

NBB-312

Cascadable Broadband GaAs MMIC Amplifier
DC to 12GHz

The NBB-312 cascadable broadband InGaP/GaAs MMIC amplifier is a low-cost, high-performance solution for general purpose RF and microwave amplification needs. This 50 Ω gain block is based on a reliable HBT proprietary MMIC design, providing unsurpassed performance for small-signal applications. Designed with an external bias resistor, the NBB-312 provides flexibility and stability. The NBB-312 is packaged in a low cost, surface-mount ceramic package, providing ease of assembly for high-volume tape-and-reel requirements. It is available in either 1,000 or 3,000 piece-per-reel quantities. Connectorized evaluation board designs optimized for high frequency are also available for characterization purposes.



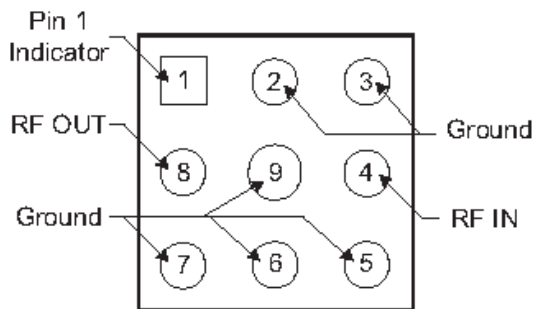
Package: MPGA, Bowtie, 3x3, Ceramic

Features

- Reliable, Low-Cost HBT Design
- 12.5dB Gain
- High P1dB of +15.8dBm at 6GHz
- Single Power Supply Operation
- 50 Ω I/O Matched for High Frequency Use

Applications

- Narrow and Broadband Commercial and Military Radio Designs
- Linear and Saturated Amplifiers
- Gain Stage or Driver Amplifiers for MWRadio/Optical Designs (PTP/PMP/LMDS/UNII/VSAT/WiFi/Cellular/DWDM)



Functional Block Diagram

Ordering Information

NBB-312	Cascadable Broadband GaAs MMIC Amplifier DC to 12GHz
NBB-312-T1	Tape & Reel, 1000 Pieces
NBB-312-E	Fully Assembled Evaluation Board
NBB-X-K1	Extended Frequency InGaP Amp Designer's Tool Kit

Absolute Maximum Ratings

Parameter	Rating	Unit
RF Input Power	+20	dBm
Power Dissipation	350	mW
Device Current	70	mA
Channel Temperature	150	°C
Operating Temperature	-45 to +85	°C
Storage Temperature	-65 to +150	°C

Exceeding any one or a combination of these limits may cause permanent damage.



Caution! ESD sensitive device.



RFMD Green: RoHS compliant per EU Directive 2011/65/EU, halogen free per IEC 61249-2-21, <1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony solder.

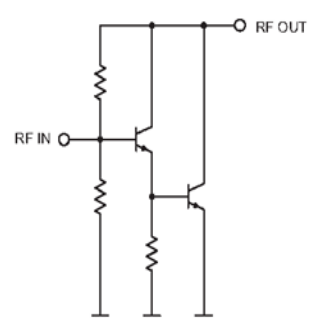
Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

Nominal Operating Parameters

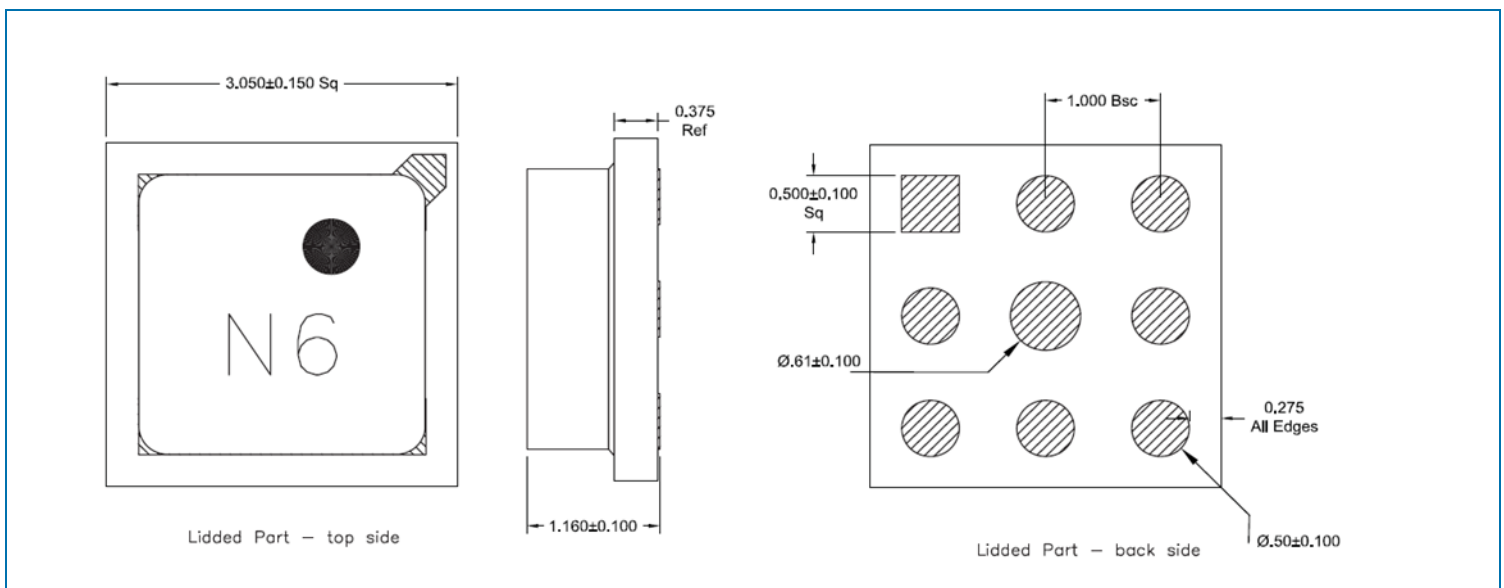
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Performance					V _D = +4.6V, I _{CC} = 50mA, Z ₀ = 50Ω, T _A = +25°C
Small Signal Power Gain, S21		12.9		dB	f = 0.1GHz to 1.0GHz
	12.0	12.9		dB	f = 1.0GHz to 4.0GHz
		11.7		dB	f = 4.0GHz to 8.0GHz
	9.0	9.7		dB	f = 8.0GHz to 12.0GHz
Gain Flatness, GF		±0.6		dB	f = 0.1GHz to 8.0GHz
Input VSWR		1.2:1			f = 0.1GHz to 7.0GHz
		1.65:1			f = 7.0GHz to 10.0GHz
		2.0:1			f = 10.0GHz to 12.0GHz
Output VSWR		1.5:1			f = 0.1GHz to 12.0GHz
Bandwidth, BW		11.0		GHz	BW3 (3dB)
Output Power at -1dB Compression, P1dB		14.9		dBm	f = 2.0GHz
		15.8		dBm	f = 6.0GHz
		15.0		dBm	f = 8.0GHz
		12.0		dBm	f = 12.0GHz
Noise Figure, NF		4.9		dB	f = 3.0GHz
Third Order Intercept, IP3		+24.0		dBm	f = 2.0GHz
Reverse Isolation, S12		-15.6		dB	f = 0.1GHz to 12.0GHz
Device Voltage, V _D	4.4	4.6	4.8	V	
Gain Temperature Coefficient, $\delta G_T/\delta T$		-0.0015		dB/°C	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
MTTF versus Temperature at $I_{CC} = 50\text{mA}$					
Case Temperature		85		°C	
Junction Temperature		123		°C	
MTTF		>1,000,000		hours	
Thermal Resistance					
θ_{JC}		152		°C/W	$\frac{J_T - T_{CASE}}{V_D \cdot I_{CC}} = \theta_{JC} (\text{°C/Watt})$

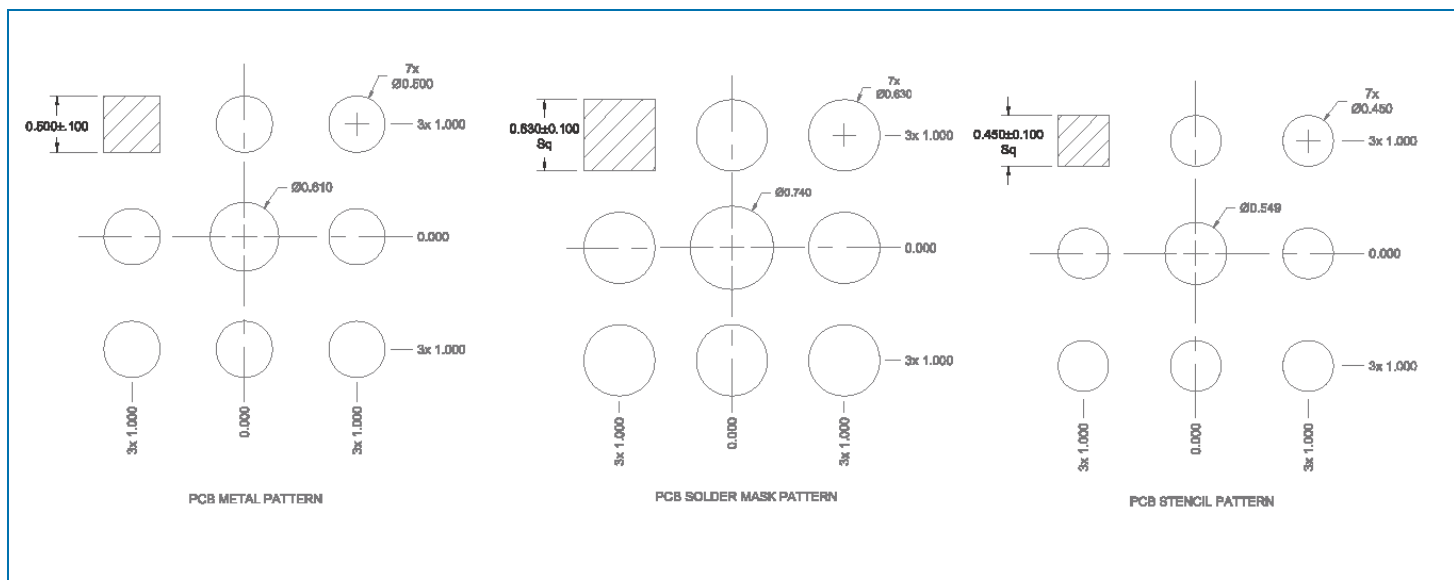
Pin Names and Descriptions

Pin	Name	Description	Interface Schematic
1-3	GND	Ground connection. For best performance, keep traces physically short and connect immediately to ground plane.	
4	RFIN	RF input pin. This pin is NOT internally DC blocked. A DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. DC coupling of the input is not allowed, because this will override the internal feedback loop and cause temperature instability.	
5-7	GND	Ground connection. For best performance, keep traces physically short and connect immediately to ground plane.	
8	RFOUT	RF output and bias pin. Biasing is accomplished with an external series resistor and choke inductor to V_{CC}. The resistor is selected to set the DC current into this pin to a desired level. The resistor value is determined by the following equation: $R = \frac{(V_{CC} - V_{DEVICE})}{I_{CC}}$ Care should also be taken in the resistor selection to ensure that the current into the part never exceeds maximum datasheet operating current over the planned operating temperature. This means that a resistor between the supply and this pin is always required, even if a supply near 8.0V is available, to provide DC feedback to prevent thermal runaway. Alternatively, a constant current supply circuit may be implemented. Because DC is present on this pin, a DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. The supply side of the bias network should also be well bypassed.	
9	GND	Ground connection. For best performance, keep traces physically short and connect immediately to ground plane.	

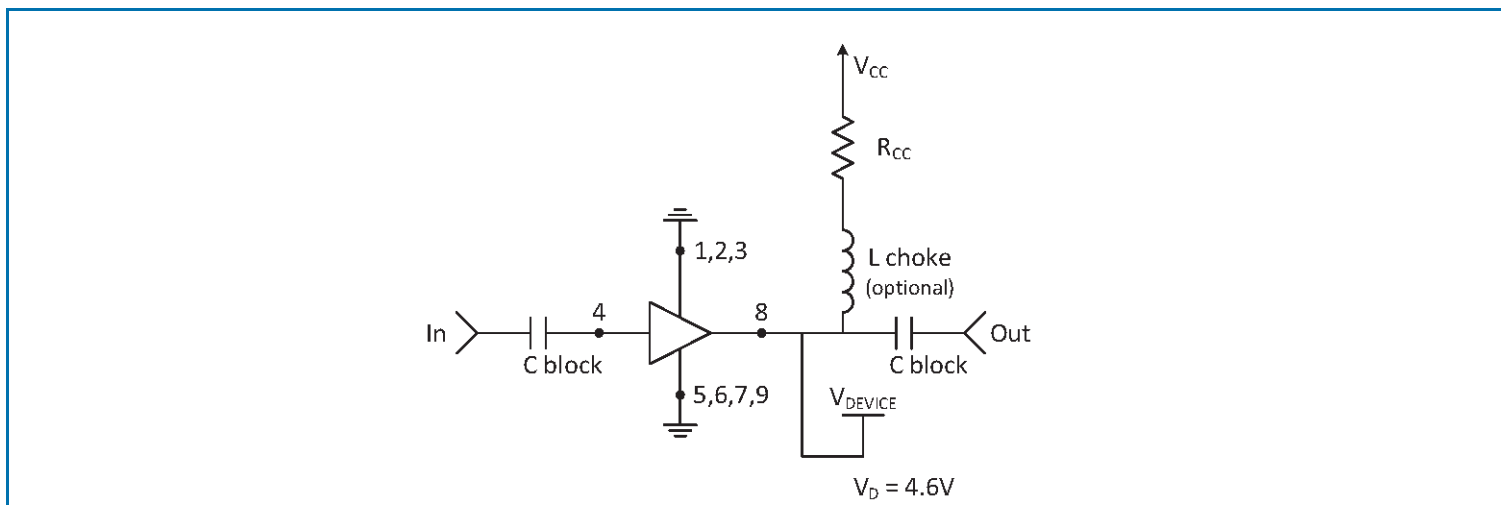
Package Drawing



Recommended PCB Layout



Typical Bias Configuration



NOTE: Application notes related to biasing circuit, device footprint, and thermal considerations are available on request.

Recommended Bias Resistor Values

Supply Voltage, V_{CC} (V)	8	10	12	15	20
Bias Resistor, R_{CC} (Ω)	60	100	140	200	300

Application Notes

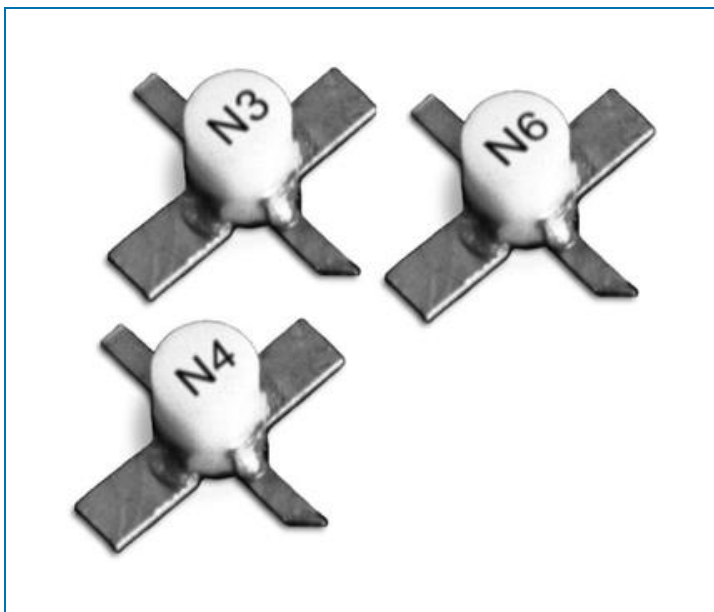
Bonding Temperature (Wedge or Ball)

It is recommended that the heater block temperature be set to $160^{\circ}\text{C} \pm 10^{\circ}\text{C}$.

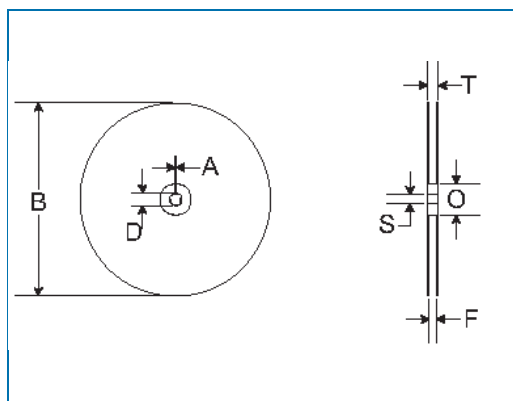
Extended Frequency InGaP Amplifier Designer's Tool Kit (NBB-X-K1)

This tool kit was created to assist in the design-in of the RFMD NBB- and NLB- series InGaP HBT gain block amplifiers. Each tool kit contains the following:

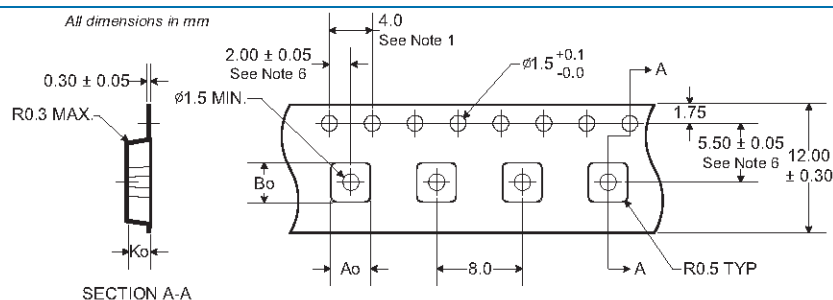
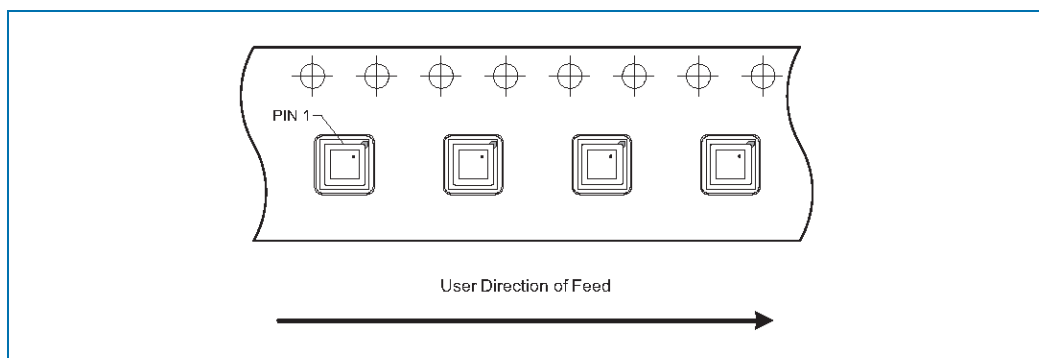
- 5 each NBB-300, NBB-310 and NBB-400 Ceramic Micro-X Amplifiers
- 5 each NLB-300, NLB-310 and NLB-400 Plastic Micro-X Amplifiers
- 2 Broadband Evaluation Boards and High Frequency SMA Connectors
- Broadband Bias Instructions and Specification Summary Index for ease of operation



Tape and Reel Dimensions (all dimensions in millimeters)



330 mm (13") REEL			Micro-X, MPGA	
	ITEMS	SYMBOL	SIZE (mm)	SIZE (inches)
FLANGE	Diameter	B	330 +0.25/-4.0	13.0 +0.079/-0.158
	Thickness	T	18.4 MAX	0.724 MAX
	Space Between Flange	F	12.4 +2.0	0.488 +0.08
HUB	Outer Diameter	O	102.0 REF	4.0 REF
	Spindle Hole Diameter	S	13.0 +0.5/-0.2	0.512 +0.020/-0.008
	Key Slit Width	A	1.5 MIN	0.059 MIN
	Key Slit Diameter	D	20.2 MIN	0.795 MIN



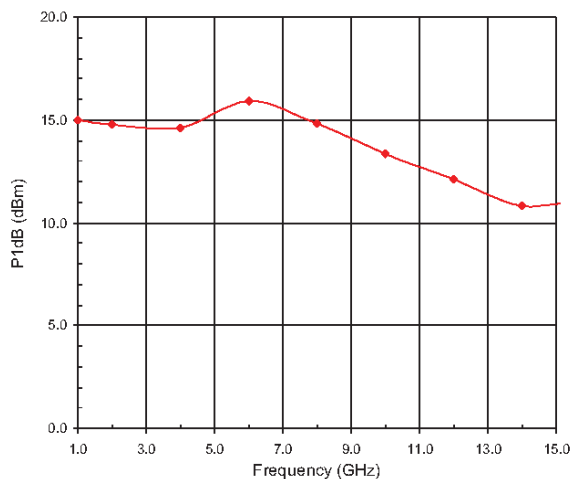
NOTES:

- 10 sprocket hole pitch cumulative tolerance ± 0.2 .
- Camber not to exceed 1 mm in 100 mm.
- Material: PS+C
- Ao and Bo measured on a plane 0.3 mm above the bottom of the pocket.
- Ko measured from a plane on the inside bottom of the pocket to the surface of the carrier.
- Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

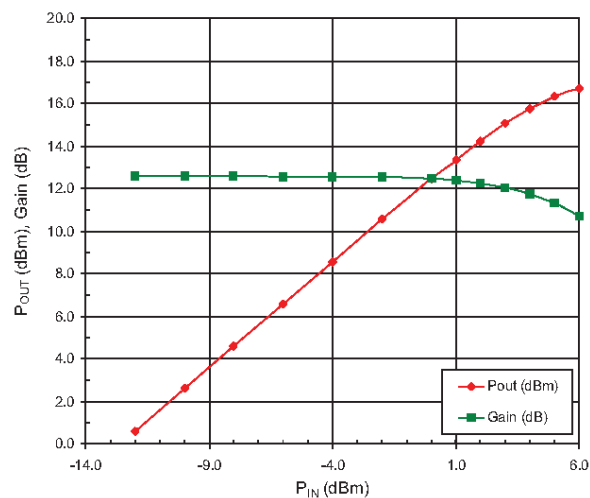
Ao = 3.6 MM
Bo = 3.6 MM
Ko = 1.7 MM

Typical Performance

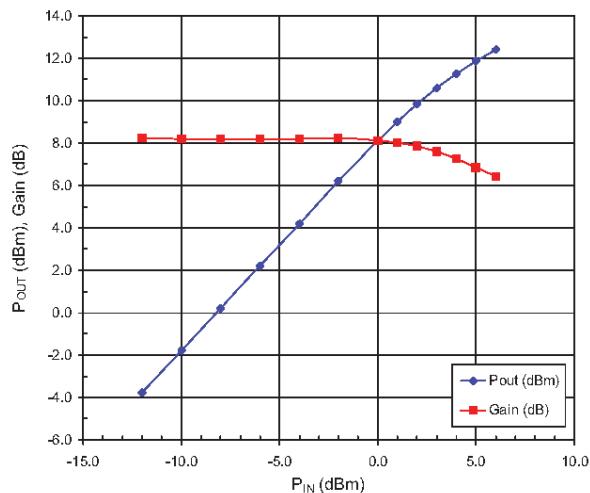
P1dB versus Frequency at 25°C



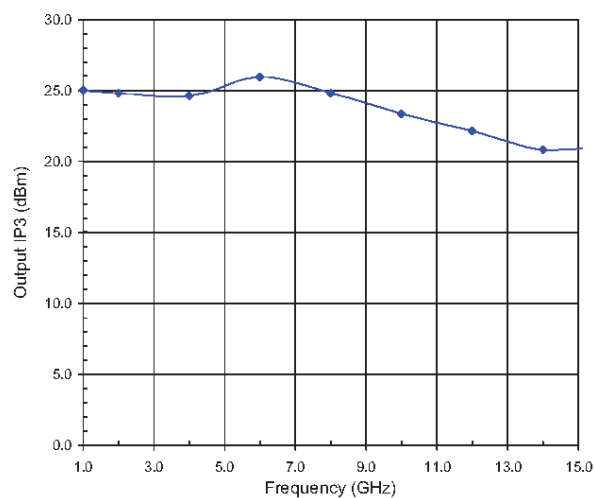
$P_{OUT}/Gain$ versus P_{IN} at 6 GHz



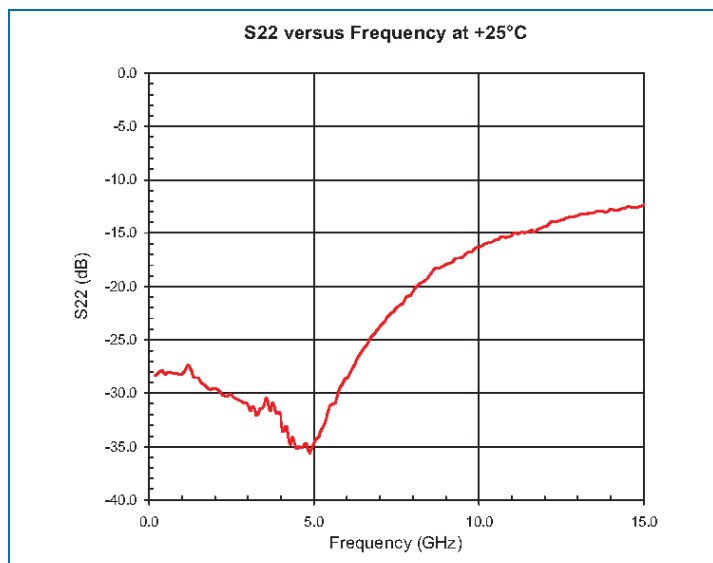
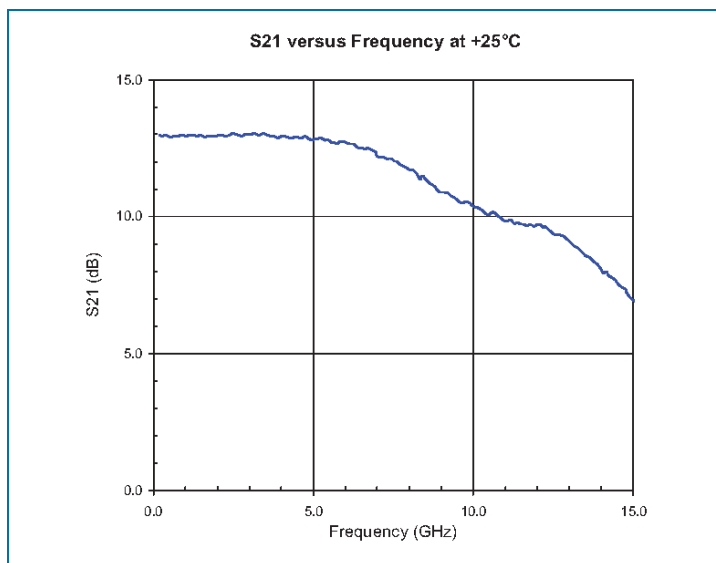
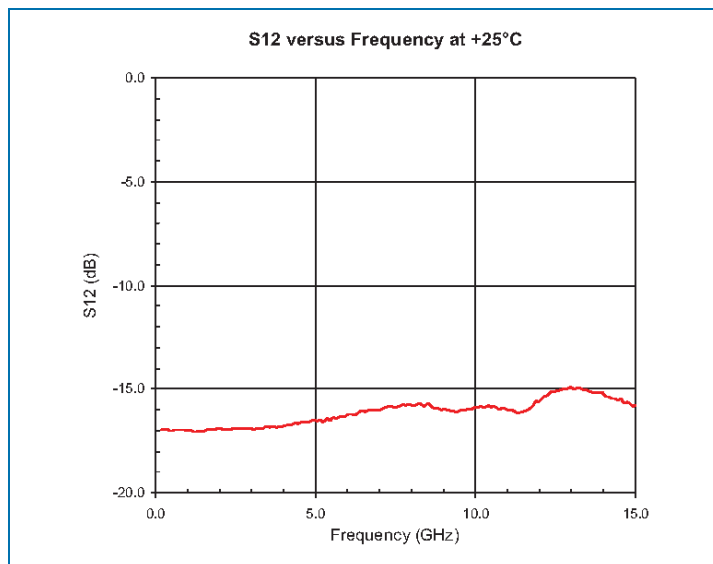
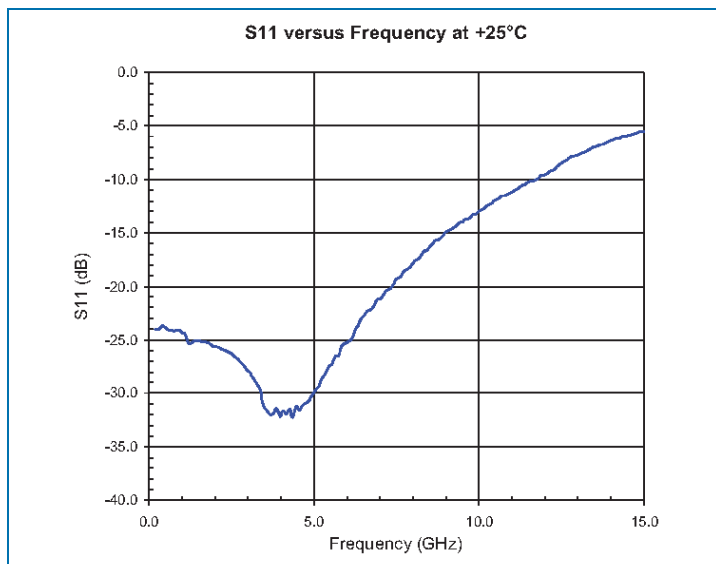
$P_{OUT}/Gain$ versus P_{IN} at 14 GHz



Third Order Intercept versus Frequency at 25°C



Typical Performance (continued)



Note: The s-parameter gain results shown above include device performance as well as evaluation board and connector loss variations. The insertion losses of the evaluation board and connectors are as follows:

1GHz to 4GHz = -0.06dB
 5GHz to 9GHz = -0.22dB
 10GHz to 14GHz = -0.50dB
 15GHz to 20GHz = -1.08dB

RoHS Banned Material Content

RoHS Compliant: Yes
 Package Total Weight in Grams (g): 0.028
 Compliance Date Code: N/A
 Bill of Materials Revision: -
 Pb Free Category: e4

Bill of Materials	Parts Per Million (PPM)					
	Pb	Cd	Hg	Cr VI	PBB	PBDE
Die	0	0	0	0	0	0
Molding Compound	0	0	0	0	0	0
Lead Frame	0	0	0	0	0	0
Die Attach Epoxy	0	0	0	0	0	0
Wire	0	0	0	0	0	0
Solder Plating	0	0	0	0	0	0

This RoHS banned material content declaration was prepared solely on information, including analytical data, provided to RFMD by its suppliers, and applies to the Bill of Materials (BOM) revision noted

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[NBB-312-T1](#)