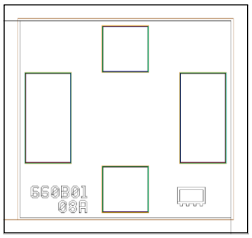
High Gain

Monolithic Amplifier Die

MAR-8A-D+

50Ω DC to 1 GHz



The Big Deal

- High gain, 31.5 dB at 0.1 GHz
- High IP3, up to +25 dBm
- Low noise figure, 3.1 dB typ up to 1 GHz

Product Overview

MAR-8A-D+ is a wideband amplifier Die offering high gain and low noise figure. It has repeatable performance from lot to lot. MAR-8A-D+ uses Darlington configuration and is fabricated using InGaP HBT technology.

Key Features

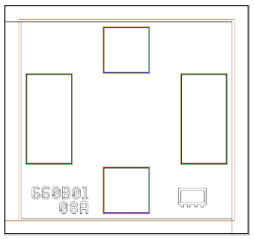
Feature	Advantages
High Gain, 31 dB typ. at 0.1GHz	The MAR-8A-D+ provides high gain eliminating need for multiple stages reducing cost and real estate. Minimizes the effect of noise figure follow up stages on overall noise figure.
High Dynamic Range Low Noise Figure, 3.1dB typ. up to 1 GHz High IP3, +25 dBm	Combination of low noise and high IP3 makes this MMIC amplifier die ideal for use in low noise receiver front end (RFE) as it gives the user advantages of sensitivity and two-tone IM performance at both ends of the dynamic range.
Unpackaged die	Enables the user to integrate the amplifier directly into hybrids.

High Gain

Monolithic Amplifier Die

MAR-8A-D+

50Ω DC to 1 GHz



Product Features

- High gain, 31.5 dB at 0.1 GHz, reduces component count
- Internally Matched to 50 Ohms
- High power output, +12.5 dBm typ.
- Low noise
- Improved stability
- Protection against power supply transients
- Protected by US Patent 6,943,629

+RoHS Compliant

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

Ordering Information: Refer to Last Page

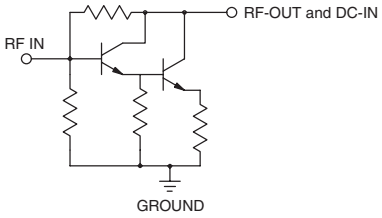
Typical Applications

- Cellular Infrastructure
- UHF/VHF transmitters/receivers

General Description

MAR-8A-D+ (RoHS compliant) is a wideband amplifier Die offering high gain and low noise figure. It has repeatable performance from lot to lot. MAR-8A-D+ uses Darlington configuration and is fabricated using InGaP HBT technology.

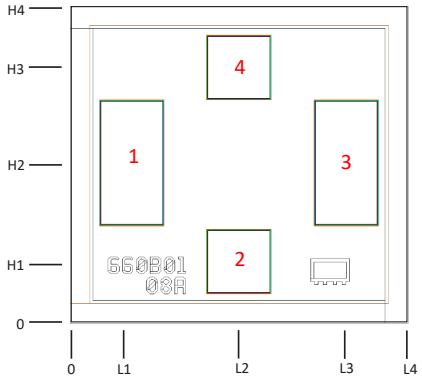
Simplified Schematic and Pad description



Pad #	Function	Description
4	RF IN	RF input pad. This pad requires the use of an external DC blocking capacitor chosen for the frequency of operation.
2	RF-OUT and DC-IN	RF output pad 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.
1,3	GROUND	Connections to ground.

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	Thickness	Bond Pad Size (RF In, RF Out and DC In)	Ground Pad Size
95	260	425	520	95	248	395	490	100	100 x 100	100 x 195

Electrical Specifications[1] at 25°C and 35mA, unless noted

Parameter		Min.	Typ.	Max.	Units
Frequency Range[2]		DC		1	GHz
Gain	f=0.1 GHz f=1 GHz		31.5 25	— —	dB
Input Return Loss	f=DC to 1 GHz		15.5		dB
Output Return Loss	f=DC to 1 GHz		11		dB
Output Power @ 1 dB compression	f=1 GHz		+12.5		dBm
Output IP3	f=1 GHz		+25		dBm
Noise Figure	f=1 GHz		3.1		dB
Recommended Device Operating Current			36		mA
Device Operating Voltage		3.2	3.7	4.2	V
Device Voltage Variation vs. Temperature at 36 mA			+1.2		mV/°C
Device Voltage Variation vs. Current at 25°C			11.3		mV/mA
Thermal Resistance, junction-to-case[3]			119		°C/W

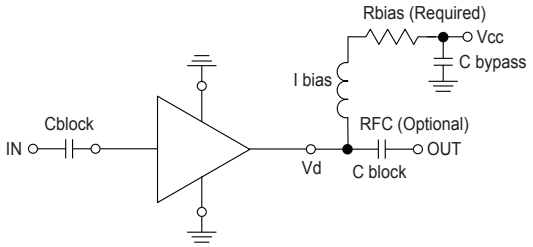
1. Measured on Mini-Circuits characterization test board. Die packaged in a plastic micro-x package and soldered on test board TB-432-8A+. See characterization test circuit (Fig. 1)
2. Guaranteed specification DC-1 GHz. Low frequency cut off determined by external coupling capacitors.
3. Case is defined as ground leads.

Absolute Maximum Ratings[4]

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Operating Current	65mA
Power Dissipation	250mW
Input Power	13dBm

Permanent damage may occur if any of these limits are exceeded.
These ratings are not intended for continuous normal operation.
[4] Full temperature range.

Recommended Application and Characterization Test Circuit



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

R BIAS	
Vcc	**Bias Resistor Value[1]**
7	88.7
8	118
9	143
10	174
11	200
12	226
13	255
14	280
15	309

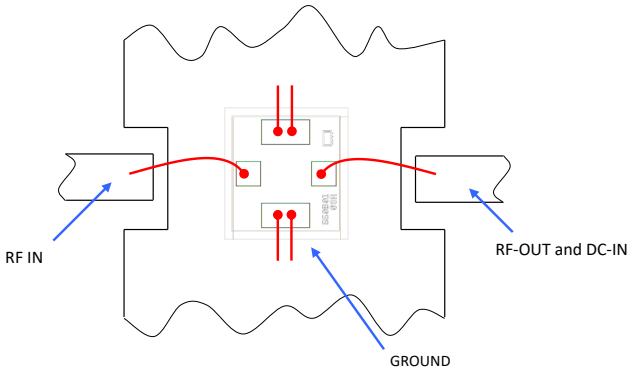
1. 1% resistor values (ohms) for optimum bias.

Fig 1. Block Diagram of Test Circuit used for characterization. (DUT, Die packaged in plastic micro-x package, soldered on Mini-Circuits Characterization test board TB-432-8A+)

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.
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*	MAR-8A-DG+
	Medium†, Partial wafer: KGD*<3020	MAR-8A-DP+
	Large†, Full Wafer	MAR-8A-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 2 (2000V to <4000V) in accordance with ANSI/ESD STM 5.1 - 2001

** Measured on Mini-Circuits characterization test board. Die packaged in a plastic micro-x package and soldered on test board TB-432-8A+.

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=36mA; Vd=3.97V @ 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)
50	31.43	34.52	15.52	12.46	1.04	0.74	26.36	12.85	2.13
60	31.50	34.53	15.95	12.54	1.04	0.74	26.45	12.91	2.17
80	31.37	34.43	15.47	12.61	1.04	0.74	26.70	12.84	2.20
100	31.34	34.46	15.08	12.65	1.04	0.74	26.46	12.80	2.26
120	31.23	34.26	16.14	12.68	1.04	0.74	26.22	12.72	2.27
140	31.12	34.40	15.51	12.71	1.05	0.72	25.93	12.64	2.25
160	30.87	34.30	16.55	12.75	1.05	0.71	25.69	12.63	2.31
180	30.83	34.21	15.57	12.83	1.05	0.71	25.74	12.55	2.28
200	30.66	34.15	16.03	12.87	1.06	0.70	25.98	12.65	2.28
220	30.51	34.09	16.32	12.98	1.06	0.69	26.13	12.74	2.36
240	30.37	33.95	16.36	13.01	1.06	0.69	25.95	12.72	2.36
260	30.17	33.96	16.06	13.10	1.07	0.67	26.00	12.64	2.41
280	29.96	33.80	15.82	13.16	1.07	0.67	26.02	12.56	2.46
300	29.82	33.75	16.13	13.19	1.07	0.66	25.79	12.38	2.55
320	29.63	33.62	15.92	13.26	1.08	0.66	25.69	12.49	2.51
340	29.44	33.52	16.23	13.33	1.08	0.65	25.67	12.60	2.54
360	29.25	33.39	16.19	13.40	1.08	0.64	25.60	12.59	2.61
380	29.07	33.24	16.23	13.45	1.08	0.64	25.60	12.60	2.62
400	28.89	33.16	16.64	13.55	1.09	0.63	25.53	12.55	2.63
420	28.71	32.95	16.47	13.60	1.08	0.63	25.43	12.54	2.64
440	28.47	32.82	16.47	13.67	1.09	0.62	25.39	12.63	2.63
460	28.32	32.70	16.56	13.76	1.09	0.62	25.59	12.62	2.71
480	28.15	32.54	16.43	13.82	1.09	0.62	25.55	12.58	2.71
500	27.96	32.40	16.78	13.91	1.09	0.61	25.68	12.63	2.76
520	27.78	32.24	16.20	13.90	1.09	0.61	25.79	12.67	2.73
540	27.58	32.01	16.37	13.96	1.09	0.61	25.85	12.69	2.76
560	27.43	31.89	16.42	14.04	1.09	0.60	25.81	12.68	2.82
580	27.24	31.74	16.74	14.04	1.09	0.60	25.82	12.68	2.79
600	27.10	31.56	16.50	14.11	1.09	0.60	25.94	12.72	2.81
620	26.88	31.40	16.32	14.12	1.09	0.59	25.97	12.74	2.81
640	26.72	31.25	16.61	14.19	1.09	0.59	25.91	12.71	2.78
660	26.58	31.07	16.70	14.16	1.09	0.59	26.06	12.68	2.85
680	26.39	30.85	16.78	14.22	1.08	0.60	26.13	12.75	2.84
700	26.20	30.73	16.42	14.22	1.08	0.59	26.19	12.77	2.83
750	25.82	30.29	16.63	14.37	1.08	0.59	26.04	12.82	2.81
800	25.42	29.88	16.83	14.31	1.08	0.59	25.90	12.76	2.88
850	25.04	29.50	16.78	14.30	1.07	0.59	25.76	12.82	2.86
900	24.65	29.08	16.80	14.32	1.07	0.58	25.35	12.73	2.84
940	24.29	28.71	17.07	14.27	1.07	0.58	25.52	12.81	2.92
1000	23.95	28.33	16.83	14.17	1.06	0.58	25.65	12.78	2.87

Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

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=29mA; Vd=3.87V @ 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)
50	30.34	33.78	12.12	9.83	1.04	0.75	24.75	11.10	2.14
60	30.47	33.87	12.82	9.88	1.04	0.75	24.92	11.17	2.15
80	30.33	33.96	12.37	9.95	1.05	0.73	25.19	11.10	2.17
100	30.33	33.84	12.33	10.01	1.04	0.74	24.87	11.03	2.24
120	30.24	33.71	12.87	10.07	1.04	0.74	24.64	10.77	2.23
140	30.14	33.72	12.89	10.12	1.04	0.73	24.35	10.63	2.22
160	29.95	33.68	13.71	10.14	1.05	0.71	24.09	10.57	2.28
180	29.90	33.60	12.95	10.19	1.04	0.72	24.05	10.48	2.24
200	29.74	33.52	13.13	10.29	1.05	0.71	24.27	10.66	2.27
220	29.62	33.53	13.50	10.35	1.05	0.69	24.43	10.82	2.31
240	29.48	33.44	13.51	10.38	1.05	0.69	24.21	10.85	2.33
260	29.32	33.29	13.35	10.49	1.05	0.68	24.27	10.62	2.38
280	29.15	33.24	13.37	10.56	1.05	0.67	24.22	10.41	2.47
300	29.05	33.13	13.71	10.59	1.05	0.67	23.87	10.22	2.51
320	28.87	33.03	13.75	10.69	1.06	0.66	23.82	10.49	2.50
340	28.71	32.96	13.97	10.78	1.06	0.65	23.70	10.55	2.53
360	28.55	32.82	13.89	10.88	1.06	0.65	23.63	10.58	2.57
380	28.38	32.69	13.94	10.95	1.06	0.64	23.63	10.65	2.58
400	28.21	32.58	14.26	11.06	1.06	0.63	23.59	10.57	2.59
420	28.06	32.41	14.27	11.13	1.06	0.63	23.45	10.44	2.62
440	27.86	32.27	14.35	11.21	1.06	0.63	23.41	10.52	2.60
460	27.73	32.17	14.47	11.33	1.06	0.62	23.62	10.52	2.69
480	27.58	32.02	14.47	11.39	1.06	0.62	23.62	10.47	2.69
500	27.41	31.90	14.75	11.49	1.07	0.61	23.75	10.58	2.72
520	27.25	31.75	14.34	11.54	1.06	0.61	23.90	10.62	2.73
540	27.06	31.56	14.55	11.65	1.06	0.61	24.01	10.77	2.71
560	26.94	31.41	14.72	11.78	1.06	0.61	23.96	10.57	2.73
580	26.77	31.25	14.95	11.82	1.06	0.60	23.99	10.65	2.77
600	26.65	31.11	14.78	11.89	1.06	0.60	24.18	10.81	2.79
620	26.44	30.93	14.73	11.96	1.06	0.60	24.24	10.73	2.79
640	26.31	30.81	14.93	12.08	1.06	0.60	24.15	10.70	2.77
660	26.16	30.63	15.12	12.10	1.06	0.60	24.26	10.70	2.78
680	26.00	30.43	15.17	12.21	1.06	0.60	24.41	10.67	2.81
700	25.85	30.31	15.00	12.26	1.06	0.60	24.63	10.79	2.80
750	25.48	29.92	15.21	12.41	1.05	0.59	24.71	11.05	2.80
800	25.12	29.50	15.39	12.50	1.05	0.59	24.50	10.77	2.81
850	24.75	29.14	15.48	12.65	1.05	0.59	24.62	11.05	2.86
900	24.38	28.74	15.55	12.74	1.04	0.59	24.41	11.24	2.84
940	24.07	28.37	15.78	12.77	1.04	0.59	24.41	11.07	2.89
1000	23.73	28.03	15.70	12.88	1.04	0.59	24.81	11.17	2.84

Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

Typical Performance Data

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

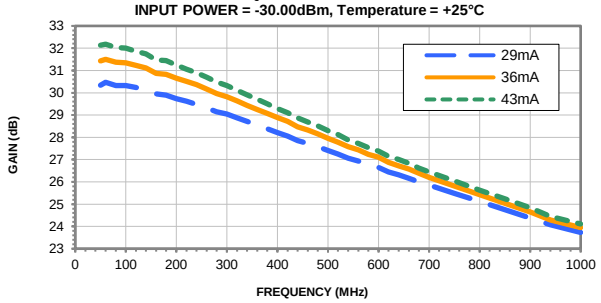
TEST CONDITIONS: Id=43mA; Vd=4.05V @ Temperature = +25degC

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)
50	32.14	34.94	18.00	14.96	1.04	0.75	27.84	13.78	2.16
60	32.18	34.77	19.49	15.04	1.03	0.76	27.96	13.75	2.17
80	32.03	34.91	18.34	15.08	1.04	0.74	28.19	13.69	2.22
100	32.01	34.73	17.44	15.24	1.04	0.75	27.92	13.68	2.29
120	31.86	34.85	18.61	15.27	1.05	0.73	27.70	13.70	2.32
140	31.74	34.87	18.22	15.27	1.05	0.72	27.44	13.82	2.29
160	31.47	34.69	19.59	15.25	1.06	0.71	27.24	13.86	2.31
180	31.44	34.62	17.74	15.35	1.06	0.71	27.31	13.74	2.29
200	31.25	34.56	17.98	15.39	1.06	0.70	27.55	13.62	2.29
220	31.06	34.44	19.01	15.51	1.06	0.69	27.65	13.62	2.38
240	30.90	34.36	18.33	15.49	1.07	0.69	27.49	13.59	2.39
260	30.70	34.27	18.22	15.57	1.07	0.68	27.51	13.69	2.43
280	30.48	34.17	17.86	15.58	1.07	0.67	27.64	13.84	2.49
300	30.32	34.14	18.05	15.53	1.08	0.66	27.48	13.86	2.58
320	30.11	33.97	17.86	15.57	1.08	0.66	27.39	13.76	2.55
340	29.91	33.87	18.09	15.65	1.09	0.65	27.33	13.66	2.55
360	29.71	33.74	18.06	15.69	1.09	0.64	27.23	13.54	2.64
380	29.51	33.59	17.76	15.67	1.09	0.64	27.18	13.56	2.64
400	29.29	33.46	18.08	15.75	1.09	0.63	27.07	13.66	2.65
420	29.10	33.30	17.92	15.73	1.09	0.63	26.96	13.70	2.67
440	28.87	33.13	17.86	15.72	1.10	0.62	26.93	13.68	2.67
460	28.69	32.99	17.90	15.77	1.10	0.62	27.08	13.65	2.72
480	28.51	32.82	17.70	15.82	1.10	0.62	27.01	13.60	2.75
500	28.30	32.68	18.03	15.84	1.10	0.61	27.08	13.58	2.77
520	28.12	32.52	17.34	15.81	1.10	0.61	27.11	13.55	2.78
540	27.88	32.32	17.70	15.74	1.10	0.60	27.11	13.51	2.79
560	27.72	32.18	17.61	15.79	1.10	0.60	27.04	13.52	2.86
580	27.54	32.00	17.90	15.70	1.10	0.60	27.02	13.51	2.83
600	27.38	31.82	17.51	15.74	1.10	0.60	27.10	13.52	2.83
620	27.15	31.65	17.39	15.70	1.10	0.60	27.05	13.55	2.85
640	27.00	31.48	17.50	15.72	1.10	0.60	27.01	13.57	2.82
660	26.84	31.30	17.69	15.64	1.10	0.60	27.16	13.57	2.88
680	26.62	31.12	17.78	15.67	1.10	0.59	27.15	13.56	2.86
700	26.45	30.96	17.57	15.59	1.10	0.59	27.06	13.51	2.83
750	26.04	30.51	17.52	15.63	1.09	0.59	26.79	13.32	2.86
800	25.62	30.08	17.81	15.47	1.09	0.59	26.68	13.54	2.89
850	25.24	29.67	17.80	15.39	1.08	0.59	26.34	13.35	2.92
900	24.83	29.27	17.72	15.25	1.08	0.59	25.85	13.12	2.87
940	24.45	28.87	18.10	15.10	1.08	0.59	26.13	13.41	2.94
1000	24.11	28.47	17.76	14.98	1.07	0.59	26.05	13.26	2.93

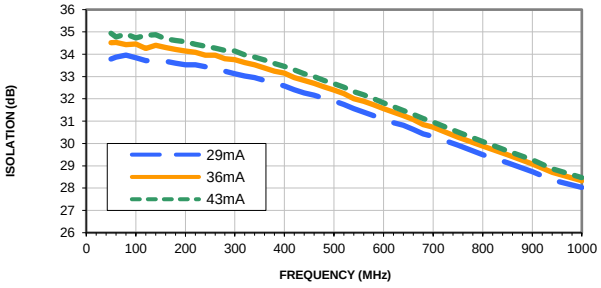
Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

Typical Performance Curves

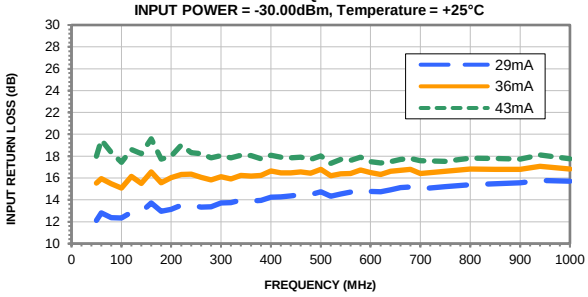
GAIN vs. FREQUENCY & DEVICE CURRENT
INPUT POWER = -30.00dBm, Temperature = +25°C



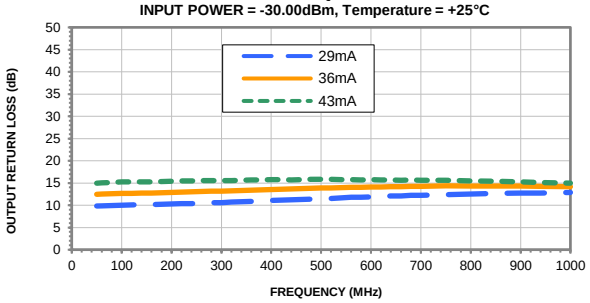
ISOLATION vs. FREQUENCY & DEVICE CURRENT
INPUT POWER = -30dBm, Temperature = +25°C



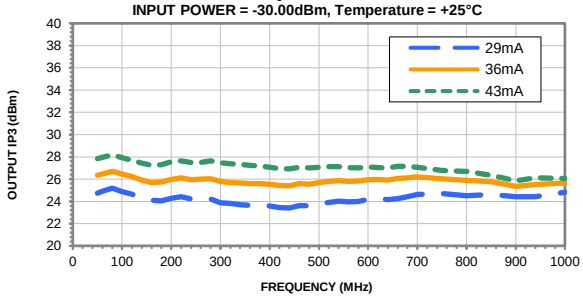
INPUT RETURN LOSS vs. FREQUENCY & DEVICE CURRENT
INPUT POWER = -30.00dBm, Temperature = +25°C



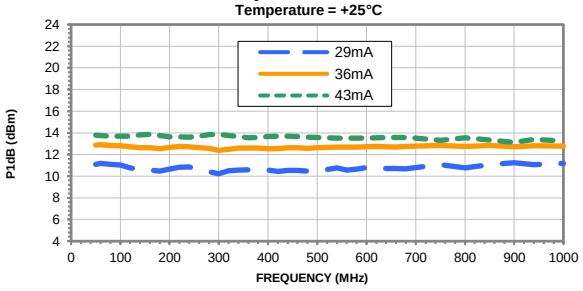
OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE CURRENT
INPUT POWER = -30.00dBm, Temperature = +25°C



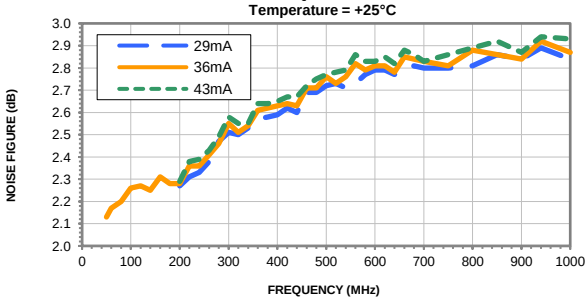
OUTPUT IP3 vs. FREQUENCY & DEVICE CURRENT
INPUT POWER = -30.00dBm, Temperature = +25°C



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



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



Note: Test data measured on Mini-Circuits plastic Micro-X package characterization test board TB-432-8A+

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)	

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