

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

The 2SC5288 is ideal for the driver stage amplifier in 1.9GHz-band digital cordless phones (DECT, PHS, etc.).

FEATURES

- $P_{-1} = 24$ 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 |
|-------------|-------------|---|
| 2SC5288-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.)

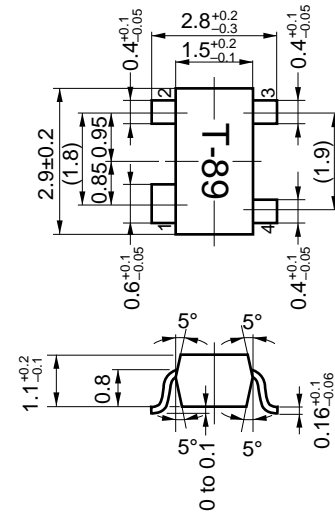
ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C)

| 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 | °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

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, | 23 | 24 | | dBm |
| Power Gain | G _P | I _{CQ} = 1 mA (class AB operation) | 7 | 8 | | dB |
| Collector Efficiency | η _C | Duty factor 1/8 | 50 | 60 | | % |

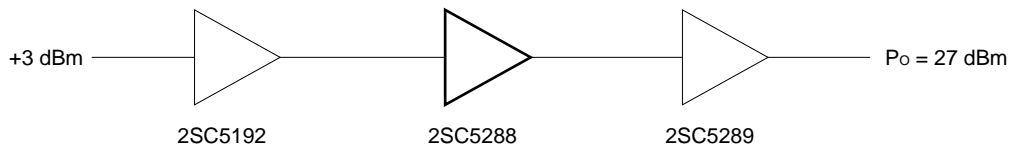
Note Pulse Measurement: PW ≤ 350 μs, Duty cycle ≤ 2 %, Pulsed

h_{FE} Classification

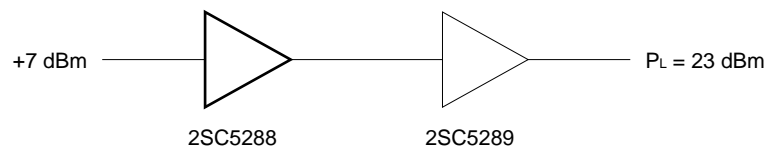
| | |
|-----------------|--------------|
| Rank | FB |
| Marking | T89 |
| h _{FE} | more than 60 |

APPLICATION EXAMPLES

(1) Power amplifier for DECT

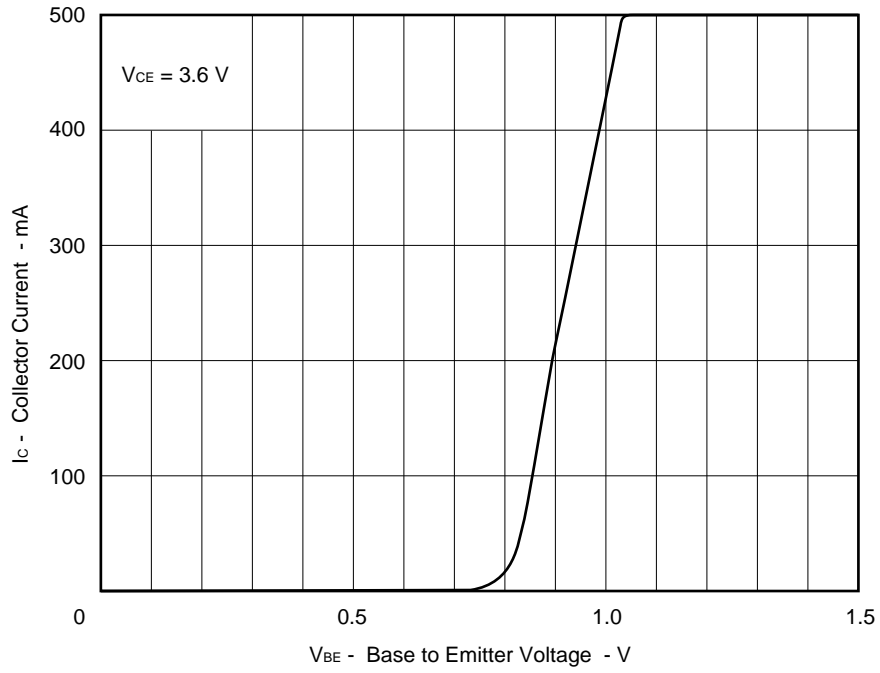


(2) Power amplifier for PHS

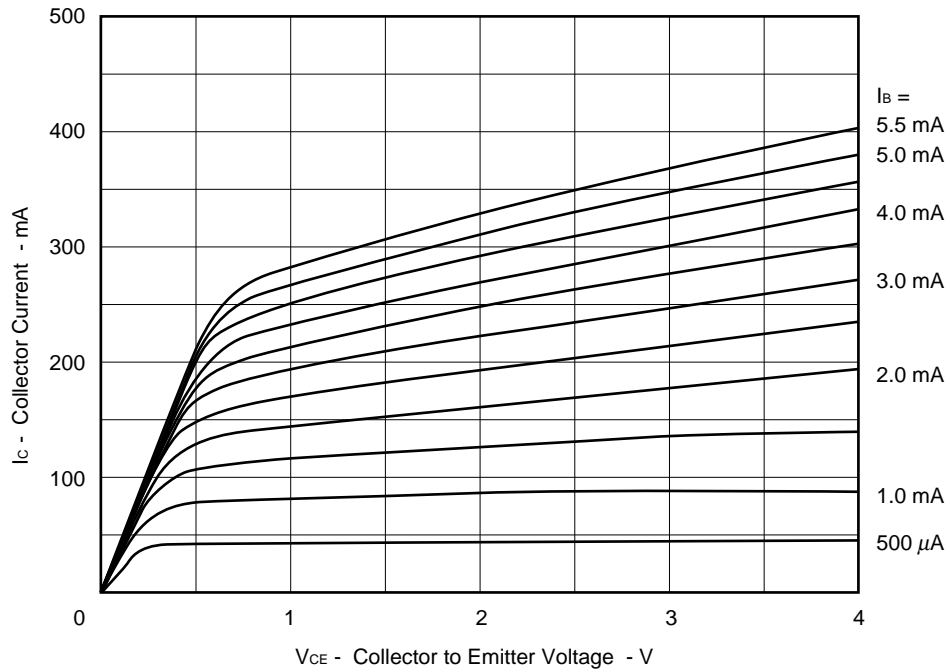


TYPICAL CHARACTERISTICS (T_A = 25 °C)

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 MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-----------|--------|----------|--------|-----------|--------|-----------|---------|
| | 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 MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-----------|--------|----------|--------|-----------|--------|-----------|--------|
| | 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 MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-----------|--------|----------|--------|-----------|--------|-----------|--------|
| | 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 | 133.63 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 |

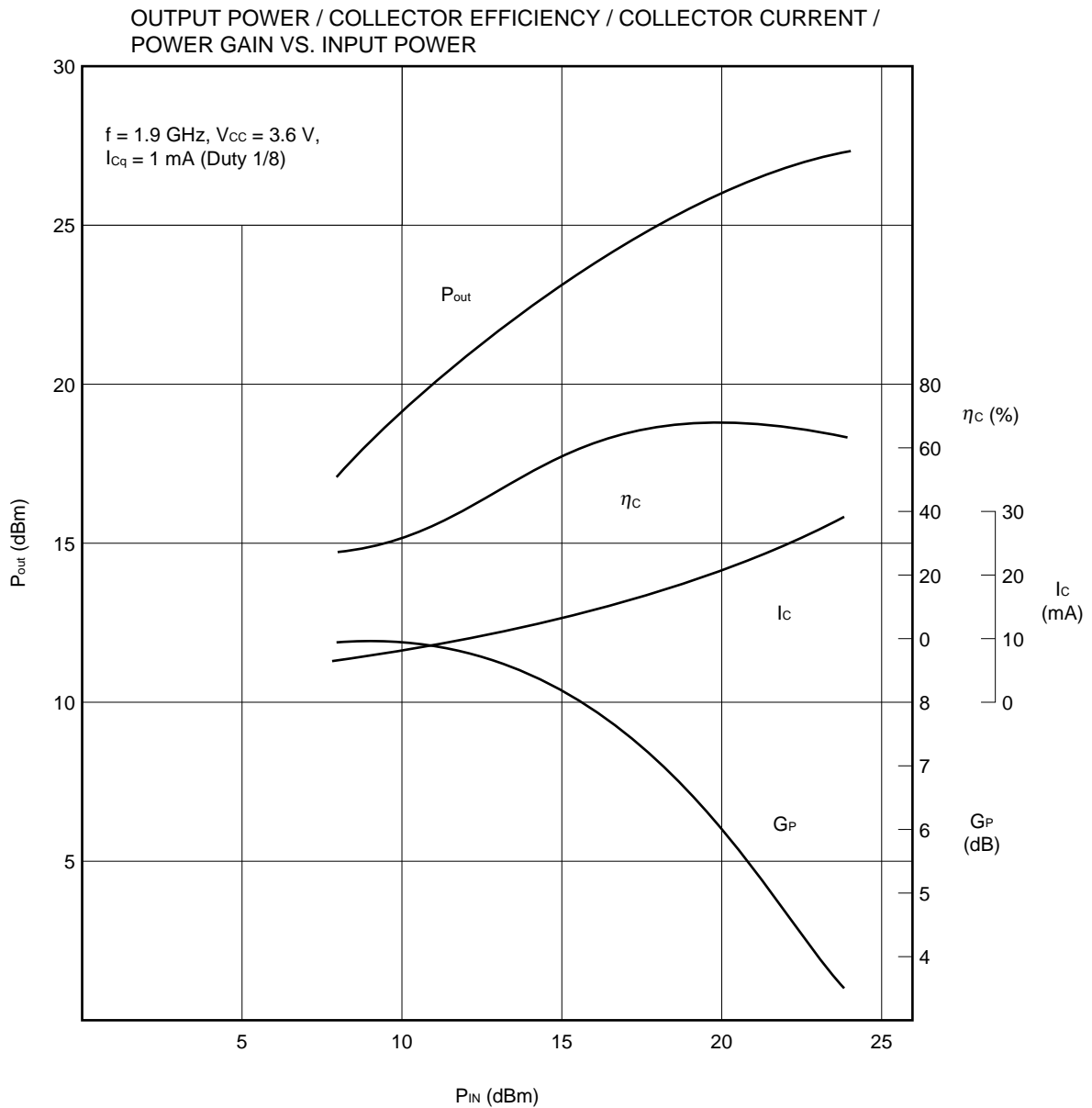
(V_{CE} = 3.6 V, I_c = 50 mA)

| FREQUENCY MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-----------|--------|----------|--------|-----------|--------|-----------|--------|
| | 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 MHz | S11 | | S21 | | S12 | | S22 | |
|------------------|-----------|--------|----------|--------|-----------|--------|-----------|--------|
| | 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

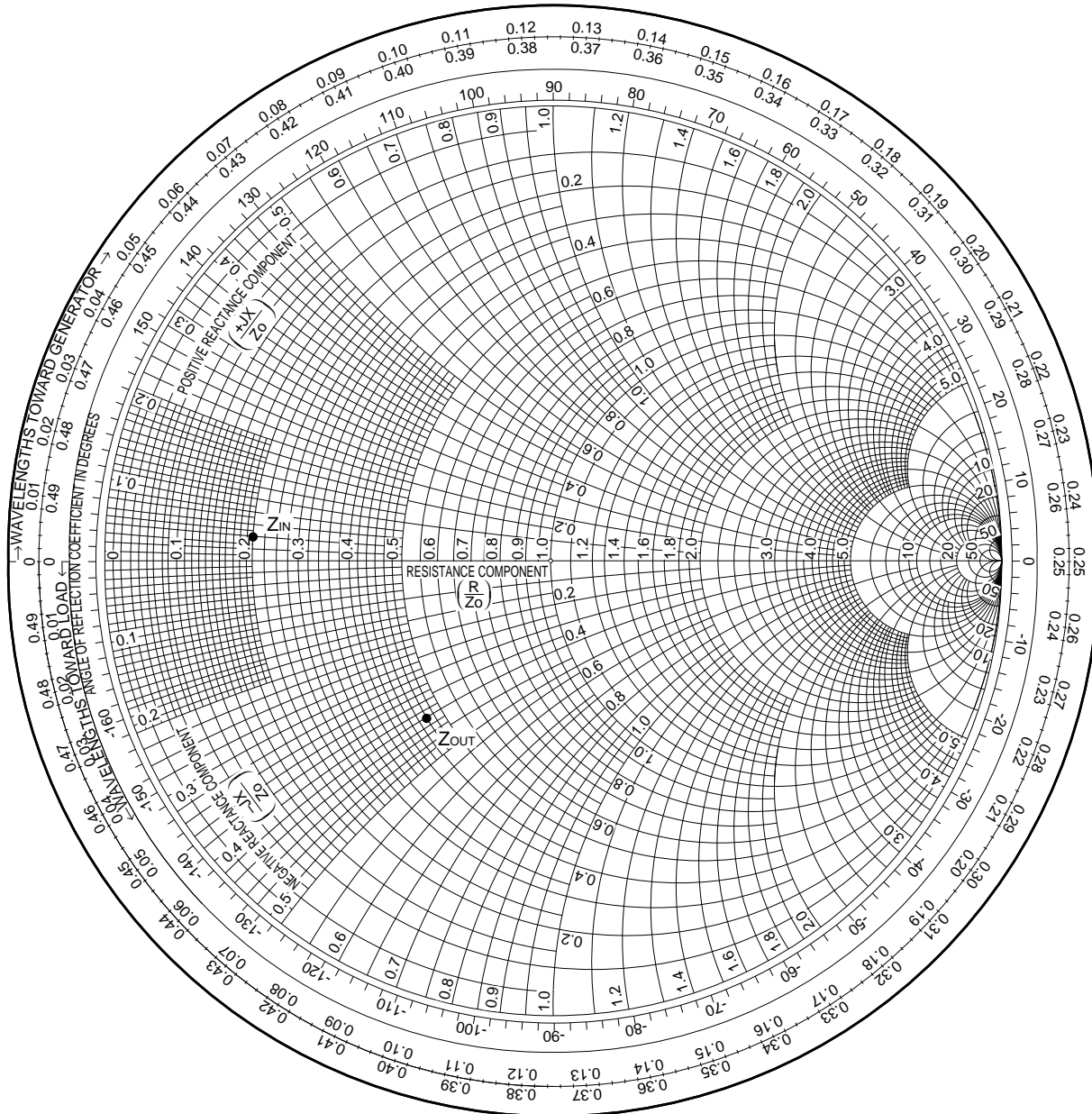


(Reference) Data from the above graph

| | | |
|-------------------------|------|-----|
| 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; $V_{CE} = 3.6 \text{ V}$, $I_{cQ} = 8 \text{ mA}$ @ $P_{in} = \text{OFF}$.

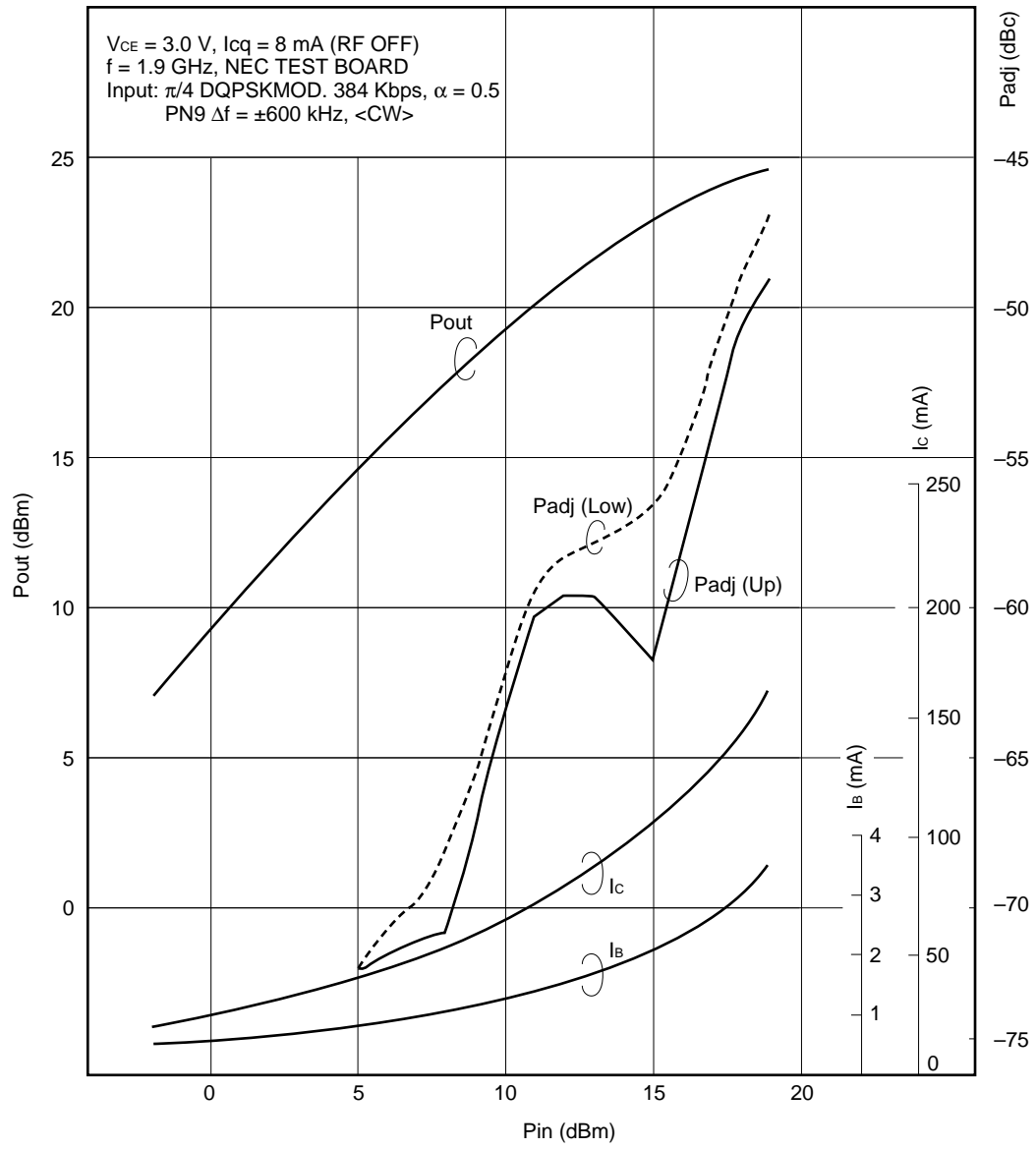
Z_{IN} (Ω), Z_{OUT} (Ω) Data



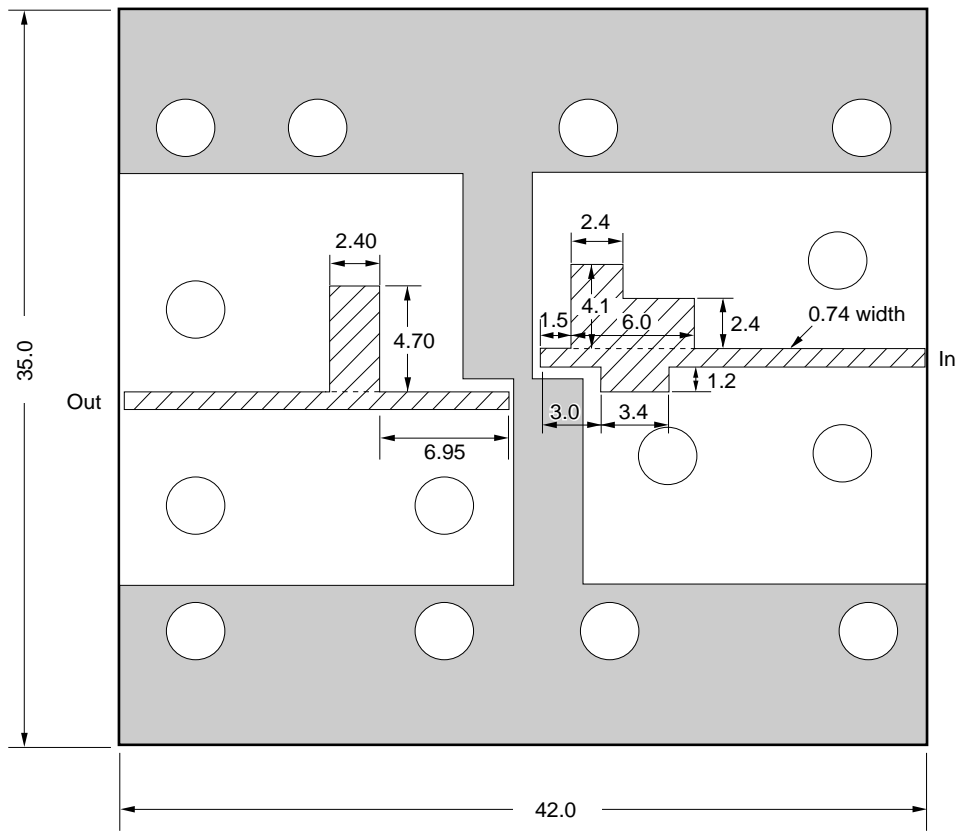
$V_{CC} = 3.6 \text{ V}$, $I_{CQ} = 1 \text{ mA}$, $\text{duty} = 1/8$

| 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.

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.

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

The quality grade of NEC devices in "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 NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.

This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.