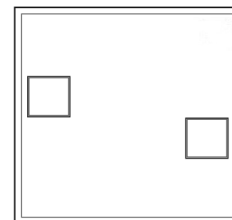


Flat Gain, Ultra-Wideband

# Monolithic Amplifier Die

GVA-123-D+

50Ω 0.01 to 12 GHz



## The Big Deal

- Ultra broadband performance
- Outstanding Gain flatness,  $\pm 0.7$  dB over 0.05 to 6 GHz
- Broadband high dynamic range without external matching components
- Unpackaged die form

## Product Overview

Mini-Circuits' GVA-123-D+ is a wideband amplifier die fabricated using InGaP GaAs HBT technology offering outstanding Gain flatness across a very wide frequency range from 0.01 to 12 GHz. It provides good input and Output return loss over wideband without the need for external matching components. Provided as an unpackaged amplifier die, this model gives users the advantage of extremely tiny size and allows easy integration directly into customer hybrids.

## Key Features

Feature	Advantages
Ultra broadband, 0.01 to 12 GHz	Covers the primary wireless communications bands: cellular, PCS, LTE, and WiMAX in a single amplifier.
Excellent Gain flatness: • $\pm 0.7$ dB over 0.05 to 6 GHz • $\pm 1.5$ dB over 0.05 to 8 GHz	Eliminates the need for gain flattening using external components.
No external matching components required.	GVA-123-D+ provides input and Output return loss of 12 to 24 dB up to 6 GHz without the need for external matching components, saving board real estate and reducing component count.
Unpackaged die	Enables the user to integrate the amplifier directly into hybrids.



# Flat Gain, Ultra-Wideband Monolithic Amplifier Die

## GVA-123-D+

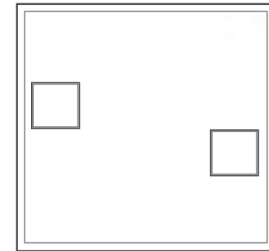
50Ω 0.01 to 12 GHz

### Product Features

- Gain, 16.7 dB typ. at 2 GHz
- Excellent Gain flatness, ±0.7 dB 0.05-6 GHz
- Excellent return loss, 24 dB at 2 GHz

### Typical Applications

- Base station infrastructure
- Test instruments
- Satellite communications
- MMDS & Wireless LAN
- LTE



**+RoHS Compliant**

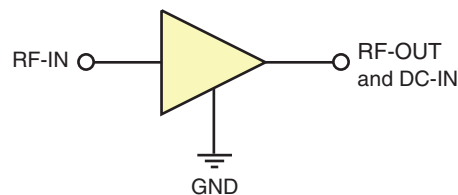
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

### General Description

GVA-123-D+ (RoHS compliant) is an advanced ultra wideband amplifier die fabricated using InGap HBT technology offering excellent Gain flatness over a broad frequency range and high IP3. In addition, the GVA-123-D+ has good input and Output return loss over a broad frequency range without the need for external matching components.

### Simplified Schematic and Pad description



Pad	Description
RF IN	RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	RF output and bias pad. DC voltage is present on this pad; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection.
GND	Connections to ground. Bottom of die.

Note: 1. Bond Pad material - Gold  
2. Bottom of Die - Gold plated

**Electrical Specifications<sup>1</sup> at 25°C and Vcc=5V, R=16.5Ω unless noted**

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.01		12.0	GHz
Gain	0.05		16.2		dB
	0.85		17.0		
	2.0		16.7		
	6.0		16.1		
	8.0		14.6		
	10.0		12.3		
	12.0		8.7		
Gain flatness	0.05-6		±0.7		dB
Input return loss	0.05		12.7		dB
	0.85		30.9		
	2.0		26.1		
	6.0		17.7		
	8.0		13.2		
	10.0		8.7		
	12.0		6.1		
Output return loss	0.05		14.0		dB
	0.85		25.3		
	2.0		24.3		
	6.0		12.1		
	8.0		10.6		
	10.0		9.7		
	12.0		7.7		
Reverse isolation	6.0		20.1		dB
Output power at 1dB compression	0.05		17.1		dBm
	0.85		16.3		
	2.0		15.9		
	6.0		13.0		
	8.0		10.3		
	10.0		8.3		
	12.0		5.9		
Output IP3	0.2		29.7		dBm
	0.85		29.8		
	2.0		29.1		
	6.0		23.8		
	8.0		21.9		
	10.0		20.0		
	12.0		14.6		
Noise figure	0.2		3.9		dB
	0.85		3.9		
	2.0		3.9		
	6.0		4.4		
	8.0		4.7		
	10.0		4.7		
	12.0		6.0		
Supply operating voltage (Vcc) <sup>2</sup>		4.8	5.0	5.2	V
Device operating current at Vcc=5V		42	48	57	mA
Device current variation vs. voltage			0.019		mA/mW
Thermal resistance, junction-to-ground lead			149		°C/W

1. Measured on Mini-Circuits Die Characterization test board . See Characterization Test Circuit (Fig. 1)

2. 16.5Ω series resistor from VCC to RF-OUT & DC-IN Pad is required. See Figure 1

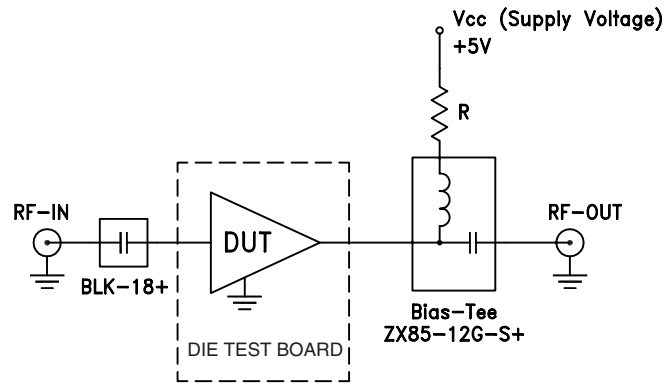
**Absolute Maximum Ratings<sup>3</sup>**

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Operating Current at 5V (Vcc) & 16.5Ω resistor	100 mA
Power Dissipation	0.34 W
Input Power (CW)	28 dBm (5 min max.) 11 dBm (continuous)
DC Voltage on RF-OUT & DC-IN Pad <sup>4</sup>	6 V

3. Permanent damage may occur if any of these limits are exceeded.

4. For continuous operation, Vcc ≤ 5.2V

Characterization Test Circuit



**Fig 1.** Block Diagram of Test Circuit used for characterization. DUT soldered on Mini-Circuits Characterization test board. Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and Noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.(R=16.5Ω)

**Conditions:**

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.

Die Layout

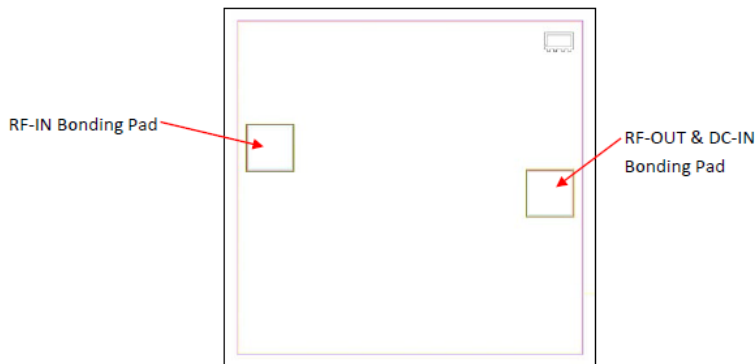


Fig 2. Die Layout

Bonding Pad Position  
(Dimensions in μm, Typical)

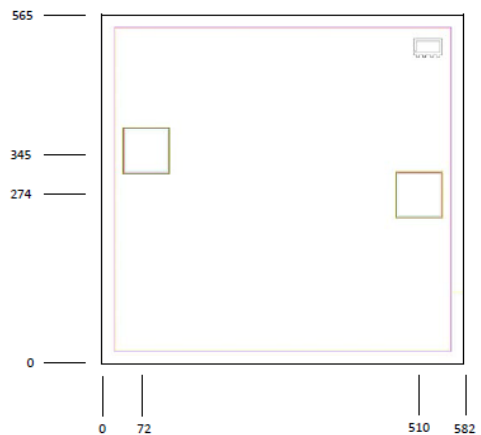


Fig 3. Bonding Pad Positions

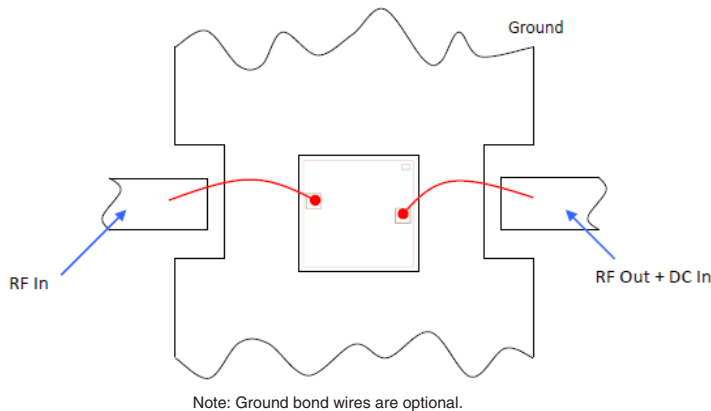
Critical Dimensions

Parameter	Values
Die Thickness, μm	100
Die Width, μm	582
Die Length, μm	565
Bond Pad Size, μm	75 x 75

### Assembly and Handling Procedure

1. Storage  
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD  
MMIC Gallium Arsenide (GaAs) amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach  
The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

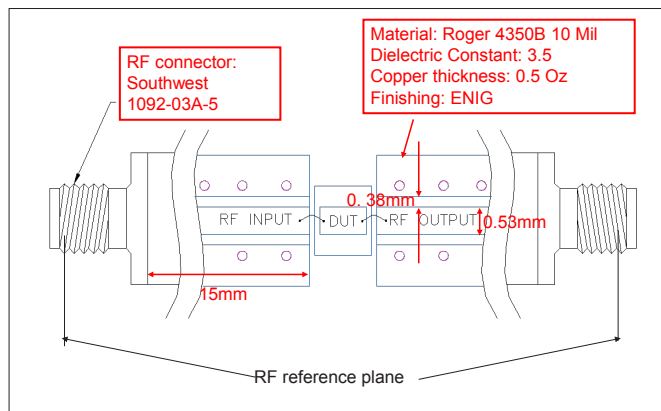
### Assembly Diagram



### Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT + DC-IN	0.6±0.1	0.15

### RF Reference Plane - No port extension



<b>Additional Detailed Technical Information</b> <i>additional information is available on our dash board.</i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)
<b>Case Style</b>	Die
<b>Die Ordering and packaging information</b>	Quantity, Package <span style="float: right;">Model No.</span>
	Small, Gel - Pak: 10,50,100 KGD* <span style="float: right;">GVA-123-DG+</span> Medium†, Partial wafer: KGD*<2700 <span style="float: right;">GVA-123-DP+</span> Large†, Full Wafer <span style="float: right;">GVA-123-DF+</span>
	†Available upon request contact sales representative
	Refer to <a href="#">AN-60-067</a>
<b>Environmental Ratings</b>	ENV-80

\*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

**ESD Rating\*\***

Human Body Model (HBM): Class 1C (1000 to <2000V) in accordance with ANSI/ESD STM 5.1 - 2001

\*\* Tested in industry standard SOT-89 package.

**Additional Notes**

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## Typical Performance Data

### Full 2-Port Extension

#### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vcc = 5V, Id = 47mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	14.29	22.95	10.49	11.54	1.27	0.92	---	15.18	7.76
20	14.72	22.49	10.88	12.08	1.22	0.87	16.93	17.47	7.51
30	15.28	21.98	11.47	12.74	1.18	0.80	17.87	16.89	6.66
40	15.84	21.36	12.19	13.22	1.13	0.71	19.23	16.84	5.98
50	16.31	21.07	12.95	14.21	1.10	0.65	19.89	17.07	5.59
60	16.60	20.58	13.92	15.04	1.08	0.58	21.49	16.93	5.21
70	16.88	20.37	14.87	16.01	1.06	0.53	23.49	16.63	4.93
80	17.08	20.19	15.85	16.94	1.05	0.49	25.43	16.60	4.67
90	17.21	20.05	16.97	17.99	1.05	0.46	26.92	16.24	4.49
100	17.33	19.93	17.96	18.88	1.04	0.43	27.76	16.05	4.41
200	17.56	19.82	28.63	26.18	1.03	0.40	29.94	15.96	3.92
250	17.50	19.89	32.58	28.19	1.04	0.42	29.79	15.90	3.90
300	17.48	19.93	35.11	29.03	1.04	0.43	30.21	16.17	3.92
350	17.44	20.01	36.28	28.60	1.04	0.44	29.78	16.23	4.01
400	17.41	20.02	36.52	28.30	1.04	0.45	30.49	16.46	3.97
450	17.38	20.05	35.97	28.07	1.05	0.46	30.47	16.40	4.01
500	17.37	20.09	34.43	28.10	1.05	0.46	30.31	16.38	3.99
550	17.36	20.11	33.17	27.74	1.05	0.47	30.06	16.40	4.00
600	17.35	20.12	32.43	27.24	1.05	0.47	30.56	16.40	3.96
650	17.34	20.12	32.08	26.65	1.05	0.47	30.22	16.46	4.02
700	17.34	20.15	32.11	26.26	1.05	0.48	30.36	16.41	3.96
750	17.33	20.15	32.05	25.91	1.05	0.48	30.29	16.14	3.95
800	17.32	20.16	32.20	25.49	1.05	0.48	30.19	16.37	3.89
850	17.31	20.16	31.89	25.15	1.05	0.48	30.04	16.37	3.86
1000	17.30	20.17	30.95	24.26	1.05	0.48	30.01	16.34	3.90
1500	17.27	20.18	27.33	23.51	1.05	0.48	29.95	16.12	3.87
2000	17.27	20.17	25.93	24.53	1.05	0.48	29.55	15.89	3.91
2500	17.28	20.12	24.05	24.04	1.05	0.48	28.36	15.80	4.00
3000	17.27	20.09	22.62	20.06	1.05	0.46	28.32	15.59	4.06
3500	17.25	20.07	22.85	17.44	1.05	0.45	27.24	15.60	4.06
4000	17.22	19.94	25.29	16.12	1.04	0.43	26.25	15.07	4.21
4500	17.19	19.86	27.26	15.66	1.03	0.42	25.47	14.45	4.27
5000	17.13	19.76	26.60	15.21	1.03	0.42	24.89	13.98	4.24
5500	17.02	19.66	21.33	13.84	1.03	0.40	24.32	13.58	4.35
6000	16.81	19.64	16.82	11.76	1.02	0.40	23.80	13.25	4.38
6500	16.49	19.65	14.10	10.18	1.01	0.41	23.32	12.49	4.51
7000	16.12	19.68	13.00	9.53	1.00	0.45	23.23	11.75	4.59
7500	15.75	19.70	12.70	9.67	1.00	0.51	23.37	11.37	4.63
8000	15.38	19.64	12.58	10.07	1.00	0.58	21.88	10.41	4.74
8500	14.96	19.59	12.19	10.29	1.01	0.63	21.46	9.67	4.78
9000	14.45	19.62	11.05	10.09	1.02	0.68	21.95	9.47	4.95
9500	13.82	19.75	9.39	9.69	1.03	0.74	21.79	9.34	5.05
10000	13.05	19.98	7.96	9.27	1.04	0.83	20.05	8.76	5.29
10500	12.20	20.29	6.92	8.98	1.06	0.91	18.29	7.70	5.47
11000	11.34	20.63	6.13	8.69	1.07	0.99	19.23	7.40	5.72
11500	10.45	20.92	5.59	8.26	1.08	1.06	17.46	6.85	5.85
12000	9.58	21.15	5.30	7.83	1.09	1.09	14.62	6.18	5.96

## Typical Performance Data

### Full 2-Port Extension

#### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vcc = 4.75V, Id = 43mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	14.24	22.72	10.78	11.46	1.25	0.91	---	14.33	7.57
20	14.66	22.44	11.08	11.87	1.23	0.87	17.71	16.47	7.38
30	15.21	21.85	11.67	12.64	1.18	0.80	21.62	15.92	6.55
40	15.76	21.29	12.37	13.12	1.13	0.71	24.69	15.95	5.88
50	16.22	20.84	13.17	13.88	1.09	0.63	25.36	16.00	5.52
60	16.51	20.51	14.07	14.92	1.08	0.58	28.15	15.65	5.12
70	16.78	20.28	15.02	15.89	1.06	0.53	28.00	14.91	4.84
80	16.98	20.10	16.00	16.86	1.05	0.49	28.01	14.93	4.61
90	17.12	19.98	17.11	17.93	1.05	0.46	27.89	14.48	4.43
100	17.23	19.88	18.07	18.79	1.04	0.44	27.77	14.08	4.35
200	17.45	19.75	28.29	25.50	1.03	0.41	28.47	14.86	3.87
250	17.40	19.83	32.31	27.21	1.04	0.43	28.29	14.82	3.87
300	17.37	19.92	36.18	27.72	1.04	0.44	28.27	15.10	3.88
350	17.34	19.94	40.42	27.05	1.04	0.45	28.37	15.40	3.95
400	17.30	19.98	43.89	26.57	1.05	0.46	28.37	15.43	3.92
450	17.27	20.02	42.30	26.42	1.05	0.47	28.81	15.37	3.96
500	17.25	20.05	38.25	26.43	1.05	0.47	28.75	15.36	3.96
550	17.24	20.06	36.09	26.11	1.05	0.48	28.66	15.36	3.94
600	17.23	20.06	35.29	25.60	1.05	0.48	29.43	15.60	3.92
650	17.22	20.09	34.70	25.24	1.05	0.48	29.39	15.43	3.98
700	17.22	20.11	33.73	25.05	1.05	0.48	28.86	15.39	3.91
750	17.20	20.12	33.13	24.81	1.05	0.49	28.71	15.33	3.92
800	17.20	20.14	32.94	24.45	1.06	0.49	28.86	15.35	3.86
850	17.19	20.13	32.56	24.15	1.05	0.49	28.53	15.35	3.81
1000	17.17	20.15	31.74	23.23	1.06	0.49	28.21	15.31	3.85
1500	17.13	20.17	27.82	22.44	1.06	0.50	28.50	15.10	3.80
2000	17.13	20.14	26.76	23.32	1.06	0.50	28.08	15.09	3.87
2500	17.13	20.14	24.96	23.26	1.06	0.49	27.47	14.79	3.94
3000	17.11	20.06	23.72	19.66	1.05	0.48	27.43	14.57	4.04
3500	17.09	20.01	23.89	17.06	1.05	0.46	26.59	14.85	4.01
4000	17.05	19.93	26.46	15.71	1.04	0.45	25.72	14.35	4.16
4500	17.01	19.82	28.98	15.24	1.04	0.44	25.06	13.95	4.22
5000	16.94	19.70	27.63	14.79	1.03	0.43	24.42	13.48	4.18
5500	16.83	19.61	21.88	13.55	1.03	0.42	23.99	13.10	4.32
6000	16.61	19.59	17.12	11.52	1.02	0.41	23.59	12.79	4.34
6500	16.27	19.59	14.24	9.98	1.01	0.42	23.19	12.05	4.46
7000	15.89	19.64	13.14	9.32	1.00	0.46	23.04	11.30	4.57
7500	15.51	19.63	12.77	9.43	1.00	0.53	23.13	10.92	4.56
8000	15.14	19.53	12.65	9.78	1.00	0.58	21.57	10.18	4.67
8500	14.72	19.53	12.23	9.97	1.01	0.64	21.12	9.44	4.69
9000	14.21	19.54	11.14	9.82	1.03	0.68	21.65	9.02	4.88
9500	13.59	19.69	9.44	9.45	1.04	0.75	21.48	8.89	4.97
10000	12.83	19.91	8.02	9.01	1.05	0.82	19.67	8.32	5.20
10500	11.99	20.17	7.03	8.72	1.06	0.90	17.95	7.27	5.36
11000	11.13	20.50	6.20	8.47	1.08	0.98	18.84	6.96	5.60
11500	10.26	20.80	5.63	8.10	1.08	1.05	17.10	6.42	5.71
12000	9.38	21.09	5.38	7.67	1.11	1.08	14.50	5.95	5.85



## Typical Performance Data

### Full 2-Port Extension

#### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vcc = 5.25V, Id = 52mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	14.65	23.49	10.84	12.63	1.33	0.93	---	15.87	7.41
20	14.99	22.48	11.77	13.16	1.23	0.86	19.85	18.18	7.22
30	15.48	21.88	11.97	12.94	1.16	0.79	19.54	17.68	6.52
40	15.92	21.40	12.59	13.73	1.13	0.72	20.05	17.70	5.93
50	16.28	20.81	13.37	14.34	1.09	0.63	20.59	17.86	5.61
60	16.64	20.93	14.17	15.53	1.09	0.61	20.58	17.86	5.25
70	16.89	20.47	15.08	16.32	1.07	0.54	21.04	17.67	4.94
80	17.09	20.28	16.00	17.25	1.06	0.50	21.92	17.63	4.71
90	17.24	20.13	16.96	18.13	1.05	0.47	22.37	17.52	4.55
100	17.35	20.04	18.02	19.09	1.04	0.45	22.66	17.43	4.44
200	17.60	19.89	27.87	27.06	1.03	0.41	30.12	17.25	3.95
250	17.55	20.02	32.53	29.29	1.04	0.43	30.27	17.18	3.95
300	17.53	20.02	33.19	30.59	1.04	0.43	31.52	17.20	3.96
350	17.49	20.08	33.93	30.54	1.04	0.45	31.94	17.23	4.06
400	17.47	20.10	33.23	29.63	1.05	0.45	32.49	17.23	3.99
450	17.44	20.13	32.17	29.26	1.05	0.46	31.99	17.36	4.05
500	17.42	20.17	32.04	28.58	1.05	0.47	31.71	17.14	4.05
550	17.42	20.16	32.05	28.44	1.05	0.47	31.66	17.16	4.03
600	17.40	20.20	31.92	28.05	1.05	0.47	32.69	17.34	4.02
650	17.39	20.20	31.23	27.90	1.05	0.48	31.85	17.21	4.05
700	17.37	20.23	30.65	27.47	1.05	0.48	31.43	17.17	4.01
750	17.37	20.23	30.71	27.20	1.05	0.48	31.40	17.12	3.99
800	17.36	20.22	31.00	26.64	1.05	0.48	31.43	17.13	3.91
850	17.36	20.23	30.37	26.49	1.05	0.48	31.28	17.13	3.90
1000	17.34	20.26	30.17	25.47	1.05	0.49	31.32	17.09	3.94
1500	17.31	20.27	27.47	24.44	1.06	0.49	31.05	16.87	3.97
2000	17.31	20.25	25.31	25.68	1.06	0.49	30.28	16.85	3.96
2500	17.30	20.24	23.24	25.34	1.06	0.49	29.50	16.55	4.03
3000	17.30	20.21	22.32	20.36	1.05	0.48	29.11	16.32	4.11
3500	17.29	20.14	22.38	18.00	1.05	0.46	27.89	16.28	4.11
4000	17.28	20.04	24.69	16.81	1.04	0.44	26.72	15.72	4.26
4500	17.26	19.94	25.76	15.91	1.04	0.43	25.77	15.11	4.31
5000	17.22	19.84	25.74	15.67	1.03	0.42	25.27	14.42	4.30
5500	17.12	19.74	21.05	14.18	1.03	0.40	24.56	14.22	4.42
6000	16.93	19.69	16.87	12.19	1.02	0.40	24.07	13.67	4.43
6500	16.61	19.74	14.13	10.48	1.01	0.41	23.62	12.90	4.60
7000	16.26	19.77	12.82	9.71	1.01	0.44	23.48	12.17	4.68
7500	15.89	19.76	12.51	9.94	1.00	0.51	23.69	11.58	4.71
8000	15.52	19.70	12.42	10.37	1.00	0.58	22.32	10.62	4.78
8500	15.11	19.69	12.17	10.62	1.01	0.63	21.84	9.88	4.87
9000	14.61	19.67	11.08	10.36	1.02	0.68	22.19	9.68	5.03
9500	13.97	19.79	9.33	10.07	1.03	0.75	22.03	9.56	5.15
10000	13.20	20.06	7.79	9.68	1.04	0.84	20.54	8.99	5.39
10500	12.35	20.35	6.82	9.25	1.06	0.92	18.79	7.93	5.59
11000	11.48	20.64	6.10	8.81	1.06	1.00	19.79	7.64	5.81
11500	10.58	21.01	5.51	8.47	1.07	1.07	18.11	7.08	5.96
12000	9.70	21.27	5.14	8.08	1.08	1.12	15.24	6.39	6.10

*Typical Performance Data*

Without Full 2-Port Extension

**Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vcc = 5V, Id = 47mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10.00	14.37	24.12	9.66	11.93	1.37	0.98	---	15.18	7.76
20.00	14.70	22.41	10.98	12.52	1.23	0.88	16.93	17.47	7.51
30.00	15.33	21.87	11.39	12.37	1.16	0.79	17.87	16.89	6.66
40.00	15.85	21.36	12.12	13.22	1.12	0.71	19.23	16.84	5.98
50.00	16.26	20.66	13.13	13.96	1.08	0.61	19.89	17.07	5.59
60.00	16.63	20.75	13.90	15.11	1.08	0.59	21.49	16.93	5.21
70.00	16.88	20.38	14.88	15.94	1.06	0.53	23.49	16.63	4.93
80.00	17.08	20.21	15.86	16.89	1.05	0.49	25.43	16.60	4.67
90.00	17.22	20.07	16.86	17.82	1.05	0.46	26.92	16.24	4.49
100.00	17.31	19.99	17.93	18.79	1.04	0.44	27.76	16.05	4.41
200.00	17.51	19.86	27.95	26.56	1.04	0.42	29.94	15.96	3.92
250.00	17.44	19.97	33.35	28.53	1.04	0.44	29.79	15.90	3.90
300.00	17.41	20.00	35.37	29.30	1.04	0.45	30.21	16.17	3.92
350.00	17.36	20.09	36.62	29.05	1.05	0.47	29.78	16.23	4.01
400.00	17.33	20.12	35.76	28.46	1.05	0.47	30.49	16.46	3.97
450.00	17.29	20.18	34.53	28.03	1.05	0.48	30.47	16.40	4.01
500.00	17.27	20.16	34.27	27.38	1.05	0.49	30.31	16.38	3.99
550.00	17.25	20.19	34.07	27.25	1.06	0.49	30.06	16.40	4.00
600.00	17.23	20.22	33.86	26.83	1.06	0.50	30.56	16.40	3.96
650.00	17.22	20.24	33.12	26.76	1.06	0.50	30.22	16.46	4.02
700.00	17.19	20.26	32.38	26.26	1.06	0.51	30.36	16.41	3.96
750.00	17.18	20.28	32.33	26.11	1.06	0.51	30.29	16.14	3.95
800.00	17.17	20.31	32.38	25.66	1.06	0.51	30.19	16.37	3.89
850.00	17.15	20.31	31.71	25.46	1.06	0.51	30.04	16.37	3.86
1000.00	17.12	20.35	31.24	24.56	1.07	0.52	30.01	16.34	3.90
1500.00	17.04	20.41	28.07	23.60	1.07	0.54	29.95	16.12	3.87
2000.00	16.99	20.43	26.12	24.77	1.08	0.54	29.55	15.89	3.91
2500.00	16.95	20.44	24.35	24.66	1.08	0.55	28.36	15.80	4.00
3000.00	16.91	20.45	23.38	20.26	1.08	0.55	28.32	15.59	4.06
3500.00	16.85	20.42	23.67	17.93	1.08	0.54	27.24	15.60	4.06
4000.00	16.81	20.36	26.11	16.71	1.07	0.53	26.25	15.07	4.21
4500.00	16.74	20.30	27.36	15.81	1.07	0.53	25.47	14.45	4.27
5000.00	16.66	20.19	27.21	15.60	1.07	0.52	24.89	13.98	4.24
5500.00	16.53	20.11	22.10	14.25	1.06	0.52	24.32	13.58	4.35
6000.00	16.30	20.07	17.72	12.34	1.06	0.51	23.80	13.25	4.38
6500.00	15.94	20.16	14.88	10.70	1.06	0.53	23.32	12.49	4.51
7000.00	15.55	20.22	13.56	9.98	1.06	0.56	23.23	11.75	4.59
7500.00	15.14	20.23	13.27	10.19	1.07	0.62	23.37	11.37	4.63
8000.00	14.74	20.20	13.16	10.60	1.08	0.67	21.88	10.41	4.74
8500.00	14.30	20.23	12.93	10.84	1.10	0.72	21.46	9.67	4.78
9000.00	13.77	20.23	11.88	10.62	1.13	0.75	21.95	9.47	4.95
9500.00	13.11	20.37	10.18	10.40	1.16	0.81	21.79	9.34	5.05
10000.00	12.31	20.63	8.67	10.01	1.20	0.88	20.05	8.76	5.29
10500.00	11.44	20.94	7.73	9.60	1.25	0.94	18.29	7.70	5.47
11000.00	10.56	21.27	7.02	9.21	1.31	1.00	19.23	7.40	5.72
11500.00	9.64	21.62	6.45	8.92	1.38	1.05	17.46	6.85	5.85
12000.00	8.75	21.89	6.10	8.54	1.45	1.08	14.62	6.18	5.96



*Typical Performance Data*

Without Full 2-Port Extension

**Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vcc = 4.75V, Id = 43mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	14.27	22.17	10.64	11.38	1.18	0.90	---	14.33	7.57
20	14.63	22.34	11.23	12.37	1.23	0.87	17.71	16.47	7.38
30	15.26	21.81	11.61	12.26	1.16	0.79	21.62	15.92	6.55
40	15.78	21.26	12.36	13.10	1.12	0.71	24.69	15.95	5.88
50	16.17	20.68	13.15	13.87	1.09	0.62	25.36	16.00	5.52
60	16.55	20.58	14.29	14.95	1.08	0.58	28.15	15.65	5.12
70	16.80	20.29	15.15	15.78	1.06	0.52	28.00	14.91	4.84
80	17.00	20.12	16.12	16.73	1.05	0.49	28.01	14.93	4.61
90	17.14	19.99	17.09	17.61	1.05	0.46	27.89	14.48	4.43
100	17.23	19.89	18.10	18.54	1.04	0.44	27.77	14.08	4.35
200	17.44	19.77	27.74	25.74	1.04	0.41	28.47	14.86	3.87
250	17.38	19.84	33.72	27.31	1.04	0.43	28.29	14.82	3.87
300	17.35	19.89	37.07	27.45	1.04	0.44	28.27	15.10	3.88
350	17.30	19.97	39.60	27.37	1.05	0.46	28.37	15.40	3.95
400	17.28	19.99	39.78	27.02	1.05	0.46	28.37	15.43	3.92
450	17.25	20.05	38.10	26.65	1.05	0.47	28.81	15.37	3.96
500	17.22	20.05	37.30	26.04	1.05	0.48	28.75	15.36	3.96
550	17.21	20.07	36.32	25.99	1.05	0.48	28.66	15.36	3.94
600	17.19	20.10	35.46	25.72	1.05	0.49	29.43	15.60	3.92
650	17.18	20.11	34.68	25.49	1.06	0.49	29.39	15.43	3.98
700	17.16	20.13	34.08	25.02	1.06	0.49	28.86	15.39	3.91
750	17.15	20.14	33.70	24.80	1.06	0.50	28.71	15.33	3.92
800	17.13	20.17	33.37	24.52	1.06	0.50	28.86	15.35	3.86
850	17.12	20.18	32.72	24.35	1.06	0.50	28.53	15.35	3.81
1000	17.09	20.22	31.99	23.40	1.06	0.51	28.21	15.31	3.85
1500	17.02	20.25	28.23	22.58	1.07	0.52	28.50	15.10	3.80
2000	16.98	20.26	26.50	23.66	1.07	0.53	28.08	15.09	3.87
2500	16.95	20.26	25.25	23.49	1.07	0.53	27.47	14.79	3.94
3000	16.91	20.24	24.04	19.89	1.07	0.52	27.43	14.57	4.04
3500	16.86	20.24	24.49	17.49	1.07	0.52	26.59	14.85	4.01
4000	16.80	20.15	27.27	16.23	1.06	0.51	25.72	14.35	4.16
4500	16.73	20.11	28.53	15.40	1.06	0.51	25.06	13.95	4.22
5000	16.64	19.99	27.98	15.12	1.06	0.50	24.42	13.48	4.18
5500	16.50	19.92	22.35	13.94	1.05	0.50	23.99	13.10	4.32
6000	16.25	19.88	17.69	12.07	1.05	0.50	23.59	12.79	4.34
6500	15.89	19.94	14.73	10.47	1.05	0.51	23.19	12.05	4.46
7000	15.47	20.02	13.40	9.77	1.05	0.55	23.04	11.30	4.57
7500	15.06	20.04	13.08	9.93	1.05	0.61	23.13	10.92	4.56
8000	14.65	20.02	12.97	10.32	1.07	0.67	21.57	10.18	4.67
8500	14.21	19.98	12.67	10.52	1.08	0.71	21.12	9.44	4.69
9000	13.67	20.00	11.66	10.33	1.11	0.75	21.65	9.02	4.88
9500	13.01	20.16	10.01	10.13	1.14	0.81	21.48	8.89	4.97
10000	12.22	20.39	8.49	9.72	1.17	0.87	19.67	8.32	5.20
10500	11.34	20.75	7.58	9.33	1.23	0.94	17.95	7.27	5.36
11000	10.47	21.03	6.88	9.01	1.27	1.00	18.84	6.96	5.60
11500	9.57	21.38	6.29	8.73	1.33	1.05	17.10	6.42	5.71
12000	8.68	21.70	5.92	8.35	1.40	1.08	14.50	5.95	5.85



*Typical Performance Data*

Without Full 2-Port Extension

**Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

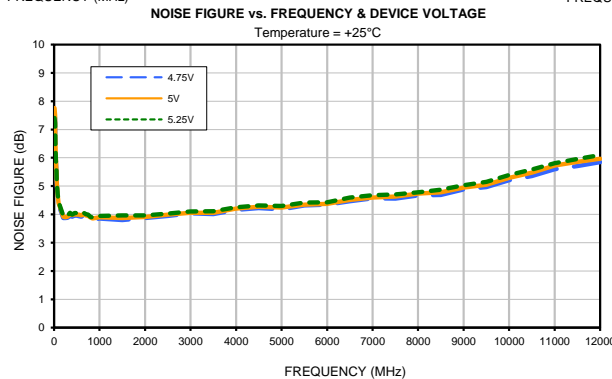
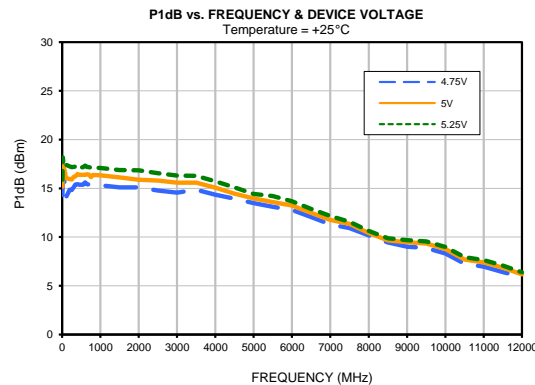
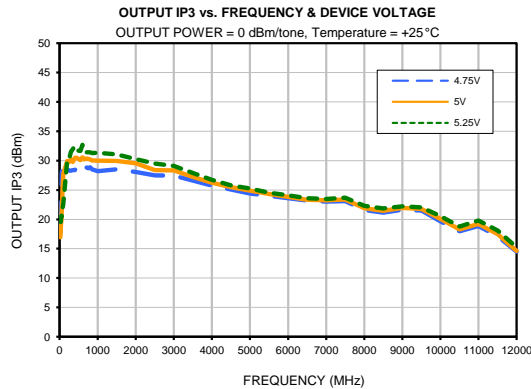
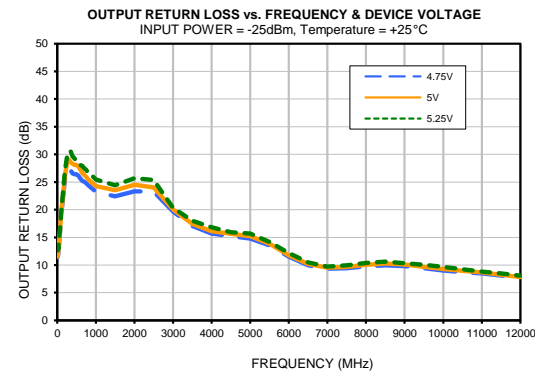
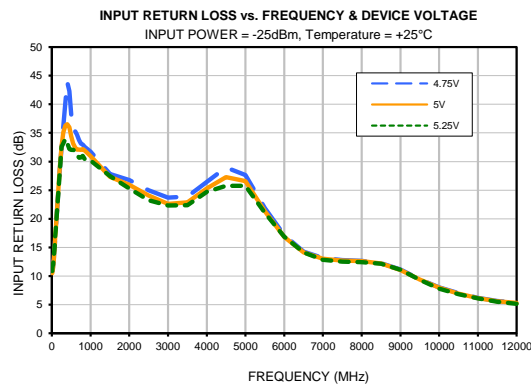
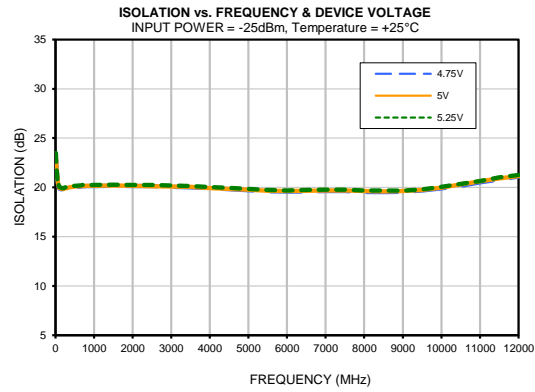
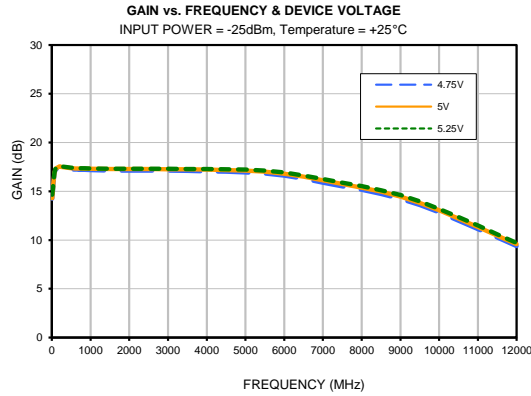
TEST CONDITIONS: Vcc = 5.25V, Id =52mA @Temperature = +25°C

FREQ.	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
					K	Measure			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	14.69	22.10	11.40	12.12	1.17	0.88	---	15.87	7.41
20	15.03	22.61	11.62	13.13	1.24	0.87	19.85	18.18	7.22
30	15.51	21.98	11.95	12.92	1.16	0.79	19.54	17.68	6.52
40	15.95	21.46	12.56	13.72	1.13	0.72	20.05	17.70	5.93
50	16.30	21.18	13.27	14.54	1.11	0.66	20.59	17.86	5.61
60	16.66	20.49	14.31	15.40	1.07	0.57	20.58	17.86	5.25
70	16.90	20.46	15.10	16.28	1.07	0.54	21.04	17.67	4.94
80	17.10	20.28	16.04	17.19	1.06	0.50	21.92	17.63	4.71
90	17.25	20.16	16.99	18.07	1.05	0.47	22.37	17.52	4.55
100	17.35	20.05	18.05	19.01	1.04	0.45	22.66	17.43	4.44
200	17.57	19.92	27.95	26.92	1.04	0.41	30.12	17.25	3.95
250	17.51	20.00	32.70	29.28	1.04	0.43	30.27	17.18	3.95
300	17.48	20.05	33.45	30.59	1.04	0.45	31.52	17.20	3.96
350	17.43	20.14	34.01	30.43	1.05	0.46	31.94	17.23	4.06
400	17.40	20.17	33.31	29.80	1.05	0.47	32.49	17.23	3.99
450	17.36	20.22	32.22	29.33	1.05	0.48	31.99	17.36	4.05
500	17.33	20.26	32.07	28.69	1.06	0.49	31.71	17.14	4.05
550	17.32	20.25	32.05	28.57	1.06	0.49	31.66	17.16	4.03
600	17.30	20.29	32.04	28.03	1.06	0.50	32.69	17.34	4.02
650	17.28	20.30	31.46	27.94	1.06	0.50	31.85	17.21	4.05
700	17.26	20.32	30.83	27.51	1.06	0.51	31.43	17.17	4.01
750	17.25	20.34	30.93	27.24	1.06	0.51	31.40	17.12	3.99
800	17.23	20.37	31.10	26.70	1.06	0.51	31.43	17.13	3.91
850	17.22	20.38	30.61	26.53	1.06	0.52	31.28	17.13	3.90
1000	17.19	20.42	30.35	25.55	1.07	0.52	31.32	17.09	3.94
1500	17.10	20.50	27.76	24.55	1.07	0.54	31.05	16.87	3.97
2000	17.05	20.50	25.72	25.79	1.08	0.55	30.28	16.85	3.96
2500	17.01	20.54	23.70	25.50	1.08	0.55	29.50	16.55	4.03
3000	16.97	20.53	22.75	20.54	1.08	0.55	29.11	16.32	4.11
3500	16.92	20.52	22.94	18.24	1.08	0.54	27.89	16.28	4.11
4000	16.89	20.42	25.30	17.06	1.07	0.53	26.72	15.72	4.26
4500	16.83	20.37	26.32	16.17	1.07	0.53	25.77	15.11	4.31
5000	16.76	20.31	26.32	15.96	1.07	0.53	25.27	14.42	4.30
5500	16.65	20.25	21.71	14.51	1.07	0.52	24.56	14.22	4.42
6000	16.42	20.22	17.54	12.53	1.06	0.52	24.07	13.67	4.43
6500	16.06	20.27	14.83	10.85	1.06	0.53	23.62	12.90	4.60
7000	15.68	20.34	13.57	10.12	1.06	0.56	23.48	12.17	4.68
7500	15.29	20.38	13.30	10.36	1.07	0.62	23.69	11.58	4.71
8000	14.90	20.35	13.22	10.80	1.08	0.67	22.32	10.62	4.78
8500	14.47	20.31	13.00	11.06	1.11	0.72	21.84	9.88	4.87
9000	13.94	20.36	11.94	10.84	1.13	0.75	22.19	9.68	5.03
9500	13.28	20.49	10.23	10.58	1.16	0.81	22.03	9.56	5.15
10000	12.49	20.77	8.70	10.19	1.20	0.88	20.54	8.99	5.39
10500	11.61	21.06	7.74	9.78	1.26	0.94	18.79	7.93	5.59
11000	10.73	21.37	7.05	9.37	1.31	1.00	19.79	7.64	5.81
11500	9.81	21.77	6.49	9.06	1.39	1.05	18.11	7.08	5.96
12000	8.91	22.07	6.13	8.66	1.47	1.08	15.24	6.39	6.10



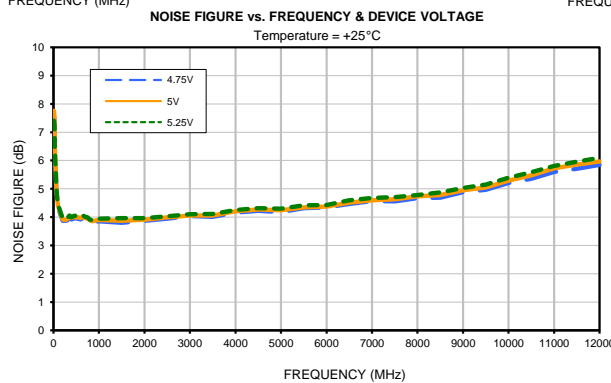
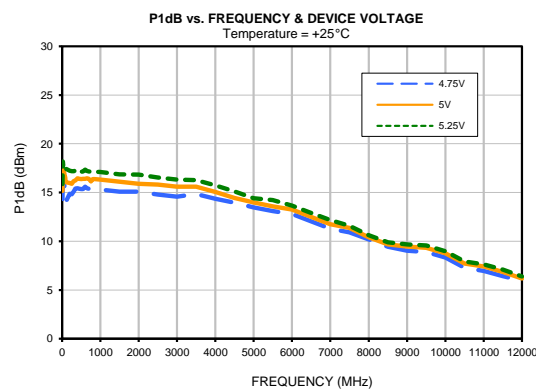
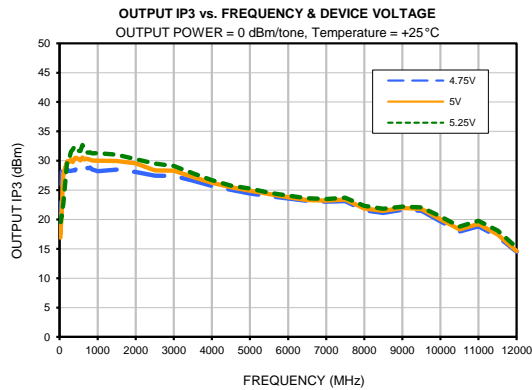
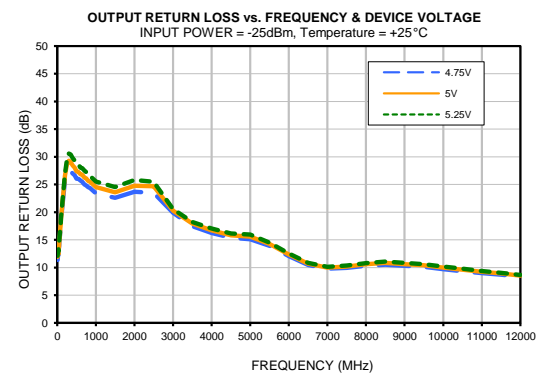
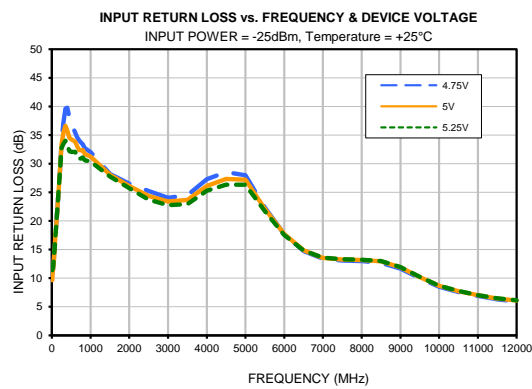
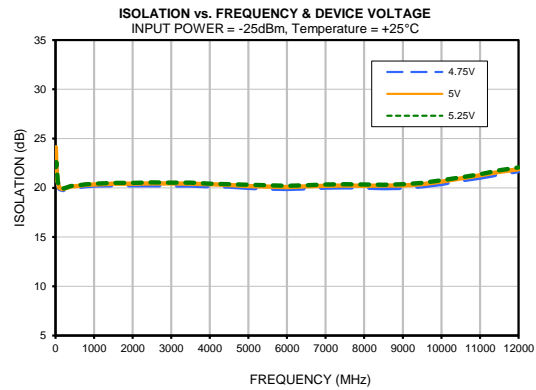
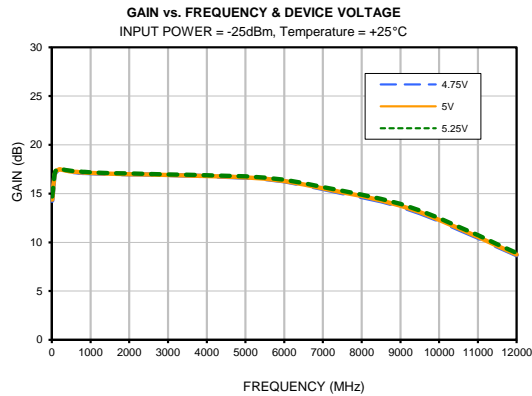
## Typical Performance Curves

### Full 2-Port Extension



## Typical Performance Curves

### Without Full 2-Port Extension



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment (Die)	-65° to 150°C	Individual Model Data Sheet
Storage Environment(Packaging)	-40° to 70°C and 40 to 60% humidity (In Factory Shipped Package)	