

# AM1146 – Amplifier

## 2 to 18 GHz Variable Gain Amplifier

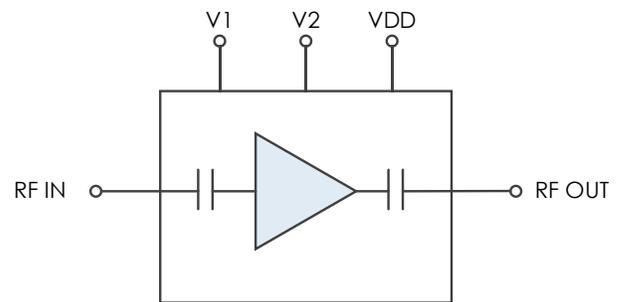
### Description

The AM1146 is a wideband digitally controlled variable gain amplifier that covers the 2-18 GHz frequency range. It provides 2dB of gain variation with approximately equal steps of 0.6dB. Output IP3, P1dB, and noise figure are decoupled from the gain variation, so the AM1146 provides consistent noise figure and nonlinear performance for any gain state. The device is packaged in a 3mm QFN with internal 50Ω matching which makes the AM1146 ideal for demanding, low SWaP applications.

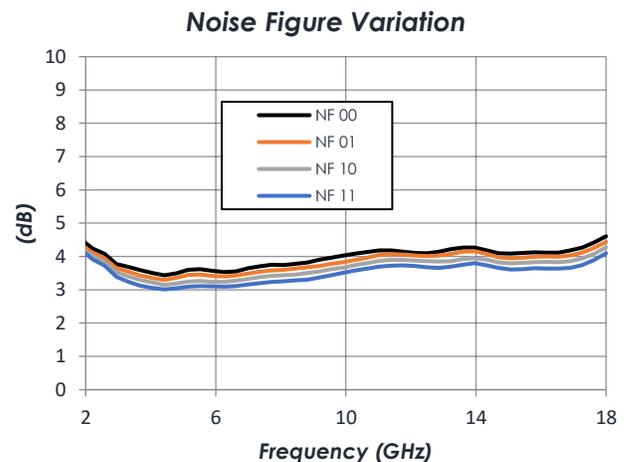
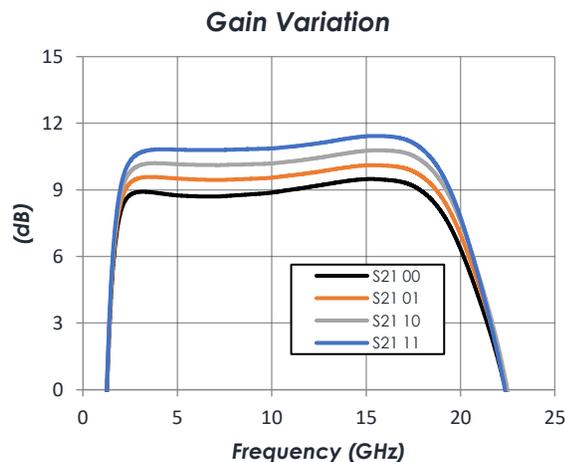
### Features

- 2 dB Total Gain Variation
- 9-11 dB Gain
- 3.6 dB Noise Figure
- +26 dBm OIP3
- +14 dB P1dB
- 260 mW DC Power Consumption
- +3.3V VDD and Control
- 3mm QFN Package
- -40C to +85C Operation
- Unconditionally Stable

### Functional Diagram



### Characteristic Performance



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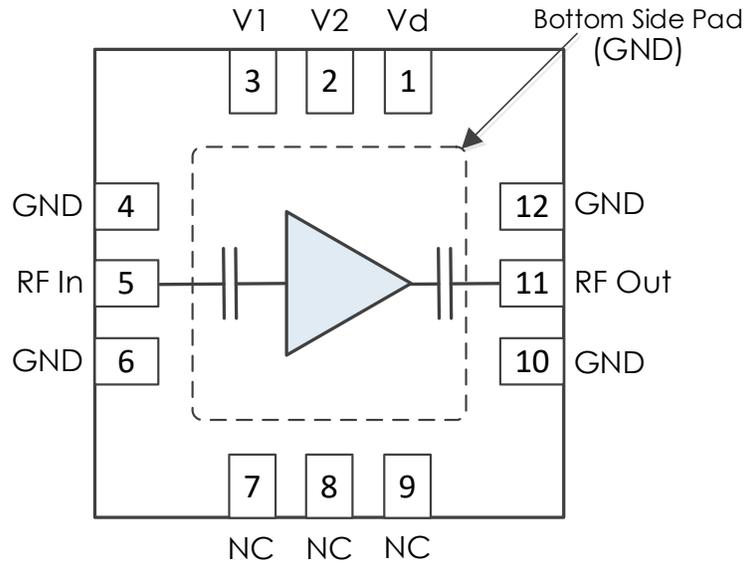
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## Revision History

<b>Date</b>	<b>Revision Number</b>	<b>Notes</b>
March 18, 2022	1	Initial Release

**Pin Layout and Definitions**



Pin Number	Pin Name	Pin Function
1	Vd	DC Power Input
2	V2	Control Voltage 2
3	V1	Control Voltage 1
4	GND	Ground - Common
5	RF In	RF Input – 50 Ohms – AC Coupled
6	GND	Ground - Common
7-9	NC	No Connect
10	GND	Ground - Common
11	RF Out	RF Output – 50 Ohms – AC Coupled
12	GND	Ground - Common

**\*Note: NC pins may be grounded or left floating.**

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### Specifications

#### Absolute Maximum Ratings

	Minimum	Maximum
Supply Voltage	-0.3 V	+3.6 V
RF Input Power		20 dBm
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
Storage Temperature Range (Recommended)	-50 C	+125 C
Moisture Sensitivity Level	MSL 3	



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

#### Recommended Operating Conditions

	Minimum	Typical	Maximum
Supply Voltage		+3.3 V	
Operating Case Temperature	-40 C		+85 C

#### Thermal Information

Junction to Case Thermal Resistance ( $\theta_{JC}$ )	215 C/W
Nominal Junction Temperature at +85C Ambient	+142 C
Channel Temperature to Maintain 1 Million Hour MTF	+175 C

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### DC Electrical Characteristics

(T = 25 °C unless otherwise specified)

Parameter	Testing Conditions	Minimum	Typical	Maximum
DC Supply Voltage			+3.3 V	
DC Supply Current	All States, VDD = +3.3V		79 mA	
Power Dissipated	VDD = +3.3V		260 mW	
Logic Level Low		-0.1 V		+0.4 V
Logic Level High		+2.2 V		+VDD
DC Control Current	VDD = +3.3V		<100 $\mu$ A	

### RF Performance

(T = 25 °C unless otherwise specified)

Parameter	Testing Conditions	Minimum	Typical	Maximum
Frequency Range		2 GHz		18 GHz
Gain	State 00, f=10 GHz		8.9 dB	
	State 01, f=10 GHz		9.6 dB	
	State 10, f=10 GHz		10.2 dB	
	State 11, f=10 GHz		10.9 dB	
Return Loss	State 00, f=10 GHz		-11.5 dB	
	State 01, f=10 GHz		-11.4 dB	
	State 10, f=10 GHz		-11.3 dB	
	State 11, f=10 GHz		-10.5 dB	
Output IP3	f = 10 GHz		+26.5 dBm	
Output P1dB	f = 10 GHz		+14 dBm	
Noise Figure	State 00, f=10 GHz		4.1 dB	
	State 01, f=10 GHz		3.8 dB	
	State 10, f=10 GHz		3.7 dB	
	State 11, f=10 GHz		3.6 dB	

**\*Note:** OIP3 measured with 10MHz tone spacing

### Timing Characteristics

(T = 25 °C unless otherwise specified)

Parameter	Minimum	Typical	Maximum
Switching Speed		20 ns	

**\*Note:** Timing Characteristics measured from 50% control to 90% RF.

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### State Table

(T = 25 °C unless otherwise specified)

V1	V2	10GHz Gain
Low	Low	8.9 dB
Low	High	9.6 dB
High	Low	10.2 dB
High	High	10.9 dB

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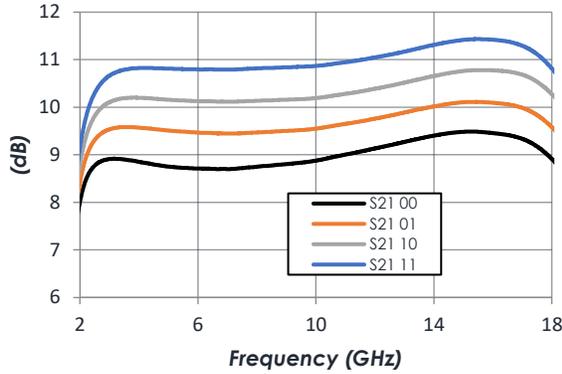
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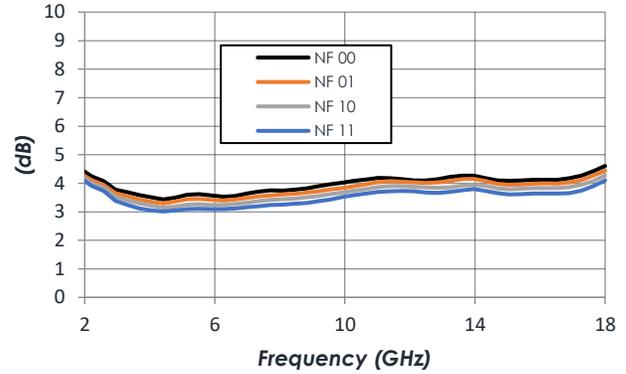
### Typical Performance

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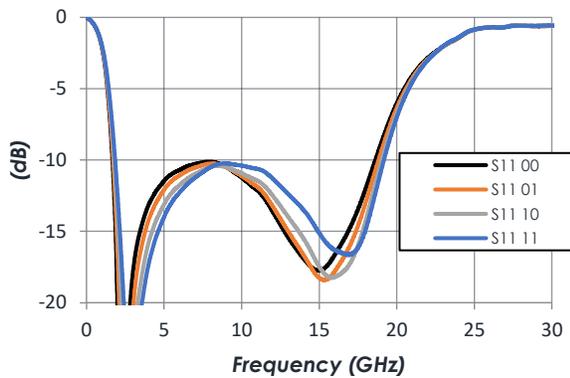
**Gain Variation**



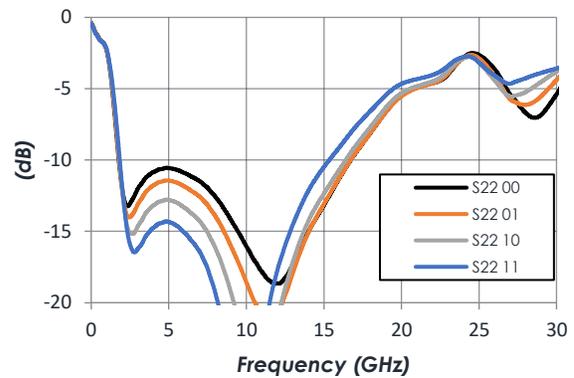
**Noise Figure Variation**



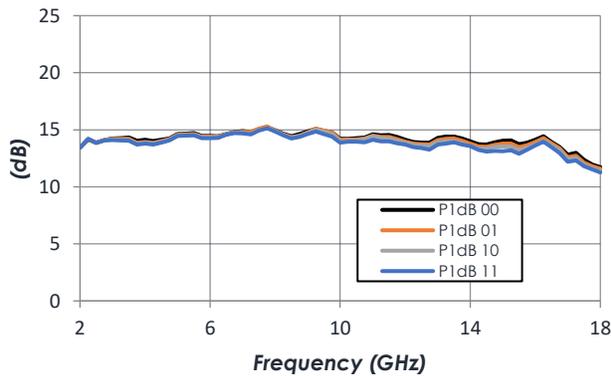
**Input Return Loss Variation**



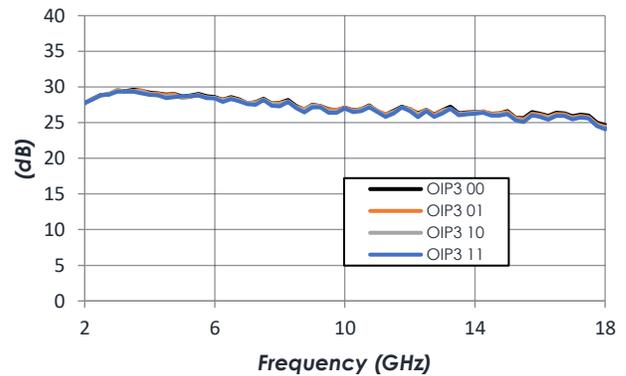
**Output Return Loss Variation**



**P1dB Variation**



**OIP3 Variation**



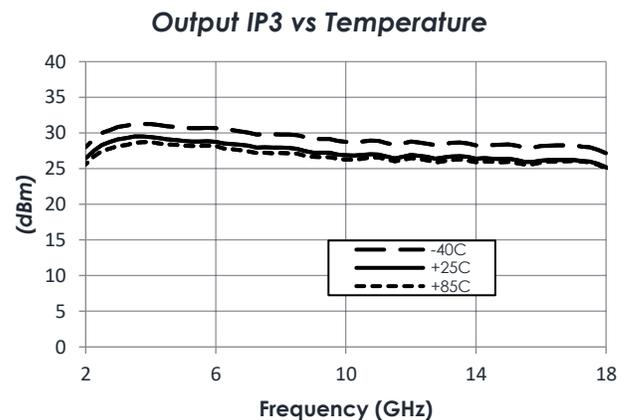
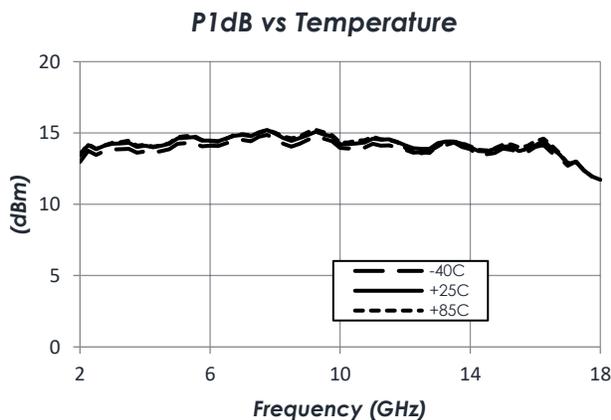
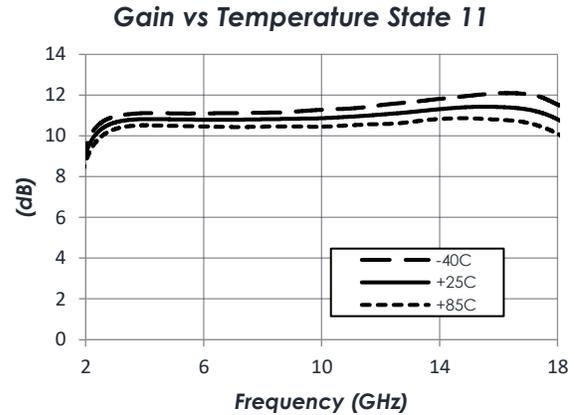
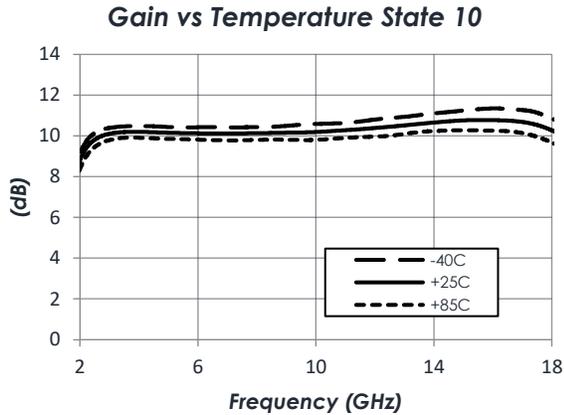
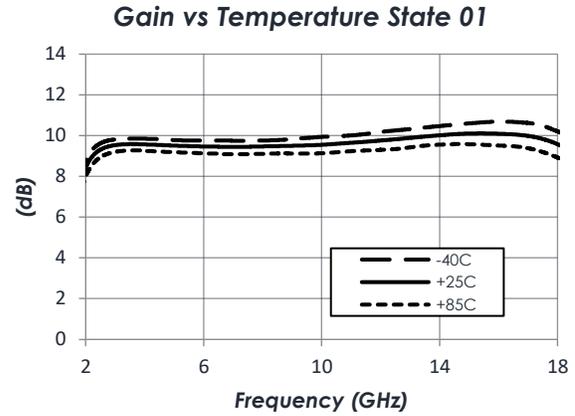
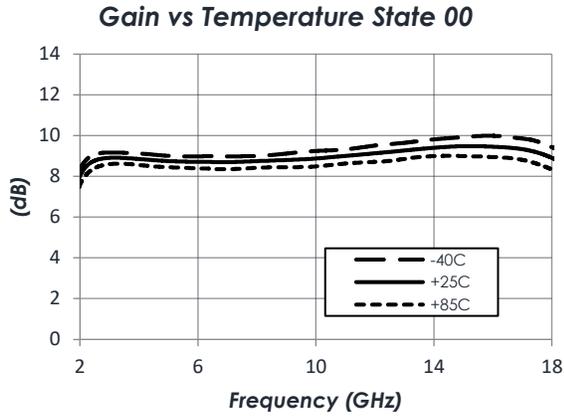
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### Typical Performance (continued)

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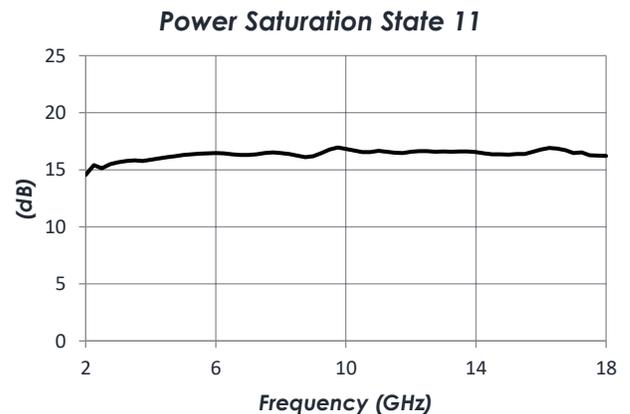
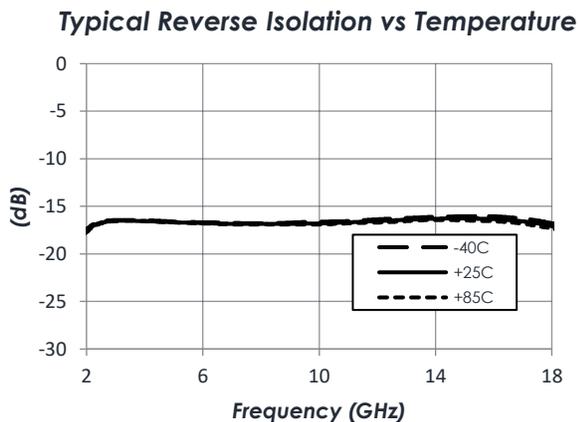
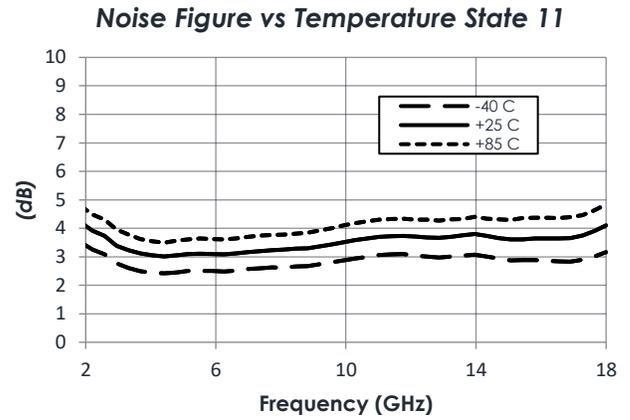
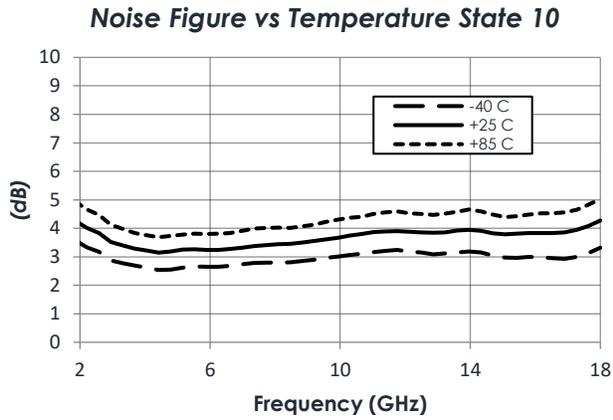
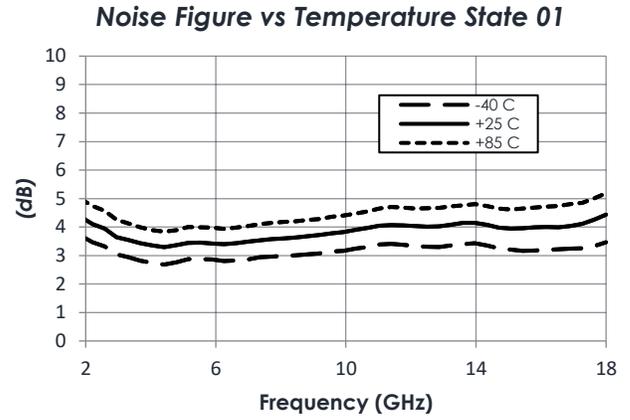
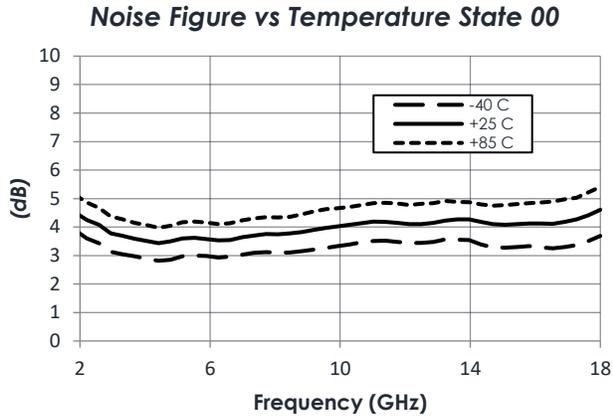
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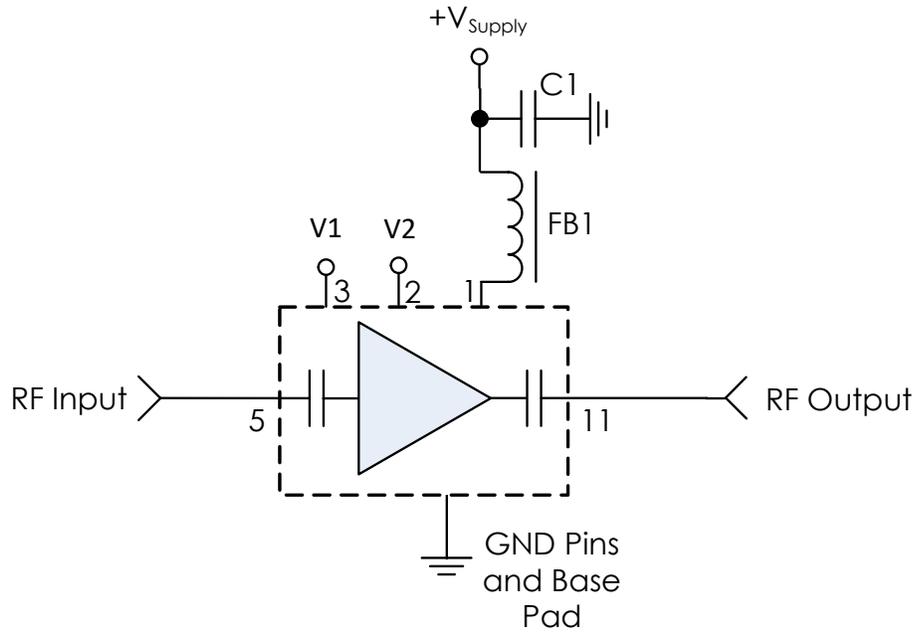
### Typical Performance (continued)

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**Typical Application**



**Recommended Component List (or equivalent):**

Part	Value	Part Number	Manufacturer
C1	0.1 uF	C1005X7R1H104K05BB	TDK
FB1	-	MMZ1005A222E	TDK

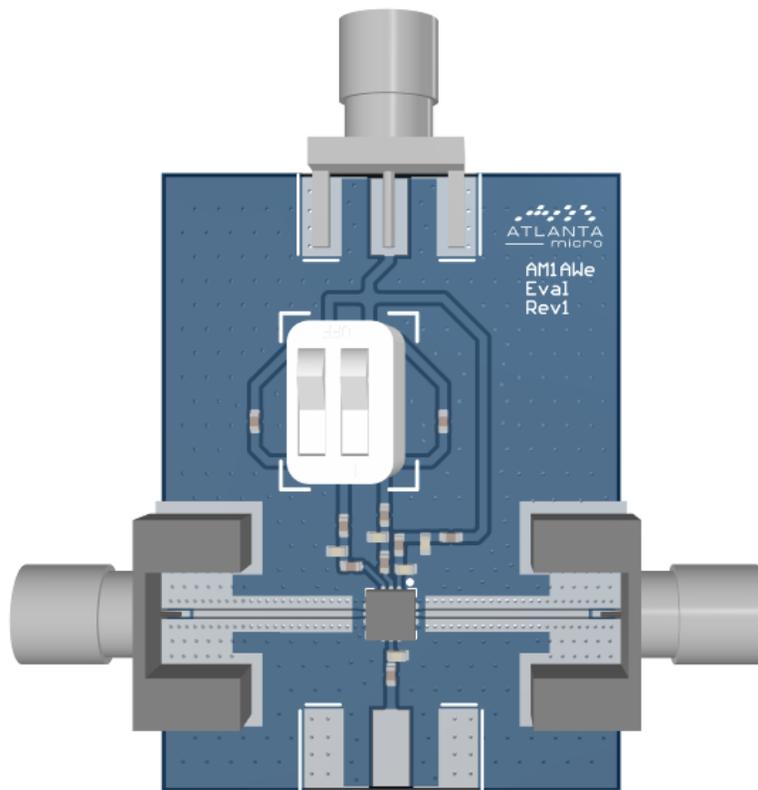
**Notes:**

1. Control lines are filtered internally providing high frequency isolation.
2. AM1146 is AC coupled. No external DC blocking caps are required.

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### Evaluation PC Board



### Related Parts

Part Number	Description
AM1101	2 GHz to 26.5 GHz Bypassable Amplifier
AM1102	2 GHz to 22 GHz Low Noise Amplifier
AM1134	6 GHz to 26.5 GHz Low Noise Amplifier
AM1135	6 GHz to 26.5 GHz Variable Gain Amplifier
AM1145	2 GHz to 18 GHz Variable Slope Amplifier

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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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