NBB-502

Cascadable Broadband GaAs MMIC Amplifier
DC to 4GHz

Package: MPGA, Bowtie, 3x3, Ceramic

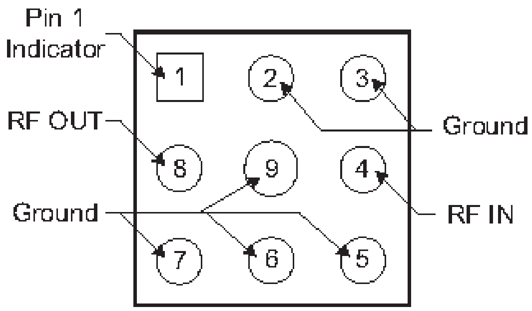
The NBB-502 cascadable broadband InGaP/GaAs MMIC amplifier is a low-cost, high-performance solution for general purpose RF and microwave amplification needs. This 50Ω gain block is based on a reliable HBT proprietary MMIC design, providing unsurpassed performance for small-signal applications. Designed with an external bias resistor, the NBB-502 provides flexibility and stability. The NBB-502 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.

Features

- Reliable, Low-Cost HBT Design
- 19.0dB Gain, +13.0dBm P1dB at 2GHz
- High P1dB of +14.0dBm at 6.0GHz
- Single Power Supply Operation
- 50Ω 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-502	Cascadable Broadband GaAs MMIC Amplifier DC to 4GHz
NBB-502-T1	Tape & Reel, 1000 Pieces
NBB-502-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	300	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.

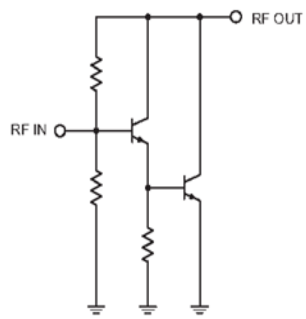
Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute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

Nominal Operating Parameters

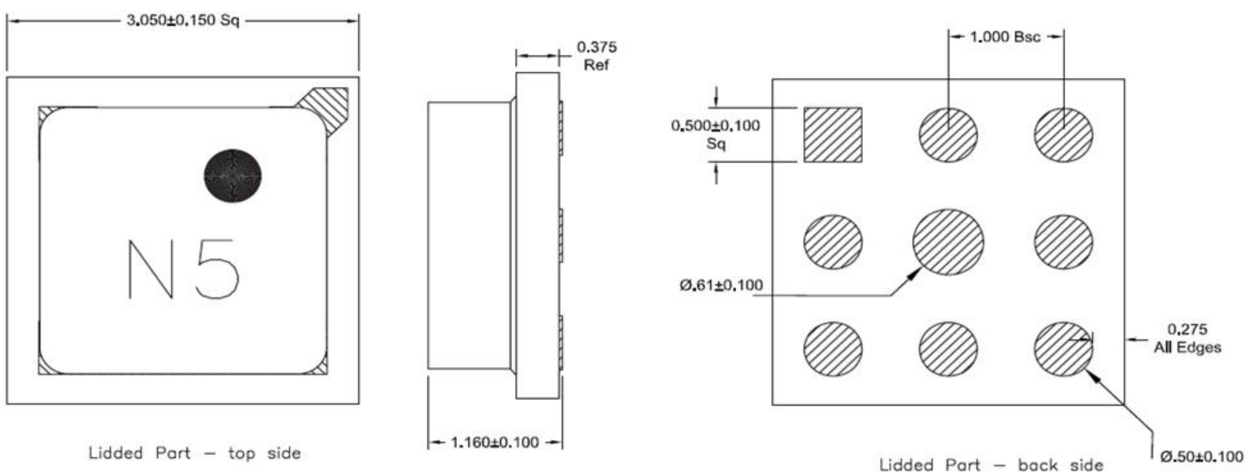
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Performance					**V_D = +3.9V, I_{CC} = 35mA, Z_0 = 50Ω, T_A = +25°C**
Small Signal Power Gain, S21	19.0	20.5		dB	f = 0.1GHz to 1.0GHz
		19.0		dB	f = 1.0GHz to 2.0GHz
	16.0	17.0		dB	f = 2.0GHz to 4.0GHz
Gain Flatness, GF		±0.8		dB	f = 1.0GHz to 3.0GHz
Input and Output VSWR		1.55:1			f = 0.1GHz to 4.0GHz
		1.50:1			f = 4.0GHz to 6.0GHz
		1.55:1			f = 6.0GHz to 10.0GHz
Bandwidth, BW		4.2		GHz	BW3 (3dB)
Output Power at -1dB Compression, P1dB		13.0		dBm	f = 2.0GHz
		14.0		dBm	f = 6.0GHz
Noise Figure, NF		4.0		dB	f = 3.0GHz
Third Order Intercept, IP3		+23.0		dBm	f = 2.0GHz
Reverse Isolation, S12		-17.0		dB	f = 0.1GHz to 10.0GHz
Device Voltage, V_D	3.6	3.9	4.2	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} = 35mA					
Case Temperature		85		°C	
Junction Temperature		109.4		°C	
MTTF		>1,000,000		hours	
Thermal Resistance					
θ_{JC}		179		°C/W	$\frac{J_T - T_{CASE}}{V_D \cdot I_{CC}} = \theta_{JC}(°C/Watt)$

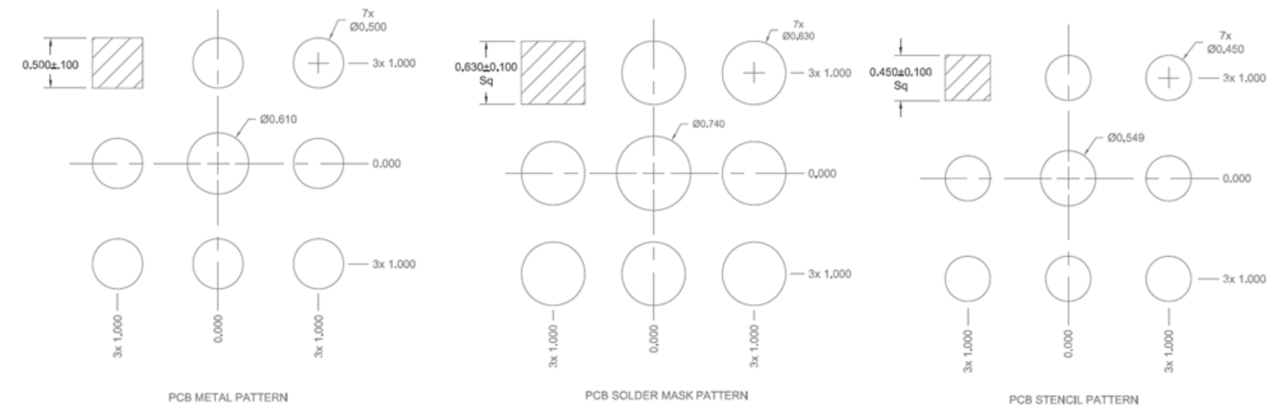
Pin Names and Descriptions

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 5.0V 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.	

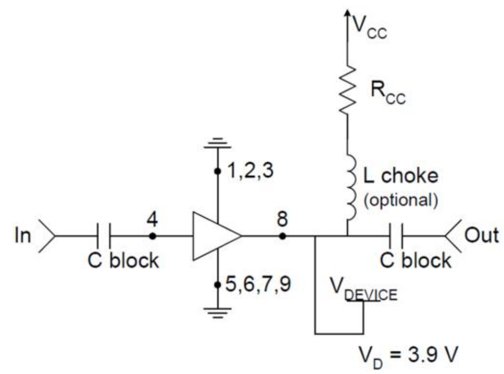
Package Drawing



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)	5	8	10	12	15	20
Bias Resistor, R_{CC} (Ω)	31	117	174	231	317	460

Application Notes

Die Attach
The die attach process mechanically attaches the die to the circuit substrate. In addition, it electrically connects the ground to the trace on which the chip is mounted, and establishes the thermal path by which heat can leave the chip.

Wire Bonding
Electrical connections to the chip are made through wire bonds. Either wedge or ball bonding methods are acceptable practices for wire bonding.

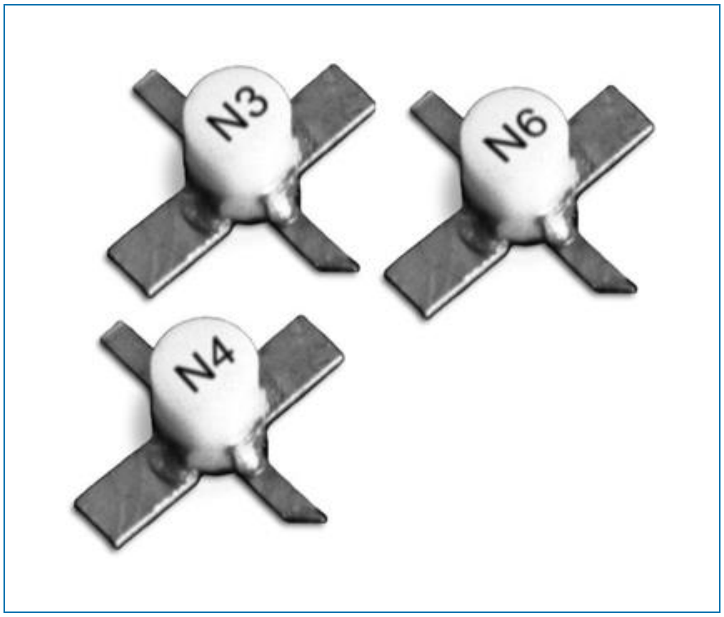
Assembly Procedure
Epoxy or eutectic die attach are both acceptable attachment methods. Top and bottom metallization are gold. Conductive silver-filled epoxies are recommended. This procedure involves the use of epoxy to form a joint between the backside gold of the chip and the metallized area of the substrate. A 150°C cure for 1 hour is necessary. Recommended epoxy is Ablebond 84-1LMI from Ablestik.

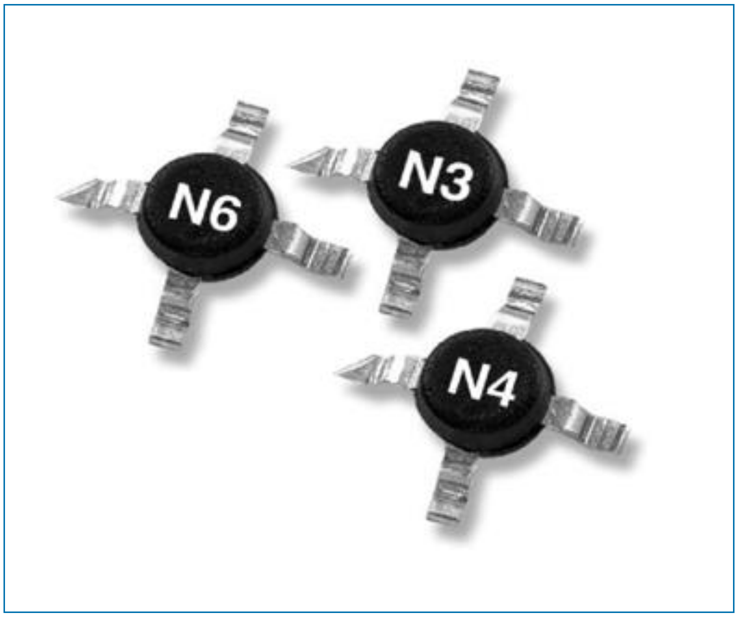
Bonding Temperature (Wedge or Ball)
It is recommended that the heater block temperature be set to 160°C ± 10°C.

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

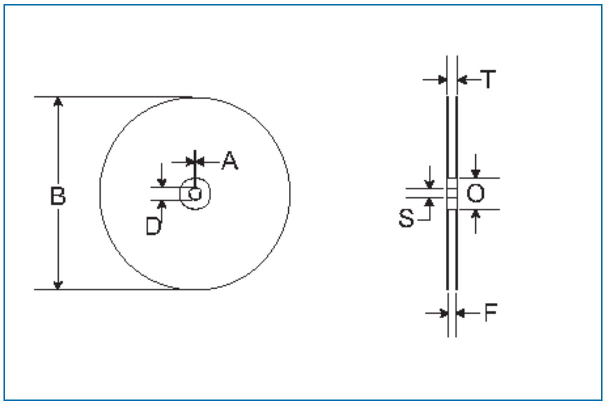
This tool kit was created to assist in the design-in of the RFMD NBB- and NLB- series InGap HBT gain block amplifiers. Each tool kit contains the following:

- 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

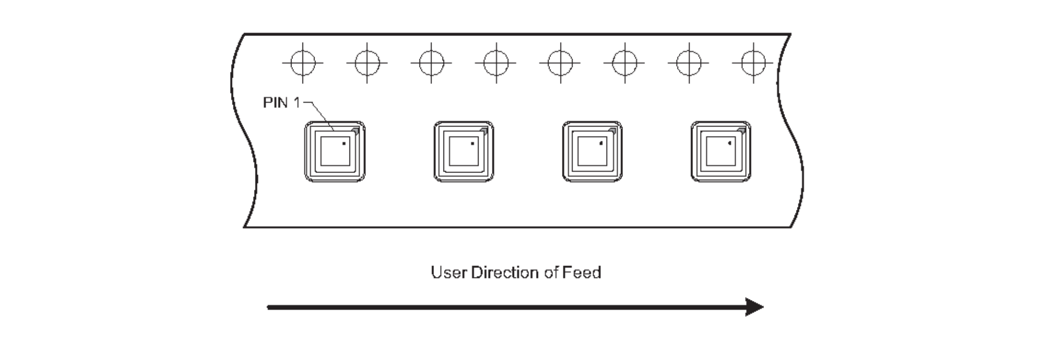


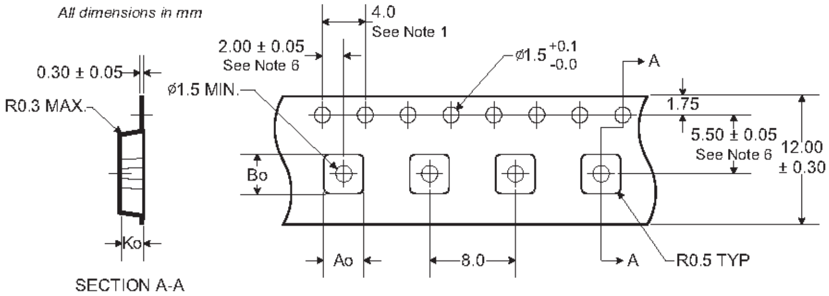


Tape and Reel Dimensions (all dimensions in millimeters)



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

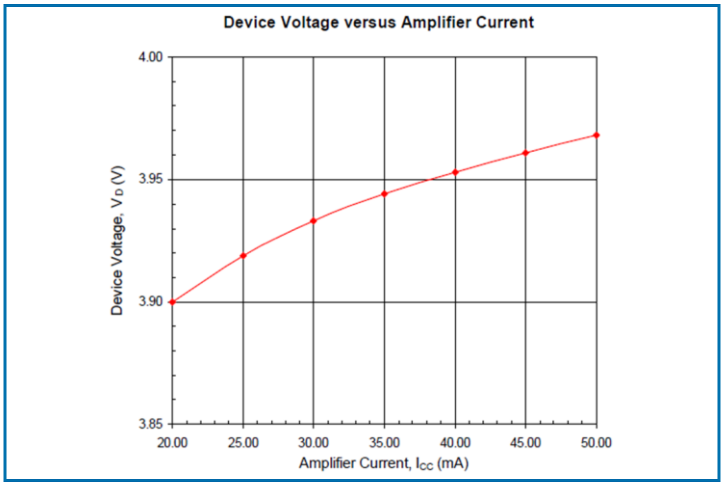


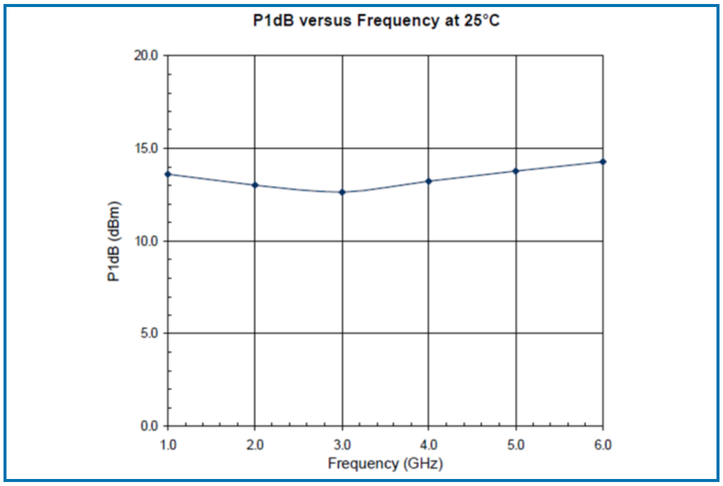


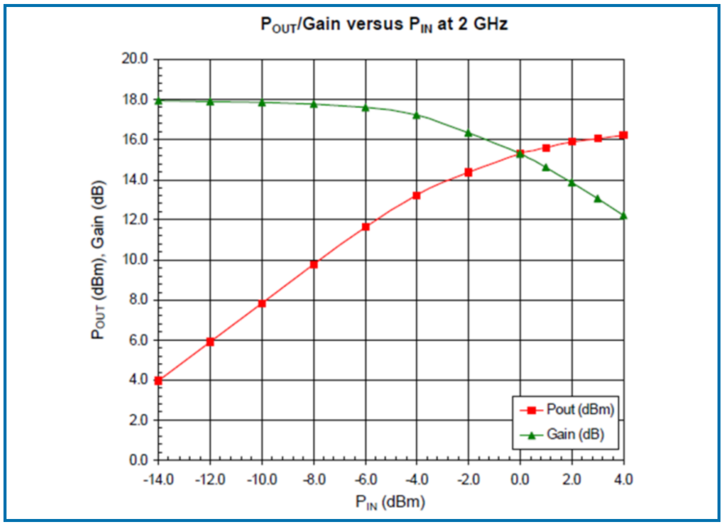
NOTES:
1. 10 sprocket hole pitch cumulative tolerance ±0.2.
2. Camber not to exceed 1 mm in 100 mm.
3. Material: PS+C
4. Ao and Bo measured on a plane 0.3 mm above the bottom of the pocket.
5. Ko measured from a plane on the inside bottom of the pocket to the surface of the carrier.
6. Pocket position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

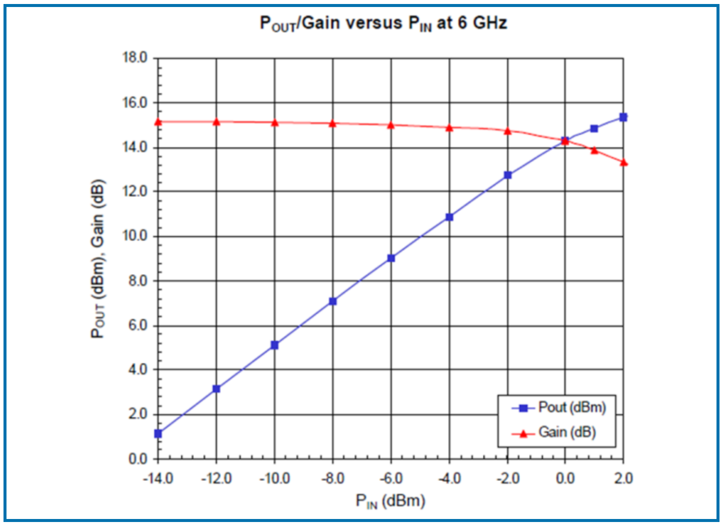
Ao = 3.6 MM
Bo = 3.6 MM
Ko = 1.7 MM

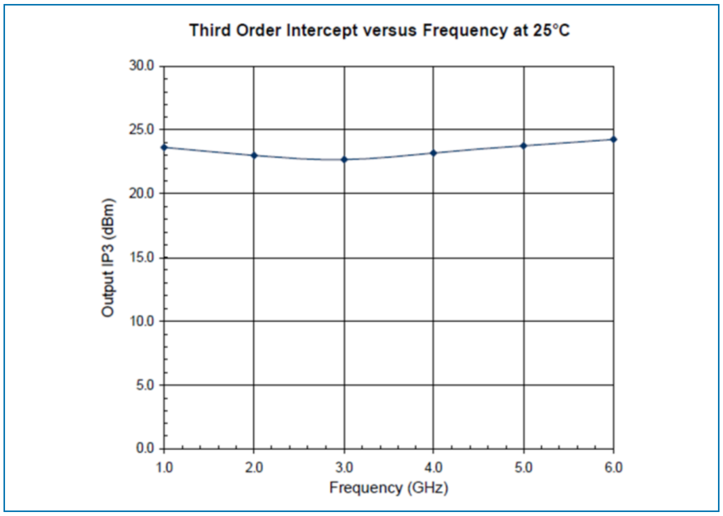
Typical Performance



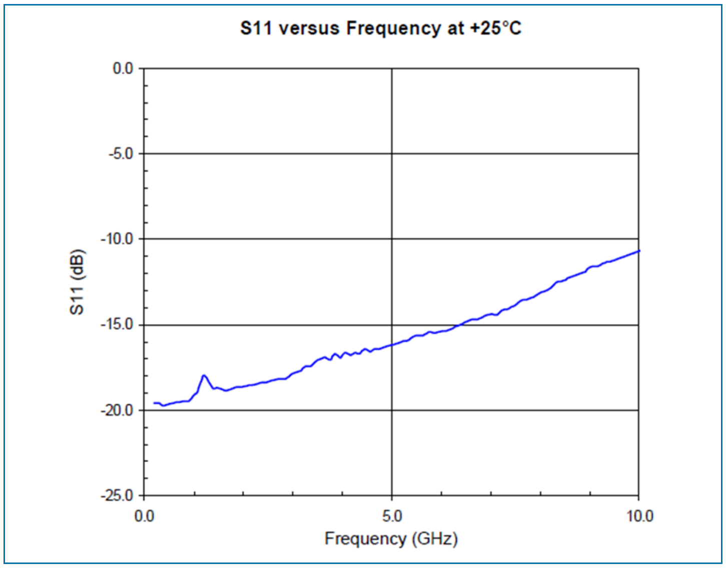


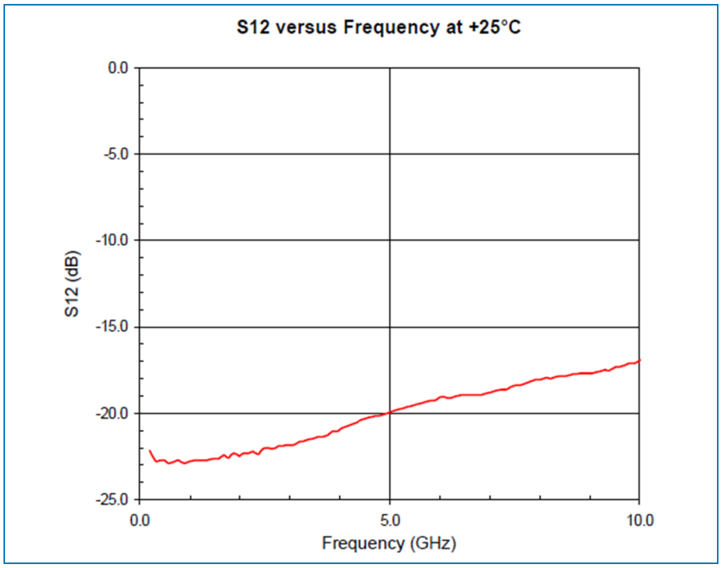


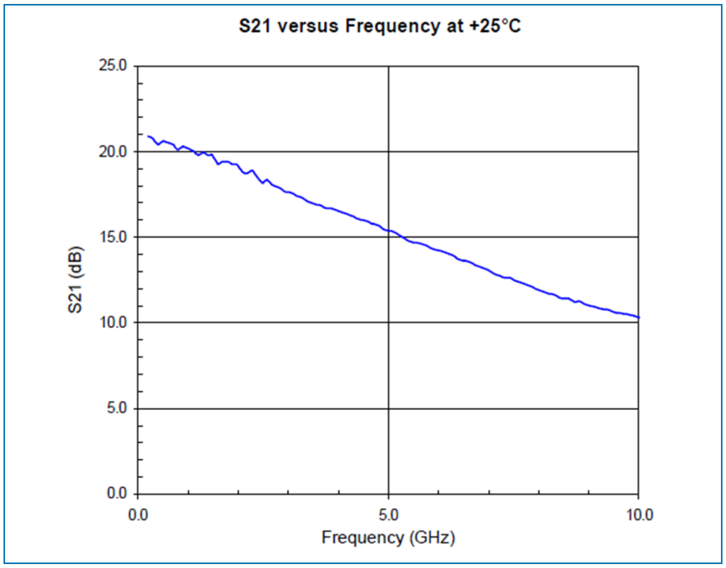


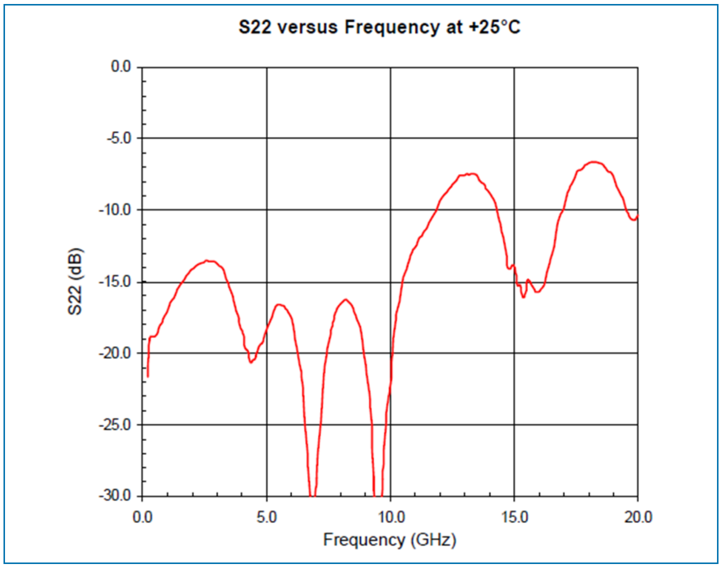


Typical Performance (continued)









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