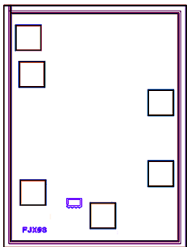
Wideband

Monolithic Amplifier Die

TSY-172LNB-D+

50Ω 0.03 to 1.7 GHz



The Big Deal

- Very wideband, 30 MHz – 1.7 GHz
- Low NF over entire frequency band, 1.4 dB
- Low current and low voltage (2.7V and 7.7 mA)
- Internal bypass switching

Product Overview

TSY-172LNB-D+ (RoHS compliant) is an advanced Low Voltage, Low Current, Low Noise wideband By-pass amplifier Die fabricated using GaAs E-PHEMT technology offering extremely high dynamic range over a broad frequency range. It has integrated switches enabling users to bypass the amplifier.

Key Features

Feature	Advantages
Ultra-wideband: 30 MHz – 1.7 GHz	Ideal for a wide range of receiver applications including military, commercial wireless, and instrumentation.
Low Voltage & Low Current 2.7V & 7.7 mA	Ideal for Battery operated systems
High IP3 24.7 dBm typ at 1 GHz	Provides enhanced linearity over broad frequency range under high signal conditions.
Internal bypass switch feature draws 0.2 mA during Bypass	Prolongs battery life by switching to bypass mode
Unpackaged Die	Enables the user to integrate the amplifier directly into hybrids

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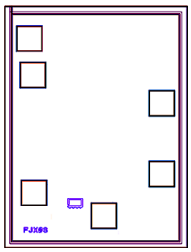


Product Features

- Wideband: 0.03-1.7 GHz
- Built-in Bypass switching
- Low Noise figure: 1.4 dB typ.
- P1dB: +17.5 dBm typ.
- Low current and low voltage (2.7V and 7.7 mA)

Typical Applications

- Wireless Base Station Systems
- Test and Measurement Systems
- Multi-Band Receivers

+RoHS Compliant

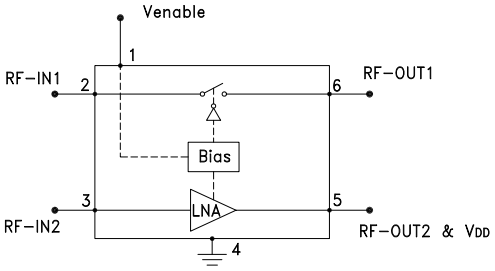
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

TSY-172LNB-D+(RoHS compliant) is an advanced Low Voltage, Low Current, Low Noise wideband Bypass amplifier Die fabricated using GaAs E-PHEMT technology offering extremely high dynamic range over a broad frequency range. It has integrated switches enabling users to bypass the amplifier.

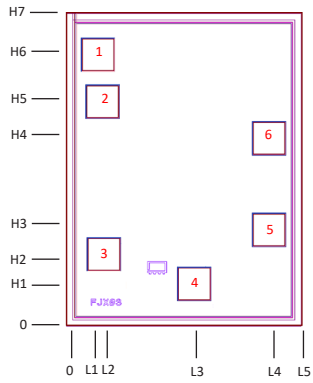
Simplified Schematic and Pad description



Pad#	Function
2	RF-IN1
3	RF-IN2
1	Voltage Enable
6	RF-OUT1
5	RF-OUT2 + DC
4	Ground

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

Bonding Pad Position



Dimensions in µm, Typical

L1	L2	L3	L4	L5	H1	H2	H3	H4	H5	H6	H7	Die Thickness	Bond Pad Size
76	90	306.5	486	562	101	171	229.5	448	536	648	746	100	75 x 75

Electrical Specifications[1] at 25°C, Zo=50Ω & V_{DD}=2.7V unless otherwise noted

Parameter	Condition (GHz)	Amplifier - ON			Amplifier - Bypass	Units
		Min.	Typ.	Max.	Typ.	
Frequency Range		0.03		1.7	0.03 - 1.7	GHz
Noise Figure	0.03		1.3		0.3	dB
	0.5		1.2		0.8	
	1.0		1.4		1.3	
	1.5		1.8		1.8	
	1.7		1.9		2.4	
Gain/ Insertion loss	0.03		15.3		-0.5	dB
	0.5		14.7		-0.8	
	1.0		13.1		-1.8	
	1.5		11.0		-3.2	
	1.7		10.1		-3.7	
Input Return Loss	0.03		13		19	dB
	0.5		14		14	
	1.0		10		8	
	1.5		6		6	
	1.7		6		5	
Output Return Loss	0.03		16		18	dB
	0.5		18		13	
	1.0		14		7	
	1.5		11		5	
	1.7		10		6	
Output Power at 1dB Compression, AMP-ON[2]	0.03		15.8		1.2	dBm
	0.5		17.1		2.7	
	1.0		17.5		3.1	
	1.5		17.8		2.6	
	1.7		17.4		1.4	
Output IP3[3]	0.03		25.6		24.9	dBm
	0.5		26.4		28.4	
	1.0		24.7		30.4	
	1.5		24.0		23.5	
	1.7		22.4		19.5	
Device Operating Voltage (V_{DD})		2.5	2.7	3.0	0	V
Device Operating Current ($I_{D+}I_e$)		—	7.7	10.6	0.2	mA
Enable Voltage (V_e)		2.5	2.7	3.0	0	V
Device Current Variation vs. Temperature[4]			1.5		—	µA/°C
Device Current Variation vs. Voltage			0.0067		—	mA/mV
Thermal Resistance, junction-to-ground lead			229		—	°C/W

1. Measured on Mini-Circuits Characterization Test Board Die packaged in 2x2 mm, 8-lead MCLP package and soldered on TB-943+. See Characterization Test Circuit (Fig. 1)
2. Current increases to 28-54 mA typ. at P1dB
3. Tested at Pout=+6 dBm/tone
4. ((Current at 85°C - Current at -45°C)/130)

Absolute Maximum Ratings[5]

Parameter		Ratings
Operating Temperature (ground lead)		-40°C to 85°C
Total Power Dissipation		0.2W
Input Power	Amplifier - ON	10 dBm (continuous), +23 dBm (5 min. max)
	Amplifier Bypass	15 dBm (continuous), +22 dBm (5 min. max)
DC Voltage V_{DD}		6V
DC Voltage Enable		6V

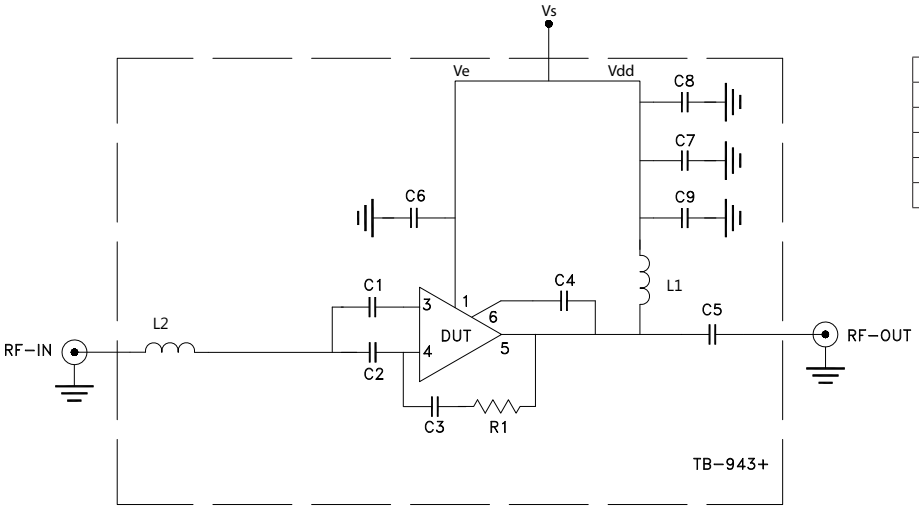
5. Permanent damage may occur if any of these limits are exceeded.
Electrical maximum ratings are not intended for continuous normal operation.

	Min.	Typ.	Max.	Units
Amplifier-ON (V_{DD}, V_e)	2.5	2.7	2.9	V
Amplifier-Bypass (V_{DD}, V_e)	—	—	0.3	

Switching Specifications

Parameter		Min.	Typ.	Max.	Units
Amplifier ON to Bypass	OFF TIME (50% Control to 10%	—	6	—	µS
	FALL TIME (90 TO 10% RF)	—	7	—	
Amplifier Bypass to ON	ON TIME (50% Control to 90%	—	59	—	µS
	RISE TIME (10% to 90% RF)	—	20	—	
Control Voltage Leakage		—	443	—	mV

Characterization Test Circuit (For reference)

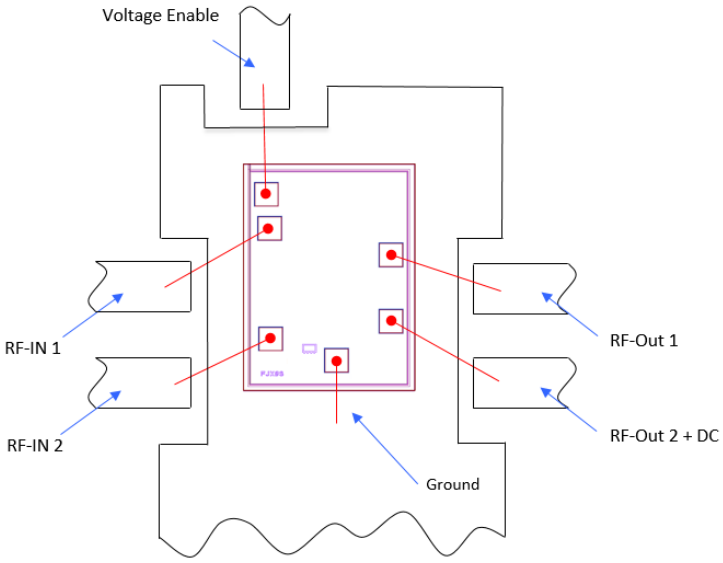


Component	Size	Value	Units
L1	0.115"X0.1"	1	µH
L2	0402	3	nH
C1 to C8	0402	0.1	µF
C9	0402	1000	pF
R1	0402	432	Ω

Fig 1. Block Diagram of Test Circuit used for characterization. (Die packaged in 2x2 mm, 8-Lead package soldered on Mini-Circuits Characterization test board TB-943+)
Gain, Return loss, Output power at 1dB compression (P1dB), 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, +6 dBm/tone at output.
3. Switching Time RF Signal: Pin=-10 dBm at 500 MHz. VDD=Venable=0 to 2.5. / 2.7 / 2.9V, Pulse Signal=500 Hz, 50% duty cycle.

Assembly Diagram



Assembly and Handling Procedure

1. Storage
   Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD
   MMIC GaAs E-PHEMT 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 worksta tion. 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 (.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 5,10,50,100 KGD*	TSY-172LNB-DG+
	Medium†, Partial wafer: KGD*<2385	TSY-172LNB-DP+
	Large†, Full Wafer	TSY-172LNB-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 1A (Pass 250V) in accordance with ANSI/ESD STM 5.1 - 2001

** Tested in industry standard MCLP 2X2 mm, 8-lead 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: Vd = 2.70V, Id = 7.97mA @ Temperature = +25°C

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	14.51	20.00	8.64	7.65	1.08	0.50	30.75	15.13	1.74
20	15.26	19.32	12.44	12.85	1.08	0.55	27.96	15.68	1.31
30	15.39	19.18	13.59	15.85	1.07	0.56	26.81	16.01	1.27
40	15.45	19.12	14.14	17.82	1.07	0.56	26.60	16.71	1.24
50	15.46	19.11	14.64	19.13	1.07	0.56	25.89	17.01	1.22
60	15.47	19.09	14.85	20.01	1.07	0.57	26.79	16.80	1.17
70	15.47	19.08	14.89	20.58	1.07	0.57	27.29	16.72	1.19
80	15.46	19.07	14.95	20.97	1.07	0.57	28.00	16.77	1.15
90	15.46	19.06	15.08	21.19	1.07	0.57	27.74	16.95	1.15
100	15.46	19.05	15.11	21.34	1.07	0.57	27.91	16.57	1.16
150	15.42	19.06	15.09	21.39	1.07	0.57	31.46	16.75	1.18
200	15.37	19.03	15.09	20.62	1.07	0.58	28.28	16.73	1.14
250	15.31	19.05	15.09	20.11	1.07	0.59	36.03	16.98	1.18
300	15.24	19.02	15.07	19.23	1.07	0.59	28.04	16.94	1.15
350	15.15	19.03	14.97	18.64	1.07	0.60	33.82	16.85	1.20
400	15.05	19.00	14.80	17.95	1.07	0.61	28.48	16.98	1.22
450	14.95	18.98	14.63	17.23	1.06	0.62	27.57	17.21	1.22
500	14.83	18.97	14.36	16.65	1.06	0.64	33.07	17.39	1.22
550	14.70	18.98	14.04	16.17	1.06	0.65	30.16	17.13	1.25
600	14.56	18.97	13.72	15.70	1.06	0.67	28.52	17.17	1.29
650	14.41	18.96	13.31	15.20	1.06	0.69	29.00	17.32	1.30
700	14.23	18.98	12.85	14.75	1.06	0.71	29.57	17.19	1.31
750	14.09	18.96	12.47	14.52	1.06	0.72	29.69	17.57	1.29
800	13.92	18.97	12.02	14.21	1.06	0.74	30.49	17.47	1.36
850	13.74	18.97	11.57	13.86	1.06	0.76	29.93	17.28	1.36
900	13.54	18.99	11.10	13.49	1.05	0.78	28.79	17.37	1.39
950	13.34	19.01	10.64	13.16	1.05	0.81	28.75	17.76	1.40
1000	13.12	19.06	10.20	12.80	1.06	0.83	33.08	17.87	1.40
1100	12.50	19.34	9.11	12.10	1.08	0.90	27.48	17.63	1.48
1200	12.25	19.22	8.32	12.77	1.07	0.94	26.96	17.81	1.56
1300	11.86	19.25	7.76	11.77	1.07	0.96	27.01	17.86	1.65
1400	11.40	19.35	7.13	10.98	1.07	0.99	26.64	17.76	1.69
1500	10.93	19.48	6.54	10.25	1.07	1.01	24.66	18.36	1.75
1600	10.44	19.62	6.02	9.51	1.08	1.03	23.52	18.36	1.80
1700	9.95	19.79	5.56	8.83	1.09	1.04	22.65	17.89	1.93
1800	9.46	19.94	5.14	8.16	1.10	1.04	22.24	17.66	2.05
1900	8.97	20.13	4.76	7.51	1.11	1.03	21.17	17.36	2.15
2000	8.47	20.35	4.42	6.91	1.12	1.02	20.74	17.19	2.21

Note: Test data of Die packaged in industry standard 2x2 mm, 8-lead MCLP 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: Vd = 2.50V, Id = 6.69mA @ Temperature = +25°C

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	13.81	19.70	8.06	7.17	1.09	0.51	25.08	14.59	1.83
20	14.59	18.95	11.17	11.88	1.08	0.56	24.80	15.14	1.38
30	14.74	18.81	12.11	14.29	1.08	0.57	24.43	15.44	1.34
40	14.79	18.74	12.53	15.66	1.08	0.58	23.87	16.15	1.27
50	14.81	18.73	12.87	16.45	1.08	0.58	23.33	16.48	1.29
60	14.82	18.71	13.02	16.91	1.08	0.58	23.98	16.27	1.24
70	14.82	18.69	13.07	17.17	1.08	0.58	25.14	16.19	1.28
80	14.82	18.69	13.09	17.34	1.08	0.58	26.18	16.24	1.23
90	14.82	18.67	13.17	17.41	1.08	0.58	26.97	16.44	1.21
100	14.81	18.66	13.19	17.45	1.08	0.58	29.32	16.05	1.22
150	14.77	18.67	13.22	17.50	1.08	0.59	28.57	16.23	1.23
200	14.72	18.64	13.25	17.07	1.08	0.59	29.06	16.22	1.22
250	14.67	18.65	13.28	16.87	1.07	0.60	27.18	16.47	1.26
300	14.60	18.62	13.31	16.33	1.07	0.60	26.77	16.43	1.29
350	14.51	18.62	13.27	15.99	1.07	0.62	27.50	16.34	1.27
400	14.42	18.60	13.18	15.52	1.07	0.62	26.45	16.48	1.28
450	14.31	18.57	13.11	15.02	1.06	0.63	25.99	16.73	1.30
500	14.20	18.56	12.95	14.60	1.06	0.65	27.53	16.90	1.24
550	14.06	18.57	12.75	14.24	1.06	0.66	28.64	16.64	1.29
600	13.93	18.55	12.54	13.87	1.06	0.68	27.77	16.66	1.33
650	13.77	18.55	12.22	13.47	1.05	0.69	27.82	16.86	1.33
700	13.60	18.56	11.88	13.12	1.05	0.71	27.68	16.71	1.38
750	13.46	18.54	11.59	12.93	1.05	0.73	27.01	17.10	1.39
800	13.28	18.55	11.21	12.67	1.05	0.75	26.83	16.98	1.44
850	13.10	18.55	10.84	12.36	1.05	0.77	26.30	16.76	1.42
900	12.90	18.57	10.45	12.06	1.04	0.79	25.92	16.86	1.44
950	12.70	18.60	10.02	11.78	1.04	0.81	25.43	17.24	1.47
1000	12.48	18.65	9.63	11.47	1.04	0.83	26.20	17.35	1.48
1100	11.85	18.95	8.60	10.95	1.06	0.90	24.23	17.09	1.56
1200	11.61	18.82	7.91	11.49	1.05	0.94	24.10	17.24	1.62
1300	11.21	18.87	7.36	10.61	1.05	0.96	24.21	17.29	1.71
1400	10.74	18.99	6.75	9.95	1.05	0.99	23.81	17.14	1.76
1500	10.26	19.14	6.17	9.34	1.05	1.01	22.74	17.93	1.83
1600	9.77	19.31	5.66	8.71	1.06	1.02	22.14	17.95	1.89
1700	9.27	19.50	5.21	8.12	1.07	1.03	21.47	17.57	2.01
1800	8.77	19.68	4.81	7.55	1.08	1.03	21.20	17.20	2.13
1900	8.28	19.90	4.44	6.98	1.09	1.03	20.35	16.84	2.25
2000	7.77	20.15	4.10	6.47	1.10	1.02	19.93	16.70	2.34

Note: Test data of Die packaged in industry standard 2x2 mm, 8-lead MCLP package

Typical Performance Data

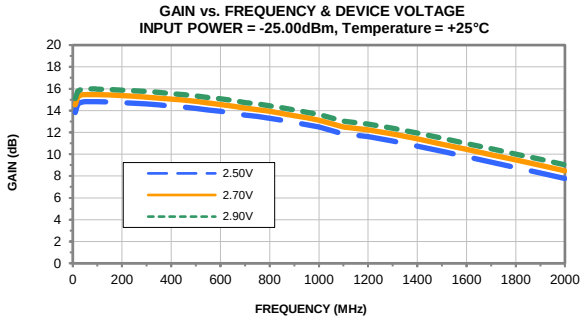
Definitions:
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

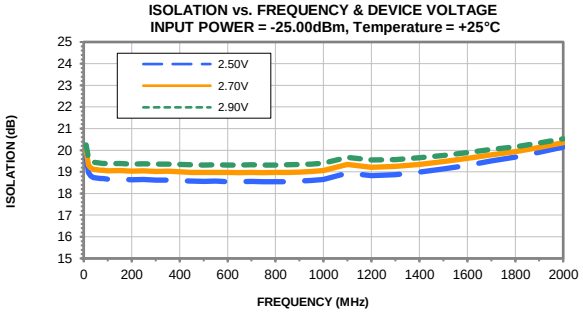
TEST CONDITIONS: Vd = 2.90V, Id = 9.31mA @ Temperature = +25°C

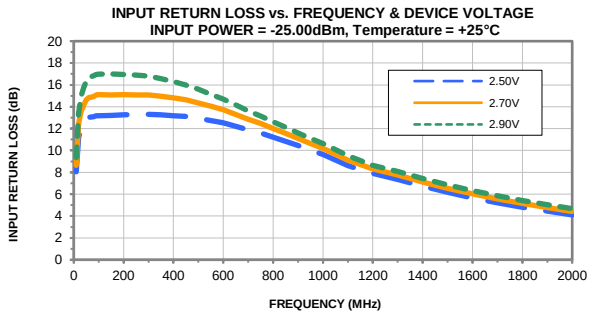
FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP-3 Output	1dB Comp. Output	Noise Figure
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Measure	(dBm)	(dBm)	(dB)
10	15.11	20.25	9.33	7.98	1.08	0.49	28.88	15.61	1.71
20	15.78	19.62	13.40	13.47	1.07	0.53	28.43	16.10	1.28
30	15.91	19.50	14.99	16.93	1.07	0.54	27.55	16.45	1.22
40	15.96	19.44	15.75	19.46	1.07	0.55	28.14	17.15	1.18
50	15.97	19.43	16.34	21.41	1.07	0.55	27.58	17.42	1.17
60	15.98	19.41	16.63	22.89	1.07	0.55	28.02	17.22	1.12
70	15.98	19.40	16.76	24.14	1.07	0.55	26.69	17.14	1.13
80	15.98	19.39	16.84	25.12	1.07	0.55	26.34	17.20	1.11
90	15.97	19.38	16.95	25.82	1.07	0.55	25.77	17.35	1.08
100	15.96	19.38	16.97	26.32	1.07	0.55	25.53	17.00	1.09
150	15.93	19.38	17.00	26.69	1.07	0.56	26.52	17.17	1.10
200	15.88	19.36	16.97	24.96	1.07	0.56	25.58	17.14	1.10
250	15.82	19.38	16.89	23.71	1.07	0.57	27.33	17.39	1.13
300	15.74	19.35	16.80	22.26	1.07	0.58	26.05	17.33	1.17
350	15.66	19.36	16.57	21.23	1.07	0.59	27.37	17.27	1.16
400	15.56	19.34	16.30	20.28	1.07	0.60	26.66	17.38	1.16
450	15.45	19.32	16.00	19.33	1.07	0.61	26.01	17.58	1.16
500	15.33	19.32	15.59	18.58	1.06	0.63	27.13	17.76	1.19
550	15.20	19.33	15.13	17.96	1.06	0.64	26.63	17.51	1.19
600	15.07	19.32	14.70	17.39	1.06	0.66	26.02	17.56	1.20
650	14.92	19.31	14.16	16.81	1.06	0.68	26.20	17.66	1.24
700	14.74	19.33	13.61	16.28	1.06	0.70	26.48	17.58	1.26
750	14.60	19.31	13.14	16.01	1.06	0.72	26.91	17.94	1.30
800	14.43	19.32	12.62	15.65	1.06	0.74	27.34	17.85	1.29
850	14.25	19.32	12.11	15.25	1.06	0.76	27.79	17.70	1.31
900	14.05	19.34	11.61	14.83	1.06	0.78	27.46	17.79	1.34
950	13.85	19.36	11.10	14.45	1.06	0.80	28.01	18.17	1.34
1000	13.64	19.40	10.64	14.02	1.07	0.82	28.09	18.28	1.33
1100	13.02	19.67	9.50	13.13	1.09	0.89	30.59	18.07	1.42
1200	12.76	19.55	8.63	13.93	1.08	0.93	28.90	18.25	1.50
1300	12.38	19.57	8.07	12.78	1.08	0.95	28.43	18.31	1.59
1400	11.93	19.65	7.44	11.84	1.08	0.98	29.34	18.24	1.66
1500	11.46	19.76	6.84	10.98	1.09	1.01	26.30	18.65	1.69
1600	10.98	19.89	6.32	10.12	1.09	1.02	24.68	18.61	1.76
1700	10.50	20.03	5.85	9.34	1.10	1.03	23.72	18.08	1.88
1800	10.01	20.16	5.42	8.58	1.11	1.03	23.19	17.99	1.97
1900	9.52	20.34	5.03	7.86	1.12	1.03	21.93	17.73	2.07
2000	9.02	20.53	4.68	7.19	1.13	1.02	21.47	17.52	2.15

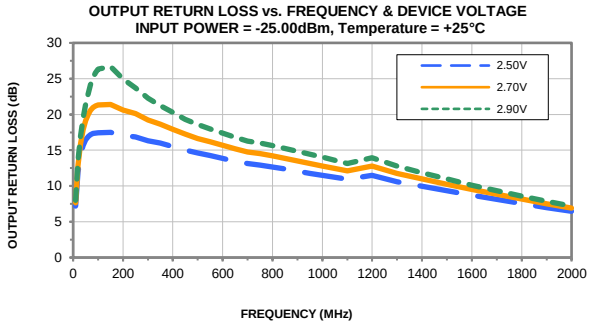
Note: Test data of Die packaged in industry standard 2x2 mm, 8-lead MCLP package

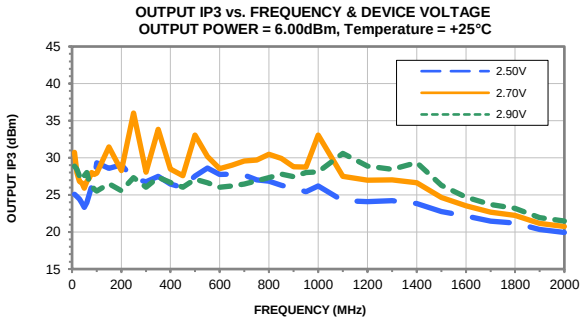
Typical Performance Curves

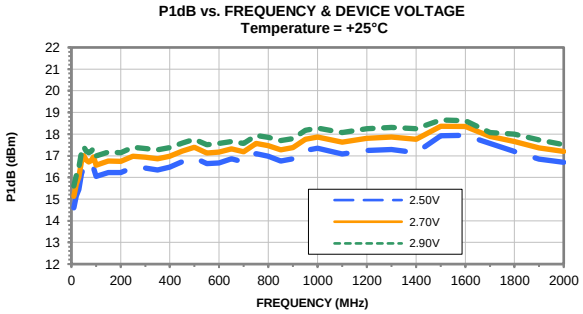


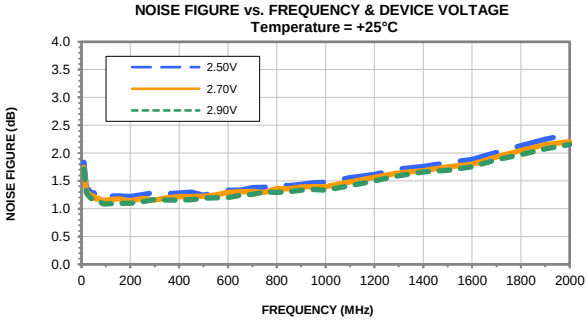












Note: Test data of Die packaged in industry standard 2x2 mm, 8-lead MCLP package

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)	