

L to S BAND LOW NOISE AMPLIFIER NPN GaAs HBT

FEATURES

- For Low Noise & High Gain amplifiers
NF = 1.0 dB TYP. G_a = 15.0 dB TYP. MSG = 15.0 dB TYP. (@f = 2 GHz, $V_{CE} = 2$ V, $I_c = 3$ mA, $Z_s = Z_L = 50 \Omega$)
OIP₃ = 15 dBm TYP. (@f = 2 GHz, $V_{CE} = 2$ V, $I_c = 3$ mA, $Z_s = Z_L = 50 \Omega$)
- 4-pin super minimold package
- Grounded Emitter Transistor

ORDERING INFORMATION (PLAN)

Part Number	Package	Marking	Supplying Form
NE52118-T1	4-pin super minimold	V41	Embossed tape 8 mm wide. Pin 3, pin 4 face to perforation side of the tape. Qty 3 kp/reel.

Remark To order evaluation samples, please contact your local NEC sales office.
(Part number for sample order: NE52118)

ABSOLUTE MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit
Collector to Emitter Voltage	V_{CEO}	5.0	V
Collector to Base Voltage	V_{CBO}	3.0	V
Emitter to Base Voltage	V_{EBO}	3.0	V
Collector Current	I_c	7	mA
Base Current	I_B	0.3	mA
Total Power Dissipation	P_{tot}	30	mW
Junction Temperature	T_j	+125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +125	$^\circ\text{C}$

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

RECOMMENDED OPERATING CONDITIONS (T_A = +25 °C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Collector to Emitter Voltage	V _{CE}	1.5	2.0	3.0	V
Collector Current	I _C	–	3	6	mA

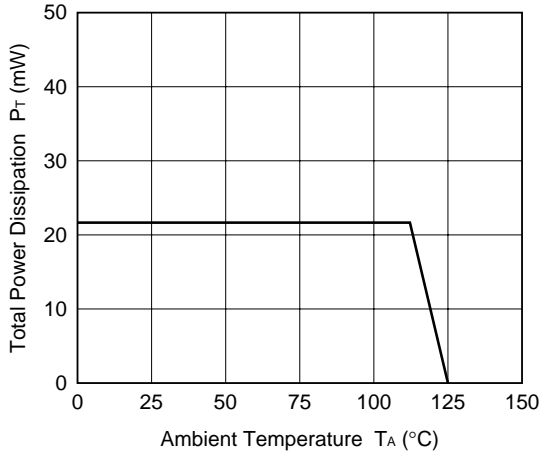
ELECTRICAL CHARACTERISTICS (T_A = +25°C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Emitter to Base Leak Current	I _{EBO}	V _{EBO} = 3 V	–	0.2	1.0	μA
Collector to Base Leak Current	I _{CBO}	V _{CBO} = 3 V	–	0.2	1.0	μA
Collector to Emitter Leak Current	I _{CEO}	V _{CEO} = 5 V	–	0.5	2.0	μA
DC current gain	h _{FE}	V _{CE} = 2 V, I _C = 3 mA	50	90	140	–
Base to Emitter Forward Voltage	V _{FBE}	I _{BE} = 100 μA	1.0	1.2	1.4	V
Base to Collector Forward Voltage	V _{FBC}	I _{BC} = 100 μA	0.7	1.0	1.3	V
Noise Figure	NF	V _{CE} = 2 V, I _C = 3 mA, f = 2 GHz, Z _S = Z _L = 50 Ω	–	1.0	1.5	dB
Associated Gain	G _a		13.5	15	–	dB
Out Third-Order Distortion Intercept Point	OIP ₃		–	15	–	dBm
Noise Figure	NF	V _{CE} = 2 V, I _C = 5 mA, f = 2 GHz, Z _S = Z _L = 50 Ω	–	1.0	–	dB
Associated Gain	G _a		–	16.3	–	dB

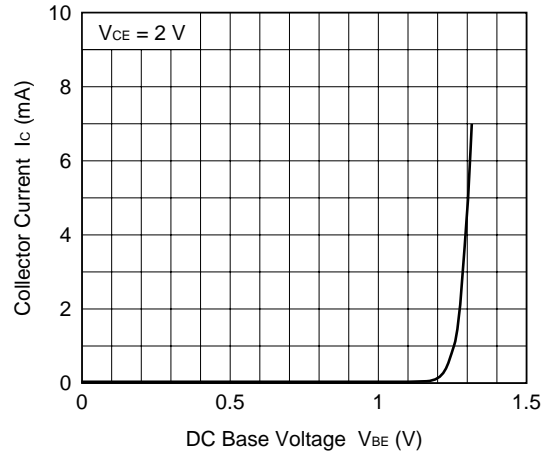
TYPICAL CHARACTERISTICS ($T_A = +25^\circ\text{C}$)

DC CHARACTERISTICS

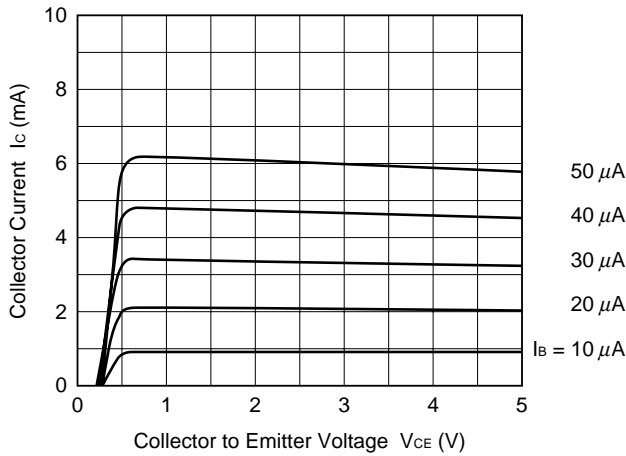
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



COLLECTOR CURRENT vs. DC BASE VOLTAGE

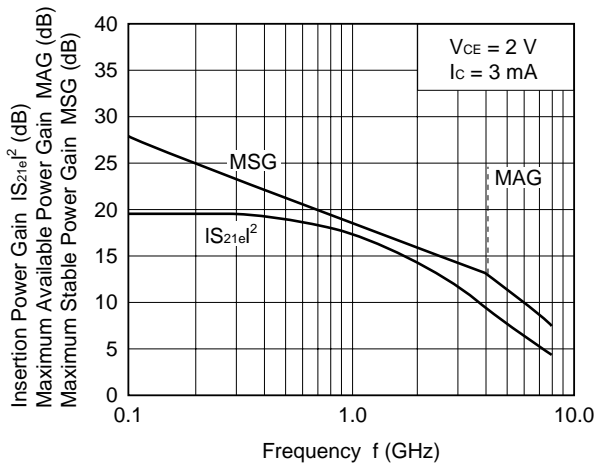


COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE

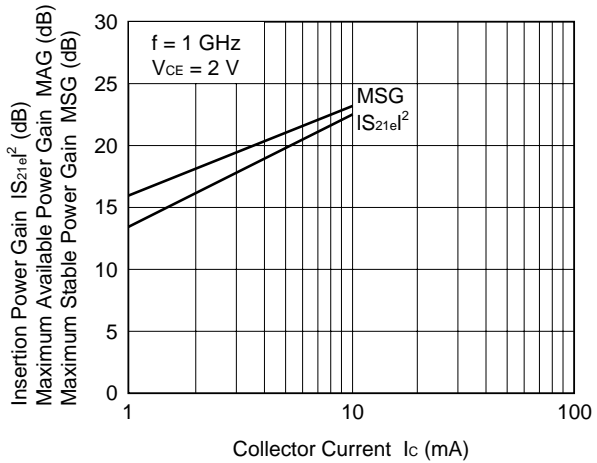


GAIN CHARACTERISTICS

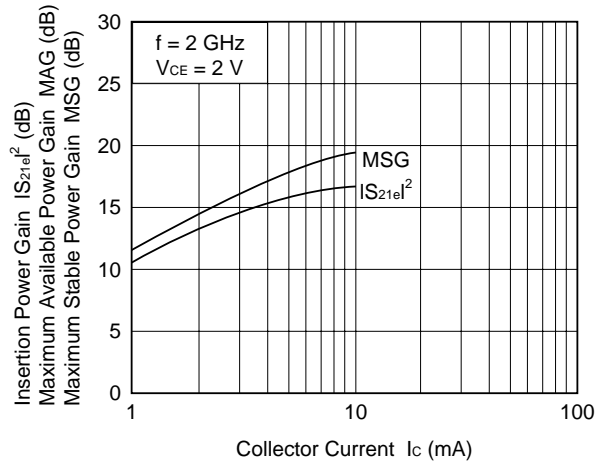
INSERTION POWER GAIN, MAXIMUM AVAILABLE POWER GAIN, MAXIMUM STABLE POWER GAIN vs. FREQUENCY



INSERTION POWER GAIN, MAXIMUM AVAILABLE POWER GAIN, MAXIMUM STABLE POWER GAIN vs. COLLECTOR CURRENT

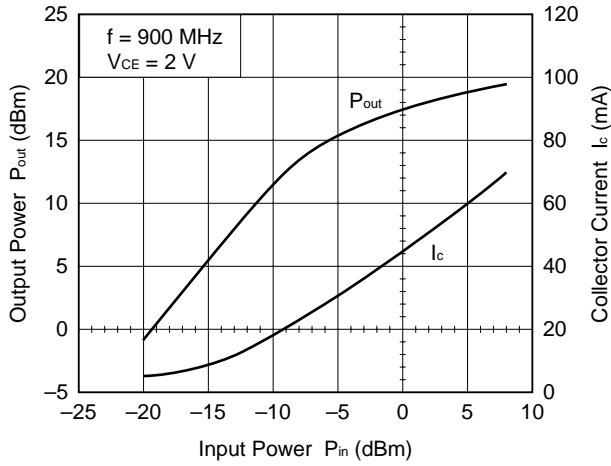


INSERTION POWER GAIN, MAXIMUM AVAILABLE POWER GAIN, MAXIMUM STABLE POWER GAIN vs. COLLECTOR CURRENT

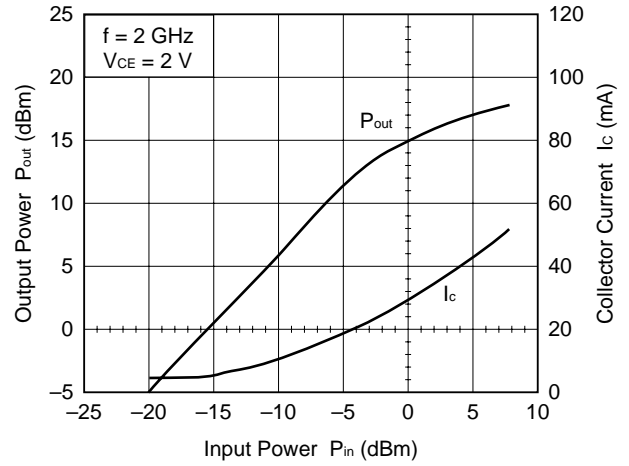


OUTPUT CHARACTERISTICS

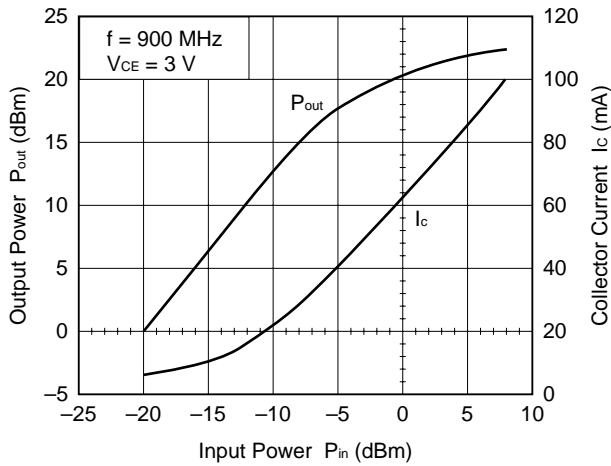
OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER



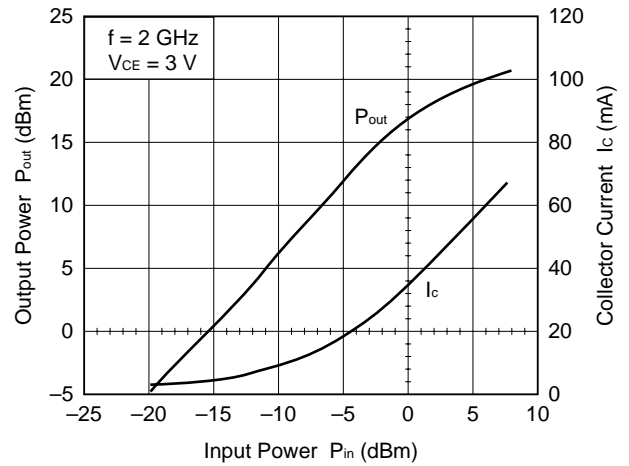
OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER



OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER



OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER



**S-PARAMETERS
MAG. AND ANG.**

V_{CE} = 2 V, I_C = 3 mA

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
400	0.878	-27.7	8.567	154.4	0.048	68.1	0.965	-23.2
500	0.868	-34.8	8.361	148.6	0.057	65.3	0.952	-27.6
600	0.849	-41.6	8.204	142.8	0.069	61.0	0.916	-32.6
700	0.836	-47.4	7.969	137.8	0.078	57.2	0.890	-37.1
800	0.806	-53.3	7.758	132.6	0.084	54.4	0.866	-41.5
900	0.790	-59.5	7.584	127.9	0.090	47.0	0.839	-45.2
1000	0.764	-64.6	7.242	123.1	0.096	45.9	0.819	-49.5
1100	0.740	-70.3	7.089	118.3	0.102	41.8	0.792	-53.8
1200	0.726	-75.4	6.860	114.2	0.108	39.3	0.752	-56.9
1300	0.715	-80.2	6.588	109.9	0.114	35.9	0.733	-60.0
1400	0.690	-84.3	6.397	105.3	0.115	33.2	0.713	-63.8
1500	0.679	-89.3	6.155	101.8	0.119	29.1	0.687	-66.0
1600	0.656	-93.3	5.968	98.2	0.124	27.9	0.660	-69.2
1700	0.640	-97.6	5.785	95.0	0.126	25.9	0.638	-71.6
1800	0.631	-101.4	5.559	91.1	0.129	23.9	0.617	-74.0
1900	0.612	-105.2	5.362	87.5	0.134	22.8	0.603	-76.5
2000	0.553	-109.5	5.094	84.9	0.131	19.5	0.529	-77.9
2100	0.541	-114.0	4.900	81.3	0.134	16.7	0.523	-81.2
2200	0.516	-117.6	4.774	78.2	0.132	16.0	0.495	-83.6
2300	0.501	-121.9	4.601	75.1	0.136	11.4	0.483	-85.9
2400	0.504	-125.0	4.499	72.3	0.137	11.2	0.471	-87.6
2500	0.503	-128.1	4.350	69.1	0.139	10.2	0.455	-90.3
2600	0.480	-132.7	4.229	66.3	0.138	9.2	0.428	-92.9
2700	0.476	-136.0	4.119	63.5	0.143	5.4	0.419	-93.5
2800	0.464	-140.5	4.007	60.3	0.138	6.5	0.399	-98.2
2900	0.453	-143.9	3.894	57.9	0.142	4.3	0.396	-99.3
3000	0.447	-147.9	3.778	54.9	0.140	4.0	0.377	-102.4
3500	0.433	-163.0	3.377	42.5	0.149	-5.1	0.324	-114.3
4000	0.434	-179.9	3.000	30.1	0.149	-10.7	0.289	-127.6
4500	0.433	166.0	2.730	18.3	0.152	-16.9	0.259	-141.0
5000	0.448	153.3	2.490	7.1	0.155	-23.0	0.250	-154.2
5500	0.467	141.7	2.291	-4.6	0.154	-27.5	0.240	-168.8
6000	0.484	131.9	2.104	-15.7	0.156	-33.6	0.247	176.7
6500	0.509	122.2	1.949	-26.9	0.161	-39.9	0.255	163.5
7000	0.540	113.4	1.809	-38.2	0.160	-45.2	0.269	147.1
7500	0.562	105.7	1.668	-49.0	0.161	-51.3	0.292	133.9
8000	0.595	97.9	1.543	-59.7	0.157	-56.0	0.329	122.1

AMPLIFIER PARAMETERS

V_{CE} = 2 V, I_c = 3 mA

FREQUENCY MHz	GU _{max} dB	GA _{max} dB	S ₂₁ ² dB	S ₁₂ ² dB	K	Delay ns	Mason's U dB	G ₁ dB	G ₂ dB
400	36.72		18.66	-26.34	0.18	0.173	29.074	6.40	11.66
500	34.77		18.45	-24.81	0.17	0.159	30.851	6.07	10.25
600	31.75		18.28	-23.16	0.22	0.163	29.073	5.54	7.93
700	30.05		18.03	-22.20	0.24	0.139	28.366	5.20	6.82
800	28.39		17.79	-21.47	0.25	0.145	29.949	4.56	6.03
900	27.14		17.60	-20.89	0.31	0.130	24.342	4.25	5.29
1000	25.84		17.20	-20.32	0.31	0.132	26.473	3.81	4.83
1100	24.75		17.01	-19.81	0.33	0.133	25.298	3.45	4.29
1200	23.60		16.73	-19.35	0.36	0.115	25.058	3.25	3.62
1300	22.83		16.38	-18.84	0.38	0.120	24.267	3.11	3.35
1400	22.00		16.12	-18.78	0.40	0.127	24.598	2.80	3.08
1500	21.25		15.78	-18.52	0.43	0.098	22.896	2.68	2.78
1600	20.45		15.52	-18.10	0.45	0.100	23.256	2.45	2.49
1700	19.80		15.25	-17.97	0.46	0.089	23.209	2.29	2.27
1800	19.19		14.90	-17.77	0.48	0.107	23.433	2.20	2.08
1900	18.58		14.59	-17.47	0.50	0.101	24.430	2.03	1.96
2000	17.15		14.14	-17.68	0.60	0.073	20.189	1.59	1.43
2100	16.70		13.80	-17.43	0.61	0.099	19.993	1.50	1.39
2200	16.14		13.58	-17.56	0.64	0.086	19.931	1.34	1.22
2300	15.67		13.26	-17.36	0.67	0.086	18.568	1.26	1.15
2400	15.42		13.06	-17.25	0.68	0.079	19.197	1.27	1.09
2500	15.04		12.77	-17.14	0.69	0.087	19.529	1.27	1.01
2600	14.54		12.53	-17.18	0.72	0.078	19.111	1.14	0.88
2700	14.25		12.30	-16.90	0.74	0.079	18.160	1.11	0.84
2800	13.86		12.06	-17.19	0.77	0.089	19.006	1.05	0.75
2900	13.55		11.81	-16.94	0.78	0.066	18.535	1.00	0.74
3000	13.18		11.55	-17.07	0.81	0.086	18.666	0.97	0.67
3500	11.95		10.57	-16.56	0.88	0.072	17.244	0.90	0.48
4000	10.83		9.54	-16.56	0.95	0.068	16.795	0.91	0.38
4500	9.93	11.68	8.72	-16.39	1.02	0.066	16.071	0.90	0.30
5000	9.18	10.60	7.92	-16.21	1.06	0.062	15.736	0.97	0.28
5500	8.53	9.72	7.20	-16.25	1.11	0.065	15.441	1.07	0.26
6000	7.89	9.03	6.46	-16.11	1.14	0.062	14.953	1.16	0.27
6500	7.39	8.61	5.80	-15.89	1.13	0.062	15.059	1.30	0.29
7000	6.97	8.26	5.15	-15.91	1.14	0.062	15.045	1.50	0.33
7500	6.48	7.82	4.44	-15.89	1.15	0.060	14.508	1.64	0.39
8000	6.17	7.72	3.77	-16.09	1.13	0.059	14.731	1.90	0.50

**S-PARAMETERS
MAG. AND ANG.**

V_{CE} = 2 V, I_C = 5 mA

FREQUENCY MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
400	0.816	-37.6	13.111	147.8	0.044	62.4	0.921	-30.6
500	0.793	-46.0	12.508	141.6	0.052	59.8	0.894	-36.2
600	0.767	-54.8	12.024	134.9	0.062	56.7	0.844	-42.5
700	0.738	-62.3	11.440	129.0	0.067	50.8	0.800	-47.7
800	0.705	-68.8	10.904	123.4	0.072	48.1	0.764	-52.6
900	0.679	-76.1	10.463	118.1	0.078	43.7	0.730	-56.9
1000	0.654	-81.5	9.832	113.7	0.082	40.5	0.692	-60.9
1100	0.631	-88.0	9.389	108.4	0.085	38.4	0.665	-65.8
1200	0.607	-93.6	8.911	104.8	0.089	36.0	0.624	-68.7
1300	0.595	-98.8	8.461	100.4	0.092	34.7	0.595	-72.0
1400	0.573	-103.3	8.137	96.4	0.097	31.4	0.579	-75.7
1500	0.562	-108.0	7.761	92.9	0.097	30.9	0.550	-77.7
1600	0.545	-112.1	7.415	89.3	0.101	28.0	0.527	-80.8
1700	0.528	-116.4	7.119	86.3	0.103	27.4	0.503	-82.7
1800	0.522	-120.0	6.783	83.1	0.105	25.0	0.481	-85.3
1900	0.507	-123.7	6.491	79.8	0.109	24.1	0.467	-87.6
2000	0.459	-129.1	6.123	77.5	0.106	22.5	0.401	-89.3
2100	0.450	-133.6	5.908	74.0	0.108	20.8	0.394	-92.1
2200	0.435	-137.7	5.663	71.4	0.107	20.0	0.375	-95.1
2300	0.423	-141.9	5.454	68.7	0.110	17.7	0.364	-98.0
2400	0.428	-144.7	5.287	66.1	0.113	18.1	0.348	-99.5
2500	0.426	-147.0	5.111	63.5	0.115	17.1	0.338	-102.3
2600	0.416	-152.5	4.940	60.8	0.116	14.9	0.317	-104.7
2700	0.412	-155.7	4.788	58.4	0.120	14.1	0.308	-105.9
2800	0.404	-159.3	4.634	55.5	0.120	13.5	0.295	-110.3
2900	0.401	-162.4	4.491	53.2	0.120	10.5	0.292	-112.1
3000	0.394	-166.0	4.360	50.5	0.122	9.6	0.276	-115.9
3500	0.398	179.5	3.831	39.2	0.126	3.8	0.243	-129.1
4000	0.416	164.9	3.362	27.7	0.139	-0.6	0.219	-144.8
4500	0.422	152.3	3.050	16.5	0.142	-6.9	0.208	-160.3
5000	0.444	141.7	2.779	5.9	0.149	-12.7	0.211	-174.9
5500	0.469	131.7	2.540	-5.1	0.153	-17.7	0.216	170.7
6000	0.487	123.5	2.333	-15.6	0.160	-24.2	0.234	156.9
6500	0.514	115.1	2.149	-26.1	0.162	-30.5	0.246	144.7
7000	0.551	107.5	1.988	-36.9	0.168	-37.7	0.273	130.7
7500	0.572	100.5	1.826	-47.1	0.170	-44.9	0.300	119.3
8000	0.605	93.5	1.695	-57.6	0.175	-51.7	0.344	109.3

AMPLIFIER PARAMETERS

V_{CE} = 2 V, I_c = 5 mA

FREQUENCY MHz	G _{Umax} dB	G _{Amax} dB	S ₂₁ ² dB	S ₁₂ ² dB	K	Delay ns	Mason's U dB	G ₁ dB	G ₂ dB
400	35.28		22.35	-27.12	0.22	0.216	30.148	4.76	8.17
500	33.23		21.94	-25.62	0.22	0.172	32.121	4.31	6.98
600	30.85		21.60	-24.15	0.24	0.187	33.991	3.85	5.40
700	29.02		21.17	-23.53	0.29	0.165	30.128	3.41	4.44
800	27.55		20.75	-22.91	0.31	0.154	30.965	2.98	3.81
900	26.37		20.39	-22.17	0.35	0.147	28.906	2.68	3.30
1000	25.11		19.85	-21.69	0.39	0.123	27.898	2.42	2.83
1100	24.19		19.45	-21.38	0.40	0.147	29.995	2.21	2.54
1200	23.14		19.00	-21.05	0.43	0.101	28.540	2.00	2.14
1300	22.35		18.55	-20.73	0.45	0.123	30.955	1.90	1.90
1400	21.71		18.21	-20.25	0.48	0.110	28.684	1.73	1.78
1500	21.01		17.80	-20.31	0.50	0.099	31.716	1.64	1.56
1600	20.35		17.40	-19.87	0.53	0.098	28.687	1.53	1.42
1700	19.74		17.05	-19.74	0.55	0.084	29.766	1.42	1.27
1800	19.15		16.63	-19.57	0.58	0.091	28.363	1.38	1.15
1900	18.60		16.25	-19.29	0.60	0.091	29.501	1.29	1.07
2000	17.53		15.74	-19.47	0.70	0.062	23.586	1.03	0.76
2100	17.14		15.43	-19.31	0.71	0.097	23.790	0.98	0.73
2200	16.63		15.06	-19.42	0.75	0.072	23.253	0.91	0.66
2300	16.21		14.73	-19.14	0.76	0.077	22.510	0.86	0.62
2400	15.90		14.46	-18.94	0.77	0.073	23.451	0.88	0.56
2500	15.57		14.17	-18.82	0.79	0.072	23.454	0.87	0.53
2600	15.16		13.87	-18.72	0.82	0.074	22.247	0.83	0.46
2700	14.84		13.60	-18.39	0.83	0.067	22.392	0.81	0.43
2800	14.49		13.32	-18.42	0.85	0.081	22.221	0.77	0.40
2900	14.20		13.05	-18.39	0.87	0.065	21.203	0.76	0.39
3000	13.87		12.79	-18.28	0.90	0.073	20.866	0.73	0.34
3500	12.68		11.67	-17.99	0.97	0.065	19.807	0.75	0.26
4000	11.57		10.53	-17.15	0.99	0.064	20.243	0.82	0.21
4500	10.73	12.07	9.69	-16.96	1.04	0.062	18.996	0.85	0.19
5000	10.03	11.35	8.88	-16.54	1.05	0.059	19.180	0.96	0.20
5500	9.38	10.60	8.10	-16.31	1.07	0.061	19.004	1.08	0.21
6000	8.78	10.08	7.36	-15.91	1.06	0.058	19.223	1.17	0.24
6500	8.25	9.56	6.65	-15.79	1.07	0.058	18.693	1.33	0.27
7000	7.87	9.69	5.97	-15.47	1.03	0.060	22.385	1.57	0.34
7500	7.36	9.30	5.23	-15.38	1.03	0.057	21.970	1.72	0.41
8000	7.11		4.58	-15.13	0.95	0.058		1.98	0.55

PRECAUTION

Avoid high static voltage and electric fields.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your NEC sales representative.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared Reflow	Package peak temperature: 230 °C or below Time: 30 seconds or less (at 210 °C) Count: 3, Exposure limit: None ^{Note}	IR30-00-3
VPS	Package peak temperature: 215 °C or below Time: 40 seconds or less (at 200 °C) Count: 2, Exposure limit: None ^{Note}	VP15-00-2
Wave Soldering	Soldering bath temperature: 260 °C or below Time: 10 seconds or less Count: 1, Exposure limit: None ^{Note}	WS60-00-1
Partial Heating	Pin temperature: 300 °C Time: 3 seconds or less (per side of device) Exposure limit: None ^{Note}	—

Note After opening the dry pack, keep it in a place below 25 °C and 65 % RH for the allowable storage period.

Caution Do not use different soldering methods together (except for partial heating).

For details of recommended soldering conditions for surface mounting, refer to information document **SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (C10535E)**.

CAUTION

The Great Care must be taken in dealing with the devices in this guide.

The reason is that the material of the devices is GaAs (Gallium Arsenide), which is designated as harmful substance according to the law concerned.

Keep the law concerned and so on, especially in case of removal.

- **The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.**
 - No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.
 - NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.
 - Descriptions of circuits, software, and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software, and information in the design of the customer's equipment shall be done under the full responsibility of the customer. NEC Corporation assumes no responsibility for any losses incurred by the customer or third parties arising from the use of these circuits, software, and information.
 - While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.
 - NEC devices are classified into the following three quality grades:
"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.
 - Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots
 - Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
 - Specific: Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.
- The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.