

75 Ω CATV, FTTx Low Noise Amplifier 45 - 1218 MHz

Rev. V1

Features

- Single Stage, Single Ended
- 3 to 5 V Operation
- Low Current, 50 mA
- 20 dB Flat Gain
- 1.2 dB NF Noise
- Low Distortion Performance
- Lead-Free SOT-89 Plastic Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

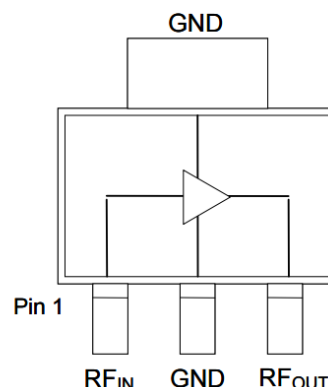
Description

The MAAL-011136 is an RF amplifier assembled in a SOT-89 plastic package. This amplifier provides 20 dB of flat gain while biased from 3 to 5 volts. The amplifier provides excellent noise figure.

The MAAL-011136 provides high gain, low noise and low distortion making it ideally suited as input stage for fiber-to-the-home (FTTh) applications and other 75 Ω infrastructure applications.

The MAAL-011136 is fabricated using GaAs pHEMT technology.

Functional Schematic



Pin Configuration

Pin No.	Pin Name	Function
1	RF _{IN}	RF Input
2	GND	Ground
3	RF _{OUT}	RF Output /Drain Supply

Ordering Information^{1,2}

Part Number	Package
MAAL-011136-TR1000	1000 Part Reel
MAAL-011136-TR3000	3000 Part Reel
MAAL-011136-001SMB	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.

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Electrical Specifications: $T_A = 25^\circ\text{C}$, $V_{DD} = 5\text{ V}$, $Z_0 = 75\ \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	45 - 1218 MHz	dB	19	20.5	22
Gain Flatness	45 - 1218 MHz	dB	—	+/- 0.2	—
Reverse Isolation	45 - 1218 MHz	dB	—	25	—
Input Return Loss	45 - 1218 MHz	dB	—	10	—
Output Return Loss	45 - 1218 MHz	dB	—	16	—
Noise Figure	45 - 1218 MHz 1218 MHz	dB	— —	1.2 1.2	— 1.6
Output IP2	45 - 1200 MHz, tone spacing 6 MHz, P_{OUT} per tone = 4 dBm	dBm	—	43	—
Output IP3	45 - 1200 MHz, tone spacing 6 MHz, P_{OUT} per tone = 4 dBm	dBm	—	32	—
P1dB	45 - 1218 MHz	dBm	—	17.5	—
Composite Triple Beat, CTB	79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz	dBc	—	-79	—
Composite Second Order, CSO	79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz	dBc	—	-62	—
I_{DD}	$V_{DD} = 5\text{ V}$	mA	—	53	62

Absolute Maximum Ratings^{3,4,5,6}

Parameter	Absolute Maximum
Input Power	10 dBm
Operating Voltage	6 volts
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°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.
- These operating conditions will ensure MTTF > 1 x 10⁶ hours.
- Junction Temperature (T_J) = Case Temperature (T_C) + $\Theta_{JC} \cdot (V \cdot I)$
Typical thermal resistance (Θ_{JC}) = 67°C/W.
a) For $T_C = 25^\circ\text{C}$,
 $T_J = 42^\circ\text{C}$ @ 5 V, 53 mA
b) For $T_C = 85^\circ\text{C}$,
 $T_J = 103^\circ\text{C}$ @ 5 V, 53 mA

Handling Procedures

Please observe the following precautions to avoid damage:

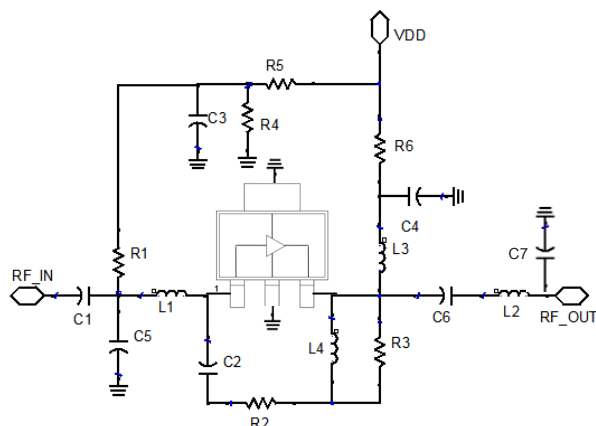
Static Sensitivity

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 1A.

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Schematic Including Off-Chip Components



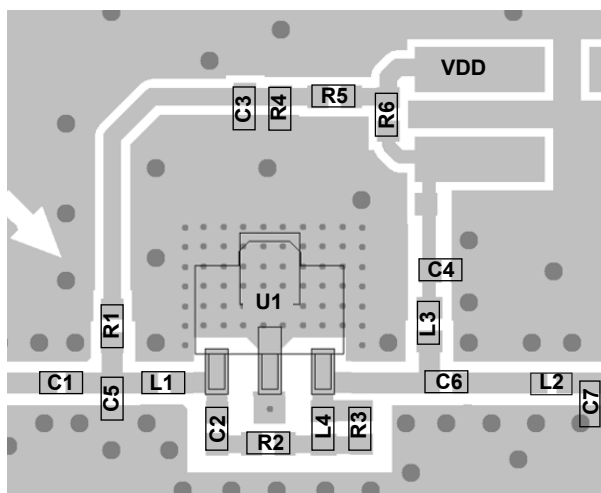
Parts List, $V_{DD} = 5\text{ V}$

Component	Value	Package
C1-C4	10 nF	0402
C5	1.5 pF	0402
C6	1000 pF	0402
C7	1.0 pF	0402
L1	6.2 nH	0402
L2	6.8 nH	0402
L3	Ferrite Bead ⁷	0402
L4	68 nH ⁸	0402
R1	8.06 k Ω	0402
R2	931 Ω	0402
R3	464 Ω	0402
R4	1.54 k Ω	0402
R5	8.06 k Ω	0402
R6	19.1 Ω	0402

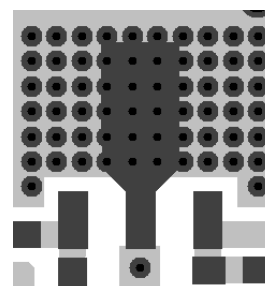
7. Murata, part number BLM15HD182SN.

8. Coilcraft, part number 0402CS-68NXJLW

Recommended PCB Layout



Recommended PCB Land Pattern



60 vias beneath package

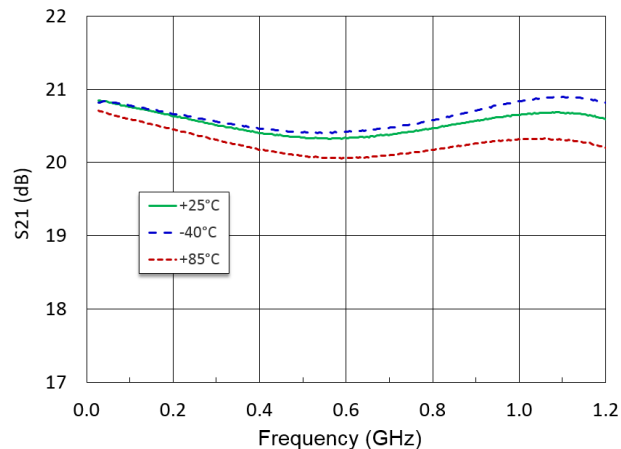
0.012 in. via diameter

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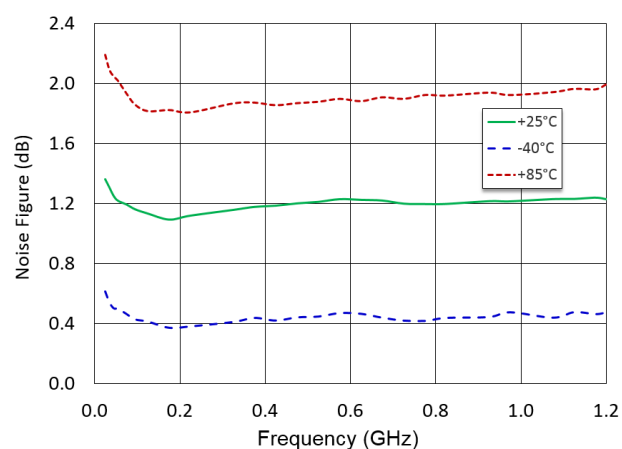
Rev. V1

Typical Performance Curves: $V_{DD} = 5\text{ V}$

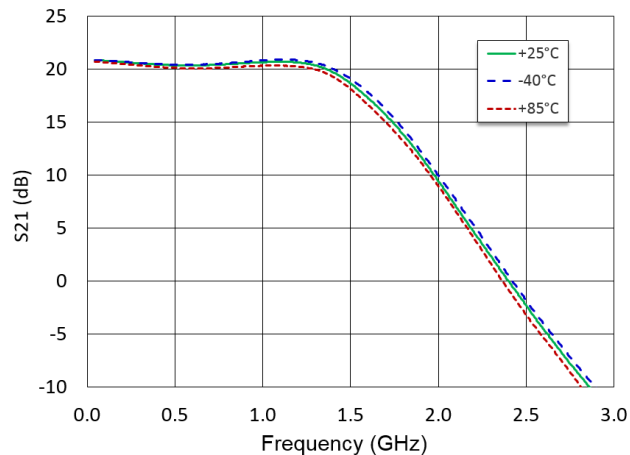
Gain to 1.218 GHz



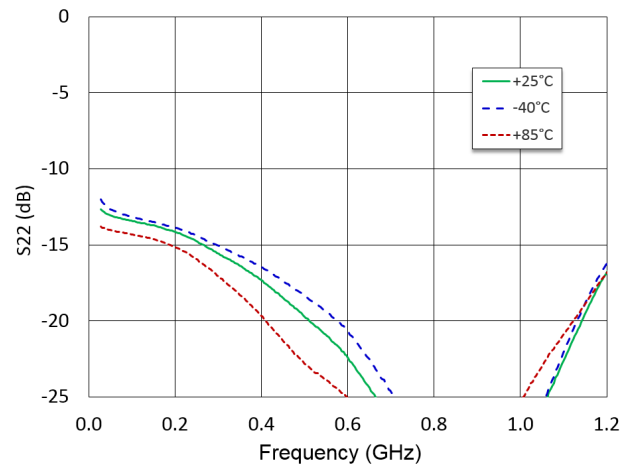
Noise Figure to 1.218 GHz



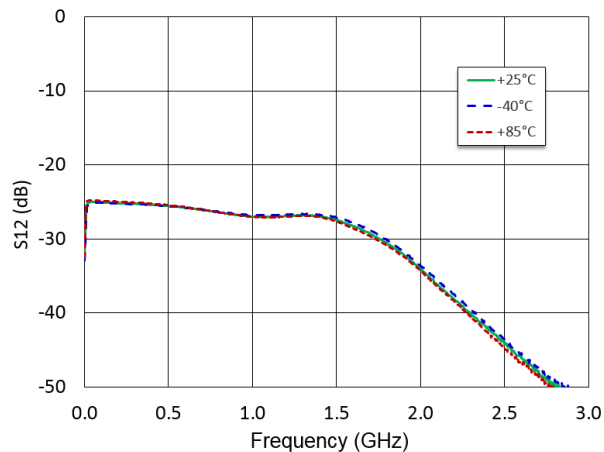
Gain to 3 GHz



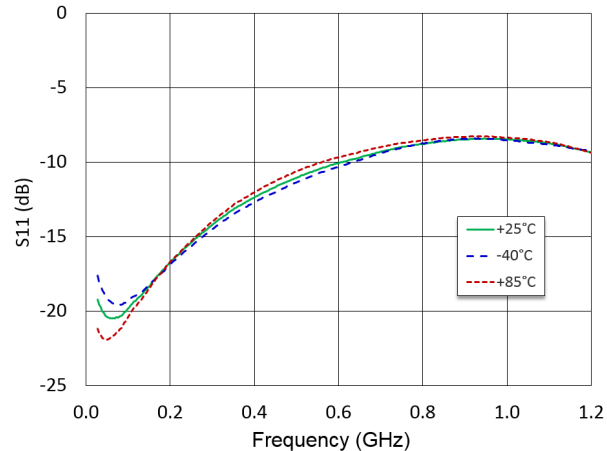
Output Return Loss to 1.218 GHz



Reverse Isolation to 3 GHz



Input Return Loss to 1.218 GHz



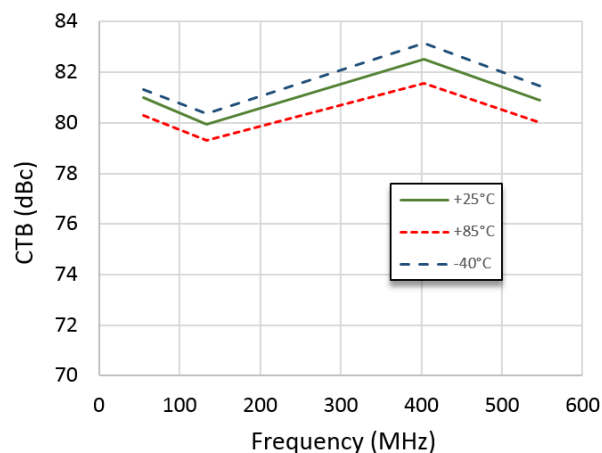
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Typical Performance Curves: $V_{DD} = 5\text{ V}$

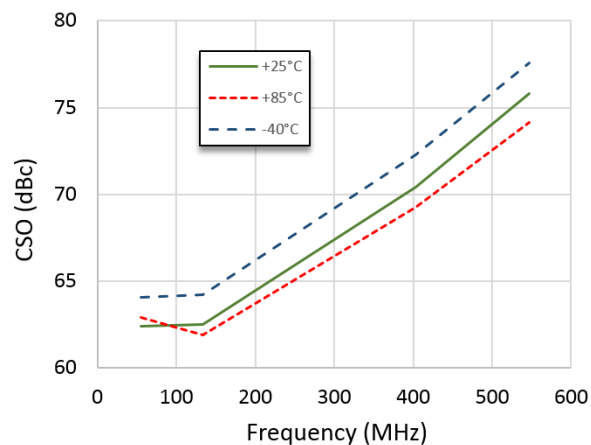
CTB

79 analog channels + QAM, 0 dB tilt,
 $P_{OUT} = 18\text{ dBmV}$ per channel



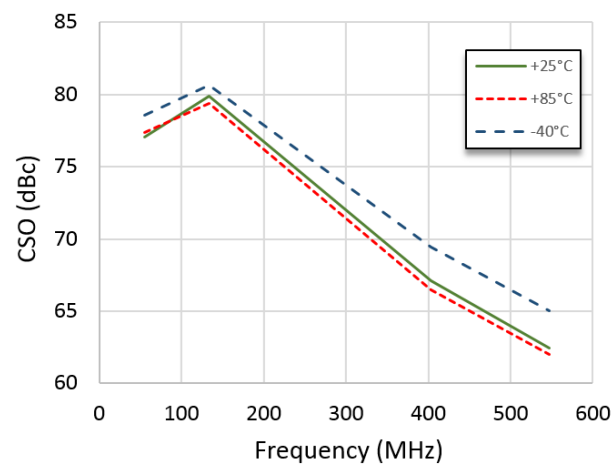
CSO Lower

79 analog channels + QAM, 0 dB tilt,
 $P_{OUT} = 18\text{ dBmV}$ per channel



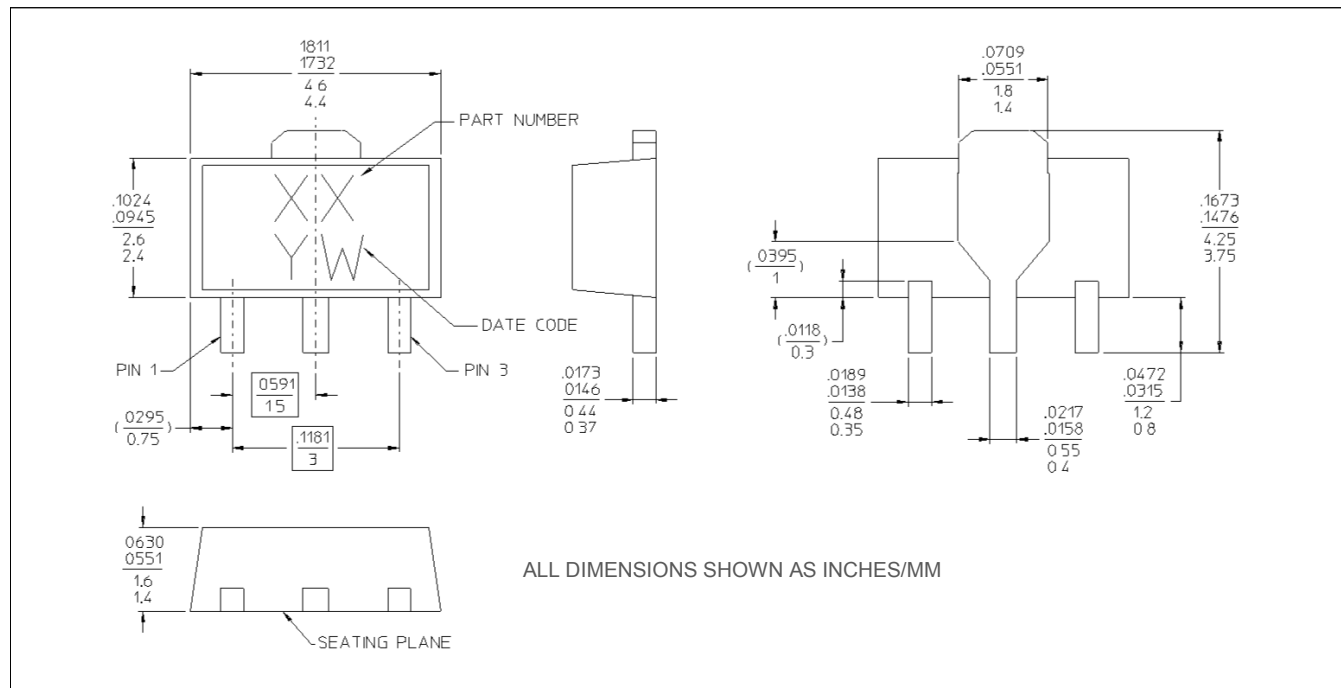
CSO Upper

79 analog channels + QAM, 0 dB tilt,
 $P_{OUT} = 18\text{ dBmV}$ per channel



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Lead Free SOT-89[†]

† 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

3 V Application

The MAAL-011136 may also be operated from 3 V V_{DD} supply with adjustment of two bias resistors:
R4 = 4.64 k Ω to set current at nominal 53 mA; and R6 = 0 Ω .

Typical Performance: $T_A = 25^\circ\text{C}$, $V_{DD} = 3\text{ V}$, $Z_0 = 75\ \Omega$

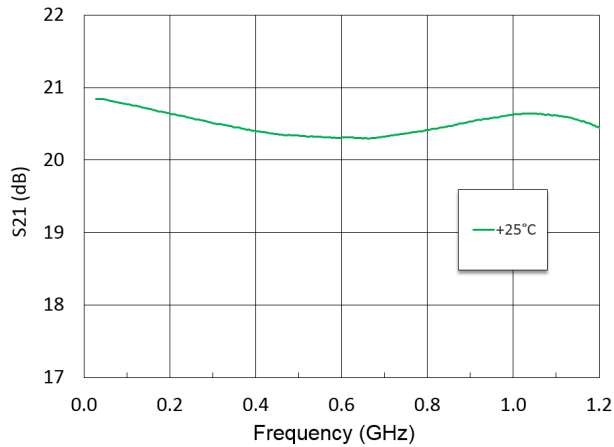
Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	45 - 1218 MHz	dB	—	20.5	—
Gain Flatness	45 - 1218 MHz	dB	—	+/- 0.2	—
Reverse Isolation	45 - 1218 MHz	dB	—	25	—
Input Return Loss	45 - 1218 MHz	dB	—	10	—
Output Return Loss	45 - 1218 MHz	dB	—	16	—
Noise Figure	45 - 100 MHz 100 - 1218 MHz	dB	—	1.2 1.2	—
Output IP2	45 - 1200 MHz, tone spacing 6 MHz, P_{OUT} per tone = 4 dBm	dBm	—	42	—
Output IP3	45 - 1200 MHz, tone spacing 6 MHz, P_{OUT} per tone = 4 dBm	dBm	—	32	—
P1dB	45 - 1218 MHz	dBm	—	16.5	—
Composite Triple Beat, CTB	79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz	dBc	—	-79	—
Composite Second Order, CSO	79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz	dBc	—	-62	—
I_{DD}	$V_{DD} = 3\text{ V}$	mA	—	53	—

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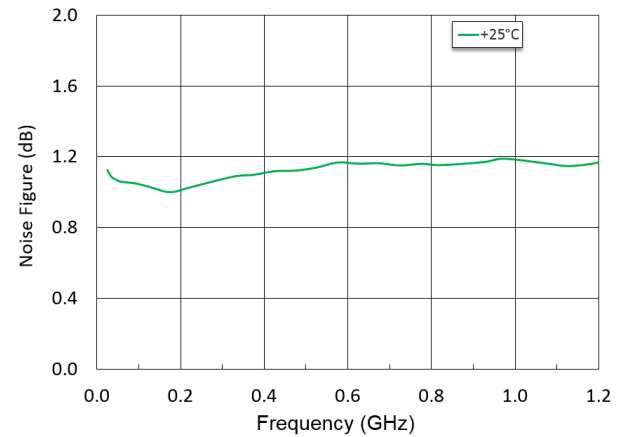
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Typical Performance Curves: $V_{DD} = 3$ V

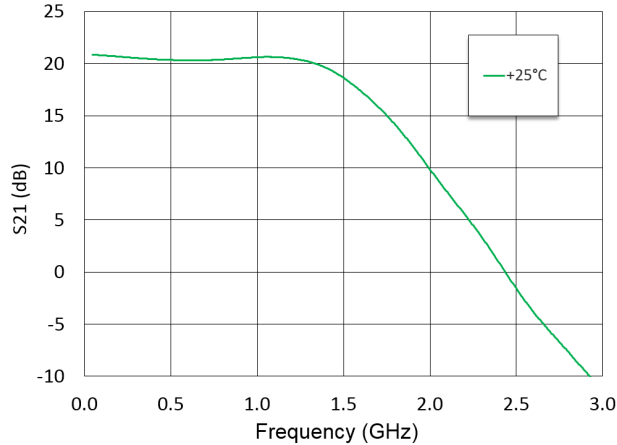
Gain to 1.218 GHz



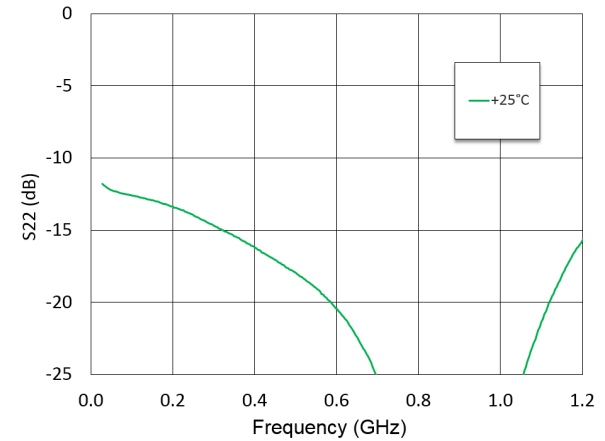
Noise Figure to 1.218 GHz



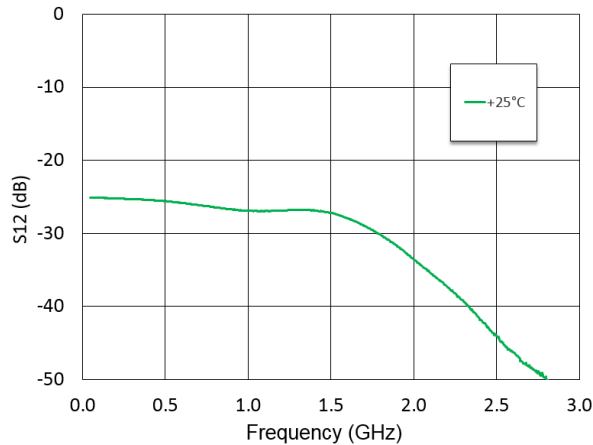
Gain to 3 GHz



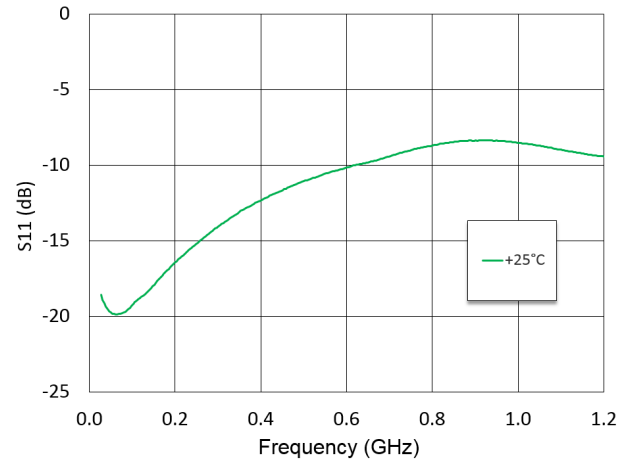
Output Return Loss to 1.218 GHz



Reverse Isolation to 3 GHz



Input Return Loss to 1.218 GHz



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