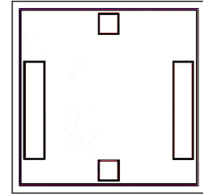


Flat Gain, High IP3

# Monolithic Amplifier Die

GVA-60-D+

50Ω 0.01 to 6 GHz



## The Big Deal

- Excellent Gain flatness and Return Loss over 50-1000 MHz
- High IP3 vs. DC Power consumption
- Broadband High Dynamic Range without external Matching Components

## Product Overview

GVA-60-D+ (RoHS compliant) is a wideband amplifier die fabricated using HBT technology offering ultra flat gain over a broad frequency range and with high IP3. In addition, the GVA-60-D+, has good input and Output return loss over a broad frequency range without the need for external matching components and has demonstrated excellent reliability.

## Key Features

Feature	Advantages
Broad Band: 0.01 to 6 GHz	Broadband covering a broad range of IF frequencies and the primary wireless communications bands: Cellular, PCS, LTE, WiMAX
High IP3 vs. DC power Consumption 39 dBm typical at 0.05 GHz 36 dBm typical at 0.85 GHz	The GVA-60-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and HBT Structure provides enhanced linearity over a broad frequency range as evidenced in the IP3 being typically 16 dB above the P 1dB point to 0.85 GHz. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none"><li>• Driver amplifiers for complex waveform up converter paths</li><li>• Drivers in linearized transmit systems</li></ul>
Outstanding Input return loss up to 1 GHz: better than 19 dB.	The GVA-60-D+ provides excellent Input return loss: 19 dB up to 1 GHz and 15.0 dB up to 2 GHz making this amplifier an ideal IF gain block that can be embedded in RF chains that have highly reflective components, and still maintain good system performance
No External Matching Components Required 9-25 dB to 2 GHz	GVA-60-D+ provides good Input and Output return loss without the need for any external matching components



Flat Gain, High IP3

# Monolithic Amplifier Die

GVA-60-D+

50Ω 0.01 to 6 GHz

## Product Features

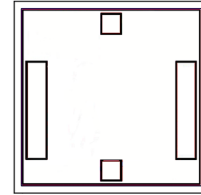
- Gain, 20 dB typ. at 0.4 GHz
- Gain flatness:  $\pm 0.3$  dB over 50-1000 MHz
- Excellent Input return loss, up to 2 GHz, 14-25 dB
- High Pout, P1dB 20.0 dBm typ. at 0.4 GHz
- High IP3, 40 dBm typ. at 400 MHz
- Excellent ESD protection, Class 1C for HBM
- No external matching components required

## Typical Applications

- Base station infrastructure
- Portable Wireless
- CATV & DBS
- MMDS & Wireless LAN
- LTE

## General Description

GVA-60-D+ (RoHS compliant) is an advanced wideband amplifier die fabricated using HBT technology that offers flat gain over a broad frequency range with high IP3. In addition, the GVA-60-D+ has excellent input and Output return loss over a broad frequency range without the need for external matching components.

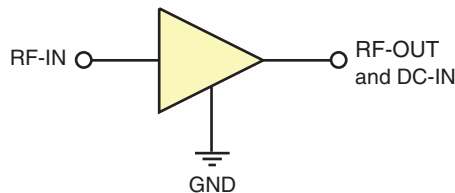


**+RoHS Compliant**

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

Ordering Information: Refer to Last Page

## 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 pin; 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, as shown in "Recommended Application Circuit", Fig. 2
GND	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

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

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

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.01		6	GHz
Gain	0.05		20.6		dB
	0.85		20.0		
	2.0		19.3		
	3.0		18.0		
	4.0		15.9		
	5.0		13.6		
	6.0		11.2		
Input return loss	0.05		23.2		dB
	0.85		20.4		
	2.0		14.78		
	3.0		15.5		
	4.0		14.9		
	5.0		14.8		
	6.0		16.2		
Output return loss	0.05		11.0		dB
	0.85		10.5		
	2.0		8.6		
	3.0		8.1		
	4.0		7.6		
	5.0		8.1		
	6.0		7.2		
Reverse isolation	2.0		24.6		dB
Output power at 1dB compression	0.05		20.0		dBm
	0.85		20.6		
	2.0		18.2		
	3.0		14.7		
	4.0		11.9		
	5.0		9.7		
	6.0		7.9		
Output IP3	0.05		38.6		dBm
	0.85		36.4		
	2.0		29.0		
	3.0		23.5		
	4.0		20.7		
	5.0		18.2		
	6.0		16.3		
Noise figure	0.05		3.7		dB
	0.85		3.9		
	2.0		3.9		
	3.0		4.1		
	4.0		4.3		
	5.0		4.4		
	6.0		4.7		
Device Operating Voltage			5.0		V
Device Operating Current		—	93	100	mA
Device Current Variation vs. Voltage			0.040		mA/mW
Thermal Resistance, junction-to-ground lead			37		°C/W

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

**Absolute Maximum Ratings<sup>2</sup>**

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to 85°C
Operating Current at 5V	140 mA
Power Dissipation	0.7 W
Input Power (CW)	28 dBm (10-1000 MHz, +5 minutes) 13 dBm (1000-5000 MHz, +5 minutes) 8 dBm (continuous) 28 dBm (10-1000 MHz, +5 minutes)
DC Voltage on RF OUT Pad 3	6V

2. Permanent damage may occur if any of these limits are exceeded.  
Electrical maximum ratings are not intended for continuous normal operation.  
For continuous operation, do not exceed 5.2V device voltage.  
Die performance measured in industry standard SOT-89 package.



**Characterization Test Circuit**

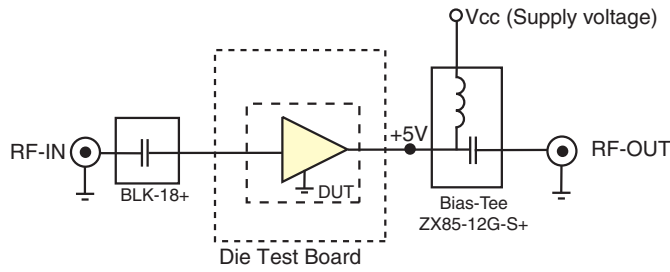


Fig 1. Block Diagram of Test Circuit used for characterization. Gain, Return loss, Output power at 1dB compression (P1 dB) , output IP3 (OIP3) and Noise figure measured using Agilent’s N5242A PNA-X microwave network analyzer.

**Conditions:**

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -18 dBm/tone at input.

**Recommended Application Circuit**

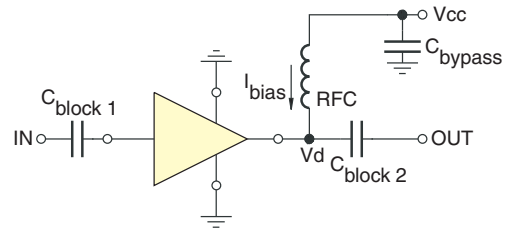


Fig 2. Test Board includes case, connectors, and Components soldered to PCB  
 Cblock1: 1000 pF  
 Cblock 2 & RFC: TCBT-14+  
 Cbypass: 0.1µF

**Die Layout**

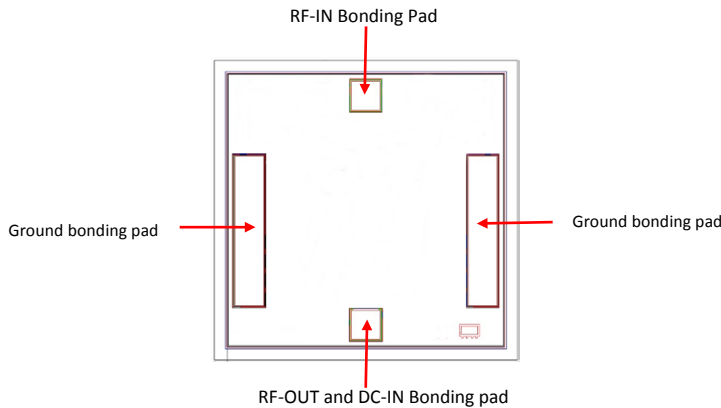


Fig 3. Die Layout

**Bonding Pad Position**  
(Dimensions in µm, Typical)

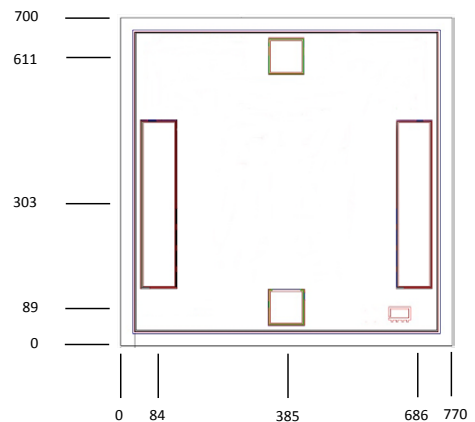


Fig 4. Bonding Pad Positions

**Critical Dimensions**

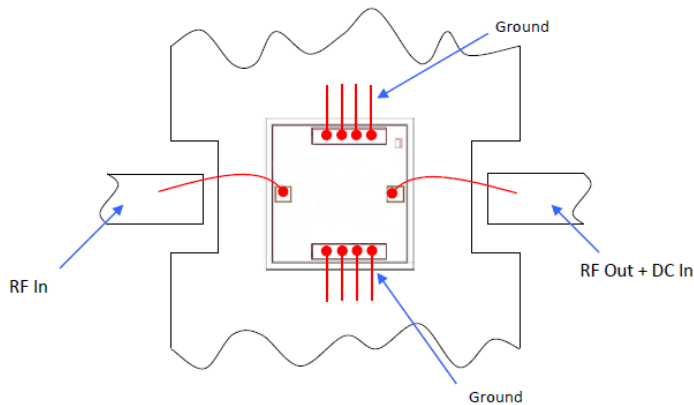
Parameter	Values
Die Thickness, µm	100
Die Width, µm	770
Die Length, µm	700
Bond Pad Size (RF-IN), RF-OUT and DC IN), µm	75 x 75
Bond Pad Size (Ground pad), µm	75 x 350

# Monolithic InGaP HBT MMIC Amplifier Die

## Assembly and Handling Procedure

- Storage**  
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
- 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.
- 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.
- 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.

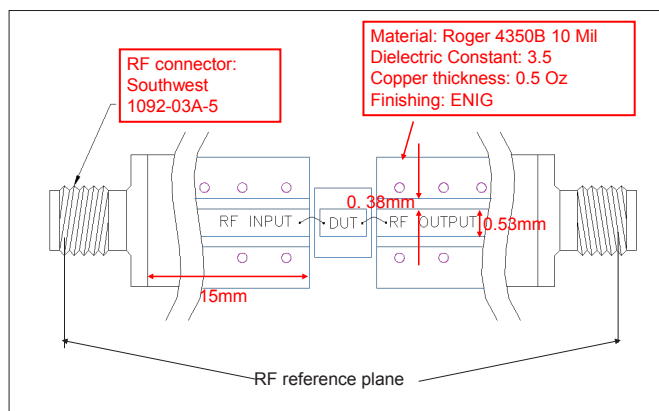
## Assembly Diagram



## Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT + DC-IN	0.5	0.15
GROUND	0.3	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-60-DG+</span> Medium†, Partial wafer: KGD*<2115 <span style="float: right;">GVA-60-DP+</span> Large†, Full Wafer <span style="float: right;">GVA-60-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: Vd = 5.00V, Id = 93mA @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	20.94	25.10	18.82	9.55	1.04	0.49	---	19.71	3.74
30	20.74	24.82	21.00	10.29	1.05	0.50	43.91	19.86	3.74
50	20.54	24.53	23.41	11.07	1.05	0.51	39.84	20.04	3.75
70	20.39	24.32	25.57	11.67	1.06	0.52	39.79	20.23	3.77
90	20.35	24.28	26.63	11.86	1.06	0.52	40.14	20.41	3.76
100	20.33	24.27	26.85	11.89	1.06	0.52	39.92	20.59	3.76
200	20.31	24.26	26.84	11.89	1.06	0.52	39.87	20.76	3.83
300	20.29	24.27	26.31	11.80	1.07	0.52	40.31	20.81	3.93
400	20.27	24.28	25.40	11.64	1.07	0.52	39.69	20.81	3.96
500	20.24	24.29	24.26	11.43	1.07	0.52	38.54	20.78	3.98
600	20.21	24.31	23.10	11.19	1.07	0.52	38.30	20.76	3.98
700	20.18	24.34	21.96	10.94	1.07	0.51	37.51	20.72	3.96
800	20.15	24.36	20.89	10.68	1.07	0.51	37.17	20.65	3.94
900	20.11	24.40	19.94	10.43	1.07	0.51	36.27	20.57	3.93
1000	20.06	24.43	19.05	10.19	1.07	0.51	35.45	20.52	3.93
1200	19.96	24.49	17.56	9.76	1.08	0.51	34.14	20.29	3.88
1400	19.85	24.54	16.39	9.40	1.08	0.51	32.95	19.95	3.92
1600	19.74	24.57	15.54	9.12	1.08	0.51	31.77	19.52	3.93
1800	19.61	24.56	15.00	8.90	1.09	0.52	30.40	18.95	3.91
2000	19.47	24.52	14.73	8.73	1.08	0.52	29.13	18.29	3.90
2100	19.39	24.49	14.68	8.66	1.08	0.52	28.17	17.95	3.91
2200	19.30	24.46	14.70	8.58	1.08	0.53	27.84	17.60	3.95
2300	19.21	24.41	14.76	8.50	1.08	0.53	27.43	17.22	4.00
2400	19.11	24.35	14.87	8.43	1.08	0.54	26.87	16.85	3.98
2500	19.01	24.29	15.00	8.34	1.07	0.54	26.26	16.52	3.98
2600	18.90	24.21	15.16	8.26	1.07	0.54	25.67	16.15	4.04
2700	18.78	24.13	15.33	8.17	1.06	0.55	25.29	15.77	4.09
2800	18.64	24.04	15.49	8.08	1.06	0.55	24.74	15.44	4.09
2900	18.50	23.96	15.64	8.00	1.05	0.56	24.41	15.12	4.08
3000	18.35	23.87	15.75	7.90	1.05	0.57	23.51	14.77	4.10
3100	18.20	23.78	15.82	7.82	1.04	0.57	23.44	14.42	4.15
3200	18.03	23.68	15.83	7.73	1.04	0.58	22.74	14.06	4.17
3300	17.85	23.57	15.78	7.65	1.03	0.59	22.34	13.78	4.14
3400	17.67	23.47	15.69	7.57	1.03	0.60	22.10	13.50	4.15
3500	17.48	23.36	15.56	7.51	1.02	0.60	21.94	13.21	4.19
3600	17.29	23.25	15.40	7.45	1.02	0.61	21.31	12.95	4.19
3700	17.09	23.14	15.23	7.41	1.02	0.62	21.40	12.71	4.21
3800	16.88	23.02	15.06	7.38	1.02	0.63	20.93	12.45	4.20
3900	16.68	22.91	14.92	7.37	1.02	0.64	20.64	12.21	4.25
4000	16.47	22.80	14.77	7.37	1.02	0.65	20.69	11.95	4.30
4100	16.26	22.69	14.64	7.38	1.02	0.66	19.94	11.74	4.32
4200	16.05	22.58	14.51	7.40	1.03	0.67	19.76	11.51	4.31
4300	15.83	22.47	14.43	7.42	1.03	0.68	19.78	11.25	4.27
4400	15.62	22.35	14.37	7.46	1.04	0.69	19.17	10.98	4.30
4500	15.40	22.23	14.35	7.50	1.04	0.70	19.30	10.73	4.38
4600	15.19	22.12	14.38	7.54	1.05	0.70	18.95	10.53	4.40
4700	14.98	22.00	14.46	7.58	1.06	0.71	18.81	10.33	4.39
4800	14.76	21.89	14.61	7.60	1.07	0.71	18.68	10.14	4.40
4900	14.54	21.78	14.77	7.63	1.08	0.72	18.52	9.94	4.39
5000	14.32	21.68	14.97	7.64	1.09	0.72	18.24	9.75	4.41



*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: Vd = 4.75V, Id = 83mA @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	20.89	25.02	18.51	9.49	1.04	0.48	---	18.90	3.68
30	20.69	24.75	20.58	10.21	1.05	0.50	41.82	19.05	3.68
50	20.49	24.48	22.85	10.97	1.05	0.51	37.95	19.22	3.68
70	20.34	24.28	24.85	11.56	1.06	0.51	38.10	19.40	3.70
90	20.30	24.24	25.80	11.74	1.06	0.52	39.24	19.56	3.69
100	20.28	24.23	26.00	11.78	1.06	0.52	39.61	19.74	3.69
200	20.26	24.22	25.97	11.77	1.06	0.52	39.53	19.89	3.76
300	20.24	24.22	25.48	11.68	1.06	0.52	39.33	19.95	3.86
400	20.22	24.23	24.66	11.52	1.07	0.52	39.20	19.98	3.90
500	20.19	24.25	23.62	11.32	1.07	0.51	38.03	19.96	3.89
600	20.16	24.27	22.54	11.08	1.07	0.51	36.80	19.95	3.89
700	20.13	24.29	21.48	10.84	1.07	0.51	36.33	19.90	3.90
800	20.09	24.31	20.47	10.58	1.07	0.51	36.03	19.85	3.85
900	20.04	24.35	19.57	10.34	1.07	0.51	35.43	19.83	3.87
1000	20.00	24.37	18.72	10.10	1.07	0.51	34.98	19.80	3.89
1200	19.89	24.44	17.29	9.68	1.08	0.51	33.55	19.65	3.82
1400	19.77	24.49	16.17	9.34	1.08	0.51	32.42	19.39	3.85
1600	19.65	24.51	15.36	9.07	1.09	0.51	31.31	19.00	3.85
1800	19.51	24.51	14.83	8.86	1.09	0.52	30.10	18.47	3.88
2000	19.36	24.47	14.57	8.69	1.09	0.52	28.51	17.81	3.83
2100	19.28	24.43	14.53	8.62	1.08	0.53	27.72	17.47	3.84
2200	19.19	24.39	14.55	8.55	1.08	0.53	27.35	17.13	3.87
2300	19.10	24.34	14.61	8.48	1.08	0.53	27.05	16.76	3.92
2400	19.00	24.28	14.73	8.41	1.08	0.54	26.44	16.39	3.91
2500	18.89	24.21	14.85	8.33	1.07	0.54	25.87	16.05	3.93
2600	18.77	24.14	15.01	8.25	1.07	0.55	25.12	15.69	3.97
2700	18.65	24.06	15.19	8.17	1.06	0.55	24.78	15.33	4.01
2800	18.52	23.97	15.35	8.07	1.06	0.56	24.26	14.99	4.02
2900	18.37	23.88	15.51	7.99	1.05	0.56	23.98	14.65	3.99
3000	18.22	23.79	15.61	7.90	1.05	0.57	23.04	14.31	4.03
3100	18.06	23.69	15.69	7.82	1.04	0.58	22.93	13.95	4.06
3200	17.89	23.59	15.71	7.74	1.04	0.58	22.25	13.64	4.07
3300	17.72	23.49	15.67	7.65	1.04	0.59	21.90	13.35	4.04
3400	17.54	23.39	15.60	7.58	1.03	0.60	21.62	13.04	4.07
3500	17.34	23.29	15.47	7.52	1.03	0.61	21.47	12.77	4.13
3600	17.15	23.18	15.33	7.46	1.03	0.62	20.85	12.51	4.09
3700	16.95	23.07	15.17	7.42	1.02	0.63	20.90	12.24	4.12
3800	16.75	22.96	15.01	7.39	1.02	0.63	20.46	11.99	4.12
3900	16.54	22.85	14.87	7.39	1.02	0.64	20.20	11.75	4.15
4000	16.34	22.73	14.73	7.39	1.03	0.65	20.27	11.49	4.20
4100	16.13	22.62	14.61	7.40	1.03	0.66	19.50	11.28	4.21
4200	15.91	22.50	14.49	7.42	1.03	0.67	19.33	11.05	4.20
4300	15.70	22.39	14.40	7.44	1.04	0.68	19.37	10.80	4.18
4400	15.49	22.27	14.35	7.48	1.04	0.69	18.75	10.53	4.23
4500	15.28	22.16	14.33	7.52	1.05	0.70	18.91	10.28	4.30
4600	15.06	22.04	14.36	7.56	1.06	0.70	18.55	10.08	4.28
4700	14.85	21.93	14.44	7.60	1.06	0.71	18.35	9.88	4.26
4800	14.64	21.82	14.60	7.63	1.07	0.72	18.27	9.69	4.29
4900	14.42	21.71	14.77	7.65	1.08	0.72	18.09	9.50	4.29
5000	14.21	21.61	14.98	7.66	1.09	0.72	17.83	9.33	4.29





## 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: Vd = 5.25V, Id = 103mA @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	20.97	25.12	19.09	9.65	1.04	0.49	---	20.20	3.79
30	20.78	24.84	21.34	10.38	1.05	0.50	42.69	20.36	3.80
50	20.58	24.56	23.86	11.15	1.05	0.51	39.15	20.53	3.81
70	20.43	24.36	26.12	11.76	1.06	0.52	39.61	20.72	3.83
90	20.38	24.31	27.27	11.95	1.06	0.52	40.23	20.88	3.83
100	20.37	24.30	27.53	11.99	1.06	0.52	40.93	21.06	3.83
200	20.35	24.29	27.54	11.98	1.06	0.52	41.92	21.22	3.90
300	20.33	24.29	26.98	11.89	1.06	0.52	41.26	21.23	4.00
400	20.31	24.30	26.01	11.73	1.07	0.52	40.09	21.23	4.03
500	20.28	24.32	24.80	11.51	1.07	0.52	39.70	21.17	4.03
600	20.26	24.34	23.56	11.27	1.07	0.52	38.97	21.12	4.04
700	20.23	24.37	22.36	11.01	1.07	0.51	38.01	21.04	4.05
800	20.19	24.40	21.24	10.75	1.07	0.51	36.86	20.93	4.01
900	20.16	24.43	20.25	10.50	1.07	0.51	36.13	20.82	3.99
1000	20.11	24.46	19.32	10.25	1.07	0.51	35.48	20.76	4.00
1200	20.02	24.53	17.79	9.81	1.08	0.51	34.53	20.50	3.96
1400	19.92	24.57	16.58	9.45	1.08	0.51	32.98	20.15	4.00
1600	19.81	24.60	15.71	9.16	1.08	0.51	31.92	19.74	4.00
1800	19.69	24.61	15.15	8.93	1.08	0.51	30.80	19.15	3.97
2000	19.55	24.57	14.87	8.75	1.08	0.52	29.53	18.50	3.96
2100	19.48	24.54	14.82	8.67	1.08	0.52	28.67	18.16	3.99
2200	19.40	24.50	14.84	8.59	1.08	0.52	28.26	17.81	4.06
2300	19.31	24.45	14.90	8.51	1.08	0.53	27.87	17.44	4.09
2400	19.22	24.39	15.01	8.43	1.07	0.53	27.34	17.05	4.04
2500	19.11	24.33	15.14	8.34	1.07	0.54	26.72	16.72	4.06
2600	19.00	24.26	15.30	8.26	1.06	0.54	26.08	16.37	4.10
2700	18.89	24.18	15.47	8.17	1.06	0.54	25.68	16.01	4.14
2800	18.76	24.10	15.63	8.07	1.05	0.55	25.08	15.68	4.18
2900	18.62	24.01	15.78	7.98	1.05	0.56	24.77	15.32	4.16
3000	18.47	23.92	15.88	7.88	1.04	0.56	23.94	14.99	4.19
3100	18.31	23.82	15.94	7.80	1.04	0.57	23.89	14.68	4.24
3200	18.15	23.73	15.94	7.71	1.03	0.58	23.19	14.37	4.25
3300	17.97	23.63	15.88	7.62	1.03	0.58	22.80	14.06	4.23
3400	17.79	23.52	15.78	7.55	1.02	0.59	22.58	13.72	4.25
3500	17.60	23.41	15.63	7.48	1.02	0.60	22.47	13.45	4.30
3600	17.41	23.30	15.46	7.42	1.01	0.61	21.85	13.19	4.30
3700	17.21	23.19	15.28	7.38	1.01	0.62	21.89	12.90	4.31
3800	17.00	23.07	15.10	7.35	1.01	0.63	21.46	12.64	4.31
3900	16.80	22.96	14.95	7.34	1.01	0.64	21.18	12.42	4.35
4000	16.59	22.85	14.79	7.34	1.01	0.65	21.19	12.18	4.39
4100	16.38	22.74	14.66	7.34	1.01	0.66	20.40	11.92	4.42
4200	16.16	22.63	14.52	7.37	1.02	0.67	20.29	11.71	4.41
4300	15.94	22.52	14.43	7.39	1.02	0.68	20.32	11.48	4.37
4400	15.73	22.40	14.38	7.43	1.03	0.69	19.64	11.25	4.42
4500	15.51	22.28	14.35	7.47	1.03	0.69	19.79	11.03	4.49
4600	15.30	22.17	14.38	7.50	1.04	0.70	19.47	10.80	4.51
4700	15.08	22.05	14.46	7.55	1.05	0.71	19.35	10.60	4.50
4800	14.87	21.94	14.60	7.57	1.06	0.71	19.22	10.41	4.52
4900	14.65	21.83	14.76	7.59	1.07	0.72	19.05	10.21	4.51
5000	14.43	21.72	14.95	7.60	1.08	0.72	18.75	9.99	4.52

*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: Vd = 5.00V, Id = 93mA @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	20.97	25.09	18.60	9.46	1.04	0.48	---	19.71	3.74
30	20.78	24.78	20.77	10.20	1.04	0.49	43.91	19.86	3.74
50	20.57	24.46	23.17	10.98	1.05	0.50	39.84	20.04	3.75
70	20.42	24.25	25.30	11.60	1.05	0.51	39.79	20.23	3.77
90	20.37	24.22	26.36	11.79	1.06	0.51	40.14	20.41	3.76
100	20.35	24.21	26.60	11.83	1.06	0.51	39.92	20.59	3.76
200	20.31	24.21	26.64	11.83	1.06	0.51	39.87	20.76	3.83
300	20.28	24.22	26.19	11.77	1.06	0.52	40.31	20.81	3.93
400	20.24	24.25	25.39	11.63	1.07	0.52	39.69	20.81	3.96
500	20.20	24.28	24.34	11.45	1.07	0.52	38.54	20.78	3.98
600	20.16	24.32	23.27	11.24	1.07	0.52	38.30	20.76	3.98
700	20.11	24.36	22.20	11.02	1.07	0.52	37.51	20.72	3.96
800	20.06	24.40	21.19	10.80	1.08	0.52	37.17	20.65	3.94
900	20.01	24.43	20.28	10.59	1.08	0.53	36.27	20.57	3.93
1000	19.96	24.47	19.43	10.39	1.08	0.53	35.45	20.52	3.93
1200	19.84	24.54	18.03	10.04	1.09	0.53	34.14	20.29	3.88
1400	19.71	24.60	16.96	9.77	1.10	0.54	32.95	19.95	3.92
1600	19.57	24.64	16.21	9.58	1.10	0.55	31.77	19.52	3.93
1800	19.43	24.65	15.74	9.44	1.11	0.56	30.40	18.95	3.91
2000	19.26	24.62	15.58	9.34	1.11	0.57	29.13	18.29	3.90
2100	19.17	24.59	15.59	9.31	1.11	0.57	28.17	17.95	3.91
2200	19.08	24.55	15.67	9.26	1.11	0.58	27.84	17.60	3.95
2300	18.98	24.50	15.79	9.21	1.11	0.59	27.43	17.22	4.00
2400	18.87	24.45	15.96	9.15	1.11	0.59	26.87	16.85	3.98
2500	18.75	24.39	16.15	9.07	1.11	0.60	26.26	16.52	3.98
2600	18.63	24.32	16.36	8.98	1.10	0.60	25.67	16.15	4.04
2700	18.49	24.25	16.59	8.89	1.10	0.61	25.29	15.77	4.09
2800	18.34	24.17	16.79	8.79	1.10	0.61	24.74	15.44	4.09
2900	18.19	24.09	16.96	8.69	1.09	0.62	24.41	15.12	4.08
3000	18.02	24.01	17.05	8.58	1.09	0.63	23.51	14.77	4.10
3100	17.84	23.92	17.08	8.48	1.09	0.64	23.44	14.42	4.15
3200	17.66	23.84	17.03	8.37	1.09	0.64	22.74	14.06	4.17
3300	17.47	23.75	16.92	8.27	1.08	0.65	22.34	13.78	4.14
3400	17.26	23.66	16.75	8.18	1.08	0.66	22.10	13.50	4.15
3500	17.06	23.57	16.53	8.10	1.08	0.67	21.94	13.21	4.19
3600	16.84	23.48	16.28	8.03	1.08	0.68	21.31	12.95	4.19
3700	16.62	23.38	16.02	7.98	1.08	0.69	21.40	12.71	4.21
3800	16.40	23.28	15.76	7.93	1.09	0.69	20.93	12.45	4.20
3900	16.18	23.19	15.53	7.91	1.09	0.70	20.64	12.21	4.25
4000	15.95	23.09	15.30	7.90	1.10	0.71	20.69	11.95	4.30
4100	15.72	23.00	15.09	7.89	1.10	0.72	19.94	11.74	4.32
4200	15.48	22.91	14.90	7.91	1.11	0.73	19.76	11.51	4.31
4300	15.25	22.81	14.74	7.93	1.12	0.74	19.78	11.25	4.27
4400	15.02	22.72	14.60	7.96	1.13	0.75	19.17	10.98	4.30
4500	14.78	22.62	14.50	8.00	1.14	0.76	19.30	10.73	4.38
4600	14.55	22.52	14.47	8.03	1.15	0.76	18.95	10.53	4.40
4700	14.32	22.42	14.48	8.06	1.17	0.77	18.81	10.33	4.39
4800	14.09	22.33	14.56	8.07	1.18	0.77	18.68	10.14	4.40
4900	13.86	22.24	14.66	8.09	1.20	0.78	18.52	9.94	4.39
5000	13.62	22.15	14.79	8.09	1.21	0.78	18.24	9.75	4.41



*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: Vd = 4.75V, Id = 83mA @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	20.93	25.05	18.45	9.40	1.04	0.48	---	18.90	3.68
30	20.73	24.74	20.46	10.13	1.04	0.49	41.82	19.05	3.68
50	20.53	24.43	22.68	10.89	1.05	0.50	37.95	19.22	3.68
70	20.37	24.21	24.66	11.49	1.05	0.50	38.10	19.40	3.70
90	20.32	24.18	25.61	11.68	1.06	0.51	39.24	19.56	3.69
100	20.30	24.17	25.83	11.72	1.06	0.51	39.61	19.74	3.69
200	20.27	24.18	25.85	11.73	1.06	0.51	39.53	19.89	3.76
300	20.23	24.19	25.44	11.66	1.06	0.51	39.33	19.95	3.86
400	20.20	24.21	24.71	11.53	1.07	0.52	39.20	19.98	3.90
500	20.15	24.24	23.75	11.35	1.07	0.52	38.03	19.96	3.89
600	20.11	24.27	22.74	11.14	1.07	0.52	36.80	19.95	3.89
700	20.06	24.31	21.74	10.93	1.07	0.52	36.33	19.90	3.90
800	20.01	24.35	20.79	10.72	1.08	0.52	36.03	19.85	3.85
900	19.95	24.39	19.93	10.51	1.08	0.52	35.43	19.83	3.87
1000	19.90	24.43	19.12	10.31	1.08	0.53	34.98	19.80	3.89
1200	19.77	24.50	17.78	9.97	1.09	0.53	33.55	19.65	3.82
1400	19.63	24.55	16.75	9.71	1.10	0.54	32.42	19.39	3.85
1600	19.49	24.59	16.03	9.53	1.10	0.55	31.31	19.00	3.85
1800	19.34	24.59	15.59	9.40	1.11	0.56	30.10	18.47	3.88
2000	19.17	24.55	15.44	9.31	1.11	0.57	28.51	17.81	3.83
2100	19.08	24.52	15.46	9.28	1.11	0.58	27.72	17.47	3.84
2200	18.98	24.48	15.54	9.24	1.11	0.58	27.35	17.13	3.87
2300	18.87	24.44	15.66	9.18	1.11	0.59	27.05	16.76	3.92
2400	18.76	24.38	15.83	9.13	1.11	0.59	26.44	16.39	3.91
2500	18.64	24.32	16.02	9.05	1.11	0.60	25.87	16.05	3.93
2600	18.51	24.25	16.23	8.97	1.11	0.61	25.12	15.69	3.97
2700	18.37	24.19	16.47	8.89	1.10	0.61	24.78	15.33	4.01
2800	18.23	24.11	16.67	8.78	1.10	0.62	24.26	14.99	4.02
2900	18.07	24.03	16.85	8.69	1.10	0.62	23.98	14.65	3.99
3000	17.90	23.95	16.95	8.58	1.10	0.63	23.04	14.31	4.03
3100	17.72	23.87	17.00	8.48	1.09	0.64	22.93	13.95	4.06
3200	17.54	23.78	16.97	8.38	1.09	0.65	22.25	13.64	4.07
3300	17.34	23.69	16.87	8.27	1.09	0.65	21.90	13.35	4.04
3400	17.14	23.60	16.72	8.19	1.09	0.66	21.62	13.04	4.07
3500	16.93	23.51	16.52	8.11	1.09	0.67	21.47	12.77	4.13
3600	16.72	23.42	16.28	8.03	1.09	0.68	20.85	12.51	4.09
3700	16.50	23.32	16.03	7.99	1.09	0.69	20.90	12.24	4.12
3800	16.28	23.23	15.78	7.94	1.09	0.70	20.46	11.99	4.12
3900	16.06	23.13	15.56	7.92	1.10	0.70	20.20	11.75	4.15
4000	15.83	23.03	15.33	7.91	1.10	0.71	20.27	11.49	4.20
4100	15.60	22.94	15.13	7.90	1.11	0.72	19.50	11.28	4.21
4200	15.37	22.85	14.94	7.92	1.12	0.73	19.33	11.05	4.20
4300	15.14	22.76	14.78	7.94	1.13	0.74	19.37	10.80	4.18
4400	14.91	22.66	14.64	7.97	1.14	0.75	18.75	10.53	4.23
4500	14.68	22.56	14.54	8.01	1.15	0.76	18.91	10.28	4.30
4600	14.45	22.46	14.50	8.04	1.16	0.76	18.55	10.08	4.28
4700	14.22	22.37	14.53	8.07	1.17	0.77	18.35	9.88	4.26
4800	13.99	22.28	14.61	8.08	1.19	0.77	18.27	9.69	4.29
4900	13.76	22.18	14.71	8.10	1.20	0.78	18.09	9.50	4.29
5000	13.53	22.09	14.84	8.10	1.22	0.78	17.83	9.33	4.29



*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)

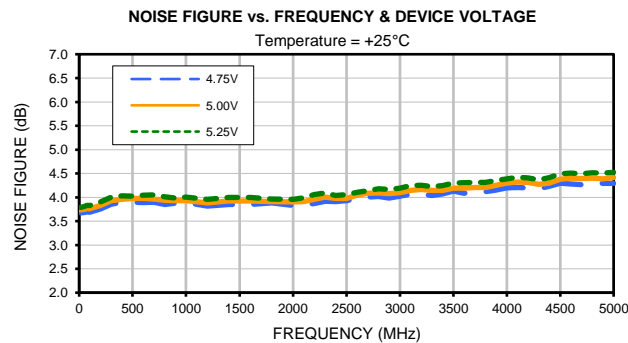
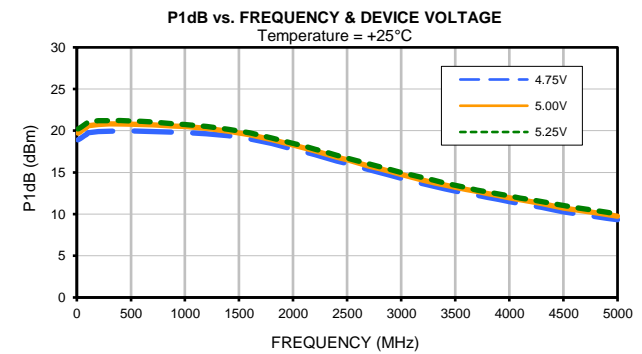
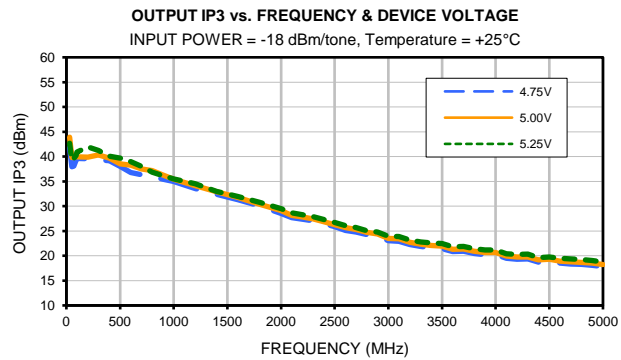
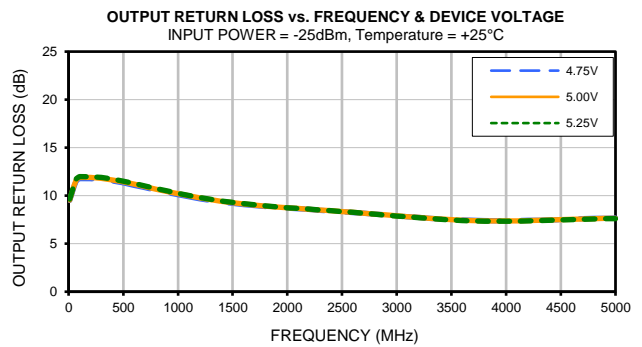
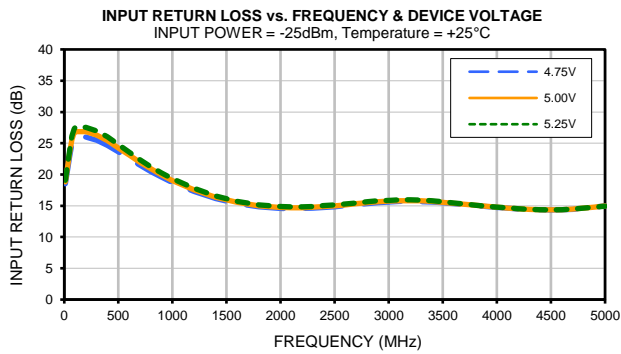
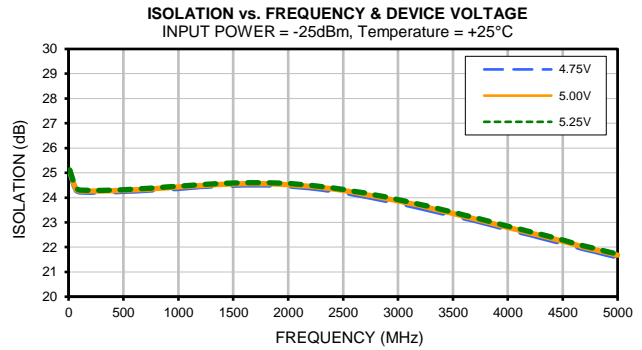
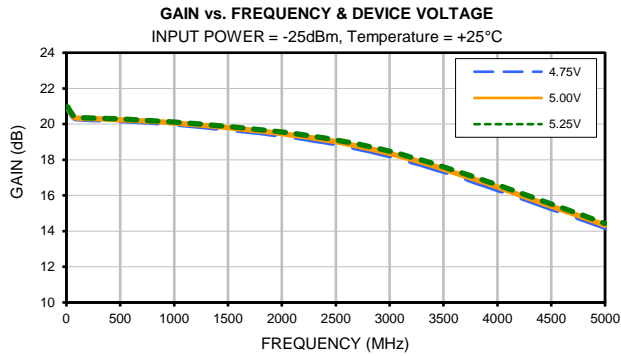
TEST CONDITIONS: Vd = 5.25V, Id = 103mA @Temperature = +25°C

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	21.01	25.04	18.95	9.56	1.03	0.48	---	20.20	3.79
30	20.81	24.76	21.16	10.30	1.04	0.49	42.69	20.36	3.80
50	20.61	24.48	23.61	11.07	1.05	0.50	39.15	20.53	3.81
70	20.45	24.28	25.84	11.68	1.05	0.51	39.61	20.72	3.83
90	20.40	24.24	26.98	11.88	1.06	0.51	40.23	20.88	3.83
100	20.38	24.24	27.26	11.92	1.06	0.51	40.93	21.06	3.83
200	20.35	24.24	27.31	11.92	1.06	0.52	41.92	21.22	3.90
300	20.31	24.25	26.85	11.85	1.06	0.52	41.26	21.23	4.00
400	20.28	24.28	25.99	11.71	1.07	0.52	40.09	21.23	4.03
500	20.24	24.30	24.86	11.53	1.07	0.52	39.70	21.17	4.03
600	20.20	24.34	23.71	11.32	1.07	0.52	38.97	21.12	4.04
700	20.16	24.38	22.59	11.10	1.07	0.52	38.01	21.04	4.05
800	20.11	24.42	21.53	10.87	1.08	0.52	36.86	20.93	4.01
900	20.06	24.46	20.59	10.66	1.08	0.53	36.13	20.82	3.99
1000	20.01	24.50	19.70	10.45	1.08	0.53	35.48	20.76	4.00
1200	19.89	24.57	18.25	10.09	1.09	0.53	34.53	20.50	3.96
1400	19.77	24.64	17.14	9.81	1.10	0.54	32.98	20.15	4.00
1600	19.64	24.68	16.36	9.61	1.10	0.55	31.92	19.74	4.00
1800	19.50	24.69	15.88	9.46	1.11	0.56	30.80	19.15	3.97
2000	19.35	24.66	15.71	9.36	1.11	0.57	29.53	18.50	3.96
2100	19.26	24.63	15.72	9.32	1.11	0.57	28.67	18.16	3.99
2200	19.17	24.59	15.80	9.27	1.11	0.58	28.26	17.81	4.06
2300	19.07	24.55	15.92	9.21	1.11	0.58	27.87	17.44	4.09
2400	18.97	24.49	16.08	9.15	1.10	0.59	27.34	17.05	4.04
2500	18.85	24.43	16.27	9.07	1.10	0.59	26.72	16.72	4.06
2600	18.73	24.36	16.48	8.98	1.10	0.60	26.08	16.37	4.10
2700	18.60	24.29	16.71	8.89	1.10	0.60	25.68	16.01	4.14
2800	18.45	24.21	16.90	8.79	1.09	0.61	25.08	15.68	4.18
2900	18.30	24.13	17.06	8.69	1.09	0.62	24.77	15.32	4.16
3000	18.13	24.06	17.14	8.58	1.09	0.63	23.94	14.99	4.19
3100	17.95	23.98	17.15	8.47	1.08	0.63	23.89	14.68	4.24
3200	17.77	23.89	17.08	8.36	1.08	0.64	23.19	14.37	4.25
3300	17.58	23.80	16.94	8.26	1.08	0.65	22.80	14.06	4.23
3400	17.37	23.71	16.76	8.16	1.08	0.66	22.58	13.72	4.25
3500	17.16	23.62	16.52	8.08	1.08	0.67	22.47	13.45	4.30
3600	16.95	23.52	16.26	8.01	1.08	0.67	21.85	13.19	4.30
3700	16.73	23.43	15.98	7.96	1.08	0.68	21.89	12.90	4.31
3800	16.51	23.33	15.72	7.91	1.08	0.69	21.46	12.64	4.31
3900	16.28	23.23	15.47	7.89	1.08	0.70	21.18	12.42	4.35
4000	16.05	23.14	15.24	7.88	1.09	0.71	21.19	12.18	4.39
4100	15.82	23.04	15.03	7.87	1.09	0.72	20.40	11.92	4.42
4200	15.58	22.95	14.83	7.89	1.10	0.73	20.29	11.71	4.41
4300	15.35	22.85	14.66	7.91	1.11	0.74	20.32	11.48	4.37
4400	15.11	22.75	14.54	7.94	1.12	0.75	19.64	11.25	4.42
4500	14.88	22.66	14.44	7.98	1.13	0.76	19.79	11.03	4.49
4600	14.64	22.56	14.40	8.01	1.15	0.76	19.47	10.80	4.51
4700	14.41	22.47	14.43	8.04	1.16	0.77	19.35	10.60	4.50
4800	14.18	22.38	14.50	8.06	1.17	0.77	19.22	10.41	4.52
4900	13.94	22.28	14.59	8.07	1.19	0.78	19.05	10.21	4.51
5000	13.70	22.20	14.71	8.08	1.20	0.78	18.75	9.99	4.52



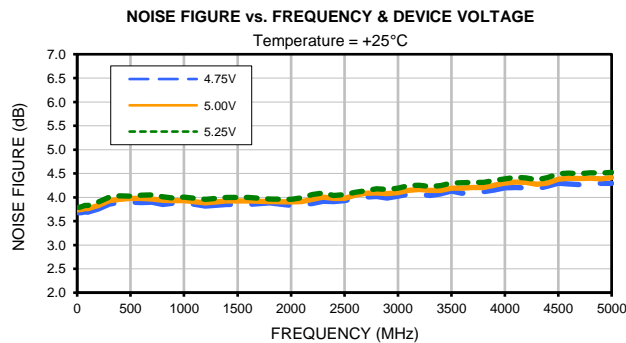
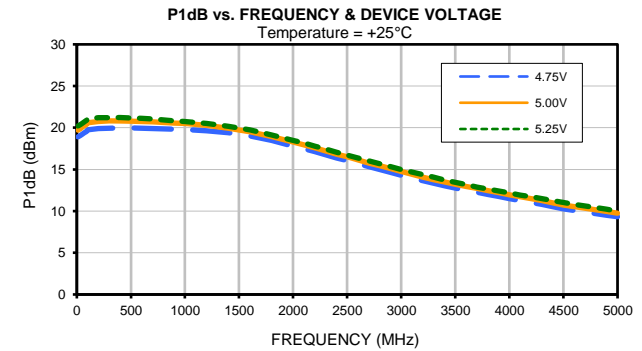
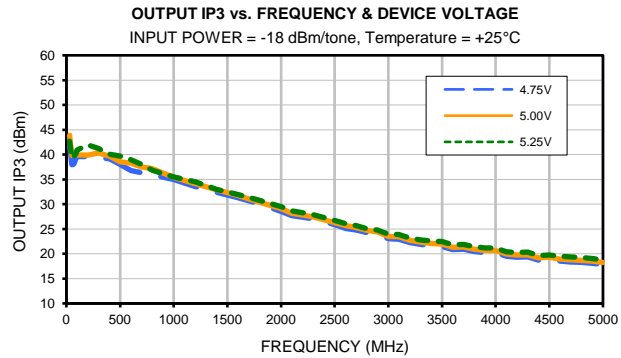
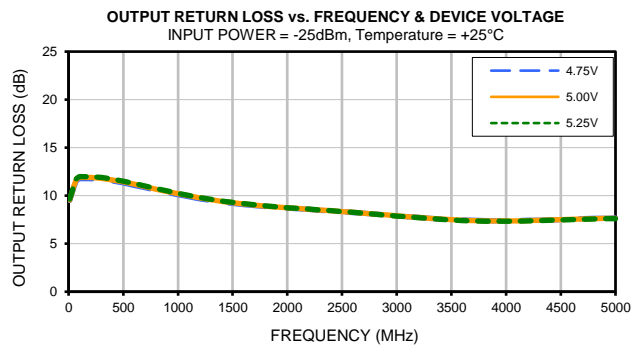
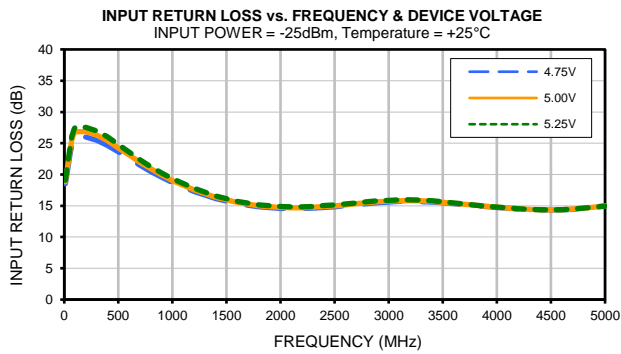
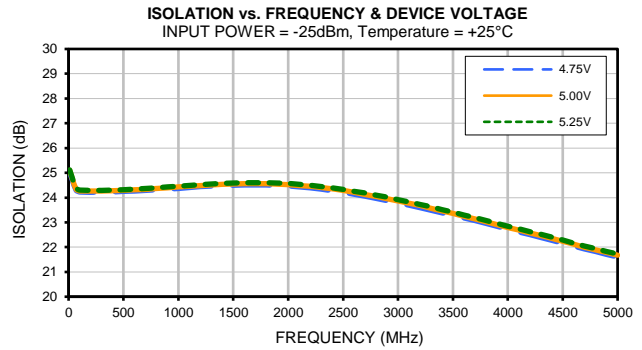
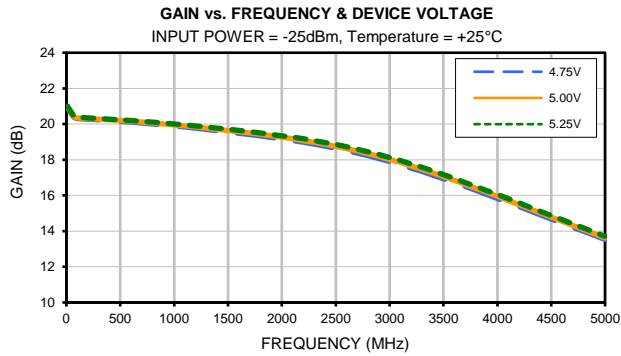
## Typical Performance Curves

### 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)	