

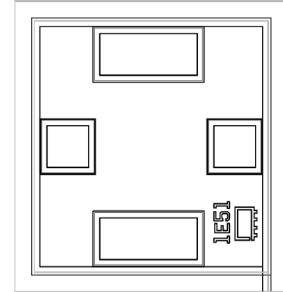
MMIC, High Linearity Monolithic Amplifier Die

ERA-51SM-D+

50Ω DC to 4 GHz

The Big Deal

- Single Voltage Supply
- High Linearity
- Transient protected, US patent 6,943,629



Product Overview

ERA-51SM-D+ (RoHS compliant) is a wideband amplifier die offering high dynamic range. It has repeatable performance from lot to lot. ERA-51SM-D+ uses Darlington configuration and is fabricated using InGaP HBT technology. Expected MTTF is 450 years at 85°C case temperature.

Key Features

Feature	Advantages
Broadband, DC to 4 GHz	Covers the primary wireless communications bands: cellular, PCS & 3G.
High IP3 versus DC power consumption <ul style="list-style-type: none">• +35.1 dBm typical at 0.1 GHz• +31 dBm typical at 3 GHz	The ERA-51SM-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and InGaP HBT structure provides enhanced linearity over a broad frequency range, evident in IP3 values typically 15 dB above the P1dB point to 3 GHz. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none">• Driver amplifiers for complex waveform up converter paths• Drivers in linearized transmit systems
Unpackaged die	Enables user to integrate it directly into hybrids



5 Volt, High Gain Monolithic Amplifier Die

ERA-51SM-D+

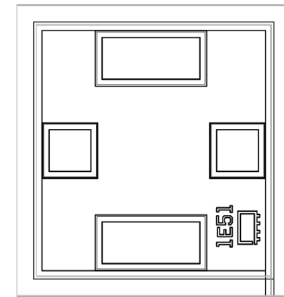
50Ω DC to 4 GHz

Product Features

- DC-4 GHz
- Single Voltage Supply
- Internally Matched to 50 Ohms
- Low Performance Variation Over Temperature
- Protected By US Patent 6,943,629

Typical Applications

- Cellular/ PCS/ 3G Base Station
- CATV, Cable Modem & DBS
- Fixed Wireless & WLAN
- Microwave Radio & Test Equipment



+RoHS Compliant

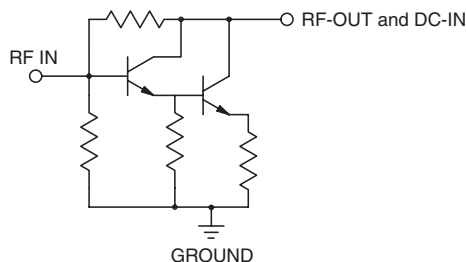
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

General Description

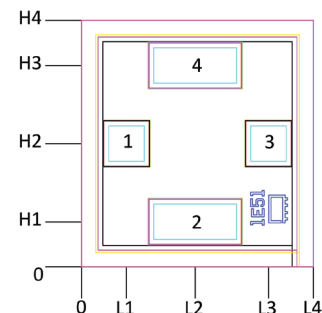
ERA-51SM-D+ (RoHS compliant) is a wideband amplifier die offering high dynamic range. It has repeatable performance from lot to lot. ERA-51SM-D+ uses Darlington configuration and is fabricated using InGaP HBT technology. Expected MTTF is 450 years at 85°C case temperature.

Simplified Schematic and Pad description



Pad#	Function
1	RF-IN
3	RF-OUT & DC-IN
2,4 and bottom of die	GROUND

Bonding Pad Position



Dimensions in μm , Typical

L1	L2	L3	L4	H1	H2	H3	H4
95.0	240.0	395.0	490.0	95.0	260.0	425.0	520.0

Thickness	Die size	Pad size 1 & 3	Pad size 2 & 4
100	490 x 520	75 x 75	175 x 75

Electrical Specifications¹ at 25°C and 4.5V, unless noted

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units	CPK
Frequency Range ²		DC		4	GHz	
Gain	0.1	—	18.0	—	dB	≥ 1.5
	1	—	17.4	—		
	2	—	16.1	—		
	3	—	14.8	—		
	4	—	12.5	—		
Magnitude of Gain Variation versus Temperature (values are negative)	0.1	—	0.0012	—	dB/°C	
	1	—	0.0020	—		
	2	—	0.0027	—		
	3	—	0.0033	—		
	4	—	0.0043	—		
Input Return Loss	0.1	—	26	—	dB	
	1	—	29	—		
	2	—	32	—		
	3	—	28	—		
	4	—	25	—		
Output Return Loss	0.1	—	28	—	dB	
	1	—	24	—		
	2	—	21	—		
	3	—	24	—		
	4	—	21	—		
Reverse Isolation	1	—	22	—	dB	
Output Power @ 1 dB compression	0.1	—	18.3	—	dBm	≥ 1.33
	1	—	18.1	—		
	2	—	17.8	—		
	3	—	16.9	—		
	4	—	14.8	—		
Saturated Output Power (at 3dB compression)	0.1	—	18	—	dBm	
	1	—	18	—		
	2	—	18	—		
	3	—	17	—		
	4	—	16	—		
Output IP3	0.1	—	35.1	—	dBm	≥ 1.33
	1	—	35.4	—		
	2	—	33.9	—		
	3	—	31	—		
	4	—	27.8	—		
Noise Figure	0.1	—	3.6	—	dB	≥ 1.33
	1	—	3.7	—		
	2	—	3.7	—		
	3	—	3.9	—		
	4	—	4	—		
Group Delay	1		100		psec	
Recommended Device Operating Current			65		mA	
Device Operating Voltage		4.2	4.5	4.8	V	≥ 1.5
Device Voltage Variation vs. Temperature at 65mA			-3.2		mV/°C	
Device Voltage Variation vs. Current at 25°C			5.8		mV/mA	
Thermal Resistance, Junction to case ³			154		°C/W	

¹ Die was packaged in a Micro-X Package and tested on test board TB-408-51+

² Guaranteed specification DC-4 GHz. Low frequency cut off determined by external coupling capacitors.

³ Case is defined as ground leads

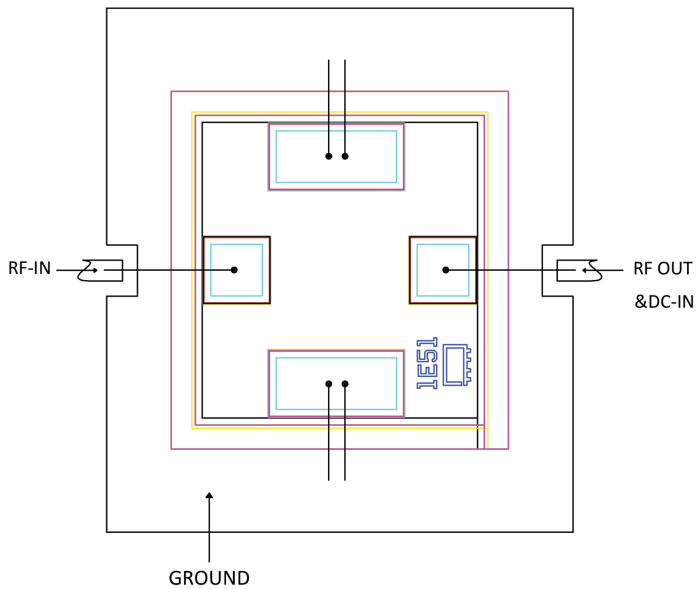
Absolute Maximum Ratings⁵

Parameter	Ratings
Operating Temperature ⁴	-45°C to 85°C
Operating Current	85mA
Power Dissipation	451mW
Input Power	13dBm

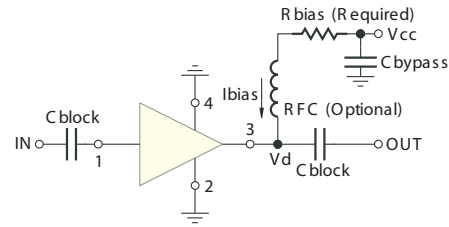
⁴ Based on typical case temperature rise 5°C above ambient.

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

Assembly Diagram



Recommended Application Circuit



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

R BIAS	
Vcc	"1%" Res. Values (ohms) for Optimum Biasing
7	40.2
8	53.6
9	68.1
10	82.5
11	97.6
12	113
13	127
14	143
15	158
16	174
17	191
18	205
19	221
20	237

Assembly and Handling Procedure

- Storage**
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
- ESD**
MMIC HBT amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
- Die Handling and Attachment**
Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition.
- 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. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

MMIC Amplifier Die

ERA-51SM-D+

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 = 65mA, Vd = 4.44V @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	Noise Figure
					K	Delta			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(dB)
50	17.81	20.79	24.67	42.04	1.06	0.71	36.18	18.43	3.06
100	17.77	20.38	24.96	45.28	1.04	0.74	36.05	18.35	3.22
200	17.74	20.43	25.67	41.08	1.05	0.73	36.93	18.40	3.14
300	17.67	20.38	24.73	37.20	1.05	0.73	37.32	18.34	3.17
400	17.63	20.42	25.02	33.55	1.05	0.73	36.84	18.28	3.14
500	17.58	20.43	24.28	31.54	1.05	0.72	36.33	18.24	3.20
600	17.50	20.44	23.62	29.51	1.06	0.71	36.24	18.16	3.18
700	17.43	20.44	23.13	28.23	1.06	0.71	36.35	18.06	3.21
800	17.36	20.44	22.31	27.17	1.06	0.71	36.17	17.89	3.21
900	17.28	20.42	22.03	26.13	1.06	0.70	36.07	17.80	3.15
1000	17.19	20.42	21.79	25.05	1.07	0.69	35.58	17.71	3.14
1100	17.09	20.45	21.32	23.89	1.07	0.68	35.34	17.74	3.13
1200	17.00	20.44	20.99	23.22	1.08	0.68	35.16	17.66	3.16
1300	16.88	20.41	20.99	22.53	1.08	0.67	34.77	17.70	3.19
1400	16.78	20.41	20.81	21.65	1.08	0.67	34.49	17.68	3.07
1500	16.66	20.41	20.47	20.94	1.09	0.66	34.66	17.58	3.15
1600	16.55	20.35	20.34	20.32	1.09	0.65	35.26	17.54	3.16
1700	16.43	20.30	20.35	19.79	1.09	0.65	34.87	17.48	3.14
1800	16.32	20.32	20.24	19.37	1.10	0.64	34.17	17.51	3.12
1900	16.20	20.31	20.35	18.98	1.11	0.63	33.59	17.51	3.18
2000	16.08	20.20	20.53	18.49	1.11	0.63	33.14	17.52	3.15
2200	15.83	20.24	20.83	17.74	1.12	0.61	32.44	17.22	3.15
2300	15.71	20.13	20.82	17.41	1.12	0.61	32.12	16.97	3.16
2400	15.56	20.13	20.93	16.91	1.13	0.60	31.73	16.83	3.19
2500	15.42	20.13	21.02	16.55	1.14	0.59	31.27	16.69	3.26
2600	15.31	20.07	21.47	16.46	1.14	0.59	30.95	16.47	3.21
2700	15.19	19.99	21.70	16.09	1.14	0.59	30.48	16.13	3.18
2800	15.04	20.01	21.98	15.75	1.15	0.57	29.99	16.17	3.24
2900	14.93	19.99	22.69	15.60	1.15	0.57	29.72	15.80	3.20
3000	14.80	19.88	23.17	15.23	1.15	0.56	29.40	15.62	3.17
3200	14.53	19.88	23.83	14.81	1.17	0.55	28.58	15.01	3.23
3300	14.45	19.74	24.66	14.47	1.16	0.55	28.10	14.84	3.29
3400	14.29	19.73	25.38	14.22	1.17	0.54	27.71	14.47	3.31
3500	14.17	19.68	25.74	14.10	1.17	0.54	27.40	14.35	3.33
3600	14.07	19.57	26.98	13.80	1.17	0.54	27.14	14.21	3.32
3800	13.81	19.46	28.41	13.48	1.18	0.52	26.53	13.74	3.37
4000	13.60	19.28	32.63	12.90	1.17	0.52	25.70	13.31	3.24

Note: Test data of die packaged in industry standard Micro-X Package



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IF/RF MICROWAVE COMPONENTS

MMIC Amplifier Die

ERA-51SM-D+

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 = 52mA, Vd = 4.36V @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	Noise Figure
					K	Delta			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(dB)
50	17.63	20.05	27.25	35.17	1.04	0.76	32.01	16.43	3.01
100	17.59	20.15	28.65	33.84	1.04	0.74	31.77	16.15	3.15
200	17.56	20.27	28.55	34.96	1.05	0.73	32.19	16.34	3.08
300	17.49	20.24	27.06	33.26	1.05	0.73	32.37	16.29	3.12
400	17.45	20.28	27.74	32.05	1.05	0.72	31.99	16.30	3.10
500	17.40	20.36	26.25	30.16	1.06	0.71	31.72	16.30	3.13
600	17.34	20.26	25.24	28.50	1.06	0.72	31.66	16.07	3.15
700	17.26	20.26	24.51	27.81	1.06	0.71	31.90	15.95	3.15
800	17.18	20.25	23.49	26.66	1.06	0.70	31.88	15.62	3.16
900	17.12	20.27	23.19	25.97	1.06	0.70	31.78	15.65	3.09
1000	17.02	20.28	22.73	24.95	1.07	0.69	31.52	15.49	3.11
1100	16.92	20.28	22.21	23.92	1.07	0.68	31.47	15.69	3.06
1200	16.84	20.25	21.80	23.19	1.08	0.68	31.47	15.54	3.11
1300	16.72	20.26	21.78	22.51	1.08	0.67	31.30	15.58	3.13
1400	16.61	20.24	21.54	21.63	1.08	0.67	31.16	15.56	3.00
1500	16.50	20.25	21.20	20.86	1.09	0.66	31.31	15.46	3.08
1600	16.41	20.20	20.99	20.23	1.09	0.65	31.92	15.55	3.10
1700	16.28	20.17	20.95	19.80	1.10	0.65	32.10	15.41	3.09
1800	16.17	20.24	20.88	19.24	1.11	0.63	31.66	15.65	3.06
1900	16.05	20.16	20.89	18.92	1.11	0.63	31.21	15.60	3.12
2000	15.94	20.12	21.08	18.38	1.11	0.63	30.96	15.59	3.09
2200	15.67	20.11	21.35	17.67	1.12	0.61	30.51	15.21	3.12
2300	15.58	20.08	21.35	17.34	1.12	0.61	30.36	15.09	3.12
2400	15.43	19.99	21.44	16.83	1.13	0.60	30.13	15.10	3.11
2500	15.29	20.00	21.51	16.46	1.13	0.59	29.72	15.14	3.17
2600	15.19	19.97	21.95	16.31	1.14	0.58	29.59	15.12	3.10
2700	15.07	19.88	22.24	15.96	1.14	0.58	29.27	14.96	3.14
2800	14.91	19.85	22.50	15.64	1.15	0.57	28.92	15.05	3.18
2900	14.81	19.80	23.13	15.49	1.15	0.57	28.70	14.80	3.14
3000	14.68	19.79	23.63	15.10	1.15	0.56	28.36	14.64	3.09
3200	14.42	19.75	24.24	14.66	1.16	0.55	27.62	14.24	3.16
3300	14.33	19.63	25.00	14.35	1.16	0.55	27.26	14.06	3.20
3400	14.19	19.63	26.13	14.04	1.17	0.54	26.86	13.77	3.26
3500	14.06	19.55	26.17	13.98	1.17	0.54	26.63	13.63	3.25
3600	13.97	19.46	27.57	13.69	1.17	0.53	26.30	13.52	3.27
3800	13.73	19.37	28.74	13.40	1.17	0.52	25.82	13.06	3.30
4000	13.49	19.24	32.78	12.84	1.18	0.52	24.98	12.64	3.17

Note: Test data of die packaged in industry standard Micro-X Package



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IF/RF MICROWAVE COMPONENTS

REV. OR
ERA-51SM-D+
5/13/2021
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Typical Performance Data

Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

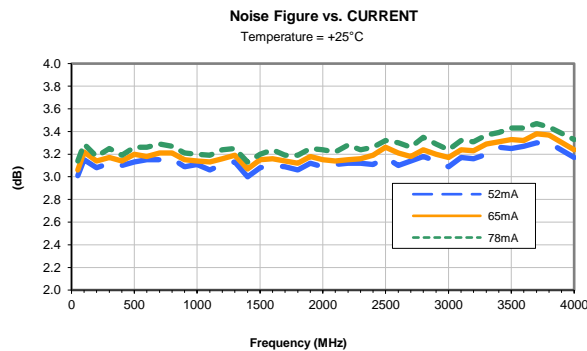
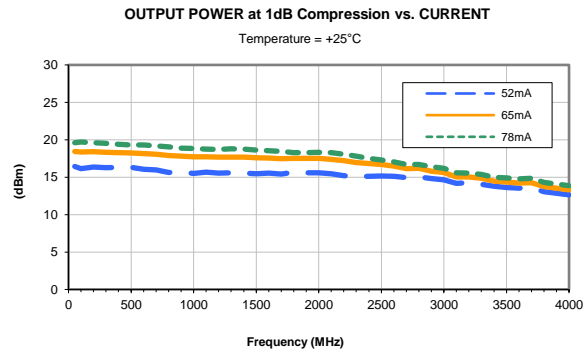
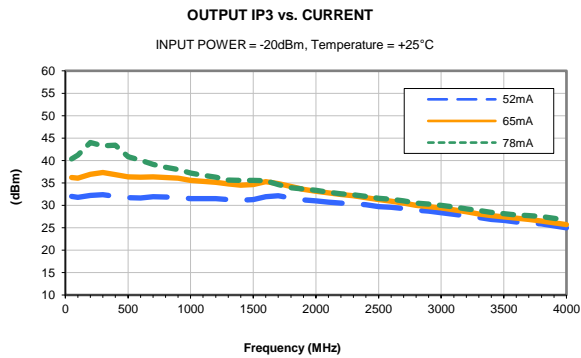
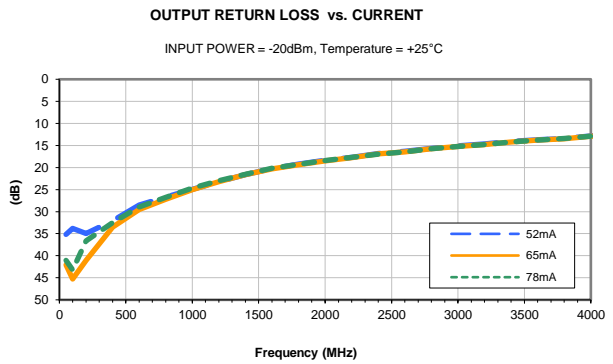
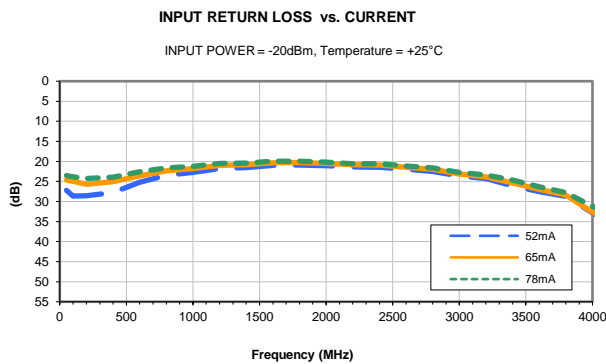
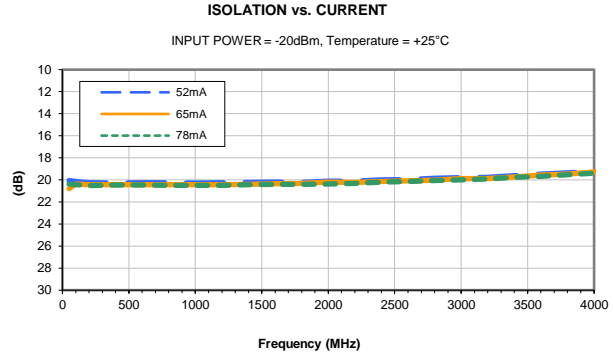
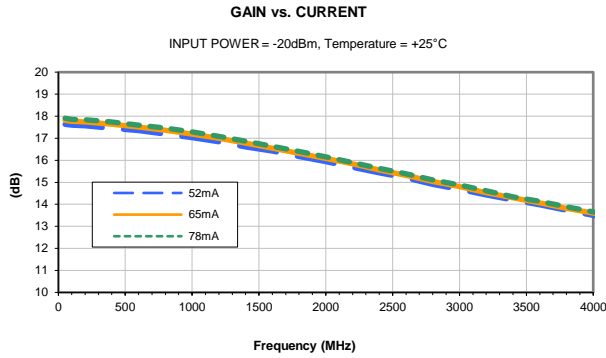
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Id = 78mA, Vd = 4.52V @Temperature = +25degC

FREQ	Gain	Isolation	Input Return Loss	Output Return Loss	Stability		IP3 Output	1dB Comp. Output	Noise Figure
					K	Delta			
(MHz)	(dB)	(dB)	(dB)	(dB)	K	Delta	(dBm)	(dBm)	(dB)
50	17.91	20.36	23.54	41.07	1.04	0.75	40.31	19.61	3.14
100	17.86	20.43	23.86	43.21	1.04	0.74	41.21	19.70	3.29
200	17.84	20.51	24.26	36.66	1.05	0.74	44.01	19.61	3.18
300	17.77	20.43	23.55	34.64	1.05	0.74	43.30	19.54	3.25
400	17.74	20.47	23.95	32.47	1.05	0.73	43.40	19.38	3.19
500	17.70	20.56	23.29	30.89	1.05	0.72	40.83	19.31	3.26
600	17.60	20.46	22.60	28.96	1.05	0.72	40.04	19.30	3.26
700	17.53	20.52	22.31	27.81	1.06	0.71	39.11	19.16	3.29
800	17.46	20.50	21.66	26.76	1.06	0.71	38.48	19.03	3.27
900	17.38	20.51	21.35	25.83	1.06	0.70	37.97	18.89	3.21
1000	17.29	20.50	21.21	24.68	1.07	0.70	37.18	18.82	3.20
1100	17.18	20.49	20.70	23.72	1.07	0.69	36.70	18.75	3.19
1200	17.09	20.49	20.51	23.00	1.07	0.68	36.30	18.71	3.24
1300	16.97	20.48	20.56	22.34	1.08	0.67	35.64	18.79	3.25
1400	16.87	20.43	20.44	21.52	1.08	0.67	35.56	18.73	3.13
1500	16.75	20.43	20.06	20.78	1.09	0.66	35.58	18.64	3.20
1600	16.64	20.40	19.95	20.17	1.09	0.66	35.49	18.53	3.24
1700	16.52	20.41	20.02	19.73	1.10	0.65	34.65	18.45	3.19
1800	16.40	20.39	19.91	19.31	1.10	0.64	33.95	18.29	3.19
1900	16.27	20.39	19.99	18.93	1.11	0.63	33.62	18.28	3.25
2000	16.15	20.36	20.18	18.45	1.11	0.63	33.33	18.31	3.24
2200	15.89	20.31	20.56	17.72	1.12	0.61	32.57	18.08	3.28
2300	15.79	20.23	20.58	17.44	1.12	0.61	32.34	17.79	3.24
2400	15.63	20.21	20.60	16.96	1.13	0.60	32.02	17.53	3.26
2500	15.49	20.19	20.71	16.60	1.13	0.59	31.59	17.28	3.32
2600	15.38	20.13	21.13	16.46	1.14	0.59	31.33	17.04	3.30
2700	15.25	20.09	21.32	16.09	1.14	0.58	31.02	16.68	3.26
2800	15.11	20.04	21.62	15.77	1.15	0.58	30.50	16.71	3.35
2900	15.00	20.03	22.30	15.61	1.15	0.57	30.26	16.38	3.29
3000	14.87	19.99	22.77	15.25	1.16	0.56	30.02	16.18	3.24
3200	14.61	19.92	23.36	14.82	1.17	0.55	29.20	15.54	3.31
3300	14.50	19.82	24.22	14.49	1.16	0.55	28.85	15.37	3.37
3400	14.34	19.75	24.64	14.23	1.17	0.54	28.40	15.00	3.39
3500	14.23	19.71	25.24	14.09	1.17	0.54	28.14	14.91	3.43
3600	14.13	19.67	26.33	13.76	1.17	0.53	27.82	14.76	3.43
3800	13.89	19.52	27.76	13.45	1.18	0.53	27.48	14.32	3.44
4000	13.66	19.39	31.22	12.90	1.18	0.52	26.71	13.86	3.33

Note: Test data of die packaged in industry standard Micro-X Package

Typical Performance Curves



Note: Test data of die packaged in industry standard Micro-X Package

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)	