

Features

- 19 dB Gain
- 7 dB Noise Figure
- 8 V Bias
- Low Distortion
- Wide Bandwidth for DOCSIS 3.1
- Lead-Free 3 mm 16-lead PQFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description

The MAAM-011156 is a GaAs single stage differential amplifier assembled in a lead-free 3 mm 16-lead PQFN plastic package. This amplifier provides 19 dB of gain while biased at 8 volts and also offers a power down function. The amplifier provides excellent linearity and high output power with greater than 30 dB MER for 64 QAM modulation with 16 channels and 58 dBmV per channel.

It is ideally suited for use in CATV return path amplifier applications especially the wide bandwidth of DOCSIS 3.1.

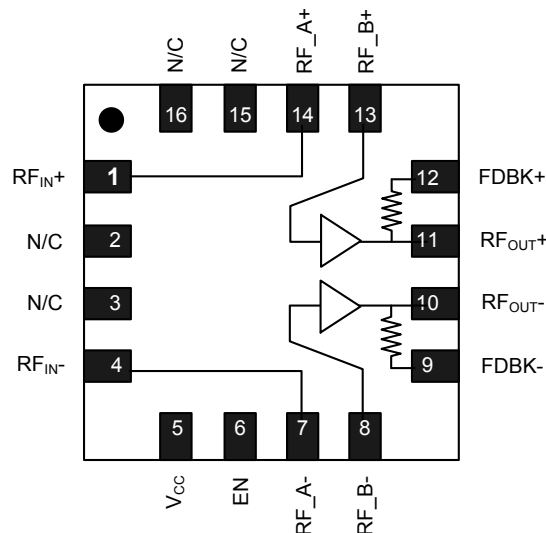
Ordering Information^{1,2}

| Part Number | Package |
|--------------------|-----------------|
| MAAM-011156-TR1000 | 1000 piece reel |
| MAAM-011156-TR3000 | 3000 piece reel |
| MAAM-011156-001SMB | Sample Board |

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

*Restrictions on Hazardous Substances,
European Union Directive 2011/65/EU.

Functional Schematic



Pin Designations

| Pin | Function | Function |
|-----|---------------------|------------------|
| 1 | RF _{IN+} | RF Input+ |
| 2 | N/C | No Connection |
| 3 | N/C | No Connection |
| 4 | RF _{IN-} | RF Input- |
| 5 | V _{CC} | Bias Voltage |
| 6 | EN | Enable |
| 7 | RF _{A-} | RF Input Node A- |
| 8 | RF _{B-} | RF Input Node B- |
| 9 | FDBK- | Feedback- |
| 10 | RF _{OUT-} | RF Output- |
| 11 | RF _{OUT+} | RF Output+ |
| 12 | FDBK+ | Feedback+ |
| 13 | RF _{B+} | RF Input Node B+ |
| 14 | RF _{A+} | RF Input Node A+ |
| 15 | N/C | No Connection |
| 16 | N/C | No Connection |
| 17 | Paddle ³ | Ground |

3. The exposed paddle centered on the package bottom must be connected to RF and DC ground.

Amplifier, CATV Return Path Differential 5 - 300 MHz

Rev. V3

Electrical Specifications: $T_A = 25^\circ\text{C}$, $V_{CC} = 8\text{ V}$, $EN = 5\text{ V}$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|--------------------|---|-------|--------------|--------------|--------------|
| Gain | -10 dBm P_{IN} , 100 MHz -10 dBm P_{IN} , 250 MHz | dB | 18.5 18.0 | 19.5 19.5 | 21.5 21.0 |
| Noise Figure | 5 - 300 MHz | dB | — | 7 | — |
| Input Return Loss | 5 - 300 MHz | dB | — | 20 | — |
| Output Return Loss | 5 - 300 MHz | dB | — | 18 | — |
| Reverse Isolation | 5 - 300 MHz | dB | — | 26 | — |
| 64 QAM MER | 16 Channels (5 - 250 MHz), 57 dBmV/Ch. | dBm | 30 | 35 | — |
| P1dB | 5 - 300 MHz | dBm | — | 28 | — |
| OIP3 | Two tones at 1 MHz spacing, $P_{OUT} = +12\text{ dBm}$ per tone, 200 MHz | dBm | — | 44 | — |
| OIP2 | Two tones at 1 MHz spacing, $P_{OUT} = +12\text{ dBm}$ per tone, 5 - 300 MHz | dBm | — | 78 | — |
| I_{CC} | $V_{CC} = +8\text{ V}$, $EN = 5\text{ V}$ | mA | — | 210 | 240 |
| I_{CC_OFF} | $V_{CC} = +8\text{ V}$, $EN = 0\text{ V}$ | mA | — | 1 | — |

Absolute Maximum Ratings^{4,5}

| Parameter | Absolute Maximum |
|-------------------------------------|------------------|
| Input Power | 11 dBm |
| Bias Voltage | 10 V |
| Junction Temperature ^{6,7} | +150°C |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +125°C |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with $T_J \leq 150^\circ\text{C}$ will ensure $MTTF > 1 \times 10^6$ hours.
- Junction Temperature (T_J) = $T_C + \Theta_{jc} * (V * I)$
Typical thermal resistance (Θ_{jc}) = 16° CW.
 - For $T_C = +25^\circ\text{C}$,
 $T_J = 52^\circ\text{C}$ @ 8 V, 210 mA
 - For $T_C = +85^\circ\text{C}$,
 $T_J = 112^\circ\text{C}$ @ 8 V, 210 mA

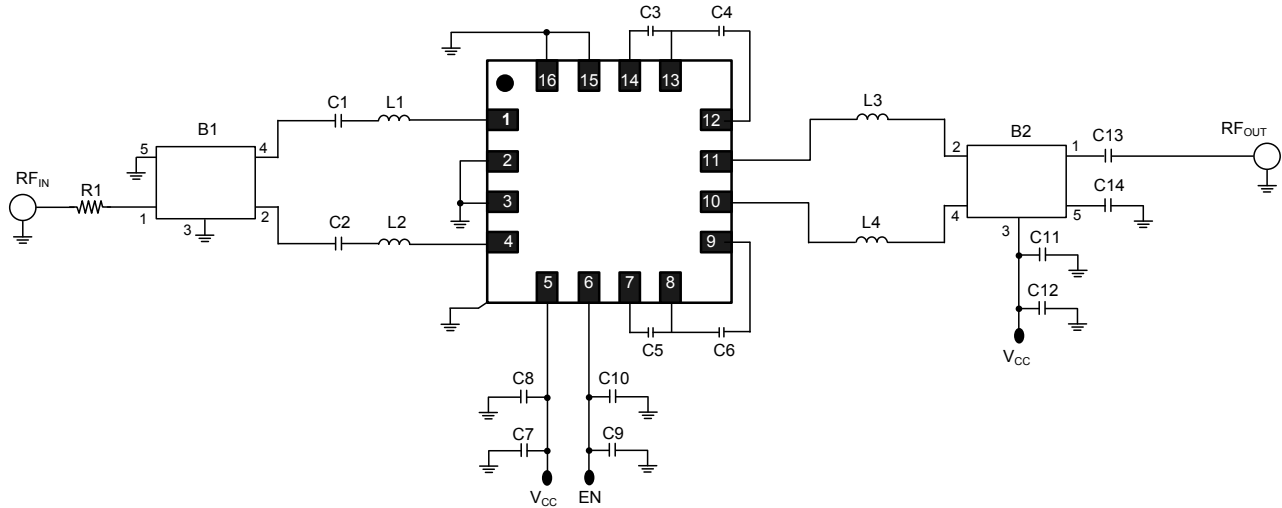
Handling Procedures

Please observe the following precautions to avoid damage:

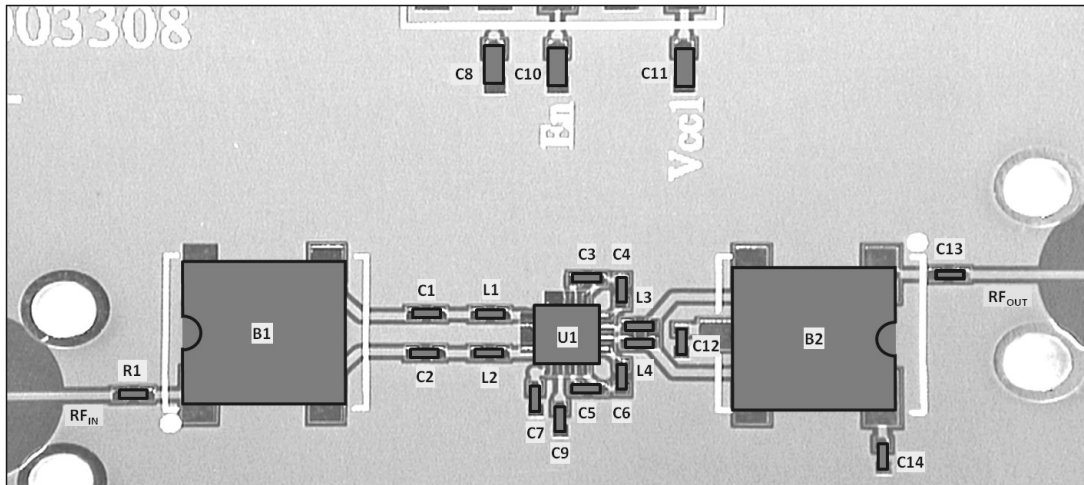
Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1B devices.

Schematic PCB Layout



Sample Board

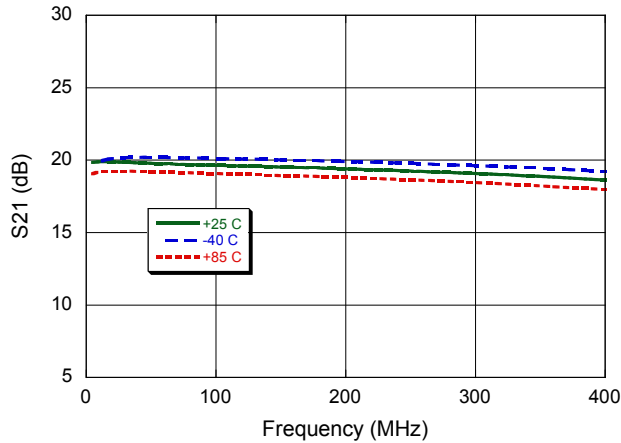


Off-Chip Component Values

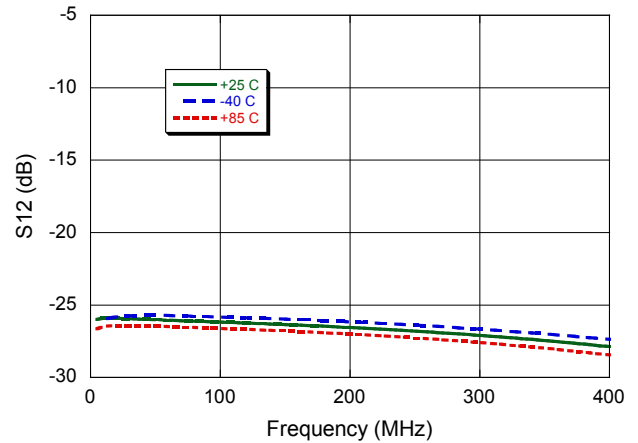
| Component | Value | Package |
|------------------|--|---------|
| C1 - C6, C13 | 0.01 μ F | 0402 |
| C7, C9, C12, C14 | 0.1 μ F | 0402 |
| C8, C10, C11 | 1 μ F | 0603 |
| R1 | 0 Ω | 0402 |
| L1 - L4 | 18 nH | 0402 |
| B1 - B2 | 1:2 Transformer Balun, MACOM's MABA-011029 | |

Typical Performance Curves

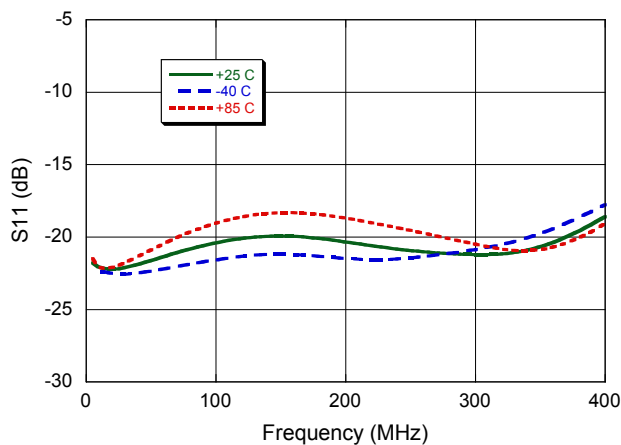
Gain



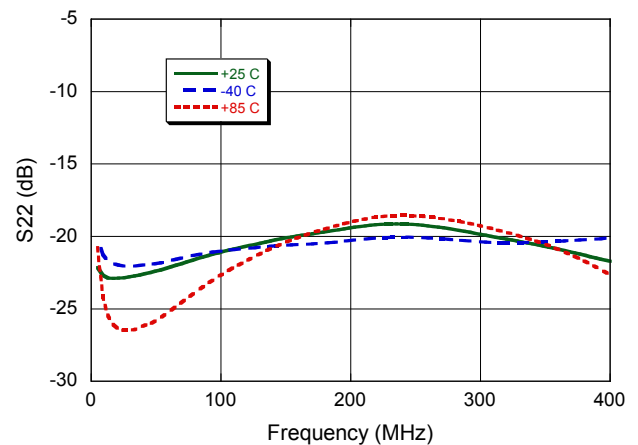
Reverse Isolation



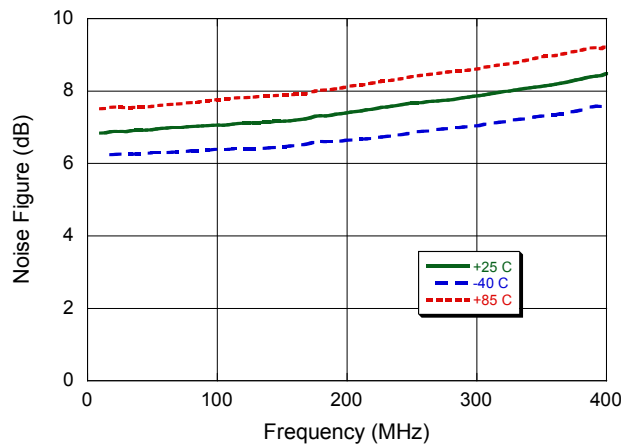
Input Return Loss



Output Return Loss

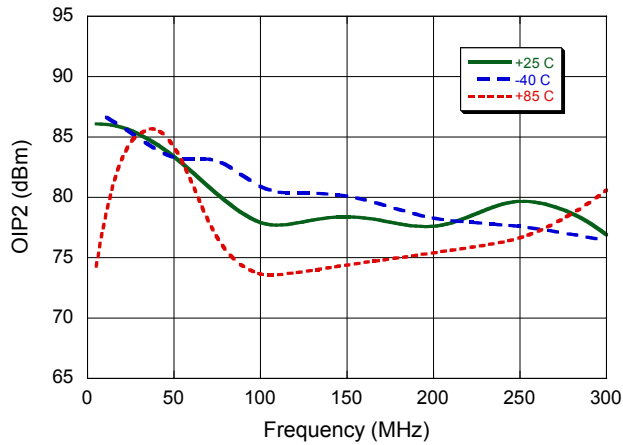


Noise Figure

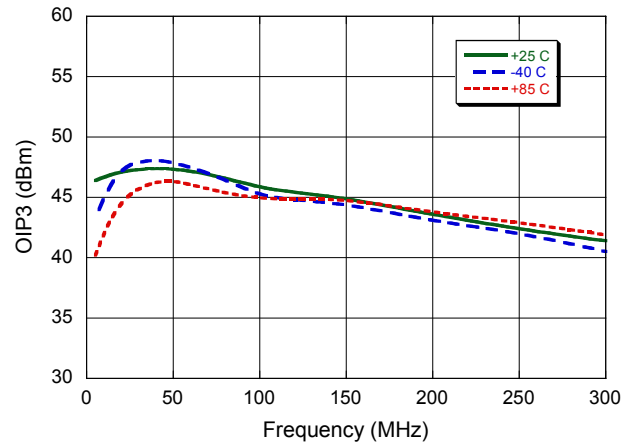


Typical Performance Curves

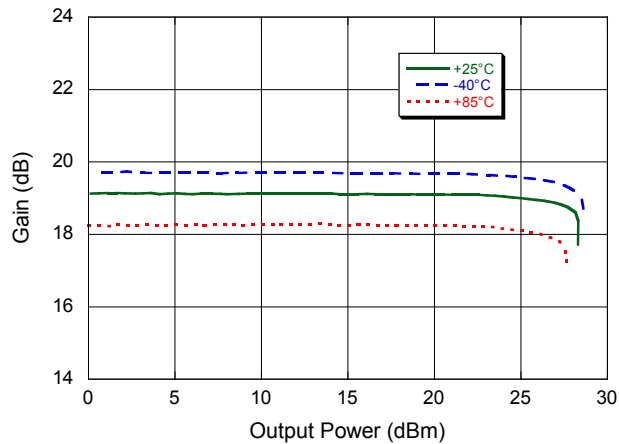
OIP2 @ $P_{OUT} = 12$ dBm



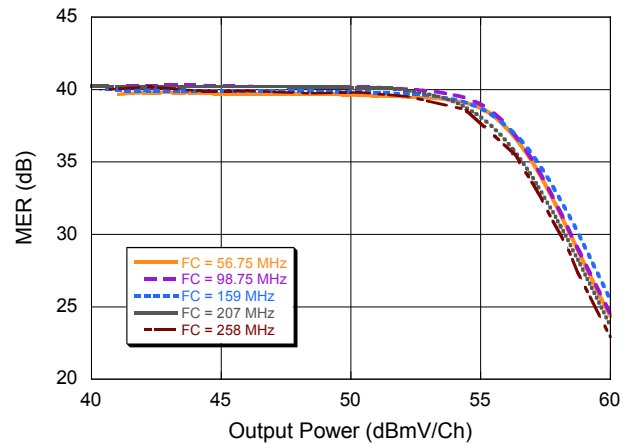
OIP3 @ $P_{OUT} = 12$ dBm



P1dB @ 250 MHz



64 QAM Modulation Error Ratio⁸

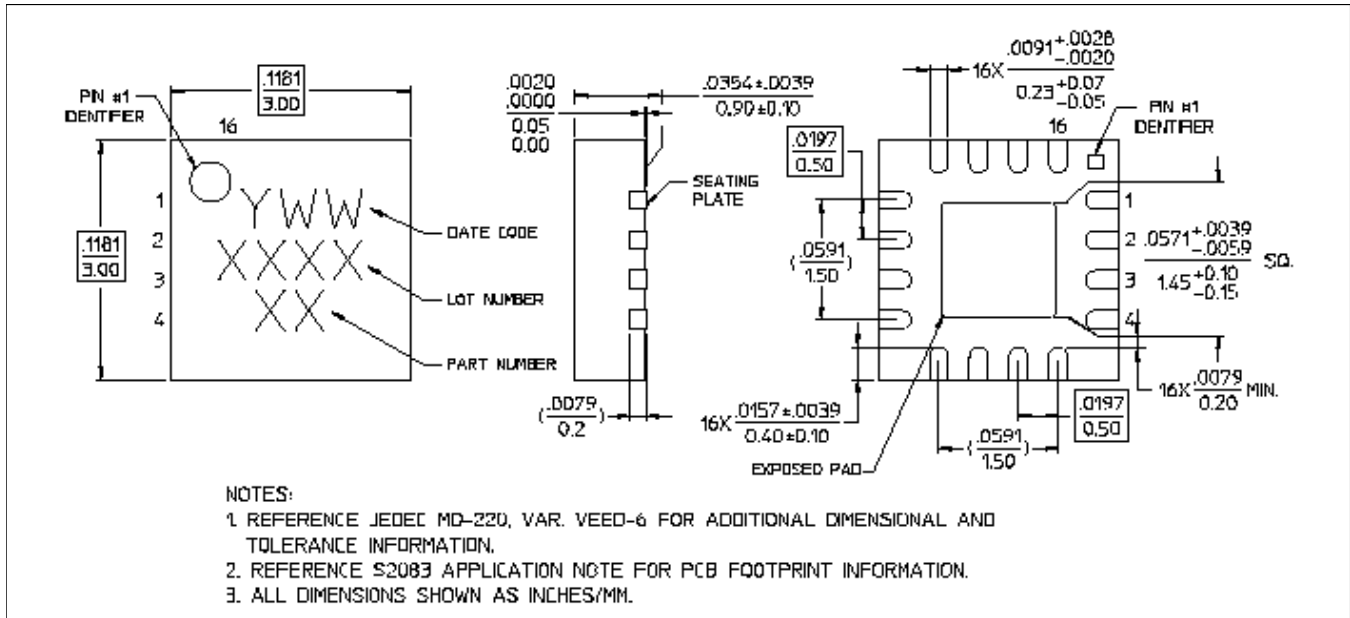


8. Fc is the carrier frequency for 9th of 16 contiguous 6 MHz 64 QAM channels. MER measured on 9th channel.

Amplifier, CATV Return Path Differential 5 - 300 MHz

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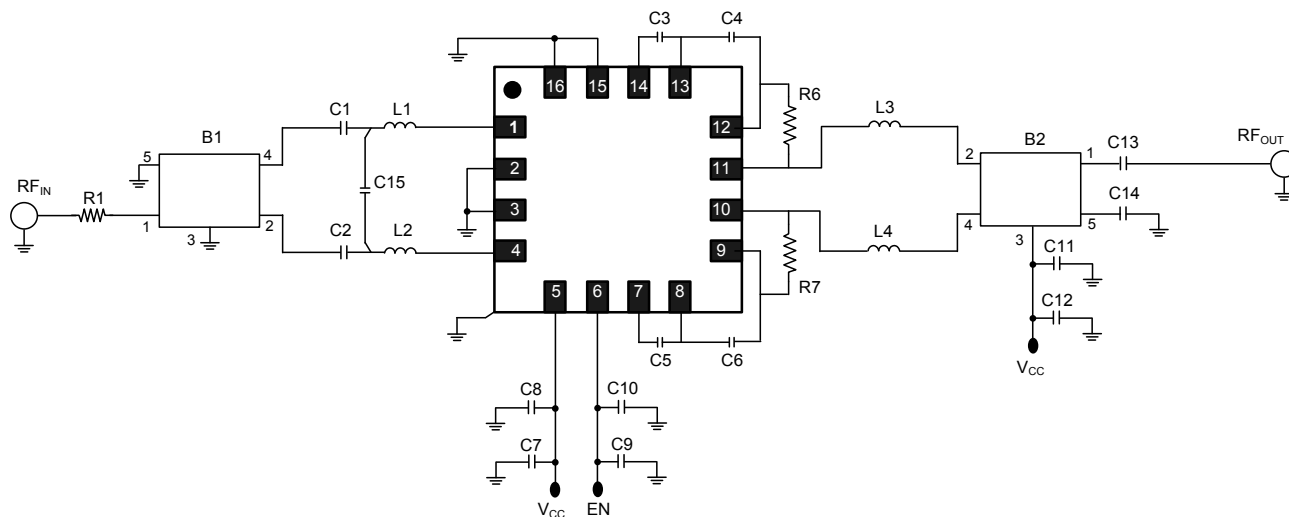
Lead-Free 3 mm 16-Lead PQFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.

Applications Section - 15 dB and 10 dB Gain

Schematic PCB Layout



Off-Chip Component Values Parts List

15 dB Gain

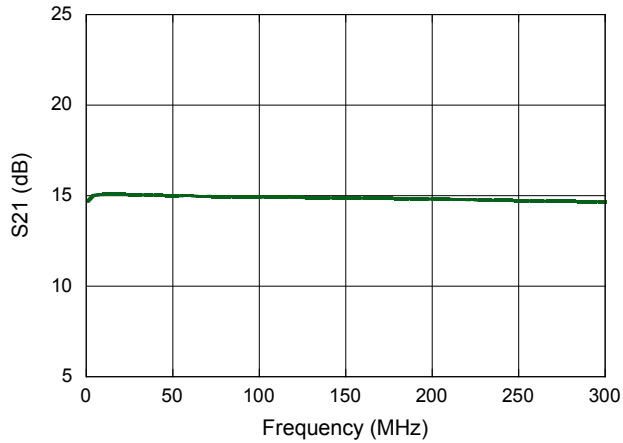
| Component | Value | Package |
|------------------|--|---------|
| C1 - C6, C13 | 0.01 μ F | 0402 |
| C7, C9, C12, C14 | 0.1 μ F | 0402 |
| C8, C10, C11 | 1 μ F | 0603 |
| C15 | 6.2 pF | 0402 |
| L1, L2 | 18 nH | 0402 |
| L3, L4 | 0 Ω | 0402 |
| R1 | 0 Ω | 0402 |
| R6, R7 | 560 Ω | 0402 |
| B1 - B2 | 1:1 Transformer Balun, MACOM's MABA-009572 | |

10 dB Gain

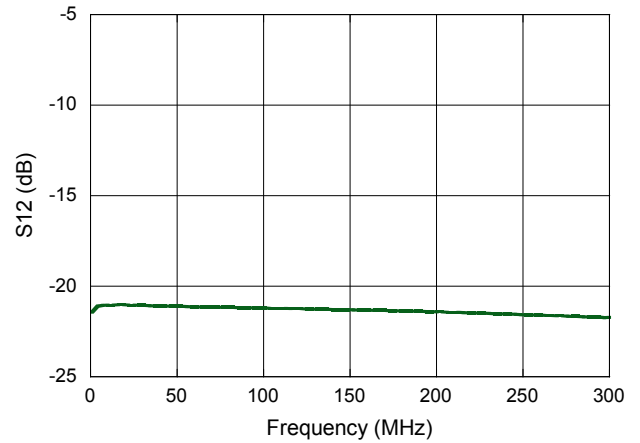
| Component | Value | Package |
|------------------|--|---------|
| C1 - C6, C13 | 0.01 μ F | 0402 |
| C7, C9, C12, C14 | 0.1 μ F | 0402 |
| C8, C10, C11 | 1 μ F | 0603 |
| C15 | 4 pF | 0402 |
| L1, L2 | 4.7 nH | 0402 |
| L3, L4 | 0 Ω | 0402 |
| R1 | 0 Ω | 0402 |
| R6, R7 | 160 Ω | 0402 |
| B1 - B2 | 1:1 Transformer Balun, MACOM's MABA-009572 | |

Applications Section - 15 dB Gain Curves

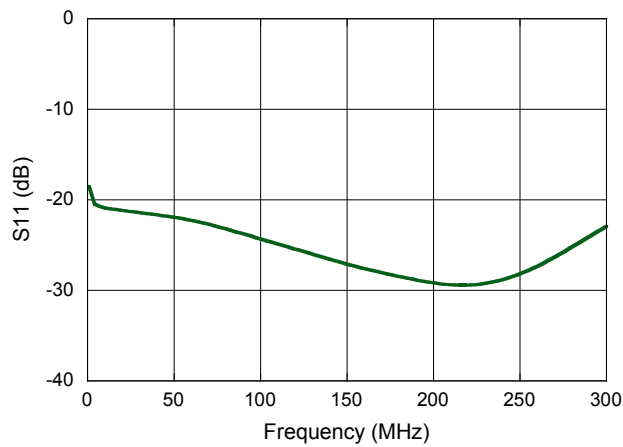
Gain @ 15 dB



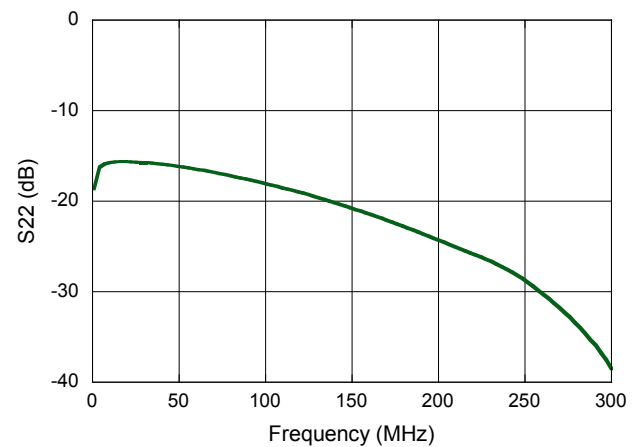
Reverse Isolation with 15 dB Gain



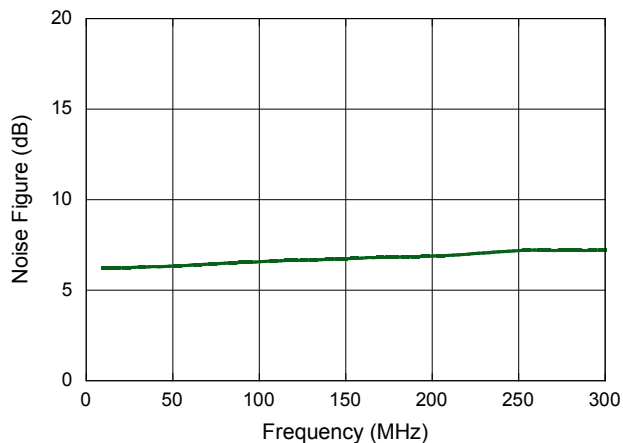
Input Return Loss with 15 dB Gain



Output Return Loss with 15 dB Gain

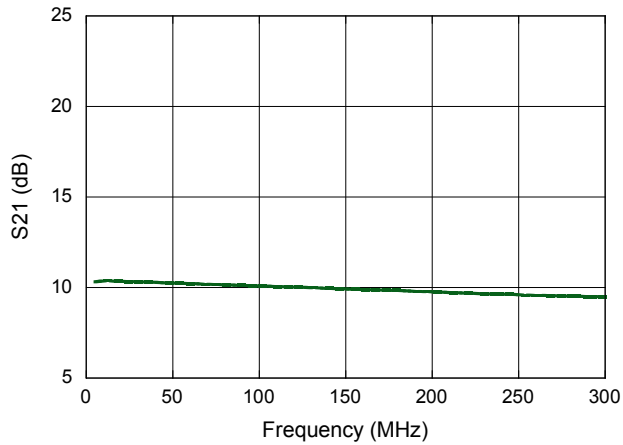


Noise Figure with 15 dB Gain

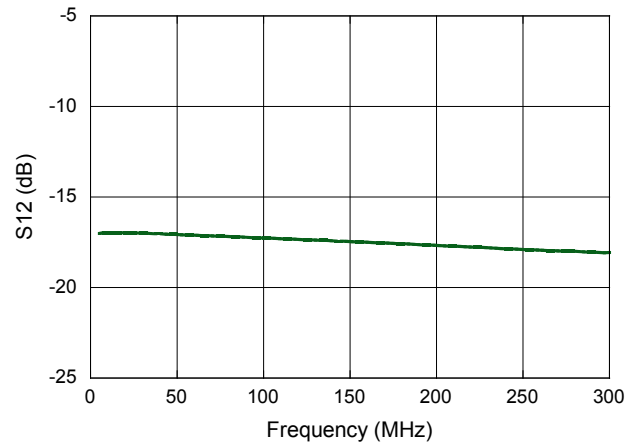


Applications Section - 10 dB Gain Curves

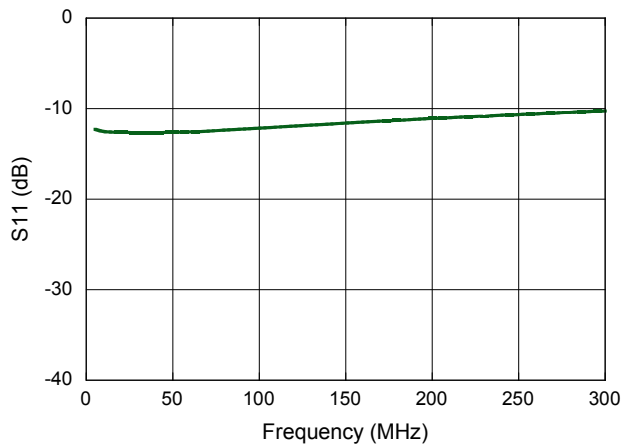
Gain @ 10 dB



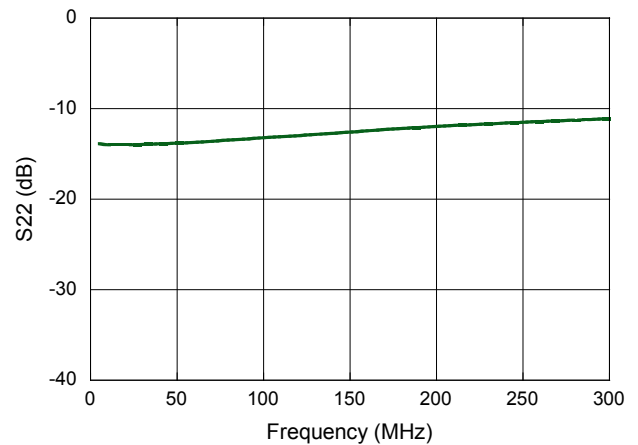
Reverse Isolation with 10 dB Gain



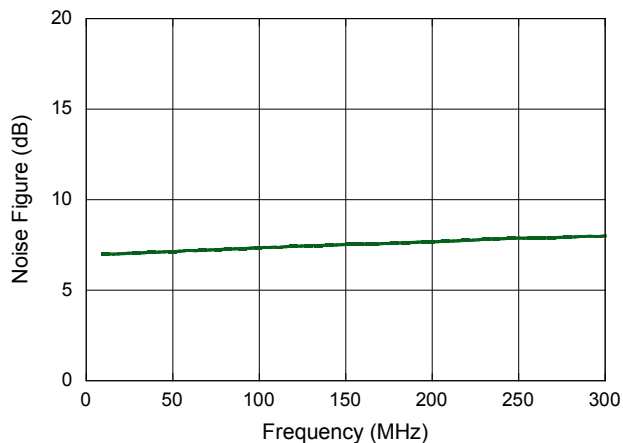
Input Return Loss with 10 dB Gain



Output Return Loss with 10 dB Gain



Noise Figure with 10 dB Gain



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