

## MAMF-011119

Rev. V2

#### Features

- High Power SPDT Switch and 2-Stage LNA
- Broadband: 1 6 GHz
- No External Matching Components Required
- RX Mode Gain:
  - 35.0 dB @ 2.50 GHz 34.5 dB @ 3.75 GHz 33.5 dB @ 4.50 GHz
- RX Mode Noise Figure: 1.2 dB @ 2.50 GHz 1.3 dB @ 3.75 GHz
  - 1.5 dB @ 4.50 GHz
- TX Mode at 2.3 5.0 GHz: Insertion Loss: 0.4 dB P0.1dB: 40.5 dBm
- Single 5 V Bias
- Low DC Current: 78 mA in RX Mode
- Integrated Control Circuitry with 1.8 V Logic
- Lead-Free 6 mm 20 Lead QFN Package
- HBM ESD Class 1C
- RoHS\* Compliant

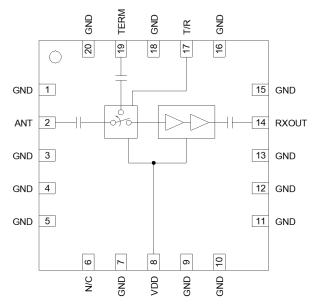
#### Description

The MAMF-011119 is a compact surface mount, highly integrated high power SPDT switch and 2-stage low noise amplifier (LNA) module. It includes an antenna switch and a LNA in a compact 6 mm QFN package. All the bias circuitry and matching components are internal to the module.

This module operates from 1 - 6 GHz and features high power handling, low noise figure, high linearity and low power consumption. The module requires a single 5 V supply and the T/R switch is 1.8 V CMOS compatible.

The MAMF-011119 is ideally suited for 5G Massive MIMO, Small Cell BTS, or other TDD-based communication systems.

#### **Functional Schematic**



### Pin Configuration<sup>3</sup>

Pin #	Pin Name	Description
1, 3-5, 7, 9-13, 15, 16, 18, 20	GND	Ground
2	ANT	RF Antenna Port
6	N/C	Internally No Connect
8	V <sub>DD</sub>	Supply Voltage
14	RXOUT	RX Output Port
17	T/R	Logic Signaling Pin
19	TERM	Termination Port
21	Paddle <sup>4</sup>	Ground

3. MACOM recommends connecting GND and No Connection (N/C) pins to ground.

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

#### **Ordering Information**<sup>1,2</sup>

Part #	Package
MAMF-011119-TR1000	1000 piece reel
MAMF-011119-TR3000	3000 piece reel
MAMF-011119-001SMB	Sample Board

Reference Application Note M513 for reel size information.
All sample boards include 5 loose parts.

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

1

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



#### AC Electrical Specifications (RX Mode) P<sub>IN</sub> = -30 dBm, T<sub>C</sub> = +25°C, V<sub>DD</sub> = 5 V, Z<sub>0</sub> = 50 $\Omega$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Gain	ANT to RXOUT, 2.5 GHz ANT to RXOUT, 3.75 GHz	dB	32	35.0 34.5	37
Input IP3	P <sub>IN</sub> /tone = -33 dBm, Tone Delta = 2 MHz, ANT to RXOUT, 2.5 GHz ANT to RXOUT, 3.75 GHz	dBm	_	-6 -4	_
Input P1dB	ANT to RXOUT, 2.5 GHz ANT to RXOUT, 3.75 GHz	dBm	-20	-18 -17	
Noise Figure	ANT to RXOUT, 2.5 GHz ANT to RXOUT, 3.75 GHz	dB	_	1.2 1.3	Ι
ANT Port Return Loss	ANT Port, 2.5 GHz ANT Port, 3.75 GHz	dB	_	17 21	—
RXOUT Port Return Loss	RXOUT Port, 2.5 GHz RXOUT Port, 3.75 GHz	dB		21 24	_
Reverse Isolation	RXOUT to ANT, 2.5 GHz RXOUT to ANT, 3.75 GHz	dB	_	51 50	—

### AC Electrical Specifications (TX Mode)

### $P_{IN}$ = -30 dBm, $T_c$ = +25°C, $V_{DD}$ = 5 V, $Z_0$ = 50 $\Omega$ (unless otherwise indicated)

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Insertion Loss	ANT to TERM, 2.5 GHz ANT to TERM, 3.75 GHz	dB	—	0.4 0.4	1.0
P0.1dB Compression Point	ANT to TERM, 2.5 GHz ANT to TERM, 3.75 GHz	dBm	—	40.5 40.5	—
ANT Port Return Loss	ANT Port, 2.5 GHz ANT Port, 3.75 GHz	dB	_	22 25	—
TERM Port Return Loss	TERM Port, 2.5 GHz TERM Port, 3.75 GHz	dB	_	21 25	—
ANT Port Input Power	ANT Port, 2.5 GHz, CW, $T_c$ = 105°C ANT Port, 2.5 GHz, LTE (8dB PAR), $T_c$ = 105°C	dBm	_	39 37	—

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



#### **Transient Electrical Specifications**

### Freq. = 2.5 GHz, $P_{IN}$ = -30 dBm, $T_C$ = 25°C, $V_{DD}$ = 5 V, $Z_0$ = 50 $\Omega$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
T/R Gain Settling Time	ANT to RXOUT gain settling time within 0.3 dB of final value after T/R command	μs		0.3	
T/R Insertion Loss Settling Time	ANT to TERM path insertion loss settling time within 0.3 dB of final value after T/R command	μs	_	0.3	Ι
Power on Gain Settling Time	ANT to RXOUT gain settling time within 0.5 dB of final value after DC power on	ms	_	1	—
Power on Insertion Loss Settling Time	ANT to TERM settling time within 0.5 dB of final value after DC power on	ms		1	_

# DC Electrical Specifications $T_c = 25^{\circ}C$ , $V_{DD} = 5 V$ , $Z_0 = 50 \Omega$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Supply Voltage	—	V	4.75	5	5.25
Supply Current	RX Mode TX Mode	mA	_	78 1.4	_
T/R Control Voltage	RX Mode, Logic High TX Mode, Logic Low	V	1.073 -0.3	_	2.5 0.683
T/R Logic Input Current	RX Mode, Logic High TX Mode, Logic Low	μA	—	40 -2	—

#### **Control Truth Table**

T/R Control			
RX Mode Logic High			
TX Mode	Logic Low or Open		

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



#### Absolute Maximum Ratings<sup>5,6</sup>

Parameter	Absolute Maximum
Antenna Input Power <sup>7</sup> Freq. = 2.5 GHz: RX Mode TX Mode	23 dBm LTE (8 dB PAR), 26 dBm CW 39 dBm LTE (8 dB PAR), 42 dBm CW
DC Voltages: V <sub>DD</sub> , ANT & TERM T/R & RXOUT	-0.5 to +5.5 V -0.5 to +2.75 V
Junction Temperature: RX Mode <sup>8,10</sup> TX Mode <sup>7</sup>	+150°C +125°C +140°C
Operating Temperature <sup>9</sup>	-40°C to +105°C
Storage Temperature	-55°C to +150°C

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

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

7. Single event, up to 10 seconds duration.

8. 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 10<sup>6</sup> hours.

9. Operating/Case temperature (T<sub>C</sub>) is the temperature of the exposed paddle.

10. Junction Temperature (T<sub>J</sub>) = T<sub>C</sub> +  $\Theta_{JC}$  \* P<sub>DISS</sub> where P<sub>DISS</sub> 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.

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

#### **Power Supplies**

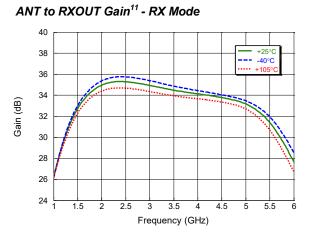
De-coupling capacitors should be placed at the V<sub>DD</sub> supply pin to minimize noise and fast transients. Supply voltage change or transients should have a slew rate smaller than 1 V / 10  $\mu$ s. In addition, all control pins should remain at 0 V (+/- 0.3 V) and no RF power should be applied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

4

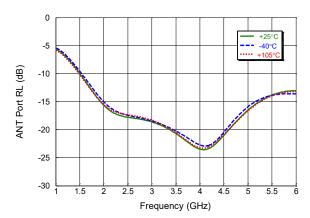
MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



# Typical Performance Curves $P_{IN}$ = -30 dBm, $V_{DD}$ = 5 V, $Z_0$ = 50 $\Omega$ (unless otherwise indicated)

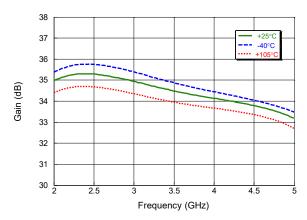


ANT Port Return Loss - RX Mode

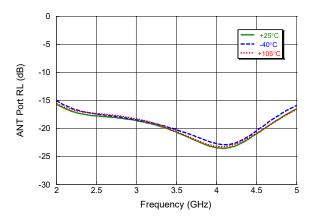


RXOUT Port Return Loss - RX Mode

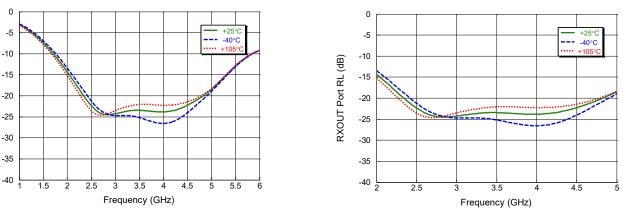




ANT Port Return Loss - RX Mode



RXOUT Port Return Loss - RX Mode



11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.

5

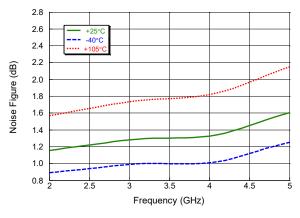
RXOUT Port RL (dB)

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit www.macom.com for additional data sheets and product information.

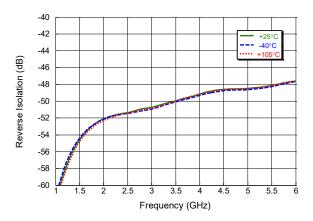


#### **Typical Performance Curves** $P_{IN} = -30 \text{ dBm}, V_{DD} = 5 \text{ V}, Z_0 = 50 \Omega$ (unless otherwise indicated)

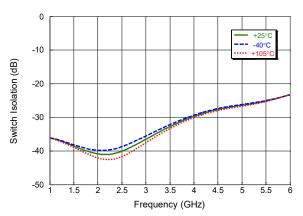
#### ANT to RXOUT Noise Figure<sup>11</sup> - RX Mode



ANT to RXOUT Port Reverse Isolation<sup>11</sup> - RX Mode

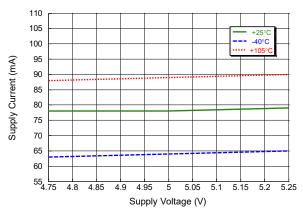


ANT to TERM Port Switch Isolation<sup>11</sup> - RX Mode

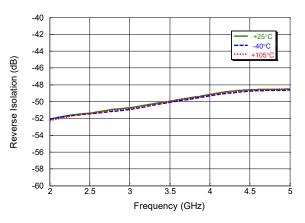


11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.

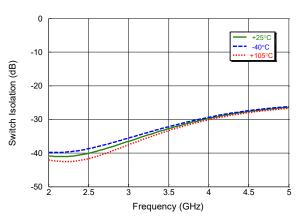
Supply Current - RX Mode



ANT to RXOUT Port Reverse Isolation<sup>11</sup> - RX Mode



ANT to TERM Port Switch Isolation<sup>11</sup> - RX Mode



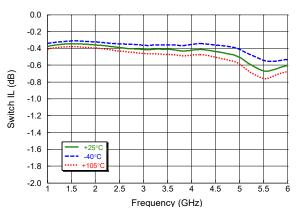
<sup>6</sup> 

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit www.macom.com for additional data sheets and product information.

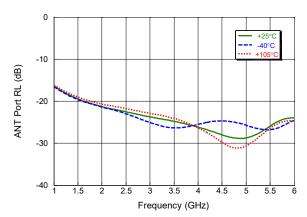


## Typical Performance Curves $P_{IN} = -30 \text{ dBm}, V_{DD} = 5 \text{ V}, Z_0 = 50 \Omega$ (unless otherwise indicated)

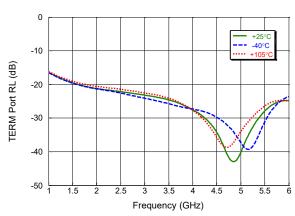
ANT to TERM Switch Insertion Loss<sup>11</sup> - TX Mode



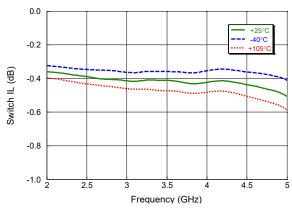
ANT Port Return Loss - TX Mode



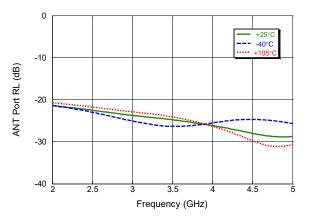




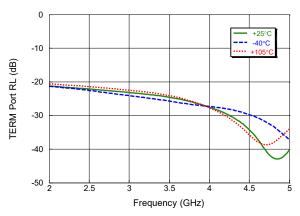
ANT to TERM Switch Insertion Loss<sup>11</sup> - TX Mode



ANT Port Return Loss - TX Mode



TERM Port Return Loss - TX Mode



11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.

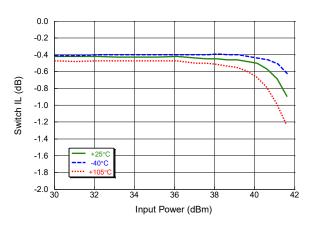
<sup>7</sup> 



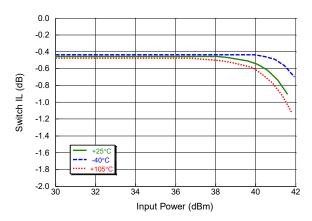
MAMF-011119 Rev. V2

#### Typical Performance Curves $P_{IN} = -30 \text{ dBm}, V_{DD} = 5 \text{ V}, Z_0 = 50 \Omega \text{ (unless otherwise indicated)}$

ANT to TERM Port Compression Characteristic<sup>11</sup> at 2.5 GHz - TX mode



ANT to TERM Port Compression Characteristic<sup>11</sup> at 3.75 GHz - TX mode



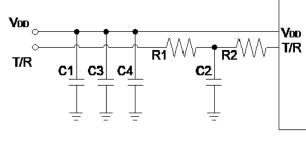
11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.

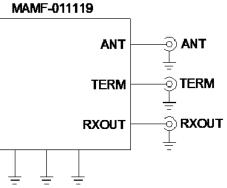
8

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.

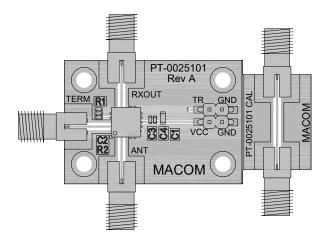


#### **Sample Board Schematic**





#### Sample Board PCB Layout



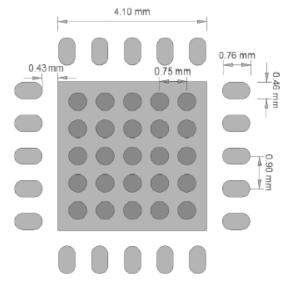
#### • Material: Megtron 4S R-5735S

- Dielectric thickness: 0.254 mm
- Track/Gap: 0.45/0.6 mm
- Finished copper thickness: 44 µm +/- 10 µm
- Finish both sides: 0.075 µm gold over 4.5 µm nickel
- Further layout information available on request

#### **Parts List**

Part	Value	Case style
C1	10 µF	0603
C2	5 pF	0402
C3	10 nF	0402
C4	470 pF	0402
R1	1 kΩ	0402
R2	100 Ω	0402

### **Recommended Thermal Land Pattern**



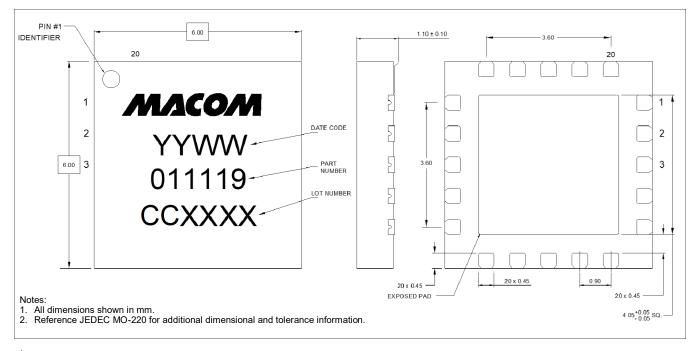
- 25 Ground Vias
- 0.5 mm Diameter, 1/2 oz. Copper

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



MAMF-011119 Rev. V2

#### Lead-Free 6 mm 20-Lead QFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 3 requirements in accordance to JEDEC J-STD-020D. Plating is NiPdAuAg over Copper

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.



MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.

<sup>11</sup> 

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit <u>www.macom.com</u> for additional data sheets and product information.