



# CITCRYO4-12B

## Cryogenic HEMT Low Noise Amplifier

### KEY FEATURES

- Very low noise, average 3K, over 4 to 12 GHz.
- Operates with wide range of DC supply voltage.
- Provides usable gain and noise at DC power as low as 4 mW.
- Input/Output return loss is  $<-10$  dB.

### PERFORMANCE

#### FEATURES

- RF Frequency
  - 4 to 12 GHz
- Gain
  - $35 \text{ dB} \pm 2 \text{ dB}$
- Average noise temperature
  - 3 Kelvin
- Average noise figure
  - 0.05 dB

#### APPLICATIONS

- ✓ Radio astronomy arrays
- ✓ Satellite and Space Communication
- ✓ Research & development
- ✓ Quantum computing



## Description

CMT's new enhanced cryogenic low noise amplifier, the CITCRYO4-12B, has been designed to meet the stringent requirements for quantum applications.

### A SUBSTANTIAL ADVANCEMENT

- The CITCRYO4-12B can achieve a noise temperature of 4 K through a 4 to 8 GHz frequency band.
- Its lowest noise temperature measured is 2.5K with a gain of 35 dB at 5 GHz. This is a substantial advancement from the original CMT's CITCRYO4-12A.
- In its standard configuration, it comes with female SMA connectors on the RF-input and output and a 4-pin 2 mm pitch header for the DC power connections. The amplifier requires three (3) separate DC voltages.

### LOW POWER CONSUMPTION

- The amplifier can achieve a very low power consumption as low as 4 mW with a noise temperature of less than 6 K from 4 to 6 GHz.
- Its input return loss is less than 10 dB throughout this frequency band.

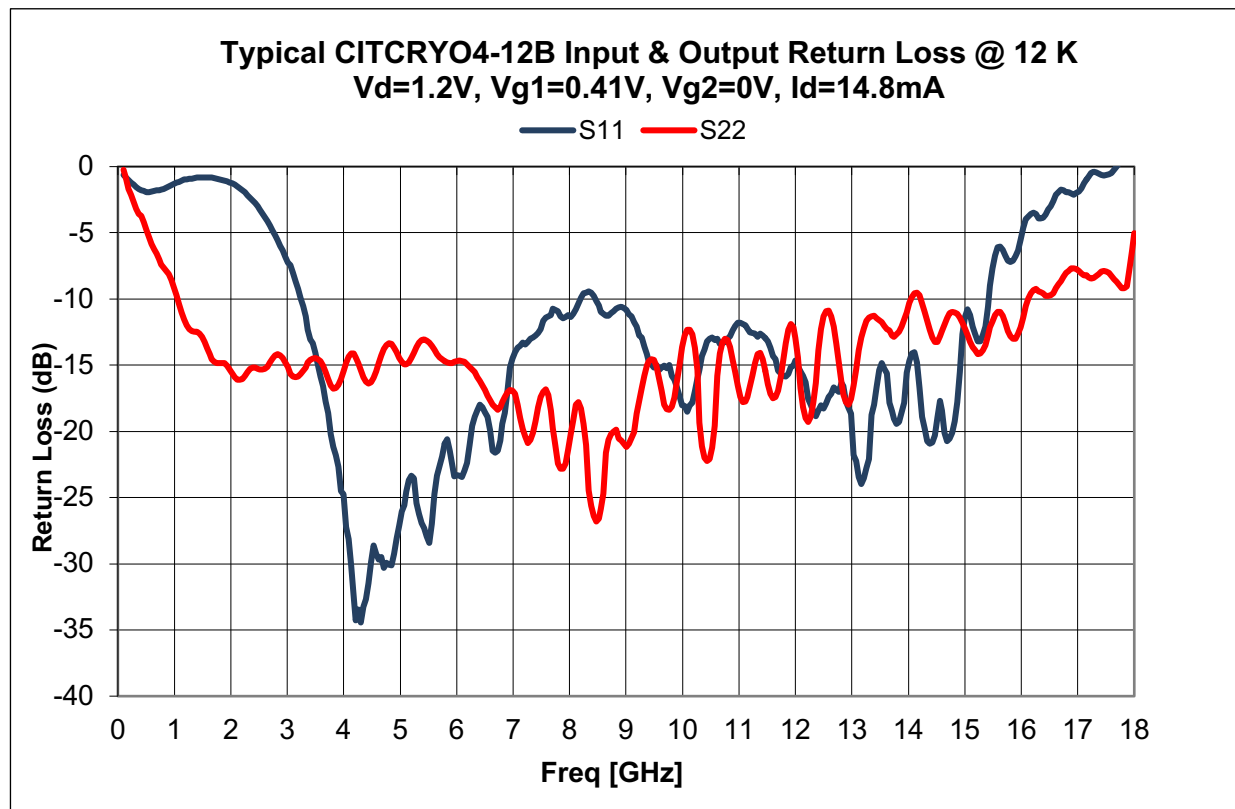
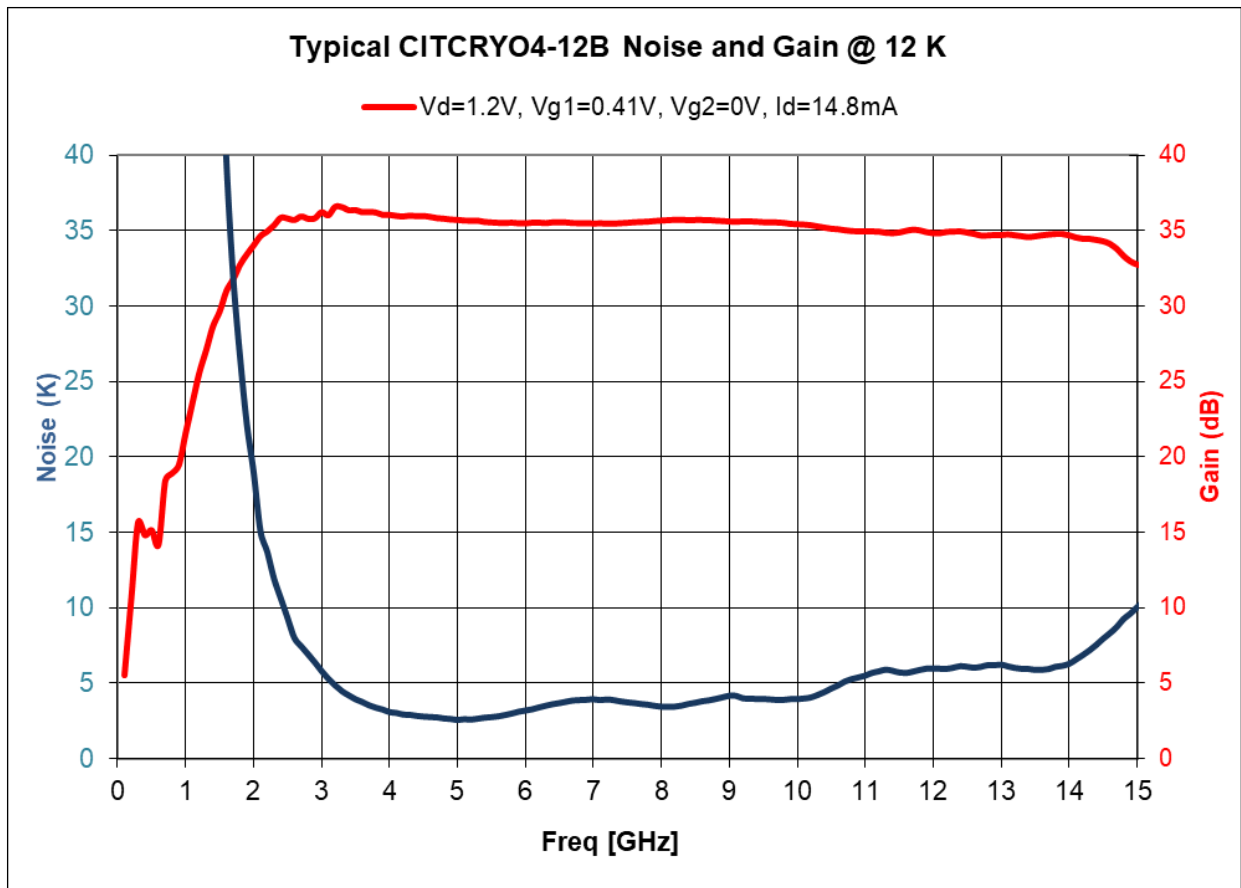
## Electrical Specifications @ 12 K

Description	Typical	Minimum	Maximum
<b>RF Frequency</b>	2.5–15 GHz	4 GHz	12 GHz
<b>Gain</b>	35 dB	35 dB ± 2 dB	
<b>Noise Temperature</b>	3K	3K	6K
<b>IRL (-20log S<sub>11</sub> )</b>	-15 dB	< -10 dB	
<b>ORL (-20log S<sub>22</sub> )</b>	-15 dB	< -10 dB	
<b>Drain Voltage</b>	1.2 V	0.6 V	1.5 V

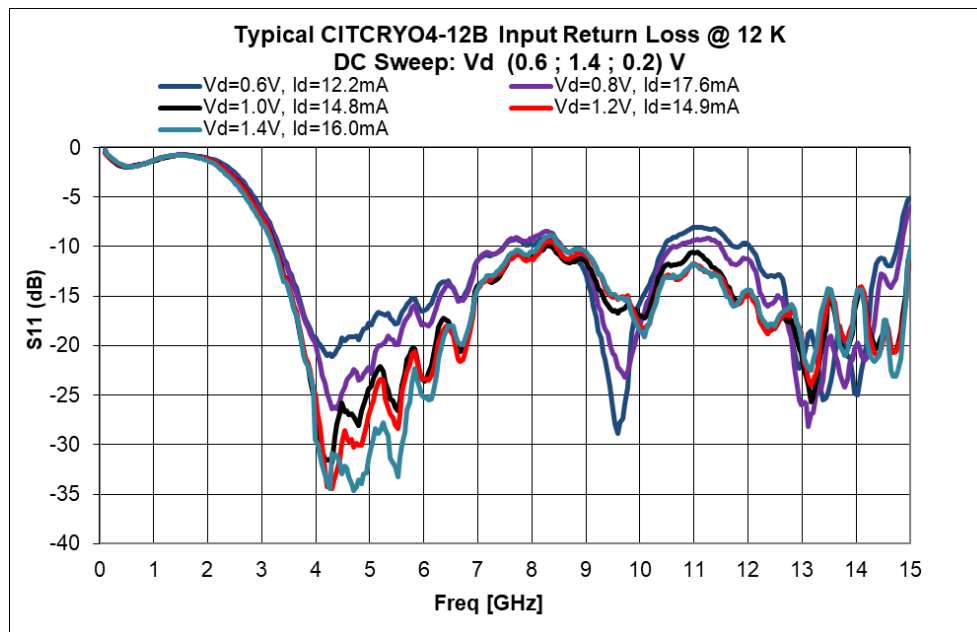
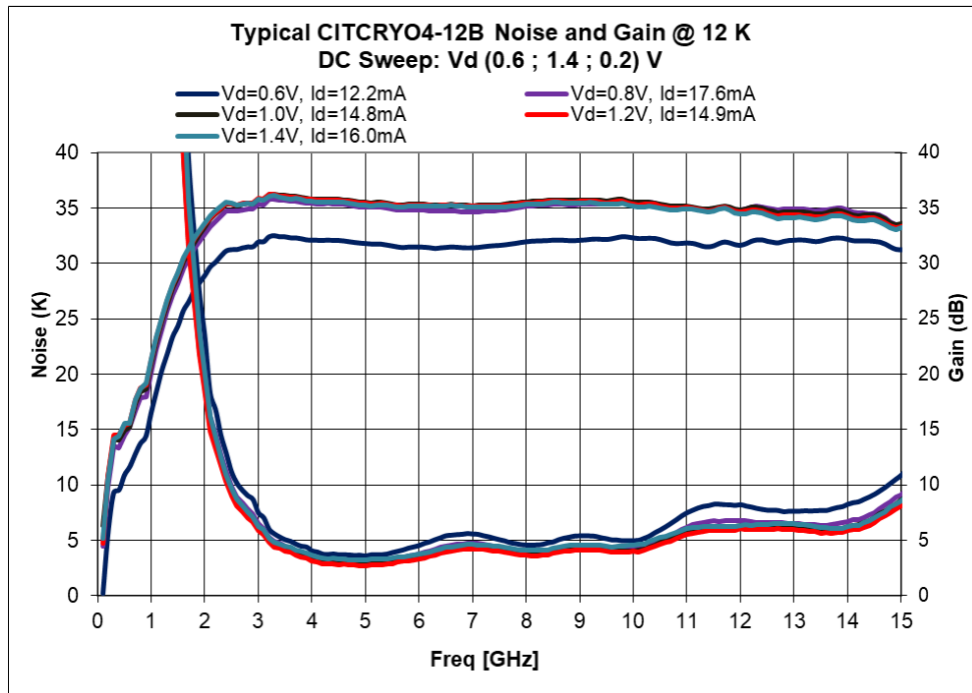
## Electrical Specifications @ 300 K

Description	Typical	Minimum	Maximum
<b>RF Frequency</b>	2.5–14 GHz	4 GHz	12 GHz
<b>Gain</b>	35 dB	35 dB ± 2 dB	
<b>Noise Temperature</b>	50 K	33K	56K
<b>IRL (-20log S<sub>11</sub> )</b>	-15 dB	< -10 dB	
<b>ORL (-20log S<sub>22</sub> )</b>	-15 dB	< -10 dB	
<b>DC Voltage</b>	1.8 V	1.0 V	2.0 V

# Typical Test Results – Optimum DC Bias @ 12 K



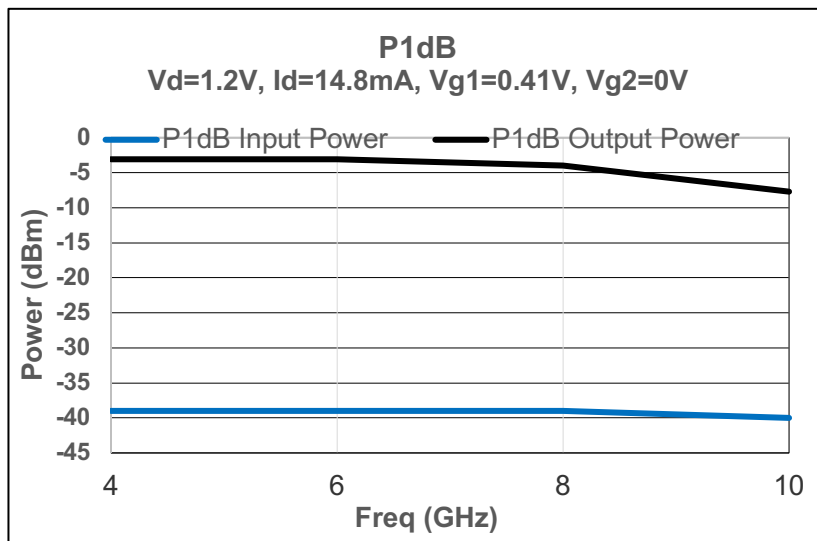
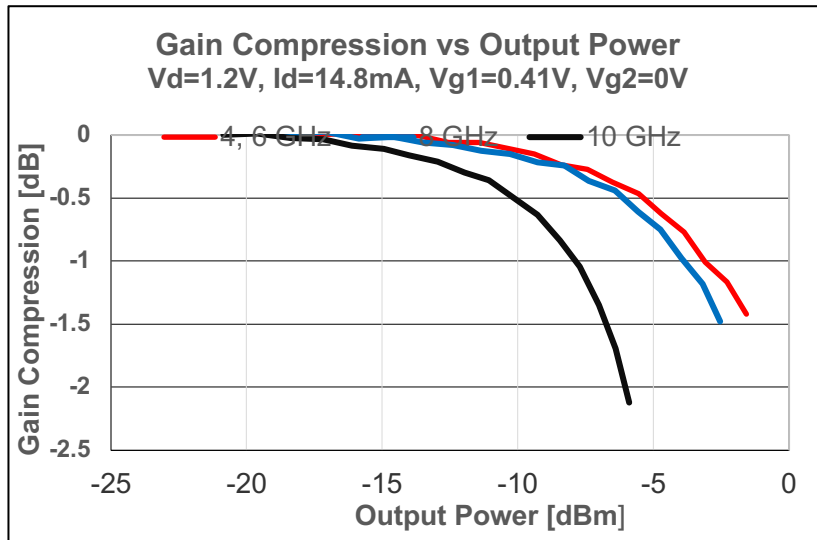
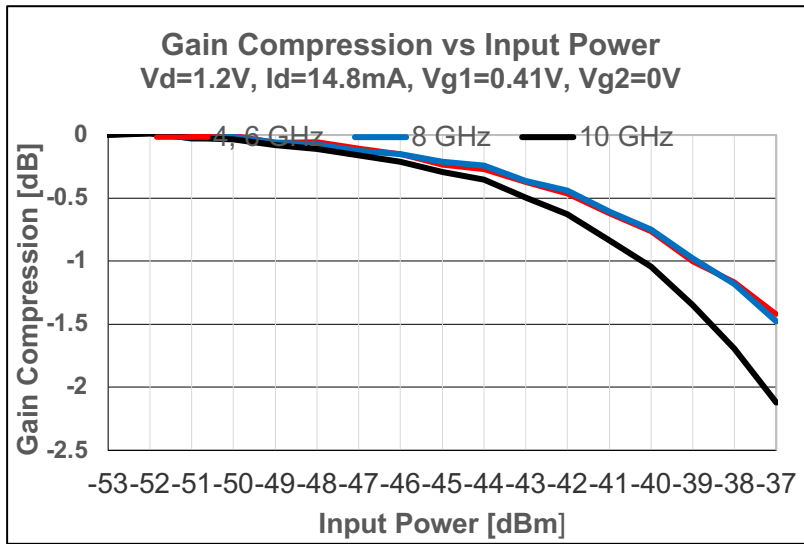
# Typical Test Results – DC Bias Sweep @ 12 K



Vd (V)	Vg1 (V)	Vg2 (V)	Id (mA)
0.6	0.37	0.47	12.2
0.8	0.45	0.54	17.6
1.0	0.51	0.23	14.8
1.2	0.41	0.00	14.9
1.4	0.54	-0.14	16.0

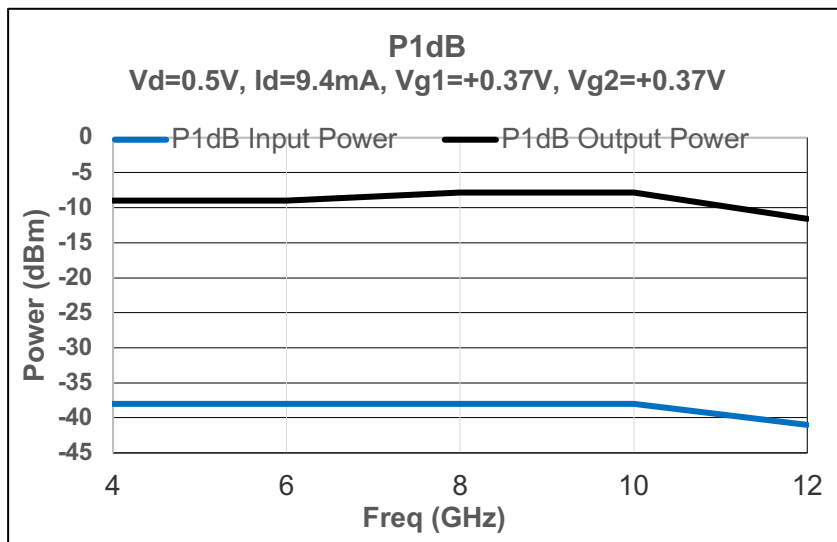
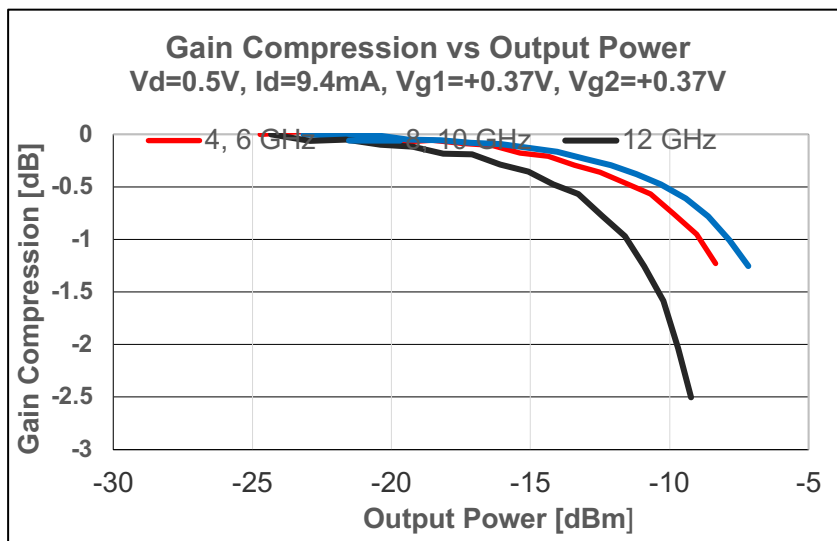
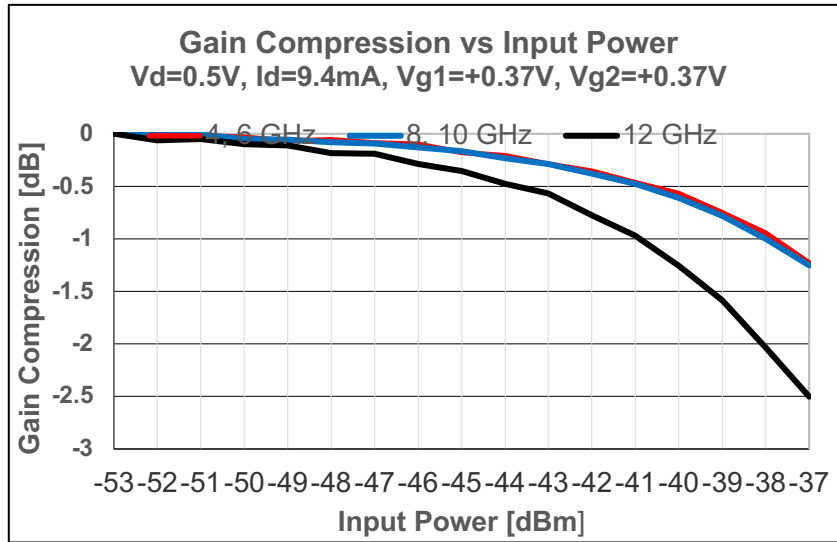
# Typical Test Results – Gain Compression, P1dB

$V_d=1.2V, T_c=12K$

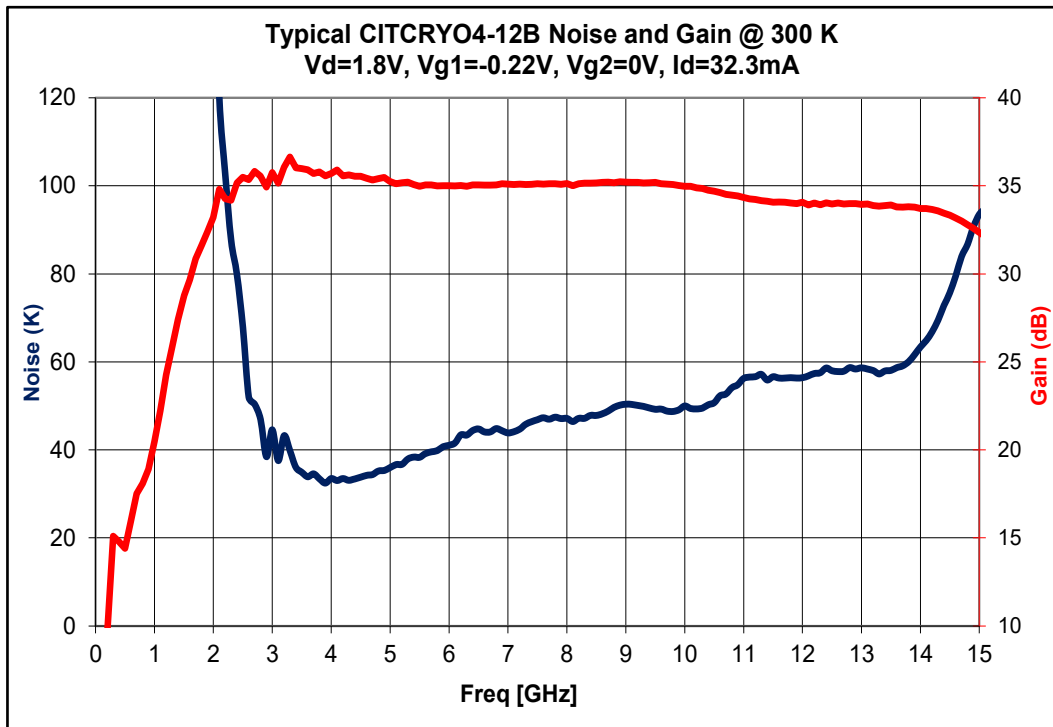


# Typical Test Results – Gain Compression, P1dB

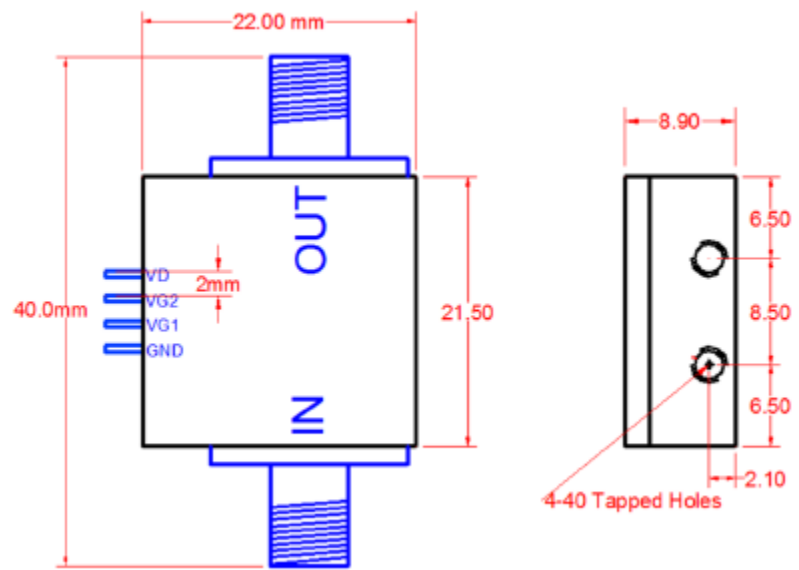
$V_d=0.5V, T_c=12K$



# Typical Test Results – Optimum DC Bias @ 300 K



## CAD Housing Drawing



\*Dimensions are in mm

# Optional Input Bias Tee

As an option, the amplifier can be supplied with a DC bias tee for an external device connected to the amplifier input. The bias tee is formed by two (2) resistors connected to the input; as shown in Figure 1. One (1) resistor can be used as a source of current and the other senses the voltage across the external device. Voltages applied to the bias tee have a small effect on amplifier operation. At 12 K, 20 KΩ resistors increase noise by 0.5 K.

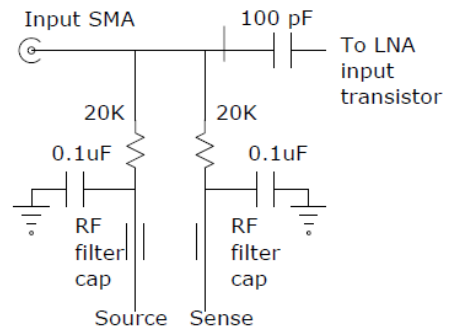
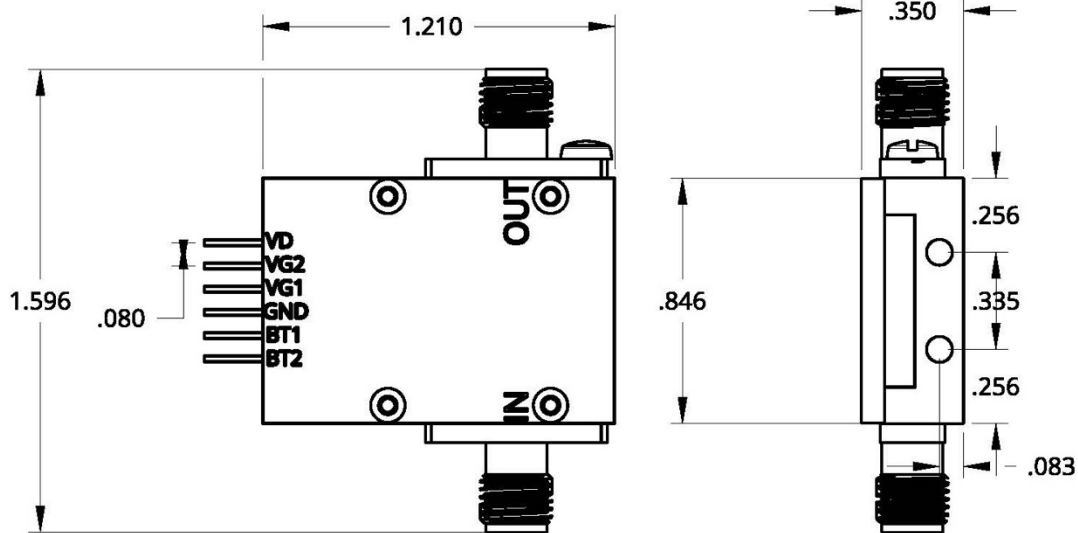


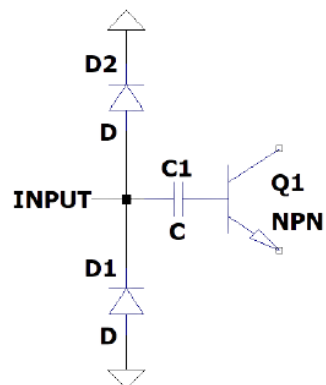
Figure 1. Bias Tee Schematic



# Optional Input Protection Diodes

As an option, the amplifier can be supplied with ESD protection & voltage spike protection at the RF input to the amplifier. There will be a slight degradation of the amplifier performance. Please note that the optional input protection diodes cannot be used if DC voltages are applied to the RF line using input bias tees.

To order an amplifier with internal bias resistors, add the resistance to the part #. For instance, CITCRYO4-12B-PD.



**D1 & D2 = Input Protection Diodes**

Figure 2. Protection Diodes Schematic



# Product Care and Maintenance

- Use care to not bend (and break) the DC bias pin when tightening the output SMA connector.
- The amplifier should not be connected to the power supply when connecting the input connector.
- Set the power of Port 1 in your VNA to be less than -45 dB when testing the amplifier. Otherwise, the amplifier may saturate, and the data obtained will be incorrect.
- Do not attempt to open the amplifier.
- Electrostatic discharge may damage the amplifier.

## Contact Information

### Sales & Quotes

<b>Name</b>	Ms. Denise L. Smith
<b>Email Address</b>	<a href="mailto:Denise@CosmicMicroTech.com">Denise@CosmicMicroTech.com</a>
<b>Phone Number</b>	+1 (424) 456-7722
<b>Address</b>	15711 Condon Avenue, Unit A3, Lawndale, CA 90260, USA

### Technical Questions

<b>Name</b>	Mr. Stephen Smith
<b>Email Address</b>	<a href="mailto:Steve@CosmicMicroTech.com">Steve@CosmicMicroTech.com</a>
<b>Phone Number</b>	+1 (424) 456-7744
<b>Address</b>	15711 Condon Avenue, Unit A3, Lawndale, CA 90260, USA