

AM1159 – Attenuator/Amplifier

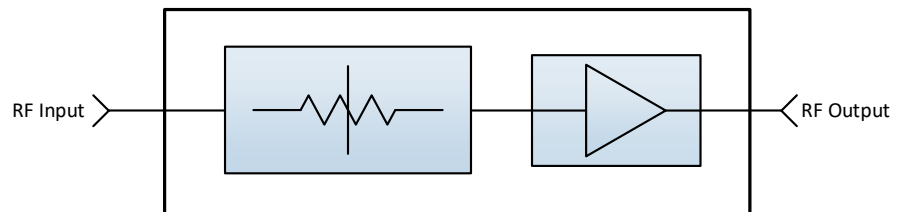
1.4 GHz to 20 GHz Step Attenuator/ Gain Block

AM1159 is a broadband MCM combining a digital step attenuator and high dynamic range gain block covering the 1.4 to 20 GHz frequency range. With internal 50Ω matching and packaged in a 4mm QFN, the AM1159 is a dramatic reduction in size from a discrete implementation of a variable gain block making it an ideal candidate for low SWaP applications.

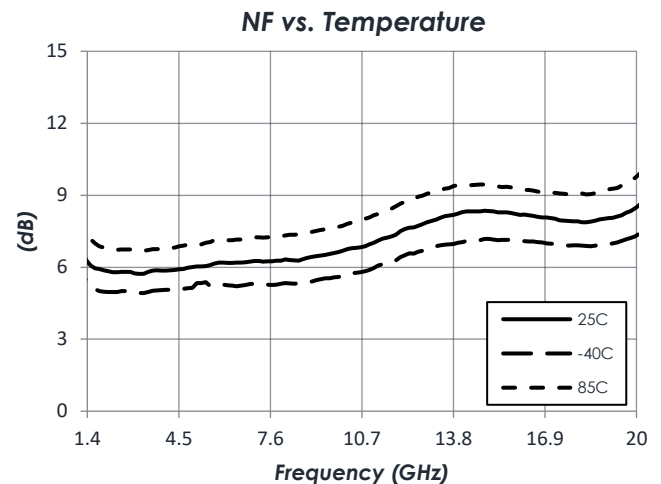
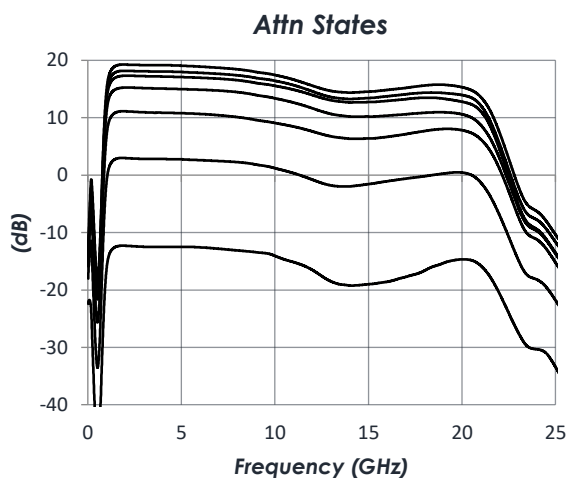
FEATURES

- Broadband, 1.4 to 20 GHz
- +3.3V and 4.1V Supply
- +3.3V to +5.0V Control
- 17.4dB Gain to 14.5dB Insertion Loss
- -16dB Return Loss
- 4mm QFN Package
- -40C to +85C Operation

FUNCTIONAL DIAGRAM



CHARACTERISTIC PERFORMANCE



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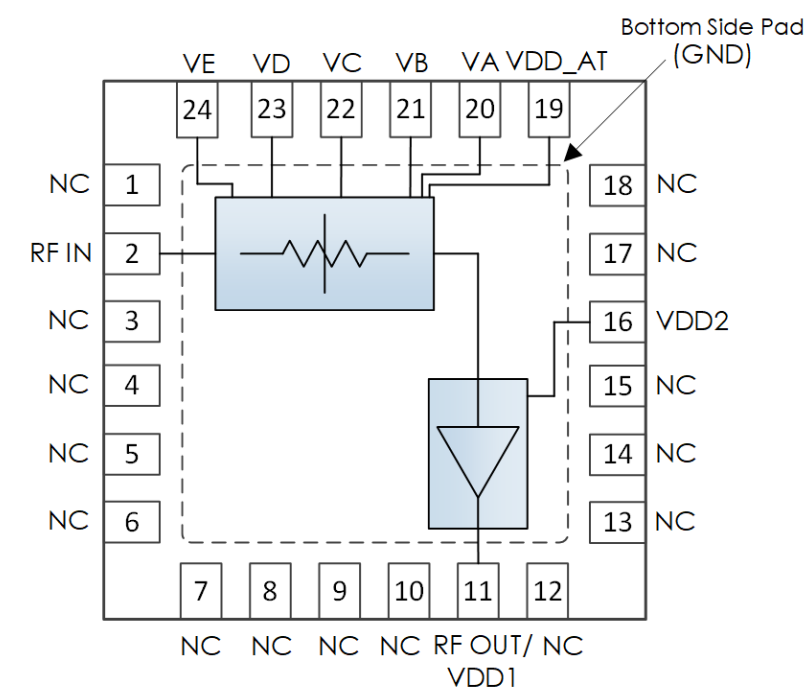
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REVISION HISTORY

Date	Revision	Notes
March 4, 2022	1	Initial Release
September 5, 2024	2	Changed to Mercury branding. No content changes.
January 9, 2025	3	Updated Performance and Plots
December 17, 2025	3.1	Plot corrections

PIN LAYOUT AND DEFINITIONS



Pin	Name	Function
1	NC	Not Connected
2	RF IN	RF Input – 50 Ohms – DC Coupled. External DC blocking capacitor required*
3-10	NC	Not Connected
11	RF OUT/ VDD1	RF Output – 50 Ohms – DC Coupled. External DC blocking capacitor required*
12	NC	Not Connected
13	NC	Not Connected
14, 15	NC	Not Connected
16	VDD2	DC Power Input
17, 18	NC	RF Output – 50 Ohms – DC Blocked
19	VDD_AT	DC Power Input
20	VA	Attenuator Control Bit A
21	VB	Attenuator Control Bit B
22	VC	Attenuator Control Bit C
23	VD	Attenuator Control Bit D
24	VE	Attenuator Control Bit E

Note: NC pins may be grounded or left open.

SPECIFICATIONS

Absolute Maximum Ratings

	Minimum	Maximum
RF Input Power		+27 dBm
Operating Junction Temperature	-40 C	+150 C
Storage Temperature Range	-55 C	+150 C

Note: Any device operation beyond the Absolute Maximum Ratings may result in permanent damage to the device. The values listed in this table are extremes and do not imply functional operation of the device at these or any other conditions beyond what is listed under Recommended Operating Conditions. Any part subjected to conditions outside of what is recommended for an extended amount of time may suffer from reliability concerns.

Handling Information

	Minimum	Maximum
Moisture Sensitivity Level	MSL 3	



Mercury products are electrostatic sensitive.
Follow safe handling practices to avoid damage.

Recommended Operating Conditions

	Minimum	Typical	Maximum
Operating Case Temperature	-40 C		+85 C

Thermal Information

Thermal Resistance (°C / W)	
Junction to Case Thermal Resistance (θ_{JC})	165 C/W
Nominal Junction Temperature at +85 C ambient	158 C
Channel Temperature to Maintain 1 Million Hour MTTF	175 C

DC Electrical Characteristics

Param	Testing Conditions	Min	Typical	Max
DC Supply Voltage	VDD1 = +4.1V	+3.8 V	+4.1 V	+4.3 V
	VDD2 = +3.3V	+3.0 V	+3.3 V	+3.5 V
DC Supply Current	VDD_AT = +3.3V	+3.0 V	+3.3 V	+3.5 V
	VDD1 = +4.1V		62 mA	
	VDD_2 = +3.3V		49 mA	
Total DC Supply Current	VDD_AT = +3.3V		1 mA	
			112 mA	
Power Dissipated	VDD1 = +4.1V		254 mW	
	VDD2 = +3.3V		162 mW	
	VDD_AT = +3.3V		3.3 mW	
Total Power Dissipated			419 mW	
Logic Level Low		-0.1 V		+0.5 V
Logic Level High		+2.0 V		+VDD V

RF Performance

Param	Testing Conditions	Min	Typical	Max
Frequency Range		1.4 GHz		20 GHz
Gain	f = 10 GHz, 0 dB Attenuation		17.3 dB	
	f = 10 GHz, 31 dB Attenuation		-14.5 dB	
Return Loss	f = 10 GHz, 0 dB Attenuation		-15.5 dB	
	f = 10 GHz, 31 dB Attenuation		-16.4 dB	
Output IP3	f = 10 GHz, 0 dB Attenuation		29.6 dB	
Output P1dB	f = 10 GHz, 0 dB Attenuation		19.7 dB	
Noise Figure	f = 10 GHz, 0 dB Attenuation		6.7 dB	

Timing Characteristics

Param	Min	Typical	Max
0 dB to 31 dB 50% CTL to 10% RF		100 ns	
31 dB to 0 dB 50% CTL to 90% RF		300 ns	

State Table

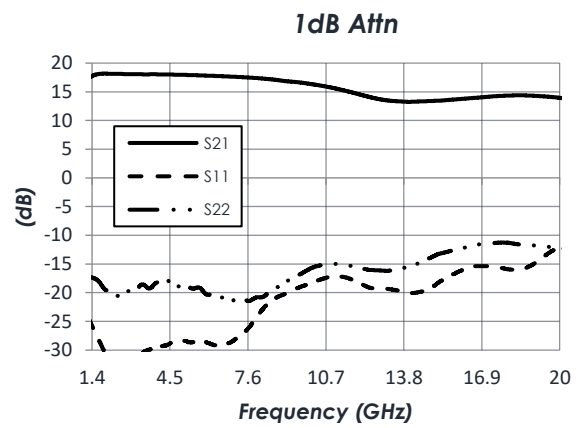
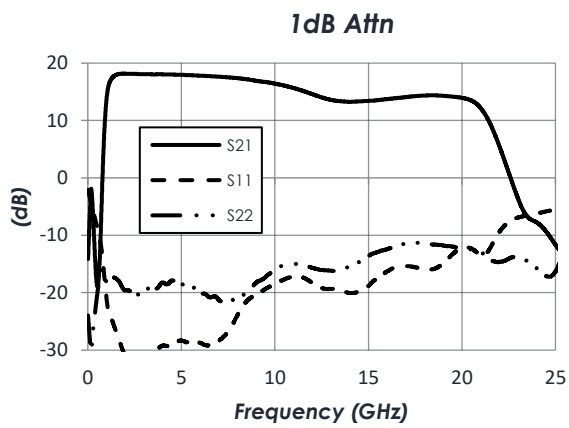
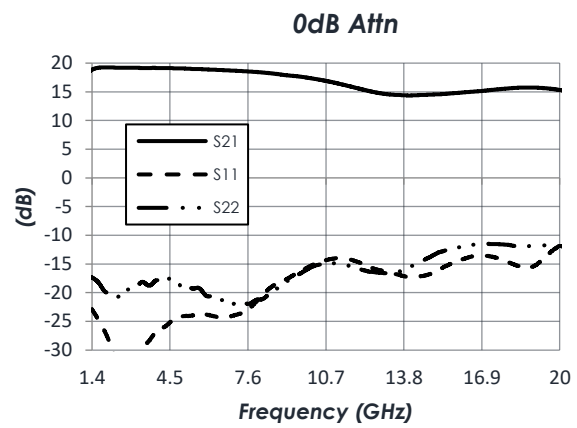
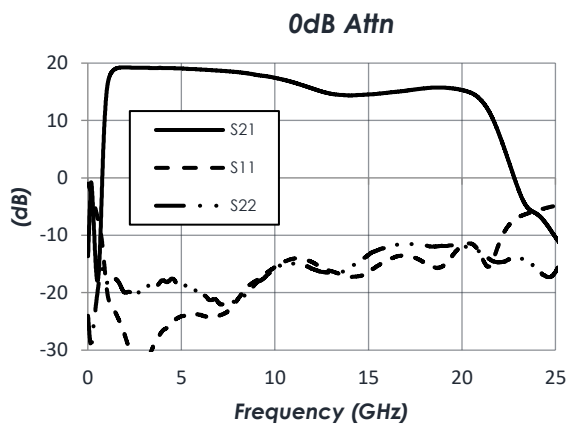
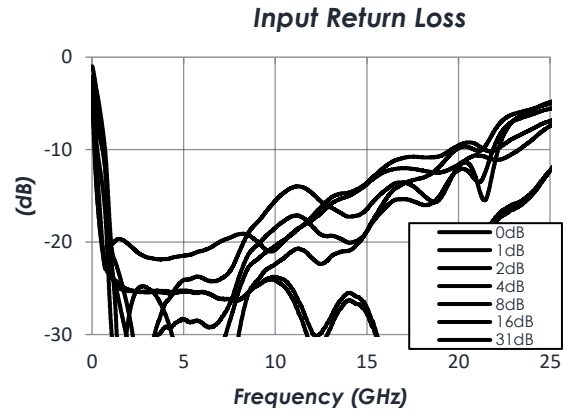
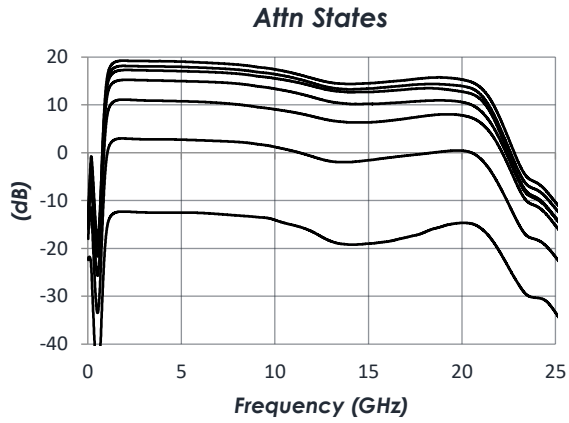
VE	VD	VC	VB	VA	Attenuation (dB)
L	L	L	L	L	Maximum Gain
L	L	L	L	H	1
L	L	L	H	L	2
L	L	H	L	L	4
L	H	L	L	L	8
H	L	L	L	L	16
H	H	H	H	H	31

Notes:

1. T = 25 °C unless otherwise specified
2. Data shown in this document is measured directly at output of device exclusive of bias tee, board, and connector effects.

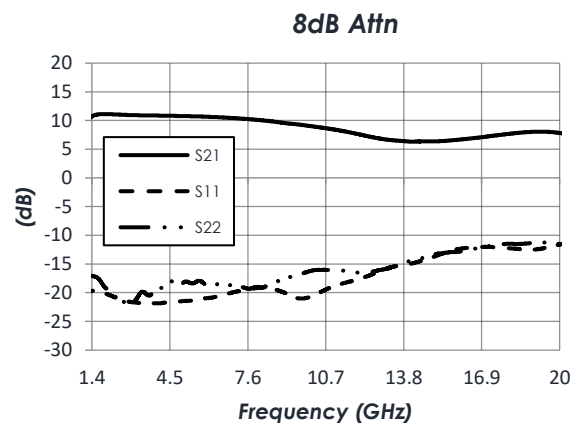
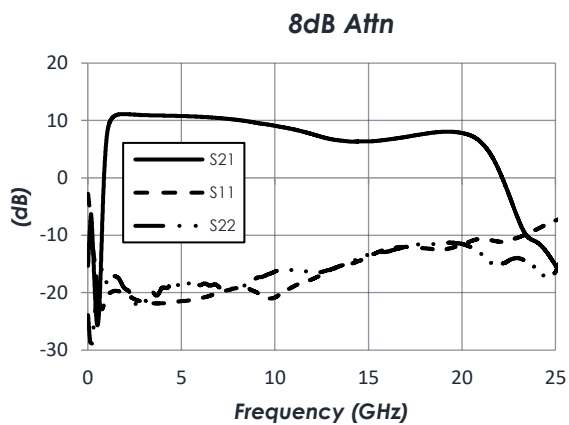
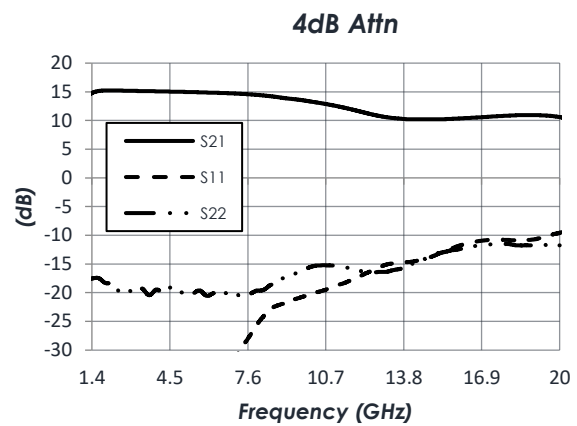
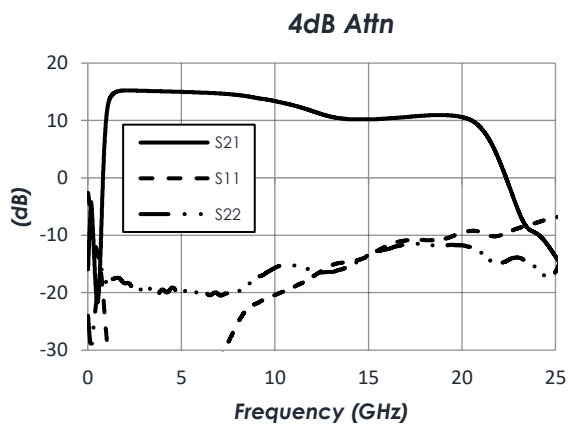
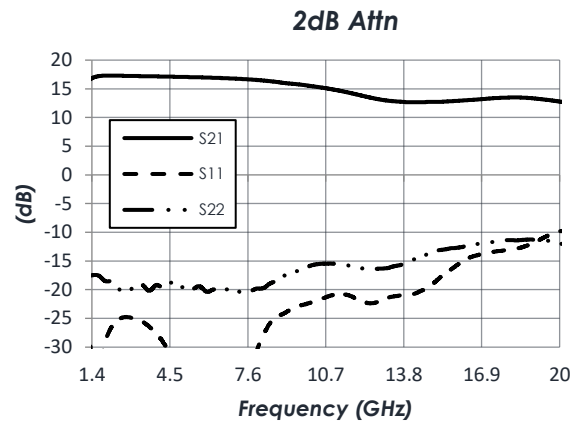
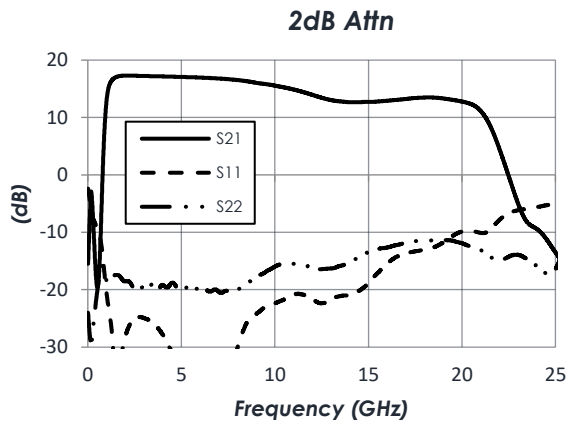
TYPICAL PERFORMANCE

(T = 25 °C unless otherwise specified.)



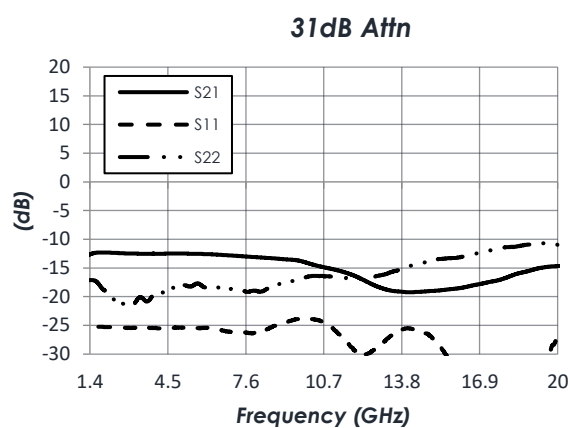
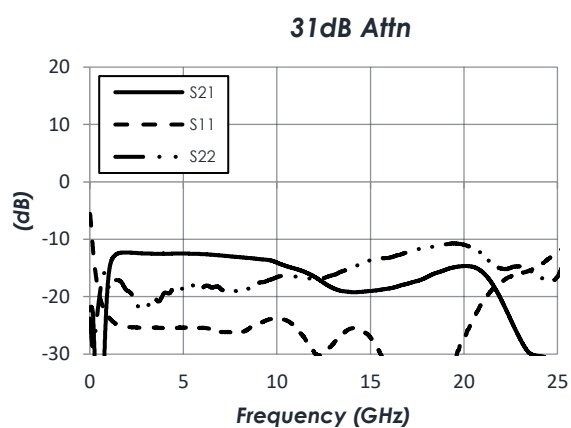
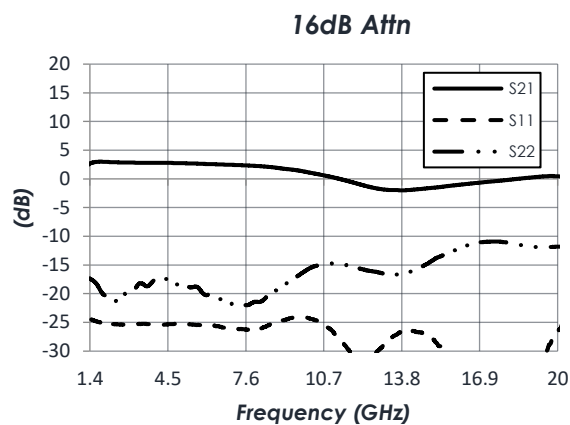
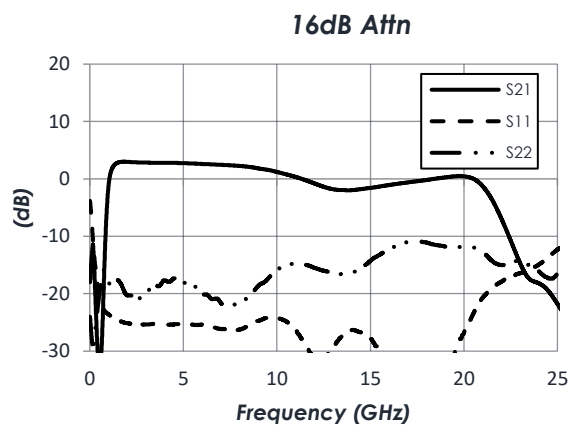
TYPICAL PERFORMANCE (CONTINUED)

(T = 25 °C unless otherwise specified.)



TYPICAL PERFORMANCE (CONTINUED)

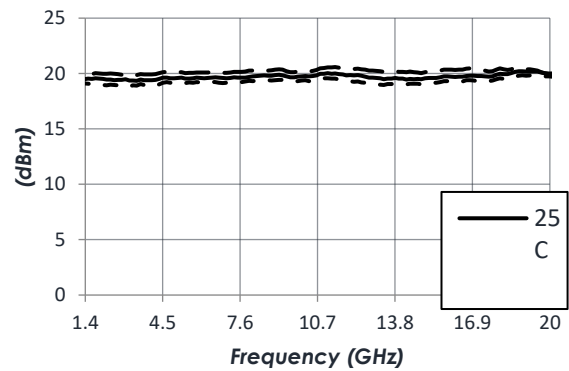
(T = 25 °C unless otherwise specified.)



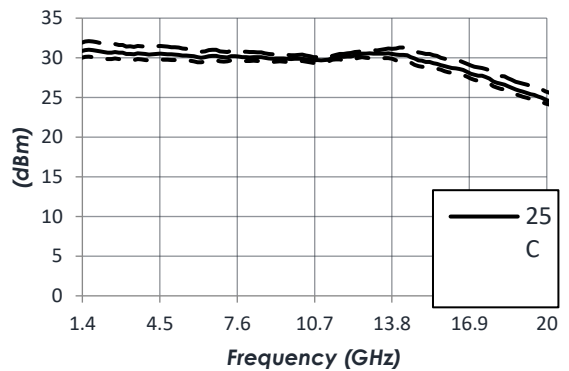
TYPICAL PERFORMANCE (CONTINUED)

(Data shown at 0dB attenuation)

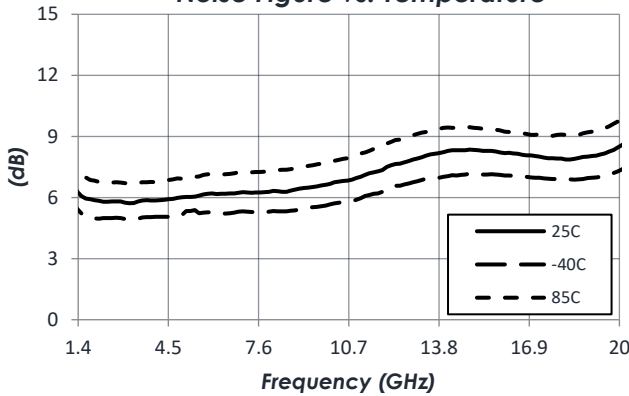
P1dB vs. Temperature



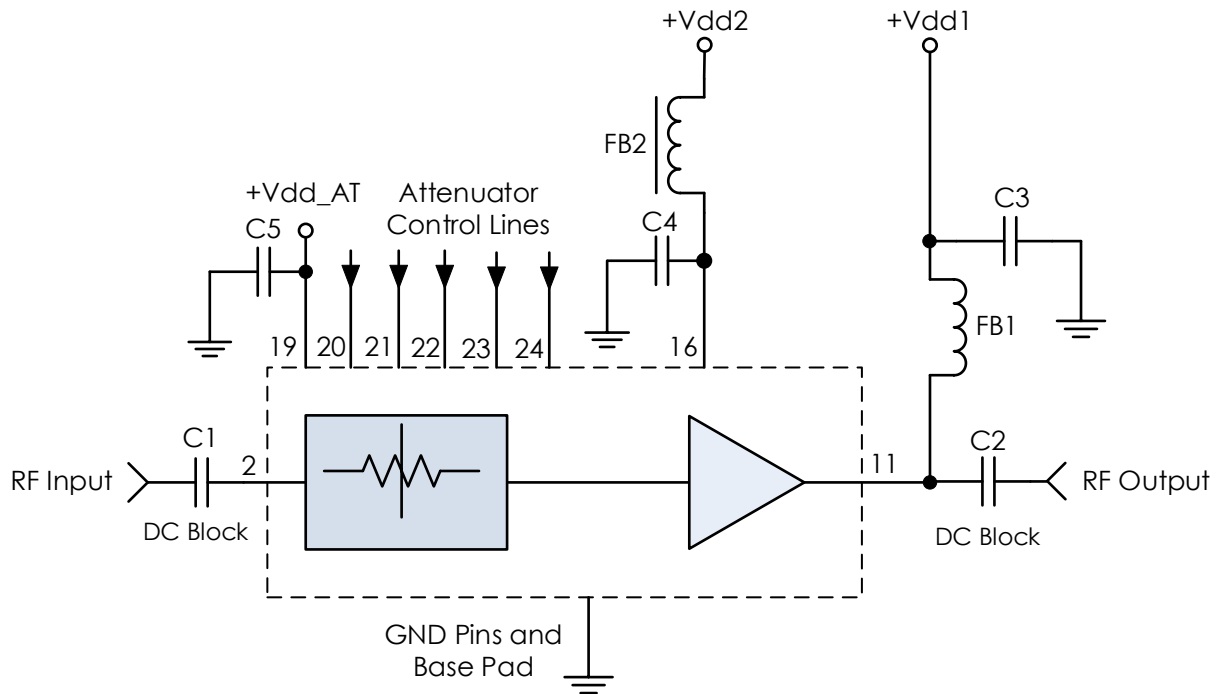
OIP3 vs. Temperature



Noise Figure vs. Temperature



TYPICAL APPLICATION



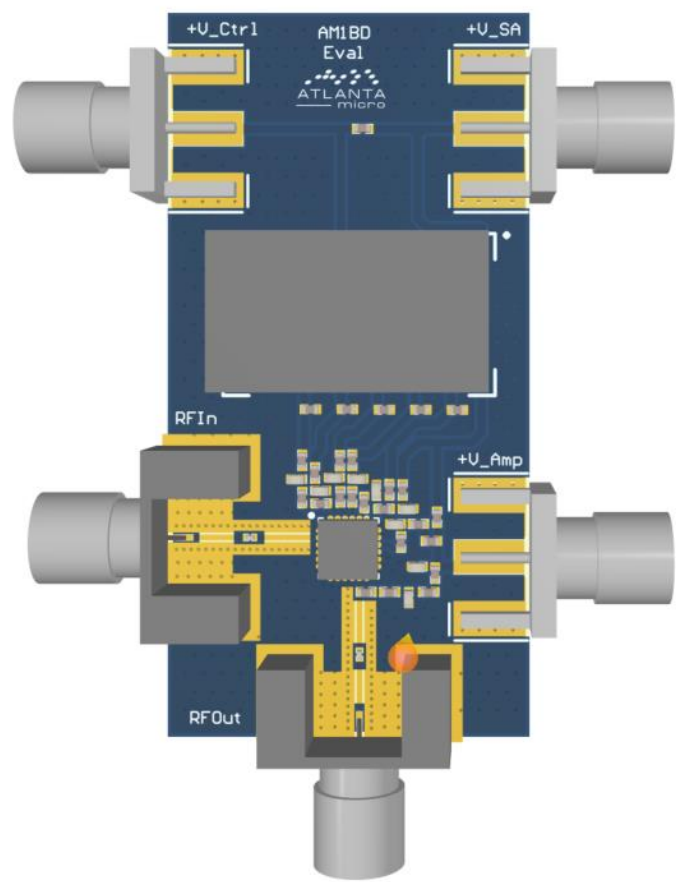
RECOMMENDED COMPONENT LIST (OR EQUIVALENT)

Part	Value	Part Number	Manufacturer
C1, C2	0.1 uF	0201BB104KW160	Passives Plus
C3- C5	0.1 uF	GRM155R71C104KA88	Murata
FB1, FB2		MMZ1005A222E	TDK

Note:

1. DC blocking capacitors should be high performance, low-loss, broadband capacitors for optimal performance.
2. Output bias tee should be optimized for the frequency range of interest. Performance may be improved by choosing a different bead, inductor, or bias tee in place of FB1.
3. Attenuator Control Lines do not have internal RC filtering. External RC filtering should be added to each control line if required.

EVALUATION PC BOARD



RELATED PARTS

Part Number		Description
AM1059	2 GHz to 9 GHz	Step Attenuator/ Gain Block
AM1115	2 GHz to 18 GHz	Variable Gain Amplifier
AM1135	6 GHz to 26.5 GHz	Variable Gain Amplifier
AM1146	2 GHz to 18 GHz	Variable Gain Amplifier

COMPONENT COMPLIANCE INFORMATION

RoHS: Mercury Systems, Inc. hereby certifies that all products comply with the EC Directive 2011/65/EC on the Restriction of Hazardous Substances, commonly known as EU-RoHS 6 and 10. All products supplied by Mercury shall be compliant with the European Directive 2011/65/EC based on the following substance list.

Substance List	Allowable Maximum Concentration
Lead (Pb)	<1000 PPM (0.1% by weight)
Mercury (Hg)	<1000 PPM (0.1% by weight)
Cadmium (Cd)	<75 PPM (0.0075% by weight)
Hexavalent Chromium (CrVI)	<1000 PPM (0.1% by weight)
Polybrominated Biphenyls (PBB)	<1000 PPM (0.1% by weight)
Polybrominated Diphenyl ethers (PBDE)	<1000 PPM (0.1% by weight)
Decabromodiphenyl Deca BDE	<1000 PPM (0.1% by weight)
Bis (2-ethylhexyl) Phthalate (DEHP)	<1000 PPM (0.1% by weight)
Butyl Benzyl Phthalate (BBP)	<1000 PPM (0.1% by weight)
Dibutyl Phthalate (DBP)	<1000 PPM (0.1% by weight)
Diisobutyl Phthalate (DIBP)	<1000 PPM (0.1% by weight)

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