NEC

# SILICON TRANSISTOR
# 2SC5289

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

The 2SC5289 is ideal for the final stage amplifier in 1.9G Hz-band digital cordless phones (DECT, PHS, etc.).

### FEATURES

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

### ORDERING INFORMATION

| Part Number | Quantity | Packing Style |
|---|---|---|
| 2SC5289-T1 | 3 Kpcs/Reel | Embossed tape 8 mm wide.<br>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.)

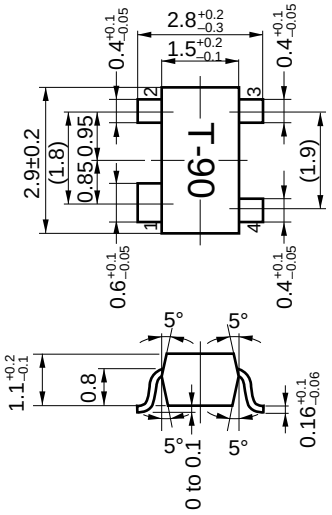
### ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C)

| 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 | °C |
| Storage Temperature | $T_{stg}$ | –65 to +150 | °C |

**Note** Pulse period is 10 msec or less.

### PACKAGE DRAWING

(Unit: mm)




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

Document No. P10250EJ2V0DS00 (2nd edition)
Date Published December 1995 P
Printed in Japan

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25 °C)

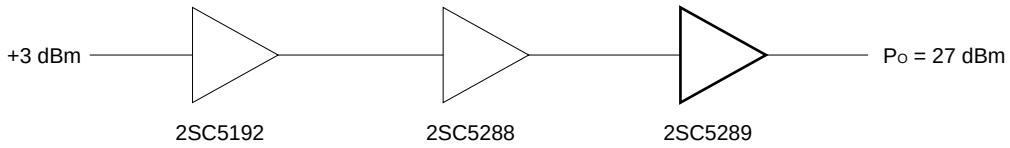
| Parameter | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Collector Cutoff Current | $I_{CBO}$ | $V_{CB}$ = 5 V, $I_E$ = 0 | | | 5 | μA |
| Emitter Cutoff Current | $I_{EBO}$ | $V_{EB}$ = 1 V, $I_C$ = 0 | | | 5 | μA |
| DC Current Gain | $h_{FE}$ | $V_{CE}$ = 3.6 V, $I_C$ = 200 mA | 60 | | | |
| Output Power | $P_{-1}$ | $V_{CC}$ = 3.6 V, f = 1.9 GHz, | 26.3 | 27.0 | | dBm |
| Power Gain | $G_P$ | $I_{Cq}$ = 1 mA (class AB operation) | 5.0 | 6.0 | | dB |
| Collector Efficiency | $\eta_C$ | Duty factor 1/8 | 60 | 70 | | % |

### $h_{FE}$ Classification

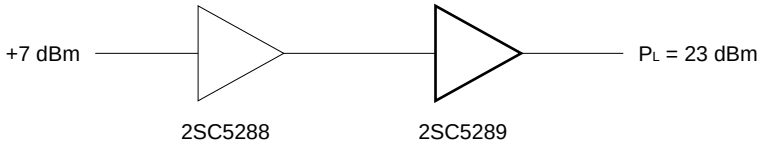
| Rank | FB |
|---|---|
| Marking | T90 |
| $h_{FE}$ | more than 60 |

## APPLICATION EXAMPLES

### (1) Power amplifier for DECT

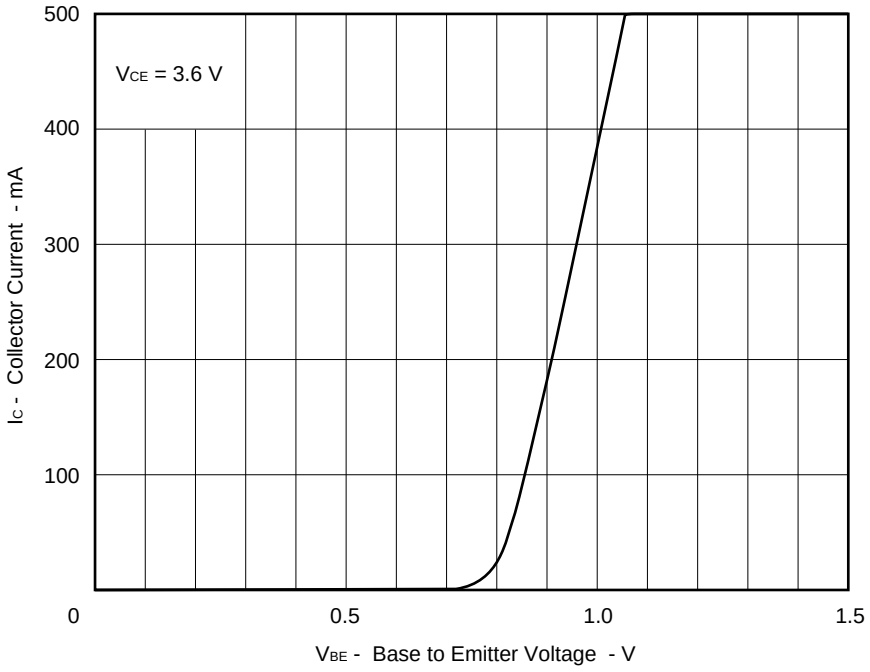



### (2) Power amplifier for PHS

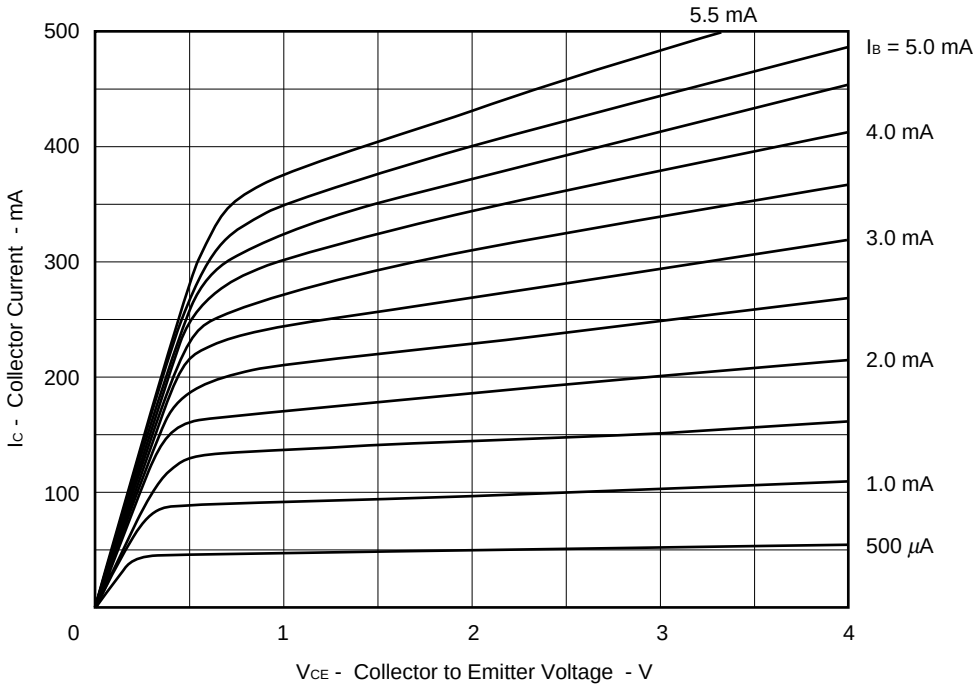


**TYPICAL CHARACTERISTICS ($T_A$ = 25 °C)**

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 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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 | 48.52 | 613.88 mU | 158.57 |
| 1 600.000 000 | 819.31 mU | 133.37 | 1.7962 U | 46.439 | 113.83 mU | 46.594 | 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 | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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 | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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 | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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)**

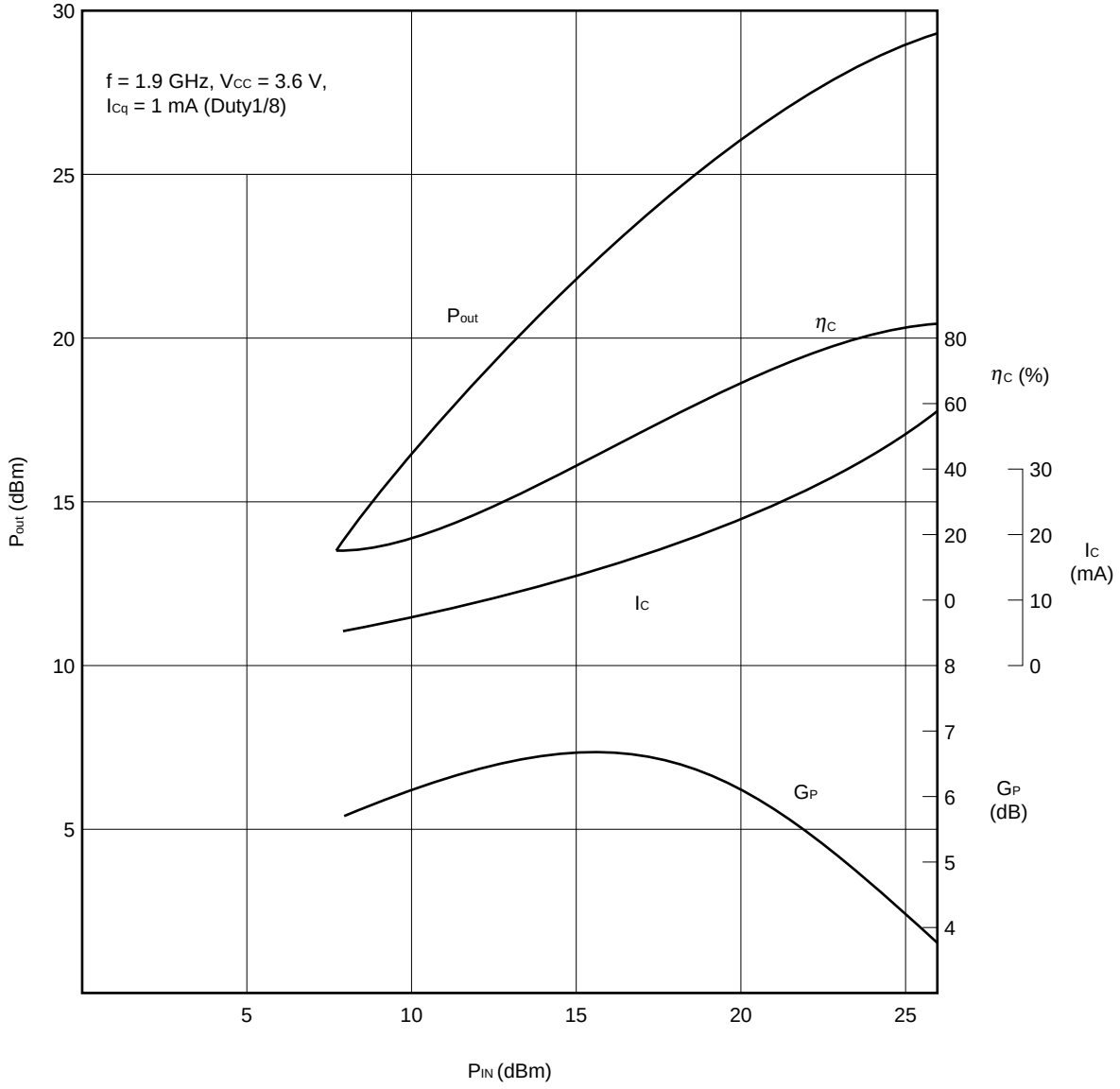
| FREQUENCY | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| MHz | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 1 500.000 000 | 811.66 mU | 136.12 | 1.9697 U | 49.003 | 107.38 mU | 47.804 | 605.34 mU | 158.29 |
| 1 600.000 000 | 814.26 mU | 133.43 | 1.8813 U | 46.439 | 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 | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| MHz | 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

OUTPUT POWER / COLLECTOR EFFICIENCY / COLLECTOR CURRENT / POWER GAIN VS. INPUT POWER

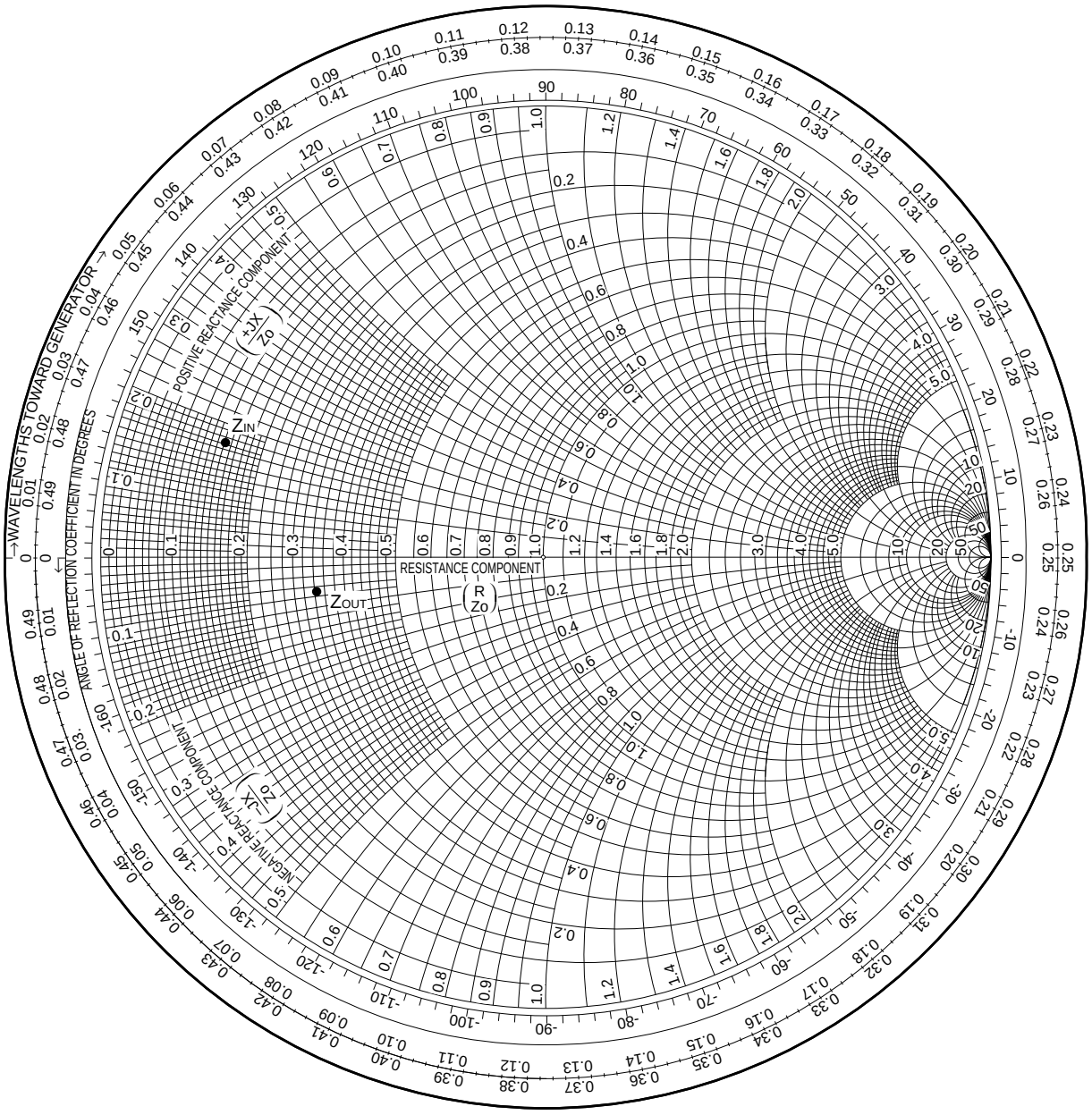



**(Reference) Data from the above graph**

| | | |
|---|---|---|
| $P_{-1}$ | 27.5 | dBm |
| $\eta_C$ (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 V, $I_{Cq}$ = 8 mA @ Pin = OFF.

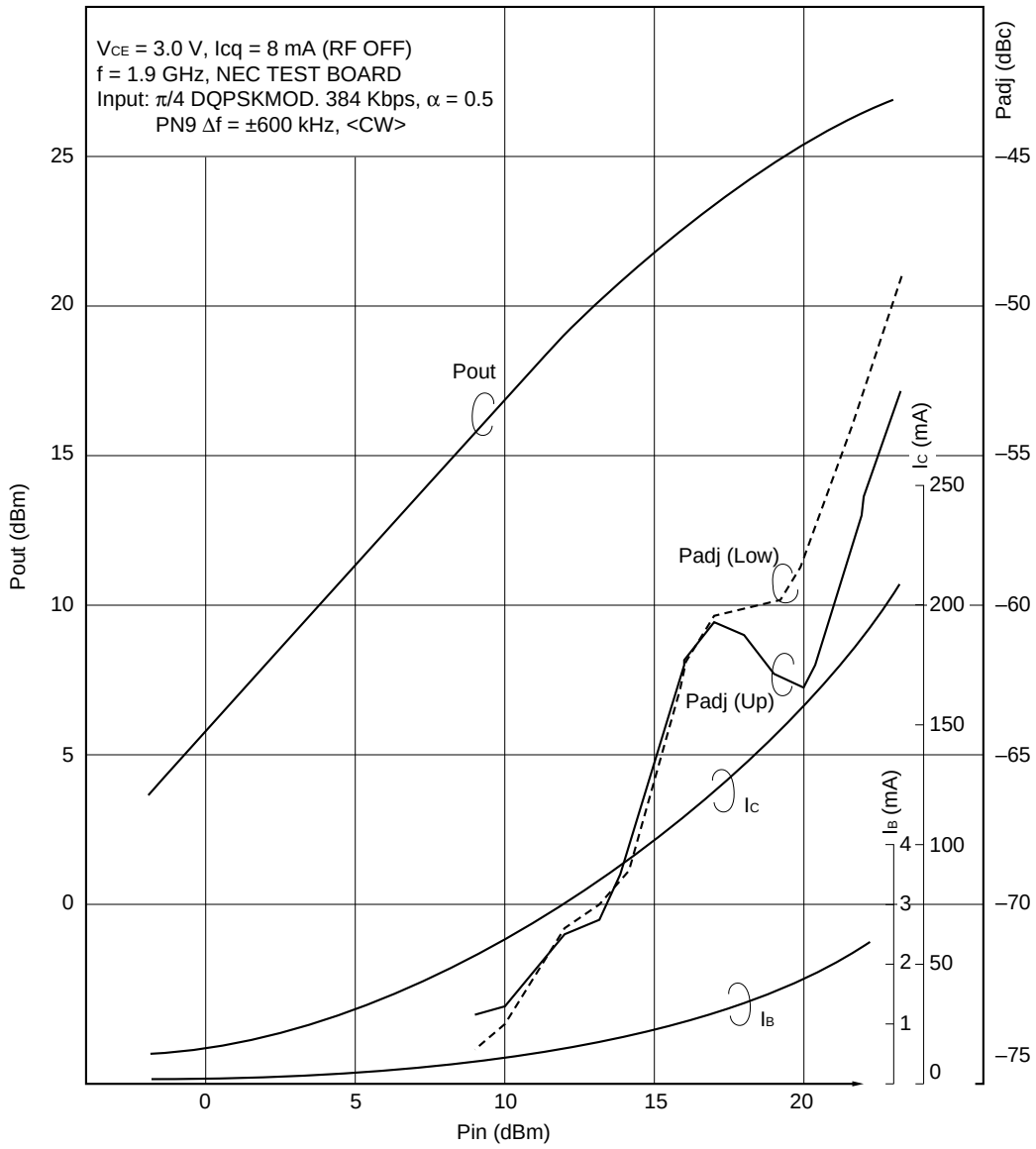
**ZIN (Ω), ZOUT (Ω) Data**



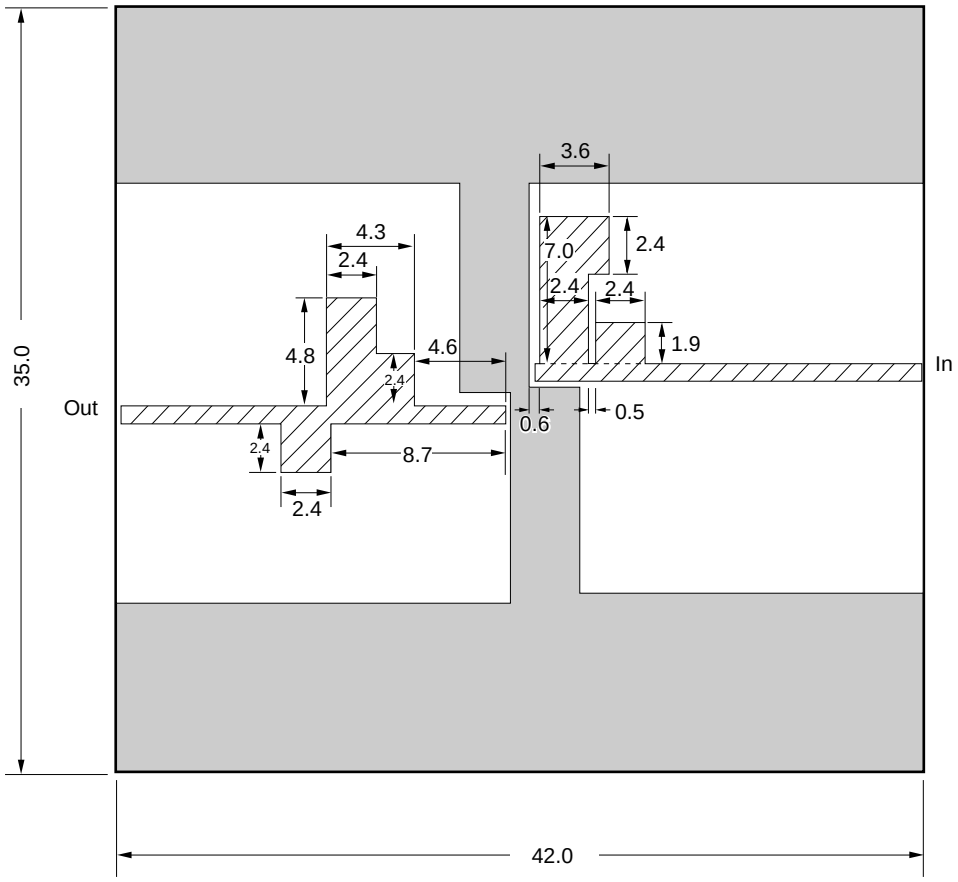

**VCC = 3.6 V, ICq = 1 mA, duty = 1/8**

| f (GHz) | Zin (Ω) | Zout (Ω) |
|---|---|---|
| 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.



M4 94.11

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