Integrated Dual Channel Switch and LNA Module 2 - 6 GHz



MAMF-011138

Rev. V3

Features

- Dual Channel Architecture
- Broadband: 2 6 GHz
- High Power Switch Handling (T_c = 105°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: 35 dB at 2.6 GHz, 34 dB @ 3.5 GHz NF: 1.2 dB at 2.6 GHz, 1.45 dB @ 3.5 GHz OIP3: 35 dBm
- Rx Low Gain Mode: Gain: 19 dB at 2.6 GHz, 19.5 dB @ 3.5 GHz NF: 1.2 dB at 2.6 GHz, 1.45 dB @ 3.5 GHz OIP3: 30 dBm
- Single 5 V Supply, 115 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-011138-TR1000	1000 piece reel
MAMF-011138-001SMB	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, 16, 21, 23, 25, 26, 28, 30, 35, 38, 40	Ground	
4	Load Ch1	
7	Load Ch2	
12	Antenna Input Ch2	
14	Switch/LNA Enable Ch2	
15, 18-20, 31-33, 36	No Connect	
17	Switch/LNA V _{DD} Ch2	
22	Rx Output Ch2	
24	LNA Bypass Ch2	
27	LNA Bypass Ch1	
29	Rx Output Ch1	
34	Switch/LNA V _{DD} Ch1	
37	Switch/LNA Enable Ch1	
39	Antenna Input Ch1	

2. Blocking Capacitors are required on all RF Ports.

- MACOM recommends connecting unused package pins to ground.
- The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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Electrical Specifications: Freq. = 2.6 GHz, P_{IN} = -35 dBm, T_c = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω Parameter Conditions Units Min. Тур. Max. 2.6 GHz 31 35.0 Gain at Rx High Gain Mode 3.5 GHz dB 30 34.0 5.0 GHz 29 32.5 2.6 GHz 1.20 NF at Rx High Gain Mode 3.5 GHz dB 1.45 5.0 GHz 1.70 Input RL at Rx High Gain Mode dB 15 Output RL at Rx High Gain Mode dB 12 ____ ____ Tone Spacing = 10 MHz P_{OUT} / Tone = +3 dBm Output IP3 at Rx High Gain Mode dBm 33 ____ P_{OUT} / Tone = +10 dBm 35 Output P1dB at Rx High Gain Mode dBm 19.5 ____ 17 19.0 2.6 GHz Gain at Rx Low Gain Mode 3.5 GHz dB 17 19.5 5.0 GHz 16 19.3 2.6 GHz 1.20 NF at Rx Low Gain Mode 3.5 GHz dB 1.45 5.0 GHz 1.70 Input RL at Rx Low Gain Mode dB 15 ____ Output RL at Rx Low Gain Mode dB 12 Tone Spacing = 10 MHz Output IP3 at Rx Low Gain Mode dBm 30 Pout / Tone = +3 dBm Output P1dB at Rx Low Gain Mode dBm 15.5 dB 0.35 Insertion Loss at Tx Mode ____ ____ 0.8 25 Return Loss at Tx Mode dB ____ ____ Power Handling at Tx Mode Average Power (8 dB PAR) W 10 ____ ____ Supply Voltage V 4.75 5 5.25 Logic High 1.2 3.45 Control Voltage V Logic Low 0 0.6 Logic High +80 Logic Input Current μΑ Logic Low -2 Rx High Gain 115 Rx Low Gain Supply Current (V_{DD}) per Channel mΑ 50 Tx mode 2

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Parameter	Conditions	Units	Min.	Тур.	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 Channels⁵		dB	_	42	_
Switch Isolation, ANT to Load	Rx Mode	dB	—	17	—
Switch Isolation, ANT to Rx output	Tx Mode	dB	_	66	_

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

LNASWCTRL1 / LNASWCTRL2 control management			
Logic Level	L or open	н	
LNAs	ON	OFF	
Switch	Antenna to RX	Antenna to Load	
BP1 / BP2 control management			
Logic Level	L or open	Н	
Mode	No Bypass (HGM ⁶)	Bypass (LGM ⁷)	

6. HGM: High Gain Mode.

7. LGM: Low Gain Mode.

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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 $T_J \le +150^{\circ}C$ (RX Mode) and $T_J \le +125^{\circ}C$ (TX Mode) will ensure MTTF >> 1 x 10⁶ hours.

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

13. Junction Temperature (T_J) = T_C + Θ_{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.

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

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 μ 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.

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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 µF	0603
C301 - C306	20 pF	0402
R1, R2, R3, R4, R6, R7	0 R	0402
R16, R26	DNP	0402
R5, R8, R13, R23	1 kΩ	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.







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



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



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



Channel 2 LNA Gain 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 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 1 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 LNA Noise Figure over swept Frequency (& Temp.) in Rx High Gain Mode



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



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



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Channel 1 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 1 LNA Output P1dB 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 2 LNA Output P1dB over swept Frequency (& Temp.) in Rx High 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 1 LNA Output P1dB over swept Frequency (& V_{DD}) in Rx Low Gain Mode



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



Channel 2 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 Low Gain Mode



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



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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} /Tone = 10 dBm & 10 MHz tone spacing in HGM.



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



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



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



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



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



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



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



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



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



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



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



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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 with P_{OUT} /Tone = 6 dBm with 10 MHz & 50 MHz tone spacing in HGM.



Ch-2-Ch Isolation over swept Frequency in High Gain Mode



Channel 2 OIP3 over swept frequency with P_{OUT} /Tone = 6 dBm with 10 MHz & 50 MHz tone spacing in HGM.



Ch-2-Ch Isolation over swept Frequency in Low Gain Mode



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Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding) $P_{IN} = -35 \text{ dBm}, V_{DD} = 5 \text{ V}, T_C = +25^{\circ}\text{C}, Z_0 = 50 \Omega$ (unless otherwise indicated)

Channel 1 Wideband LNA Gain¹⁵ over swept Frequency in Rx High Gain Mode



Channel 1 Wideband ANT Port Return Loss¹⁵ over swept Frequency in Rx High Gain Mode



Channel 1 Wideband RXOUT Port Return Loss¹⁵ over swept Frequency in Rx High Gain Mode



14 15. As measured at the Sample Board RF Launcher Reference Planes

Channel 2 Wideband LNA Gain¹⁵ over swept Frequency in Rx High Gain Mode



Channel 2 Wideband ANT Port Return Loss¹⁵ over swept Frequency in Rx High Gain Mode



Channel 2 Wideband RXOUT Port Return Loss¹⁵ over swept Frequency in Rx High Gain Mode





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Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding) $P_{IN} = -35 \text{ dBm}, V_{DD} = 5 \text{ V}, T_{C} = +25^{\circ}\text{C}, Z_{0} = 50 \Omega$ (unless otherwise indicated)





Channel 1 Wideband ANT Port Return Loss¹⁶ over swept Frequency in Rx Low Gain Mode



Channel 1 Wideband RXOUT Port Return Loss¹⁶ over swept Frequency in Rx Low Gain Mode



15 16. As measured at the Sample Board RF Launcher Reference Planes

Channel 2 Wideband LNA Gain¹⁶ over swept Frequency in Rx Low Gain Mode



Channel 2 Wideband ANT Port Return Loss¹⁶ over swept Frequency in Rx Low Gain Mode



Channel 2 Wideband RXOUT Port Return Loss¹⁶ over swept Frequency in Rx Low Gain Mode





Typical Performance Curves: P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z₀ = 50 Ω (unless otherwise indicated)

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



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



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



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



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



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



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



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Typical Performance On Sample Board (No RF Connector/Trace Loss De-embedding) $P_{IN} = -10 \text{ dBm}, V_{DD} = 5 \text{ V}, T_C = +25^{\circ}\text{C}, Z_0 = 50 \Omega$ (unless otherwise indicated)

Channel 1 Wideband Switch Insertion Loss¹⁷ over swept Frequency in Tx Mode



Channel 1 Wideband ANT Port Return Loss¹⁷ over swept Frequency in Tx Mode



Channel 1 Wideband LOAD Port Return Loss¹⁷ over swept Frequency in Tx Mode



18 17. As measured at the Sample Board RF Launcher Reference Planes

Channel 2 Wideband Switch Insertion Loss¹⁷ over swept Frequency in Tx Mode



Channel 2 Wideband ANT Port Return Loss¹⁷ over swept Frequency in Tx Mode



Channel 2 Wideband LOAD Port Return Loss¹⁷ over swept Frequency in Tx Mode



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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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