Integrated High Power Switch and LNA Module 1.5 - 5 GHz

MAMF-011153
Rev. V2

Features

- High Power Switch and 2-Stage LNA with Integrated DC converter and Switch Driver
- TX High RF Input Power: 50 W CW @ +105°C, 3.5 GHz
- RX Mode Current: 130 mA @ 5 V (650 mW)
- TX Mode Current: 100 mA @ 5 V (500 mW)
- RX Noise Figure: 1.4 dB, 3.5 GHz
- Rx Gain: 34.5 dB @ 3.5 GHz
- Rx Output IP3: 30 dBm @ 3.5 GHz
- Single 5 V Supply
- Compatible with 1.8 V and 3.3 V logic
- Lead-Free 8 mm 16-Lead Package
- RoHS* Compliant

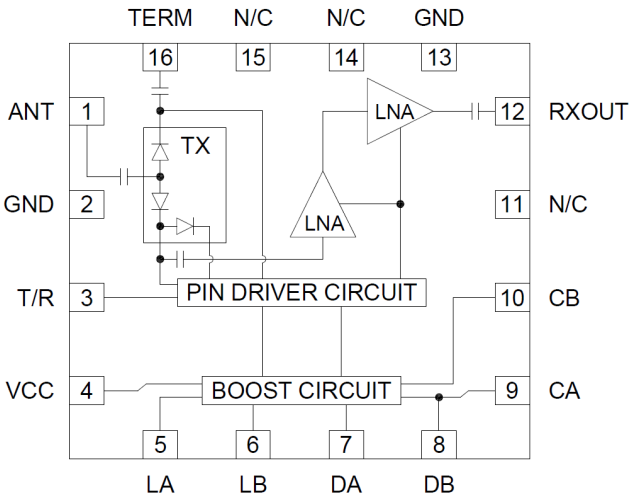
Applications

- High Power TDD 4G & 5G Basestation
- Wireless Infrastructure
- TDD-Based Communication Systems

Description

The MAMF-011153 is a highly integrated, broadband, high power switched LNA module. Including a 2-stage low noise amplifier, PIN diode switch, pin diode driver and DC-DC converter all in a compact low cost 8 mm QFN package. 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 and LNA can be controlled with 1.8 V or 3.3 V logic.

Functional Schematic



Pin Names[2]

Pin #	Function	Pin #	Function
1	Antenna	8	DB ext. diode cathode
2, 13	GND	9	CA ext. Cap
3	T/R	10	CB ext. Cap
4	VCC	11, 14, 15	N/C
5	LA ext. inductor	12	RX out
6	LB ext. inductor	16	TERM
7	DA ext. diode Anode	17	Paddle[3]

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

Ordering Information[1]

Part Number	Package
MAMF-011153-TR0500	500 part reel
MAMF-011153-001SMB	Sample Board

1. Reference Application Note M513 for reel size information.

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

Pin Description

Pin #	Name	Description
11,14,15	N/C	No Internal Connection.
1	ANT	RF antenna input/output port 50 ohms. Internally DC blocked.
3	T/R	Switch Control, Tx mode Low state, Rx mode High state.
4	VCC	DC Power Supply Voltage.
5	LA	External inductor connection for internal power supply.
6	LB	External inductor connection for internal power supply.
7	DA	External diode anode connection for internal power supply.
8	DB	External diode cathode connection for internal power supply.
9	CA	External capacitor connection for internal power supply.
10	CB	External capacitor connection for internal power supply.
12	RXOUT	RF LNA output port 50 ohms. Internally DC blocked.
16	TERM	RF termination port 50 ohms. Internally DC blocked.
2,13	GND	Ground connection.
Paddle	GND	Exposed Pad. The exposed pad must be connected to a large RF/DC ground island providing thermal capabilities for heat dissipation

AC Electrical Specifications: P_{IN} = -30 dBm, T_C = +25°C, V_{CC} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	Rx Mode, 1.5 - 5 GHz Rx Mode, 3.5 GHz	dB	— 32	35.0 34.8	—
Noise Figure	Rx Mode, 1.5 - 5 GHz	dB	—	1.4	—
Input Return Loss	Rx Mode, 1.5 - 5 GHz Tx Mode, 1.5 - 5 GHz	dB	—	22 20	—
Output Return Loss	Rx Mode, 1.5 - 5 GHz Tx Mode, 1.5 - 5 GHz	dB	—	15 17	—
Reverse Isolation	Rx Mode, 1.5 - 5 GHz	dB	—	55	—
Switch Isolation	ANT to TERM, Rx Mode, 1.5 - 5 GHz ANT to RXOUT, Tx Mode, 1.5 - 5 GHz	dB	—	15 57	—
Insertion Loss	Tx Mode, 1.5 - 5 GHz Tx Mode, 3.5 GHz	dB	—	0.42 0.40	— 0.8
Output IP3	1 MHz spacing, -33 dBm/tone Rx Mode, 1.5 - 5 GHz	dBm	—	30	—
Output P1dB	Rx Mode, 1.5 - 5 GHz	dBm	—	16	—
Input P0.1 dB	Tx Mode, 3.5GHz	dBm	—	>47.5	—

DC Electrical Specifications: V_{CC} = 5 V

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Supply Voltage	V_{CC}	V	4.5	5	5.5
Supply Current	Rx Mode Tx Mode	mA	—	130 100	—
T/R Control Voltage	Logic High - Rx Mode Logic Low -Tx Mode	V	1.2 0	—	3.45 0.6
Logic Input Current	Logic High - Rx Mode Logic Low -Tx Mode	µA	-30 -50	—	100 50

Transient Electrical Specifications: V_{CC} = 5 V

Parameter	Test Conditions	Units	Min.	Typ.	Max.
RF Switching Time	50% CTL to 10/90% RF	ns	—	420	—

Control Truth Table

T/R	Path
Low (0 - 0.6 V)	TERM
High (1.2 - 3.6 V)	RXOUT

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. HBM Class 1C, CDM Class C3.

Recommended Operating Conditions

Parameter	Conditions	Unit	Min.	Typ.	Max.
Antenna Input Power	Freq. = 3.5 GHz: RX Mode TX Mode	dBm	—	-30 47	-10 48
DC Voltages: RXOUT VCC T/R	—	V	0 4.5 0	0 5 0/1.8	+2.75 +5.5 +3.6
Operating Temperature[4]	—	°C	-40	—	+105
Junction Temperature: RX Mode[5,6] TX Mode	—	°C	—	—	+140 +165
Storage Temperature	—	°C	-65	—	+150

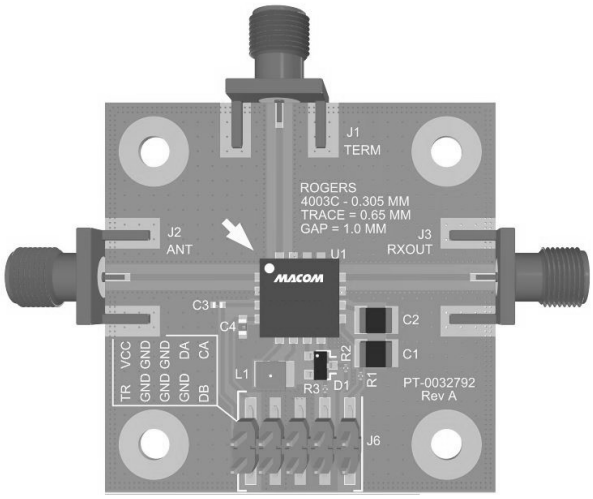
4. Operating/Case Temperature (T_C) is measured at the exposed pad.
5. Operating at nominal conditions with $T_J \leq +125°C$ will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature (T_J) = $T_C + \Theta_{JC} * P_{DISS}$ where P_{DISS} is the total DC & RF dissipated power.
   - RX Mode: Typical thermal resistance (Θ_{JC}) = 33.4 ºC/W.

Absolute Maximum Ratings[7,8]

Parameter	Conditions	Unit	Min.	Typ.	Max.
Antenna Input Power[9]	Freq. = 3.5 GHz: RX Mode TX Mode	dBm	—	—	22.0 48.5
DC Voltages: RXOUT VCC T/R	—	V	-0.5 -0.3 -0.3	—	+2.75 +5.50 +3.60
Junction Temperature: RX Mode TX Mode	—	°C	—	—	+150 +175
Storage Temperature	—	°C	-55	—	+150

7. Exceeding any one or combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Single event, up to 10 seconds duration.

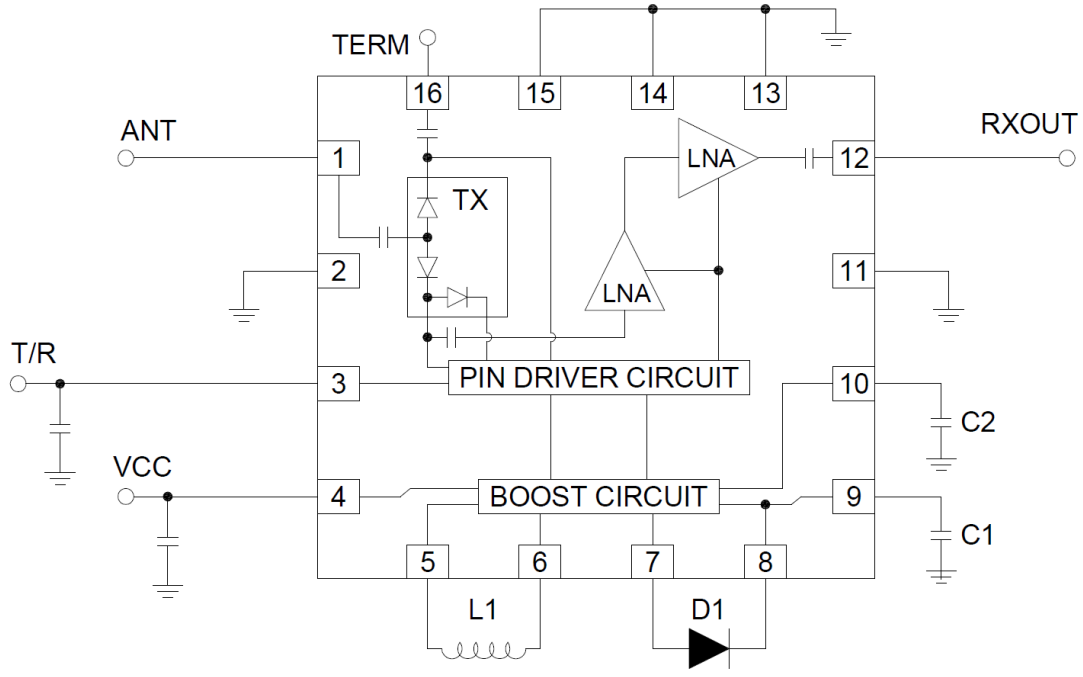
PCB Layout



Parts List

Part	Value	Case Style
L1	10 µH	2.5 x 2 mm
C1,C2	2.2 µF	1210
C3	10 pF	0402
C4	1 µF	0603
D1	CMPSH-3CE	SOT-23

Application Schematic

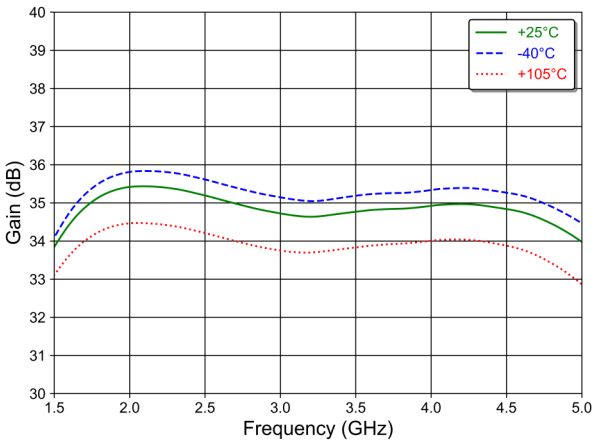


Power Supplies

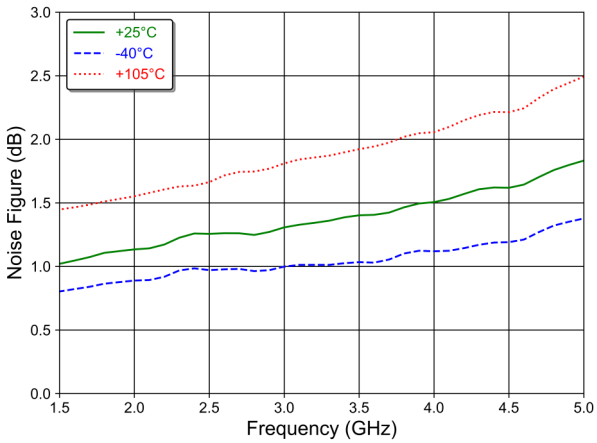
De-coupling capacitors should be placed at the VCC supply pin to minimize noise and fast transients. Supply voltage change or transients should have a slew rate smaller than 1 V / 10 µs. In addition, all control pins should remain at 0 V (+/- 0.3 V) and no RF power should be applied while the supply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

Rx Mode
Typical Performance Curves: TR = 1.8 V, P_{IN} = -30 dBm, V_{CC} = 5 V, Z_0 = 50 Ω

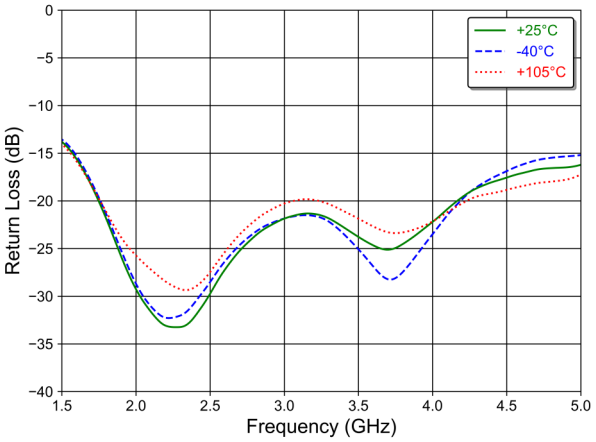
LNA Gain over swept Frequency [10]



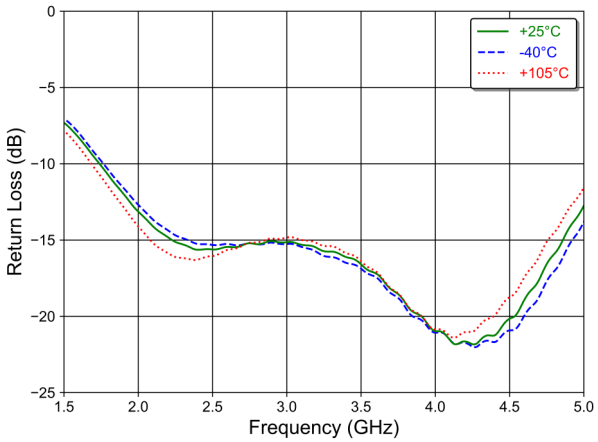
Noise Figure over swept Frequency [10]



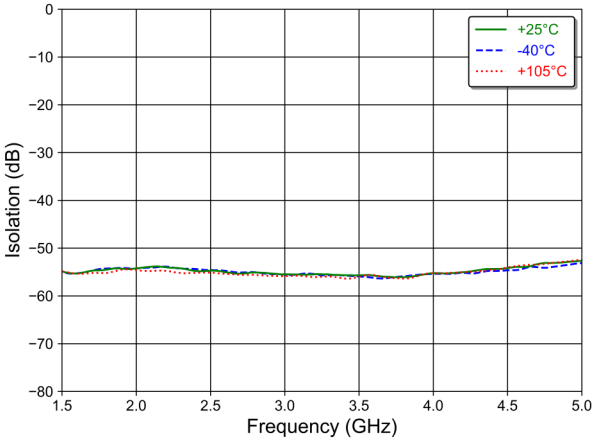
ANT Port Return Loss over swept Frequency



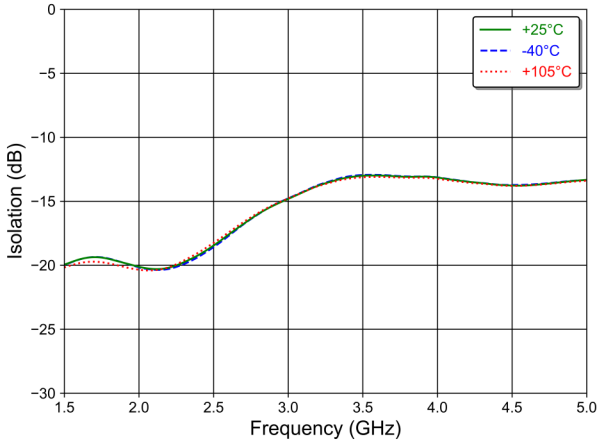
RXOUT Port Return Loss over swept Frequency



Reverse Isolation over swept Frequency

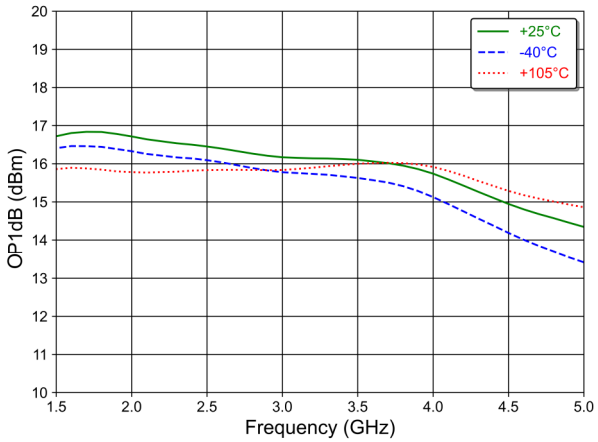


ANT to TERM Isolation over swept Frequency

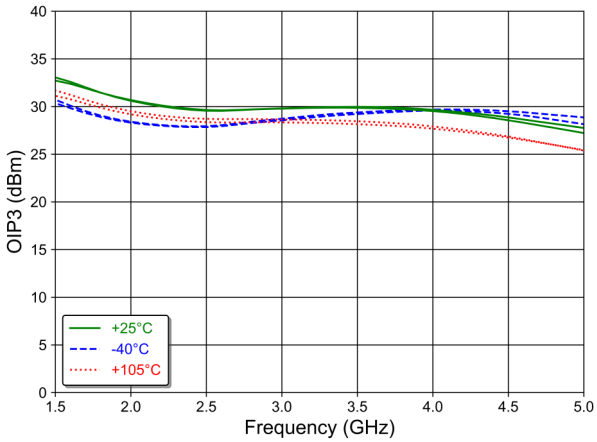


Rx Mode
Typical Performance Curves: TR = 1.8 V, P_{IN} = -30 dBm, V_{CC} = 5 V, Z_0 = 50 Ω

Gain Compression over swept Frequency

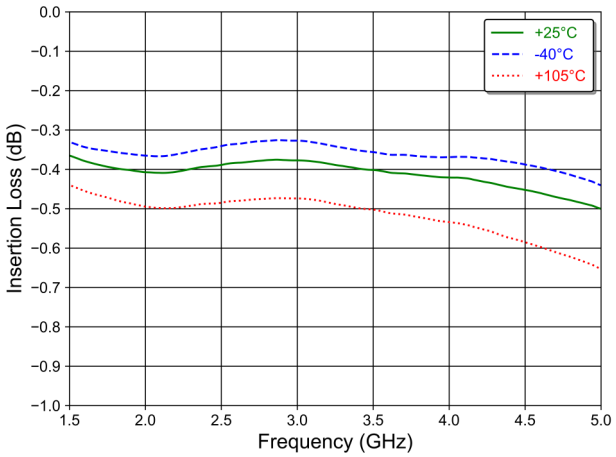


OIP3 –33 dBm/Tone, 1 MHz tone spacing over swept Frequency

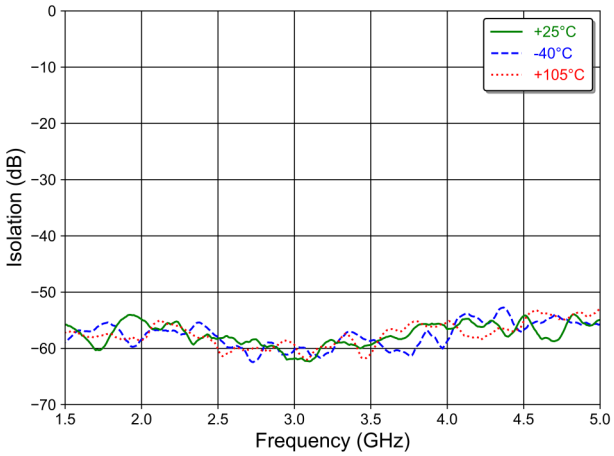


Tx Mode
Typical Performance Curves: TR = 0 V, P_{IN} = -30 dBm, V_{CC} = 5 V, Z_0 = 50 Ω

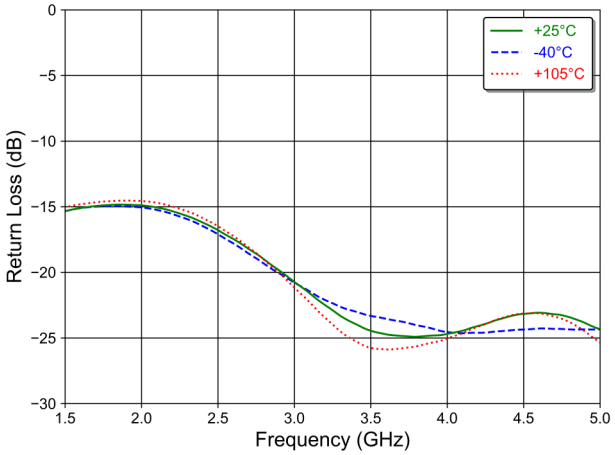
Switch Insertion Loss over swept Frequency[10]



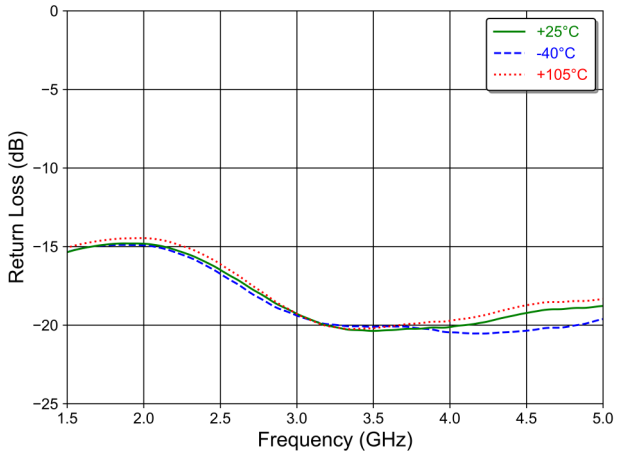
ANT to RX isolation over swept Frequency



ANT Port Return Loss over swept Frequency

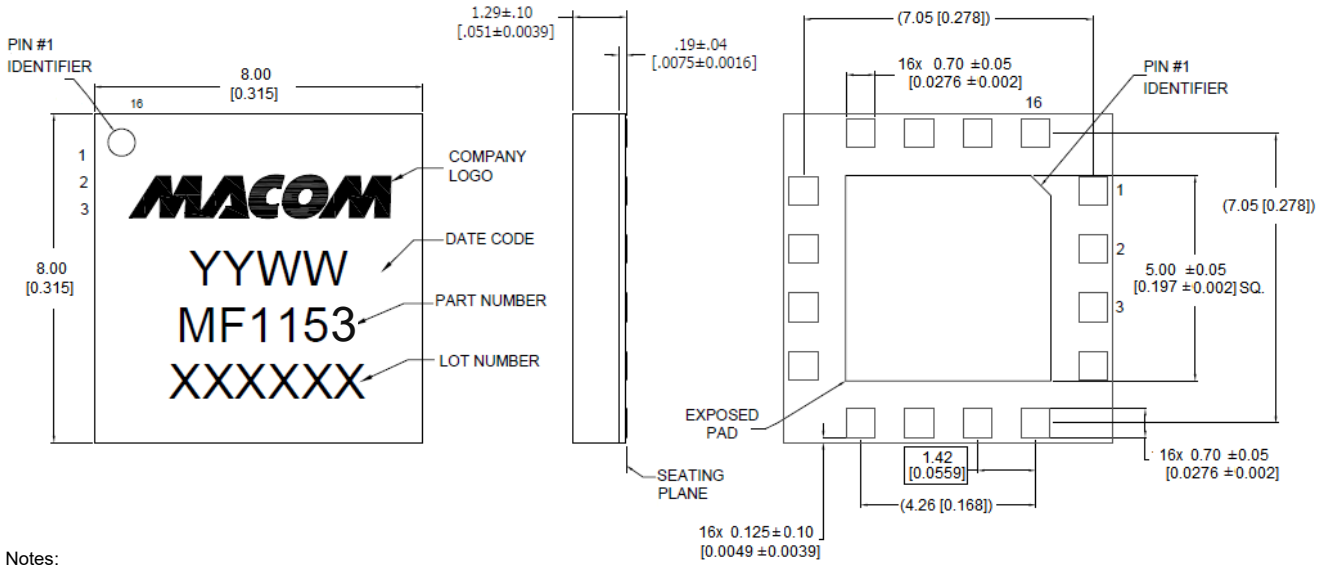


TERM Port Return Loss over swept Frequency



10. For Gain, Noise Figure and Insertion Loss RF trace and connector losses are de-embedded.

Lead-Free 8 mm 16-Lead SMT†



Notes:
1. Dimensions are in mm [in]
2. Reference JEDEC MO-220 for additional dimensional and tolerance information

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

Revision History

Rev	Date	Change Description
V1	6/30/23	Initial Release
V2	7/25/23	Corrected noise figure plots. Fixed minor typographical errors.

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MAMF-011153-TR0500 MAMF-011153-001SMB