Features

- High Power SPDT Switch and 2-Stage LNA
- Broadband: 1 - 6 GHz
- LNA Gain:
  35.1 dB @ 2.5 GHz; 34.7 dB @ 3.75 GHz;
  35.0 dB @ 4.7 GHz
- LNA Noise Figure:
  0.86 dB @ 2.5 GHz; 0.88 dB @ 3.75 GHz;
  0.98 dB @ 4.7 GHz
- RX Mode Switch Insertion loss:
  0.33 dB @ 2.5 GHz; 0.36 dB @ 3.75 GHz;
  0.46 dB @ 4.7 GHz
- TX Mode at 2.0 - 5.0 GHz:
  Insertion Loss: 0.3 dB
  P0.1dB: 40.6 dBm
- Single 5 V Supply
- Low DC Current: 80 mA in RX Mode
- Integrated Control Circuitry with 1.8 V Logic
- Lead-Free 3 mm 16 Lead QFN Package
- RoHS* Compliant

Applications

- 5G Massive MIMO
- Wireless Infrastructure
- TDD-based communication systems

Description

The MAMF-011156 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 3 mm QFN package. All the bias circuitry and matching components are internal to the module.

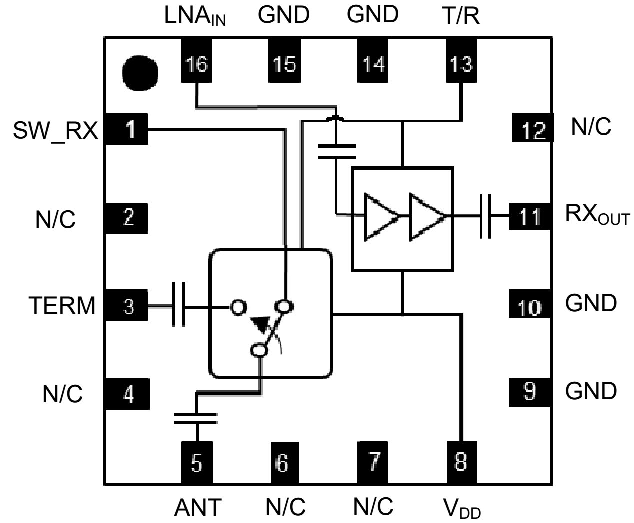
This module operates from 1 - 6 GHz and features high power handling, low noise figure, high linearity and low power consumption. The module requires a single 5 V supply and the T/R switch is 1.8 V CMOS compatible.

Ordering Information[1]

Part Number	Package
MAMF-011156-TR1000	1000 part reel
MAMF-011156-001SMB	Sample Board

1. Reference Application Note M513 for reel size information.

Functional Block



Pin Configuration[2]

Pin #	Pin Name	Description
1	SW_RX[3]	Switch RX Port
2,4,6,7,12	N/C	Internally No Connect
3	TERM	Termination Port
5	ANT	Antenna Port
8	V_{DD}	Supply Voltage
9,10,14,15	GND	Ground
11	RX_{OUT}	RX Output Port
13	T/R	Logic Signaling Pin
16	LNA_{IN}	LNA Input Port
17	Paddle[4]	Ground

2. MACOM recommends connecting N/C pins to ground.
3. DC blocking capacitor must be connected to pin 1.
4. The exposed pad centered on the package bottom must be connected to PCB ground with low electrical and thermal resistances.

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

AC Electrical Specifications (LNA, RX Mode): P_{IN} = -30 dBm, T_C = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	LNA_{IN} to RX_{OUT} 2.5 GHz 3.75 GHz 4.7 GHz	dB	32 32 —	35.1 34.7 35.0	—
Input IP3	P_{IN}/tone = -30 dBm, Tone Delta = 2 MHz, LNA_{IN} to RX_{OUT} 2.5 GHz 3.75 GHz 4.7 GHz	dBm	—	-4.3 -3.7 -4.7	—
Input P1dB	LNA_{IN} to RX_{OUT} 2.5 GHz 3.75 GHz 4.7 GHz	dBm	—	-17.2 -17.5 -18.8	—
Noise Figure	LNA_{IN} to RX_{OUT} 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	0.86 0.88 0.98	—
LNA_{IN} Port Return Loss	LNA_{IN} Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	30 23 22	—
RX_{OUT} Port Return Loss	RX_{OUT} Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	14 17 15	—
Reverse Isolation	RX_{OUT} to LNA_{IN} 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	53 55 60	—

AC Electrical Specifications (Switch, RX Mode): P_{IN} = -10 dBm, T_C = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	ANT to SW_RX 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	0.33 0.36 0.46	1 1 —
P0.1dB Compression Point	ANT to SW_RX, 3.75 GHz, 2 μs pulse width, 10% duty cycle	dBm	—	31	—
ANT Port Return Loss	ANT Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	36 25 23	—
SW_RX Port Return Loss	SW_RX Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	32 27 23	—
ANT - TERM Isolation	ANT to TERM 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	27 24 21	—

AC Electrical Specifications (Switch, TX Mode):
P_{IN} = -10 dBm, T_C = +25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	ANT to TERM 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	0.28 0.28 0.31	1 1 —
P0.1dB Compression Point	ANT to TERM, 3.75 GHz, 2 µs pulse width, 10% duty cycle	dBm	—	40.6	—
ANT Port Return Loss	ANT Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	23 33 23	—
TERM Port Return Loss	TERM Port 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	23 28 23	—
ANT - SW_RX Isolation	ANT to SW_RX 2.5 GHz 3.75 GHz 4.7 GHz	dB	—	29 26 24	—
ANT Port Input Power	ANT Port, 2.5 GHz, CW, T_C = 105°C ANT Port, 2.5 GHz, LTE (10 dB PAR), T_C = 105°C	dBm	—	39 36	—

Transient Electrical Specifications:
Freq. = 2.5 GHz, P_{IN} = -30 dBm, T_C = 25°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
T/R Switch Settling Time	ANT to SW_RX switch settling time within 0.3 dB of final value after T/R command	µs	—	0.3	—
T/R Gain Settling Time	LNA_{IN} to RX_{OUT} 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	—
Power on Switch Settling Time	ANT to SW_RX switch settling time within 0.5 dB of final value after DC power on	ms	—	1	—
Power on Gain Settling Time	LNA_{IN} to RX_{OUT} 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°C, V_{DD} = 5 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Supply Voltage	—	V	4.75	5	5.25
Amplifier Bias Current	RX Mode TX Mode	mA	—	80 2.3	—
T/R Control Voltage	RX Mode, Logic High TX Mode, Logic Low	V	—	1.8 0	—
T/R Logic Input Current	RX Mode, Logic High TX Mode, Logic Low	µA	—	40 +/-0.03	—

Control Truth Table

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

Absolute Maximum Ratings[5,6]

Parameter	Absolute Maximum
Antenna Input Power[7] Freq. = 3.75 GHz: RX Mode, LNA_{IN} RX Mode, ANT TX Mode, ANT	 23 dBm LTE (8 dB PAR), 26 dBm CW 28 dBm LTE (8 dB PAR), 31 dBm CW 39 dBm LTE (8 dB PAR), 42 dBm CW
DC Voltages: V_{DD}, ANT, TERM, SW_RX & LNA_{IN} T/R & RX_{OUT}	 -0.5 to +5.5 V -0.5 to +2.75 V
Junction Temperature: RX Mode[8,10] TX Mode[8,10] TX Mode[7]	 +150°C +125°C +140°C
Operating Temperature[9]	-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 $T_J \leq$ +150°C (RX Mode, LNA), $T_J \leq$ +125°C (RX Mode, Switch) and $T_J \leq$ +125°C (TX Mode) will ensure MTTF >> 1 x 10^6 hours.
9. Operating/Case temperature (T_C) is the temperature of the exposed paddle.
10. 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}) = 33.4ºC/W.
    - TX Mode: Typical thermal resistance (Θ_{JC}) = 15.3ºC/W.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

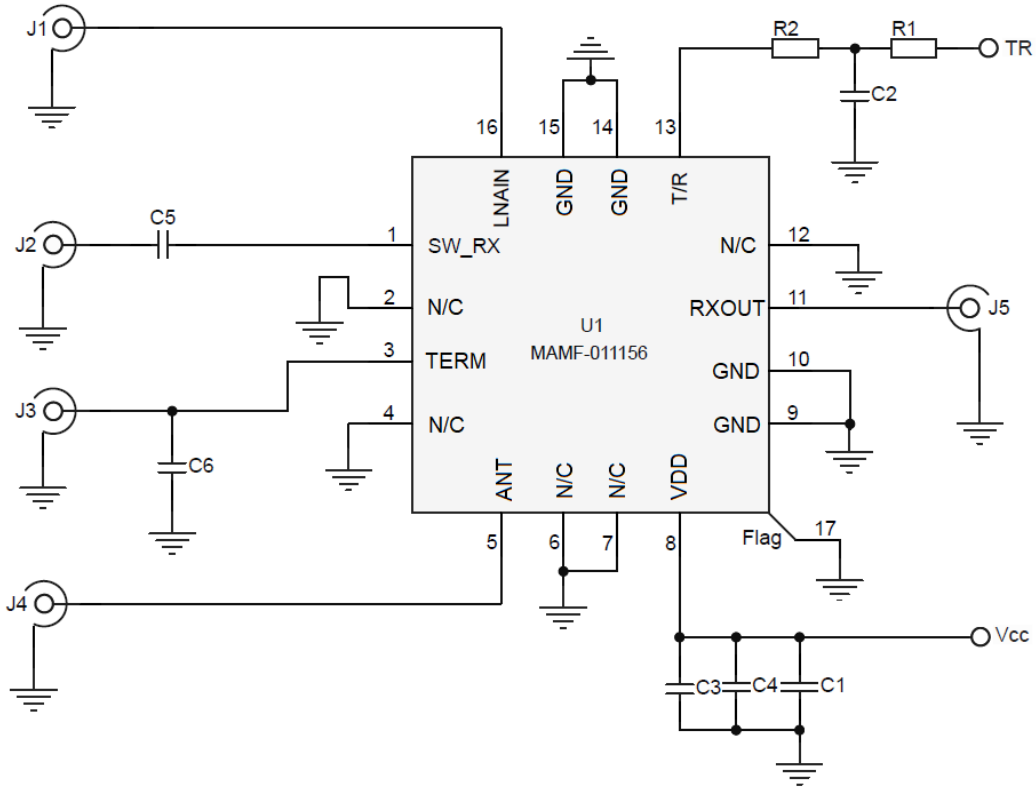
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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

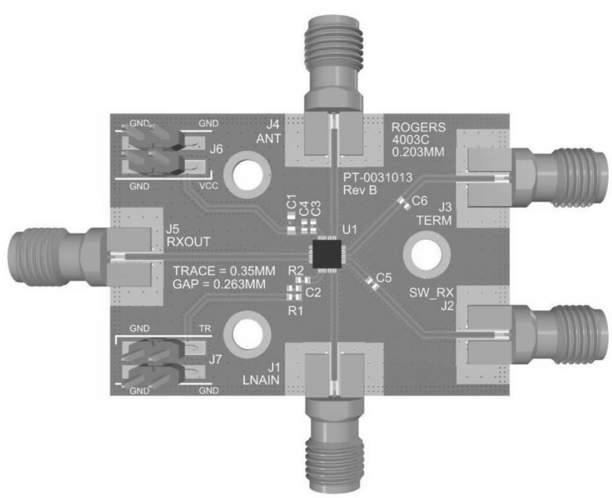
Power Supplies

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 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.

Sample Board Schematic



Sample Board PCB Layout



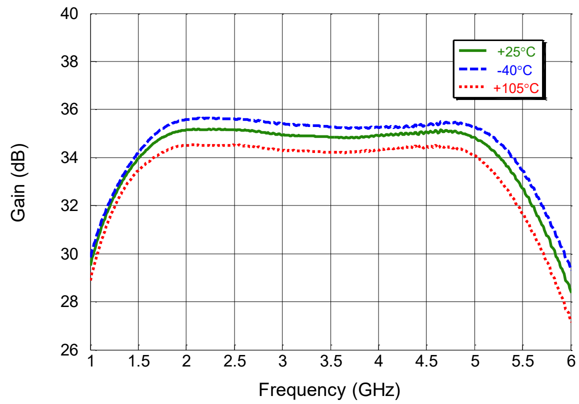
- Material: Rogers 4003C
- Dielectric thickness: 0.203 mm
- Track/Gap: 0.350/0.263 mm
- Finished copper thickness: 44 µm +/- 10 µm
- Finish both sides: 0.075 µm gold over 4.5 µm nickel
- Further layout information available on request

Parts List

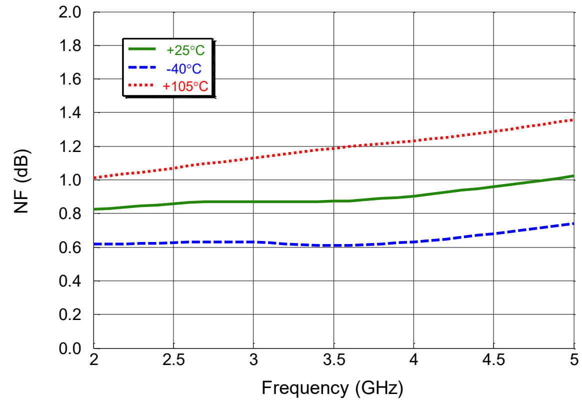
Part	Value	Case style
C1	10 µF	0603
C2	5 pF	0402
C3	470 pF	0402
C4	10 nF	0402
C5	8.2 pF	0402
C6	0.2 pF	0402
R1	1 kΩ	0402
R2	100 Ω	0402

Typical Performance Curves (LNA):
P_{IN} = -30 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

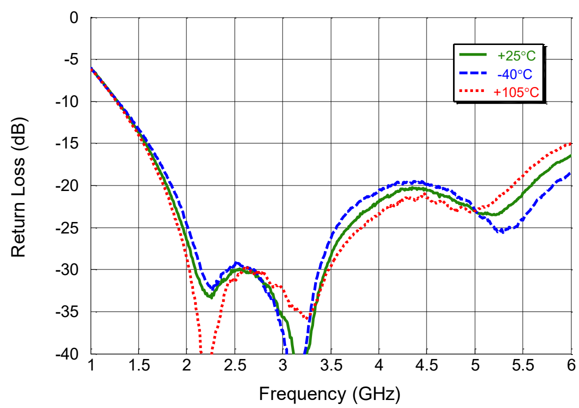
LNA$_{IN}$ to RX$_{OUT}$ Gain[11] - RX Mode



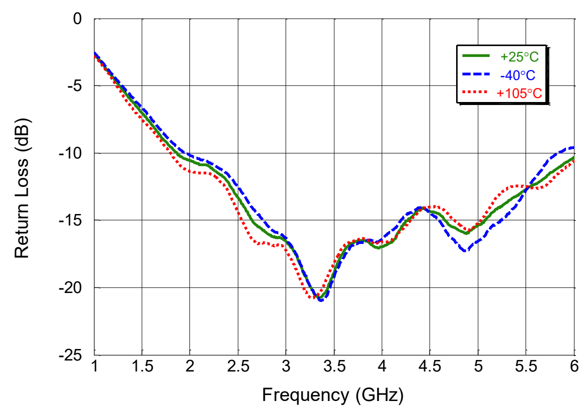
LNA$_{IN}$ to RX$_{OUT}$ Noise Figure[11] - RX Mode



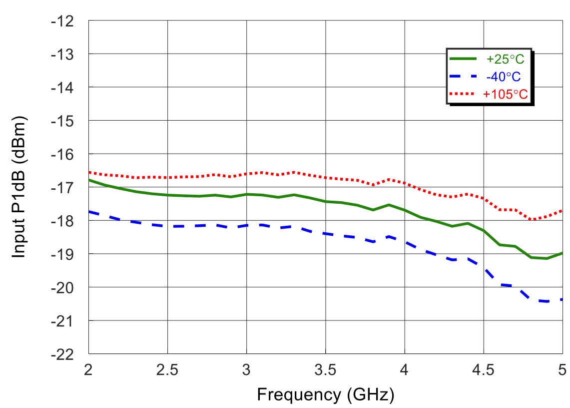
LNA$_{IN}$ Port Return Loss - RX Mode



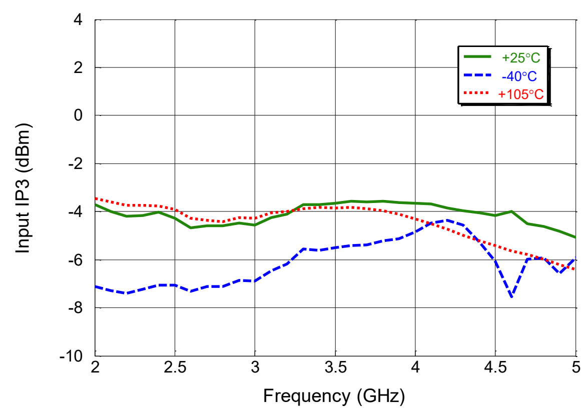
RX$_{OUT}$ Port Return Loss - RX Mode



LNA$_{IN}$ to RX$_{OUT}$ Input P1dB[11] - RX Mode



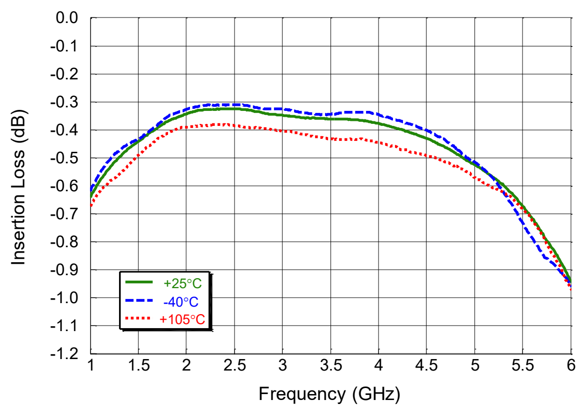
LNA$_{IN}$ to RX$_{OUT}$ Input IP3 - RX Mode



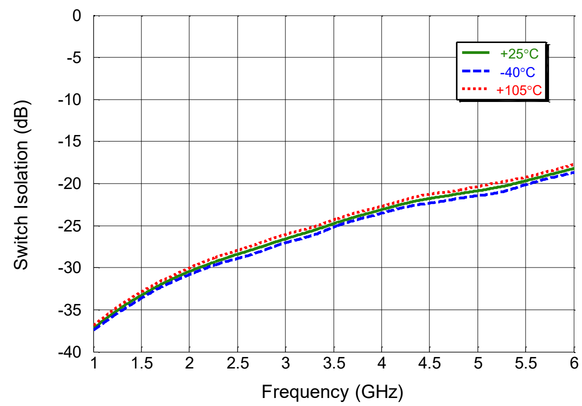
11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.

Typical Performance Curves (Switch, RX Mode): P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

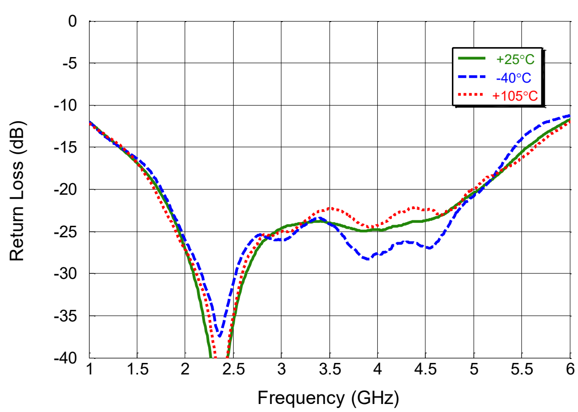
ANT to SW_RX Insertion Loss[11] - RX Mode



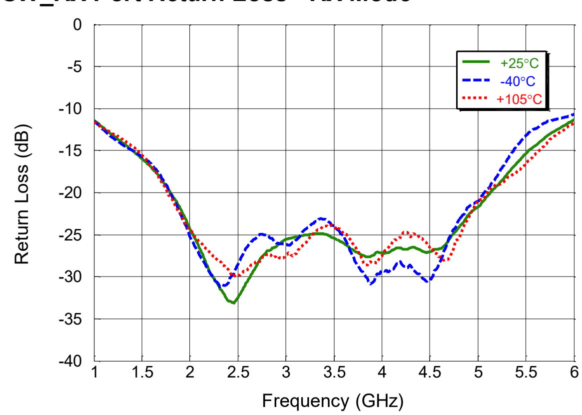
ANT to TERM Isolation[11]- RX Mode



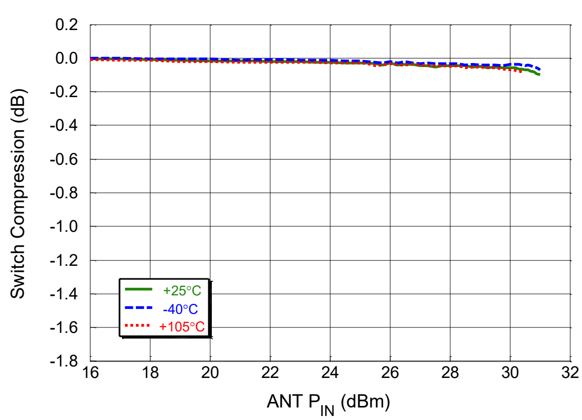
ANT Port Return Loss - RX Mode



SW_RX Port Return Loss - RX Mode



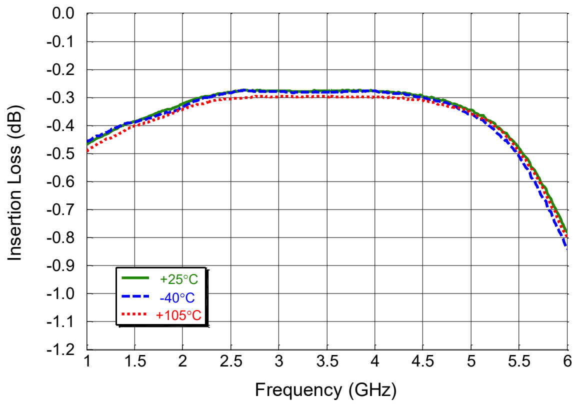
ANT to SW_RX Port Switch Compression Characteristic[11,12] at 3.75 GHz - RX mode



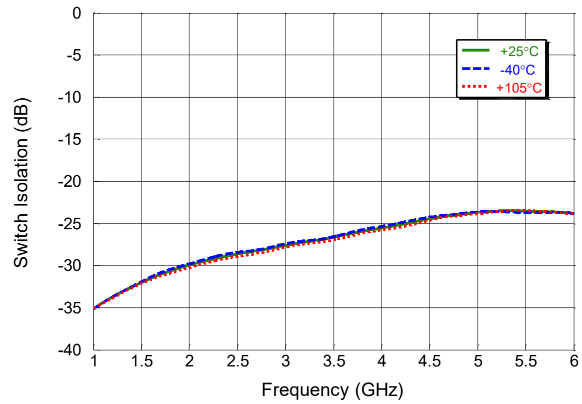
11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.
12. Measured with 2 μs pulse width, 10% duty cycle. RF trace and connector losses are de-embedded.

Typical Performance Curves (Switch, TX Mode):
P_{IN} = -10 dBm, V_{DD} = 5 V, T_C = +25°C, Z_0 = 50 Ω (unless otherwise indicated)

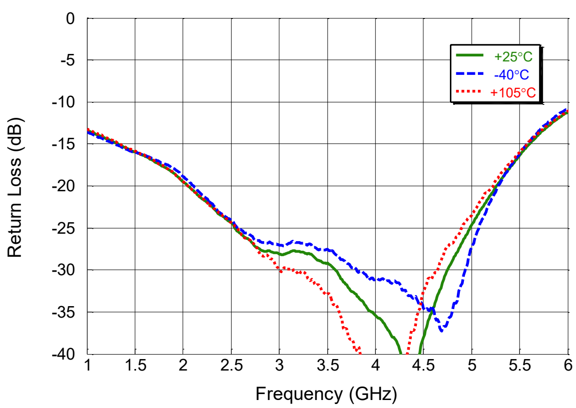
ANT to TERM Insertion Loss[11] - TX Mode



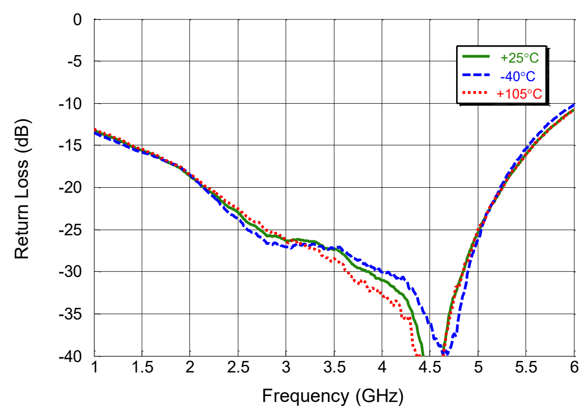
ANT to SW_RX Isolation[11] - TX Mode



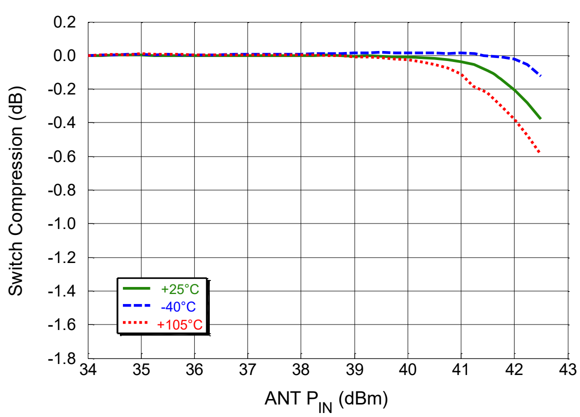
ANT Port Return Loss - TX Mode



TERM Port Return Loss - TX Mode

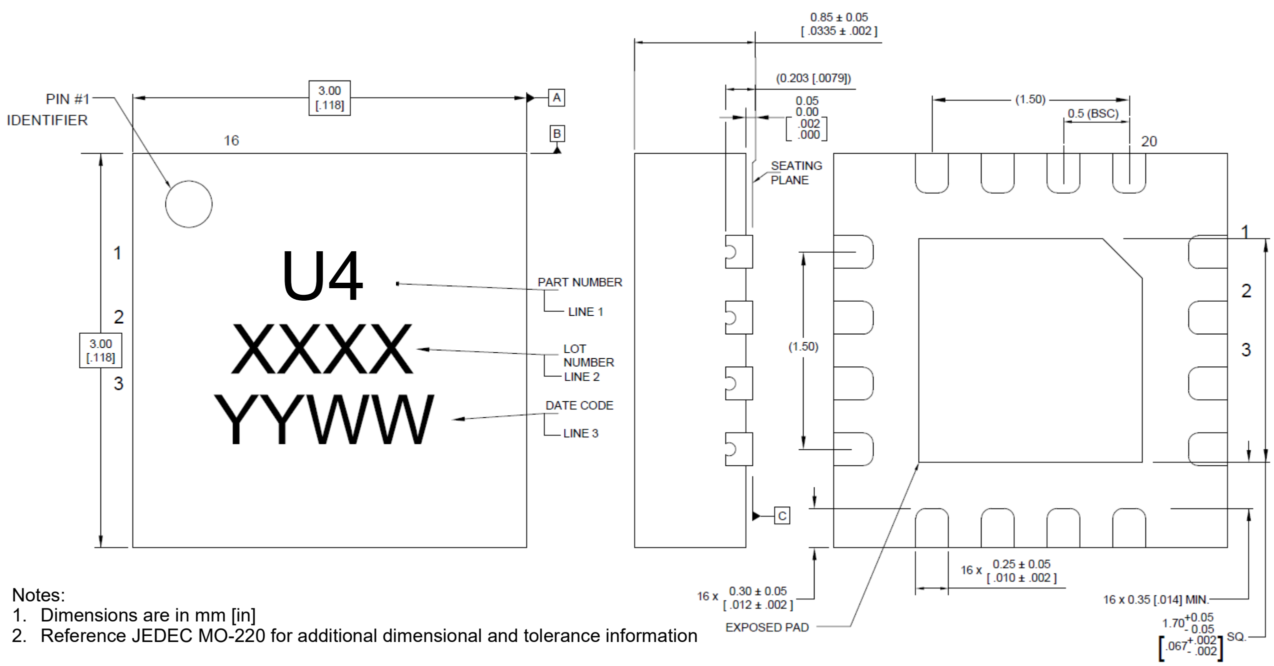


ANT to TERM Port Switch Compression Characteristic[11,12] at 3.75 GHz - TX mode



11. For gain, noise figure, insertion loss and isolation plots, RF trace and connector losses are de-embedded.
12. Measured with 2 µs pulse width, 10% duty cycle. RF trace and connector losses are de-embedded.

Lead-Free 3 mm 16-Lead QFN†



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 1 requirements in accordance to JEDEC J-STD-020D.
Plating is NiPdAu over Copper