1.5T Low Noise, Low Impedance, Pre-Amplifier Module

MAAL-011236
Rev. V1

Features

- Non-Magnetic Laminate Module
- 1.5T Frequency of 63.87 MHz
- For 50 Ω Source Impedance
- Noise Figure: 0.35 dB
- Gain: 28 dB
- Input Resistance: 1.6 Ω
- Output Impedance: 50 Ω
- Output VSWR: 1.22 :1
- Single Voltage Bias: 10 V, 9 mA
- Integrated Active Bias Circuit
- Unconditionally Stable, k>1
- RoHS* Compliant

Applications

- MRI Applications
- Medical
- RF Measurement
- Current Sensor

Description

The MAAL-011236 is a high dynamic range, single stage MMIC LNA module that includes all necessary RF matching elements. The only external component necessary is one bypass capacitor. This LNA module provides excellent low noise performance, low input impedance, and high gain characteristics suitable for multi-channel coil 1.5T MRI applications.

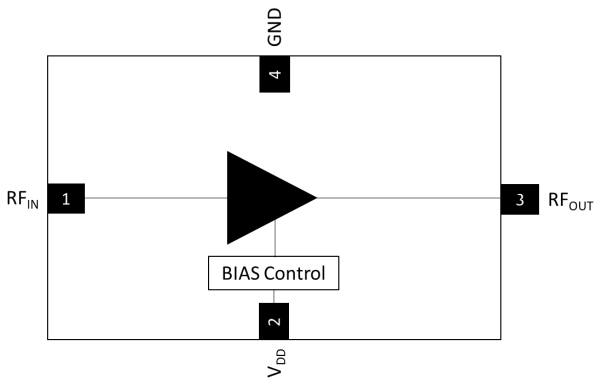
Custom frequencies & impedances available upon request.

This low noise amplifier has an integrated active bias circuit to minimize variations over temperature and process.

Integrated ESD protection results in a Class 2 HBM rating.

The 0.6” x 0.4” module uses a nonmagnetic laminate with EPIG plating and all nonmagnetic components.

Functional Block Diagram



Pin Configuration[1]

Pin #	Pin Name
1	RF_{IN}
2	V_{DD}
3	RF_{OUT}
4	GND

1. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information[2,3]

Part Number	Description
MAAL-011236-TR0100	100 piece reel
MAAL-011236-TR0500	500 piece reel
MAAL-011236-SMB	Sample Board 1.5T

2. Reference Application Note M513 for reel size information.
3. PPR sample boards contain magnetic SMT components.

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

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Pin Descriptions

Pin #	Name	Description
1	RF_{IN}	RF Input, DC blocked in module, ESD protection diodes on pin.
2	V_{DD}	Supply Voltage, ESD protection diodes on pin.
3	RF_{OUT}	RF Output, DC blocked in module, ESD protection diodes on pin
4	GND	Ground

DC Electrical Specifications: V_{DD} = +10 V, T_C = 25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
DC Current I_{DD} (I_{DS} + I_{BIAS})	P_{IN} = -30 dBm	mA	—	9	12.5

Electrical Specifications:
V_{DD} = 10 V, T_C = +25ºC, Z_{LOAD} & Z_{SOURCE} = 50 Ω, Tuned for 1.5T (F0 = 63.87 MHz)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Bandwidth	Centered at 63.87 MHz	MHz	—	1	—
Noise Figure	—	dB	—	0.35	—
Gain	—	dB	26.5	28	—
Input Impedance[4]	Real Zin Imaginary Zin	Ohms	— -2.0	1.6 0	2.0 2.0
Output Return Loss	—	dB	—	20	—
Reverse Isolation	—	dB	—	62	—
Output IP3	P_{OUT} = 0 dBm per tone, 1 MHz & 100 KHz spacing	dBm	—	26	—
Output P1dB	—	dBm	—	17	—

4. Imaginary Zin with test fixture at 77.3 mm “Delay Dist.” of RF input port and 1 Velocity Factor Port Extensions added.

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Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
RF Input Power	P_{IN}	dBm	—	-30	-10
DC Supply	V_{DD}	V	5	10	11
Junction Temperature[7,8]	T_J	°C	—	—	+150
Operating Temperature[9]	T_C	°C	0	—	+70

Absolute Maximum Ratings[5,6]

Parameter	Symbol	Unit	Min.	Max.
RF Input CW Power	P_{IN}	dBm	—	36
RF Input Power, 6% Duty Cycle	P_{IN}	dBm	—	42
DC Supply	V_{DD}	V	—	13
Junction Temperature[7,8]	T_J	°C	—	+160
Operating Temperature[9]	T_C	°C	-40	+85
Storage Temperature	—	°C	-55	+150

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. Operating at nominal conditions with $T_J \leq +150°C$ will ensure MTTF > 1 x 10^6 hours.
8. Junction Temperature (T_J) = $T_C + \Theta_{JC} * ((V * I))$. Typical thermal resistance (Θ_{JC}) = 97°C/W.
   a) For T_C = +25°C,
   T_J = 34°C @ 10 V, 9 mA
   b) For T_C = +70°C,
   T_J = 79°C @ 10 V, 9 mA
9. Operating temperature is defined at the back of device paddle.

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.

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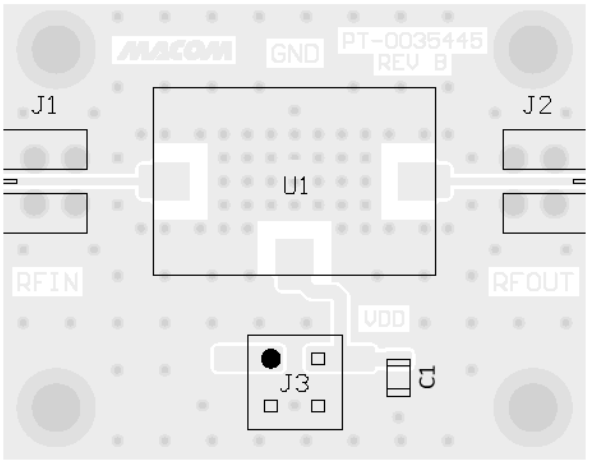
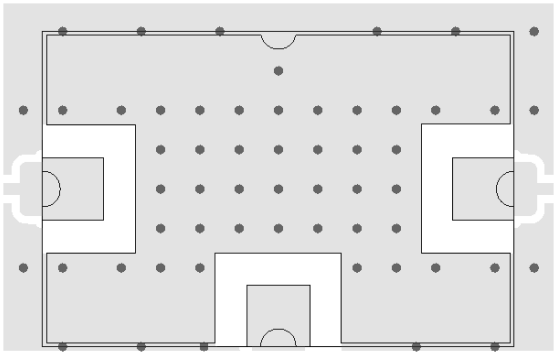
PCB Layout



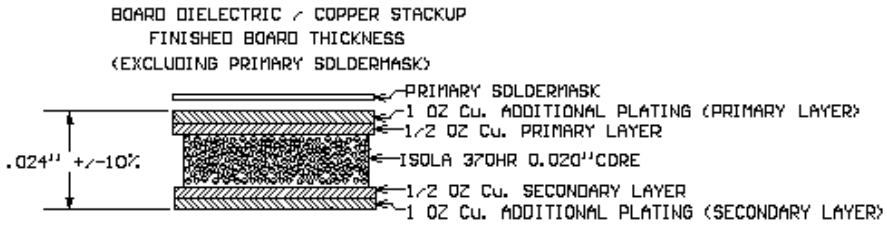
Recommended PCB Land Pattern



Part List

Part	Value	Case Style
C1	1 µF	0805

PCB Layout Stack-UP



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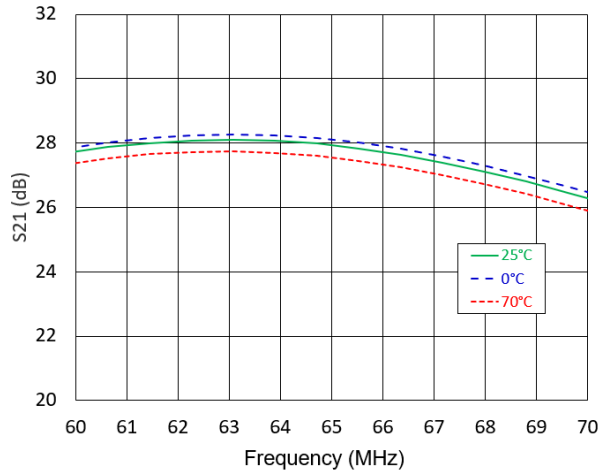
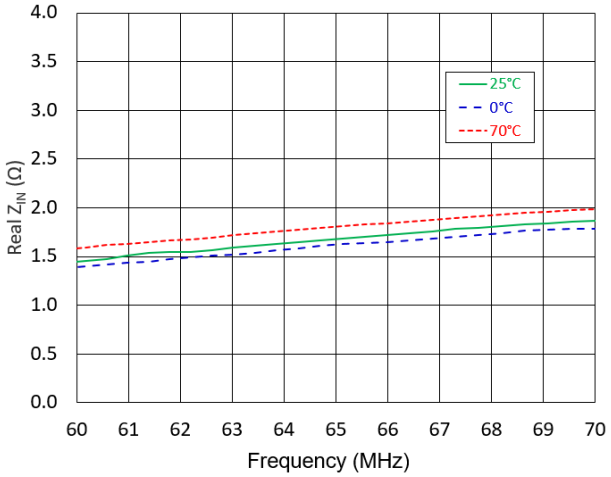
Typical Performance Curves

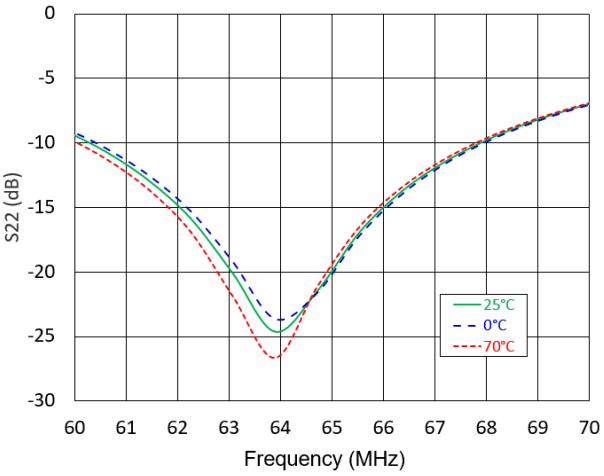
Gain



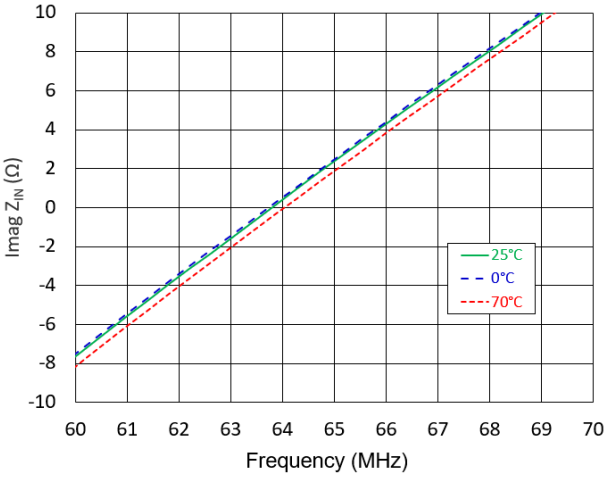
Real Z_{IN}



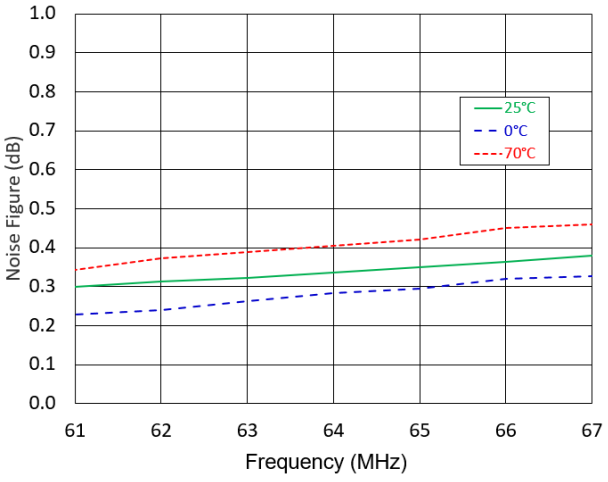
Output Return Loss



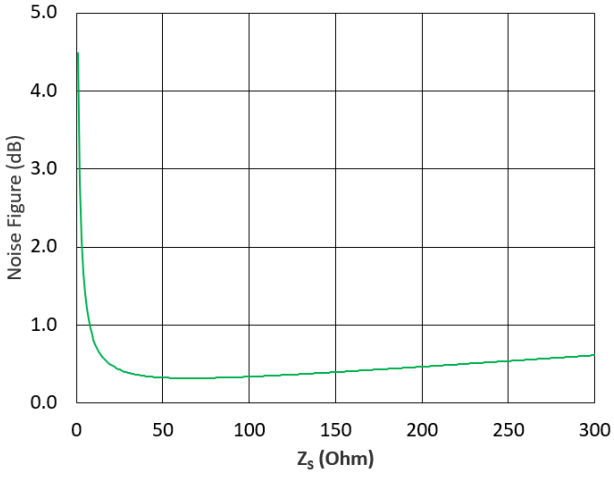
Imaginary Z_{IN}



Noise Figure



Noise Figure vs Source Impedance, Z_S @ 25°C



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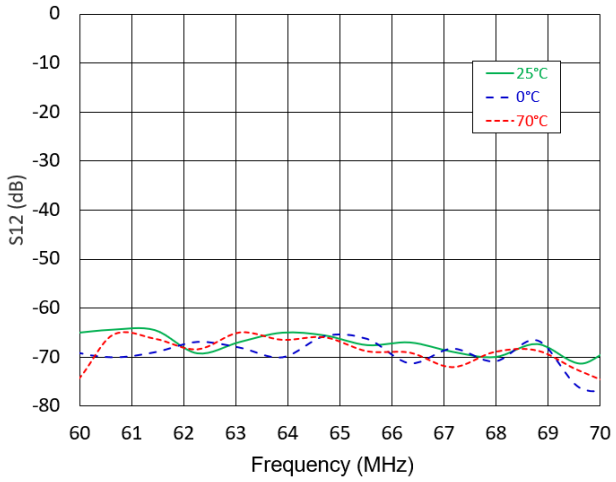
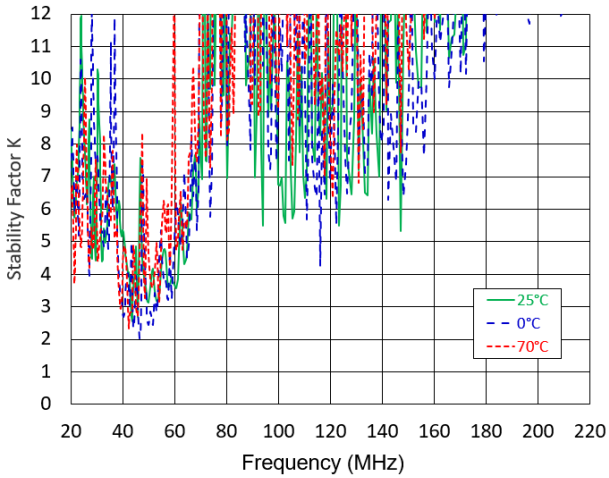
Typical Performance Curves

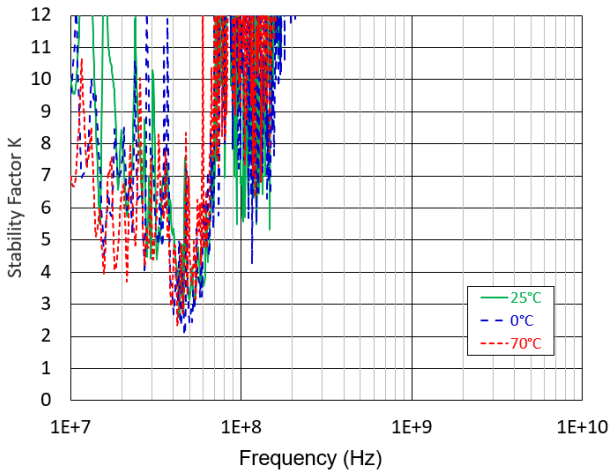
Reverse Isolation



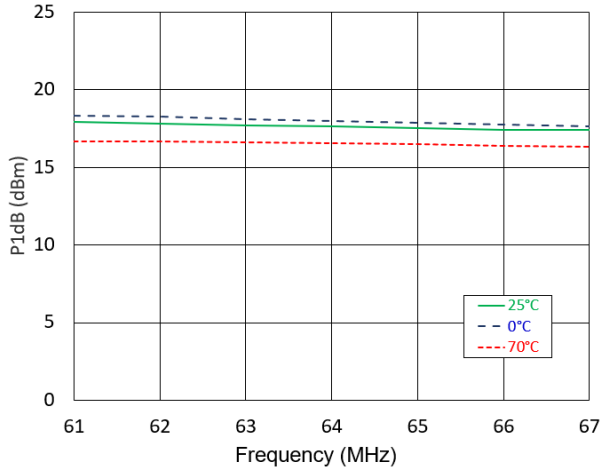
Stability Factor K



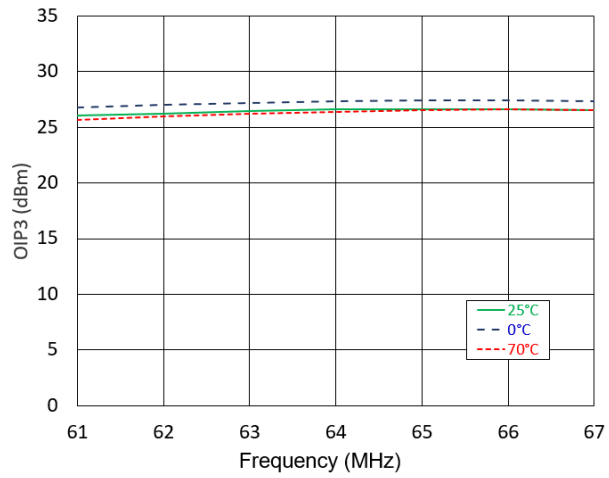
Stability Factor K to 10 GHz



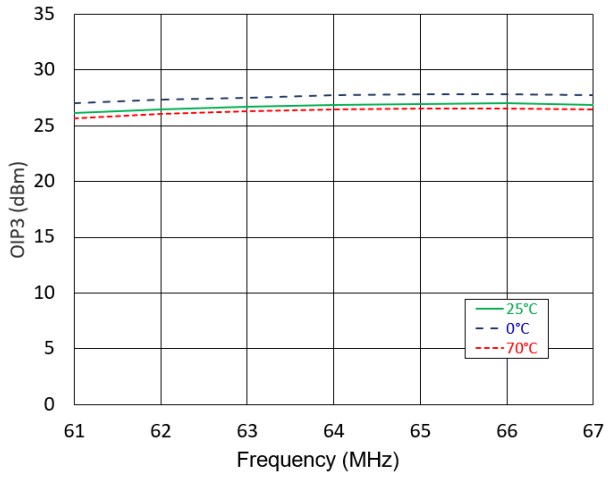
P1dB



OIP3 (P_{out} = 0 dBm / Tone, 100 kHz spacing)



OIP3 (P_{out} = 0 dBm / Tone, 1 MHz spacing)



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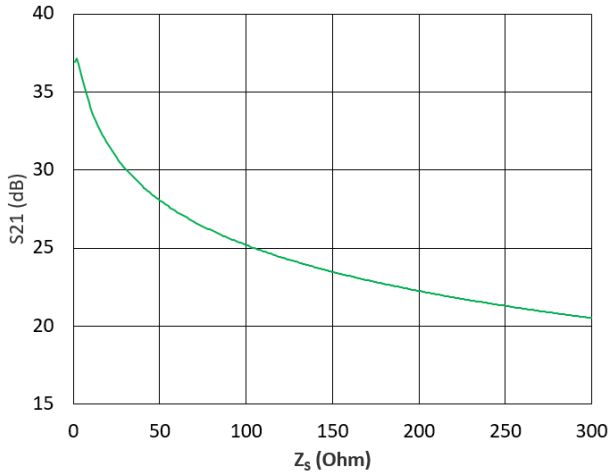
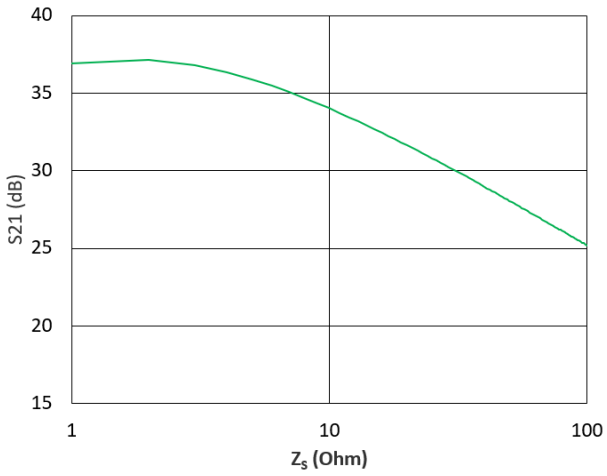
Typical Performance Curves

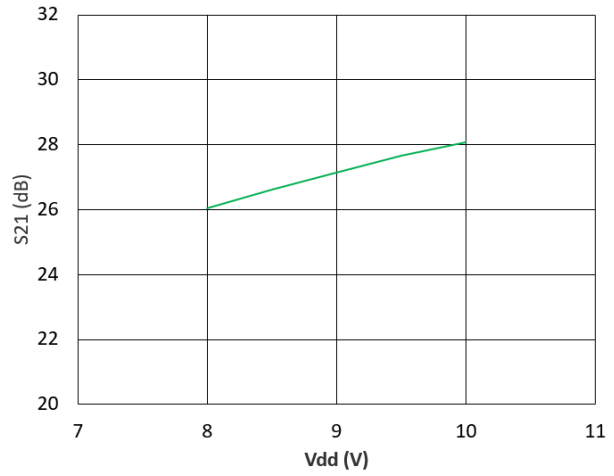
Gain vs Source Impedance, Z_S @ 25°C



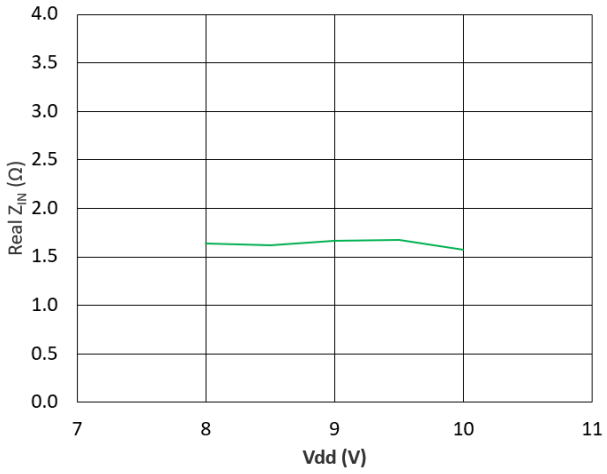
Gain vs Source Impedance, Z_S in Log Scale @ 25°C



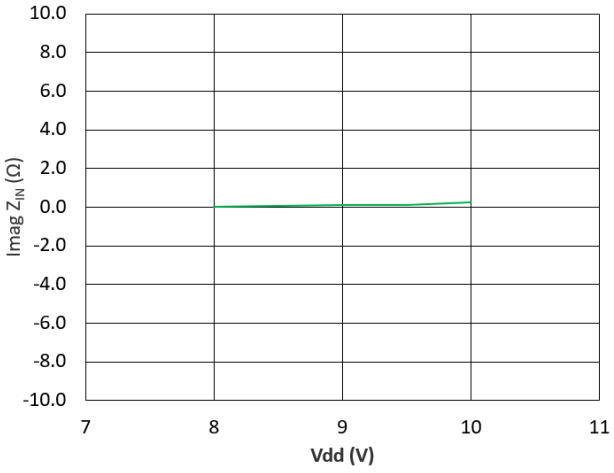
Gain vs Vdd @ 25°C



Real Z_{IN} vs Vdd @ 25°C



Imaginary Z_{IN} vs Vdd @ 25°C



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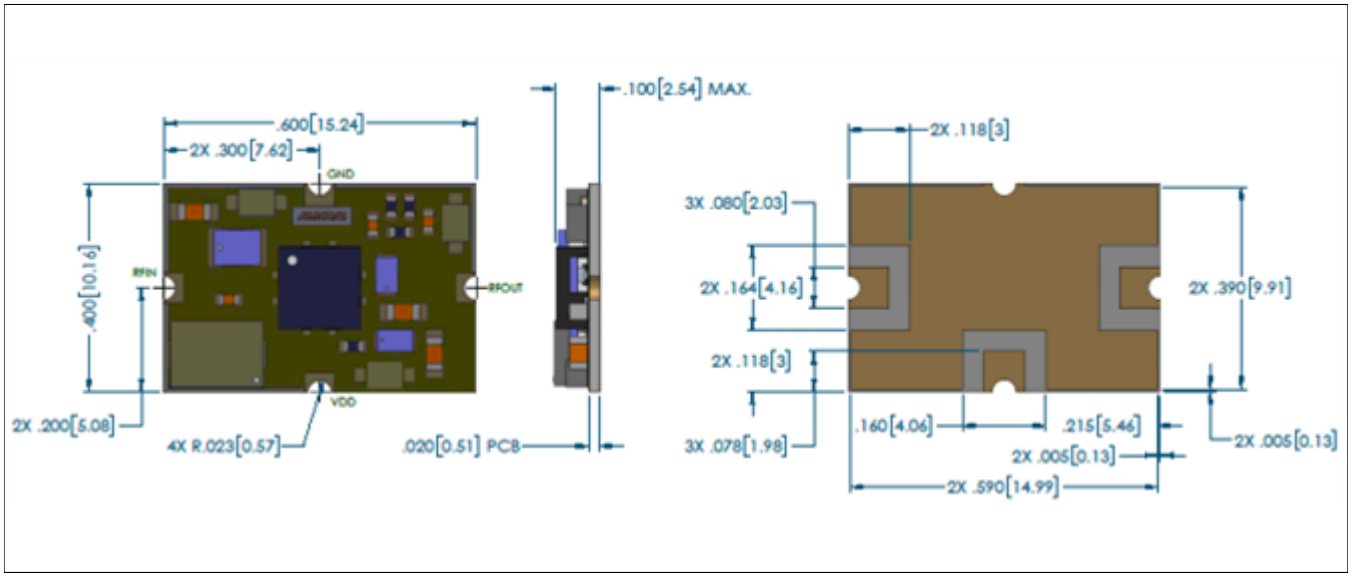
Pb - Free Non-Magnetic Laminate Package



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