

**NPN SILICON EPITAXIAL TRANSISTOR
FOR L-BAND LOW-POWER AMPLIFIER**

The NE68939 is ideal for the driver stage amplifier in 1.9GHz-band digital cordless phones (DECT, PHS, etc.).

FEATURES

- $P_{-1} = 24 \text{ dBm TYP.}$
@ $f = 1.9 \text{ GHz}$, $V_{CC} = 3.6 \text{ V}$, $I_{CQ} = 1 \text{ mA}$ (Class AB), Duty = 1/8
- 4-Pin Mini Mold Package
EIAJ: SC-61

ORDERING INFORMATION

Part Number	Quantity	Packing Style
NE68939-T1	3 Kpcs/Reel	Embossed tape 8 mm wide. Pin 3 (Base), Pin 4 (Emitter) face to perforation side of the tape.

Remark If you require an evaluation sample, please contact an NEC Sales Representative. (Unit sample quantity is 50 pcs.)

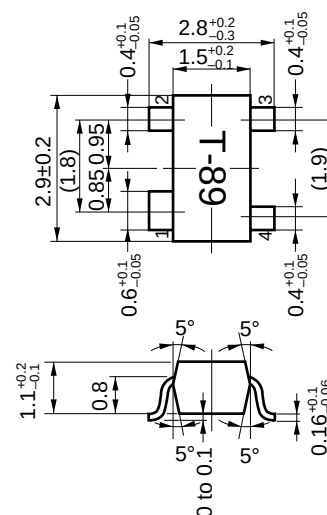
ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

Parameter	Symbol	Rating	Unit
Collector to Base Voltage	V_{CBO}	9.0	V
Collector to Emitter Voltage	V_{CEO}	6.0	V
Emitter to Base Voltage	V_{EBO}	2.0	V
Collector Current	I_C	150	mA
Total Power Dissipation	P_T	200 (CW)	mW
		1.0 (duty = 1/8) ^{Note}	W
		2.5 (duty = 1/24) ^{Note}	W
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

Note Pulse period is 10 msec or less.

PACKAGE DRAWING

(Unit: mm)

**PIN CONNECTIONS**

1. Collector
2. Emitter
3. Base
4. Emitter

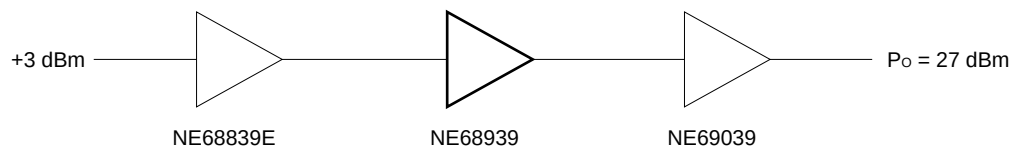
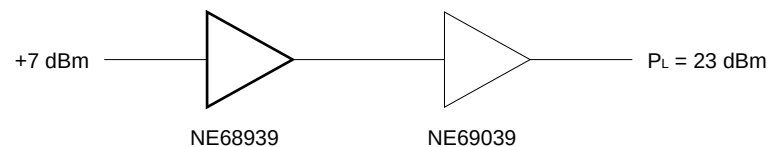
ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Collector Cutoff Current	I _{CBO}	V _{CB} = 5 V, I _E = 0			2.5	μA
Emitter Cutoff Current	I _{EBO}	V _{EB} = 1 V, I _C = 0			2.5	μA
DC Current Gain	h _{FE}	V _{CE} = 3.6 V, I _C = 100 mA ^{Note}	60			—
Output Power	P ₋₁	V _{CC} = 3.6 V, f = 1.9 GHz, I _{CQ} = 1 mA (class AB operation) Duty factor 1/8	23	24		dBm
Power Gain	G _P		7	8		dB
Collector Efficiency	η _C		50	60		%

Note Pulse Measurement: PW ≤ 350 μs, Duty cycle ≤ 2 %, Pulsed

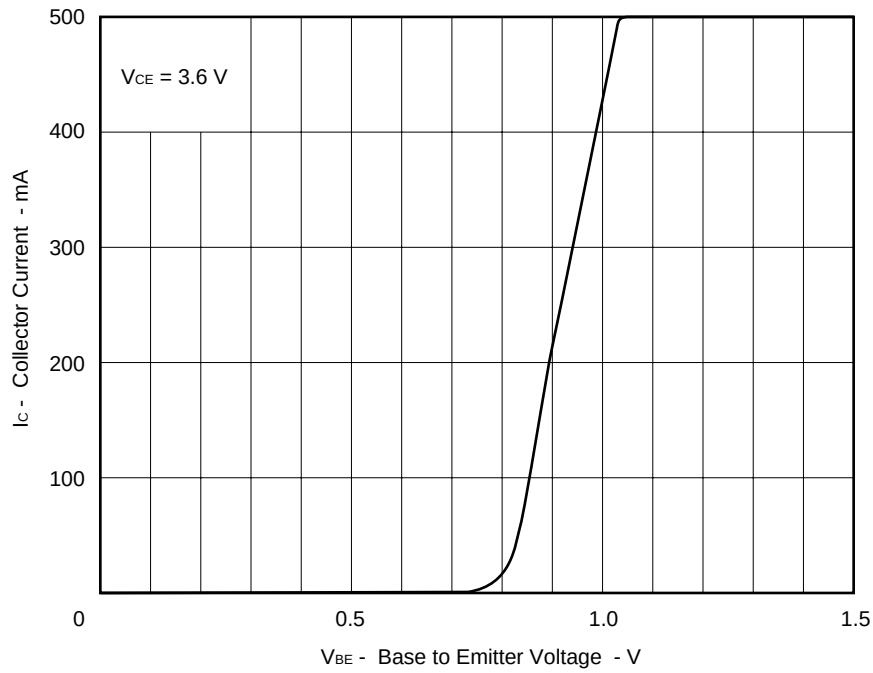
h_{FE} Classification

Rank	FB
Marking	T89
h _{FE}	more than 60

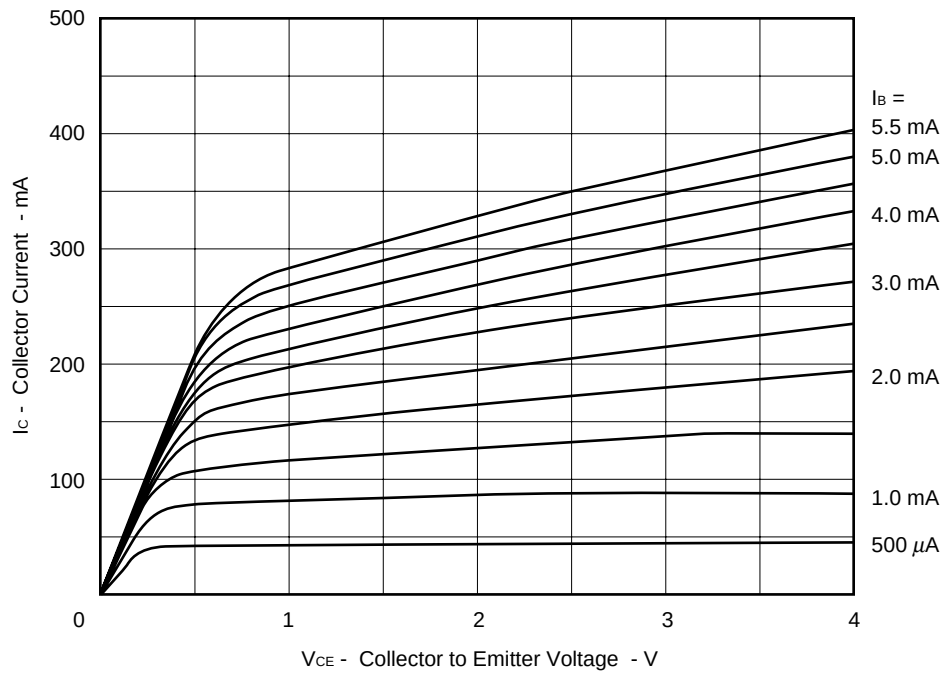
APPLICATION EXAMPLES**(1) Power amplifier for DECT****(2) Power amplifier for PHS**

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

COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



S-Parameters**(V_{CE} = 3.0 V, I_c = 10 mA)**

FREQUENCY	S11		S21		S12		S22		
	MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	719.74 mU	145.59	2.5304 U	49.912	92.605 mU	32.197	269.43 mU	-162.09	
1 600.000 000	725.17 mU	142.26	2.3524 U	46.6	96.439 mU	32.428	277.83 mU	-164.53	
1 700.000 000	730.14 mU	139.35	2.2024 U	43.606	98.551 mU	31.724	285.95 mU	-167.17	
1 800.000 000	734.51 mU	136.33	2.0758 U	40.652	101.97 mU	32.26	291.71 mU	-169.94	
1 900.000 000	736.09 mU	133.47	1.9504 U	37.767	105.91 mU	32.58	296.81 mU	-172.29	
2 000.000 000	741.91 mU	131.09	1.8424 U	35.152	109.67 mU	32.724	306.06 mU	-174.21	
2 100.000 000	748.73 mU	128.78	1.7558 U	32.448	112.75 mU	32.428	315.33 mU	-176.37	
2 200.000 000	754.01 mU	126.44	1.667 U	29.578	117.1 mU	31.998	328.73 mU	-178.23	
2 300.000 000	759.69 mU	124.26	1.5776 U	26.9	120.12 mU	31.877	339.48 mU	179.63	
2 400.000 000	766.56 mU	122.08	1.5164 U	24.484	123.62 mU	30.885	350.98 mU	178.09	
2 500.000 000	771.87 mU	119.93	1.4454 U	21.959	126.88 mU	30.505	361.52 mU	175.96	

(V_{CE} = 3.0 V, I_c = 30 mA)

FREQUENCY	S11		S21		S12		S22		
	MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	718.13 mU	140.47	2.906 U	51.601	58.392 mU	45.508	366.98 mU	172.27	
1 600.000 000	722.71 mU	137.52	2.705 U	48.766	103.52 mU	45.019	375.84 mU	170.43	
1 700.000 000	727.33 mU	134.99	2.529 U	45.978	163.77 mU	44.249	381.99 mU	168.46	
1 800.000 000	732.6 mU	132.15	2.3833 U	43.462	112.93 mU	43.234	387.24 mU	166.61	
1 900.000 000	735.5 mU	129.63	2.2398 U	41.131	117.39 mU	42.578	390.16 mU	165.06	
2 000.000 000	740.45 mU	127.49	2.1224 U	36.757	123.34 mU	41.657	397.12 mU	163.13	
2 100.000 000	745.53 mU	125.33	2.0153 U	36.255	129.41 mU	40.651	407.11 mU	161.77	
2 200.000 000	750.91 mU	123.06	1.9181 U	33.743	131.93 mU	38.405	418.19 mU	159.94	
2 300.000 000	759.01 mU	121.14	1.8178 U	31.223	136.48 mU	37.711	426.5 mU	158.37	
2 400.000 000	761.08 mU	119.16	1.7408 U	28.942	140.61 mU	37.014	434.53 mU	157.33	
2 500.000 000	767.45 mU	116.96	1.6687 U	27.03	144.07 mU	35.399	441.36 mU	155.85	

(V_{CE} = 3.0 V, I_c = 50 mA)

FREQUENCY	S11		S21		S12		S22		
	MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	721.15 mU	139.11	2.9537 U	51.692	100.55 mU	49.053	400.14 mU	168.02	
1 600.000 000	727.05 mU	136.26	2.7434 U	49.146	105.85 mU	47.828	407.06 mU	166.73	
1 700.000 000	730.75 mU	133.92	2.5727 U	46.272	111.69 mU	46.851	413.33 mU	164.57	
1 800.000 000	735.5 mU	131.13	2.4209 U	44.011	116.44 mU	45.585	417.55 mU	162.53	
1 900.000 000	738.27 mU	128.6	2.2735 U	41.521	121.1 mU	44.857	421.25 mU	161.09	
2 000.000 000	742.45 mU	126.48	2.1536 U	39.297	127.33 mU	43.381	428.43 mU	159.66	
2 100.000 000	749.88 mU	124.38	2.0444 U	36.818	131.74 mU	42.102	438.22 mU	157.56	
2 200.000 000	754 mU	122.2	1.9435 U	34.516	135.72 mU	40.877	447.62 mU	156.27	
2 300.000 000	758.95 mU	120.32	1.8414 U	32.182	140.35 mU	39.707	455.11 mU	154.95	
2 400.000 000	765.69 mU	118.28	1.7677 U	29.845	144.86 mU	38.335	463.97 mU	154	
2 500.000 000	770.1 mU	116.29	1.6901 U	27.973	148.52 mU	36.575	469.1 mU	152.35	

(V_{CE} = 3.0 V, I_c = 70 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	725.72 mU	138.48	2.9183 U	51.601	101.29 mU	50.795	413.05 mU	166.54
1 600.000 000	731.48 mU	135.64	2.7085 U	48.929	107.34 mU	49.245	422.23 mU	164.89
1 700.000 000	736.63 mU	133.22	2.5326 U	46.31	112.25 mU	47.905	423.69 mU	163.05
1 800.000 000	741.12 mU	130.55	2.3849 U	43.864	117.39 mU	47.094	430.47 mU	161.09
1 900.000 000	744.12 mU	128.14	2.244 U	41.549	122.89 mU	45.785	433.77 mU	159.47
2 000.000 000	745.43 mU	126.01	2.1246 U	39.227	127.46 mU	44.462	439.83 mU	158.28
2 100.000 000	754.57 mU	123.97	2.017 U	36.953	133.83 mU	43.227	450.55 mU	156.84
2 200.000 000	758.72 mU	121.69	1.9214 U	34.463	137.55 mU	41.607	459.09 mU	154.74
2 300.000 000	762.78 mU	119.9	1.8189 U	32.149	142.39 mU	40.26	468.51 mU	153.42
2 400.000 000	769.34 mU	117.91	1.7443 U	29.99	145.63 mU	38.636	476.88 mU	152.35
2 500.000 000	773.34 mU	115.54	1.5749 U	27.948	149.55 mU	37.522	483.41 mU	150.95

(V_{CE} = 3.6 V, I_c = 10 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	717.59 mU	145.94	2.5568 U	50.256	92.045 mU	31.534	264.79 mU	-160.24
1 600.000 000	721.79 mU	142.65	2.3759 U	46.785	95.633 mU	31.352	272.97 mU	-162.88
1 700.000 000	726.14 mU	139.73	2.2278 U	43.682	98.521 mU	32.021	279.75 mU	-165.19
1 800.000 000	730.99 mU	136.66	2.0983 U	40.895	100.75 mU	31.801	284.78 mU	-168.37
1 900.000 000	735.88 mU	133.83	1.9717 U	39.07	105.33 mU	32.224	290.08 mU	-170.47
2 000.000 000	738.72 mU	131.46	1.8724 U	35.254	109.9 mU	32.833	300.75 mU	-172.5
2 100.000 000	746.26 mU	129.08	1.7723 U	32.554	112.14 mU	32.077	309.76 mU	-174.99
2 200.000 000	751.31 mU	126.63	1.6876 U	29.787	115.73 mU	31.527	321.63 mU	-176.97
2 300.000 000	757.73 mU	124.53	1.5969 U	26.958	119.23 mU	31.539	334.37 mU	-179.34
2 400.000 000	763.91 mU	122.26	1.5288 U	24.513	123 mU	31.017	344.92 mU	179.12
2 500.000 000	768.38 mU	120.18	1.4633 U	22.183	126.73 mU	30.537	351.87 mU	177.44

(V_{CE} = 3.6 V, I_c = 30 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	713.07 mU	140.66	2.9625 U	51.575	98.097 mU	45.986	362.4 mU	172.97
1 600.000 000	718.69 mU	137.69	2.7547 U	48.925	103.33 mU	44.731	369.83 mU	170.83
1 700.000 000	723.22 mU	135.16	2.5811 U	46.187	108.37 mU	43.923	373.87 mU	169.06
1 800.000 000	727.69 mU	132.37	2.4303 U	43.705	112.28 mU	43.473	381.62 mU	167.22
1 900.000 000	731.26 mU	129.83	2.2862 U	41.155	117.6 mU	42.448	386.58 mU	165.65
2 000.000 000	735.67 mU	127.74	2.1601 U	38.757	123.17 mU	41.961	393.17 mU	163.72
2 100.000 000	742.78 mU	125.5	2.0563 U	36.315	126.96 mU	40.232	403.87 mU	161.54
2 200.000 000	746.79 mU	123.23	1.9502 U	33.768	132.97 mU	38.837	410.23 mU	160.05
2 300.000 000	751.76 mU	121.24	1.8485 U	31.47	136.92 mU	37.811	419.26 mU	158.59
2 400.000 000	758.8 mU	119.3	1.7722 U	29.162	140.21 mU	36.646	427.16 mU	157.21
2 500.000 000	762.91 mU	117.21	1.6974 U	27.198	143.33 mU	35.692	433.11 mU	156.12

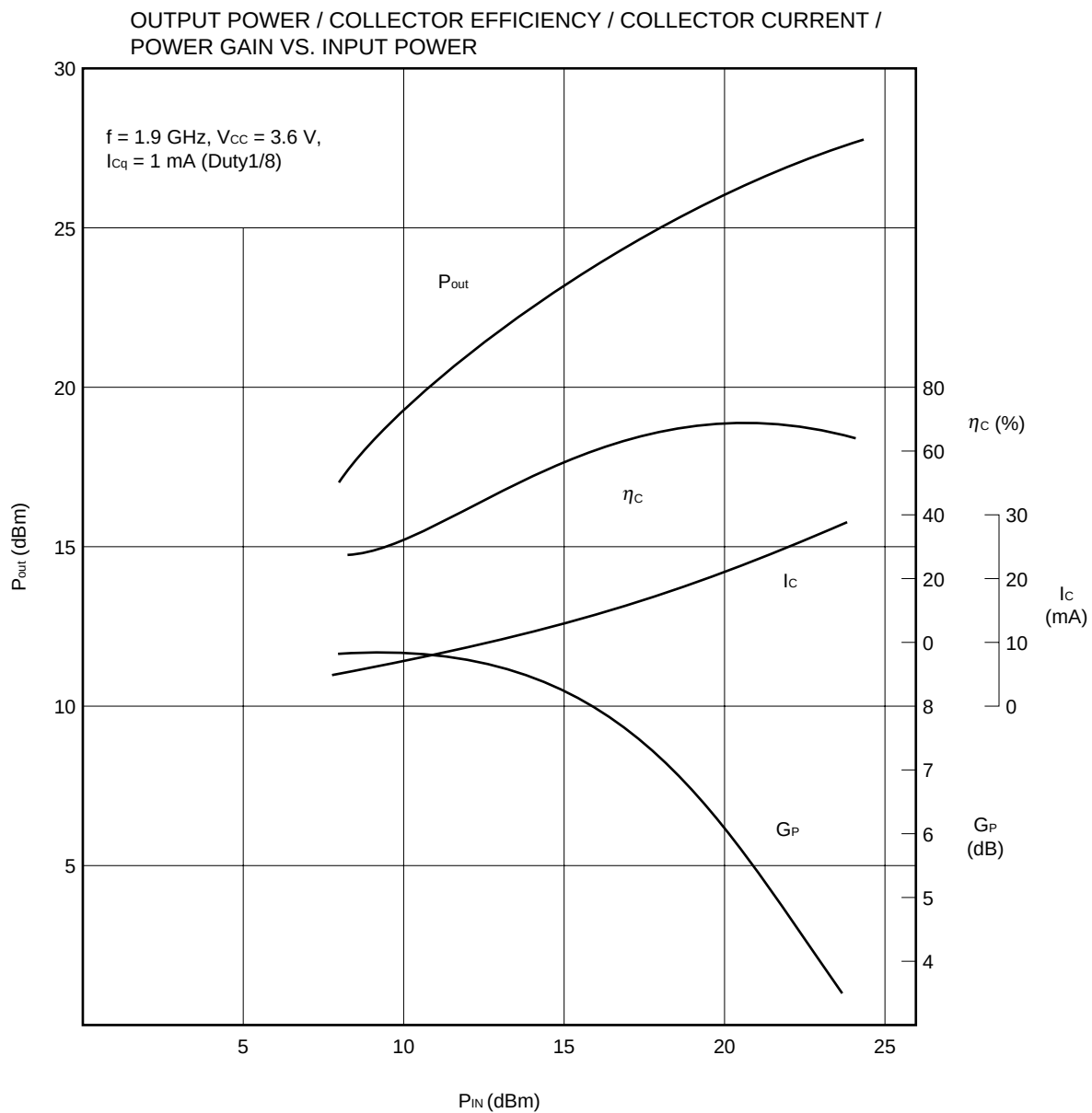
(V_{CE} = 3.6 V, I_C = 50 mA)

FREQUENCY	S11		S21		S12		S22	
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	715.8 mU	139.35	3.016 U	51.983	100.42 mU	48.822	394.84 mU	168.48
1 600.000 000	720.76 mU	136.46	2.8083 U	49.175	105.01 mU	47.71	398.8 mU	166.46
1 700.000 000	726.82 mU	133.95	2.6218 U	46.439	111.1 mU	46.454	407.45 mU	165.26
1 800.000 000	730.81 mU	131.26	2.4723 U	44.121	114.88 mU	45.698	409.49 mU	162.73
1 900.000 000	734.29 mU	128.81	2.3281 U	41.846	120.86 mU	44.515	415.56 mU	161.44
2 000.000 000	737.92 mU	126.63	2.2011 U	39.349	126.55 mU	43.095	422.56 mU	159.77
2 100.000 000	745.62 mU	124.52	2.093 U	37.055	130.53 mU	42.061	433.93 mU	158.13
2 200.000 000	749.61 mU	122.41	1.982 U	34.509	135.53 mU	40.603	440.61 mU	156.51
2 300.000 000	753.99 mU	120.45	1.8797 U	32.318	139.56 mU	39.205	450.02 mU	155.28
2 400.000 000	760.04 mU	118.54	1.8047 U	30.012	144.72 mU	38.297	460.48 mU	154.03
2 500.000 000	765.12 mU	116.37	1.7271 U	28.018	147.87 mU	36.726	484.87 mU	152.86

(V_{CE} = 3.6 V, I_C = 70 mA)

FREQUENCY	S11		S21		S12		S22	
MHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	720.28 mU	138.75	2.9933 U	51.958	100.92 mU	49.947	407.09 mU	166.83
1 600.000 000	724.79 mU	135.88	2.774 U	48.991	106.59 mU	48.93	412.38 mU	165.19
1 700.000 000	729.46 mU	133.4	2.5983 U	46.391	112.06 mU	47.781	418.33 mU	163.23
1 800.000 000	734.56 mU	130.77	2.4497 U	43.947	117.58 mU	45.554	423.16 mU	161.37
1 900.000 000	738.35 mU	128.34	2.3012 U	41.738	122.01 mU	45.325	426.92 mU	160.02
2 000.000 000	742.67 mU	126.2	2.1201 U	39.512	128.41 mU	44.366	435.11 mU	159.71
2 100.000 000	746.81 mU	124.12	2.0594 U	37.043	132.9 mU	43.082	445.52 mU	155.71
2 200.000 000	752.47 mU	121.93	1.9705 U	34.702	137.09 mU	41.148	454.54 mU	155.11
2 300.000 000	757.47 mU	120.03	1.8575 U	32.355	141.84 mU	39.941	461.66 mU	153.72
2 400.000 000	764.37 mU	119.06	1.7848 U	30.057	145.38 mU	38.731	468.19 mU	152.69
2 500.000 000	767.49 mU	115.96	1.722 U	28.063	148.85 mU	37.396	479.11 mU	151.14

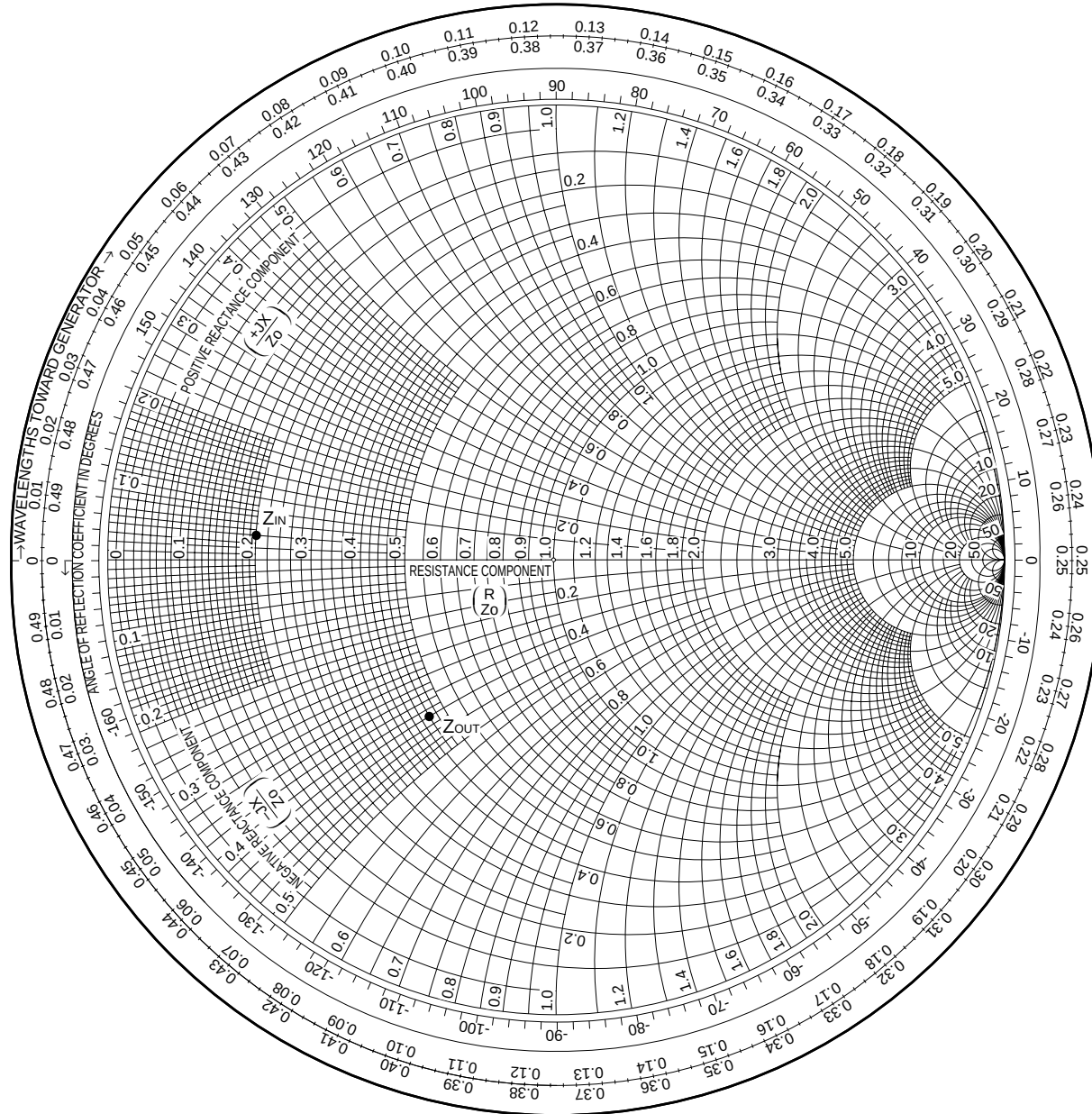
CHARACTERISTICS CURVES



(Reference) Data from the above graph

P_{-1}	24.3	dBm
η_c (at P_{-1})	62	%
I_c (at P_{-1})	15	mA
G_L	8.9	dB

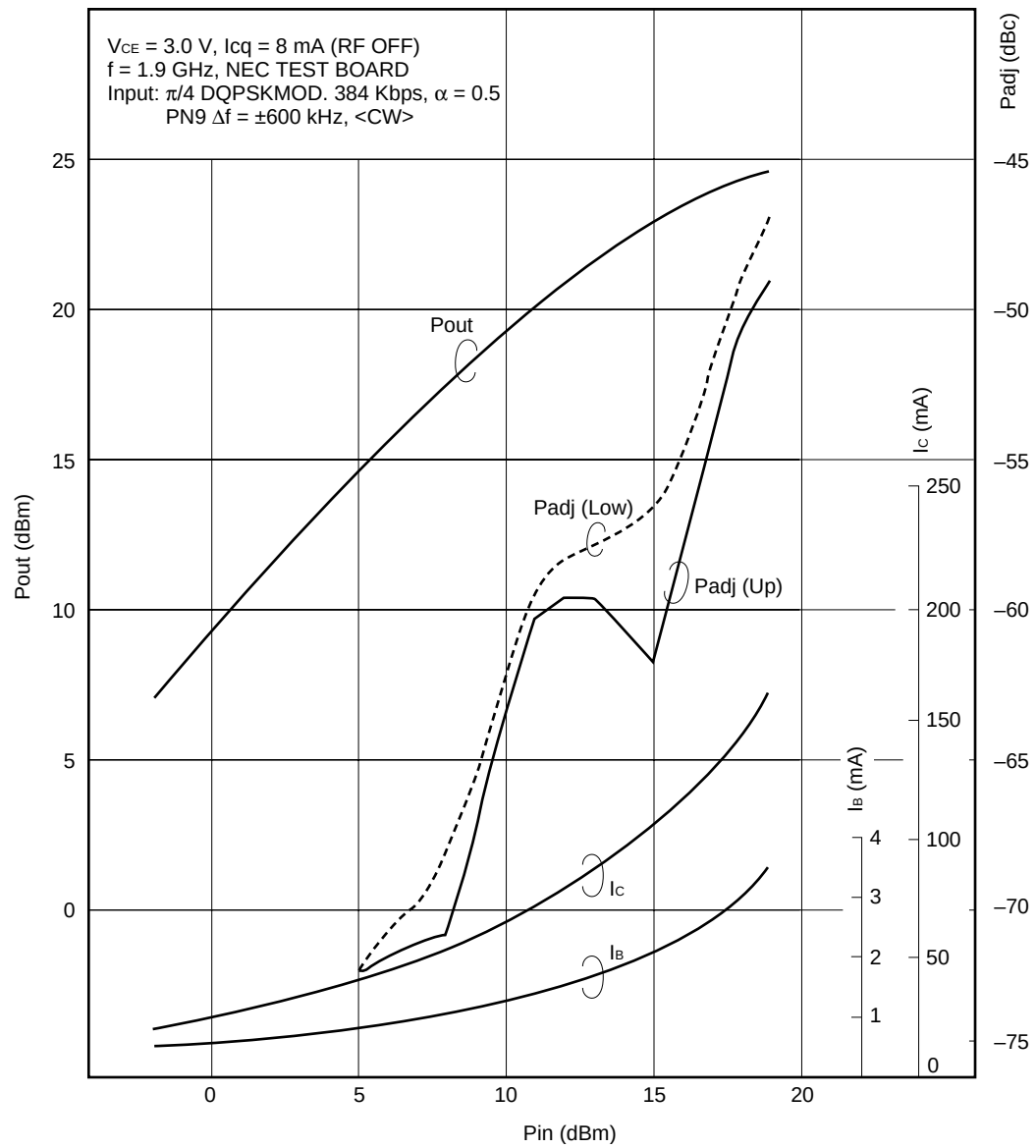
Note I_{CQ} is stand for the collector current when input power off.
 Above the I_{CQ} and I_c are showing current value at 1/8 duty operation.
 In case of CW (continuous wave) operation, the current value becomes eight times.
 Actual bias condition; $V_{CE} = 3.6 \text{ V}$, $I_{CQ} = 8 \text{ mA}$ @ $P_{in} = \text{OFF}$.

Z_{IN} (Ω), Z_{OUT} (Ω) Data

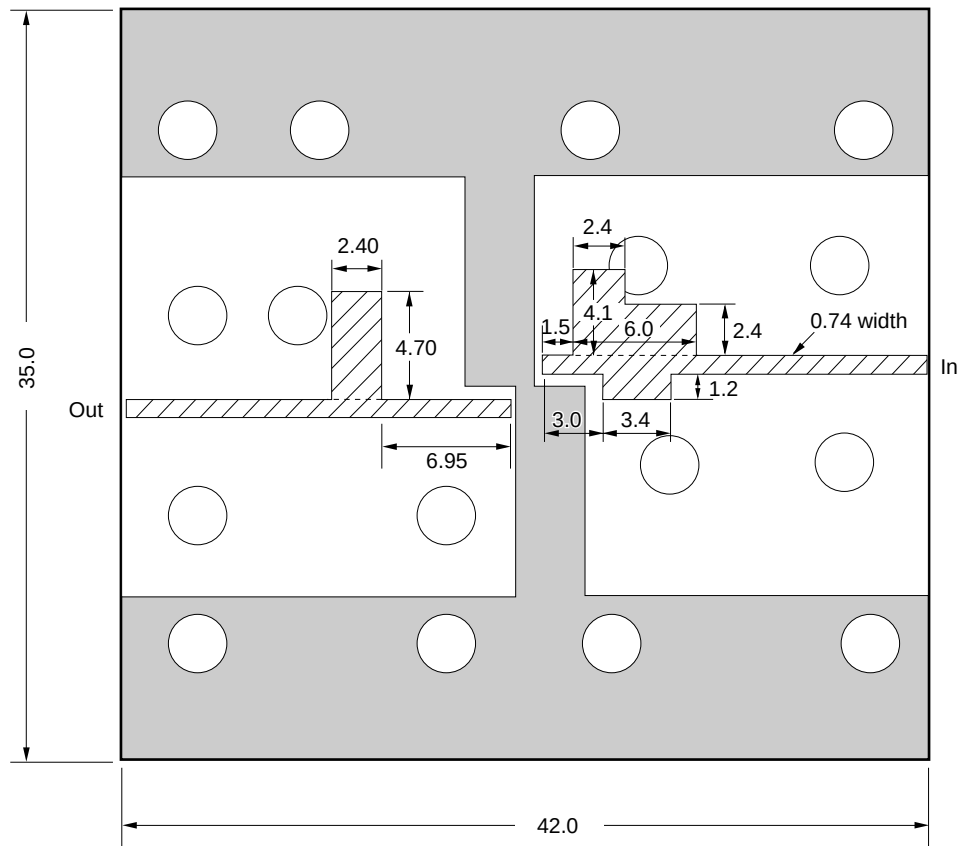
$V_{CC} = 3.6 \text{ V}$, $I_{CQ} = 1 \text{ mA}$, duty = 1/8

f (GHz)	Z_{in} (Ω)	Z_{out} (Ω)
1.9	$9.85 + j1.9$	$23.2 - j20.0$

(REFERENCE PERFORMANCE)



TEST BOARD (Unit mm)



t = 0.4 mm, polyimide substrate

[MEMO]

The application circuit and circuit constants shown in this document are for reference only and may not be employed for mass production of the application system.

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NEC devices are classified into the following three quality grades:

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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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.