

# 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.

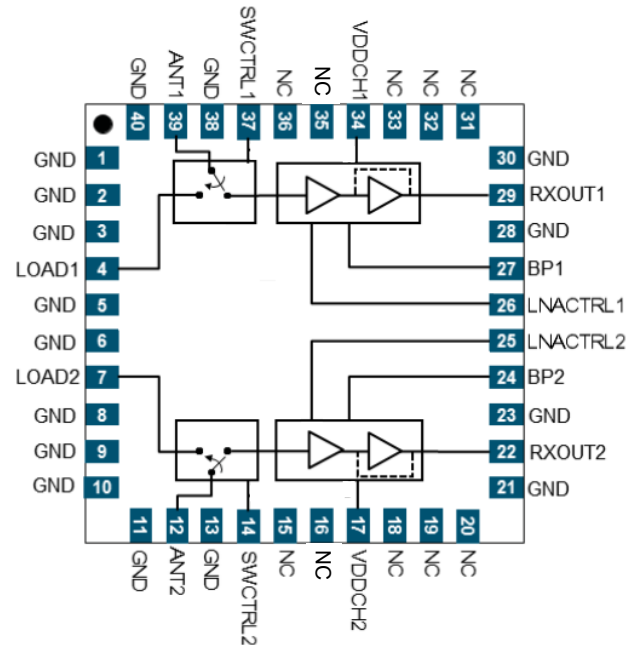
### Ordering Information<sup>1</sup>

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<sup>2,3,4</sup>

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

# Integrated Dual Channel Switch and LNA Module

## 2.3 - 3.8 GHz



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**Electrical Specifications: Freq. = 2.6 GHz, P<sub>IN</sub> = -35 dBm, T<sub>C</sub> = +25°C, V<sub>DD</sub> = 5 V, Z<sub>0</sub> = 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 <sub>OUT</sub> / Tone = +3 dBm P <sub>OUT</sub> / 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 <sub>OUT</sub> / 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 <sub>DD</sub> ) 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 <sup>5</sup>	—	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 <sup>6</sup> )	Bypass (LGM <sup>7</sup> )
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<sup>8,9</sup>

Parameter	Absolute Maximum
Antenna Input Power <sup>10</sup> 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 <sup>11,13</sup> TX Mode <sup>11,13</sup> TX Mode <sup>10</sup>	+150°C +125°C +140°C
Operating Temperature <sup>12</sup>	-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 ( $\Theta_{JC}$ ) = 33.4 °C/W.
- TX Mode: Typical thermal resistance ( $\Theta_{JC}$ ) = 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  $\mu\text{s}$ . 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

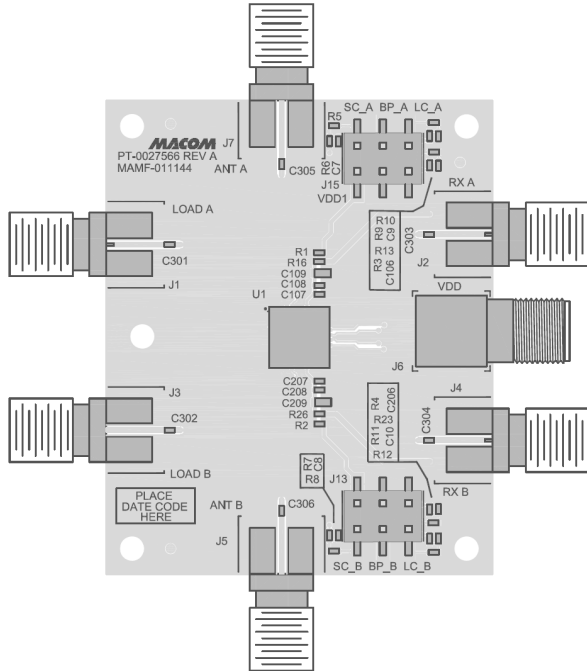
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Rev. V1

## PCB Layout

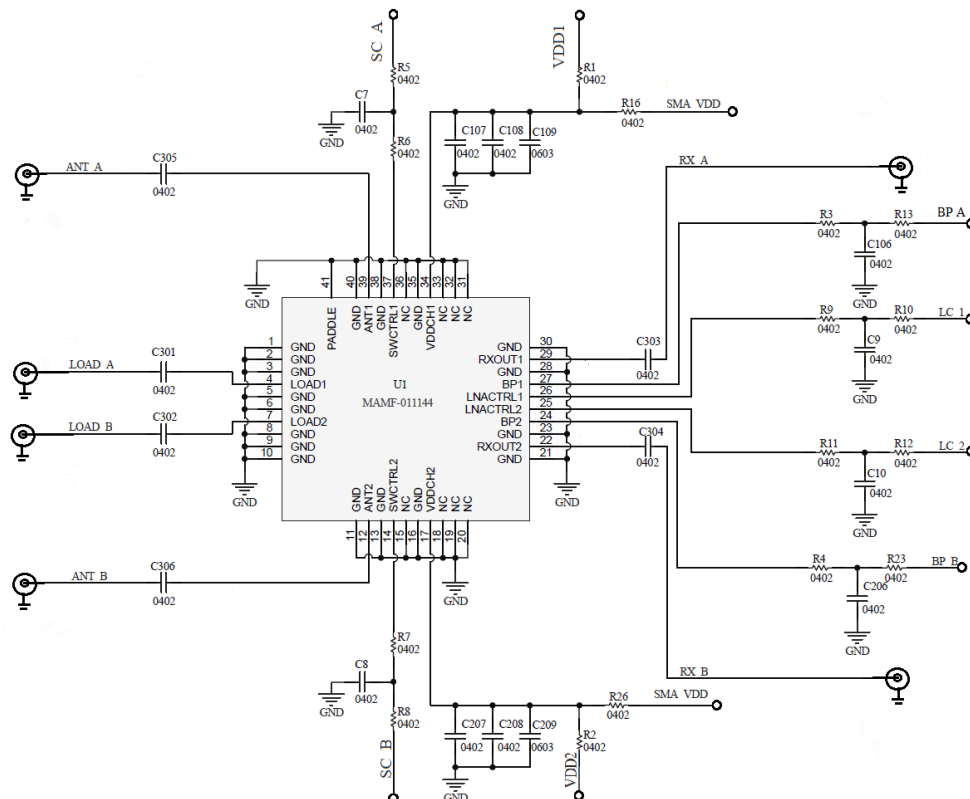


## Parts List<sup>14</sup>

Part	Value	Case Style
C7, C8, C106, C206	5 pF	0402
C107, C207	470 pF	0402
C108, C208	10 nF	0402
C109, C209	10 $\mu$ 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 $\Omega$	0402

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

## Application Schematic



# Integrated Dual Channel Switch and LNA Module

## 2.3 - 3.8 GHz



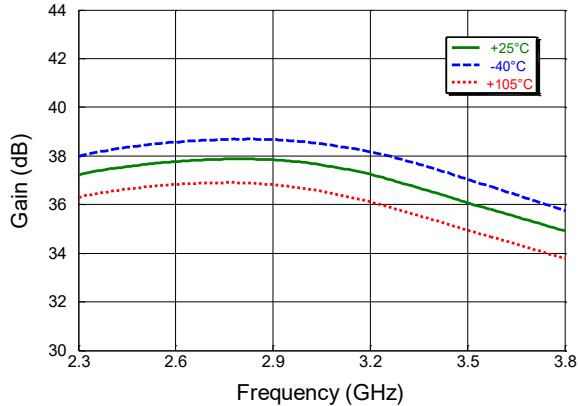
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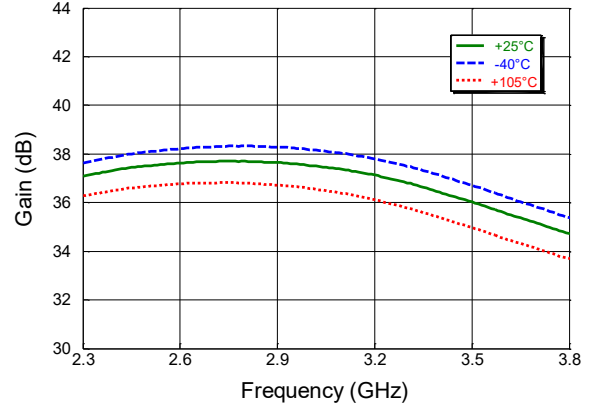
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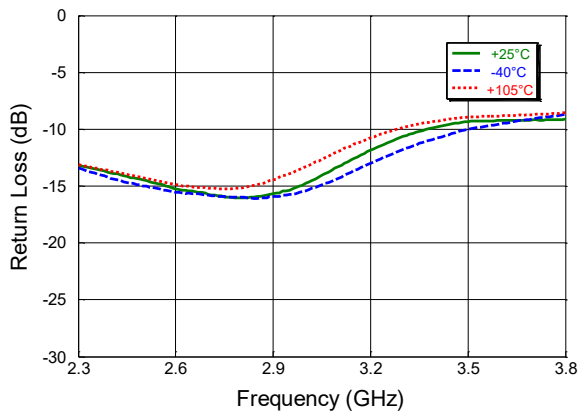
**Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode**



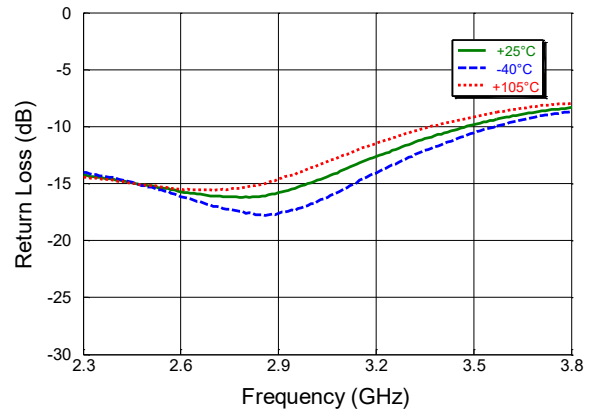
**Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx High Gain Mode**



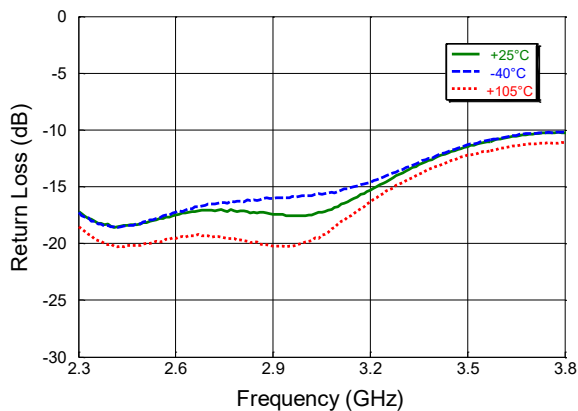
**Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode**



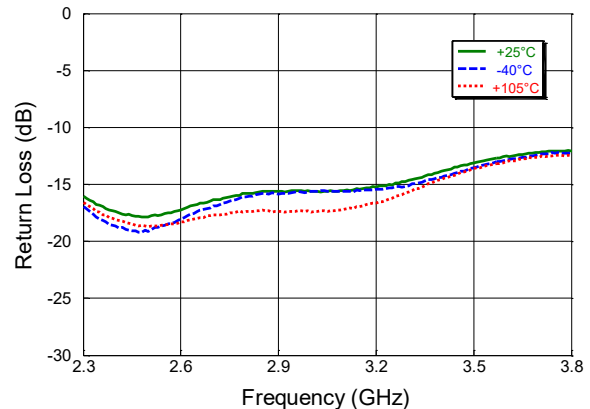
**Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx High Gain Mode**



**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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## 2.3 - 3.8 GHz



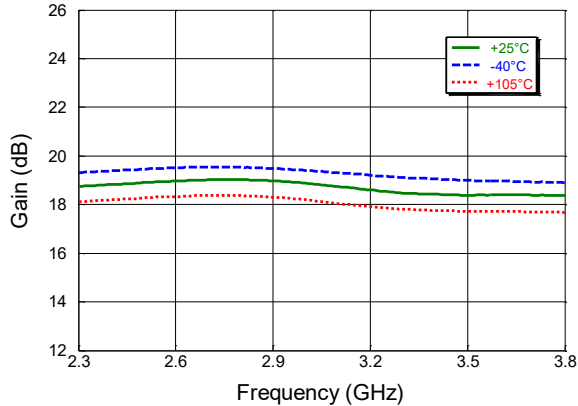
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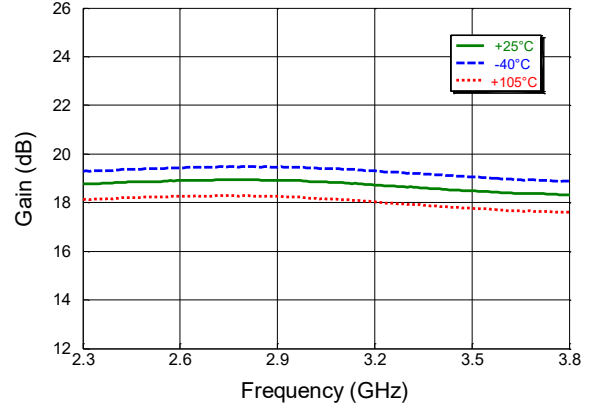
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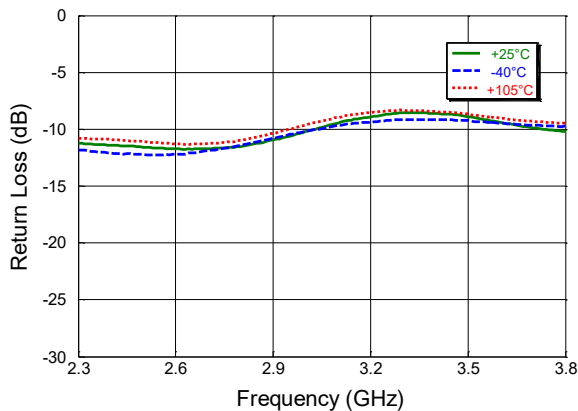
**Channel 1 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode**



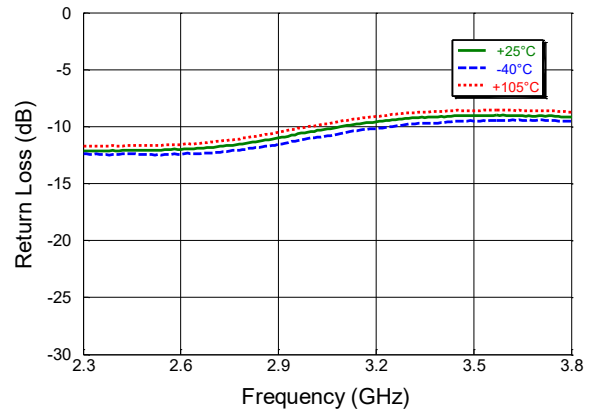
**Channel 2 LNA Gain over swept Frequency (& Temp.) in Rx Low Gain Mode**



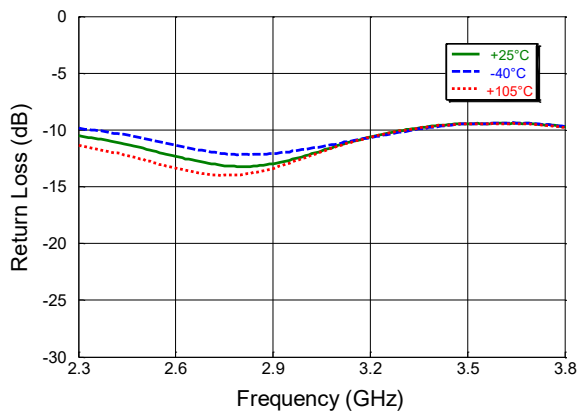
**Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode**



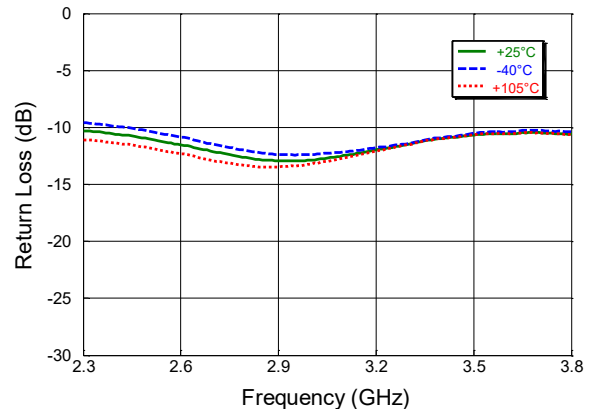
**Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode**



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



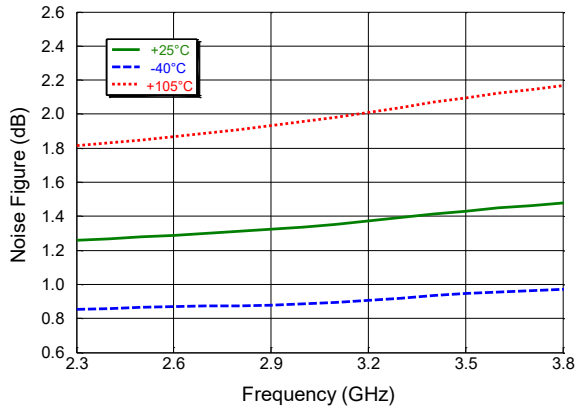
**Channel 2 RXOUT Port Return Loss over swept Frequency (& Temp.) in Rx Low Gain Mode**



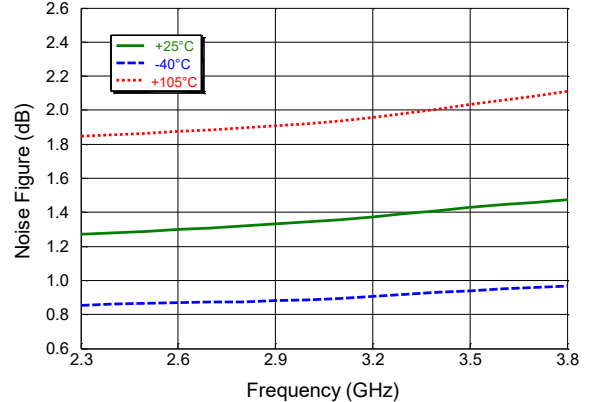
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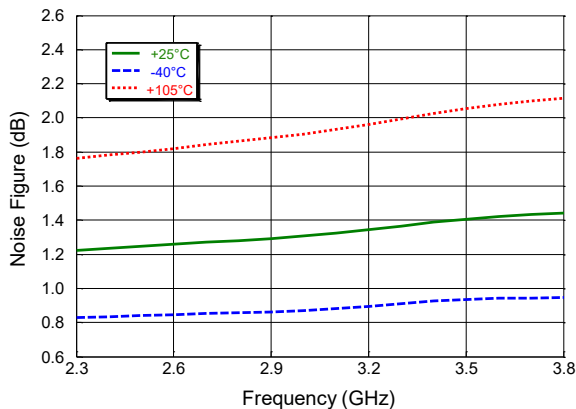
**Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode**



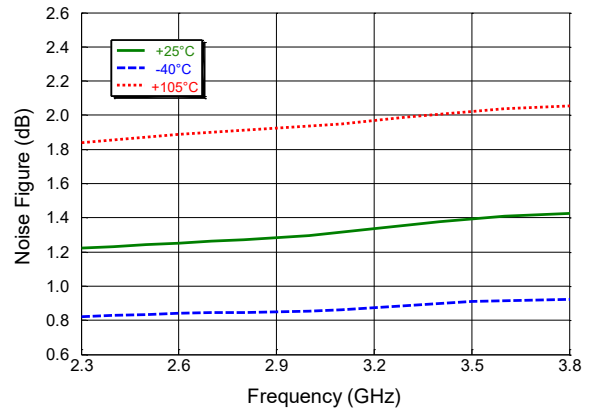
**Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode**



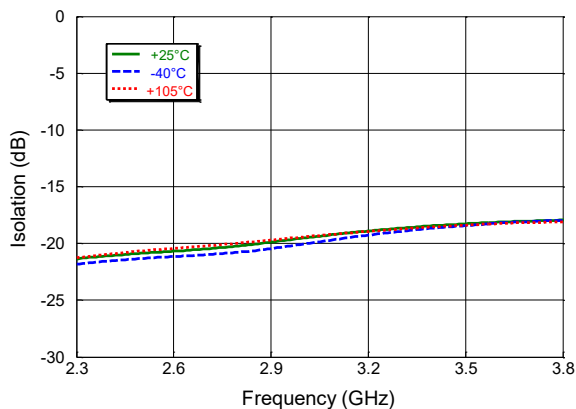
**Channel 1 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode**



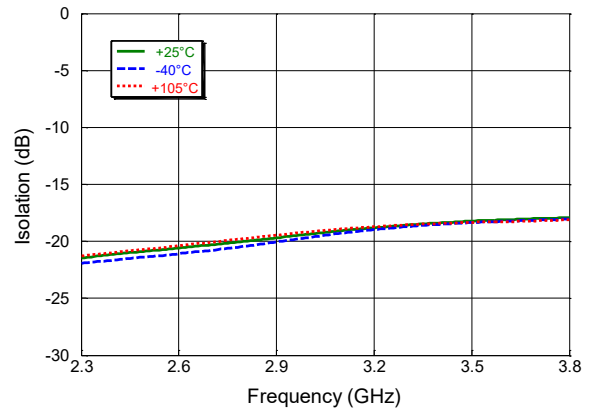
**Channel 2 LNA Noise Figure over swept Frequency (& Temp.) in Rx Low Gain Mode**



**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**





# Integrated Dual Channel Switch and LNA Module

## 2.3 - 3.8 GHz



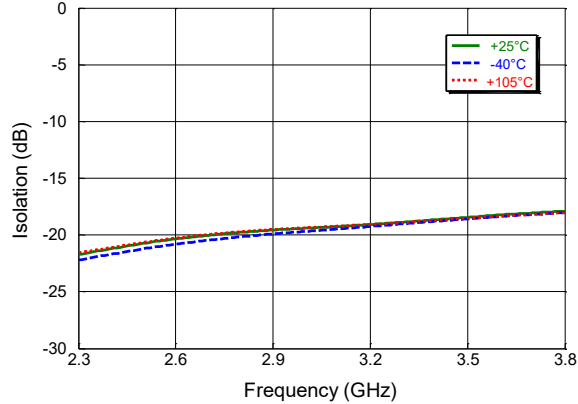
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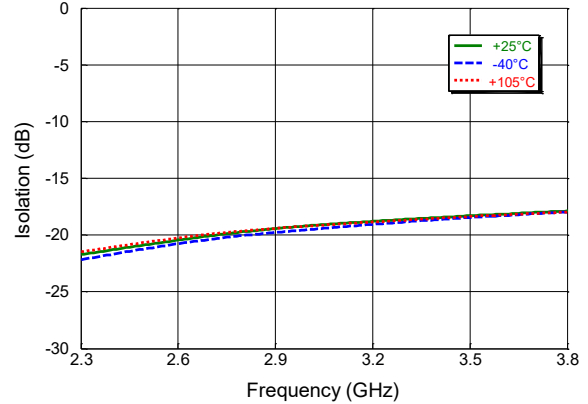
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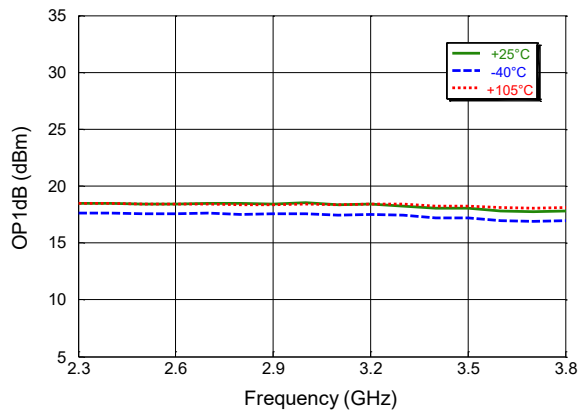
**Channel 1 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode**



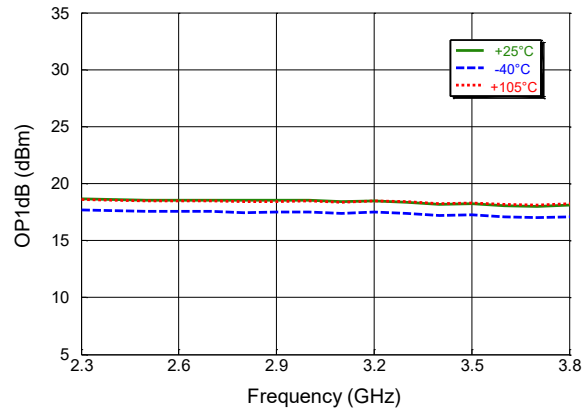
**Channel 2 ANT to LOAD Isolation over swept Frequency (& Temp.) in Rx Low Gain Mode**



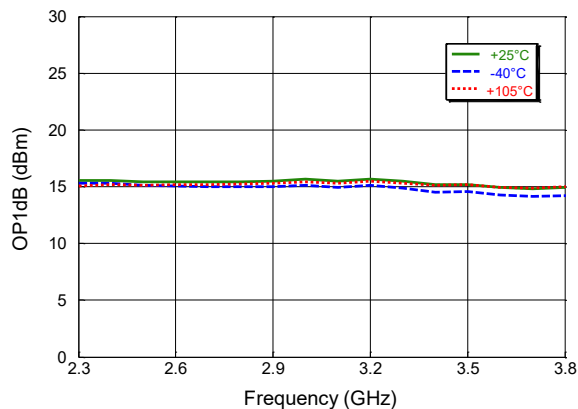
**Channel 1 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode**



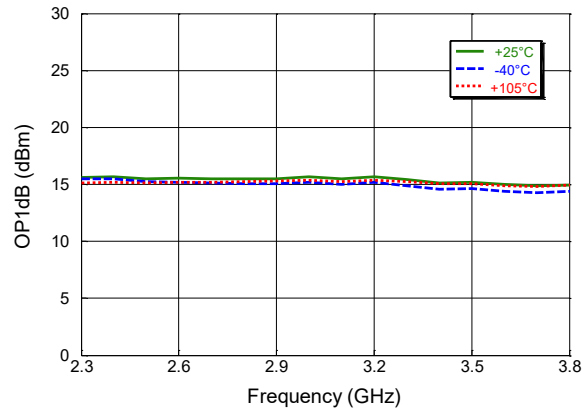
**Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx High Gain Mode**



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



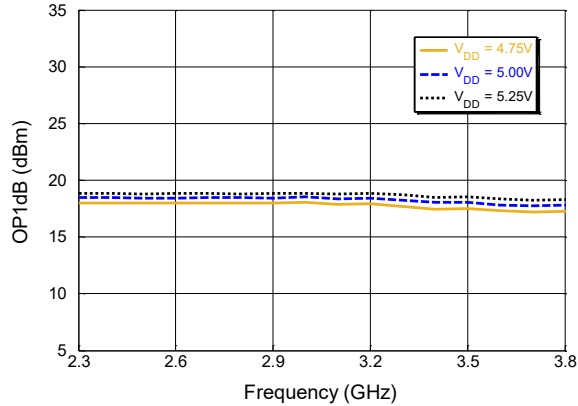
**Channel 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx Low Gain Mode**



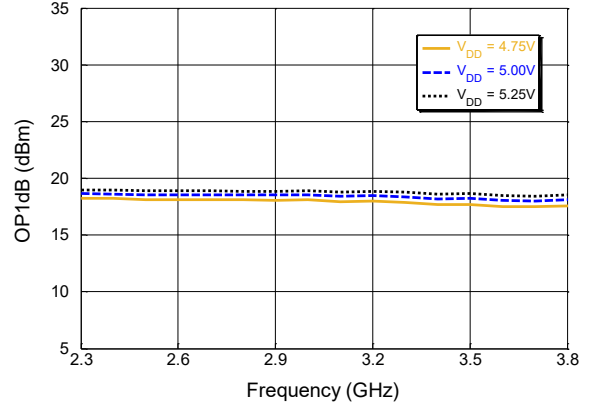
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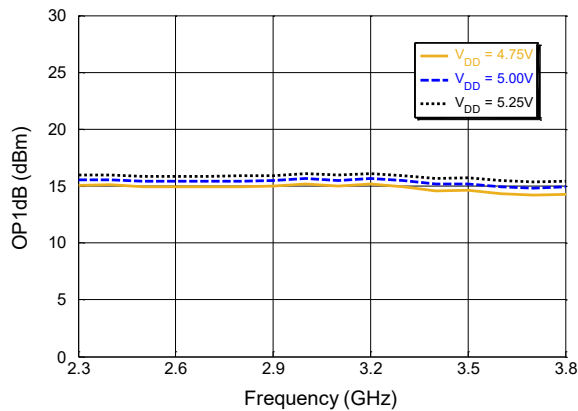
**Channel 1 LNA Output P1dB over swept Frequency (&  $V_{DD}$ ) in Rx High Gain Mode**



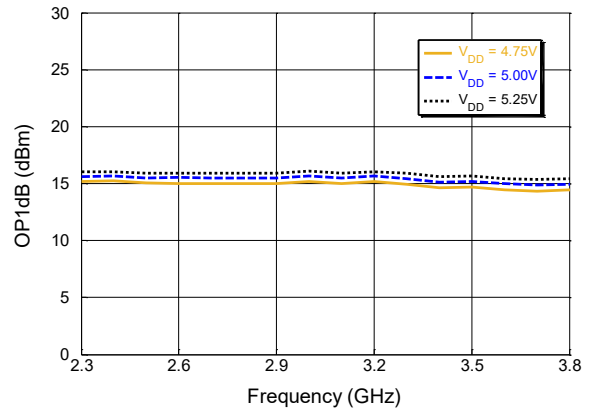
**Channel 2 LNA Output P1dB over swept Frequency (&  $V_{DD}$ ) in Rx High Gain Mode**



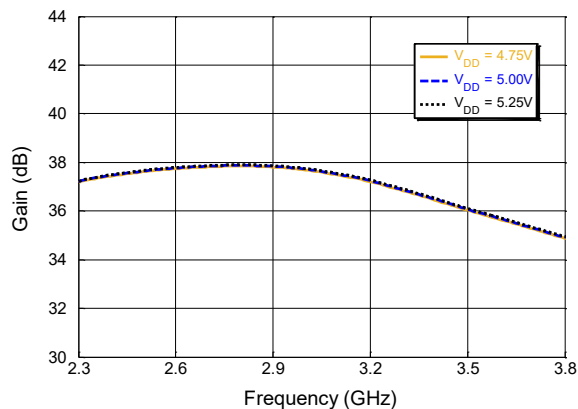
**Channel 1 LNA Output P1dB over swept Frequency (&  $V_{DD}$ ) in Rx Low Gain Mode**



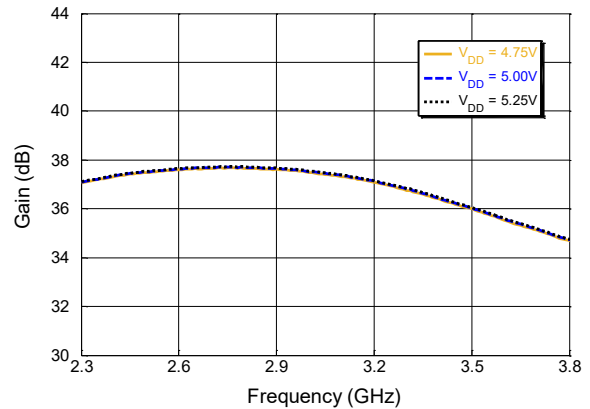
**Channel 2 LNA Output P1dB over swept Frequency (&  $V_{DD}$ ) in Rx Low Gain Mode**



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



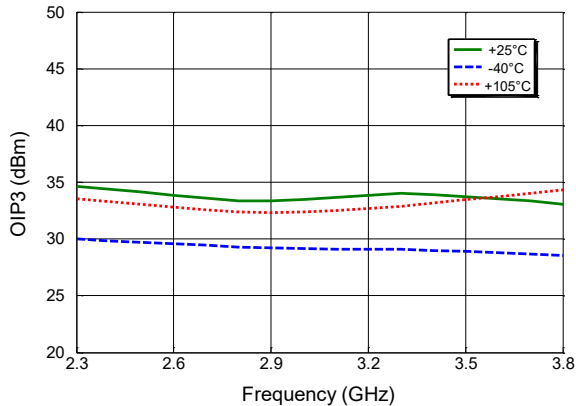
**Channel 2 LNA Gain over Frequency (&  $V_{DD}$ ) in Rx High Gain Mode**



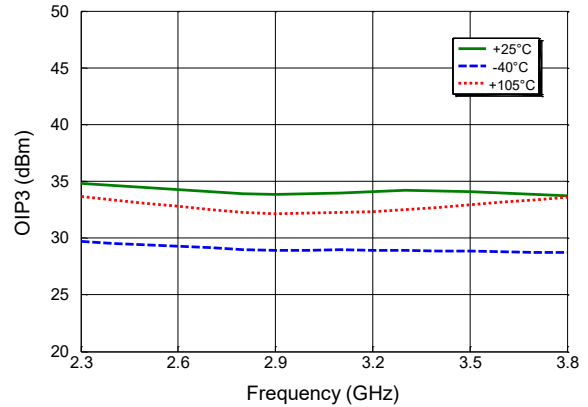
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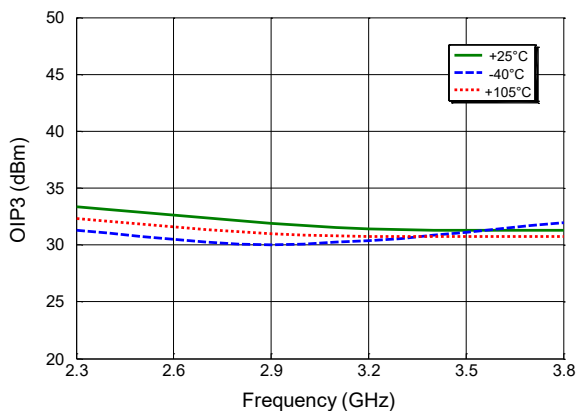
**Channel 1 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 10 \text{ dBm}$  & 10 MHz tone spacing in HGM.**



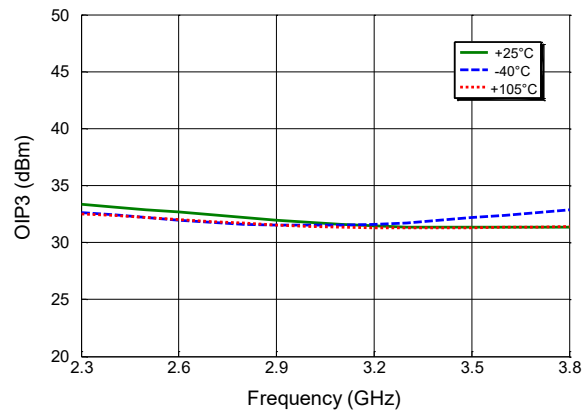
**Channel 2 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 10 \text{ dBm}$  & 10 MHz tone spacing in HGM.**



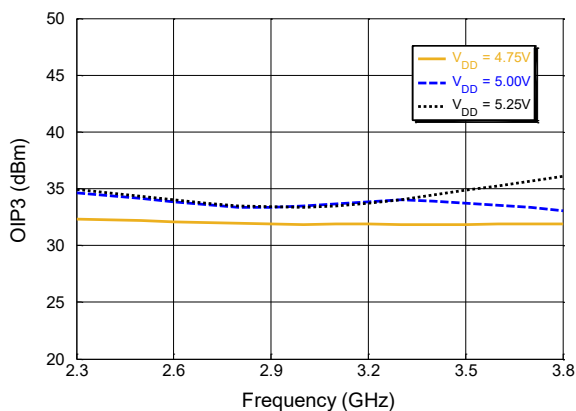
**Channel 1 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 3 \text{ dBm}$  & 10 MHz tone spacing in HGM.**



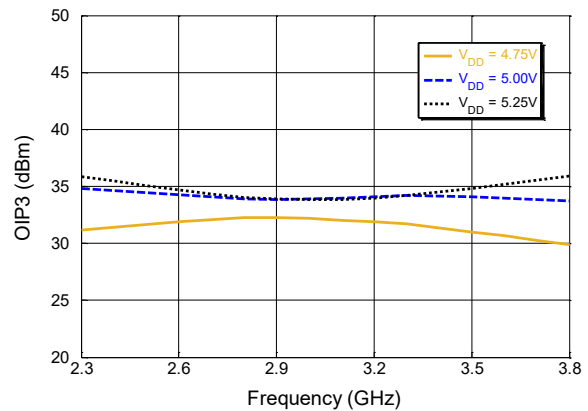
**Channel 2 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 3 \text{ dBm}$  & 10 MHz tone spacing in HGM.**



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



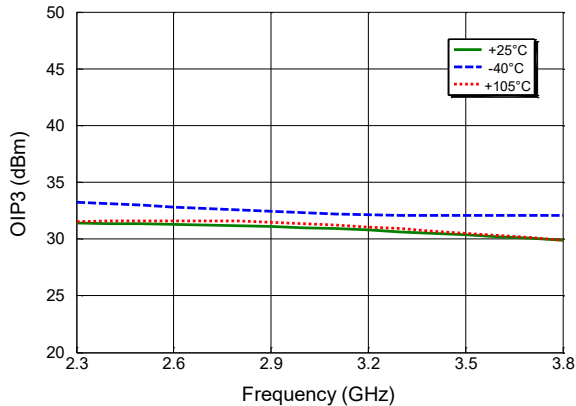
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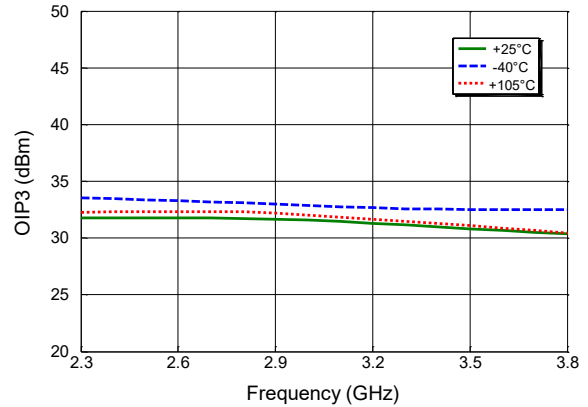
### Typical Performance Curves:

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

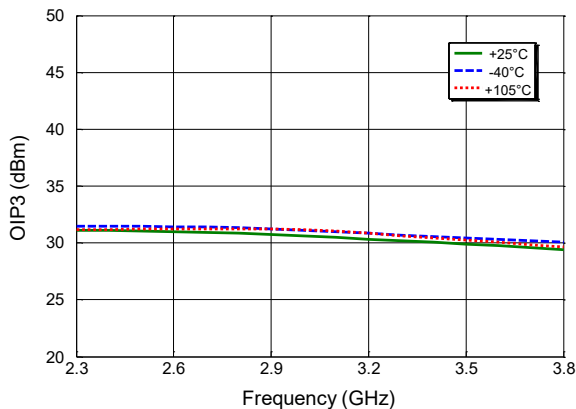
**Channel 1 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 3 \text{ dBm}$  & 10 MHz tone spacing in LGM.**



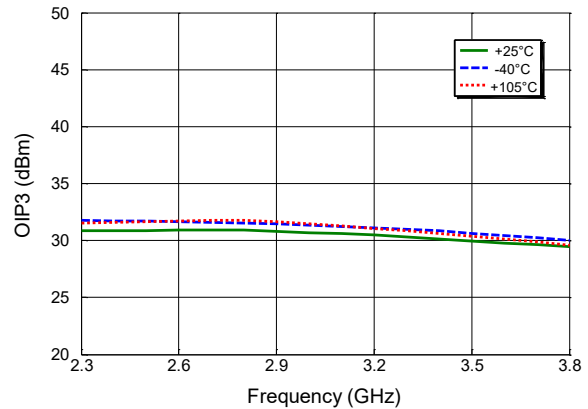
**Channel 2 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 3 \text{ dBm}$  & 10 MHz tone spacing in LGM.**



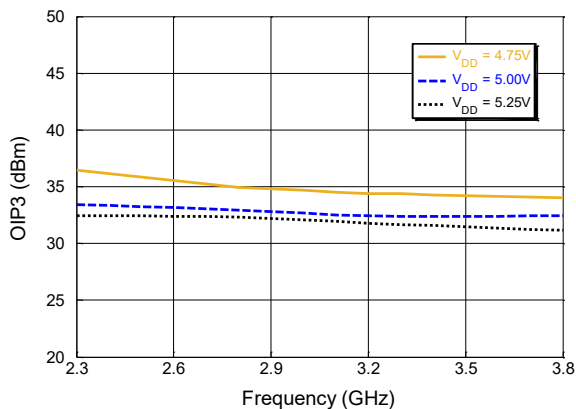
**Channel 1 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 0 \text{ dBm}$  & 10 MHz tone spacing in LGM.**



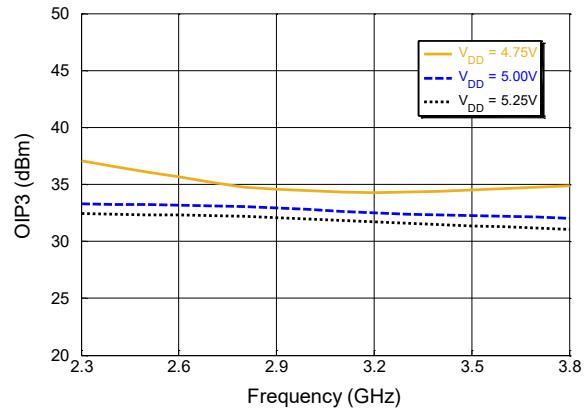
**Channel 2 OIP3 over swept Frequency (& Temp.) with  $P_{OUT}/\text{Tone} = 0 \text{ dBm}$  & 10 MHz tone spacing in LGM.**



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



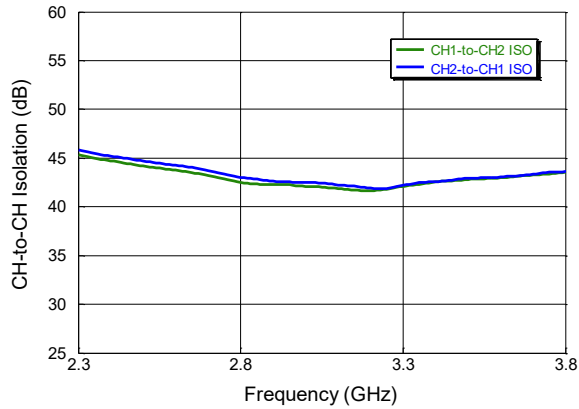
**Channel 2 OIP3 over swept Frequency (&  $V_{DD}$ ) with  $P_{OUT}/\text{Tone} = 3 \text{ dBm}$  & 10 MHz tone spacing in LGM.**



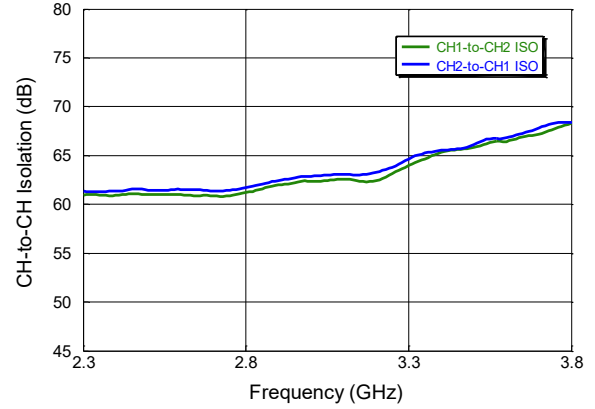
**Typical Performance Curves:**

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



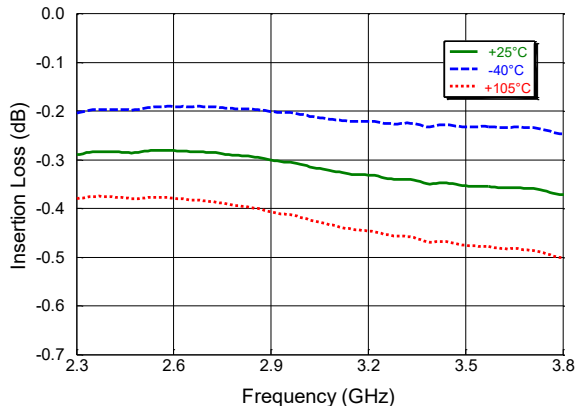
MAMF-011144

Rev. V1

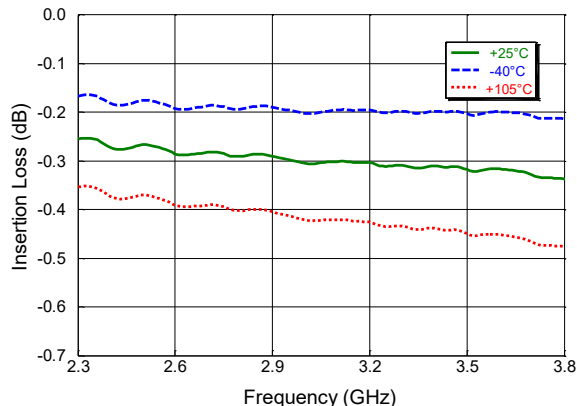
### Typical Performance Curves:

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

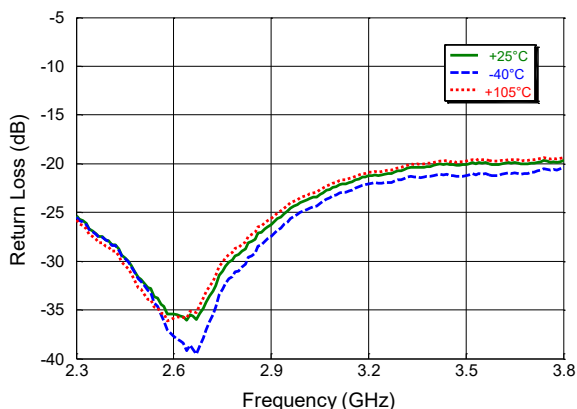
**Channel 1 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode**



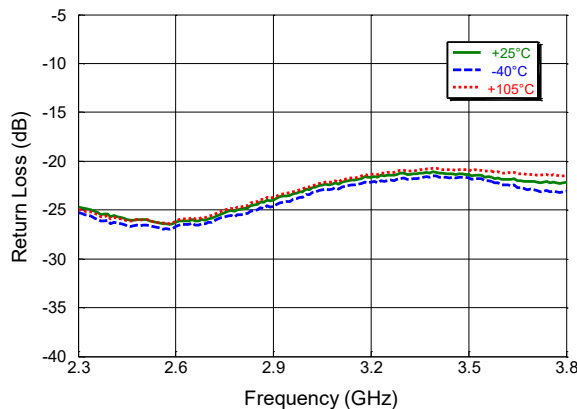
**Channel 2 Switch Insertion Loss over swept Frequency (& Temp.) in Tx Mode**



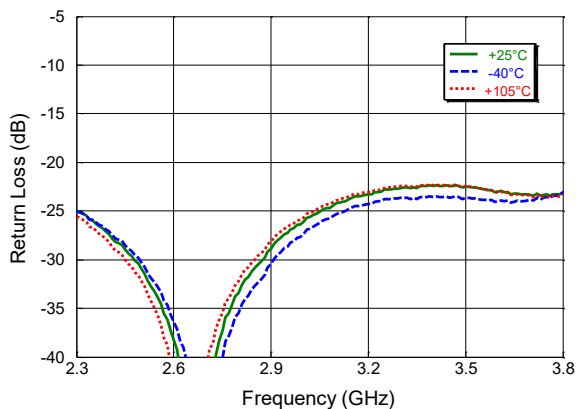
**Channel 1 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode**



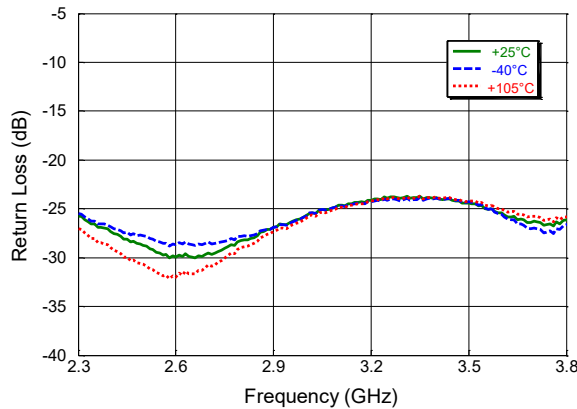
**Channel 2 ANT Port Return Loss over swept Frequency (& Temp.) in Tx Mode**



**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**



# Integrated Dual Channel Switch and LNA Module

## 2.3 - 3.8 GHz



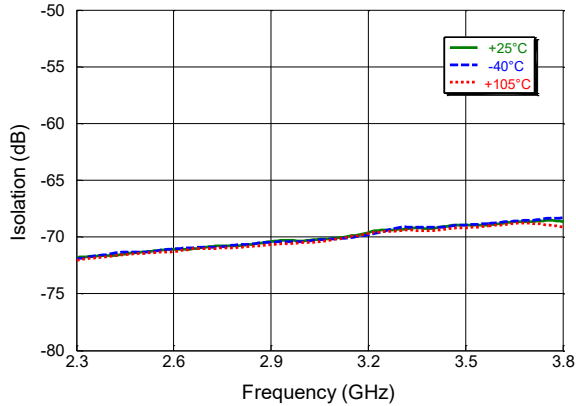
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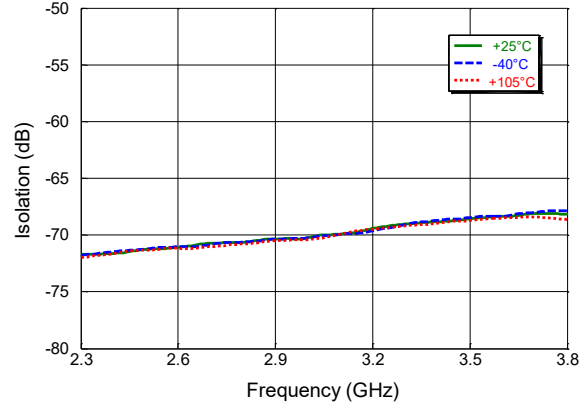
### Typical Performance Curves:

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

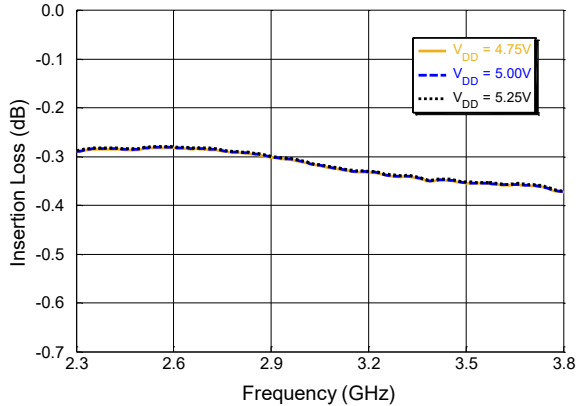
**Channel 1 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode**



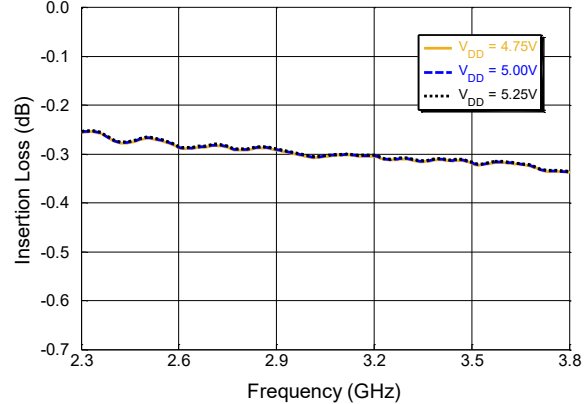
**Channel 2 ANT to RXOUT Isolation over swept Frequency (& Temp.) in Tx Mode**



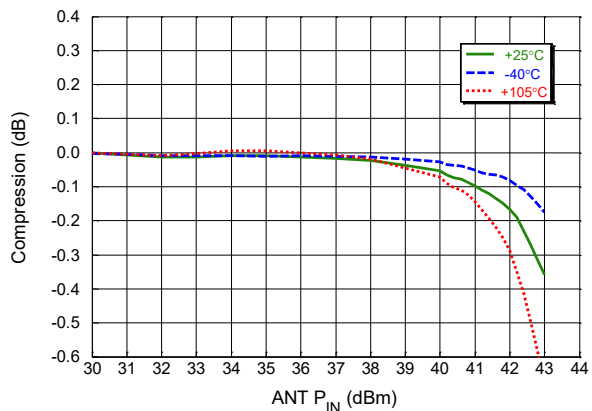
**Channel 1 Switch Insertion Loss over swept Frequency (&  $V_{DD}$ ) in Tx Mode**



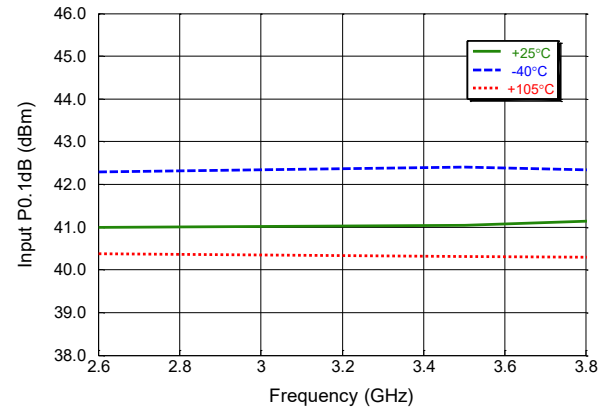
**Channel 2 Switch Insertion Loss over swept Frequency (&  $V_{DD}$ ) in Tx Mode**



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



**Switch ANT Input  $P_{0.1dB}$  Compression Point over swept Frequency (& Temp.) in Tx Mode**



# Integrated Dual Channel Switch and LNA Module

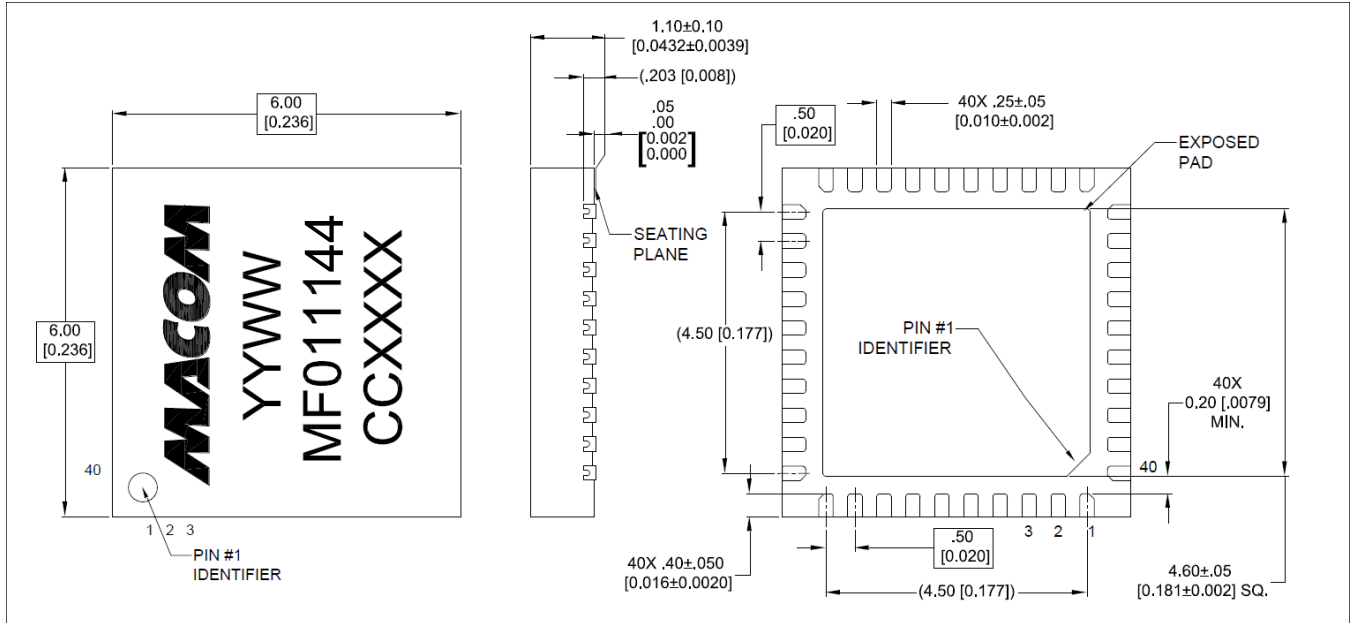
## 2.3 - 3.8 GHz



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### Lead-Free 6 mm 40-Lead QFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
 Meets JEDEC moisture sensitivity level 3 requirements.  
 Plating is NiPdAuAg



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