

CITLF3

Cryogenic SiGe Low Noise Amplifier

KEY FEATURES

- Very low noise, average 4 K over 10 MHz to 4 GHz.
- Powered from a single positive DC supply.
- Provides usable gain and noise at DC power as low as 5 mW.
- 2-pin Winchester DC connectors.
- Optional DC bias tees.
- Optional input protection diodes.
- Size 2.07 cm x 1.59 cm x 0.87 cm.

PERFORMANCE FEATURES @ 12 K

- RF Frequency
 - 0.01 to 4.0 GHz
- Gain
 - 35 dB \pm 3 dB
- Temperature
 - < 4 K
- Noise Figure
 - < 0.06 dB
- Optimum DC Power
 - $V_d = 2.0$ V
 - $I_d = 13.6$ mA



Description

- The CITLF3, a Silicon Germanium (SiGe) low noise cryogenic amplifier, intended for Radio Astronomy and Quantum physics applications. The amplifier achieves an average noise temperature of 4K (0.06dB) over the frequency range of 0.01GHz to 4 GHz when cooled to 12K or less. The minimum noise temperature is 2.5K at 100 MHz. Typical gain is 33dB and the input/output return losses are less than -10 dB. The amplifier is unconditionally stable. While the amplifier is optimum for the frequency range of 0.01 GHz to 4 GHz, the amplifier is usable from 3 MHz to 5 GHz.
- The amplifier is powered from a single positive DC power supply and is optimum at 2.0 V. Power dissipation is 27 mW at this bias. However, good noise temperature is received at a power dissipation as low as 5 mW. The low power dissipation is ideal for multi-amplifier arrays operating at 4K.
- The amplifier is 20.7 mm x 15.9 mm x 8.7 mm excluding connectors. Input and output female SMA connectors.

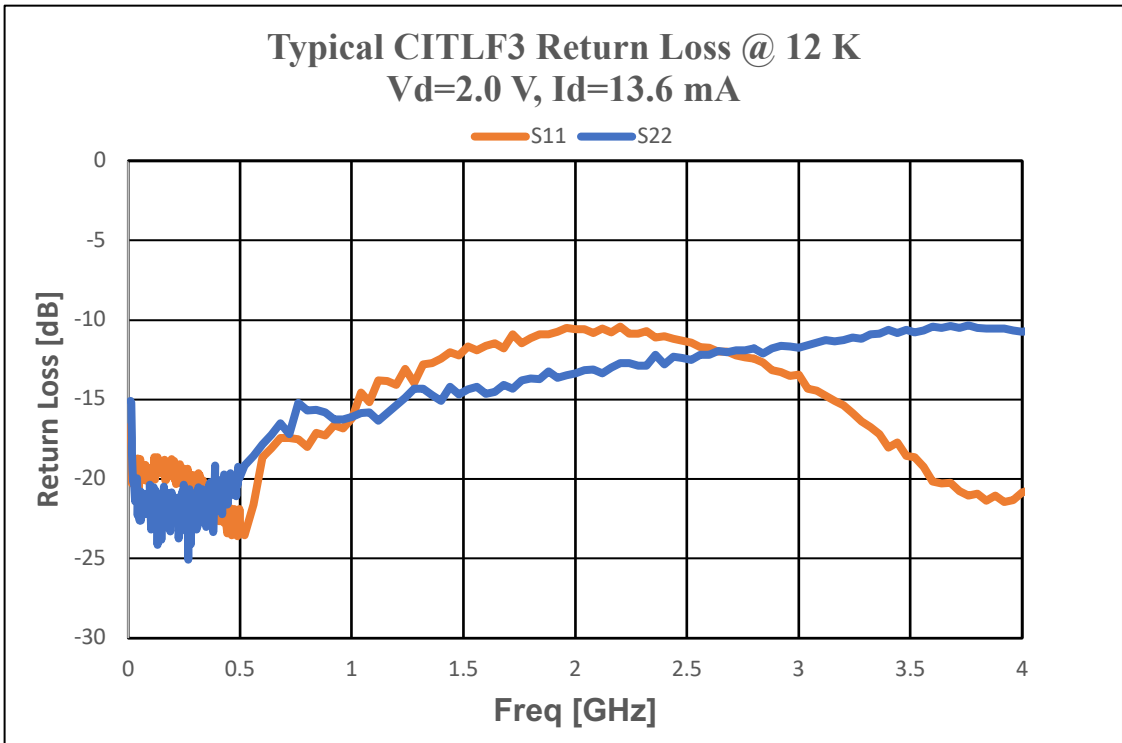
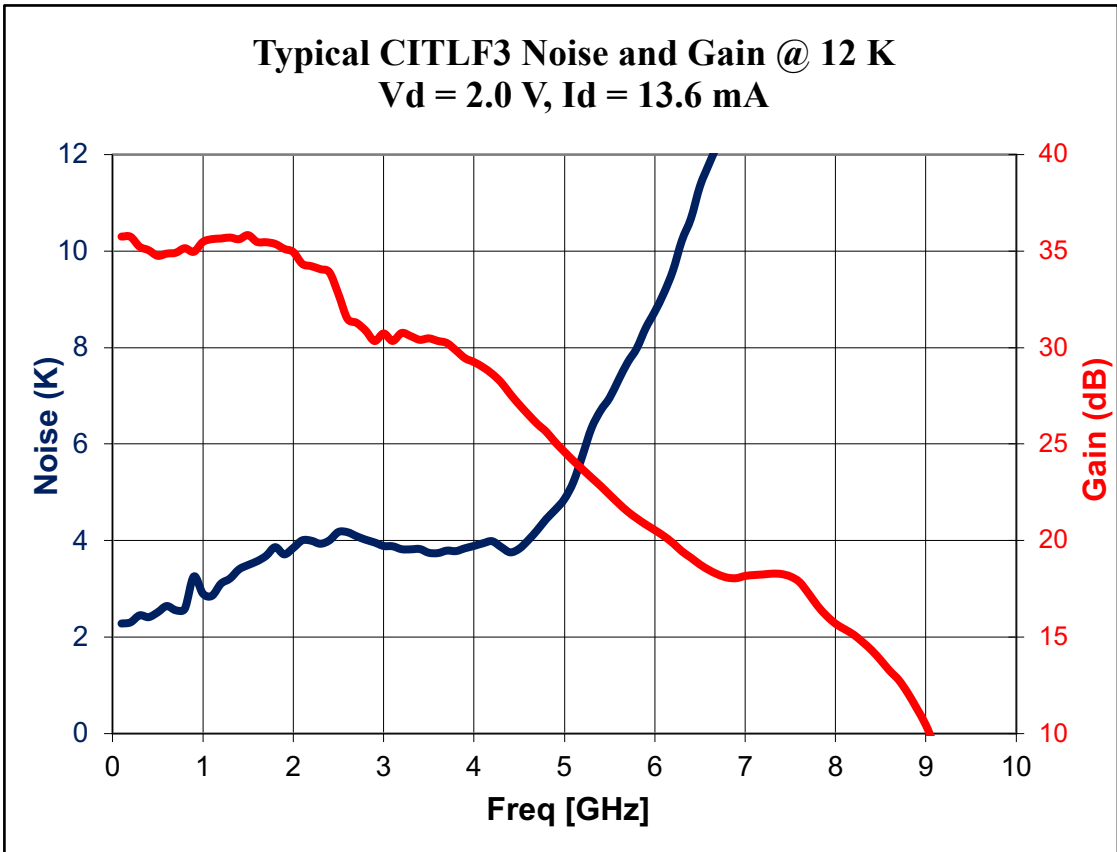
Electrical Specifications @ 12 K

Description	Typical	Minimum	Maximum
RF Frequency	.03-5 GHz	0.01 GHz	4 GHz
Gain	33 dB	33 dB \pm 3 dB	
Noise Temperature	< 4 K	2.5 K	4 K
IRL (-20log S₁₁)	-12 dB	< -10 dB	
ORL (-20log S₂₂)	-15 dB	< -10 dB	
DC Voltage	2.0 V	1.2 V	3 V
DC Current	13.6 mA	2.7 mA	27.4 mA

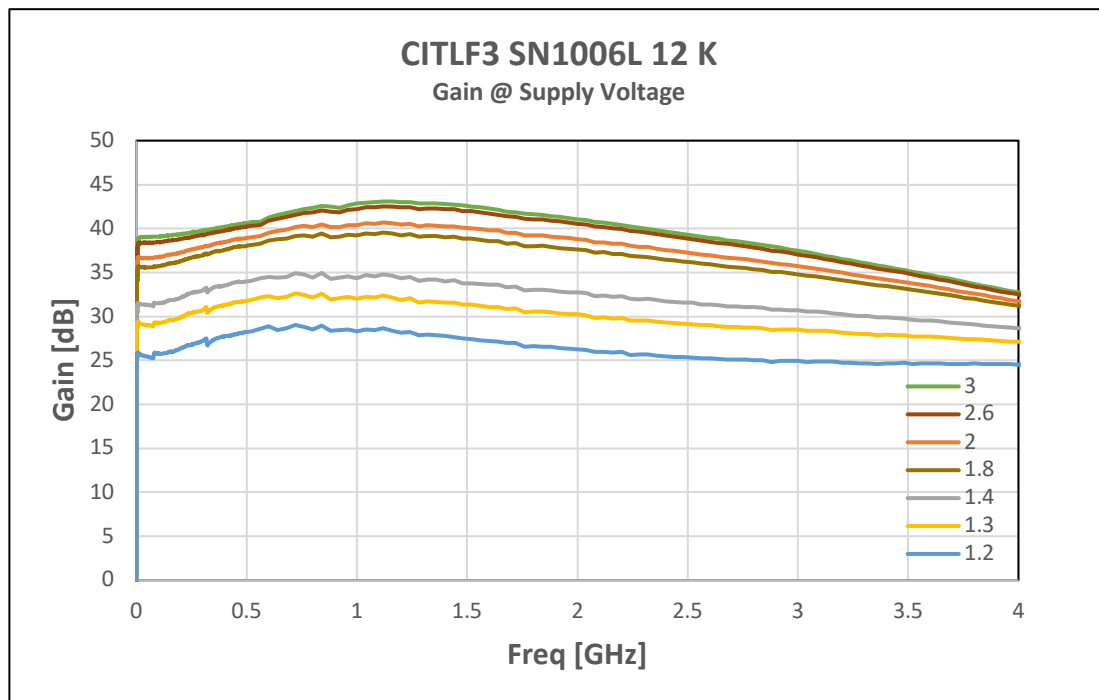
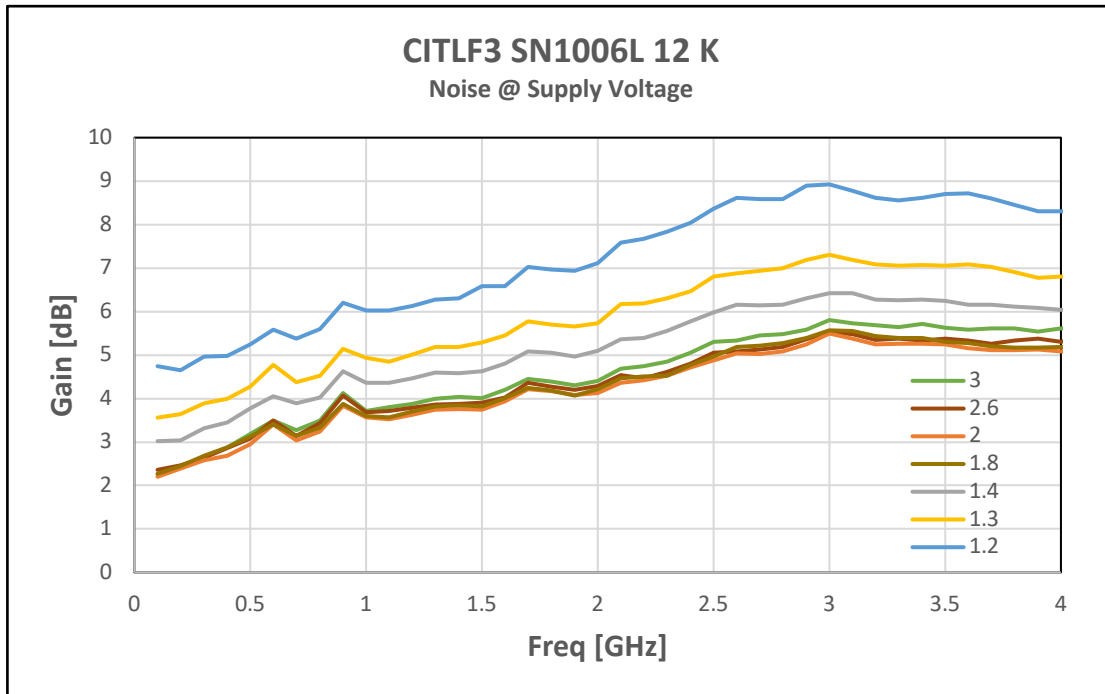
Electrical Specifications @ 300 K

Description	Typical	Minimum	Maximum
RF Frequency	.03-5 GHz	0.01 GHz	4 GHz
Gain	30 dB	30 dB \pm 5 dB	
Noise Temperature	< 60K	40 K	74 K
IRL (-20log S₁₁)	-10 dB	< -10 dB	
ORL (-20log S₂₂)	-15 dB	< -10 dB	
DC Voltage	2.0 V	1.2 V	3 V
DC Current	14.6 mA	5.4 mA	27 mA

Typical Test Results – Optimum DC Bias @ 12 K

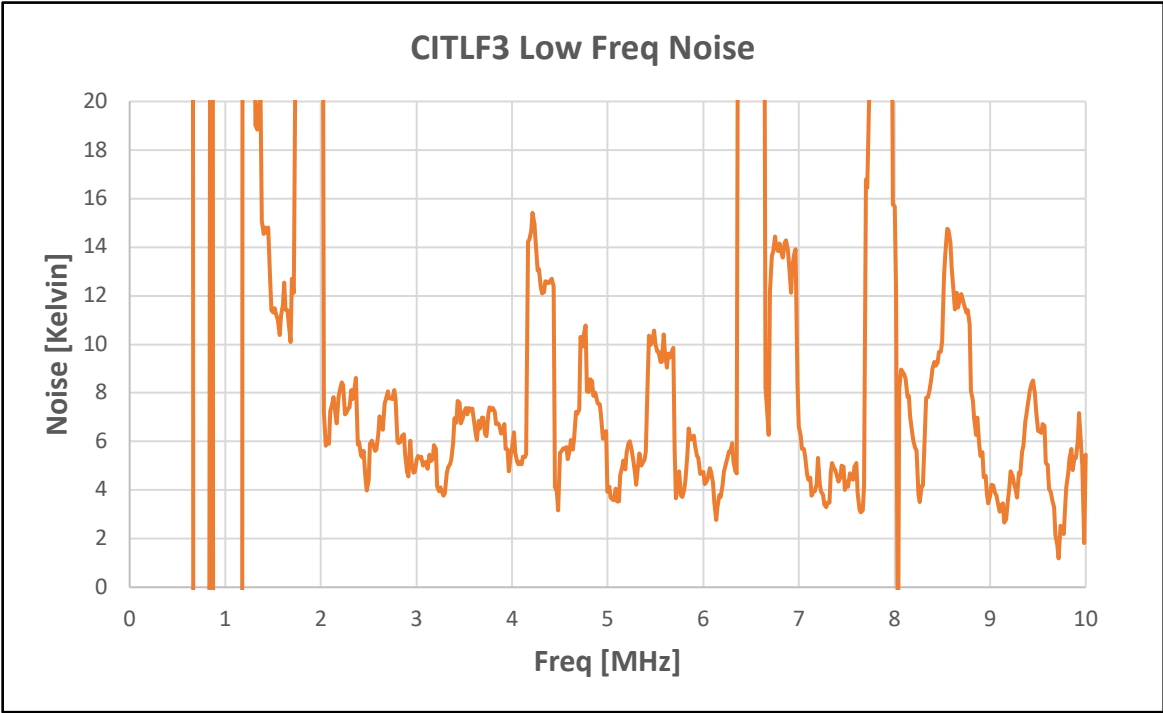
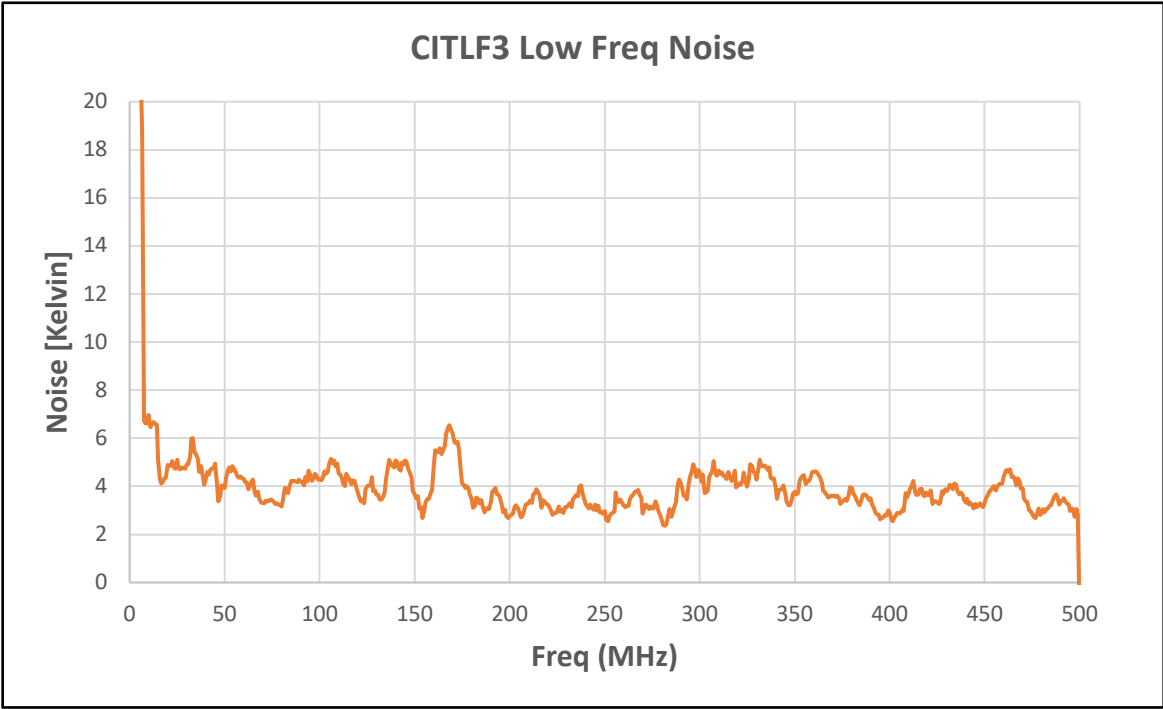


Typical Test Results – DC Bias Sweep @ 12 K

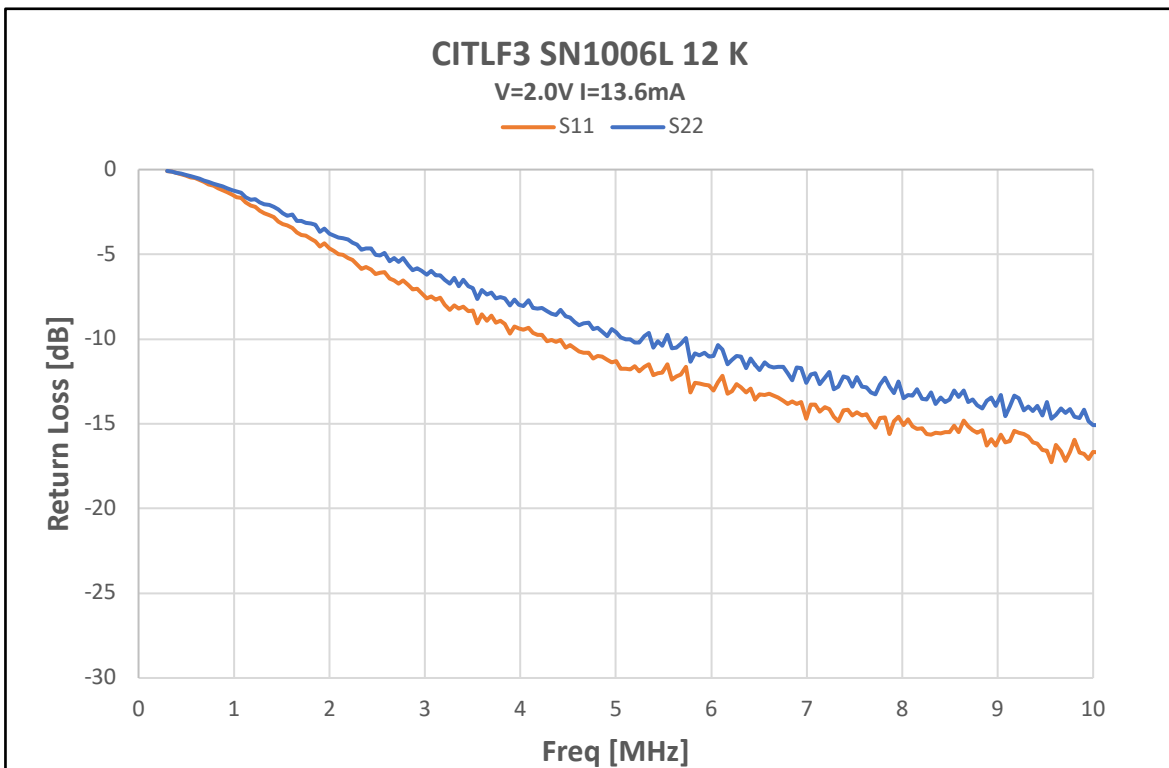
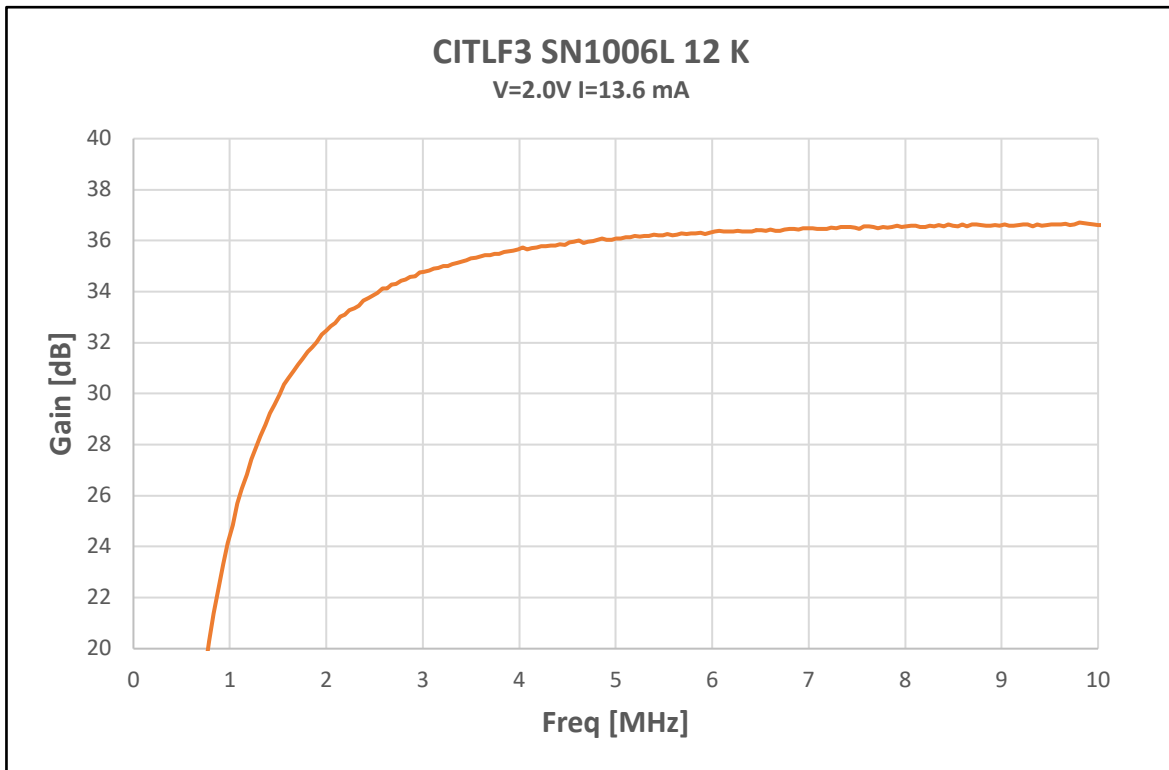


Vd (V)	Id (mA)	Pd (mW)
1.2	2.7	3.24
1.3	4	5.2
1.4	5.40	7.56
1.8	10.80	19.44
2.0	13.60	27.20
2.6	21.90	56.94
3.0	27.40	82.20

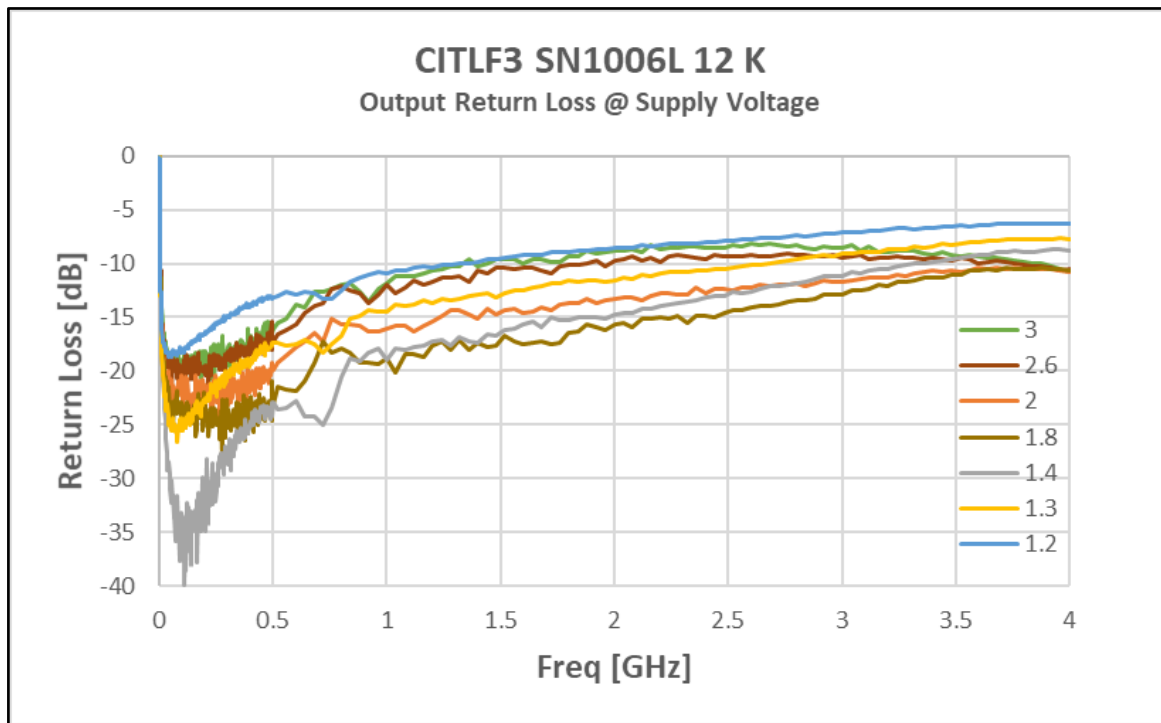
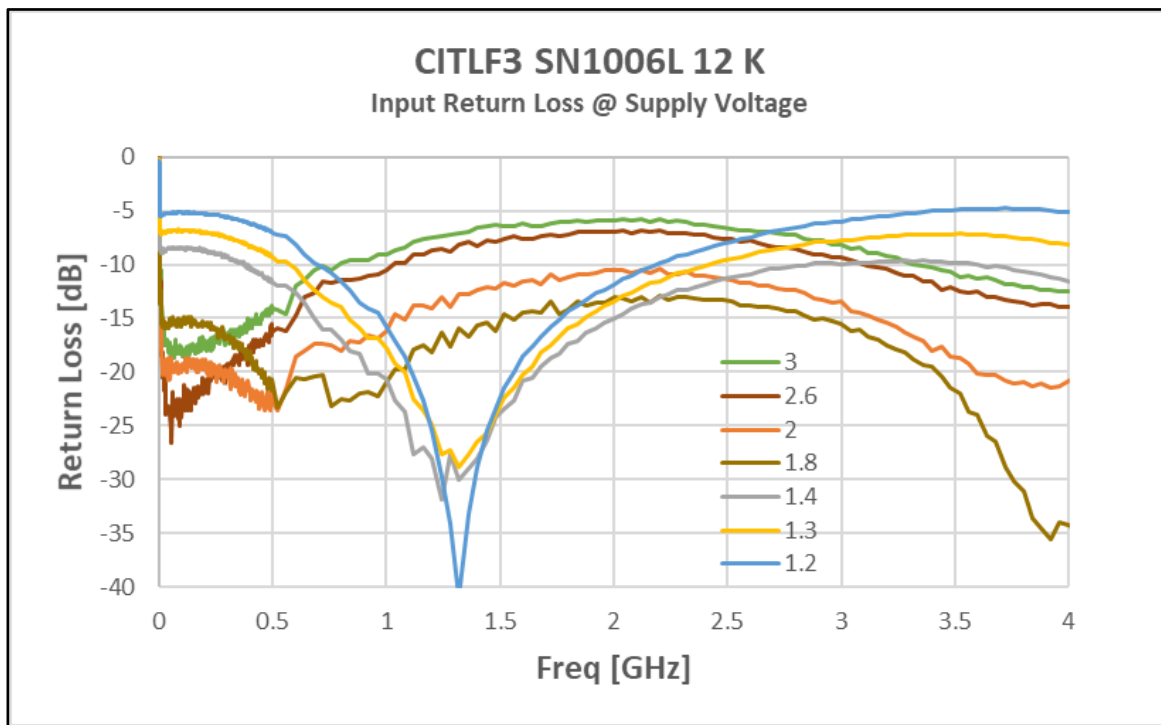
Typical Test Results – Low Freq Noise @ 12 K



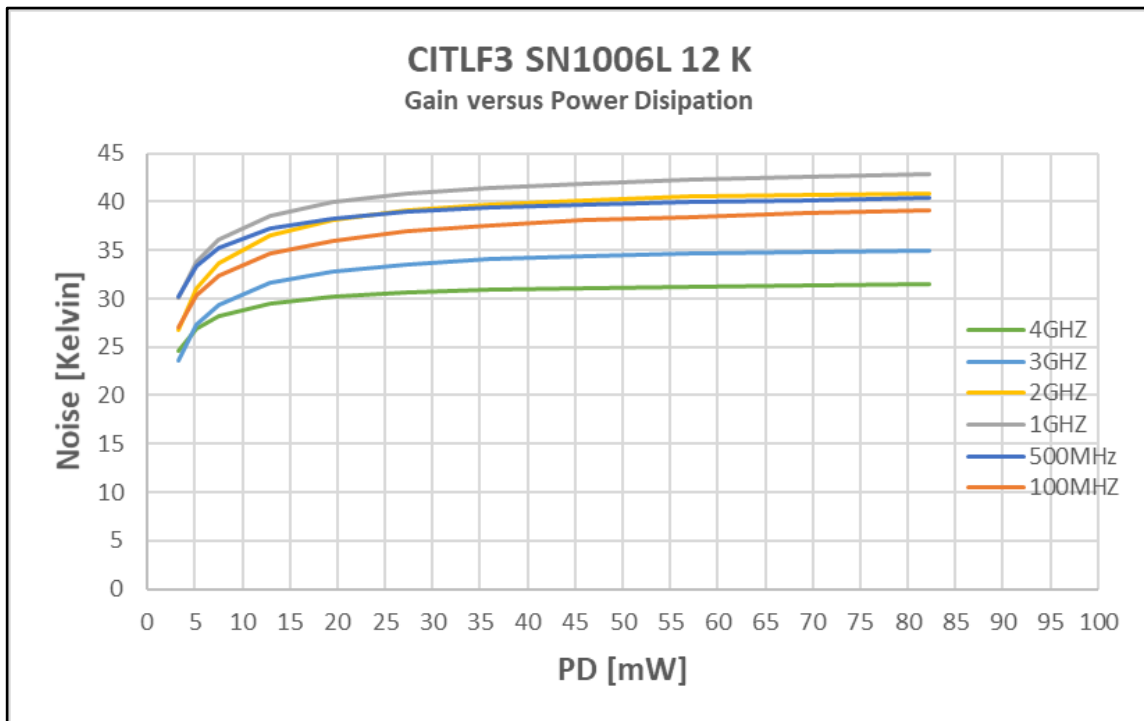
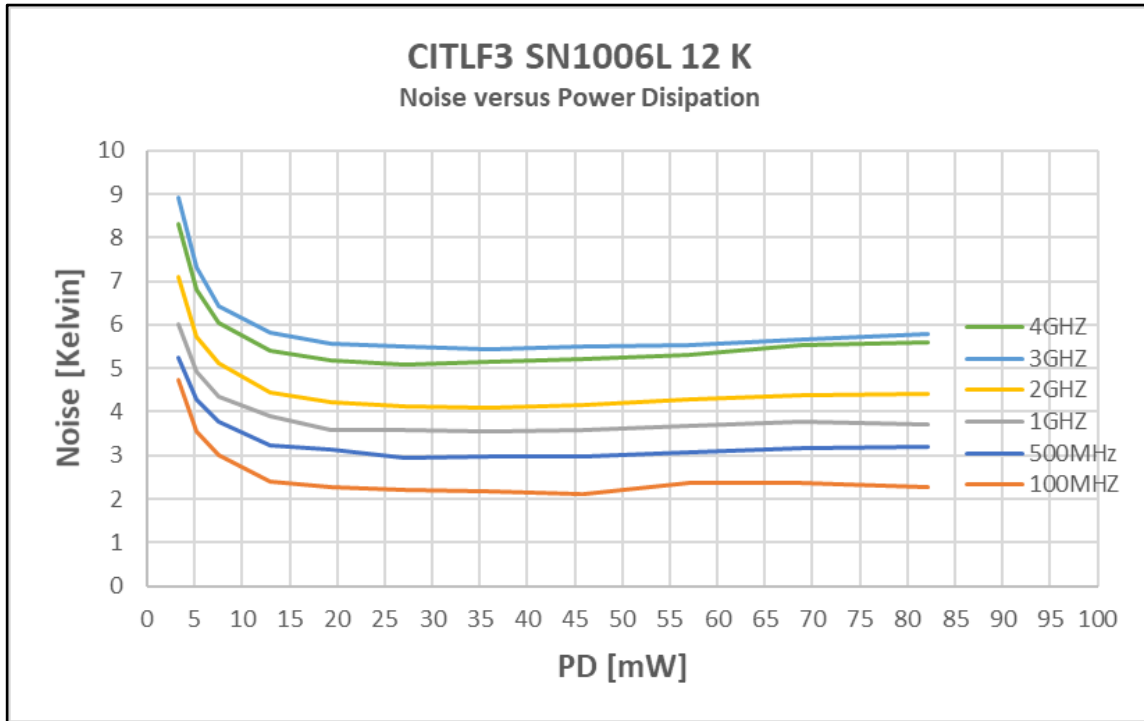
Typical Test Results – Low Freq S-Parameters @ 12 K



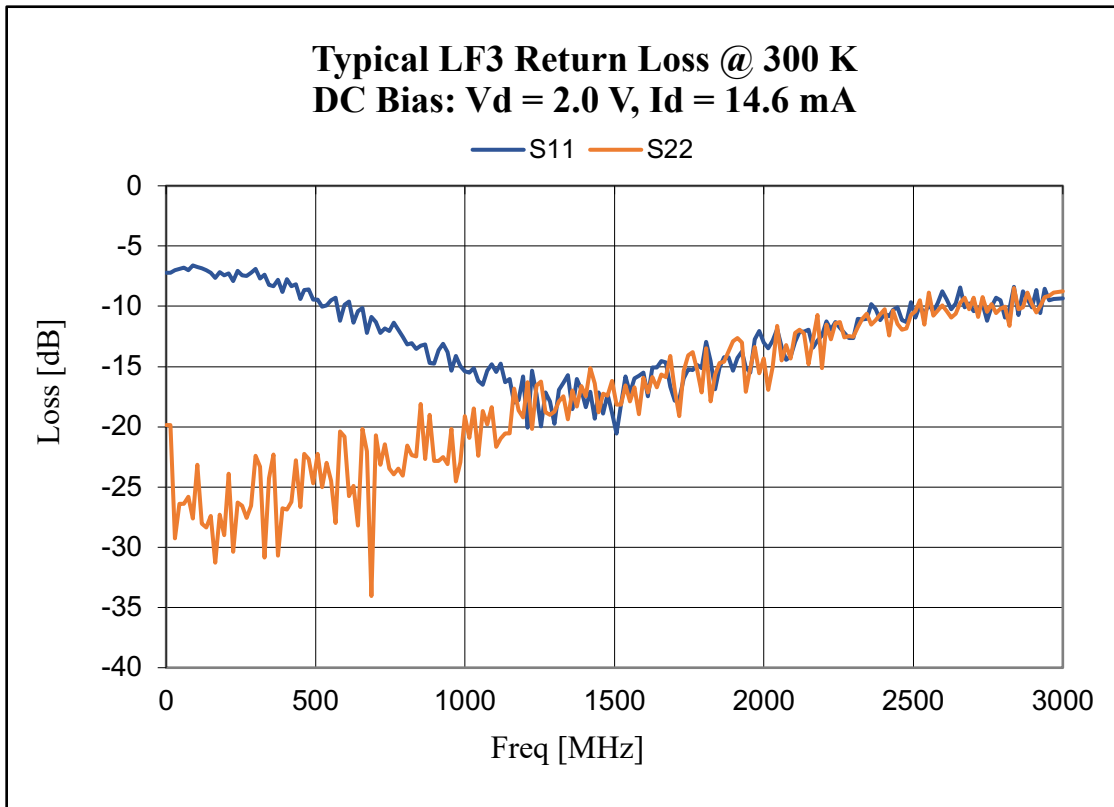
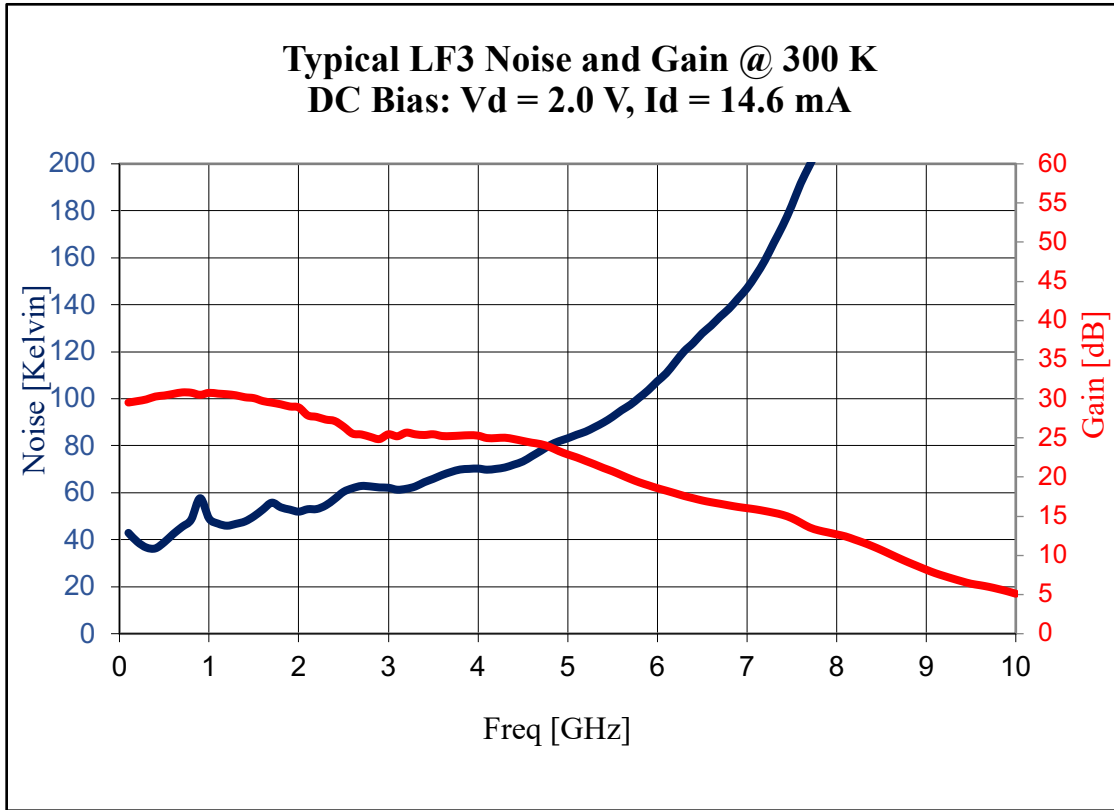
Typical Test Results – DC Bias Sweep @ 12 K



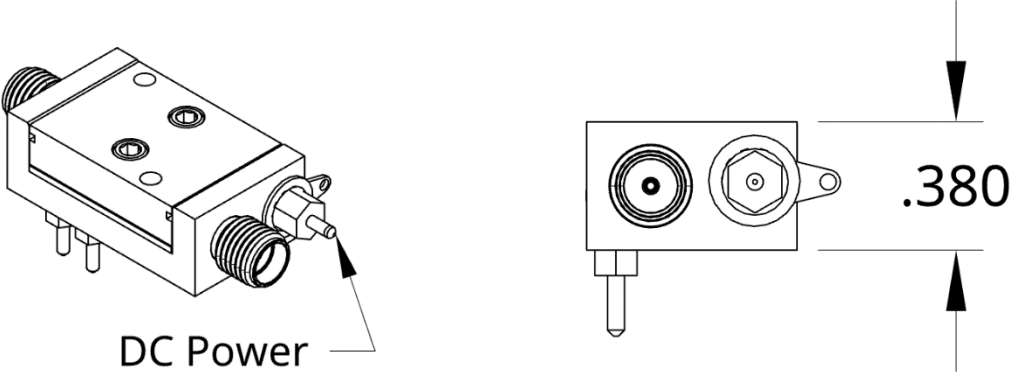
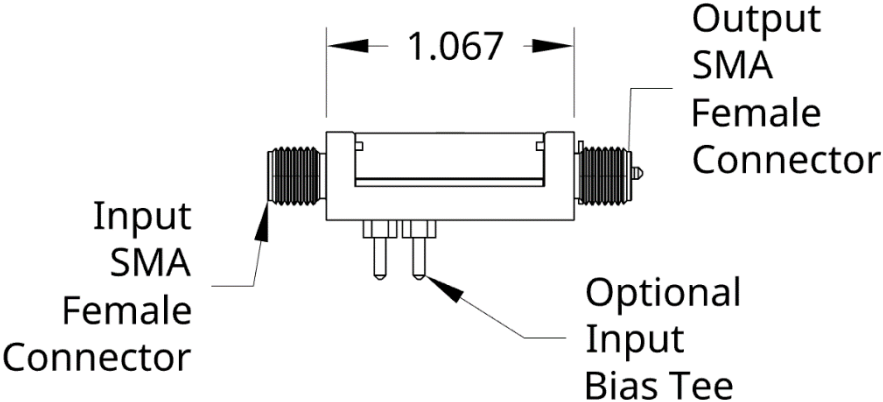
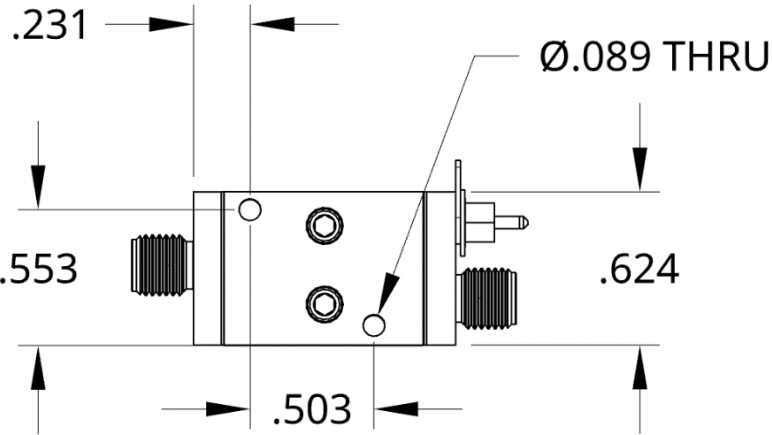
Typical Test Results – DC Bias Sweep @ 12 K



Typical Test Results – Optimum DC Bias @ 300 K



CAD Housing Drawing



*Dimensions are in inches

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.

To order an amplifier with internal bias resistors, add the resistance to the part #. For instance, CITLF3-20K.

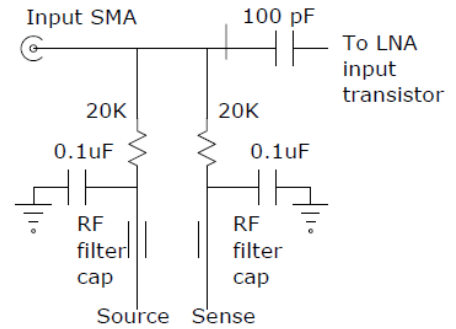
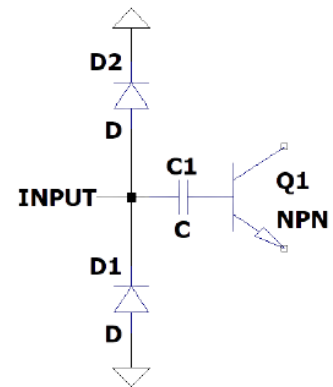


Figure 1. Bias Tee Schematic

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, CITLF3-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.

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