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AND9692/D

DAB Band-III Amplifier Using the NSVF4017SG4



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APPLICATION NOTE

Overview

This application note explains about ON Semiconductor NSVF4017SG4 which is used as a Low Noise Amplifier (LNA) for DAB (Digital Audio Broadcast).

The NSVF4017SG4 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 band-III (170 MHz to 250 MHz), the product can provide 23 dB gain and 1.06 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.

Table 1. SUMMARY OF DATA

Ta = 25°C, Input Power = -40 dBm

| Parameter | Symbol | Condition | Result | | | Unit |
|-----------------------------------|--------|---|--------|------|------|------|
| DC Voltage | Vcc | | 2.6 | 2.8 | 3.0 | V |
| DC Current | Icc | | 8.5 | 9.4 | 10.3 | mA |
| Gain | Gp1 | f = 170 MHz | 22.8 | 23.2 | 23.6 | dB |
| | Gp2 | f = 210 MHz | 22.6 | 23.0 | 23.3 | dB |
| | Gp3 | f = 250 MHz | 22.0 | 22.4 | 22.7 | dB |
| Noise Figure | NF1 | f = 170 MHz | - | 0.93 | - | dB |
| | NF2 | f = 210 MHz | - | 1.06 | - | dB |
| | NF3 | f = 250 MHz | - | 1.12 | - | dB |
| Input Return Loss | RLin1 | f = 170 MHz | 10.9 | 11.4 | 11.6 | dB |
| | RLin2 | f = 210 MHz | 11.4 | 11.7 | 11.7 | dB |
| | RLin3 | f = 250 MHz | 11.0 | 11.2 | 11.1 | dB |
| Output Return Loss | RLout1 | f = 170 MHz | 13.3 | 14.6 | 15.9 | dB |
| | RLout2 | f = 210 MHz | 13.9 | 15.3 | 16.7 | dB |
| | RLout3 | f = 250 MHz | 14.0 | 14.9 | 15.8 | dB |
| Isolation | ISL1 | f = 170 MHz | 26.0 | 26.4 | 26.7 | dB |
| | ISL2 | f = 210 MHz | 26.0 | 26.4 | 26.7 | dB |
| | ISL3 | f = 250 MHz | 26.2 | 26.6 | 27.0 | dB |
| Gain 1 dB Compression Input Power | Pin1dB | f = 210 MHz | - | -20 | - | dBm |
| Input 3rd Order Intercept Point | IIP3 | f1 = 210 MHz f2 = 211 MHz Pin = -30 dBm | - | -7 | - | dBm |

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Circuit Design

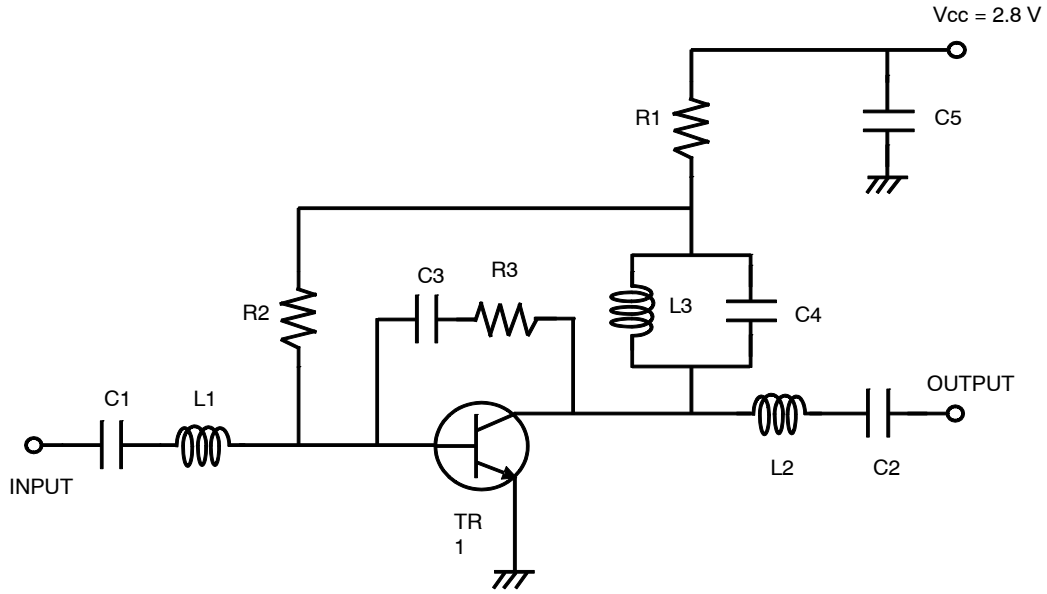


Figure 1. Circuit Design

Evaluation Board

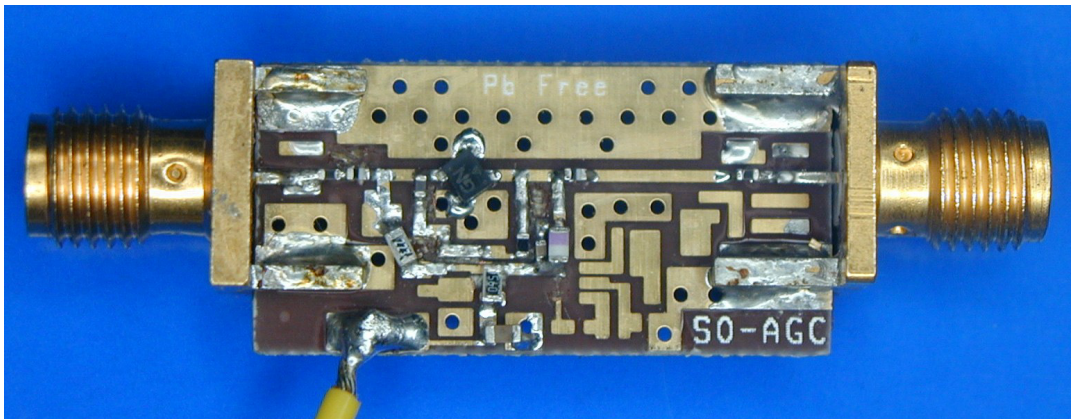


Figure 2. Evaluation Board

Table 2. BILL OF MATERIALS

| Item | Symbol | Value | Manufacturer | Size |
|-----------|----------|----------------|---------------------|----------------|
| Bip-Tr | TR1 | NSVF4017SG4 | ON Semiconductor | SC82FL |
| Capacitor | C1,C2,C3 | 1000 pF | TAIYOYUDEN | 1005 |
| | C4 | 7 pF | TAIYOYUDEN | 1005 |
| | C5 | 0.1 uF | TAIYOYUDEN | 1608 |
| Resistor | R1 | 56 Ω | Various | 1608 |
| | R2 | 22 k Ω | Various | 1608 |
| | R3 | 1.2 k Ω | Various | 1005 |
| Inductor | L1,L2 | 12 nH | TOKO LL1005-FHL12NJ | 1005 |
| | L3 | 120 nH | TOKO LL1608-FS121N | 1608 |
| Material | - | FR4 | - | 25.4 x 12.7 mm |

Power Gain

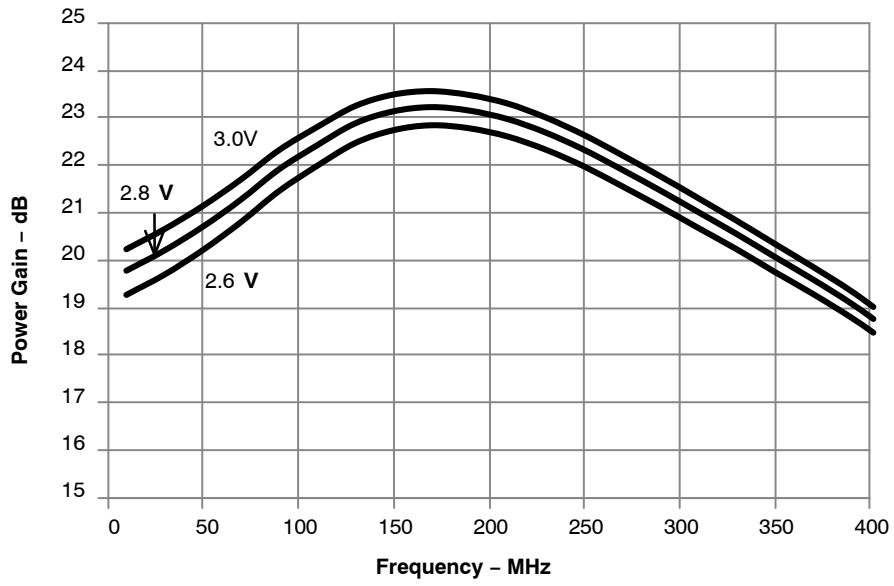


Figure 3. Power Gain

Isolation

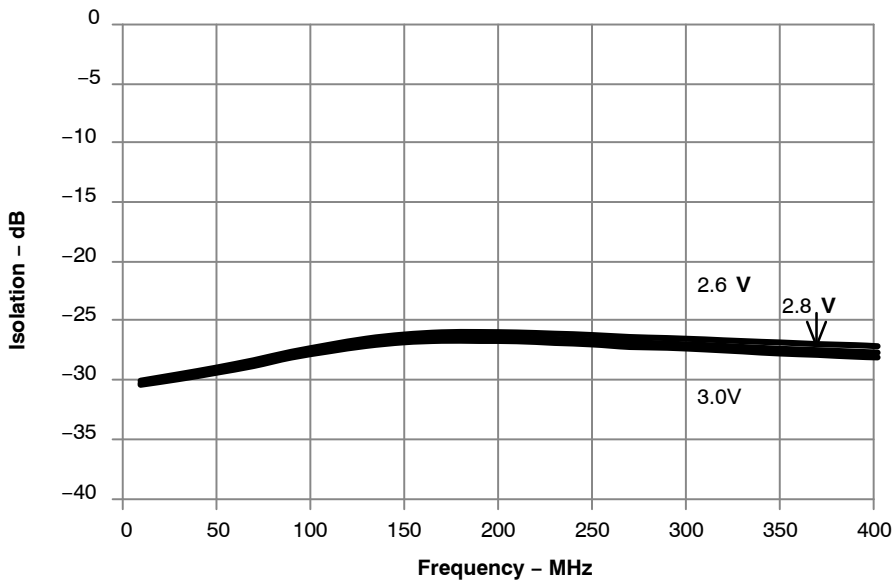


Figure 4. Isolation

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Input Return Loss

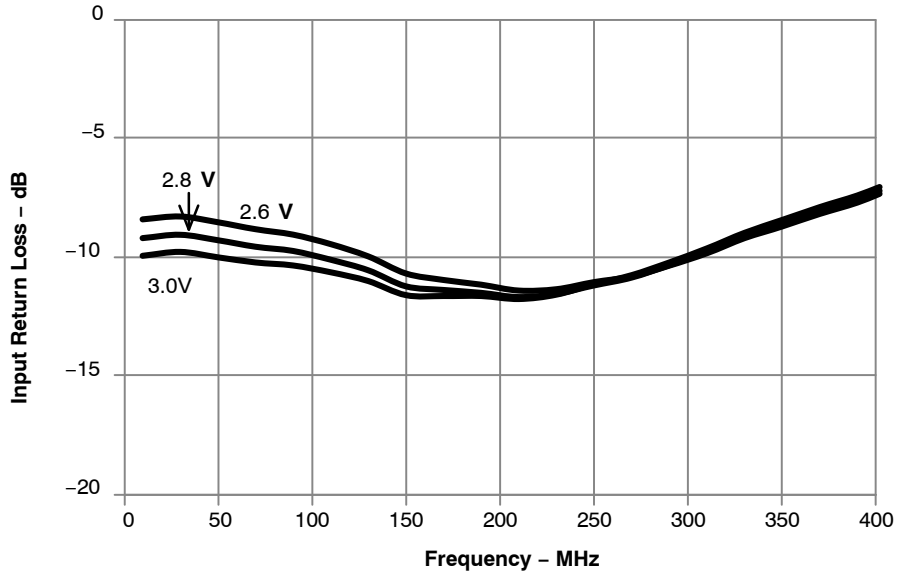


Figure 5. Input Return Loss

Output Return Loss

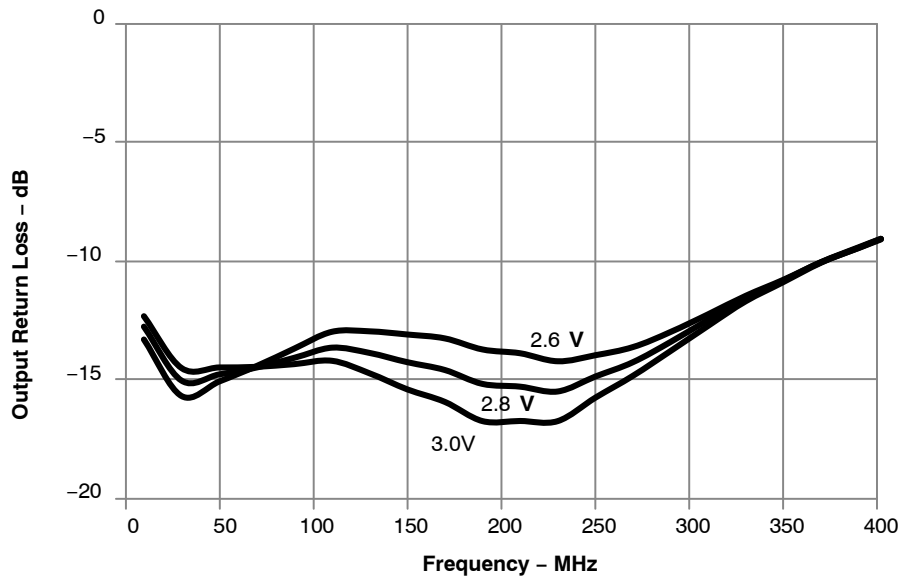


Figure 6. Output Return Loss

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Noise Figure

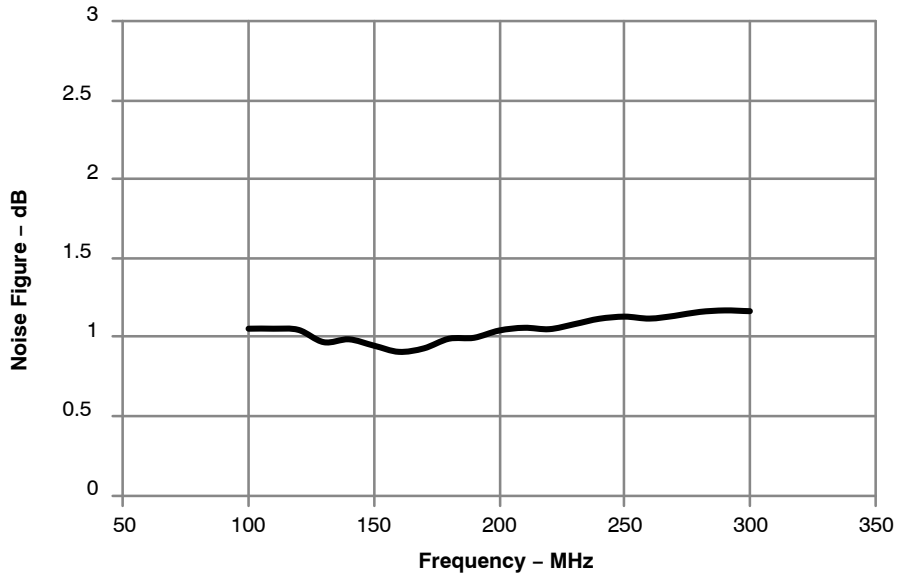


Figure 7. Noise Figure

S11, S21, S12, S22 Wide Span

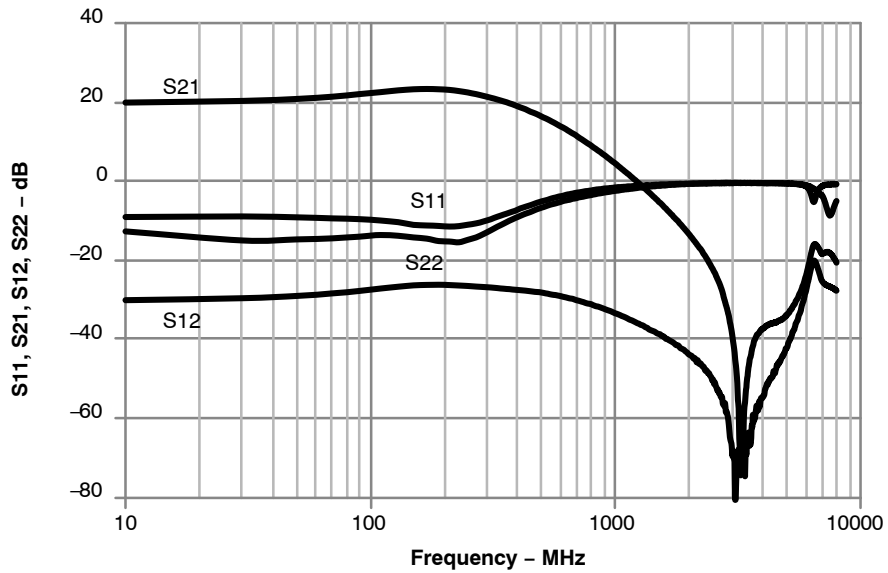


Figure 8. S11, S21, S12, S22 Wide Span

Smith Chart Input Return Loss

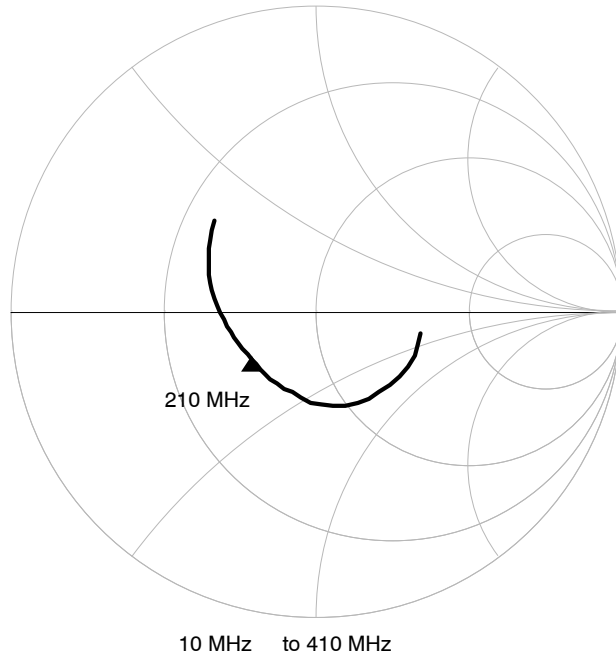


Figure 9. Smith Chart Input Return Loss

Smith Chart Output Return Loss

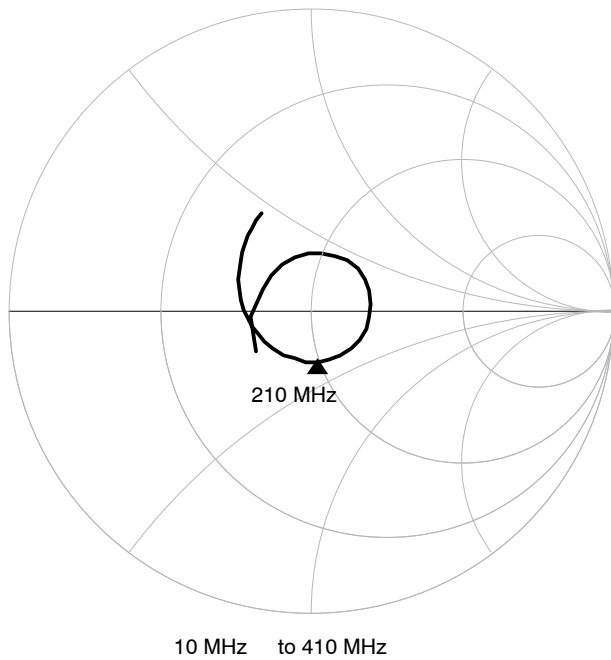


Figure 10. Smith Chart Output Return Loss

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Gain 1 dB Compression Point

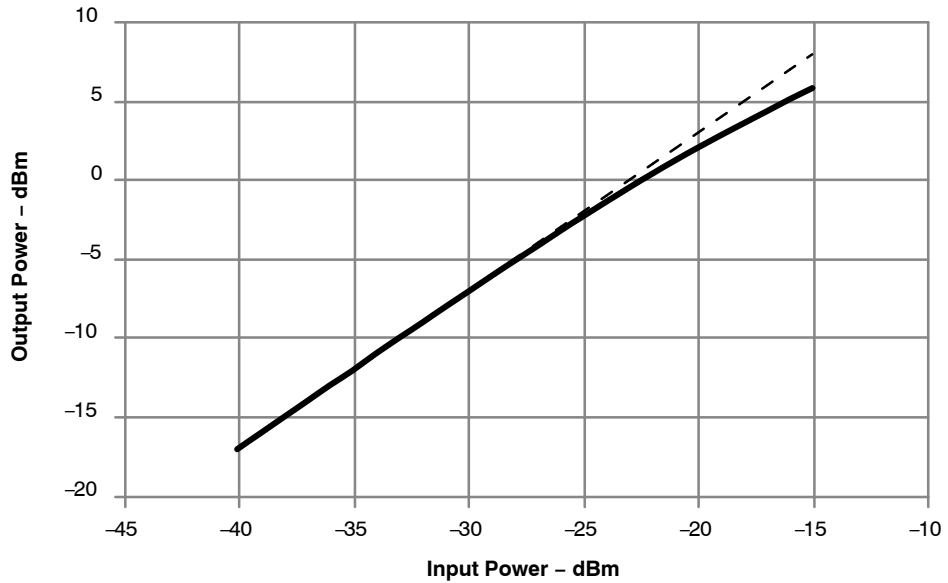


Figure 11. Gain 1 dB Compression Point

Input 3rd Order Intercept Point

f1 = 210 MHz, f2 = 211 MHz, Pin = -30 dBm

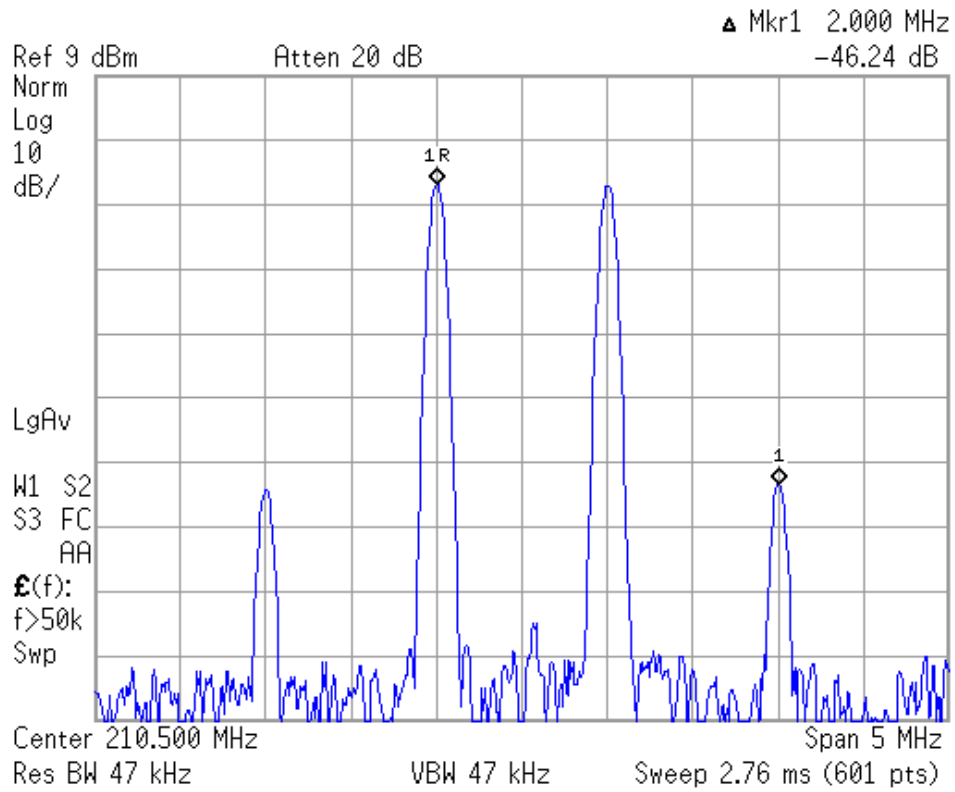



Figure 12. Input 3rd Order Intercept Point

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