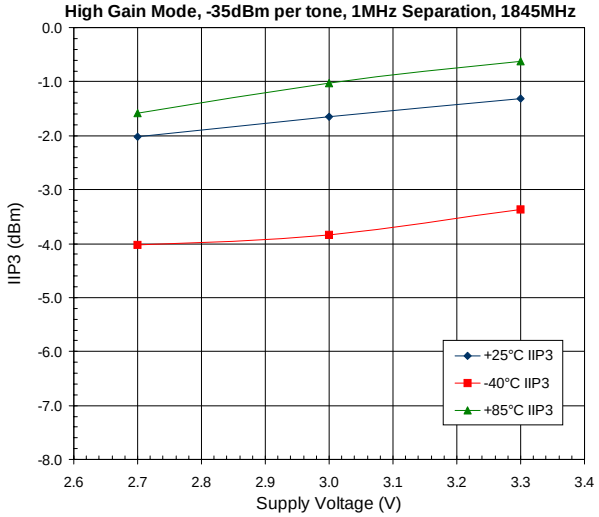

**DCS Input IP3 versus Frequency**

**High Gain Mode, -35dBm per tone, 1MHz Separation, $V_{CC}$=2.8V**

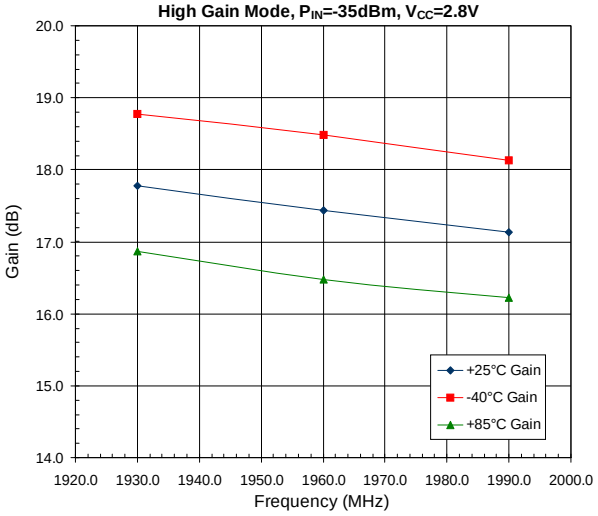



**DCS Input IP3 versus Supply Voltage**

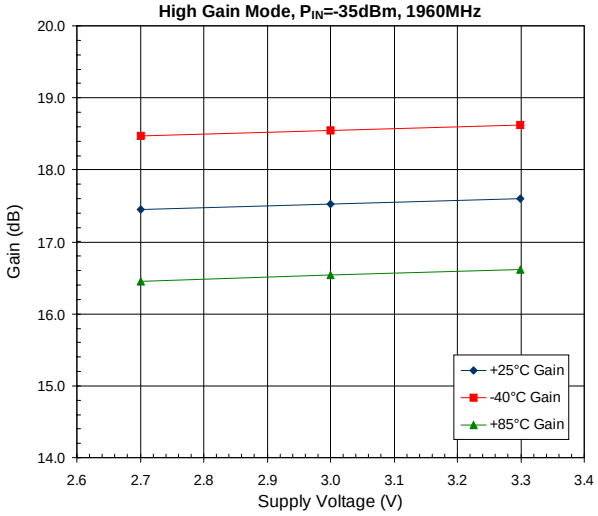
**High Gain Mode, -35dBm per tone, 1MHz Separation, 1845MHz**



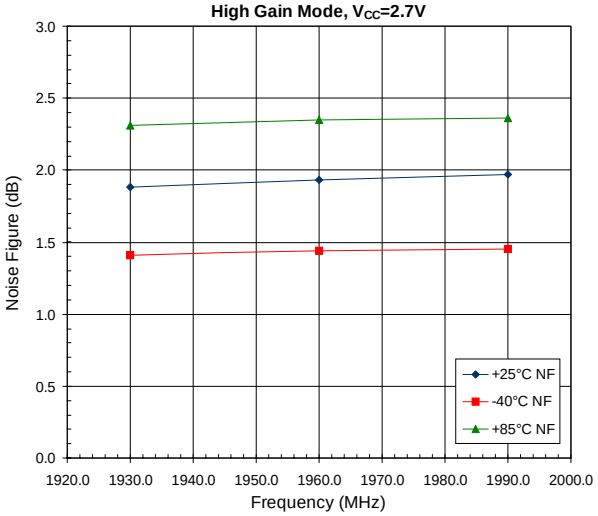
**PCS Gain versus Frequency**
**High Gain Mode, $P_{IN}$=-35dBm, $V_{CC}$=2.8V**



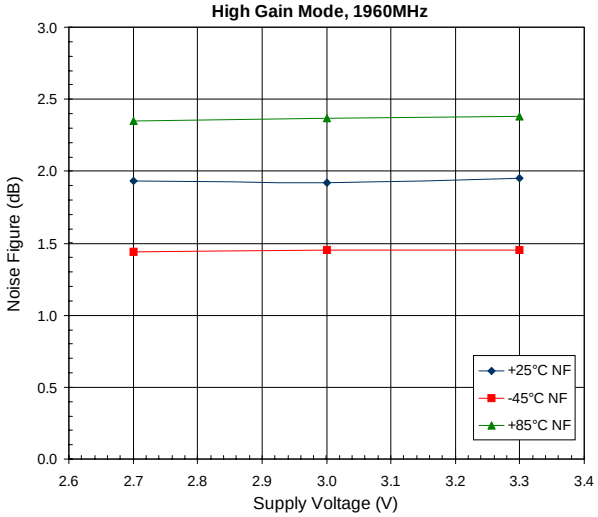

**PCS Gain versus Supply Voltage**
**High Gain Mode, $P_{IN}$=-35dBm, 1960MHz**



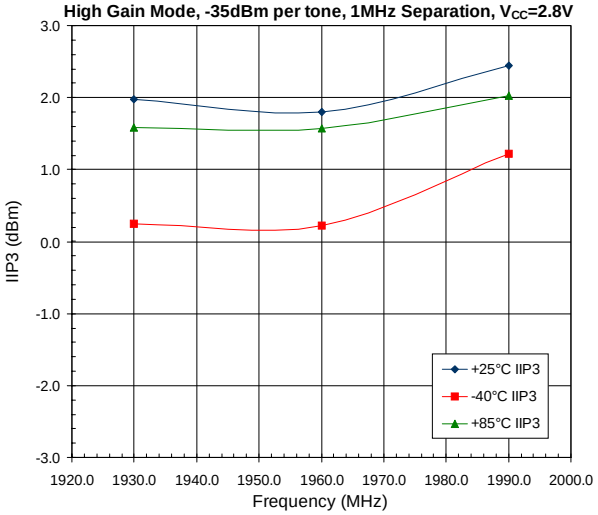

**PCS Noise Figure versus Frequency**
**High Gain Mode, $V_{CC}$=2.7V**



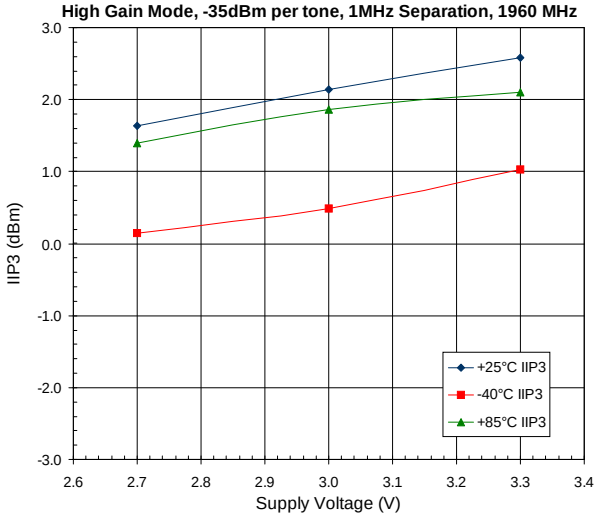

**PCS Noise Figure versus Supply Voltage**
**High Gain Mode, 1960MHz**



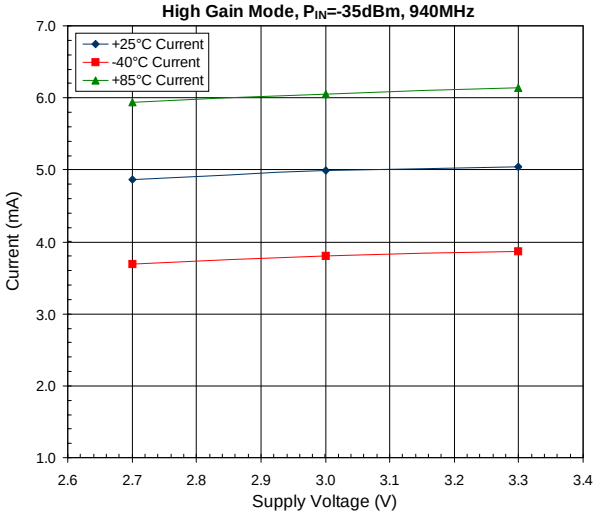

**PCS Input IP3 versus Frequency**
**High Gain Mode, -35dBm per tone, 1MHz Separation, $V_{CC}$=2.8V**



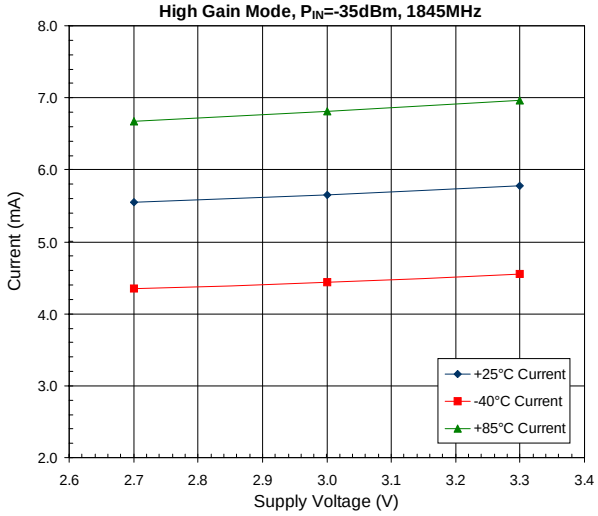

**PCS Input IP3 versus Supply Voltage**
**High Gain Mode, -35dBm per tone, 1MHz Separation, 1960 MHz**



**EGSM Current versus Supply Voltage**
**High Gain Mode, $P_{IN}$=-35dBm, 940MHz**




**DCS Current versus Supply Voltage**
**High Gain Mode, $P_{IN}$=-35dBm, 1845MHz**




**PCS Current versus Supply Voltage**
**High Gain Mode, $P_{IN}$=-35dBm, 1960MHz**