# AND9518/D

# DAB L-band Amplifier using the NSVF4020SG4

ON Semiconductor®

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**APPLICATION NOTE**

## Overview

This application note explains about ON Semiconductor's NSVF4020SG4 which is used as a Low Noise Amplifier (LNA) for DAB (Digital Audio Broadcast).

The NSVF4020SG4 is a silicon bipolar transistor best suited for high-frequency applications which is assembled in the 4-pin surface mount package.
For information about the performance, please refer to the datasheet of this product.

Since the evaluation board is adjusted to achieve optimal performance in L-band (1452 MHz to 1492 MHz), the product can provide 10 dB gain and 1.85 dB noise figure.

A standard material FR4 is used for the printed circuit board (PCB). Please note that the losses of the PCB and the SMA connector are not excluded from the noise figure.



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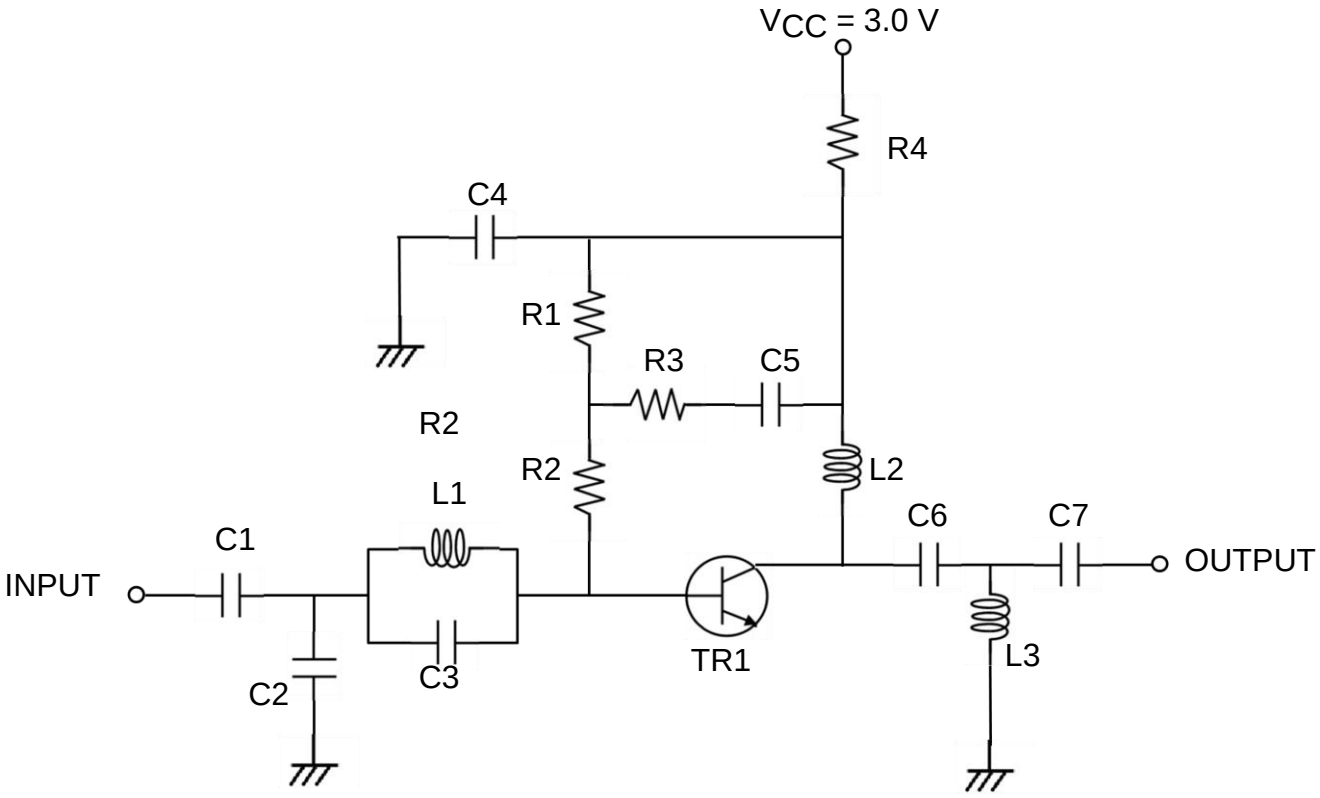
## ■ Summary of Data

Ta = 25°C, Input Power = −40 dBm

| Parameter | Symbol | Condition | Result | | | Unit |
|---|---|---|---|---|---|---|
| DC Voltage | $V_{CC}$ | | 2.7 | 3.0 | 3.3 | V |
| DC Current | $I_{CC}$ | | 6.4 | 7.4 | 8.4 | mA |
| Gain | Gp1 | f = 1452 MHz | 9.9 | 10.1 | 10.2 | dB |
| | Gp2 | f = 1472 MHz | 9.7 | 10.0 | 10.1 | dB |
| | Gp3 | f = 1492 MHz | 9.7 | 9.9 | 10.1 | dB |
| Noise Figure | NF1 | f = 1452 MHz | 1.67 | 1.69 | 1.74 | dB |
| | NF2 | f = 1472 MHz | 1.81 | 1.85 | 1.88 | dB |
| | NF3 | f = 1492 MHz | 1.86 | 1.90 | 1.94 | dB |
| Input Return Loss | RLin1 | f = 1452 MHz | 29.9 | 41.8 | 35.3 | dB |
| | RLin2 | f = 1472 MHz | 26.7 | 33.1 | 40.3 | dB |
| | RLin3 | f = 1492 MHz | 22.3 | 24.8 | 26.6 | dB |
| Output Return Loss | RLout1 | f = 1452 MHz | 8.6 | 8.4 | 8.2 | dB |
| | RLout2 | f = 1472 MHz | 9.7 | 9.5 | 9.3 | dB |
| | RLout3 | f = 1492 MHz | 9.9 | 9.7 | 9.5 | dB |
| Isolation | ISL1 | f = 1452 MHz | 15.9 | 16.0 | 16.0 | dB |
| | ISL2 | f = 1472 MHz | 15.8 | 15.9 | 15.9 | dB |
| | ISL3 | f = 1492 MHz | 15.7 | 15.7 | 15.8 | dB |
| Gain 1dB Compression Input Power | Pin1dB | f = 1472 MHz | – | −6.0 | – | dBm |
| Input 3rd Order Intercept Point | IIP3 | f1 = 1472 MHz<br>f2 = 1473 MHz<br>Pin = –20 dBm | – | 7.0 | – | dBm |

## ■ Circuit Design

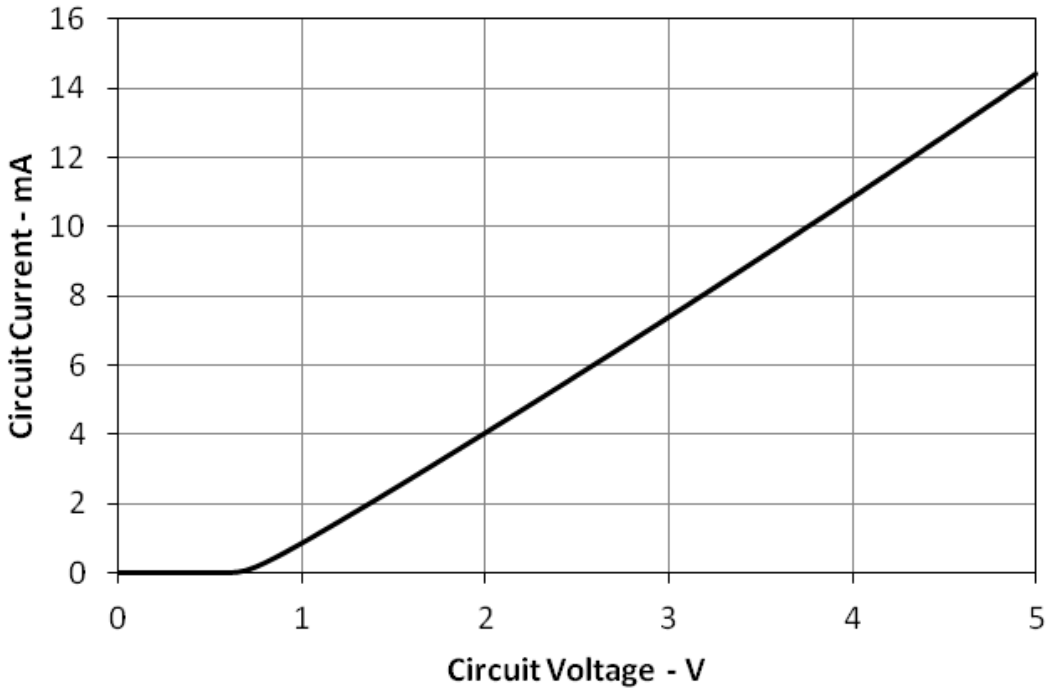



## ■ Evaluation Board

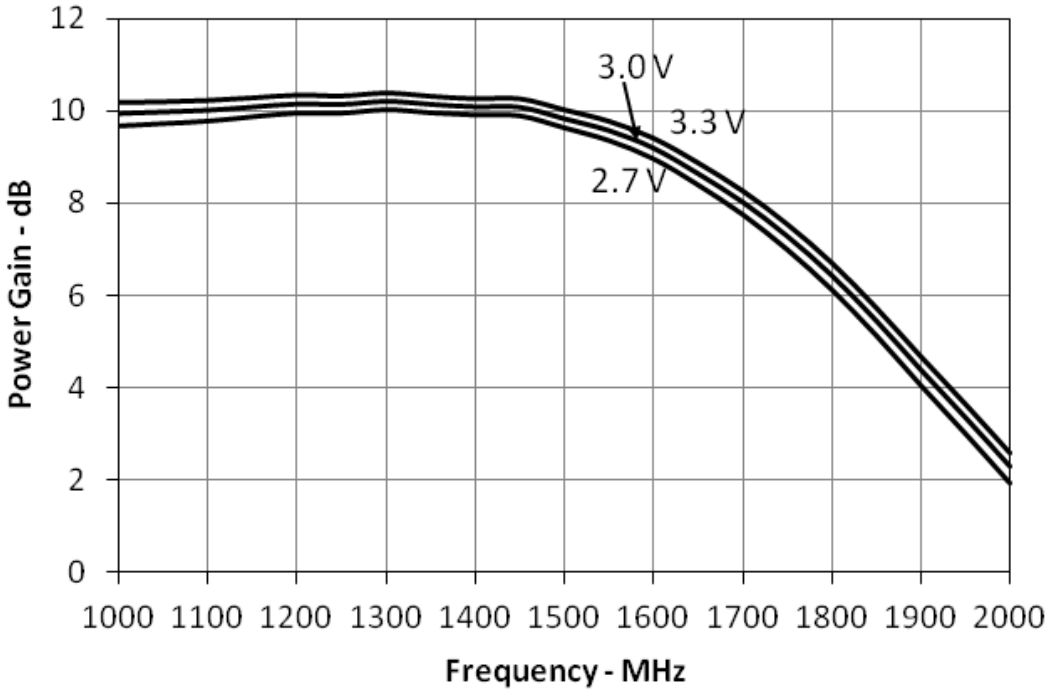
## ■ Bill of Materials

| Item | Symbol | Value | Manufacturer | Size |
|---|---|---|---|---|
| Bip-Tr | TR1 | NSVF4020SG4 | ON Semiconductor | SC82 |
| Capacitor | C1 | 56 pF | TAIYOYUDEN | 1005 |
| | C2 | 1.8 pF | TAIYOYUDEN | 1005 |
| | C3 | 1 pF | TAIYOYUDEN | 1005 |
| | C4 | 82 pF | TAIYOYUDEN | 1005 |
| | C5 | 120 pF | TAIYOYUDEN | 1005 |
| | C6 | 8 pF | TAIYOYUDEN | 1005 |
| | C7 | 120 pF | TAIYOYUDEN | 1005 |
| Resistor | R1 | 22 kΩ | Various | 1005 |
| | R2 | 820 Ω | Various | 1005 |
| | R3 | 150 Ω | Various | 1005 |
| | R4 | 47 Ω | Various | 1005 |
| Inductor | L1 | 2.7 nH | TOKO LL1005 | 1005 |
| | L2 | 56 nH | TOKO LL1005 | 1005 |
| | L4 | 3.9 nH | TOKO LL1005-FHL1N8S | 1005 |
| Material | – | FR4 | – | 25 x 25 mm |

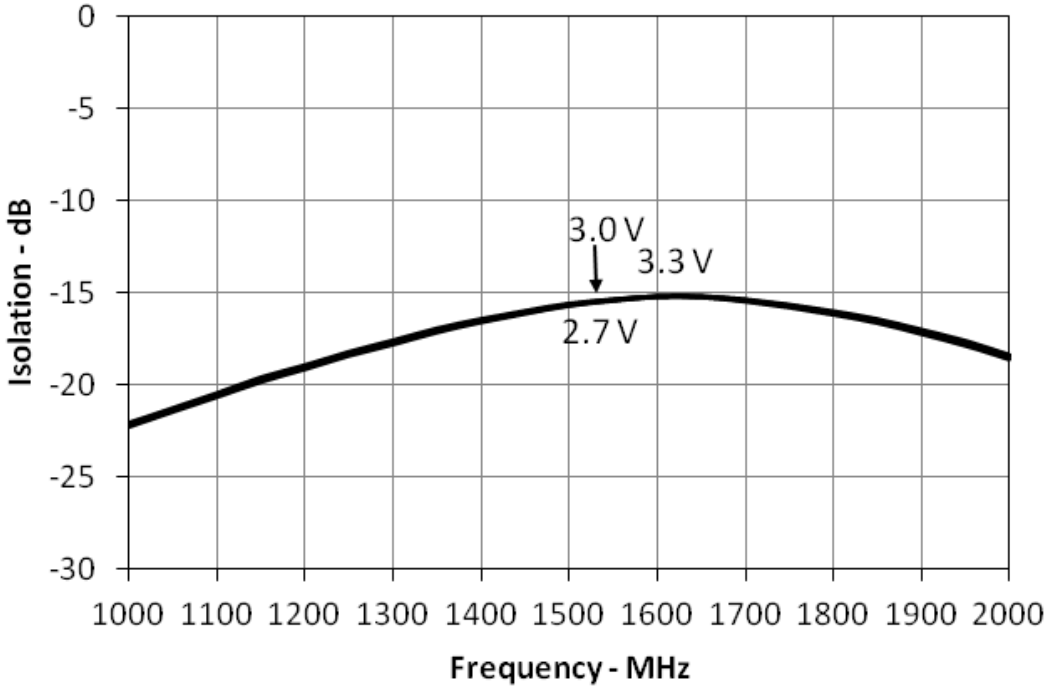
## ■ Circuit Current



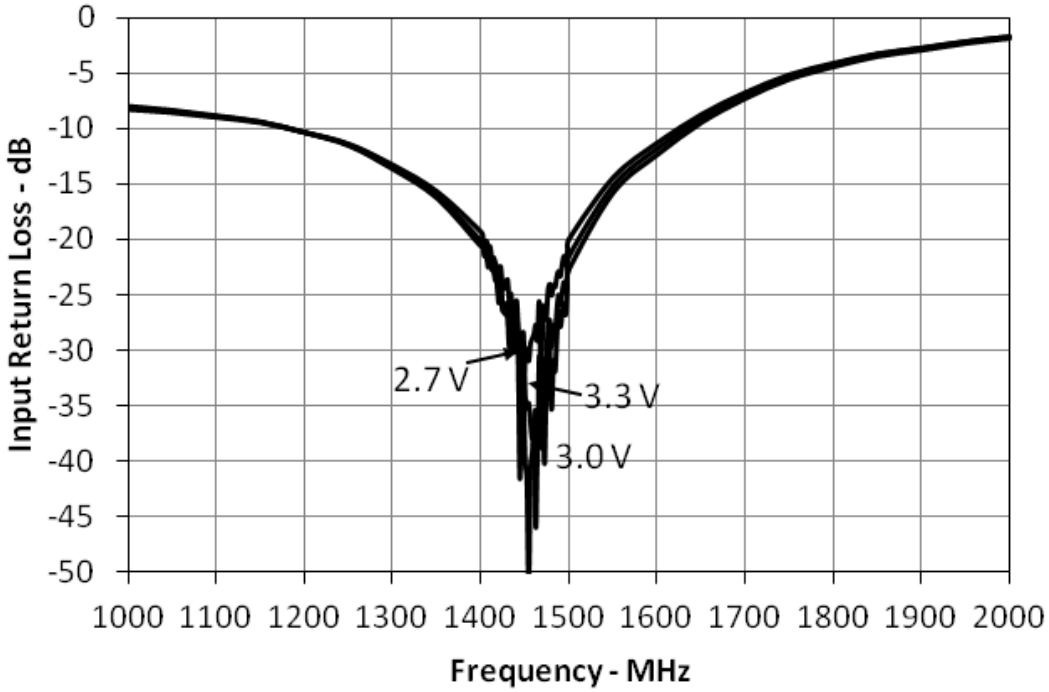
## ■ Power Gain



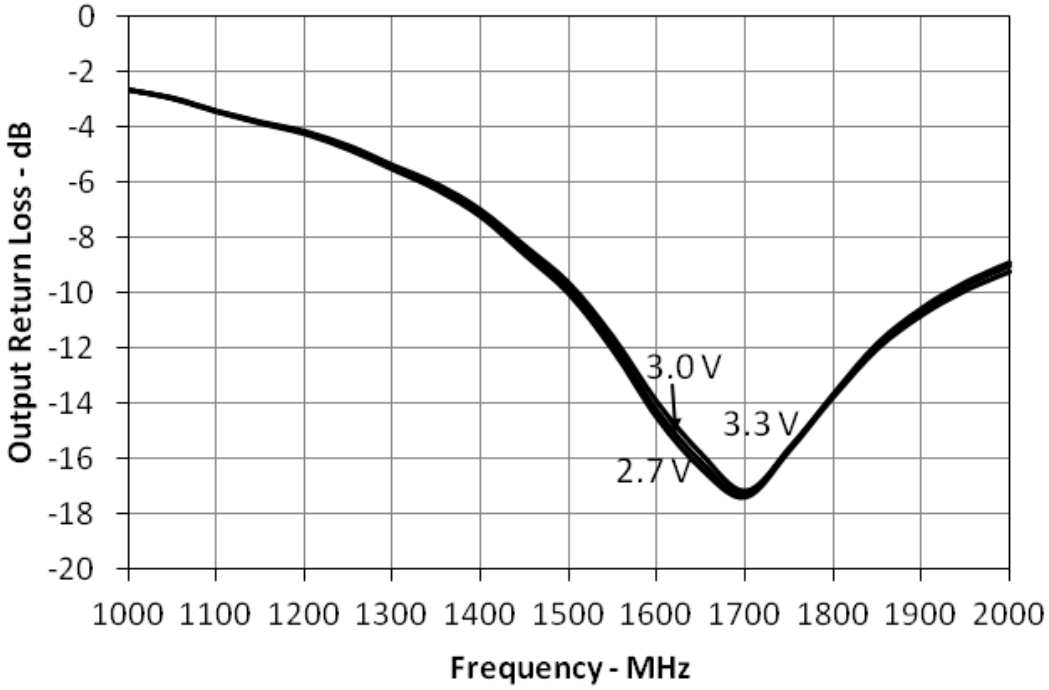

## ■ Isolation



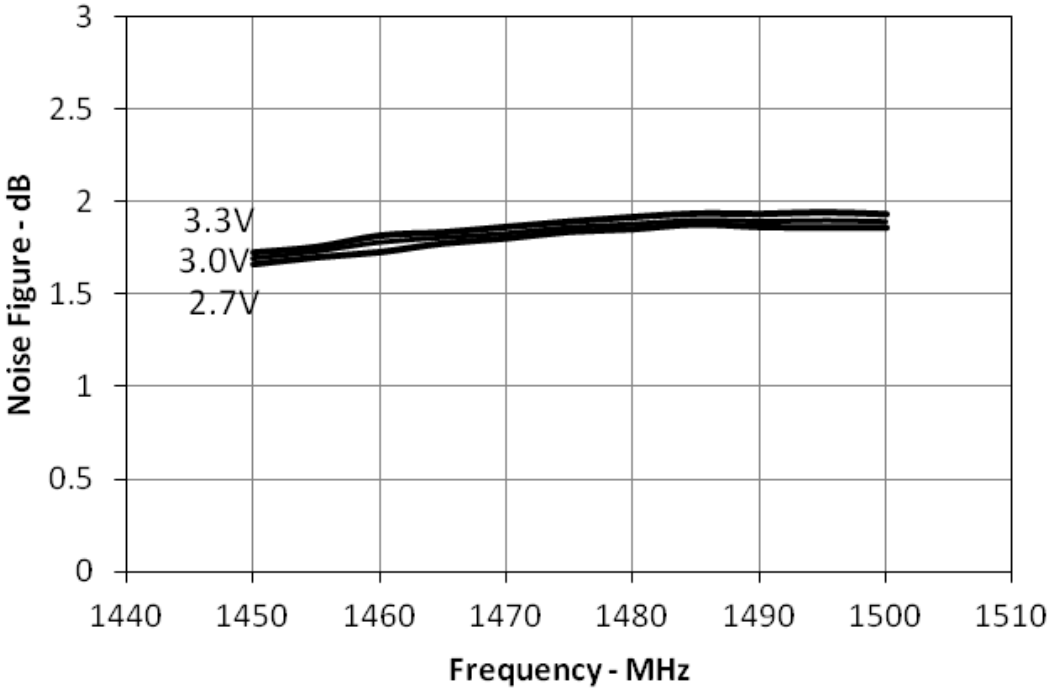
## ■ Input Return Loss



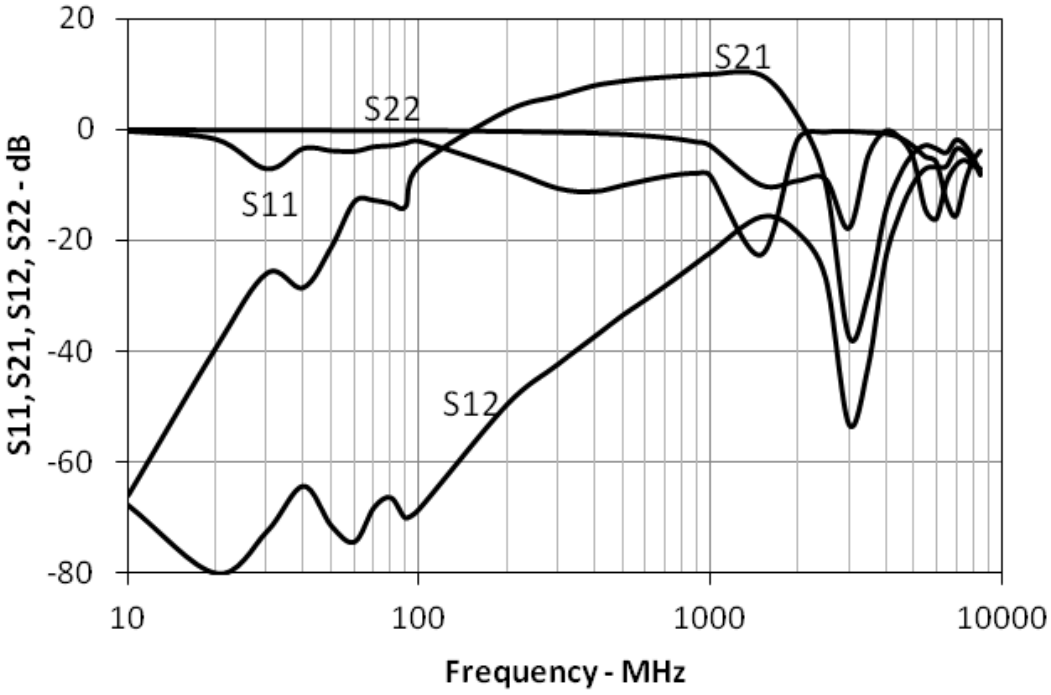

## ■ Output Return Loss



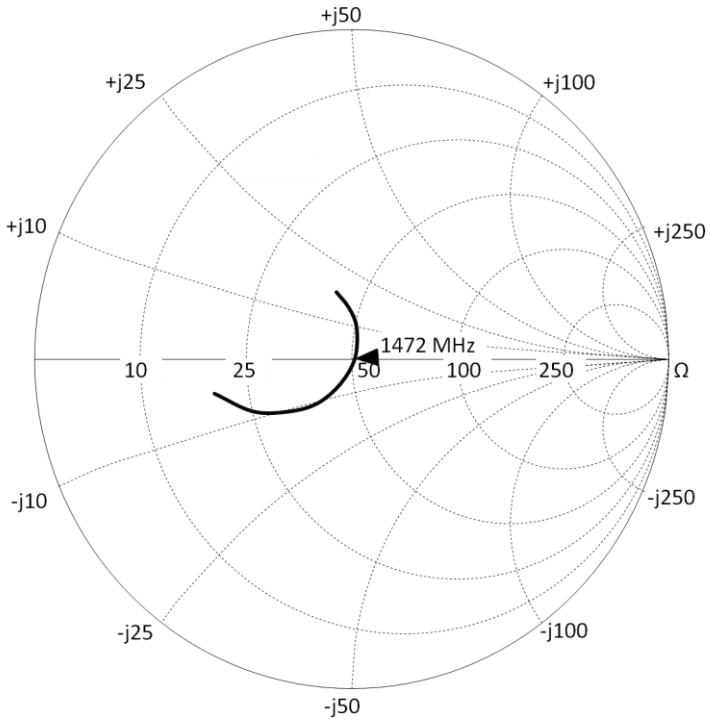
## ■ Noise Figure




## ■ S11, S21, S12, S22 Wide Span

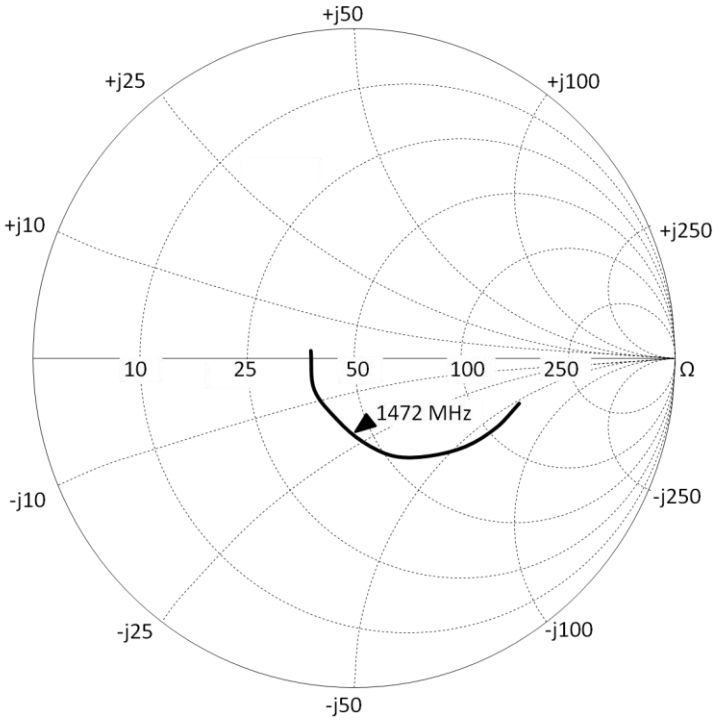


## ■ Smith Chart
## Input Return Loss




1.3 GHz to 1.7 GHz

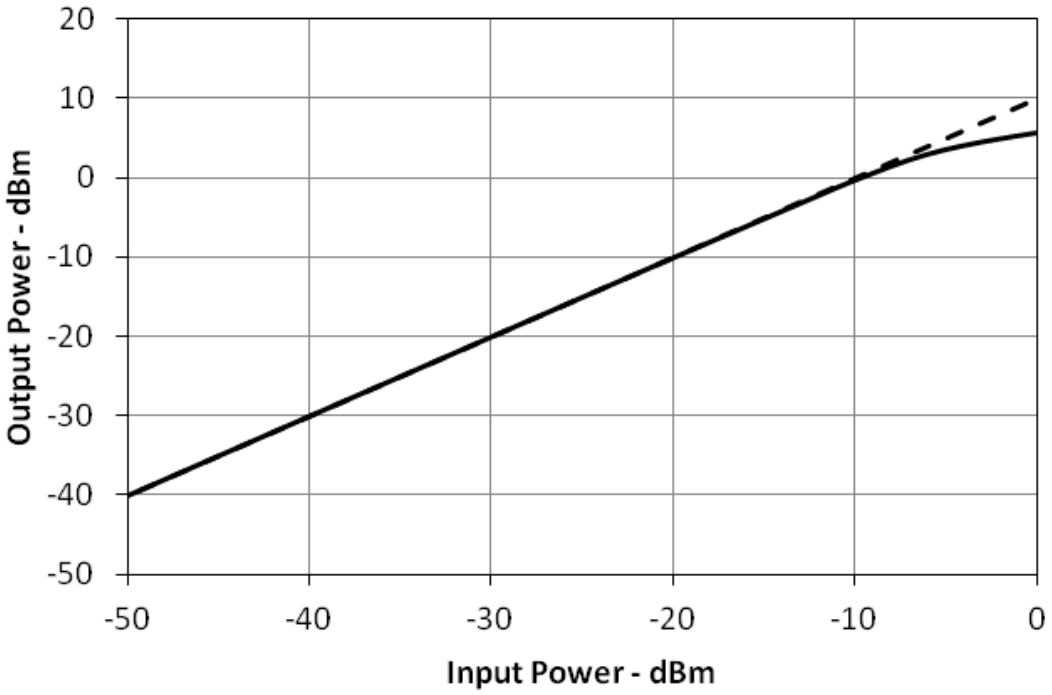
## ■ Smith Chart
## Output Return Loss




1.3 GHz to 1.7 GHz

## ■ Gain 1 dB Compression Point

f = 1472 MHz




## ■ Input 3rd Order Intercept Point

f1 = 1472 MHz, f2 = 1473 MHz, Pin = −20 dBm