Tagore Technology

# TSL8029N

## Single Channel 2 – 5GHz 100Watt Receiver Front End for MACRO base station

**Application Note: TSL8029N EVB C**

## Application Note

3300MHz~4200MHz

5V 90mA [RX-HG]

5V 50mA [RX-LG]

5V 200uA [TX]

Rev-1.0

## List of Contents

## 1. General Description

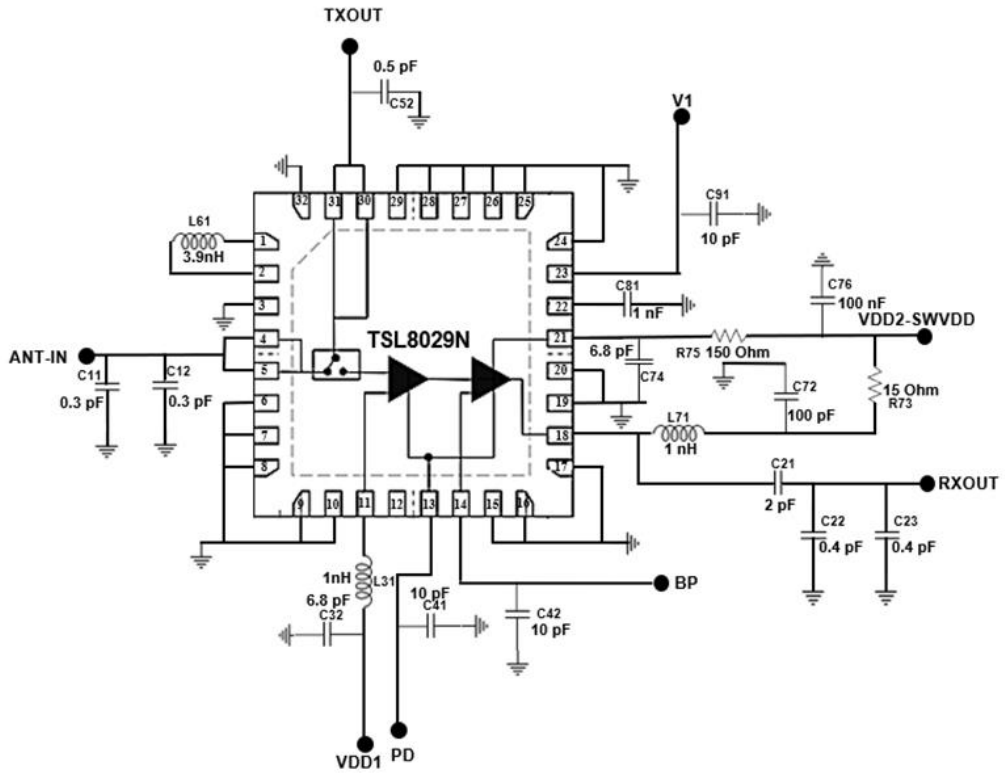
The TSL8029N is a single-channel, integrated RF, front-end, multichip module designed for different applications. The device operates from 2 GHz to 5GHz. The TSL8029N is configured with a cascading, two-stage, GaAs LNA and a GaN based SPDT switch.

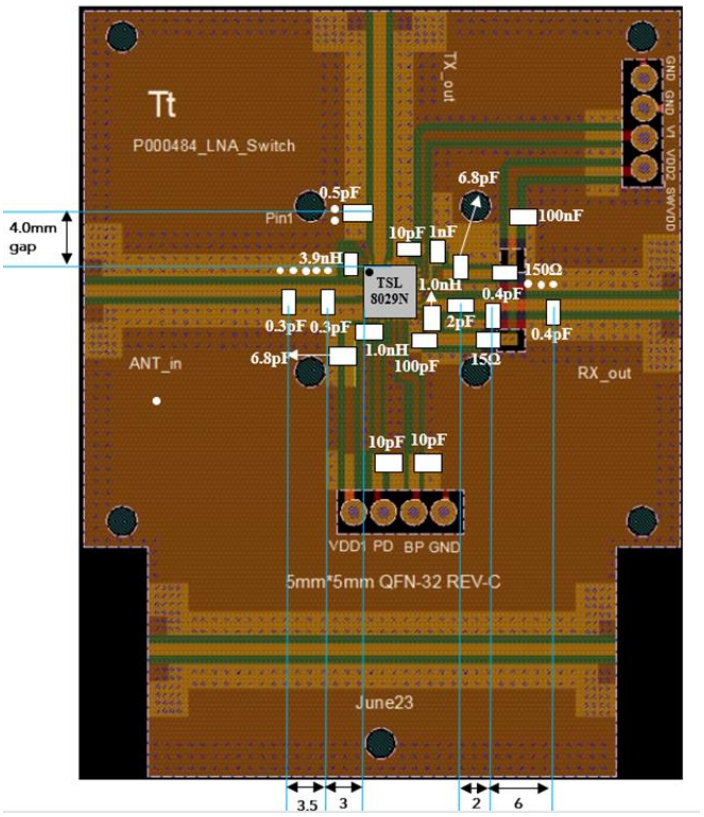
In high gain mode, the cascaded two-stage LNA and switch offer a low noise figure of 1.4 dB and a high gain of 33 dB at 3.6 GHz with an output third-order intercept point (OIP3) of 33 dBm (typical) at high gain mode. In low gain mode, one stage of the two-stage LNA is in bypass, providing 14.5 dB of gain at a lower current of 50 mA. In power-down mode, the LNAs are turned off and the device draws 4 mA.

In transmit operation, when RF inputs are connected to a termination pin (TX), the switch provides low insertion loss of 0.5 dB at 3.6GHz and handles long-term evolution (LTE) average power (8 dB peak to average ratio (PAR)) of 50 dBm for full lifetime operation.

The device comes in an RoHS compliant, compact, 5 mm × 5 mm, 32-lead LFCSP.TSL8029N EVB-C is tuned for 3.3G-4.2GHz.

## 2. TSL8029N-EVB-C Board Details






**Note:** Series cap on ANT and TX ports should have 250V voltage ratings to handle 100W power. The heatsink needs to be added at bottom of this board for proper power spreading.

**Figure 2.1 TSL8029N-EVB-C 3300MHz ~ 4200MHz Schematic and EVB Layout**

## 3. TSL8029N-EVB-C Bill of Material

| Component ID | Value | Manufacturer | Recommended Part Number | Qty |
|---|---|---|---|---|
| C11, C12 | 0.3 pF | Murata | 600S0R3BT250XT | 2 |
| C21 | 2 pF | Murata | GJM1555C1H2R0BB01D | 1 |
| C22, C23 | 0.4 pF | Murata | GJM1555C1HR40BB01J | 2 |
| L31, L71 | 1 nH | Coil craft | 0402DC-1N0XJRW | 2 |
| C32, C74 | 6.8 pF | Murata | GJM1555C1H6R8BB01D | 2 |
| C41, C42, C91 | 10pF | Murata | GJM1555C1H100JB01D | 3 |
| C52 | 0.5pF | Murata | 600S0R5BT250XT | 1 |
| L61 | 3.9 nH | Coil craft | 0402DC-3N9XGRW | 1 |
| C72 | 100 pF | AVX | 04025A101JAT4A | 1 |
| R73 | 15 Ω | Panasonic | ERJ-H2RD15R0X | 1 |
| R75 | 150 Ω | Panasonic | ERJ-2RHD1500X | 1 |
| C76 | 100 nF | TDK | C1005X7R1H104K050BE | 1 |
| C81 | 1 nF | Murata | 04025C102JAT2A | 1 |
| PCB | Rogers RO4350B, 20 mils, 1 oz copper | | | 1 |

**Table 3.1 TSL8029N-EVB-C BOM**

## 4. TSL8029N-EVB-C Biasing Sequence

| Turn ON Device | Turn OFF Device |
|---|---|
| 1. Apply bias to the VDD2_SWVDD and VDD1=5V test points.<br>2. Apply bias to the V1 test point.<br>3. Apply bias to the Vdd1 test point.<br>4. Apply bias to the BP test points.<br>5. Apply bias to the PD test point.<br>6. Apply an RF input signal. | 1. Turn RF power off.<br>2. Turn off VDD2_SWVDD and VDD1=5V test points.<br>3. Turn off V1, BP and PD |

**Table 4.1 TSL8029N-EVB-C Bias and Sequencing**

## 5. TSL8029N-EVB-C Board Measurement Summary

| Frequency (MHz) | Mode | S21 (dB) | S11 (dB) | S22 (dB) | EVB Noise Figure(dB) | OP1dBm | OIP3dBm |
|---|---|---|---|---|---|---|---|
| 3300 | RX Low Gain | 13.8 | -13.1 | -6.9 | 1.5 | 12 | 22 |
| 3600 | | 14.1 | -15.9 | -9.2 | 1.5 | 12.3 | 20 |
| 3900 | | 13.4 | -19.1 | -8.8 | 1.5 | 11 | 22 |
| 4200 | | 12.7 | -24.8 | -9 | 1.5 | 10.8 | 20 |
| 3300 | RX High Gain | 32.4 | -10.6 | -7.2 | 1.5 | 20 | 31 |
| 3600 | | 32.3 | -10.6 | -9 | 1.5 | 20.8 | 32 |
| 3900 | | 30.8 | -12.4 | -16 | 1.5 | 19 | 33 |
| 4200 | | 29.5 | -14.9 | -25.9 | 1.6 | 19.2 | 37 |
| 3300 | TX | -0.7 | -17.1 | -15.7 | | | |
| 3600 | | -0.7 | -19.6 | -18.1 | | | |
| 3900 | | -0.7 | -24.4 | -20.2 | | | |
| 4200 | | -0.7 | -22.9 | -17.5 | | | |

**Table 5.1 TSL8029N-EVB-C Electrical Characteristics Summary**

# 6. TSL8029N-EVB-C Test Results

All the tests are carried out at room temperature.

## 6.1. S parameters

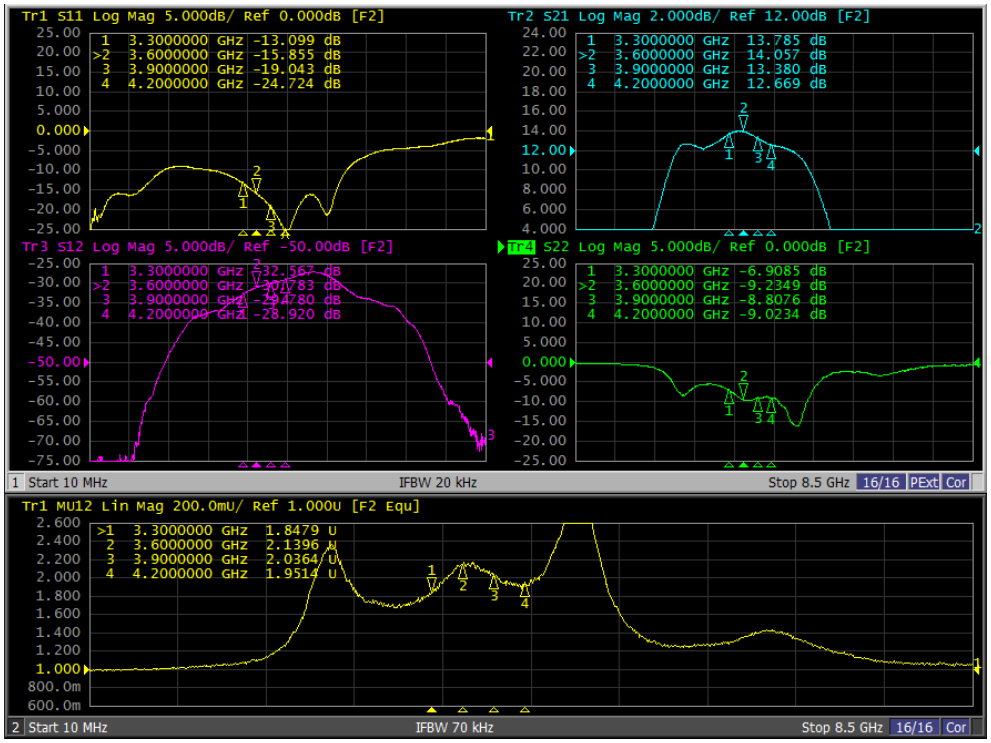



**Figure 6.1.1. S parameters of TSL8029N-EVB-C RX-LG 5V 50mA**

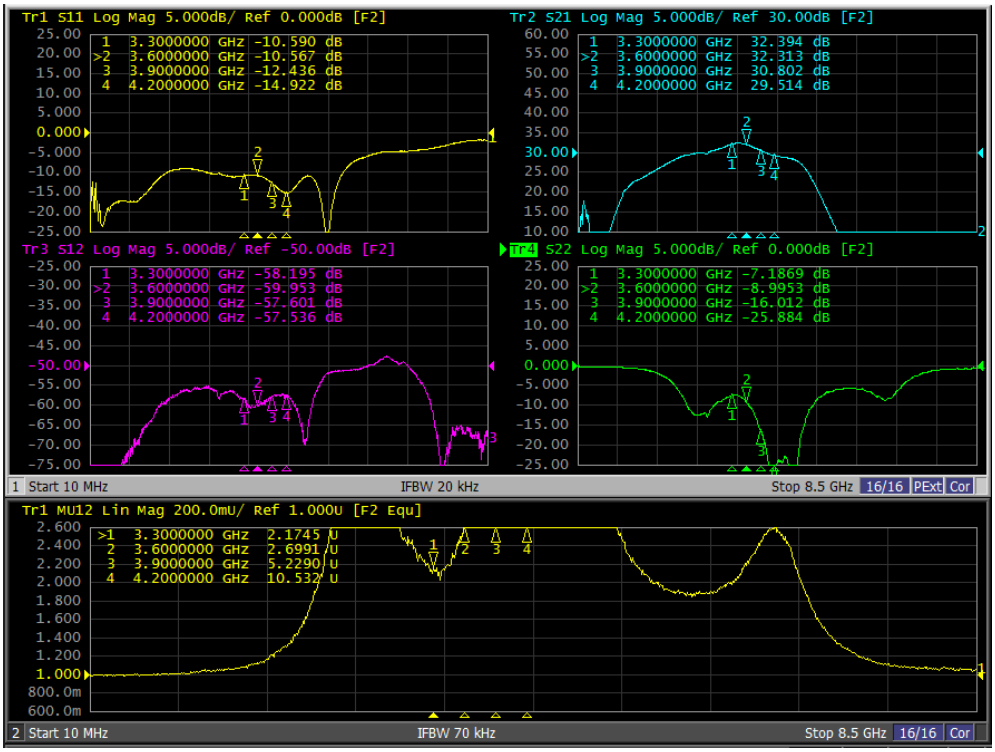
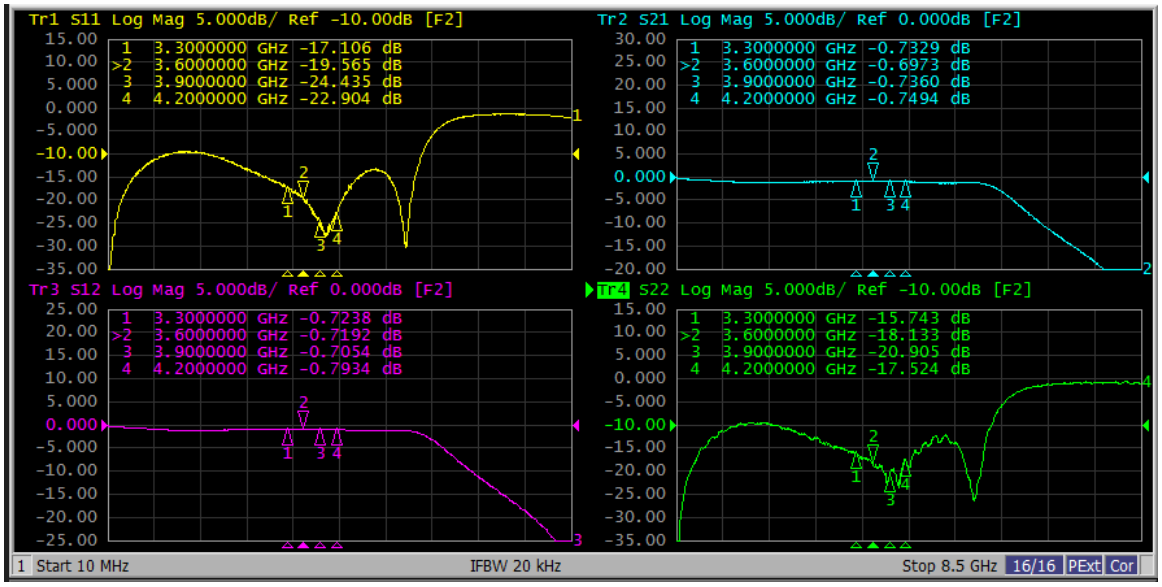



**Figure 6.1.2. S parameters of TSL8029N-EVB-C RX-HG 5V 90mA**



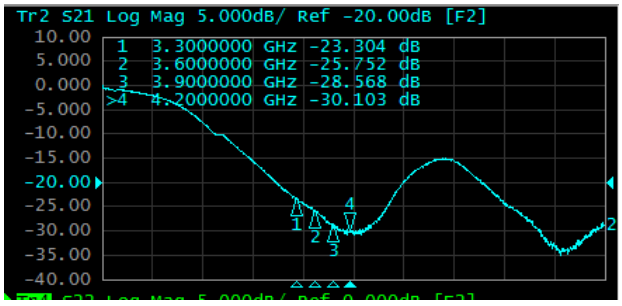




**Figure 6.1.4. ANT to TX isolation of TSL8029N-EVB-C when RX-LG is on**

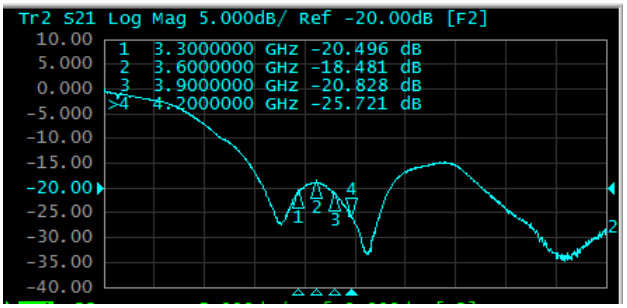



**Figure 6.1.5. ANT to TX isolation of TSL8029N-EVB-C when RX-HG is on**

**Figure 6.1.3. S parameters of TSL8029N-EVB-C TX**

## 6.2. SMA-SMA Noise Figure Test Results

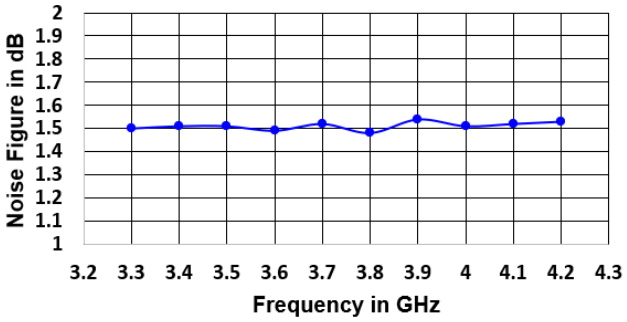



**Figure 6.2.1. SMA-SMA Noise Figure of TSL8029N-EVB-D for 5V 50mA for RX-LG mode**

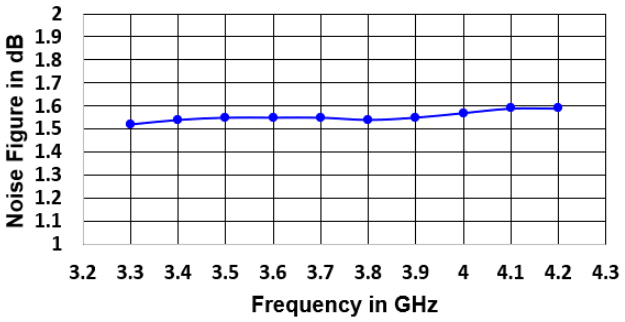



**Figure 6.2.2. SMA-SMA Noise Figure of TSL8029N-EVB-D for 5V 90mA for RX-HG mode**

****Note:** The trace loss is within the range of 0.2dB, resulting in a de-embedded NF of 1.3 to 1.4dB

## 6.3. Large Signal Test Results

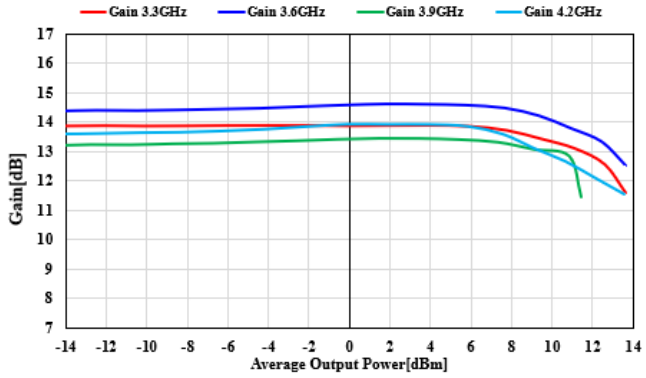



**Figure 6.3.1. Gain vs $P_{OUT}$ of TSL8029N-EVB-C for 5V 50mA for RX-LG mode**

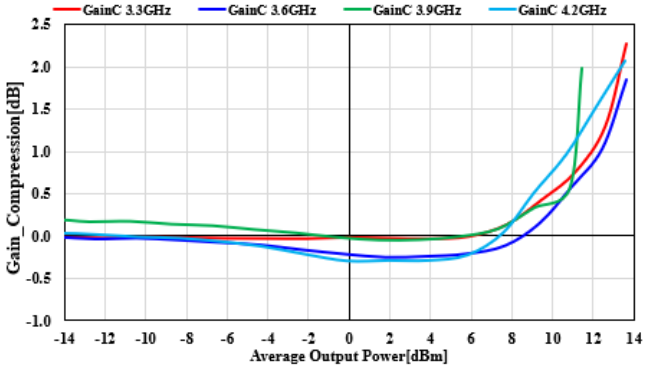



**Figure 6.3.2 Gain compression vs $P_{OUT}$ of TSL8029N-EVB-C for 5V 50mA for RX-LG mode**

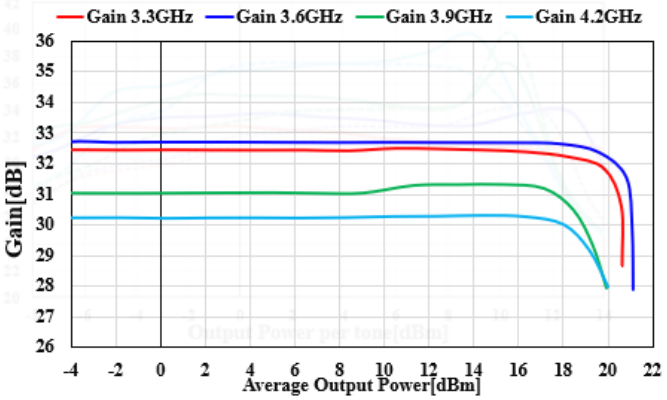



**Figure 6.3.3. Gain vs $P_{OUT}$ of TSL8029N-EVB-C for 5V 90mA for RX-HG mode**

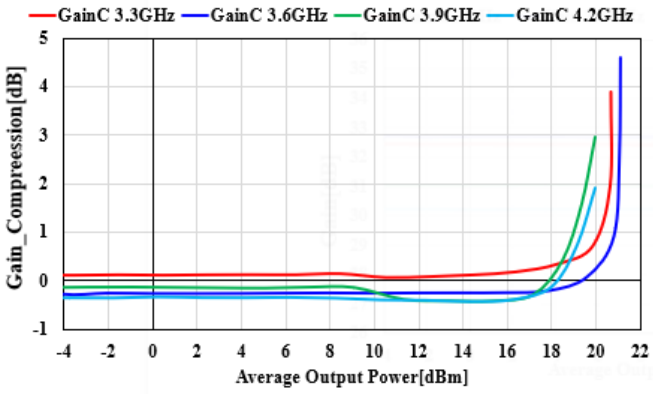



**Figure 6.3.4 Gain compression vs $P_{OUT}$ of TSL8029N-EVB-C for 5V 90mA for RX-HG mode**

## 6.4. OIP3 Test Results

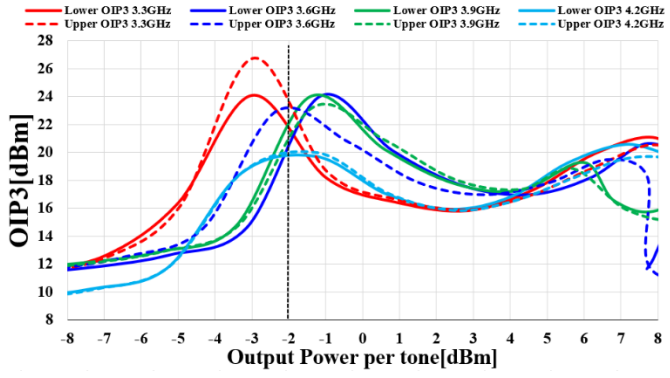



**Figure 6.4.1 OIP3dBm vs $P_{OUT}$ /tone of TSL8029N-EVB-C for 5V 50mA for RX-LG mode**

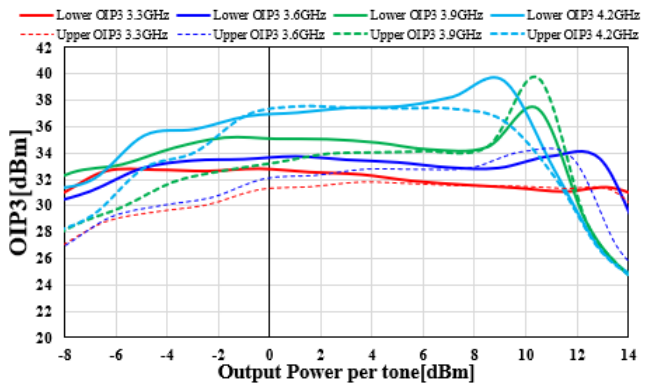



**Figure 6.4.2 OIP3dBm vs $P_{OUT}$ /tone of TSL8029N-EVB-C for 5V 90mA for RX-HG mode**

## 6.5. Temperature Test Data

**Receive Operation, Low Gain Mode, 25degreeC -40degreeC 85degreeC 105degreeC.**

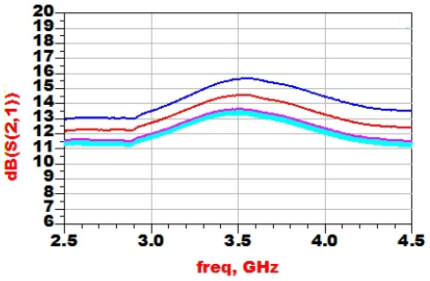



**Figure 6.5.1 S21 vs Freq**

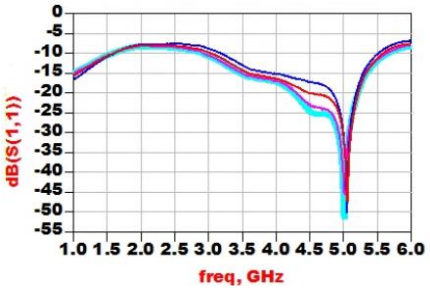



**Figure 6.5.2 S11 vs Freq**

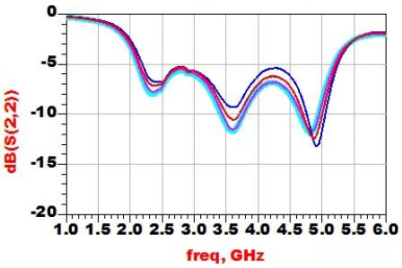



**Figure 6.5.3 S22 vs Freq**

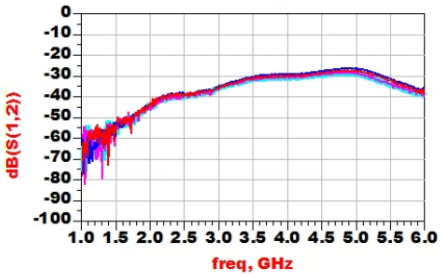



**Figure 6.5.4 S12 vs Freq**

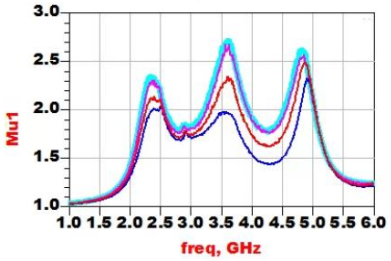



**Figure 6.5.5 Stability vs Freq**

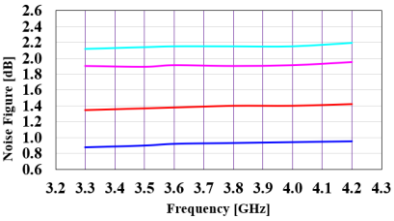



**Figure 6.5.6 NF vs Freq SMA to SMA**

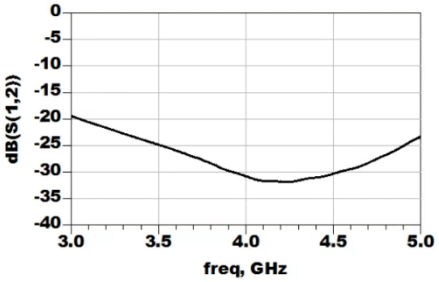



**Figure 6.5.7 ANT-TX ISO vs Freq When BP=5V and PD=0V**

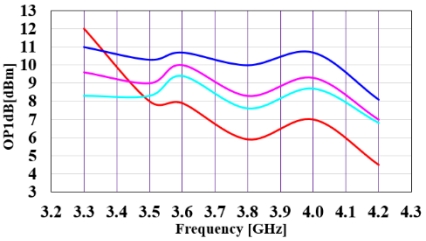



**Figure 6.5.8 OP1 vs Freq**

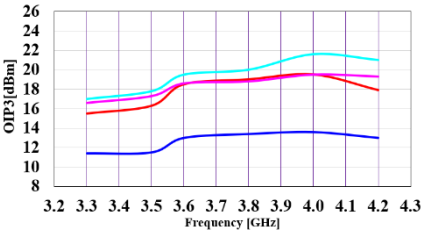



**Figure 6.5.9 OIP3 vs Freq**

**Receive Operation, High Gain Mode, 25degreeC -40degreeC 85degreeC 105degreeC.**

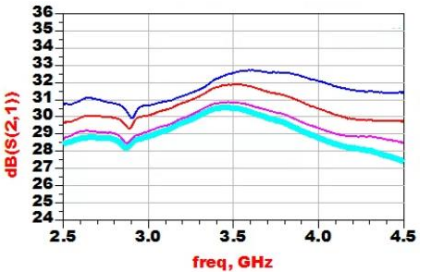



**Figure 6.5.10 S21 vs Freq**

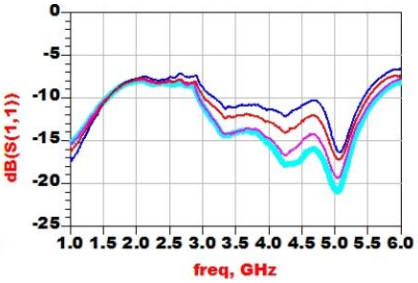



**Figure 6.5.11S11 vs Freq**

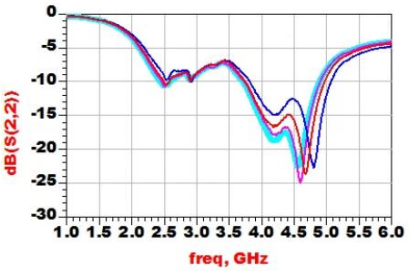



**Figure 6.5.12 S22 vs Freq**

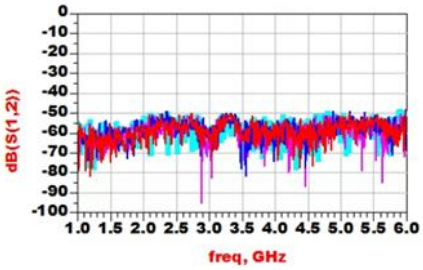



**Figure 6.5.13 S12 vs Freq**

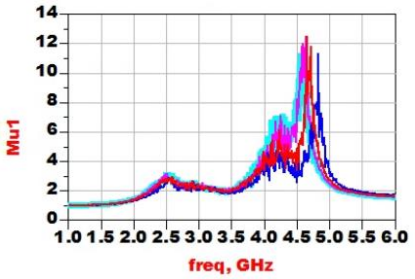



**Figure 6.5.14 Stability vs Freq [10MHz to 8.5GHz]**

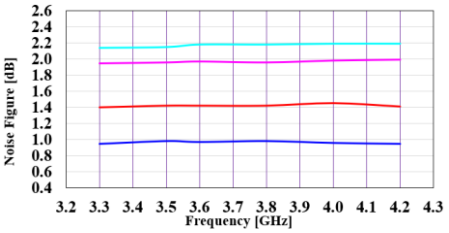



**Figure 6.5.15 NF vs Freq SMA to SMA**

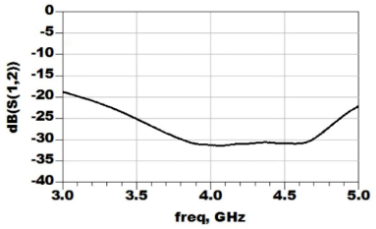



**Figure 6.5.16ANT-TX ISO vs Freq When BP=0V and PD=5V**

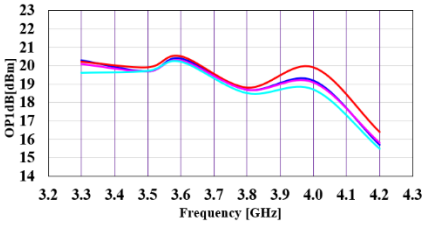



**Figure 6.5.17 OP1 vs Freq**

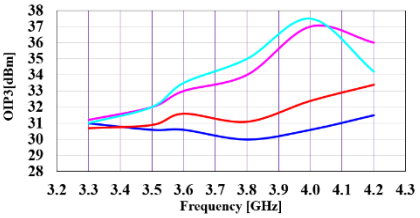



**Figure 6.5.18 OIP3 vs Freq**

**Transmit Operation, 25degreeC -40degreeC 85degreeC 105degreeC.**

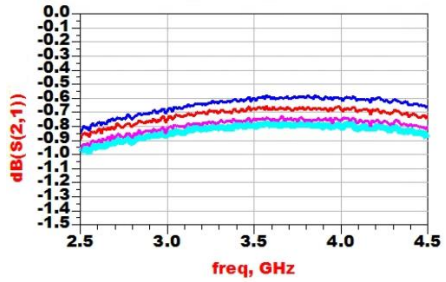



**Figure 6.5.19 S21 vs Freq**

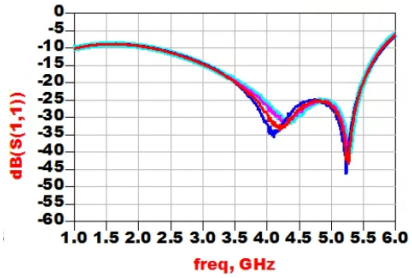



**Figure 6.5.20 S11 vs Freq**

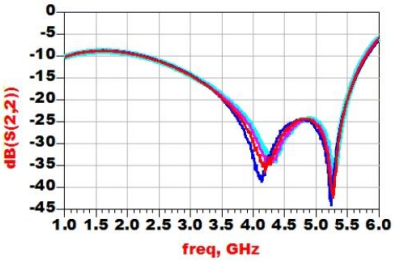



**Figure 6.5.21 S22 vs Freq**

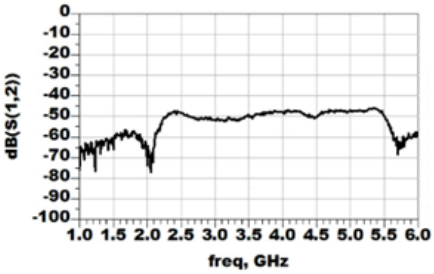



**Figure 6.5.22 ANT-RX Isolation when PD=5V and BP=0V vs Freq**

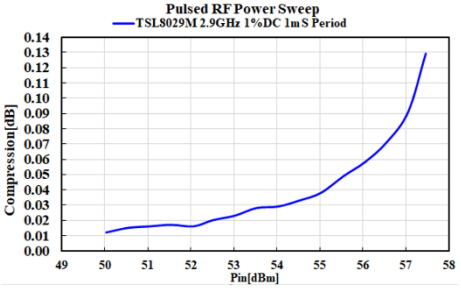



**Figure 6.5.24 Compression Vs Peak Power [2.9GHz 1% DC 1mS Period]**

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