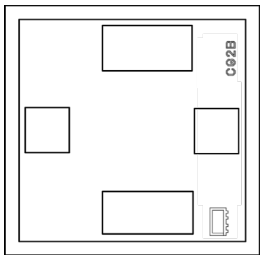
Wideband, High Gain, Low Noise

Monolithic Amplifier Die

GALI-S66-D+

50Ω DC to 3 GHz



The Big Deal

- Low Noise Figure, 2.4 dB typ.
- High Gain, 18.2 dB typ. at 2 GHz
- Excellent Return Loss, 20 dB typ.
- Internally Matched to 50 Ohms

Product Overview

GALI-S66-D+ (RoHS compliant) is a low current, low noise wideband amplifier Die offering high dynamic range.it is fabricated using GaAs HBT technology.

Key Features

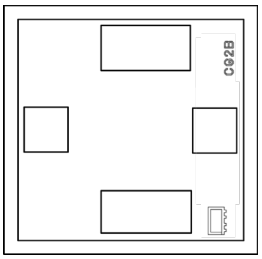
Feature	Advantages
Broad Band: DC to 3 GHz	Broadband covering primary wireless communications bands: Cellular, PCS, communication receivers and transmitters
Low Noise Figure, 2.4 dB typ.	Low noise in combination with low current saves DC power consumption and ideal for frontend applications.
High Gain, 18.2 dB at 2 GHz	Minimize the effect of subsequence stages on overall Noise Figure
Unpackaged Die	Enables the user to integrate the amplifier directly into hybrids

Wideband, High Gain, Low Noise

Monolithic Amplifier Die

GALI-S66-D+

50Ω DC to 3 GHz



Product Features

- Low Noise Figure, 2.4 dB typ.
- High Gain, 18.2 dB typ. at 2 GHz
- Frequency range, DC to 3 GHz
- Internally Matched to 50 Ohms

Typical Applications

- Cellular infrastructure
- PCS
- Communication receivers & transmitters

+RoHS Compliant

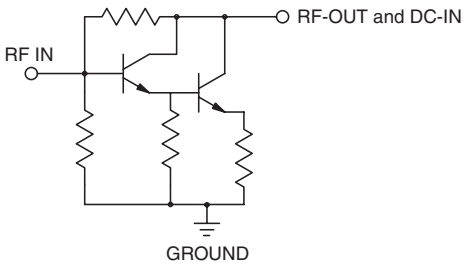
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

GALI-S66-D+ (RoHS compliant) is a low current, low noise wideband amplifier Die offering high dynamic range.it is fabricated using GaAs HBT technology.

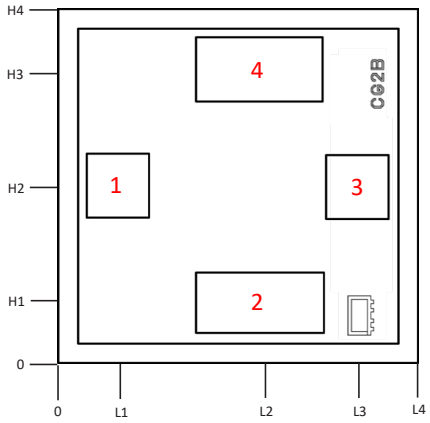
Simplified Schematic and Pad description



Pad #	Function	Description
1	RF-IN	RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.
3	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 and Bias resistor are needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit".
2,4	GROUND	Ground pads. Connect to ground per assembly diagram.

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

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	H1	H2	H3	H4
95.0	313.5	465	560	95.0	275.0	455	550

Bond pad #1 & #3	Thickness	Die size	Bond pad #2 & #4
95.0 x 95.0	100	560.0 x 550.0	145.0 x 95.0

Electrical Specifications at 25°C, and 16mA, unless noted[1]

Parameter		Min.	Typ.	Max.	Units
Frequency Range		DC		3	GHz
Gain	f=0.1 GHz	—	21.6	—	dB
	f=1 GHz	—	20.3	—	
	f=2 GHz	—	18.2	—	
	f=3 GHz	—	16.4	—	
Input Return Loss	f= DC to 3 GHz		25		dB
Output Return Loss	f= DC to 3 GHz		20		dB
Output Power @ 1 dB compression	f=2 GHz		3.3		dBm
Output IP3	f=2 GHz		19.1		dBm
Noise Figure	f=2 GHz		2.4		dB
Recommended Device Operating Current			16		mA
Device Operating Voltage		3.0	3.5	4.0	V
Device Voltage Variation vs. Temperature at 16 mA			-2.1		mV/°C
Device Voltage Variation vs. Current at 25°C			3.7		mV/mA
Thermal Resistance, junction-to-case[1]			64		°C/W

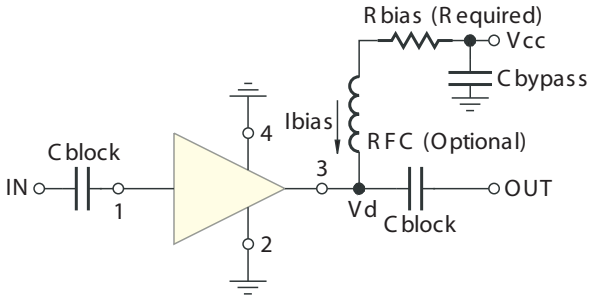
1. Measured on Mini-Circuits Characterization test board TB-409-S66+. DUT packaged in industry standard SOT-89 package. See characterization test circuit. (Fig. 1)

Absolute Maximum Ratings[3]

Parameter	Ratings
Operating Temperature	-45°C to 85°C
Operating Current	50mA
Input Power	20dBm

3. Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.

Recommended Application and Characterization Test Circuit



Test Board includes case, connectors, and components (in bold) soldered to PCB

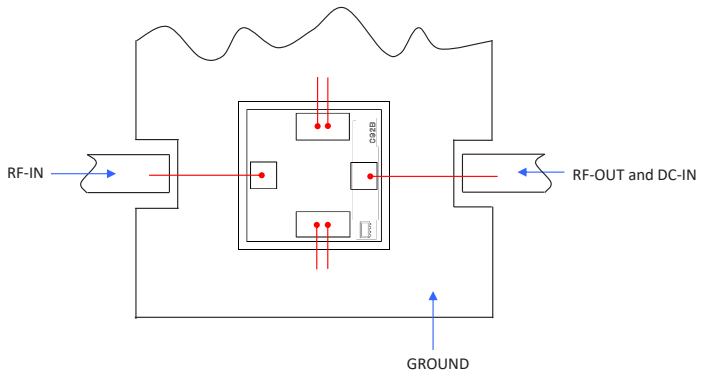
R BIAS	
Vcc	**"1%" Res. Values (ohms) for Optimum Biasing**
7	187
8	243
9	301
10	374
11	432
12	499
13	562
14	619
15	681
16	750
17	806
18	866
19	931
20	976

Fig 1. Block Diagram of Test Circuit used for characterization. (DUT, Die packaged in SOT-89 package, soldered on Mini-Circuits Characterization test board TB-409-S66+)

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, -5 dBm/tone at output.

Assembly Diagram



Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC HBT 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.

Additional Detailed Technical Information

additional information is available on our dash board.

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50,100 KGD*	GALI-S66-DG+
	Medium†, Partial wafer: KGD*<2805	GALI-S66-DP+
	Large†, Full Wafer	GALI-S66-DF+
	†*Available upon request contact sales representative*	
	Refer to AN-60-067	
Environmental Ratings	ENV80	

*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 (1000V to 2000V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard SOT-89 package.

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

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Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions

Definitions:

Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Id = 16mA, Vd = 3.51V @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	21.75	23.95	32.92	35.83	1.03	0.40	19.87	4.80	2.35
20	21.69	24.05	38.23	30.44	1.04	0.42	23.52	4.33	2.20
30	21.65	24.10	37.12	30.77	1.04	0.43	20.09	4.13	2.19
40	21.62	23.96	35.71	30.85	1.04	0.42	19.71	3.26	2.07
50	21.63	23.88	36.78	30.10	1.03	0.40	19.79	3.42	2.11
60	21.64	23.89	36.56	30.51	1.03	0.40	20.27	3.92	2.13
70	21.62	24.00	37	30.32	1.04	0.42	19.00	3.99	2.09
80	21.62	24.03	36.95	30.32	1.04	0.43	18.75	3.70	1.97
90	21.61	24.01	36.25	30.29	1.04	0.42	19.18	3.93	2.05
100	21.60	24.01	35.35	30.41	1.04	0.43	17.99	3.99	2.14
200	21.52	24.03	34.63	28.82	1.04	0.44	18.46	3.52	1.97
300	21.45	24.09	34.29	27.17	1.04	0.46	18.66	3.39	2.27
400	21.36	24.04	33.19	26.03	1.05	0.46	19.09	3.63	2.12
500	21.23	24.02	32.23	24.36	1.05	0.47	18.21	3.66	2.23
600	21.09	24.01	31.11	23.17	1.05	0.49	18.07	3.62	2.20
700	20.94	23.95	29.97	22.09	1.05	0.50	18.93	3.75	2.16
800	20.77	23.98	28.87	21.15	1.06	0.52	18.96	3.83	2.15
900	20.57	23.93	27.78	20.31	1.06	0.54	18.27	3.20	2.16
1000	20.38	23.92	26.91	19.59	1.07	0.55	17.38	3.35	2.20
1200	19.98	23.87	24.99	18.29	1.08	0.59	19.12	3.73	2.27
1400	19.53	23.79	23.26	17.29	1.10	0.62	18.50	3.54	2.21
1600	19.07	23.75	21.75	16.61	1.11	0.66	18.98	3.65	2.32
1800	18.64	23.67	20.26	15.99	1.13	0.69	19.50	3.79	2.26
2000	18.20	23.56	18.82	15.54	1.14	0.71	18.68	3.26	2.26
2200	17.80	23.46	17.59	15.12	1.15	0.74	19.03	3.17	2.36
2400	17.39	23.40	16.46	15.01	1.17	0.77	19.35	3.53	2.29
2600	17.02	23.32	15.37	14.92	1.18	0.79	19.18	3.31	2.43
2800	16.66	23.23	14.56	14.90	1.20	0.81	19.13	3.42	2.49
3000	16.34	23.17	13.66	14.83	1.21	0.83	18.95	3.28	2.38
3200	16.04	23.06	12.91	14.86	1.21	0.85	18.81	3.19	2.43
3400	15.73	23.00	12.45	15.07	1.23	0.87	18.84	3.56	2.50
3600	15.45	22.98	11.98	15.36	1.25	0.89	18.73	3.43	2.56
3800	15.28	22.86	11.39	15.14	1.24	0.90	18.83	3.64	2.61
4000	15.05	22.76	11.13	15.34	1.25	0.91	18.45	3.68	2.58
4200	14.85	22.71	10.94	15.53	1.26	0.92	18.14	3.51	2.56
4400	14.66	22.58	10.85	15.53	1.27	0.93	17.66	3.32	2.56
4600	14.53	22.48	10.63	15.30	1.26	0.93	17.63	2.99	2.62
4800	14.37	22.49	10.82	15.51	1.28	0.93	17.24	3.30	2.59
5000	14.26	22.39	10.86	15.32	1.28	0.93	16.60	2.88	2.74
5200	14.14	22.24	10.89	14.81	1.27	0.93	16.48	3.05	2.72
5400	14.07	22.24	11.16	14.68	1.29	0.93	15.80	3.06	2.72
5600	14.09	22.33	11.07	14.22	1.28	0.93	15.45	2.49	2.79
5800	14.00	22.27	11.07	13.66	1.28	0.93	14.88	2.54	2.74
6000	13.92	22.06	11.33	13.06	1.26	0.91	14.70	2.40	2.78

Note: Test data of Die packaged in industry standard SOT-89 package

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Id = 12mA, Vd = 3.49V @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	19.47	22.52	14.22	15.62	1.05	0.47	23.03	0.12	2.22
20	19.38	22.37	13.97	15.58	1.05	0.46	19.91	-0.07	2.38
30	19.32	22.40	13.86	15.53	1.05	0.47	22.41	-0.25	2.34
40	19.29	22.37	13.77	15.50	1.05	0.47	23.33	-0.87	2.21
50	19.31	22.30	13.93	15.63	1.05	0.46	21.61	-0.82	2.30
60	19.31	22.36	13.84	15.53	1.05	0.47	22.99	-0.40	2.36
70	19.30	22.40	13.89	15.60	1.05	0.48	19.25	-0.33	2.25
80	19.29	22.39	13.86	15.59	1.05	0.48	18.51	-0.55	2.14
90	19.28	22.42	13.81	15.61	1.05	0.48	19.65	-0.38	2.18
100	19.27	22.36	13.77	15.53	1.05	0.48	18.25	-0.36	2.40
200	19.21	22.38	13.76	15.64	1.05	0.49	18.41	-0.71	2.08
300	19.16	22.39	13.84	15.69	1.05	0.49	17.72	-0.84	2.53
400	19.11	22.40	13.90	15.71	1.05	0.51	18.63	-0.64	2.25
500	19.03	22.36	13.96	15.75	1.05	0.51	17.09	-0.70	2.42
600	18.93	22.38	13.99	15.77	1.05	0.53	16.54	-0.72	2.37
700	18.84	22.31	14.04	15.80	1.05	0.54	16.88	-0.65	2.32
800	18.71	22.32	14.02	15.84	1.05	0.56	16.50	-0.60	2.34
900	18.58	22.30	13.99	15.76	1.05	0.57	16.35	-1.11	2.66
1000	18.45	22.24	14.02	15.74	1.05	0.59	15.36	-0.97	2.35
1200	18.16	22.21	13.92	15.44	1.05	0.62	16.99	-0.76	2.46
1400	17.82	22.18	13.63	15.06	1.06	0.66	16.46	-0.93	2.39
1600	17.45	22.15	13.28	14.64	1.06	0.69	16.69	-0.87	2.49
1800	17.11	22.13	12.85	14.14	1.07	0.72	17.48	-0.78	2.38
2000	16.74	22.10	12.31	13.68	1.08	0.75	16.48	-1.21	2.36
2200	16.40	22.08	11.79	13.23	1.08	0.78	17.03	-1.33	2.48
2400	16.04	22.11	11.31	12.93	1.09	0.81	17.14	-0.99	2.42
2600	15.71	22.11	10.77	12.64	1.10	0.84	16.72	-1.20	2.53
2800	15.40	22.08	10.34	12.47	1.11	0.86	17.45	-1.06	2.60
3000	15.11	22.15	9.85	12.25	1.12	0.88	17.41	-1.12	2.46
3200	14.85	22.07	9.45	12.11	1.12	0.90	17.79	-1.19	2.57
3400	14.58	22.08	9.20	12.15	1.14	0.92	17.66	-0.88	2.55
3600	14.34	22.11	8.95	12.26	1.16	0.93	18.41	-0.88	2.60
3800	14.20	22.04	8.59	12.07	1.14	0.95	18.94	-0.55	2.63
4000	14.01	22.04	8.45	12.21	1.16	0.96	19.00	-0.42	2.59
4200	13.84	22.03	8.38	12.40	1.17	0.97	18.52	-0.44	2.61
4400	13.70	21.98	8.35	12.51	1.18	0.98	18.35	-0.40	2.58
4600	13.61	21.91	8.23	12.46	1.17	0.98	18.59	-0.57	2.65
4800	13.47	21.99	8.41	12.76	1.21	0.99	17.32	0.03	2.66
5000	13.39	21.90	8.46	12.83	1.21	0.99	16.81	-0.32	2.79
5200	13.31	21.85	8.50	12.66	1.20	0.99	15.87	0.22	2.79
5400	13.27	21.82	8.72	12.76	1.21	0.99	15.52	0.56	2.77
5600	13.30	21.91	8.66	12.50	1.21	0.99	14.84	-0.15	2.90
5800	13.25	21.89	8.68	12.27	1.20	0.99	14.08	0.30	2.85
6000	13.19	21.70	8.87	12.10	1.19	0.98	14.08	0.33	2.89

Note: Test data of Die packaged in industry standard SOT-89 package

Typical Performance Data

Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

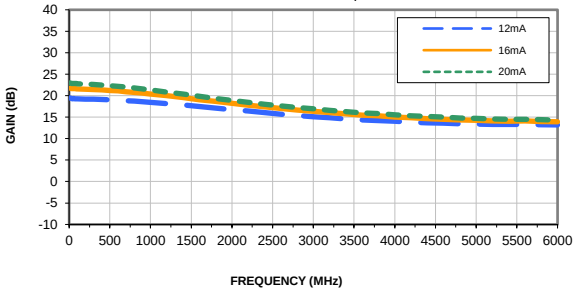
TEST CONDITIONS: Id = 20mA, Vd = 3.52V @ Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	22.97	25.99	18.81	15.85	1.05	0.46	20.53	7.89	2.37
20	22.88	25.32	19.50	16.36	1.03	0.39	24.99	7.42	2.11
30	22.85	25.29	19.59	16.42	1.03	0.39	21.76	7.23	2.13
40	22.83	25.25	19.78	16.40	1.03	0.39	20.54	6.17	2.05
50	22.83	25.15	19.62	16.23	1.03	0.38	21.18	6.38	2.04
60	22.84	25.05	19.61	16.43	1.03	0.36	22.37	6.99	2.06
70	22.82	25.21	19.62	16.35	1.03	0.39	20.52	6.99	2.01
80	22.82	25.16	19.66	16.39	1.03	0.38	20.61	6.67	1.95
90	22.81	25.23	19.71	16.35	1.03	0.39	20.94	6.97	1.97
100	22.80	25.24	19.85	16.37	1.03	0.39	19.84	7.02	2.04
200	22.71	25.19	19.99	16.29	1.03	0.40	20.30	6.47	1.95
300	22.61	25.25	20.13	16.23	1.04	0.42	20.66	6.33	2.17
400	22.50	25.20	20.27	16.24	1.04	0.43	21.33	6.69	2.07
500	22.34	25.15	20.52	16.03	1.04	0.44	20.48	6.72	2.19
600	22.17	25.16	20.76	15.89	1.05	0.46	20.62	6.64	2.13
700	21.99	25.16	21.09	15.70	1.06	0.48	21.00	6.81	2.15
800	21.78	25.08	21.49	15.54	1.06	0.49	21.53	6.90	2.06
900	21.55	25.07	21.93	15.34	1.07	0.51	20.48	6.23	2.11
1000	21.32	24.99	22.35	15.18	1.08	0.53	19.92	6.34	2.14
1200	20.85	24.89	23.27	14.87	1.09	0.56	21.47	6.82	2.23
1400	20.35	24.75	24.47	14.56	1.11	0.59	21.02	6.59	2.16
1600	19.84	24.64	25.42	14.46	1.13	0.63	21.53	6.71	2.25
1800	19.37	24.49	25.57	14.34	1.15	0.66	21.78	6.84	2.23
2000	18.90	24.29	24.44	14.28	1.16	0.68	20.86	6.27	2.22
2200	18.47	24.16	22.76	14.26	1.17	0.71	21.41	6.18	2.35
2400	18.03	24.05	21.11	14.43	1.19	0.73	21.16	6.50	2.48
2600	17.64	23.91	19.36	14.64	1.21	0.76	21.08	6.19	2.38
2800	17.26	23.75	18.09	14.87	1.22	0.78	20.88	6.26	2.51
3000	16.93	23.61	16.70	15.06	1.23	0.80	20.67	6.00	2.39
3200	16.61	23.46	15.58	15.33	1.24	0.82	20.36	5.91	2.40
3400	16.29	23.40	14.85	15.70	1.26	0.84	19.81	6.15	2.46
3600	15.99	23.29	14.18	16.19	1.27	0.85	19.68	5.91	2.55
3800	15.81	23.06	13.35	16.10	1.26	0.86	19.54	5.99	2.52
4000	15.56	22.96	12.96	16.35	1.27	0.87	19.12	5.86	2.58
4200	15.34	22.88	12.69	16.51	1.28	0.88	18.77	5.58	2.57
4400	15.14	22.72	12.51	16.45	1.28	0.89	18.36	5.28	2.57
4600	15.00	22.56	12.22	16.09	1.27	0.89	18.12	4.89	2.58
4800	14.82	22.58	12.41	16.19	1.29	0.89	17.59	4.91	2.58
5000	14.70	22.47	12.44	15.81	1.29	0.89	17.11	4.50	2.70
5200	14.57	22.29	12.45	15.12	1.28	0.89	16.99	4.44	2.74
5400	14.49	22.28	12.77	14.87	1.29	0.88	16.25	4.19	2.67
5600	14.49	22.36	12.65	14.35	1.29	0.89	15.93	3.78	2.75
5800	14.40	22.27	12.67	13.68	1.28	0.88	15.45	3.60	2.72
6000	14.30	22.10	12.97	12.88	1.27	0.86	15.12	3.37	2.73

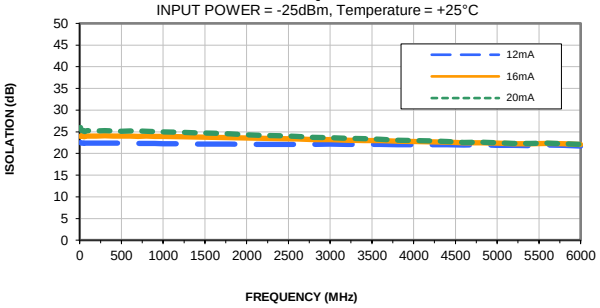
Note: Test data of Die packaged in industry standard SOT-89 package

Typical Performance Curves

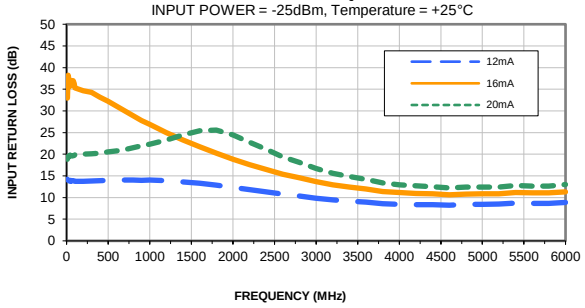
GAIN vs. FREQUENCY & CURRENT
INPUT POWER = -25dBm, Temperature = +25°C



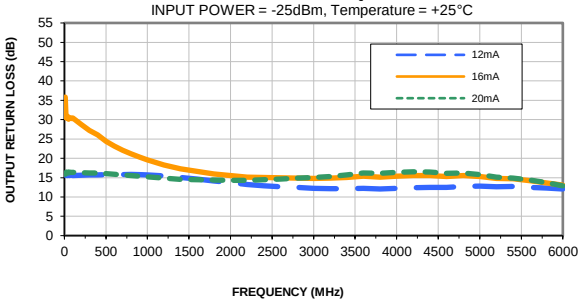
ISOLATION vs. FREQUENCY & CURRENT
INPUT POWER = -25dBm, Temperature = +25°C



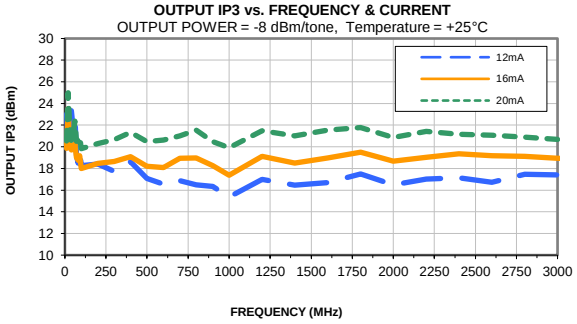
INPUT RETURN LOSS vs. FREQUENCY & CURRENT
INPUT POWER = -25dBm, Temperature = +25°C



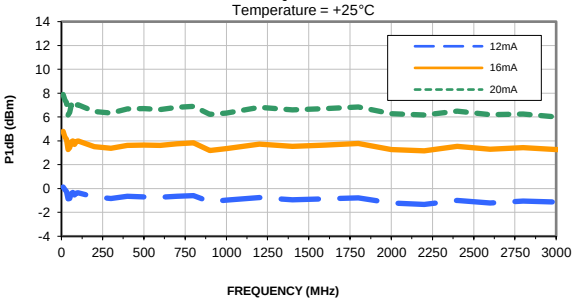
OUTPUT RETURN LOSS vs. FREQUENCY & CURRENT
INPUT POWER = -25dBm, Temperature = +25°C



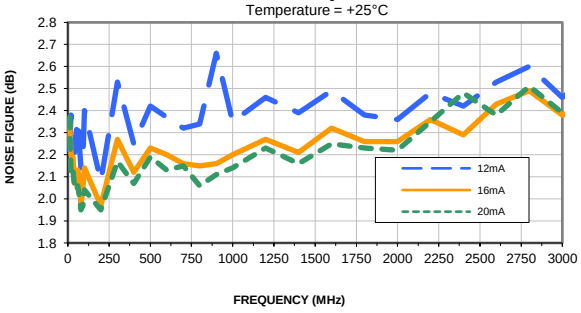
OUTPUT IP3 vs. FREQUENCY & CURRENT
OUTPUT POWER = -8 dBm/tone, Temperature = +25°C



P1dB vs. FREQUENCY & CURRENT
Temperature = +25°C



NOISE FIGURE vs. FREQUENCY & CURRENT
Temperature = +25°C



Note: Test data of Die packaged in industry standard SOT-89 package

Mini-Circuits

Environmental Specifications ENV80

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)	