# RF2304

GENERAL PURPOSE LOW-NOISE AMPLIFIER

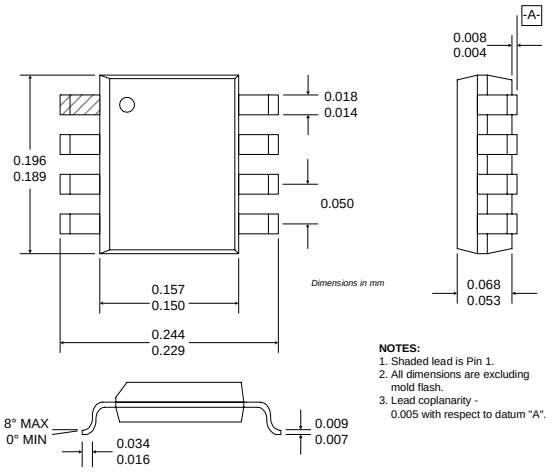


## Typical Applications

- Receive or Transmit Low-Noise Amplifiers
- FDD and TDD Communication Systems
- Commercial and Consumer Systems
- Portable Battery Powered Equipment
- Wireless LAN
- ISM Band Applications

## Product Description

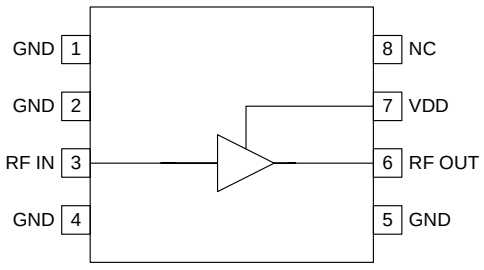
The RF2304 is a low-noise small-signal amplifier. The device is manufactured on a low-cost Gallium Arsenide MESFET process, and has been designed for use as a gain block in high-end communication systems operating from less than 300MHz to above 2.5GHz. With +6dBm output power, it may also be used as a driver in transmitter applications, or in highly linear receivers. The device is packaged in an 8-lead plastic package and is self-contained, requiring just an inductor and blocking capacitors to operate. The +6dBm output power, combined with the 1.8dB noise figure at 900MHz allows excellent dynamic range for a variety of receive and transmit applications.




Package Style: SOIC-8

### Optimum Technology Matching® Applied

- ☐ Si BJT
- ☐ Si Bi-CMOS
- ☐ GaAs HBT
- ☐ SiGe HBT
- ☑ GaAs MESFET
- ☐ Si CMOS




Functional Block Diagram

## Features

- Single 2.7V to 6.0V Supply
- 6dBm Output Power
- 8dB Small Signal Gain at 900MHz
- 1.8dB Noise Figure at 900MHz
- Low DC Current Consumption of 5mA
- 300MHz to 2500MHz Operation

## Ordering Information

| | |
|---|---|
| RF2304 | General Purpose Low-Noise Amplifier |
| RF2304 PCBA | Fully Assembled Evaluation Board |

RF Micro Devices, Inc.
7628 Thorndike Road
Greensboro, NC 27409, USA
Tel (336) 664 1233
Fax (336) 664 0454
http://www.rfmd.com

## Absolute Maximum Ratings

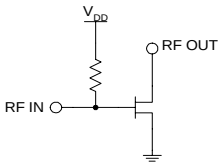
| Parameter | Rating | Unit |
|---|---|---|
| Supply Voltage ($V_{DD}$) | -0.5 to +6.5 | $V_{DC}$ |
| DC Current | 40 | mA |
| Input RF Power | +10 | dBm |
| Operating Ambient Temperature | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |

**Caution!** ESD sensitive device.



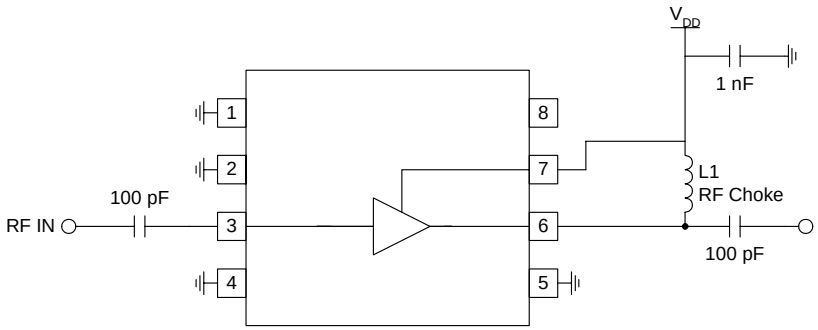


| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **Operating Range** | | | | | |
| Overall Frequency Range | 300 | | 2500 | MHz | |
| Supply Voltage | 2.7 | | 6.0 | V | |
| Operating Current ($I_{CC}$) | | 8.4 | | mA | $V_{CC}$=3V, Temp=27°C |
| | 7 | 11 | 26 | mA | $V_{CC}$=5V, Temp=27°C |
| Operating Ambient Temperature | -40 | | +85 | °C | |
| **3V Performance** | | | | | |
| Gain | | 11.7 | | dB | Freq=300MHz, $V_{CC}$=3V, Temp=27°C |
| Gain | | 8.5 | | dB | Freq=900MHz, $V_{CC}$=3V, Temp=27°C |
| Noise Figure | | 1.9 | | dB | |
| Input IP3 | | +6.9 | | dBm | |
| OP1dB | | +7.5 | | dBm | |
| Gain | | 9.2 | | dB | Freq=1950MHz, $V_{CC}$=3V, Temp=27°C |
| Noise Figure | | 1.7 | | dB | |
| Input IP3 | | +8.6 | | dBm | |
| OP1dB | | +6.9 | | dBm | |
| Gain | | 8.2 | | dB | Freq=2450MHz, $V_{CC}$=3V, Temp=27°C |
| Noise Figure | | 1.7 | | dB | |
| Input IP3 | | +10.5 | | dBm | |
| OP1dB | | +7.5 | | dBm | |
| **5V Performance** | | | | | |
| Gain | | 12.5 | | dB | Freq=300MHz, $V_{CC}$=5V, Temp=27°C |
| Gain | 10 | 12 | 14 | dB | Freq=900MHz, $V_{CC}$=5V, Temp=27°C |
| Noise Figure | | 1.9 | | dB | |
| Input IP3 | | +8.4 | | dBm | |
| OP1dB | | +8.7 | | dBm | |
| Gain | | 9.8 | | dB | Freq=1950MHz, $V_{CC}$=5V, Temp=27°C |
| Noise Figure | | 1.9 | | dB | |
| Input IP3 | | +10.0 | | dBm | |
| OP1dB | | +8 | | dBm | |
| Gain | 6 | 8 | 11 | dB | Freq=2450MHz, $V_{CC}$=5V, Temp=27°C |
| Noise Figure | | 1.6 | | dB | |
| Input IP3 | | +8.0 | | dBm | |
| OP1dB | | +6 | | dBm | |

| Pin | Function | Description | Interface Schematic |
|---|---|---|---|
| 1 | GND | Ground connection. For best performance, keep traces physically short and connect immediately to ground plane. | |
| 2 | GND | Same as pin 1. | |
| 3 | RF IN | DC coupled RF input. A broadband impedance match is produced by internal shunt resistive feedback. The DC level is approximately 200mV. If a DC path exists in the connected circuitry, an external DC-blocking capacitor is required to properly maintain the DC operating point. | |
| 4 | GND | Same as pin 1. | |
| 5 | GND | Same as pin 1. | |
| 6 | RF OUT | RF output. A broadband impedance match is produced by internal shunt resistive feedback. The DC connection to the power supply is provided through an external chip inductor having greater than 150Ω reactance at the operating frequency. An external DC-blocking capacitor is required if the following circuitry is not DC-blocked. |  |
| 7 | VDD2 | Bias control connection. This pin is normally connected to the power supply, but can be used to switch the amplifier on and off by switching between power supply voltage and ground. This pin sinks approximately 600μA when connected to $V_{DD}$, and sources less than 10μA when grounded. | |
| 8 | NC | No connection. | |

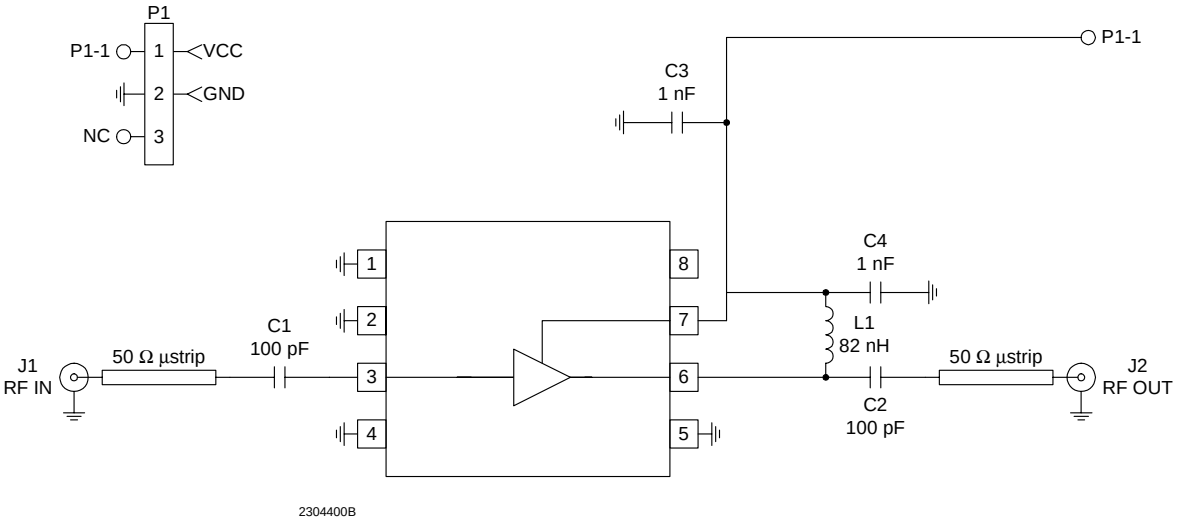


## Application Schematic



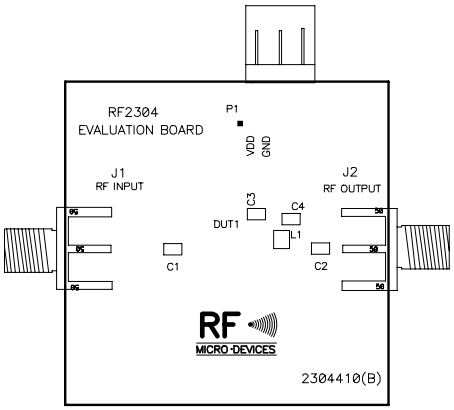
## Evaluation Board Schematic

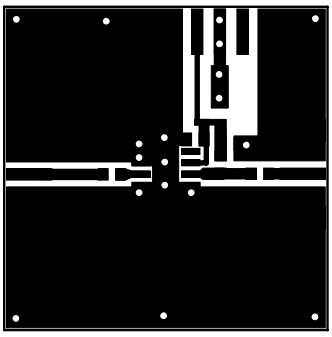
(Download Bill of Materials from www.rfmd.com.)



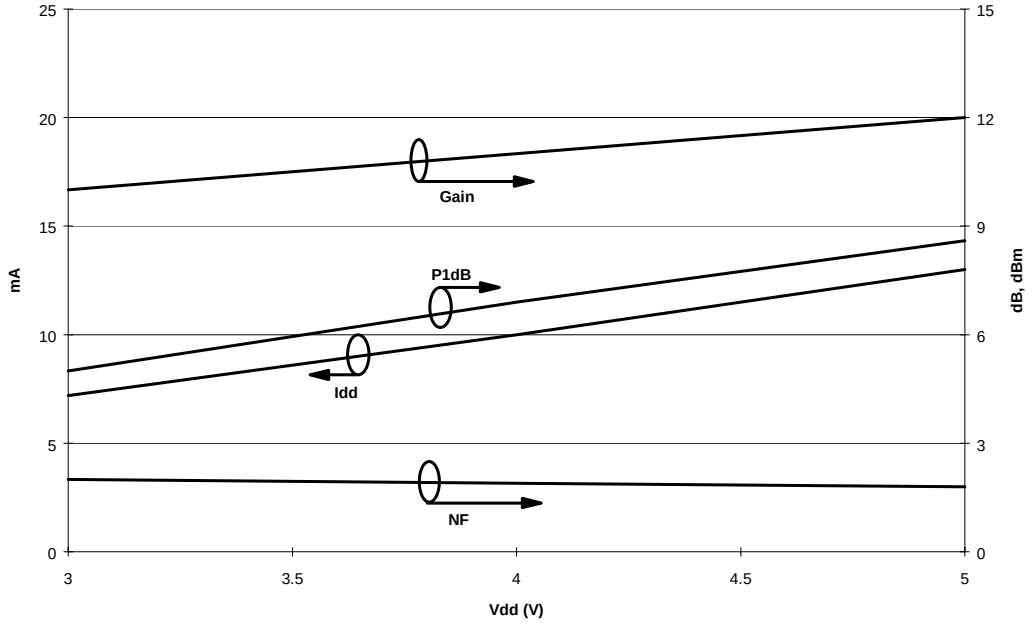

## Evaluation Board Layout

1.43” x 1.43”

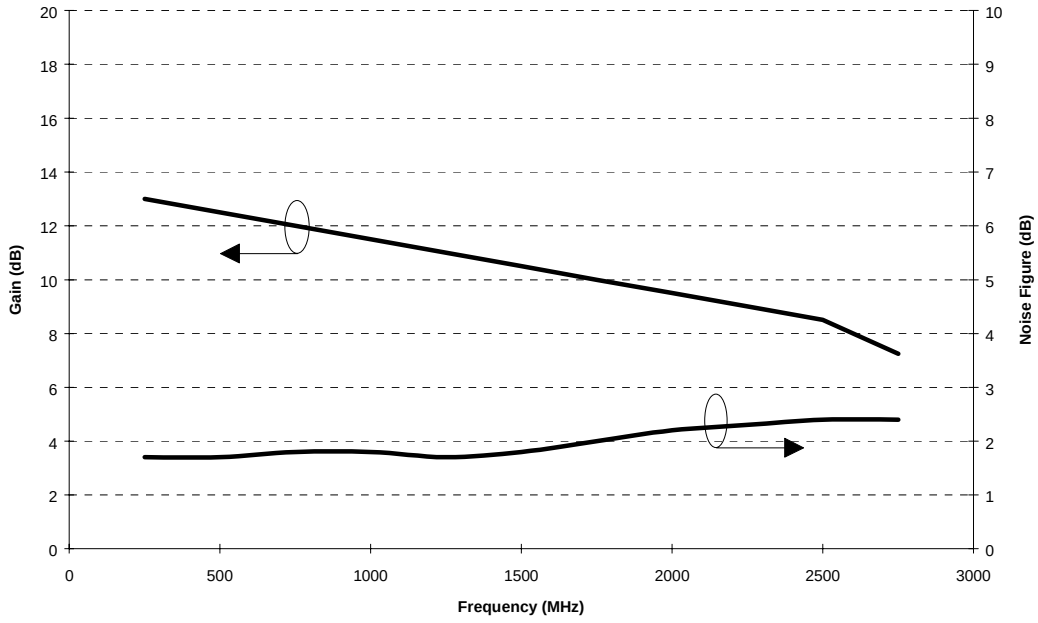


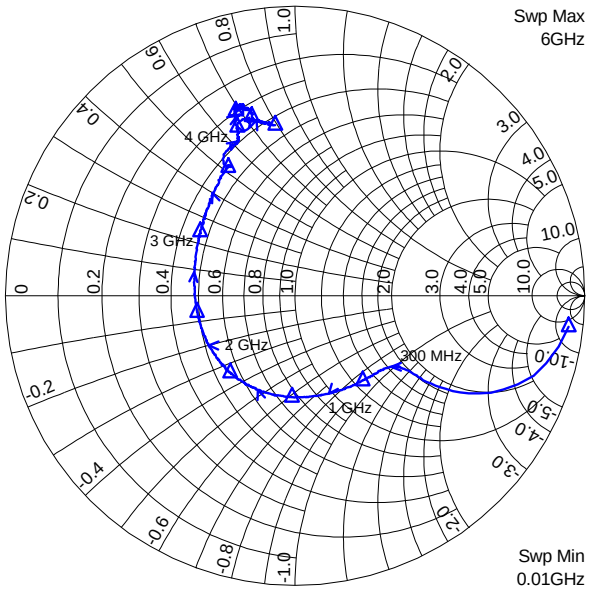
## Typical Characteristics - f=900MHz



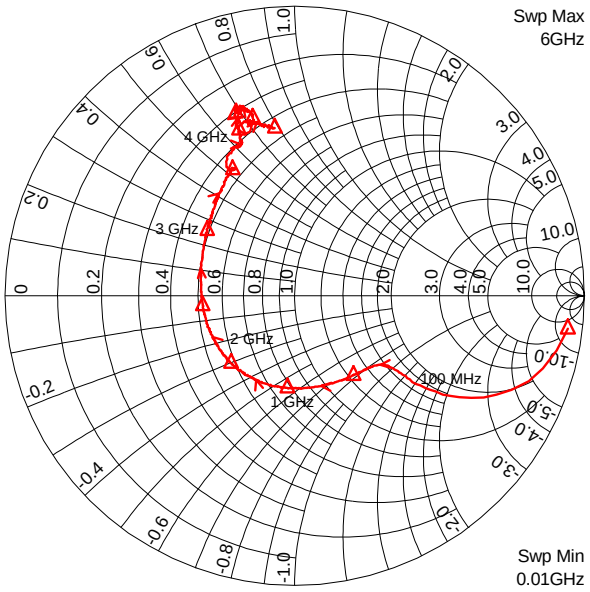

## Typical Characteristics - $V_{DD}$=5.0V



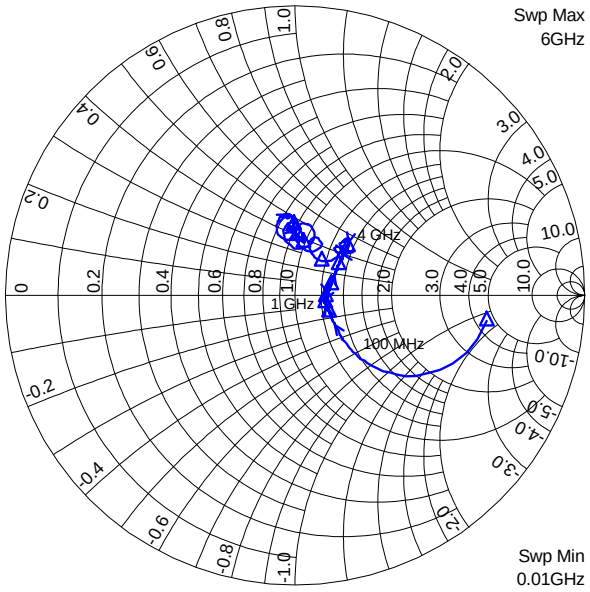
**S11 $V_{CC}$ = 3V**



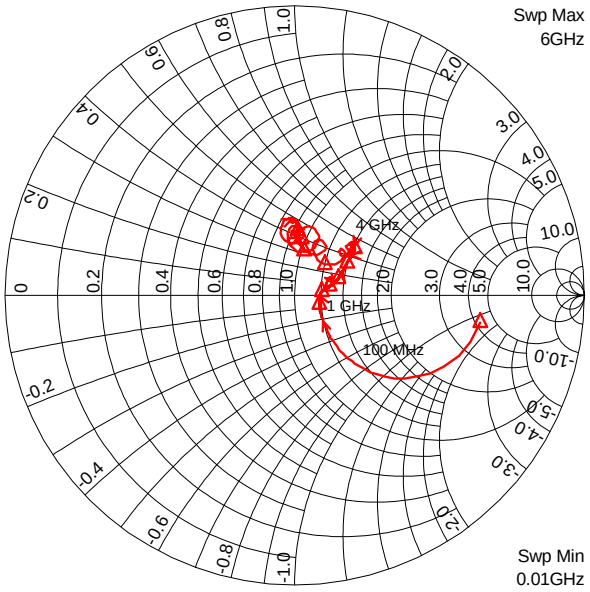

**S11 $V_{CC}$ = 5V**




**S22 $V_{CC}$ = 3V**



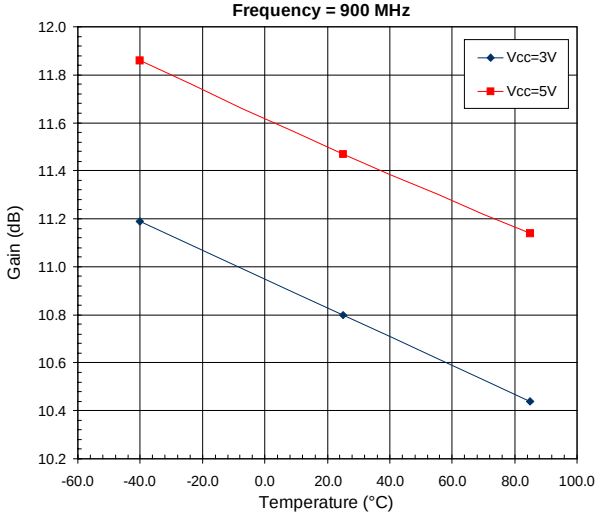

**S22 $V_{CC}$ = 5V**



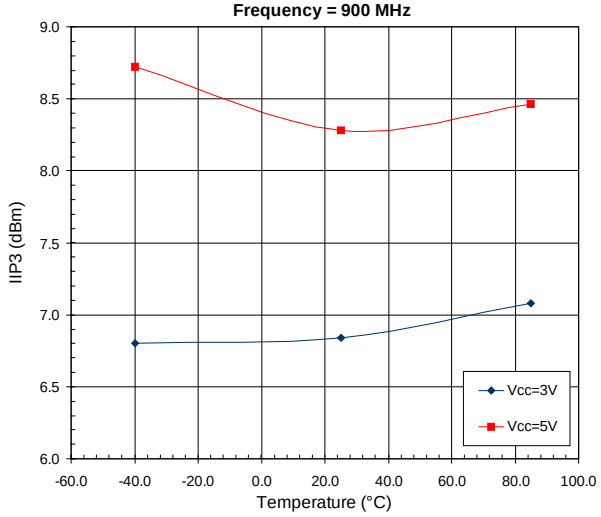

S-Parameter Conditions:
All plots are taken at ambient temperature = 25°C.

NOTE:
All S11 and S22 plots shown were taken from an RF2304 evaluation board with external input and output tuning components removed and the reference points at the RF IN and RF OUT pins.

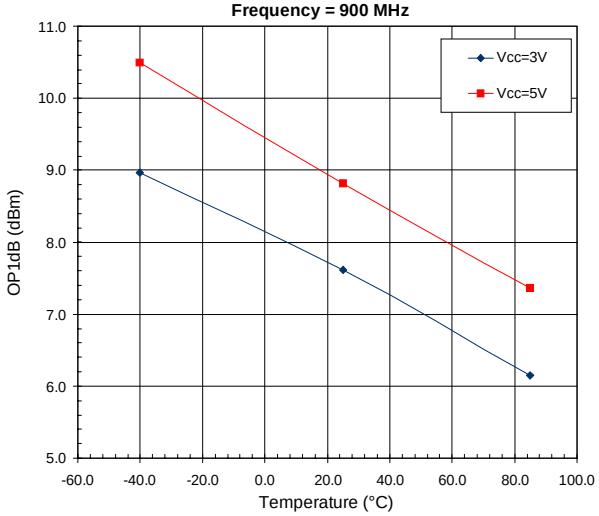
**Gain versus Temperature**
**Frequency = 900 MHz**



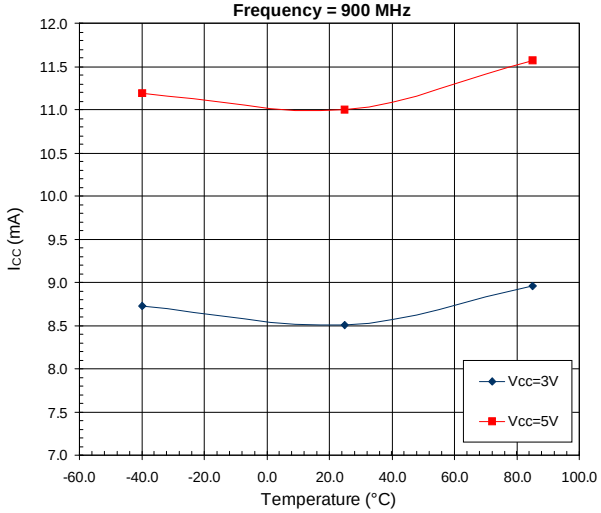

**IIP3 versus Temperature**
**Frequency = 900 MHz**



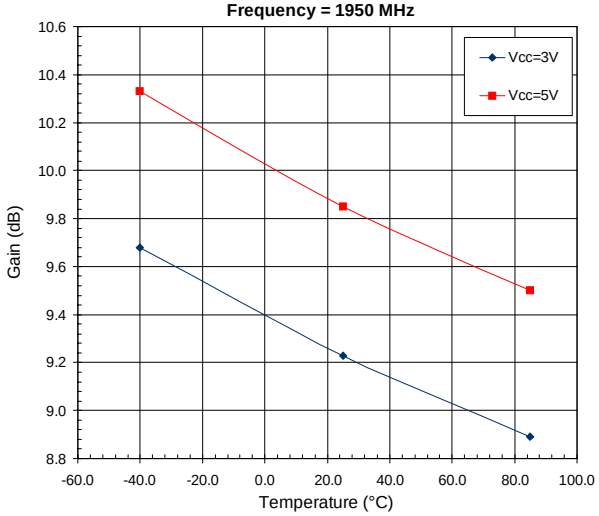

**OP1dB versus Temperature**
**Frequency = 900 MHz**



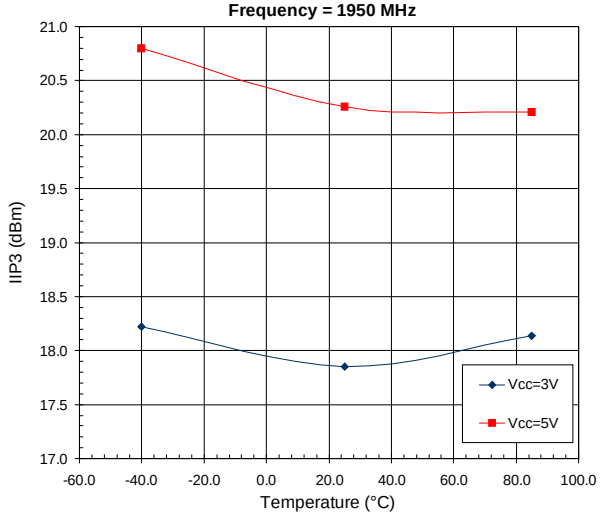

**$I_{CC}$ versus Temperature**
**Frequency = 900 MHz**



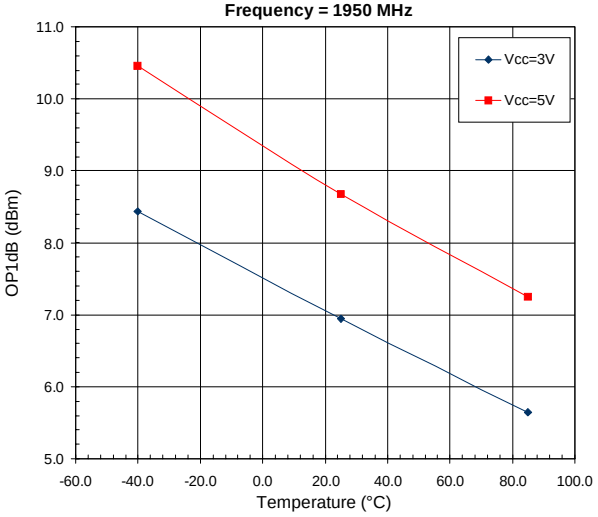

**Gain versus Temperature**
**Frequency = 1950 MHz**



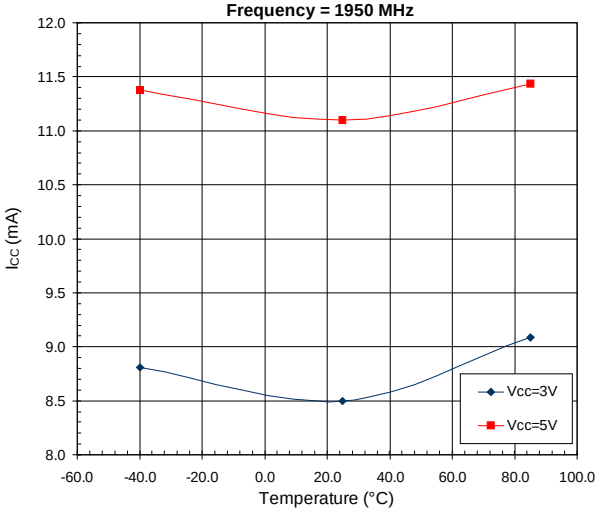

**IIP3 versus Temperature**
**Frequency = 1950 MHz**



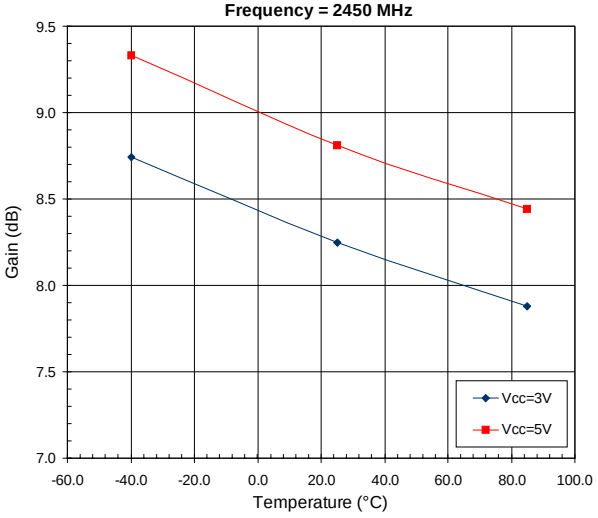
**OP1dB versus Temperature**
**Frequency = 1950 MHz**



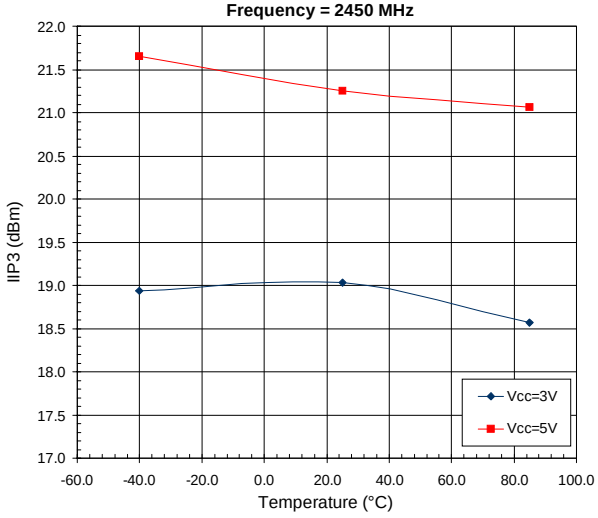

**$I_{CC}$ versus Temperature**
**Frequency = 1950 MHz**



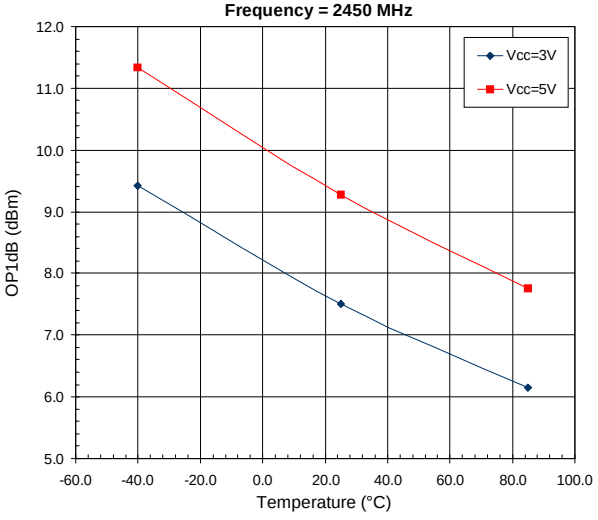

**Gain versus Temperature**
**Frequency = 2450 MHz**



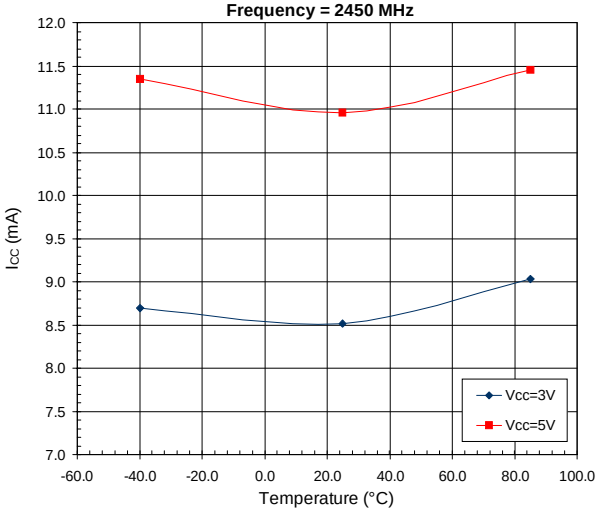

**IIP3 versus Temperature**
**Frequency = 2450 MHz**

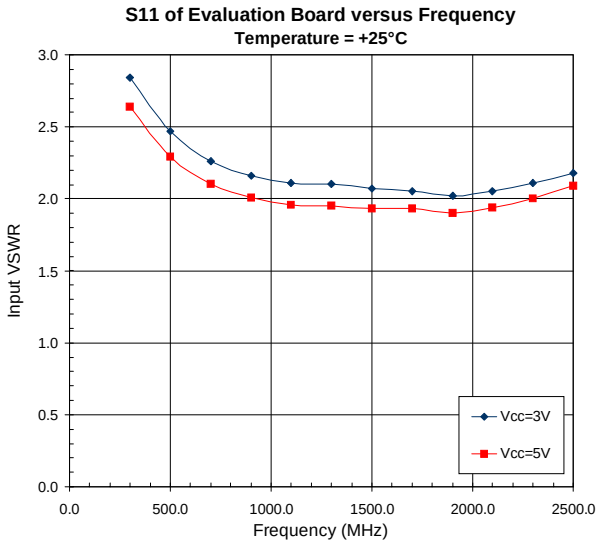


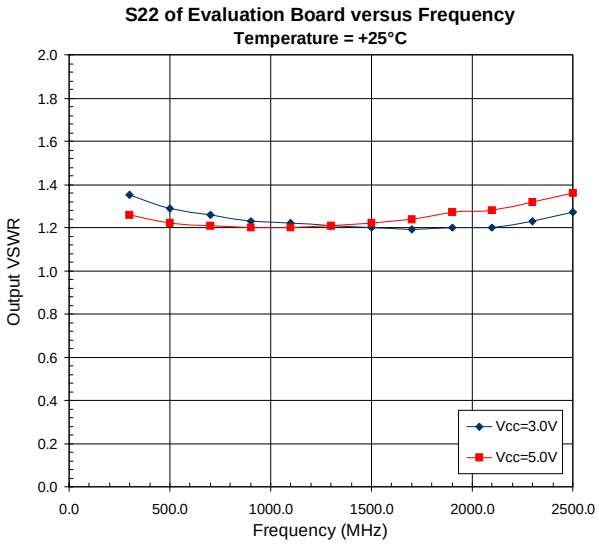

**OP1dB versus Temperature**
**Frequency = 2450 MHz**

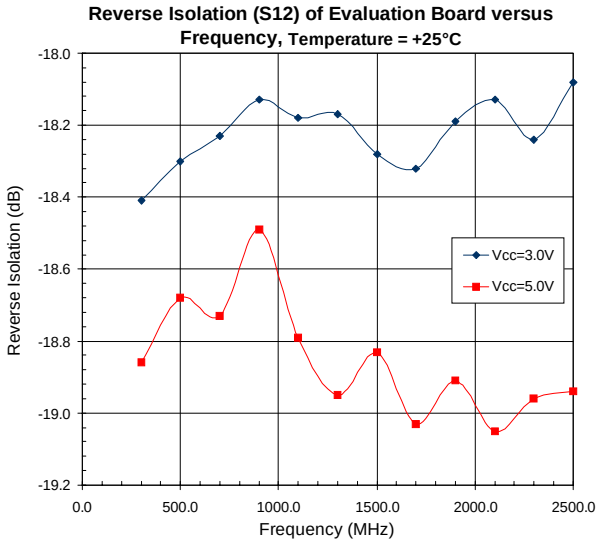



**$I_{CC}$ versus Temperature**
**Frequency = 2450 MHz**




S11 of Evaluation Board versus Frequency
Temperature = +25°C
Input VSWR
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
500.0
1000.0
1500.0
2000.0
2500.0
Frequency (MHz)
Vcc=3V
Vcc=5V


S22 of Evaluation Board versus Frequency
Temperature = +25°C
Output VSWR
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
500.0
1000.0
1500.0
2000.0
2500.0
Frequency (MHz)
Vcc=3.0V
Vcc=5.0V


Reverse Isolation (S12) of Evaluation Board versus Frequency, Temperature = +25°C
Reverse Isolation (dB)
-18.0
-18.2
-18.4
-18.6
-18.8
-19.0
-19.2
0.0
500.0
1000.0
1500.0
2000.0
2500.0
Frequency (MHz)
Vcc=3.0V
Vcc=5.0V