

Integrated Dual Channel Switch and LNA Module

2.3 - 3.8 GHz



MAMF-011144

Rev. V1

Features

- Dual Channel Architecture
- Broadband: 2.3 - 3.8 GHz
- High Power Switch Handling ($T_C = 105^\circ\text{C}$):
43 dBm LTE 8 dB PAR (<10 s, single event)
40 dBm LTE 8 dB PAR (Lifetime)
- Second LNA has Bypass Mode
- Rx High Gain Mode:
Gain: 37.8 dB at 2.6 GHz, 36 dB @ 3.5 GHz
NF: 1.25 dB at 2.6 GHz, 1.4 dB @ 3.5 GHz
OIP3: 33 dBm
- Rx Low Gain Mode:
Gain: 19 dB at 2.6 GHz, 18.5 dB @ 3.5 GHz
NF: 1.25 dB at 2.6 GHz, 1.4 dB @ 3.5 GHz
OIP3: 32 dBm
- Single 5 V Supply, 108 mA per channel
- Compatible with 1.8 V and 3.3 V logic
- Lead-Free 6 mm 40-Lead QFN Package
- RoHS* Compliant

Applications

- 5G Massive MIMO
- Wireless Infrastructure
- TDD-Based Communication Systems

Description

The highly integrated dual channel switch and LNA module includes two antenna switches and two 2-stage low noise amplifiers in a compact low cost 6 mm QFN package. The second stage LNAs can be bypassed. Mixed technologies are used to achieve high power handling, low noise figure, and low power consumption. The module only needs a single +5 V supply. T/R switch, LNA enable, and bypass function can be controlled with 1.8 V or 3.3 V logic.

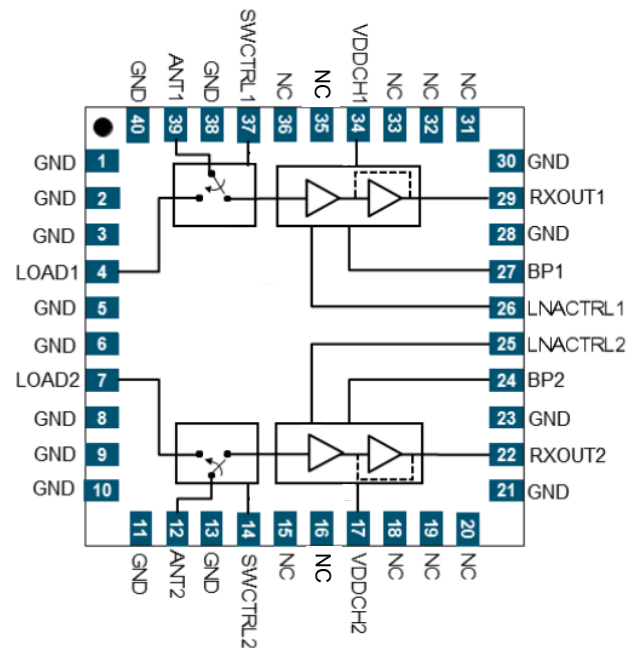
Ordering Information¹

| Part Number | Package |
|--------------------|----------------|
| MAMF-011144 | Bulk |
| MAMF-011144-TR1000 | 1000 part reel |
| MAMF-011144-001SMB | Sample Board |

1. Reference Application Note M513 for reel size information.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Functional Schematic



Pin Configuration^{2,3,4}

| Pin # | Function |
|---|-------------------------|
| 1-3, 5, 6, 8-11, 13, 21, 23, 28, 30, 38, 40 | Ground |
| 4 | Load Ch1 |
| 7 | Load Ch2 |
| 12 | Antenna Input Ch2 |
| 14 | Switch Control Ch2 |
| 15, 16, 18-20, 31-33, 35, 36 | No Connect |
| 17 | Switch/LNA V_{DD} Ch2 |
| 22 | Rx Output Ch2 |
| 24 | LNA Bypass Ch2 |
| 25 | LNA Control Ch2 |
| 26 | LNA Control Ch1 |
| 27 | LNA Bypass Ch1 |
| 29 | Rx Output Ch1 |
| 34 | Switch/LNA V_{DD} Ch1 |
| 37 | Switch Control Ch1 |
| 39 | Antenna Input Ch1 |

2. Blocking Capacitors are required on all RF Ports.

3. MACOM recommends connecting unused package pins to ground.

4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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DC-0024333

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Electrical Specifications: Freq. = 2.6 GHz, P_{IN} = -35 dBm, T_C = +25°C, V_{DD} = 5 V, Z₀ = 50 Ω

| Parameter | Conditions | Units | Min. | Typ. | Max. |
|---|--|-------|------|------|------|
| Gain at Rx High Gain Mode | 2.6 GHz | dB | 34 | 37.8 | — |
| | 3.5 GHz | | 33 | 36.0 | |
| NF at Rx High Gain Mode | 2.6 GHz | dB | — | 1.25 | — |
| | 3.5 GHz | | — | 1.4 | |
| Input RL at Rx High Gain Mode | — | dB | — | 15 | — |
| Output RL at Rx High Gain Mode | — | dB | — | 17 | — |
| Output IP3 at Rx High Gain Mode | Tone Spacing = 10 MHz P _{OUT} / Tone = +3 dBm P _{OUT} / Tone = +10 dBm | dBm | — | 33 | — |
| | | | — | 34 | |
| Output P1dB at Rx High Gain Mode | — | dBm | — | 18.5 | — |
| Gain at Rx Low Gain Mode | 2.6 GHz | dB | 17 | 19.0 | — |
| | 3.5 GHz | | | 18.5 | |
| NF at Rx Low Gain Mode | 2.6 GHz | dB | — | 1.25 | — |
| | 3.5 GHz | | | 1.4 | |
| Input RL at Rx Low Gain Mode | — | dB | — | 12 | — |
| Output RL at Rx Low Gain Mode | — | dB | — | 12 | — |
| Output IP3 at Rx Low Gain Mode | Tone Spacing = 10 MHz P _{OUT} / Tone = +3 dBm | dBm | — | 32 | — |
| Output P1dB at Rx Low Gain Mode | — | dBm | — | 15 | — |
| Insertion Loss at Tx Mode | — | dB | — | 0.3 | 0.8 |
| Return Loss at Tx Mode | — | dB | — | 28 | — |
| Power Handling at Tx Mode | Average Power (8 dB PAR) | W | — | 10 | — |
| Supply Voltage | — | V | 4.75 | 5 | 5.25 |
| Control Voltage | Logic High | V | 1.2 | — | 3.45 |
| | Logic Low | | 0 | | 0.6 |
| Logic Input Current | Logic High | μA | — | +80 | — |
| | Logic Low | | | -2 | |
| Supply Current (V _{DD}) per Channel | Rx High Gain | mA | — | 108 | — |
| | Rx Low Gain | | | 41 | |
| | Tx mode | | | 1.5 | |

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| Parameter | Conditions | Units | Min. | Typ. | Max. |
|--|----------------------|-------|------|------|------|
| RF Switching Time | 50% CTL to 10/90% RF | ns | — | 500 | — |
| High/Low Gain Mode Switching Time | 50% CTL to 10/90% RF | ns | — | 150 | — |
| Isolation Between Rx Channels ⁵ | — | dB | — | 45 | — |
| Switch Isolation, ANT to Load | Rx Mode | dB | — | 20 | — |
| Switch Isolation, ANT to Rx output | Tx Mode | dB | — | 71 | — |

5. Test conditions: both Rx channels are enabled. RF signal is present at Antenna port on one of the channels only. The isolation is defined as the difference between the 2 RX output signal levels.

Control Truth Table

| SWCTRL1 / SWCTRL2 control management | | |
|--|-------------------------------|----------------------------|
| Logic Level | L or open | H |
| LNAs | ON | OFF |
| Switch | Antenna to RX | Antenna to Load |
| BP1 / BP2 control management | | |
| Logic Level | L or open | H |
| Mode | No Bypass (HGM ⁶) | Bypass (LGM ⁷) |
| LNACTRL1 / LNACTRL2 control management | | |
| Logic Level | L or open | H |
| Mode | LNA ON | LNA OFF |

6. HGM: High Gain Mode.

7. LGM: Low Gain Mode.

Absolute Maximum Ratings^{8,9}

| Parameter | Absolute Maximum |
|--|--|
| Antenna Input Power ¹⁰ Freq. = 2.6 GHz: RX Mode TX Mode | 22 dBm LTE (8 dB PAR), 22 dBm CW 43 dBm LTE (8 dB PAR), 43 dBm CW |
| DC Voltages: ANT1/2, LOAD1/2, RXOUT1/2 VDDCH1/2, SWLNACTRL1/2, BP1/2 | -0.3 to +3.6 V -0.3 to +5.5 V -0.3 to +3.6 V |
| Junction Temperature: RX Mode ^{11,13} TX Mode ^{11,13} TX Mode ¹⁰ | +150°C +125°C +140°C |
| Operating Temperature ¹² | -40°C to +105°C |
| Storage Temperature | -55°C to +150°C |

8. Exceeding any one or combination of these limits may cause permanent damage to this device.

9. MACOM does not recommend sustained operation near these survivability limits.

10. Single event, up to 10 seconds duration.

11. Operating at nominal conditions with $T_J \leq +150^\circ\text{C}$ (RX Mode) and $T_J \leq +125^\circ\text{C}$ (TX Mode) will ensure $\text{MTTF} \gg 1 \times 10^6$ hours.

12. Operating/Case temperature (T_C) is the temperature of the exposed paddle.

13. Junction Temperature (T_J) = $T_C + \Theta_{JC} * P_{DISS}$ where P_{DISS} is the total DC & RF dissipated power.

- RX Mode: Typical thermal resistance (Θ_{JC}) = 33.4 °C/W.

- TX Mode: Typical thermal resistance (Θ_{JC}) = 9.8 °C/W.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Power Supplies

De-coupling capacitors should be placed at the V_{DD} supply pin to minimize noise and fast transients. Supply voltage change or transients should have a slew rate smaller than 1 V / 10 μs . In addition, all control pins should remain at 0 V (+/- 0.3 V) and no RF power should be applied while the supply voltage ramps or while it returns to zero.

| Parameter | Rating | Standard |
|----------------------------|----------------------|----------------------|
| Human Body Model (HBM) | 500 V (Class 1B) | ESDA/JEDEC JS-001 |
| Charged Device Model (CDM) | 1000 V (Class C3) | ESDA/JEDEC JS-002 |

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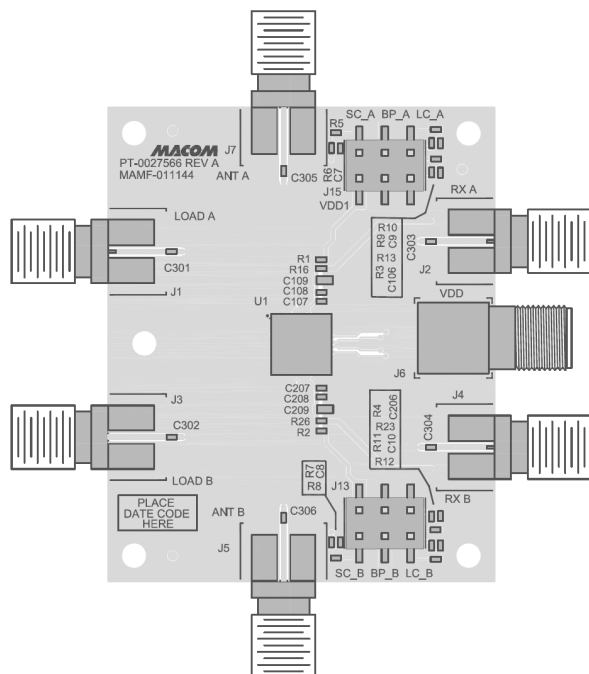
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PCB Layout

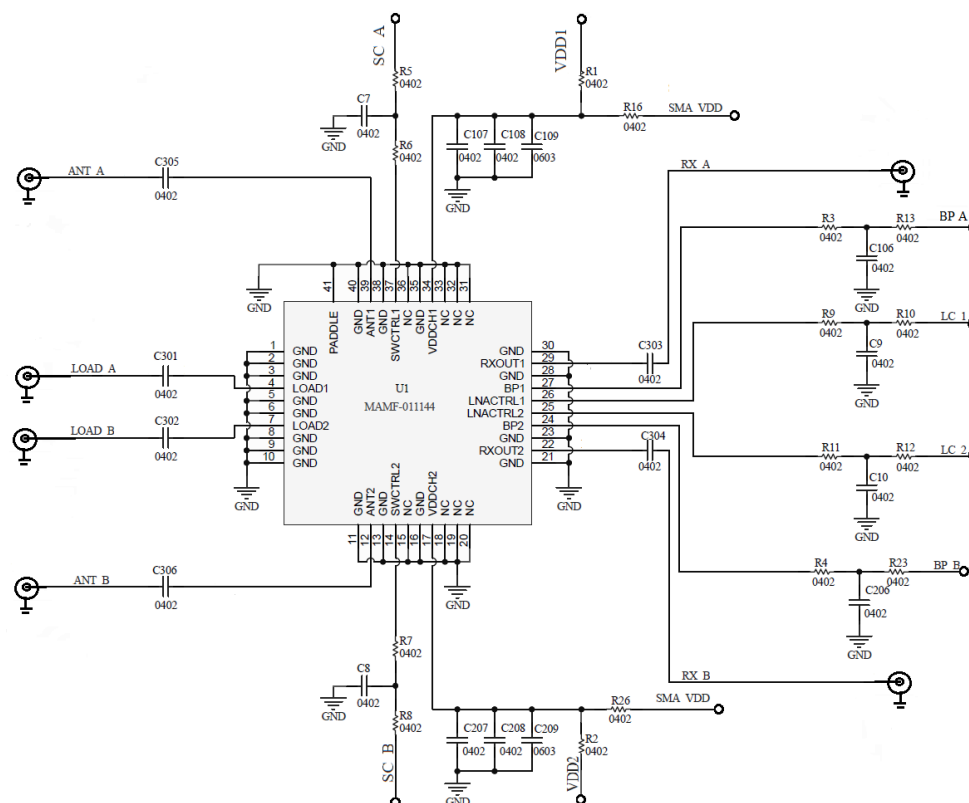


Parts List¹⁴

| Part | Value | Case Style |
|------------------------|--------------|------------|
| C7, C8, C106, C206 | 5 pF | 0402 |
| C107, C207 | 470 pF | 0402 |
| C108, C208 | 10 nF | 0402 |
| C109, C209 | 10 μ F | 0603 |
| C301 - C306 | 20 pF | 0402 |
| R1, R2, R3, R4, R6, R7 | 0 R | 0402 |
| R16, R26 | DNP | 0402 |
| R5, R8, R13, R23 | 1 k Ω | 0402 |

14. Proposed SMB parts list provides supply biasing for CH1 and CH2 via DC headers (J15/J13) with separate V_{DD1} and V_{DD2} supplies. A single V_{DD} supply may also be provided at the SMA connector (J6) by removing R1/R2 and populating R16/R26 with 0 R instead.

Application Schematic



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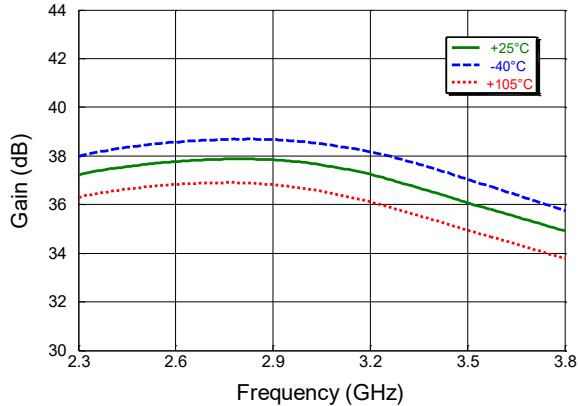
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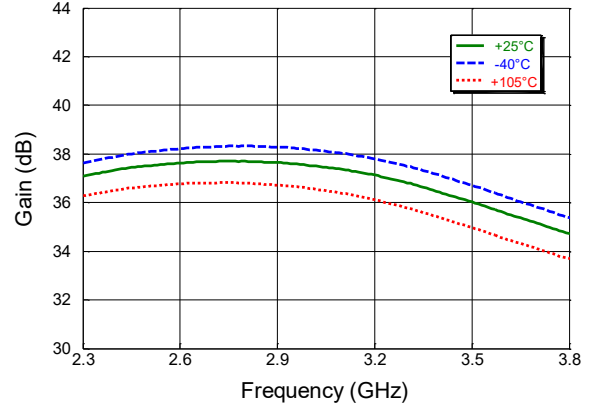
Typical Performance Curves:

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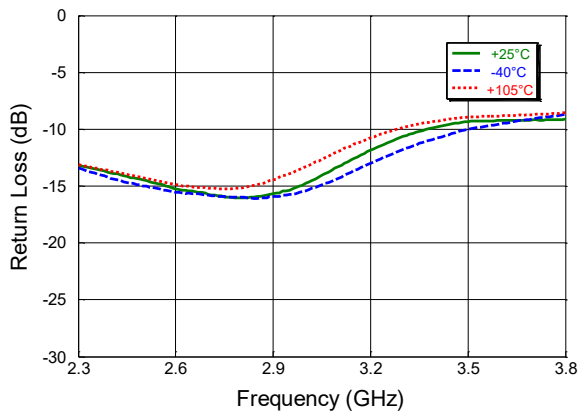
Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode



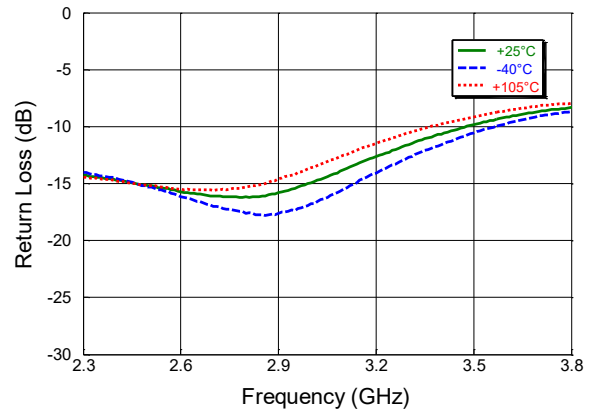
Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode



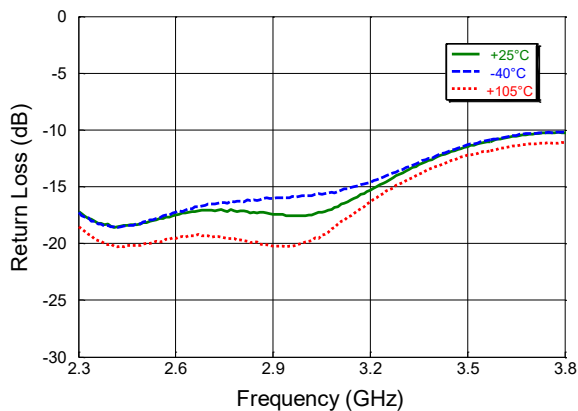
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



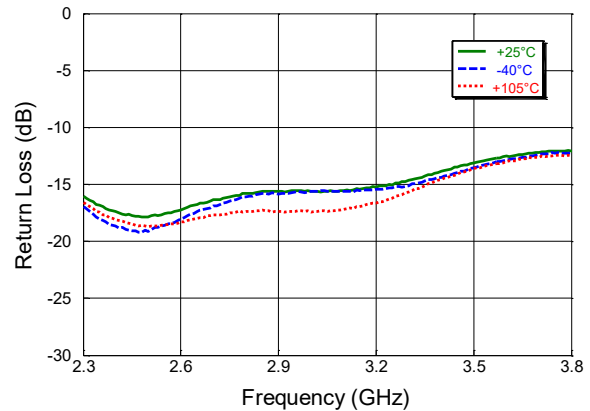
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 1 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 2 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode



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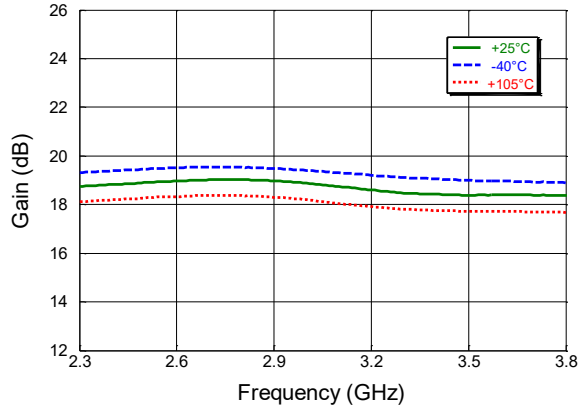
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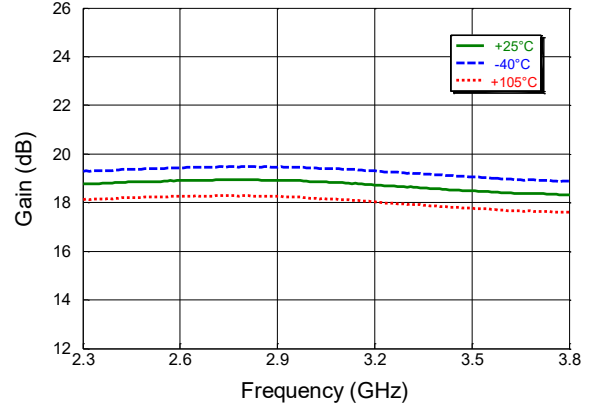
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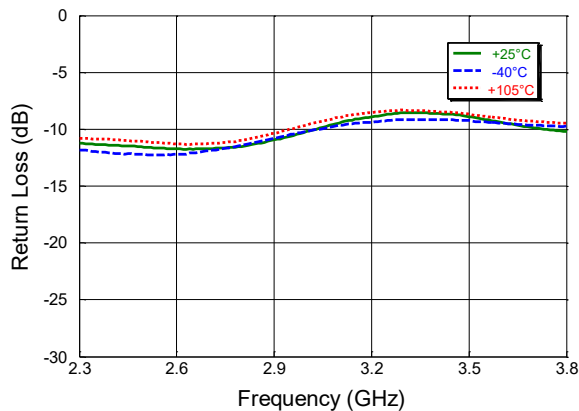
Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode



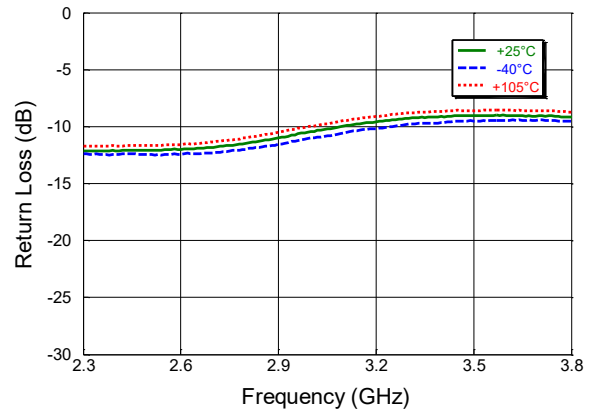
Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode



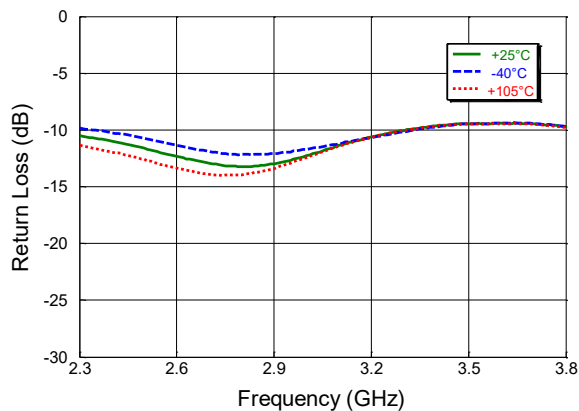
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



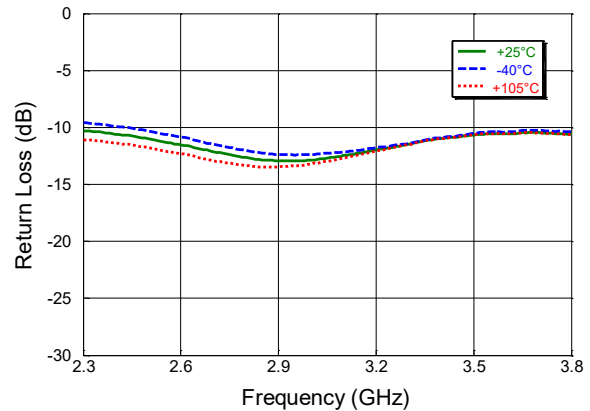
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



Channel 1 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



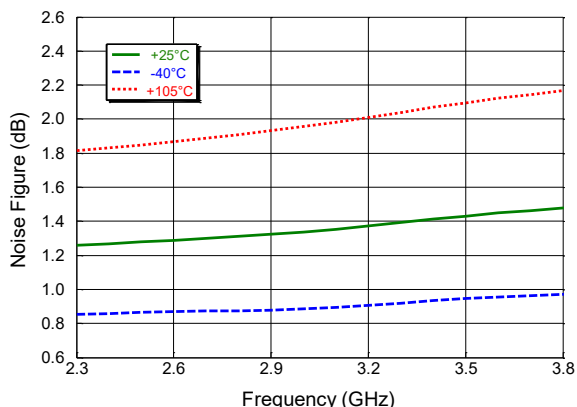
Channel 2 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode



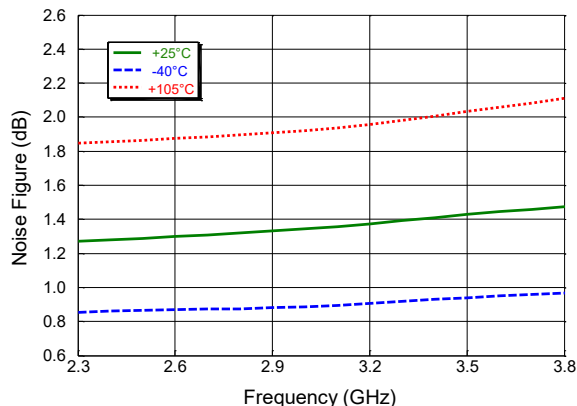
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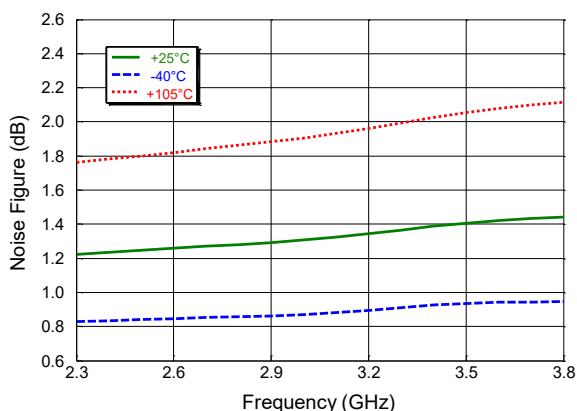
Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode



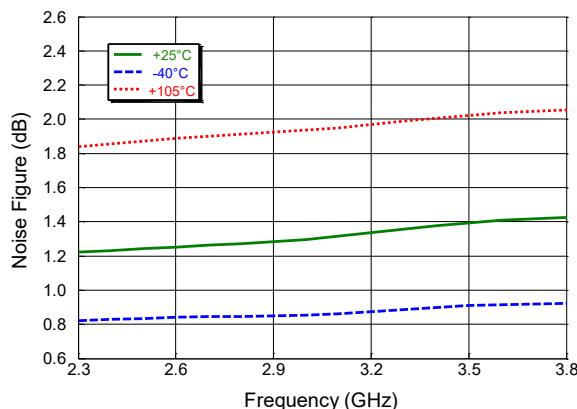
Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode



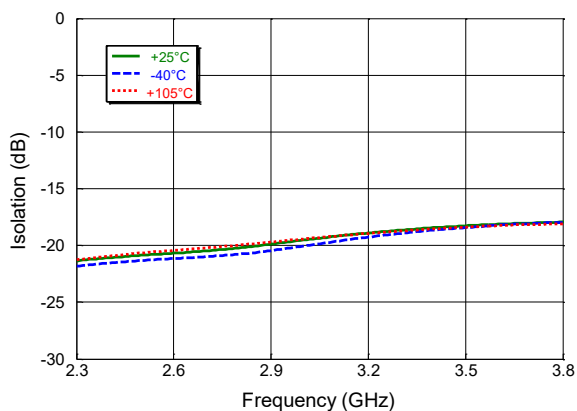
Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode



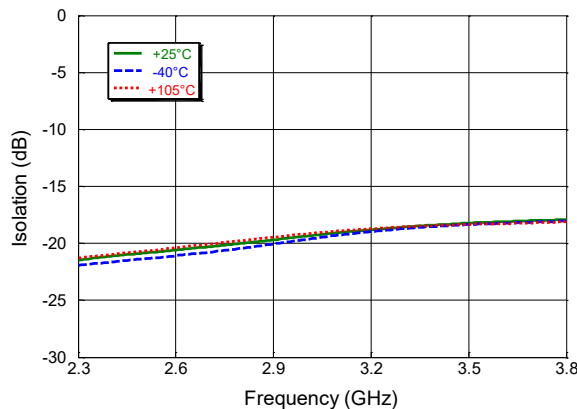
Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode



Channel 1 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 2 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx High Gain Mode



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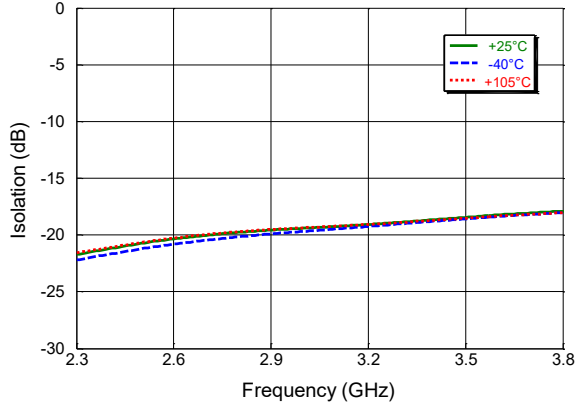
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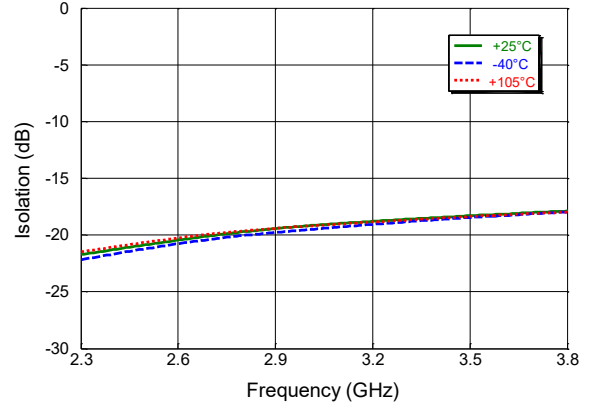
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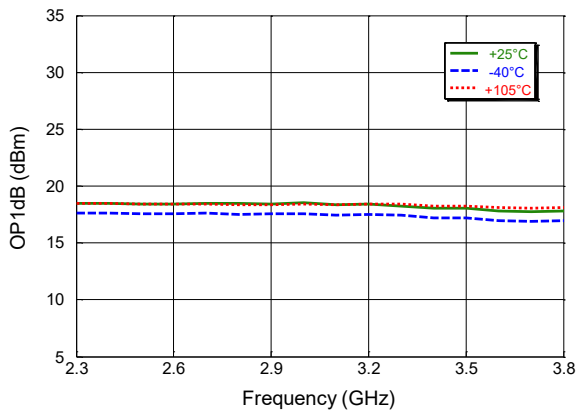
Channel 1 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode



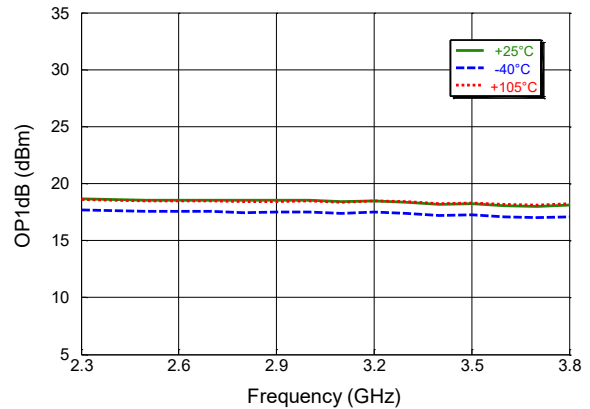
Channel 2 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode



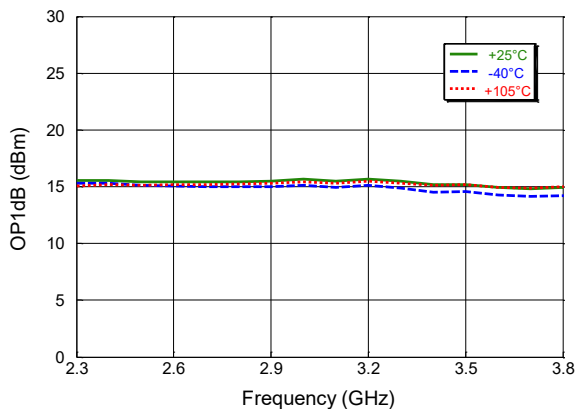
Channel 1 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode



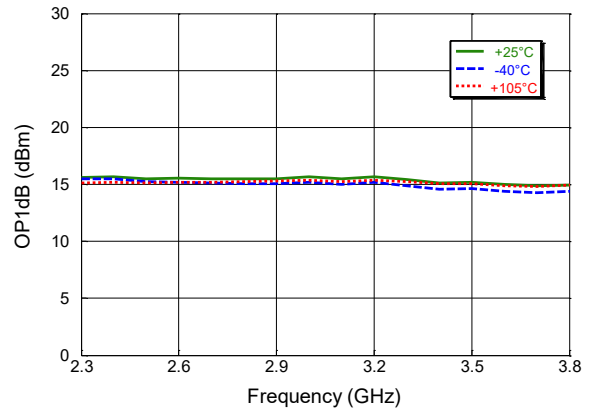
Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode



Channel 1 LNA Output P1dB over swept Frequency (& Temp.) in Rx Low Gain Mode.



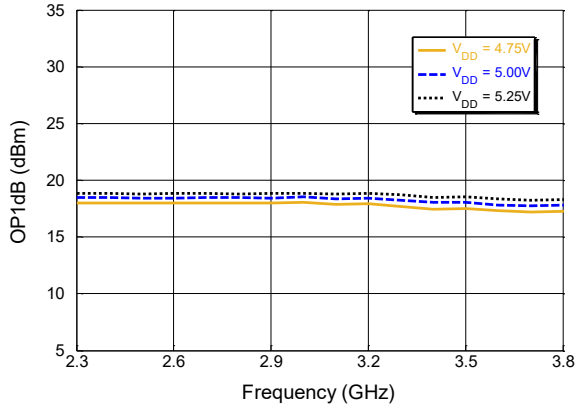
Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx Low Gain Mode



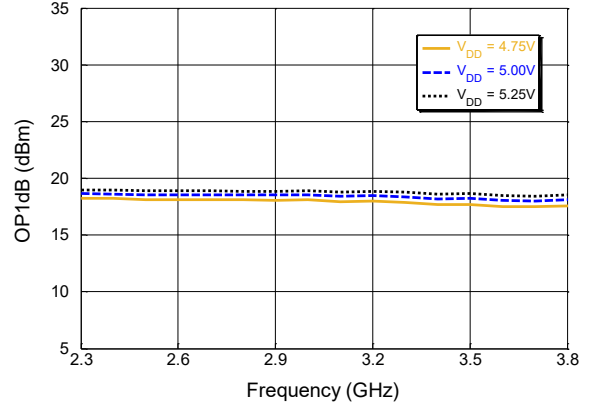
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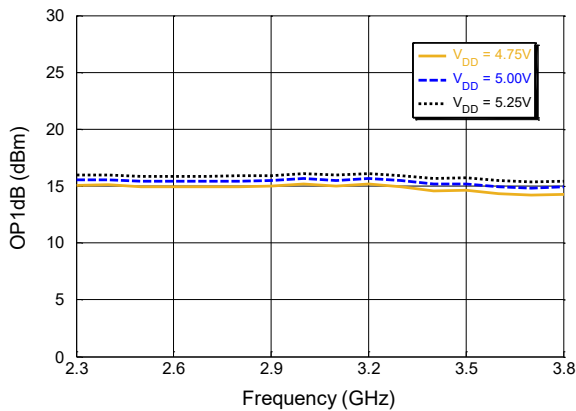
Channel 1 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx High Gain Mode



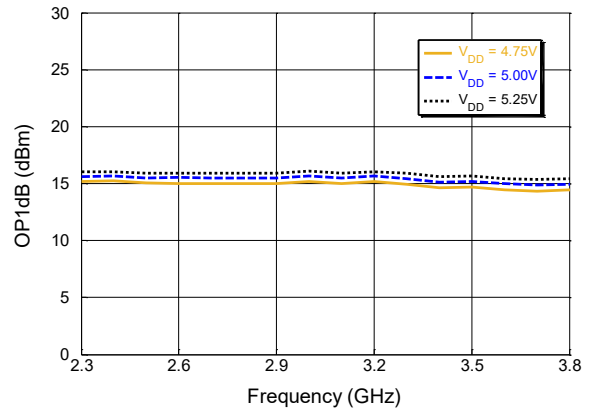
Channel 2 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx High Gain Mode



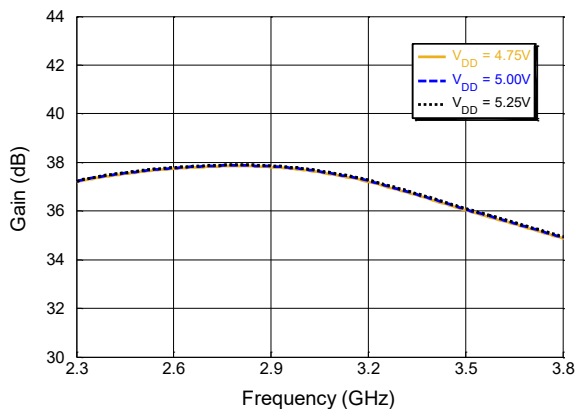
Channel 1 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx Low Gain Mode



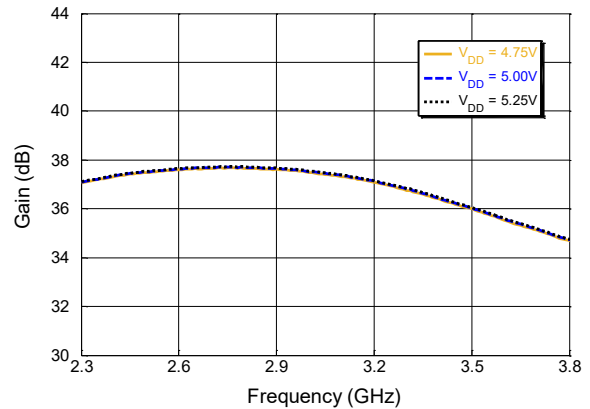
Channel 2 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx Low Gain Mode



Channel 1 LNA Gain over Frequency (& V_{DD}) in Rx High Gain Mode



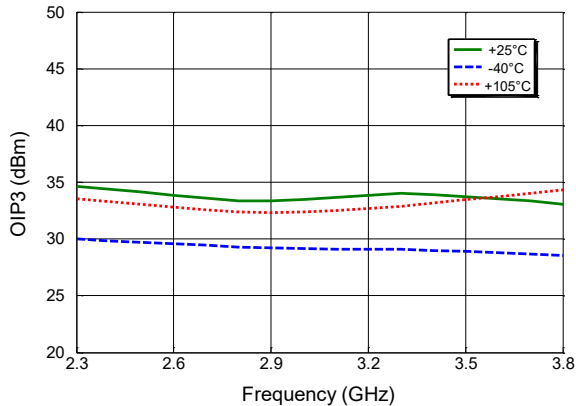
Channel 2 LNA Gain over Frequency (& V_{DD}) in Rx High Gain Mode



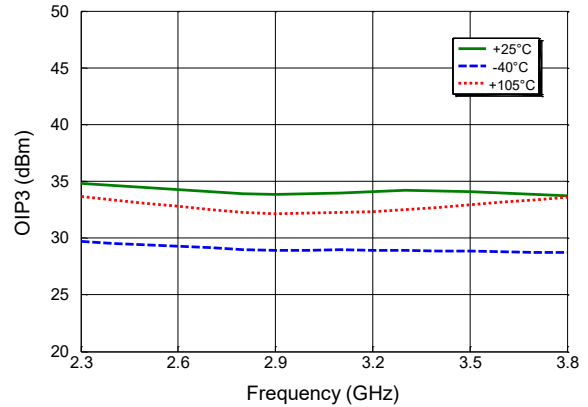
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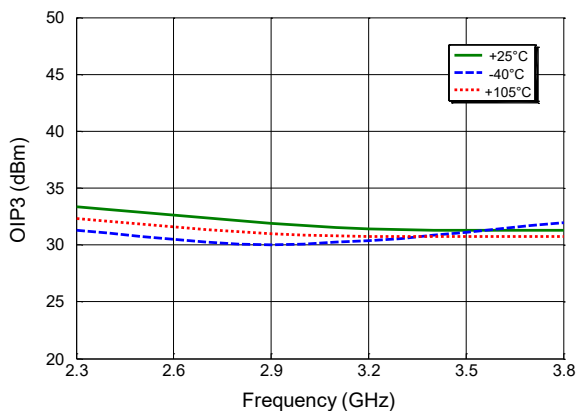
Channel 1 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 10 \text{ dBm}$ & 10 MHz tone spacing in HGM.



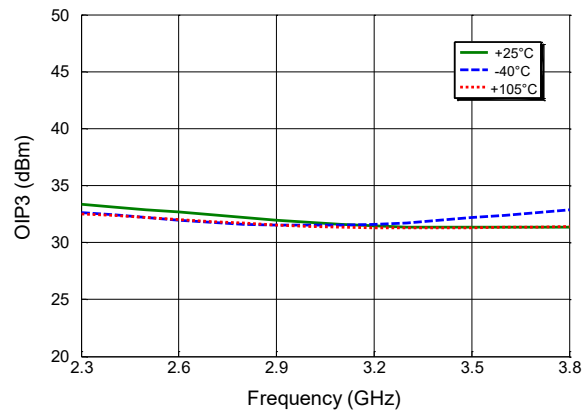
Channel 2 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 10 \text{ dBm}$ & 10 MHz tone spacing in HGM.



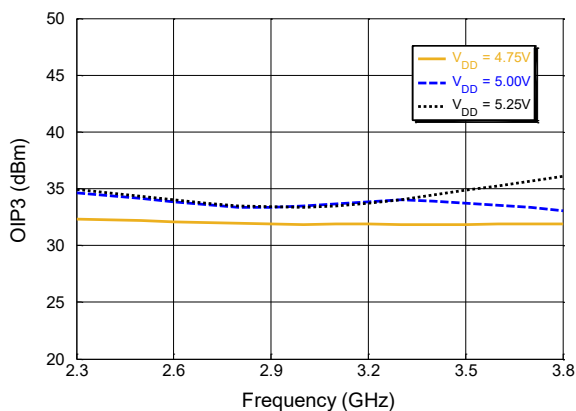
Channel 1 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in HGM.



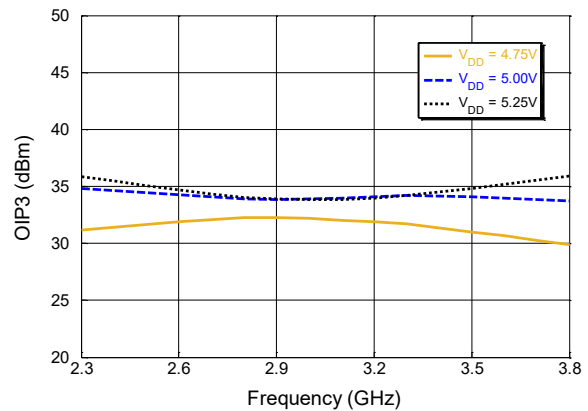
Channel 2 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in HGM.



Channel 1 OIP3 over swept frequency (& V_{DD}) with $P_{OUT}/\text{Tone} = 10 \text{ dBm}$ & 10 MHz tone spacing in HGM.



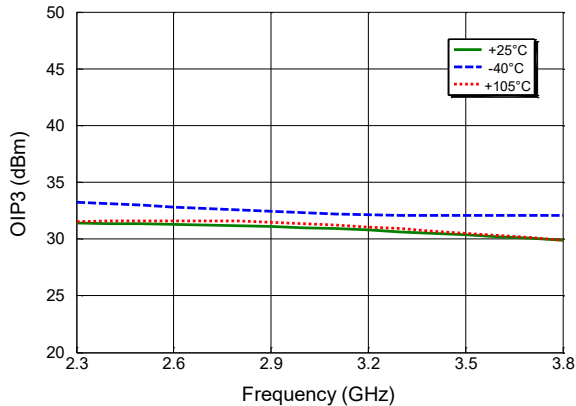
Channel 2 OIP3 over swept frequency (& V_{DD}) with $P_{OUT}/\text{Tone} = 10 \text{ dBm}$ & 10 MHz tone spacing in HGM.



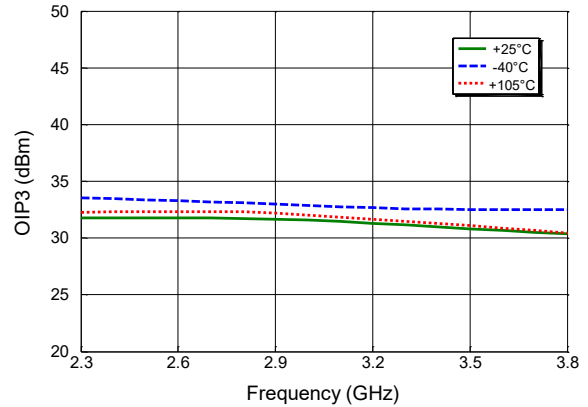
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$P_{IN} = -35 \text{ dBm}$, $V_{DD} = 5 \text{ V}$, $T_C = +25^\circ\text{C}$, $Z_0 = 50 \Omega$ (unless otherwise indicated)

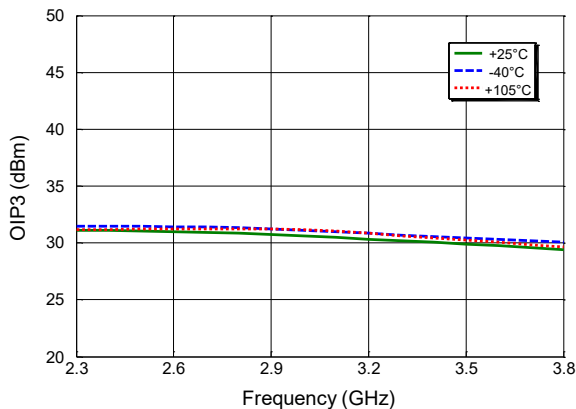
Channel 1 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in LGM.



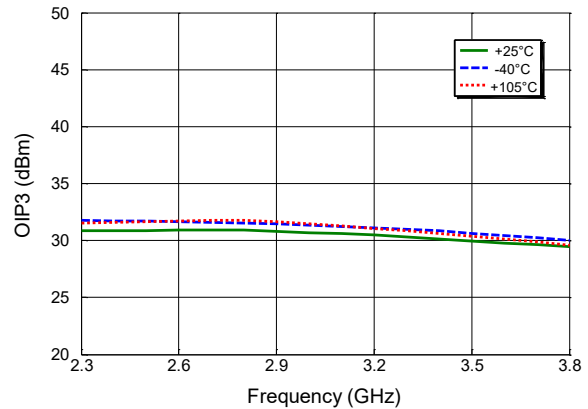
Channel 2 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in LGM.



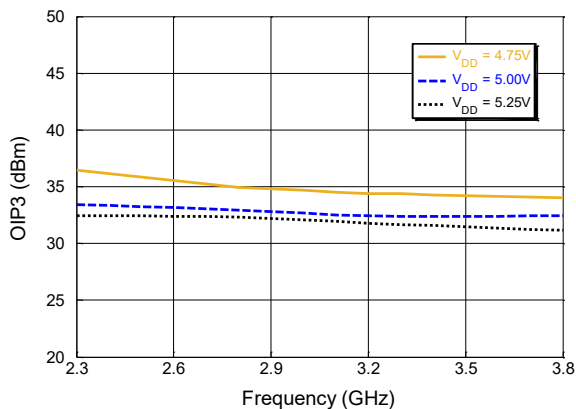
Channel 1 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 0 \text{ dBm}$ & 10 MHz tone spacing in LGM.



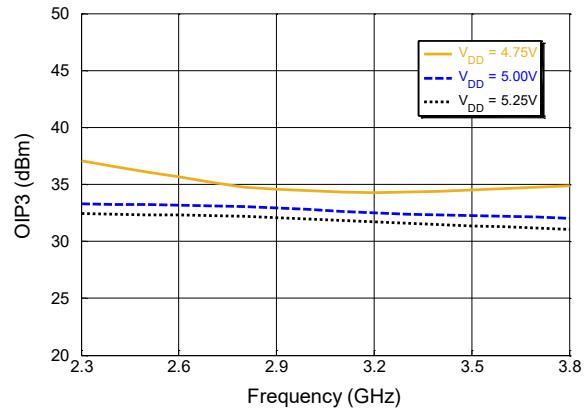
Channel 2 OIP3 over swept Frequency (& Temp.) with $P_{OUT}/\text{Tone} = 0 \text{ dBm}$ & 10 MHz tone spacing in LGM.



Channel 1 OIP3 over swept Frequency (& V_{DD}) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in LGM.



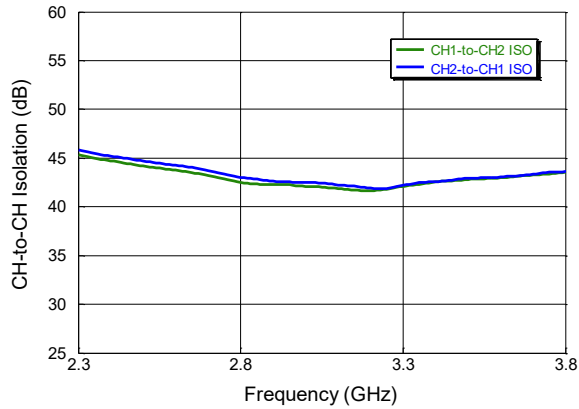
Channel 2 OIP3 over swept Frequency (& V_{DD}) with $P_{OUT}/\text{Tone} = 3 \text{ dBm}$ & 10 MHz tone spacing in LGM.



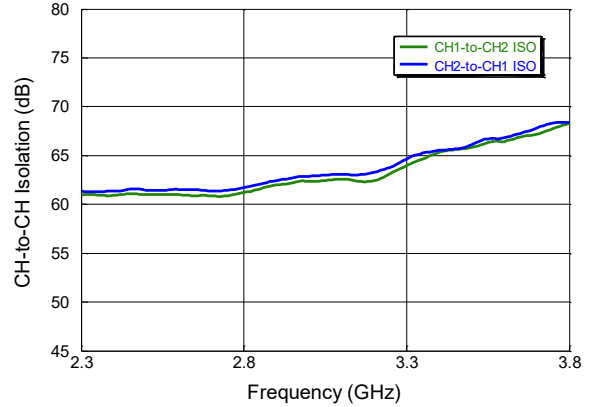
Typical Performance Curves:

$P_{IN} = -35 \text{ dBm}$, $V_{DD} = 5 \text{ V}$, $T_C = +25^\circ\text{C}$, $Z_0 = 50 \Omega$ (unless otherwise indicated)

CH-to-CH Isolation over swept Frequency in High Gain Mode



CH-to-CH Isolation over swept Frequency in Low Gain Mode



Integrated Dual Channel Switch and LNA Module

2.3 - 3.8 GHz



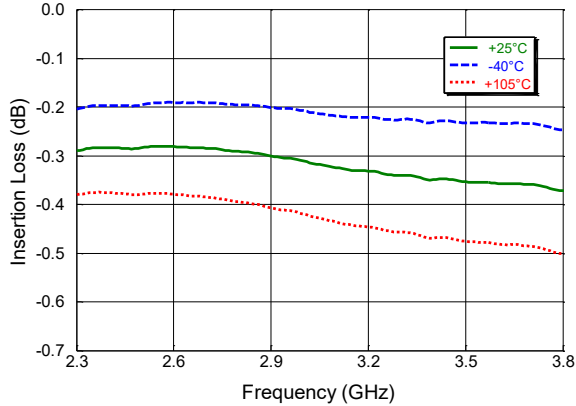
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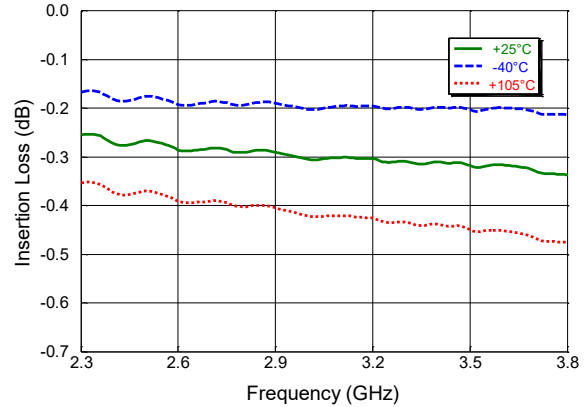
Typical Performance Curves:

$P_{IN} = -10 \text{ dBm}$, $V_{DD} = 5 \text{ V}$, $T_C = +25^\circ\text{C}$, $Z_0 = 50 \Omega$ (unless otherwise indicated)

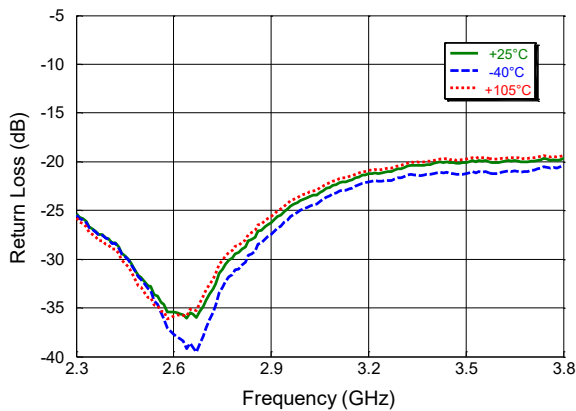
Channel 1 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode



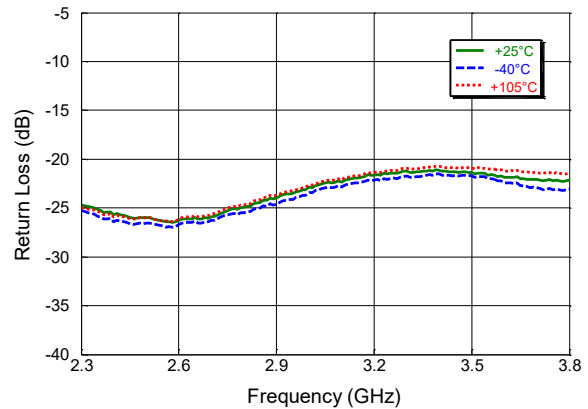
Channel 2 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode



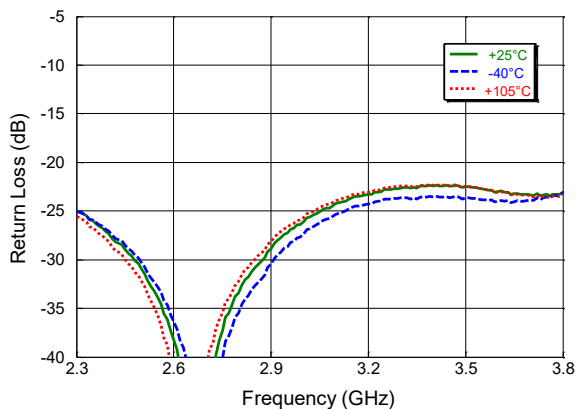
Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode



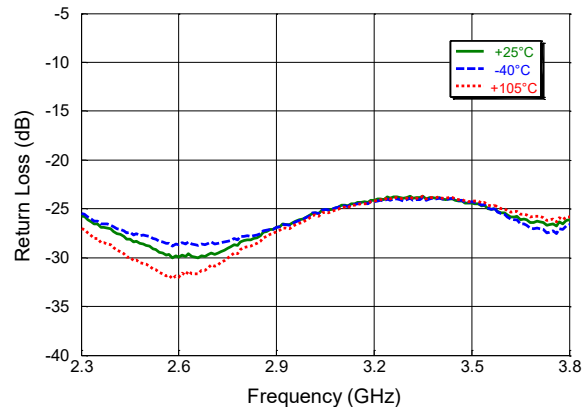
Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode



Channel 1 LOAD Port Return Loss over swept Frequency (& Temp.) in Tx Mode



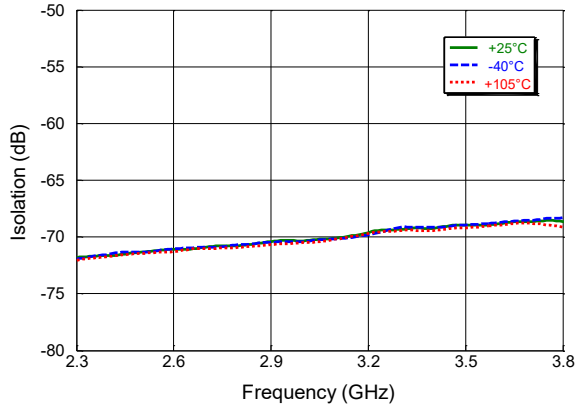
Channel 2 LOAD Port Return Loss over swept Frequency (& Temp.) in Tx Mode



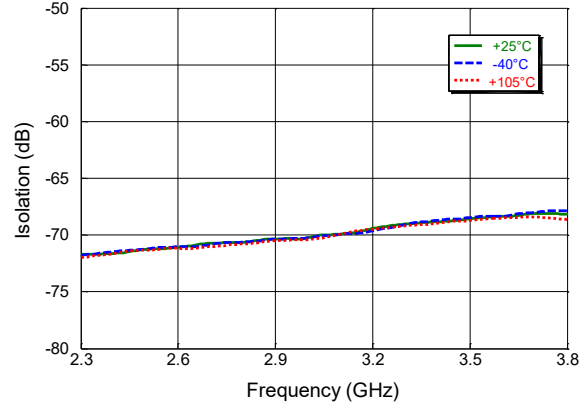
Typical Performance Curves:

$P_{IN} = -10$ dBm, $V_{DD} = 5$ V, $T_C = +25^\circ\text{C}$, $Z_0 = 50 \Omega$ (unless otherwise indicated)

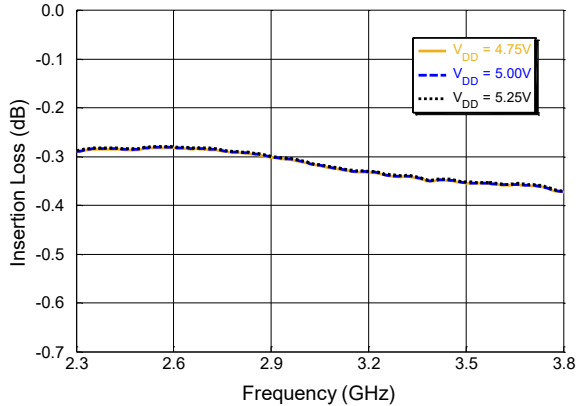
Channel 1 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode



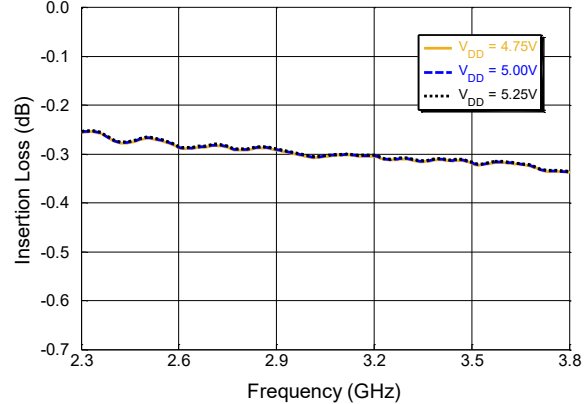
Channel 2 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode



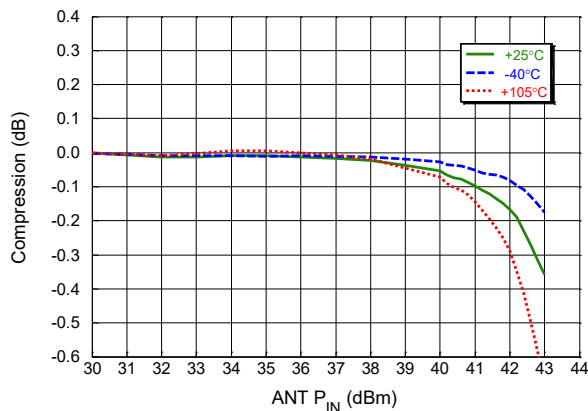
Channel 1 Switch Insertion Loss over swept Frequency (& V_{DD}) in Tx Mode



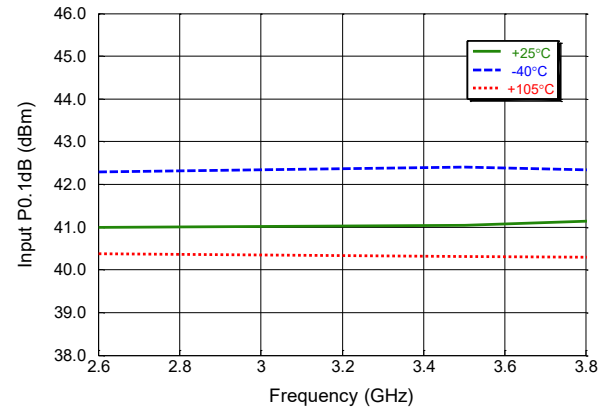
Channel 2 Switch Insertion Loss over swept Frequency (& V_{DD}) in Tx Mode



Switch Compression over swept ANT Input Power (& Temp.) at 2.6 GHz in Tx Mode



Switch ANT Input P0.1dB Compression Point over swept Frequency (& Temp.) in Tx Mode



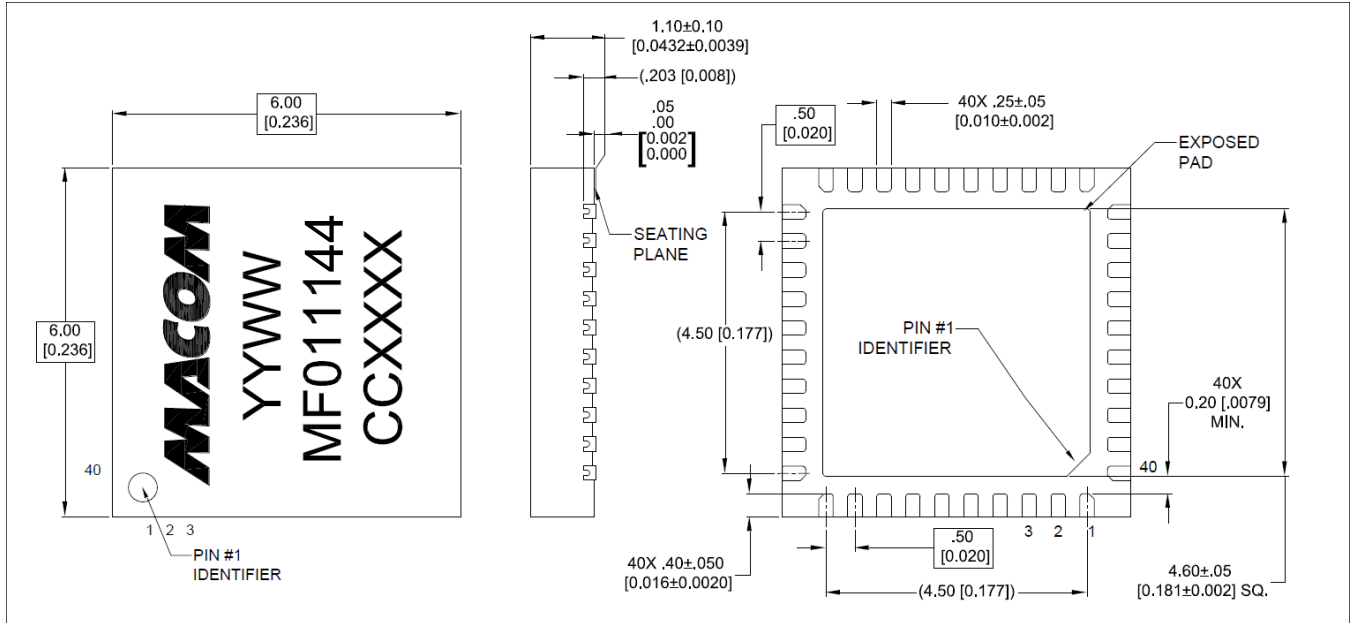
Integrated Dual Channel Switch and LNA Module 2.3 - 3.8 GHz



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Lead-Free 6 mm 40-Lead QFN[†]



[†] Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAuAg

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