

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

The NE69039 is ideal for the final stage amplifier in 1.9G Hz-band digital cordless phones (DECT, PHS, etc.).

FEATURES

- $P_{-1} = 27 \text{ dBm TYP.}$
@ $f = 1.9 \text{ GHz}$, $V_{CC} = 3.6 \text{ V}$, $I_{CQ} = 1 \text{ mA}$ (Class AB), Duty = 1/8
- 4-Pin Mini Mold Package
EIAJ: SC-61

ORDERING INFORMATION

Part Number	Quantity	Packing Style
NE69039-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.)

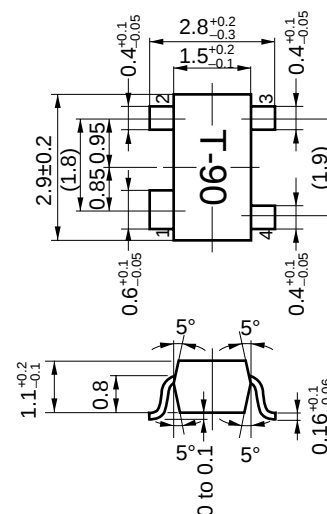
ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

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	300	mA
Total Power Dissipation	P_T	200 (CW)	mW
		1.2 (duty = 1/8) ^{Note}	W
		3.0 (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**

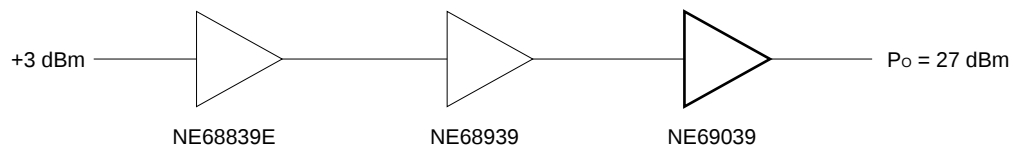
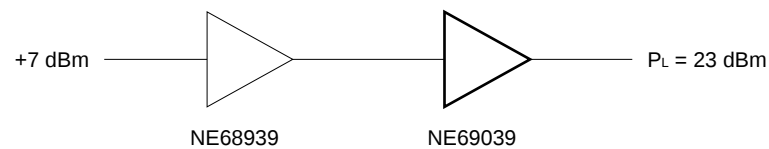
1. Collector
2. Emitter
3. Base
4. Emitter

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			5	μA
Emitter Cutoff Current	I _{EB0}	V _{EB} = 1 V, I _C = 0			5	μA
DC Current Gain	h _{FE}	V _{CE} = 3.6 V, I _C = 200 mA	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	26.3	27.0		dBm
Power Gain	G _P		5.0	6.0		dB
Collector Efficiency	η _C		60	70		%

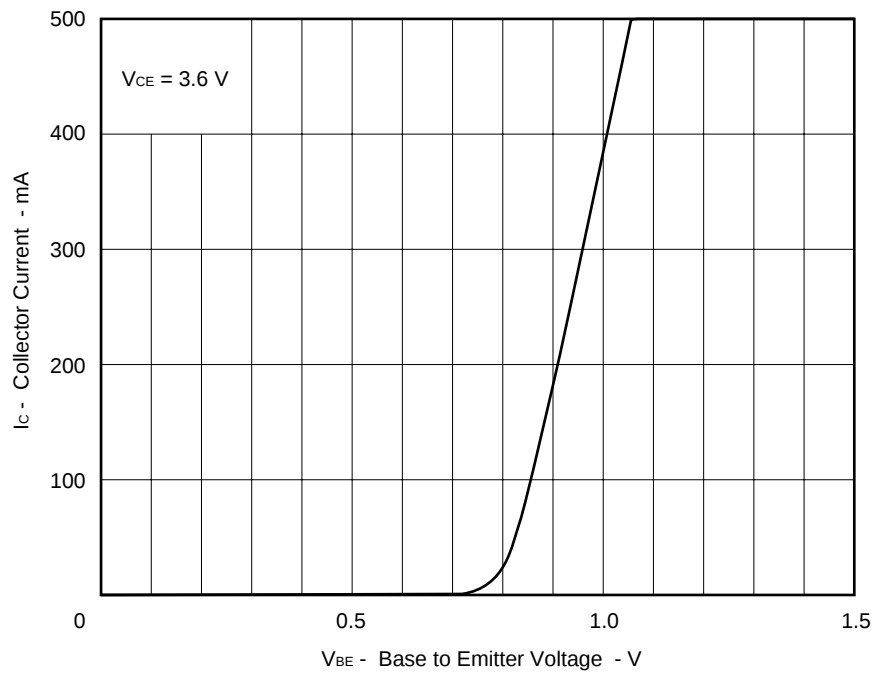
h_{FE} Classification

Rank	FB
Marking	T90
h _{FE}	more than 60

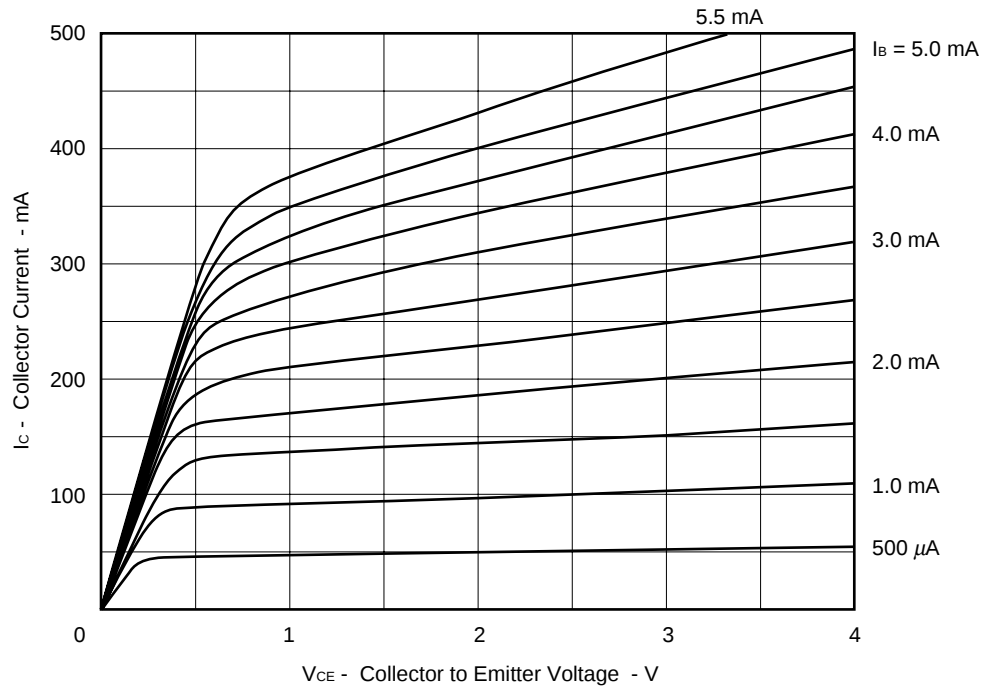
APPLICATION EXAMPLES**(1) Power amplifier for DECT****(2) Power amplifier for PHS**

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

COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



S-Parameters**(V_{CE} = 3.0 V, I_c = 60 mA)**

FREQUENCY	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	810.84 mU	138.58	1.9411 U	48.639	106.35 mU	46.46	583.53 mU	159.88
1 600.000 000	813.96 mU	133.87	1.8066 U	45.93	110.68 mU	44.993	590.28 mU	158.28
1 700.000 000	816.5 mU	131.39	1.6922 U	43.227	116.71 mU	43.52	592.75 mU	156.45
1 800.000 000	820.32 mU	128.91	1.5947 U	40.814	121.32 mU	42.529	598.22 mU	154.73
1 900.000 000	823.53 mU	126.37	1.5047 U	38.489	126.6 mU	41.046	601.49 mU	153.51
2 000.000 000	826 mU	124.27	1.4214 U	35.858	132.01 mU	39.913	606.01 mU	151.61
2 100.000 000	832.11 mU	122.04	1.3543 U	33.591	135.99 mU	38.572	611.23 mU	150.13
2 200.000 000	832.82 mU	119.84	1.2811 U	31.268	140.46 mU	37.029	618.61 mU	148.64
2 300.000 000	835.22 mU	117.85	1.2145 U	28.982	143.87 mU	35.675	623.46 mU	147.37
2 400.000 000	839.52 mU	115.84	1.1656 U	26.992	147.44 mU	34.898	629 mU	146.29
2 500.000 000	840.38 mU	113.83	1.1211 U	25.076	152.24 mU	33.256	632.59 mU	144.88

(V_{CE} = 3.0 V, I_c = 80 mA)

FREQUENCY	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	813.12 mU	136.29	1.9451 U	49.022	106.65 mU	47.457	603.6 mU	159.07
1 600.000 000	816.14 mU	133.57	1.8087 U	46.342	112.69 mU	45.889	605.91 mU	157.35
1 700.000 000	818.21 mU	131.14	1.6967 U	43.58	118.33 mU	44.529	609.17 mU	156.06
1 800.000 000	822.23 mU	128.59	1.5995 U	41.298	123.28 mU	43.227	615.78 mU	154.14
1 900.000 000	825.38 mU	126.15	1.5075 U	38.838	128.06 mU	42.023	619.82 mU	152.61
2 000.000 000	829.15 mU	124	1.4232 U	36.546	133.55 mU	40.346	623.76 mU	151.12
2 100.000 000	832.63 mU	121.76	1.3533 U	34.178	137.17 mU	39.234	630.54 mU	149.1
2 200.000 000	834.44 mU	119.51	1.2662 U	31.984	141.07 mU	37.601	634.29 mU	147.64
2 300.000 000	836.5 mU	117.57	1.2165 U	29.798	146.25 mU	36.573	636.78 mU	146.34
2 400.000 000	839.25 mU	115.54	1.1706 U	27.681	148.91 mU	35.034	644.03 mU	145.35
2 500.000 000	842.51 mU	113.57	1.127 U	25.898	153.45 mU	33.795	645.68 mU	144.07

(V_{CE} = 3.0 V, I_c = 100 mA)

FREQUENCY	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	814.76 mU	136.05	1.9314 U	49.065	107.99 mU	46.52	613.88 mU	158.57
1 600.000 000	819.31 mU	133.37	1.7962 U	46.439	113.83 mU	48.594	617.68 mU	156.93
1 700.000 000	820.45 mU	130.97	1.6833 U	43.752	119.44 mU	45.216	620.63 mU	155.09
1 800.000 000	823.79 mU	128.45	1.5864 U	41.582	123.31 mU	44.018	624.8 mU	153.83
1 900.000 000	827.67 mU	125.99	1.4947 U	38.993	128.74 mU	42.175	626.73 mU	151.85
2 000.000 000	830.69 mU	123.79	1.4116 U	36.707	134.1 mU	40.887	631.19 mU	150.46
2 100.000 000	834.12 mU	121.57	1.3432 U	34.319	138.16 mU	39.995	642.25 mU	148.78
2 200.000 000	836.05 mU	119.32	1.2755 U	32.113	142.04 mU	37.886	544.41 mU	147.45
2 300.000 000	838.39 mU	117.41	1.2099 U	30.096	146.83 mU	36.992	546.33 mU	145.95
2 400.000 000	841.47 mU	115.41	1.1664 U	27.746	150.91 mU	35.305	653.15 mU	144.75
2 500.000 000	842.96 mU	113.41	1.1146 U	26.175	154.92 mU	33.58	655.82 mU	143.5

(V_{CE} = 3.0 V, I_C = 120 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	817.28 mU	135.92	1.9053 U	49.017	108.15 mU	48.654	619.53 mU	158.16
1 600.000 000	820.4 mU	133.2	1.772 U	46.493	114.57 mU	46.991	621.8 mU	156.39
1 700.000 000	823.36 mU	130.75	1.6595 U	43.726	120.09 mU	45.655	626.29 mU	154.92
1 800.000 000	825.32 mU	128.24	1.5695 U	41.45	124.51 mU	44.155	630.47 mU	153.42
1 900.000 000	829.2 mU	125.81	1.4774 U	39.018	129.92 mU	42.933	635.85 mU	151.35
2 000.000 000	832.76 mU	123.66	1.394 U	36.696	135.38 mU	40.954	638.73 mU	150.05
2 100.000 000	836.5 mU	121.44	1.3251 U	34.448	139.38 mU	38.463	647.33 mU	148.43
2 200.000 000	837.77 mU	119.19	1.2596 U	32.257	143.42 mU	38.091	649.58 mU	147
2 300.000 000	839.95 mU	117.27	1.1933 U	30.067	147.59 mU	36.9	655.77 mU	145.6
2 400.000 000	843.73 mU	115.36	1.1516 U	27.979	151.38 mU	35.674	657.89 mU	144.41
2 500.000 000	845.73 mU	113.3	1.1061 U	25.164	155.57 mU	33.967	661.28 mU	143.06

(V_{CE} = 3.6 V, I_C = 60 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	808.3 mU	136.65	1.9727 U	48.44	105.45 mU	46.052	581.18 mU	159.62
1 600.000 000	812.04 mU	133.93	1.8331 U	45.887	112.14 mU	44.817	583.78 mU	157.84
1 700.000 000	814.93 mU	131.51	1.717 U	43.075	116.65 mU	43.513	590.19 mU	156.29
1 800.000 000	818.28 mU	128.96	1.6198 U	40.627	121.29 mU	42.255	593.64 mU	154.41
1 900.000 000	821.86 mU	126.44	1.5247 U	38.187	126.81 mU	40.746	595.96 mU	153.05
2 000.000 000	825.72 mU	124.19	1.4443 U	35.744	131.1 mU	39.637	600.82 mU	151.54
2 100.000 000	829.72 mU	122.08	1.3633 U	33.442	135.38 mU	37.827	607.63 mU	149.72
2 200.000 000	831.5 mU	119.79	1.3006 U	31.143	139.8 mU	36.841	611.6 mU	148.28
2 300.000 000	833.66 mU	117.82	1.2319 U	28.858	143.3 mU	35.421	616.97 mU	146.8
2 400.000 000	836.78 mU	115.85	1.1841 U	26.723	148.34 mU	33.849	621.4 mU	145.82
2 500.000 000	839.53 mU	113.76	1.1409 U	24.857	152.76 mU	32.978	626.63 mU	144.7

(V_{CE} = 3.6 V, I_C = 80 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	810.02 mU	136.4	1.9728 U	48.837	105.15 mU	47.085	593.74 mU	158.81
1 600.000 000	812.97 mU	133.62	1.8375 U	46.192	113.25 mU	45.405	600.04 mU	157.07
1 700.000 000	816.71 mU	131.18	1.7238 U	43.597	117.53 mU	44.256	603.01 mU	155.32
1 800.000 000	819.83 mU	128.68	1.5254 U	41.101	123.16 mU	42.965	610.67 mU	153.74
1 900.000 000	823.48 mU	126.14	1.5286 U	38.741	127.71 mU	41.206	613.44 mU	152.03
2 000.000 000	825.71 mU	123.85	1.4464 U	36.372	133.19 mU	40.31	616.32 mU	150.5
2 100.000 000	830.91 mU	121.82	1.3721 U	33.966	136.97 mU	38.649	625.55 mU	148.79
2 200.000 000	831.7 mU	119.52	1.3042 U	31.579	141.48 mU	37.348	626.62 mU	147.4
2 300.000 000	833.9 mU	117.61	1.2261 U	29.511	145.67 mU	35.89	632.27 mU	145.74
2 400.000 000	837.44 mU	115.59	1.1905 U	27.144	149.19 mU	34.415	638.49 mU	144.59
2 500.000 000	839.42 mU	113.49	1.1422 U	25.406	153.36 mU	33.499	639.69 mU	143.59

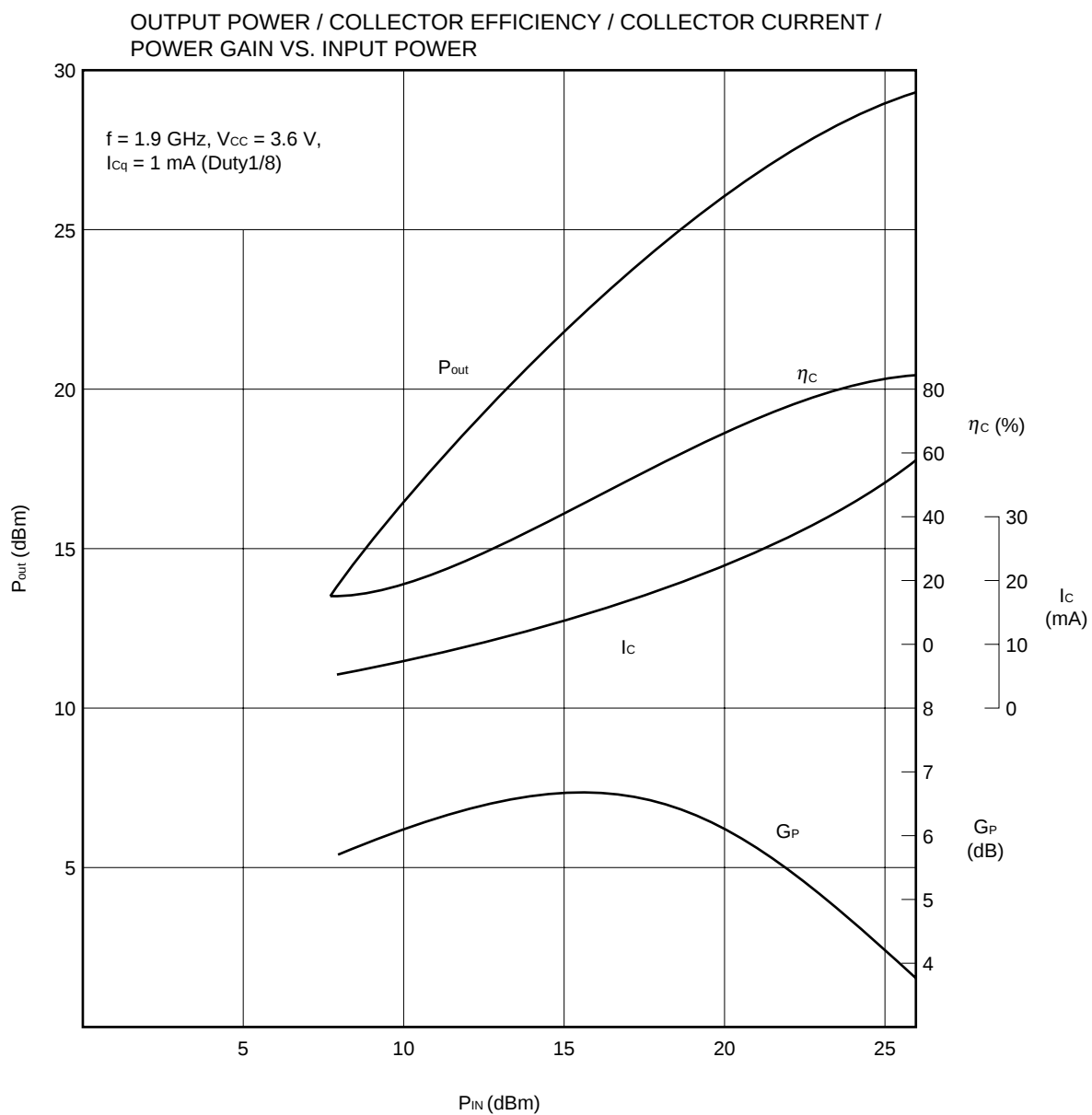
(V_{CE} = 3.6 V, I_c = 100 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	811.66 mU	136.12	1.9697 U	49.003	107.38 mU	47.804	605.34 mU	158.29
1 600.000 000	814.26 mU	133.43	1.8813 U	46.439	113.38 mU	46.29	610.91 mU	156.55
1 700.000 000	818.45 mU	131.04	1.7121 U	43.815	119.26 mU	44.804	615.04 mU	155.21
1 800.000 000	820.54 mU	128.48	1.6163 U	41.259	123.58 mU	43.22	619.69 mU	153.57
1 900.000 000	824.22 mU	126.03	1.5227 U	38.087	129.16 mU	42.119	623.96 mU	151.68
2 000.000 000	828.13 mU	123.78	1.4383 U	36.568	133.74 mU	40.513	626.33 mU	150.24
2 100.000 000	831.24 mU	121.67	1.3657 U	34.401	137.58 mU	39.212	635.21 mU	148.57
2 200.000 000	833.15 mU	119.38	1.2999 U	32.191	142.12 mU	37.807	635.78 mU	147.17
2 300.000 000	835.39 mU	117.42	1.232 U	29.872	146.24 mU	36.259	640.55 mU	145.67
2 400.000 000	838.01 mU	115.39	1.1855 U	27.857	150.55 mU	34.921	644.12 mU	144.38
2 500.000 000	841.32 mU	113.33	1.1384 U	25.845	154.24 mU	33.691	651.67 mU	143.26

(V_{CE} = 3.6 V, I_c = 120 mA)

FREQUENCY MHz	S11		S21		S12		S22	
	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
1 500.000 000	813.57 mU	135.96	1.9455 U	48.984	108.18 mU	48.385	614.69 mU	158.01
1 600.000 000	816.62 mU	133.29	1.8105 U	46.497	113.89 mU	47.178	616.3 mU	156.31
1 700.000 000	818.87 mU	130.77	1.6937 U	43.778	119.24 mU	45.229	620.14 mU	154.6
1 800.000 000	822.29 mU	128.31	1.5976 U	41.362	124.45 mU	44.199	624.25 mU	153.27
1 900.000 000	826.68 mU	125.87	1.5032 U	39.125	128.74 mU	42.33	628.44 mU	151.55
2 000.000 000	829.06 mU	123.66	1.4259 U	36.705	134.73 mU	41.256	629.25 mU	150.25
2 100.000 000	833.73 mU	121.53	1.3524 U	34.544	138.42 mU	39.367	639.79 mU	148.21
2 200.000 000	834.92 mU	119.23	1.2885 U	32.201	142.75 mU	38.267	642.22 mU	146.78
2 300.000 000	836.52 mU	117.34	1.2192 U	29.821	147.57 mU	36.681	645.15 mU	145.54
2 400.000 000	840.11 mU	115.29	1.1746 U	27.779	150.95 mU	35.369	652.07 mU	144.33
2 500.000 000	841.88 mU	113.25	1.1257 U	25.995	155.15 mU	34.088	653.43 mU	143.03

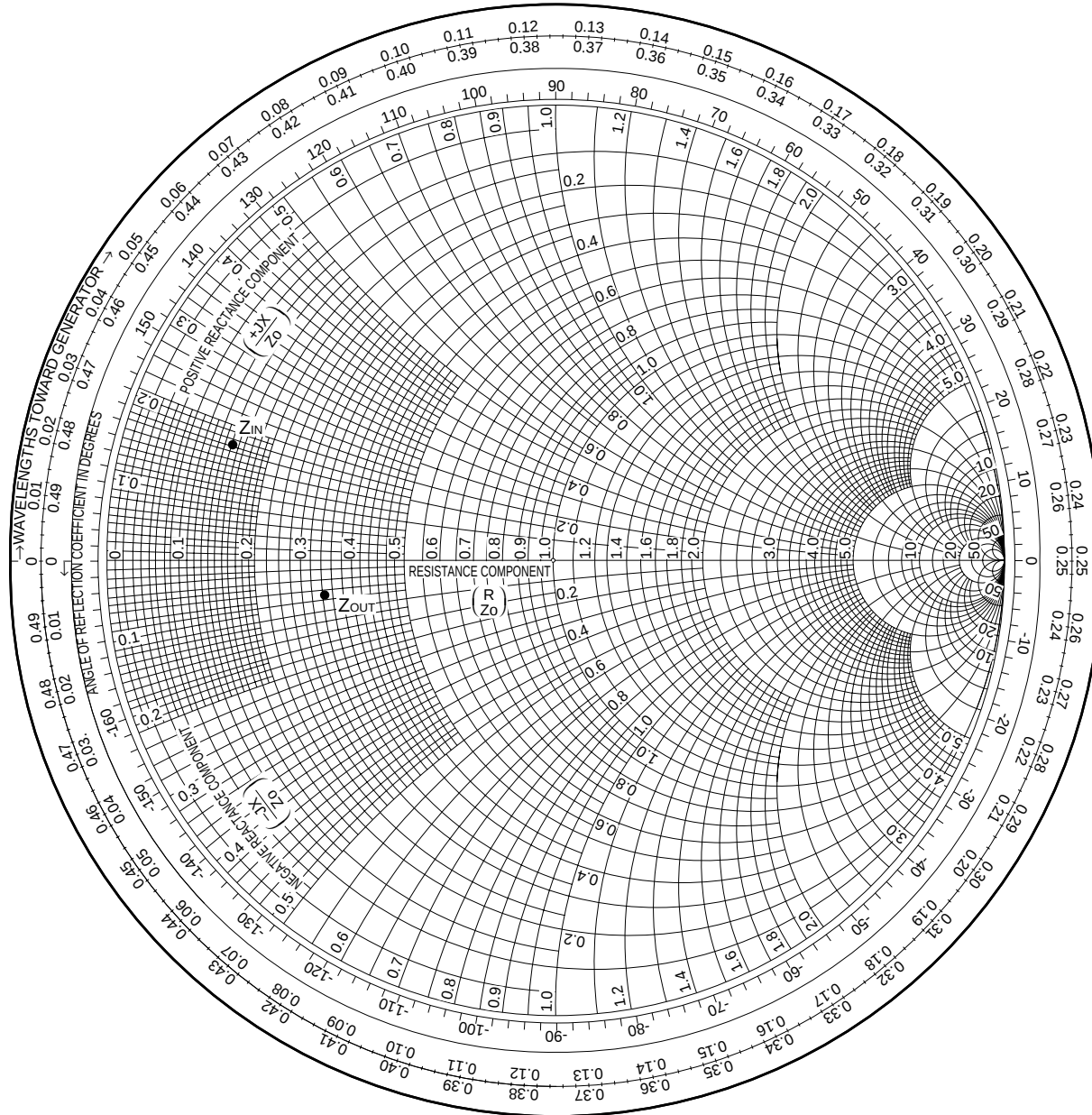
CHARACTERISTICS CURVES



(Reference) Data from the above graph

P_{-1}	27.5	dBm
η_c (at P_{-1})	72	%
I_c (at P_{-1})	27	mA
G_L	6.7	dB

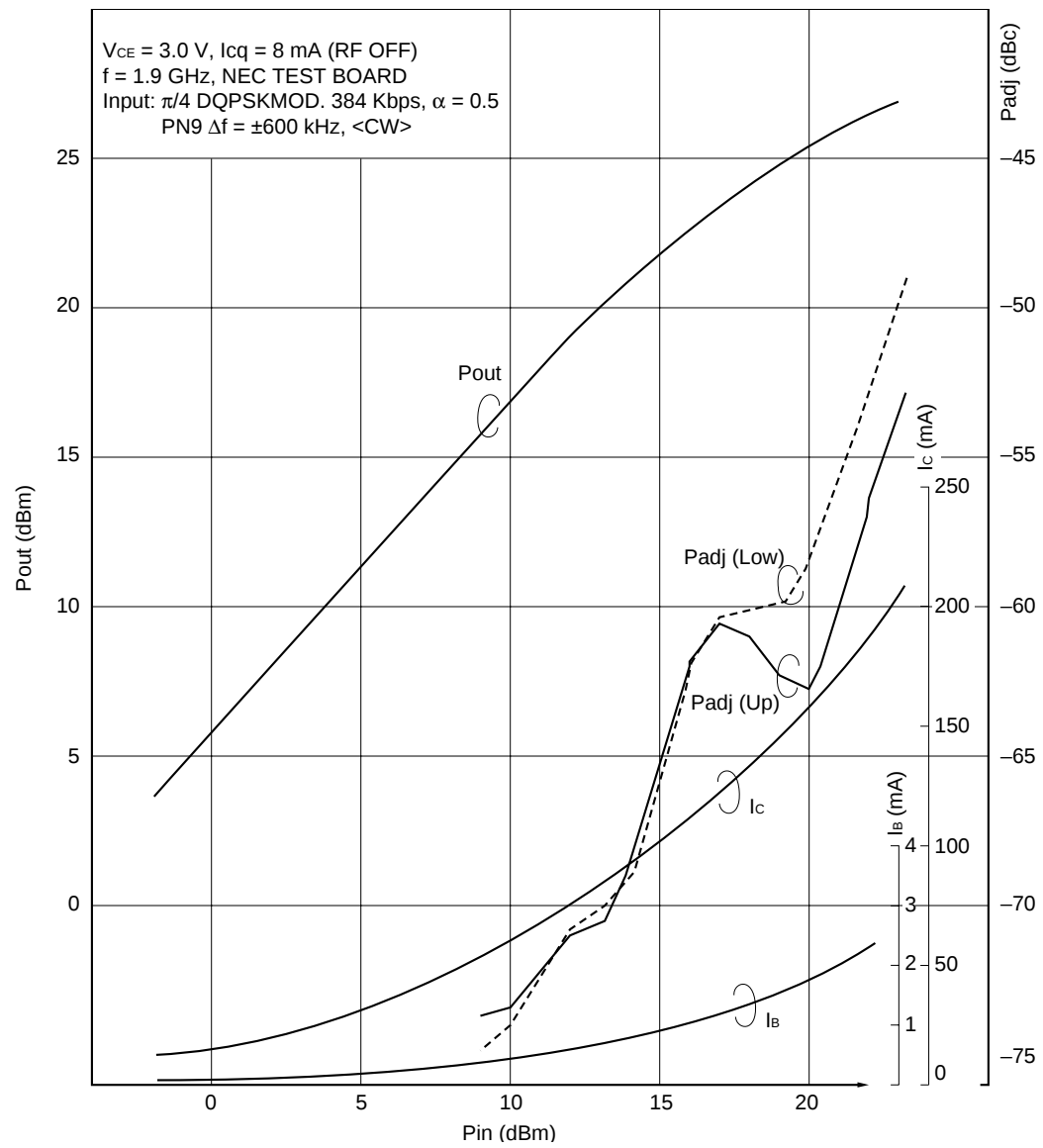
Note I_{CQ} is stand for the collector current when input power off.
 Above the I_{CQ} and I_c are showing current value at 1/8 duty operation.
 In case of CW (continuous wave) operation, the current value becomes eight times.
 Actual bias condition; $V_{CE} = 3.6 \text{ V}$, $I_{CQ} = 8 \text{ mA}$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

$Z_{in} (\Omega)$, $Z_{out} (\Omega)$ Data

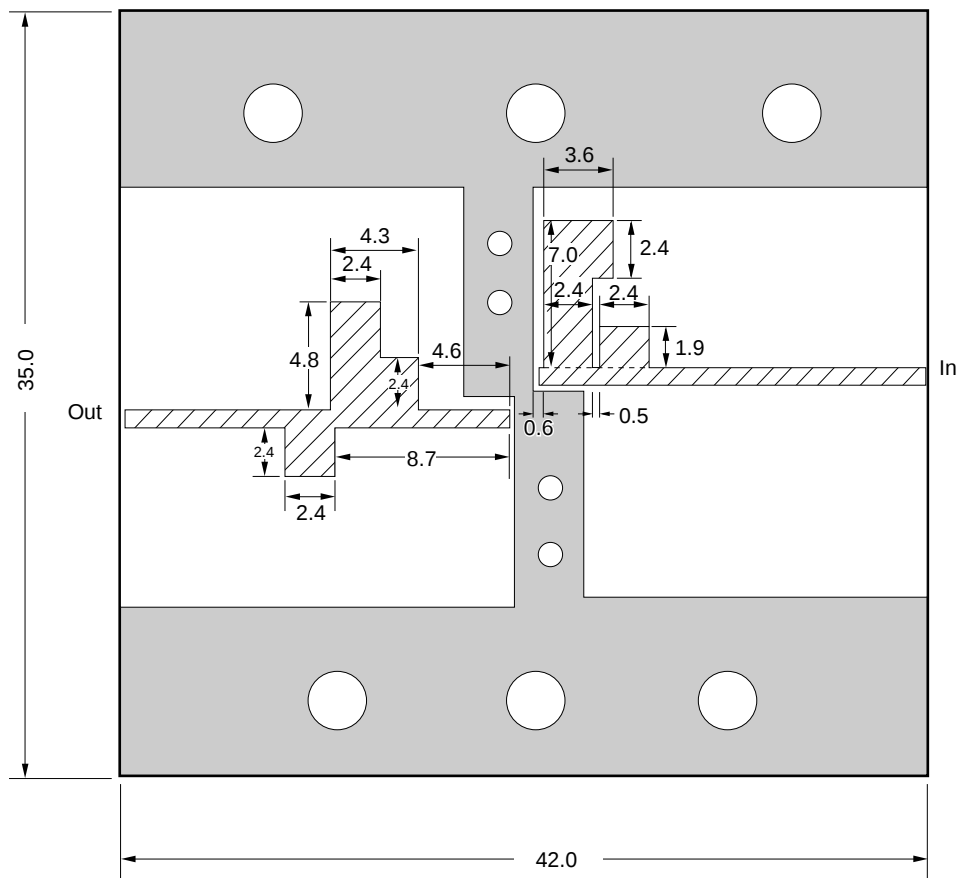
$V_{CC} = 3.6 \text{ V}$, $I_{CQ} = 1 \text{ mA}$, duty = 1/8

f (GHz)	$Z_{in} (\Omega)$	$Z_{out} (\Omega)$
1.9	$7.05 + j8.52$	$16.0 - j3.69$

(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:

"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: 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.