

SILICON TRANSISTOR
2SC5013

HIGH FREQUENCY LOW NOISE AMPLIFIER
NPN SILICON EPITAXIAL TRANSISTOR
4 PINS SUPER MINI MOLD

FEATURES

- Small Package
- High Gain Bandwidth Product ($f_T = 10 \text{ GHz TYP.}$)
- Low Noise, High Gain
- Low Voltage Operation

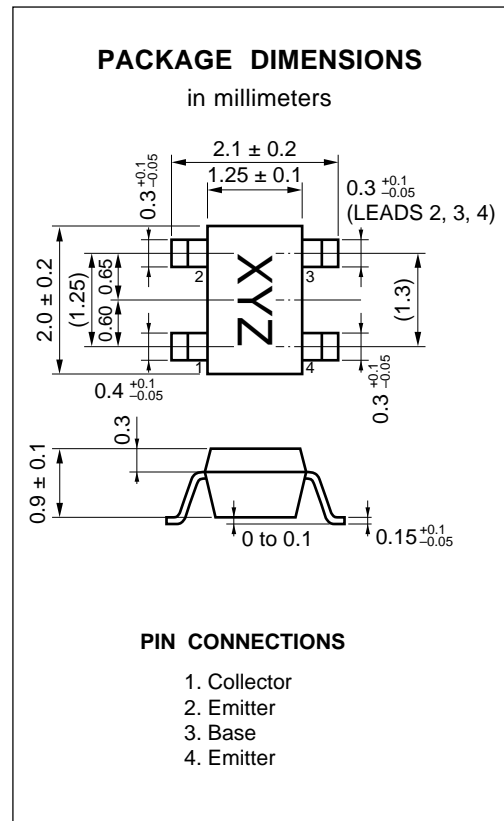
ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKING STYLE |
|-------------|--------------|--|
| 2SC5013-T1 | 3 Kpcs/Reel. | Embossed tape 8 mm wide. Pin3 (Base), Pin4 (Emitter) face to perforation side of the tape. |
| 2SC5013-T2 | 3 Kpcs/Reel. | Embossed tape 8 mm wide. Pin1 (Collector), Pin2 (Emitter) face to perforation side of the tape. |

* Please contact with responsible NEC person, If you require evaluation sample. Unit sample quantity shall be 50 pcs.
(Part No.: 2SC5013)

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

| | | | |
|------------------------------|-----------|-------------|------------------|
| Collector to Base Voltage | V_{CB0} | 20 | V |
| Collector to Emitter Voltage | V_{CE0} | 10 | V |
| Emitter to Base Voltage | V_{EB0} | 1.5 | V |
| Collector Current | I_c | 35 | mA |
| Total Power Dissipation | P_T | 150 | mW |
| Junction Temperature | T_j | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -65 to +150 | $^\circ\text{C}$ |



Caution; Electrostatic Sensitive Device.

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITION |
|--------------------------|---------------------------------|------|------|------|------|--|
| Collector Cutoff Current | I _{CB0} | | | 1.0 | μA | V _{CB} = 10 V, I _E = 0 |
| Emitter Cutoff Current | I _{EB0} | | | 1.0 | μA | V _{EB} = 1 V, I _C = 0 |
| DC Current Gain | h _{FE} | 50 | 100 | 250 | | V _{CE} = 6 V, I _C = 10 mA*1 |
| Gain Bandwidth Product | f _T | | 10 | | GHz | V _{CE} = 6 V, I _C = 10 mA |
| Feed back Capacitance | C _{re} | | 0.25 | 0.8 | pF | V _{CB} = 10 V, I _E = 0, f = 1 MHz*2 |
| Insertion Power Gain | S _{21e} ² | 7.5 | 9.5 | | dB | V _{CE} = 6 V, I _C = 10 mA, f = 2.0 GHz |
| Noise Figure | NF | | 1.8 | 3.0 | dB | V _{CE} = 6 V, I _C = 5 mA, f = 2.0 GHz |

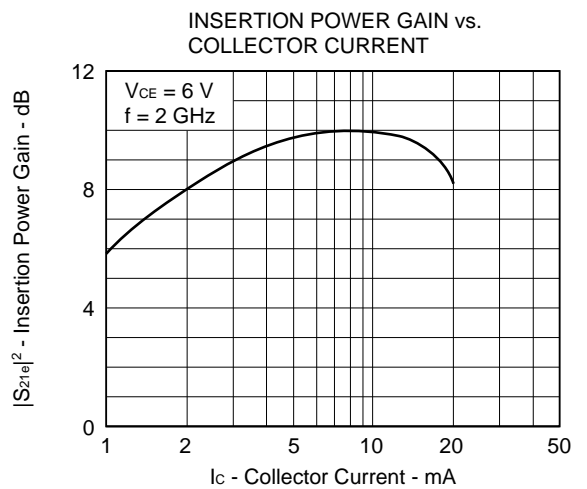
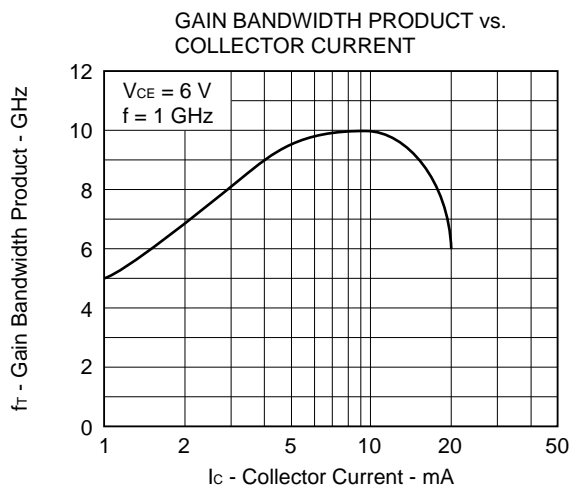
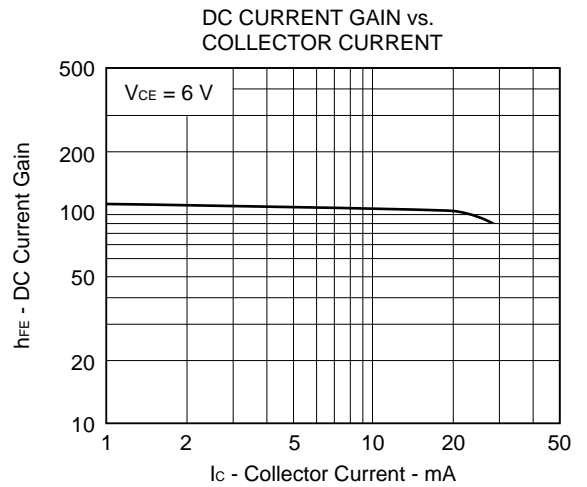
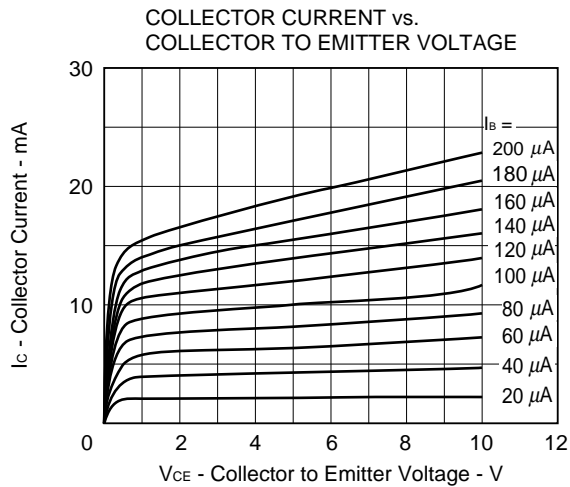
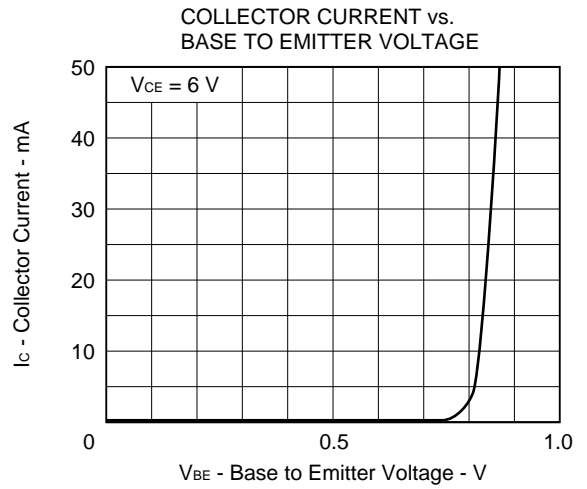
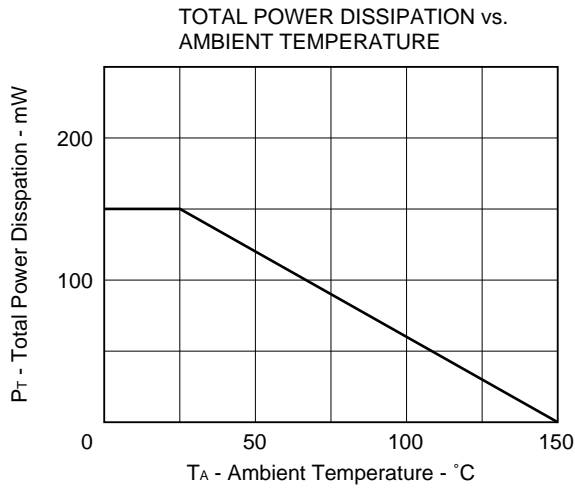
*1 Pulse Measurement; PW ≤ 350 μs, Duty Cycle ≤ 2 % Pulsed.

*2 Measured with 3 terminals bridge, Emitter and Case should be grounded.

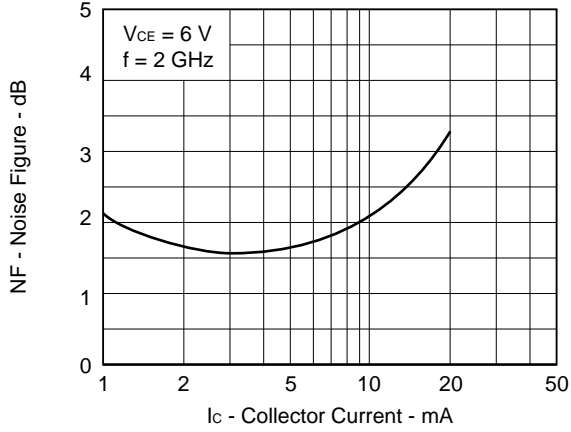
h_{FE} Classification

| | | | |
|-----------------|-----------|-----------|------------|
| Rank | EB | FB | GB |
| Marking | R46 | R47 | R48 |
| h _{FE} | 50 to 100 | 80 to 160 | 125 to 250 |

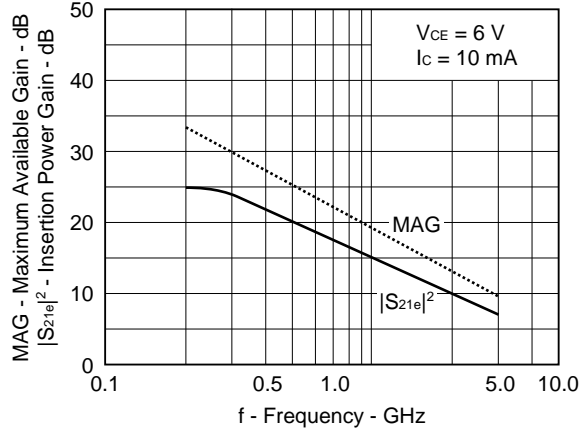
TYPICAL CHARACTERISTICS (T_A = 25 °C)



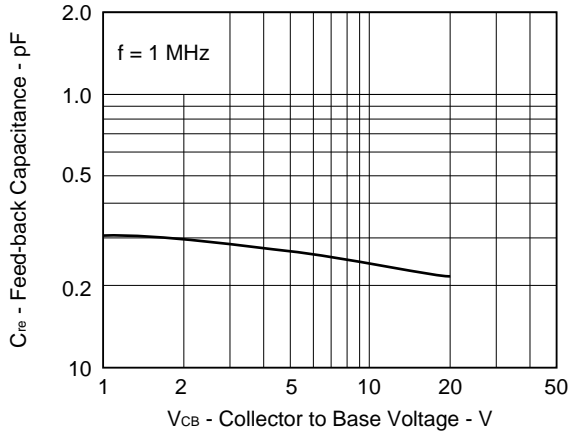
NOISE FIGURE vs.
COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN/INSERTION
POWER GAIN vs. FREQUENCY



FEED-BACK CAPACITANCE vs.
COLLECTOR TO BASE VOLTAGE



S-PARAMETER

V_{CE} = 6 V, I_c = 10 mA

| FREQUENCY f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .728 | -26.9 | 21.563 | 157.7 | .013 | 86.3 | .946 | -11.0 |
| 200.00 | .616 | -50.1 | 18.401 | 139.3 | .023 | 69.9 | .851 | -18.5 |
| 300.00 | .522 | -68.0 | 15.357 | 126.0 | .029 | 57.4 | .766 | -23.2 |
| 400.00 | .441 | -83.2 | 12.718 | 116.3 | .037 | 58.4 | .694 | -24.8 |
| 500.00 | .376 | -96.2 | 10.893 | 108.2 | .039 | 62.0 | .637 | -26.0 |
| 600.00 | .341 | -107.8 | 9.466 | 102.5 | .047 | 63.0 | .602 | -27.0 |
| 700.00 | .310 | -118.1 | 8.396 | 97.2 | .049 | 60.6 | .579 | -27.3 |
| 800.00 | .286 | -127.0 | 7.434 | 92.5 | .054 | 60.1 | .556 | -28.3 |
| 900.00 | .266 | -138.1 | 6.707 | 88.7 | .056 | 58.1 | .541 | -28.3 |
| 1000.00 | .261 | -146.1 | 6.128 | 84.7 | .065 | 59.9 | .529 | -29.2 |
| 1100.00 | .252 | -154.5 | 5.578 | 81.6 | .067 | 63.0 | .516 | -29.5 |
| 1200.00 | .249 | -160.1 | 5.111 | 78.4 | .073 | 60.2 | .506 | -31.0 |
| 1300.00 | .243 | -168.7 | 4.769 | 75.6 | .073 | 57.3 | .494 | -31.7 |
| 1400.00 | .241 | -173.0 | 4.467 | 72.5 | .082 | 56.5 | .488 | -33.7 |
| 1500.00 | .253 | -179.5 | 4.183 | 69.6 | .085 | 59.6 | .474 | -34.3 |
| 1600.00 | .251 | 174.3 | 3.932 | 67.1 | .094 | 56.7 | .471 | -36.3 |
| 1700.00 | .269 | 170.9 | 3.731 | 64.7 | .093 | 58.2 | .464 | -36.5 |
| 1800.00 | .266 | 164.5 | 3.536 | 62.0 | .098 | 59.3 | .466 | -38.0 |
| 1900.00 | .269 | 161.6 | 3.372 | 60.0 | .100 | 56.7 | .457 | -40.0 |
| 2000.00 | .285 | 158.2 | 3.233 | 57.1 | .116 | 56.2 | .451 | -42.0 |
| 2100.00 | .289 | 154.8 | 3.071 | 55.4 | .117 | 57.0 | .449 | -44.3 |
| 2200.00 | .300 | 150.6 | 2.935 | 52.3 | .120 | 58.5 | .445 | -46.0 |
| 2300.00 | .298 | 149.3 | 2.812 | 50.8 | .128 | 57.4 | .440 | -47.1 |
| 2400.00 | .293 | 144.6 | 2.720 | 48.4 | .127 | 57.1 | .432 | -47.0 |
| 2500.00 | .315 | 143.0 | 2.623 | 45.8 | .137 | 55.1 | .425 | -52.2 |
| 2600.00 | .326 | 138.8 | 2.542 | 43.9 | .144 | 54.7 | .419 | -50.4 |
| 2700.00 | .327 | 137.8 | 2.435 | 42.4 | .151 | 50.4 | .419 | -54.7 |
| 2800.00 | .320 | 136.4 | 2.376 | 39.4 | .158 | 53.9 | .427 | -57.6 |
| 2900.00 | .327 | 135.1 | 2.285 | 37.9 | .161 | 48.7 | .425 | -60.2 |
| 3000.00 | .337 | 129.1 | 2.218 | 34.6 | .160 | 50.1 | .419 | -61.9 |

V_{CE} = 3 V, I_c = 5 mA

| FREQUENCY f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .836 | -17.9 | 13.996 | 164.7 | .015 | 73.5 | .971 | -8.3 |
| 200.00 | .768 | -34.4 | 12.918 | 150.7 | .025 | 72.7 | .918 | -15.1 |
| 300.00 | .692 | -48.4 | 11.709 | 138.9 | .038 | 66.8 | .862 | -20.5 |
| 400.00 | .614 | -61.2 | 10.317 | 129.2 | .044 | 60.2 | .793 | -23.9 |
| 500.00 | .535 | -72.4 | 9.260 | 120.2 | .051 | 55.8 | .731 | -27.1 |
| 600.00 | .490 | -82.3 | 8.326 | 113.8 | .056 | 55.6 | .684 | -29.1 |
| 700.00 | .435 | -92.9 | 7.553 | 107.6 | .063 | 55.6 | .658 | -30.6 |
| 800.00 | .398 | -100.8 | 6.791 | 102.1 | .065 | 58.1 | .614 | -32.6 |
| 900.00 | .362 | -110.0 | 6.194 | 97.7 | .070 | 54.7 | .591 | -32.8 |
| 1000.00 | .333 | -118.3 | 5.724 | 93.2 | .074 | 54.2 | .567 | -33.4 |
| 1100.00 | .318 | -126.0 | 5.263 | 89.6 | .079 | 55.3 | .548 | -34.7 |
| 1200.00 | .297 | -133.4 | 4.837 | 85.7 | .084 | 53.9 | .542 | -35.6 |
| 1300.00 | .281 | -141.4 | 4.538 | 82.5 | .085 | 53.3 | .516 | -36.7 |
| 1400.00 | .275 | -147.5 | 4.256 | 79.4 | .090 | 52.0 | .509 | -37.9 |
| 1500.00 | .263 | -155.9 | 4.004 | 76.0 | .099 | 50.6 | .488 | -38.2 |
| 1600.00 | .268 | -162.3 | 3.770 | 73.3 | .099 | 49.4 | .491 | -39.3 |
| 1700.00 | .277 | -169.6 | 3.597 | 70.7 | .105 | 49.9 | .484 | -40.0 |
| 1800.00 | .267 | -174.9 | 3.407 | 67.7 | .109 | 51.2 | .475 | -41.7 |
| 1900.00 | .262 | -179.5 | 3.244 | 65.6 | .112 | 50.2 | .468 | -43.4 |
| 2000.00 | .276 | 175.7 | 3.118 | 62.3 | .119 | 51.9 | .460 | -46.6 |
| 2100.00 | .273 | 169.3 | 2.967 | 59.5 | .120 | 50.4 | .453 | -47.4 |
| 2200.00 | .283 | 164.4 | 2.837 | 56.5 | .127 | 47.6 | .446 | -49.3 |
| 2300.00 | .291 | 161.1 | 2.726 | 54.5 | .129 | 49.7 | .441 | -50.5 |
| 2400.00 | .283 | 155.3 | 2.635 | 52.3 | .135 | 50.6 | .431 | -51.1 |
| 2500.00 | .302 | 153.1 | 2.538 | 49.3 | .138 | 50.0 | .429 | -53.9 |
| 2600.00 | .304 | 148.2 | 2.458 | 47.3 | .143 | 49.1 | .426 | -53.3 |
| 2700.00 | .313 | 145.8 | 2.365 | 45.9 | .147 | 47.8 | .418 | -57.4 |
| 2800.00 | .304 | 143.9 | 2.296 | 42.6 | .156 | 45.9 | .436 | -60.7 |
| 2900.00 | .320 | 143.1 | 2.209 | 41.0 | .157 | 44.9 | .417 | -60.2 |
| 3000.00 | .311 | 136.6 | 2.122 | 37.9 | .166 | 46.4 | .426 | -64.2 |

S-PARAMETER

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

| FREQUENCY f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .902 | -13.0 | 9.558 | 168.7 | .014 | 84.4 | .979 | -6.1 |
| 200.00 | .851 | -26.2 | 9.143 | 157.3 | .028 | 74.3 | .954 | -11.7 |
| 300.00 | .802 | -37.4 | 8.623 | 147.3 | .039 | 69.7 | .919 | -16.7 |
| 400.00 | .740 | -48.4 | 7.924 | 138.3 | .047 | 62.4 | .870 | -20.8 |
| 500.00 | .673 | -58.7 | 7.396 | 129.6 | .059 | 58.6 | .820 | -24.6 |
| 600.00 | .628 | -68.1 | 6.856 | 122.9 | .064 | 56.0 | .777 | -27.4 |
| 700.00 | .570 | -77.1 | 6.376 | 116.2 | .069 | 53.7 | .741 | -29.3 |
| 800.00 | .525 | -85.5 | 5.838 | 110.2 | .075 | 52.2 | .698 | -32.1 |
| 900.00 | .476 | -94.0 | 5.406 | 105.2 | .079 | 51.0 | .671 | -33.0 |
| 1000.00 | .444 | -101.0 | 5.065 | 100.2 | .086 | 48.3 | .650 | -34.5 |
| 1100.00 | .414 | -108.1 | 4.698 | 96.0 | .088 | 48.0 | .621 | -35.7 |
| 1200.00 | .382 | -115.4 | 4.347 | 91.6 | .095 | 47.4 | .606 | -37.3 |
| 1300.00 | .362 | -123.1 | 4.108 | 88.0 | .097 | 47.5 | .584 | -38.4 |
| 1400.00 | .347 | -129.7 | 3.874 | 84.3 | .098 | 45.7 | .570 | -39.5 |
| 1500.00 | .331 | -136.8 | 3.663 | 80.7 | .100 | 45.9 | .543 | -40.5 |
| 1600.00 | .323 | -144.1 | 3.457 | 77.5 | .103 | 44.4 | .540 | -41.8 |
| 1700.00 | .325 | -151.0 | 3.312 | 74.7 | .107 | 46.4 | .525 | -42.7 |
| 1800.00 | .311 | -156.6 | 3.143 | 71.5 | .113 | 44.2 | .523 | -44.8 |
| 1900.00 | .299 | -161.8 | 3.009 | 68.8 | .114 | 46.4 | .515 | -46.4 |
| 2000.00 | .316 | -169.4 | 2.883 | 65.2 | .118 | 44.7 | .504 | -47.9 |
| 2100.00 | .303 | -176.8 | 2.746 | 62.4 | .123 | 45.6 | .492 | -50.0 |
| 2200.00 | .311 | 179.4 | 2.636 | 59.0 | .125 | 43.0 | .488 | -51.8 |
| 2300.00 | .308 | 173.8 | 2.539 | 57.0 | .128 | 44.0 | .486 | -52.1 |
| 2400.00 | .298 | 169.7 | 2.446 | 54.5 | .137 | 45.1 | .470 | -53.4 |
| 2500.00 | .319 | 164.0 | 2.371 | 51.4 | .141 | 42.7 | .468 | -55.8 |
| 2600.00 | .323 | 161.0 | 2.291 | 49.2 | .139 | 43.4 | .463 | -56.2 |
| 2700.00 | .320 | 158.3 | 2.203 | 47.5 | .143 | 42.6 | .462 | -58.9 |
| 2800.00 | .318 | 155.2 | 2.146 | 44.2 | .149 | 42.2 | .469 | -62.4 |
| 2900.00 | .339 | 152.9 | 2.066 | 42.5 | .150 | 42.5 | .457 | -63.6 |
| 3000.00 | .322 | 146.3 | 1.987 | 39.1 | .162 | 41.3 | .458 | -66.6 |

V_{CE} = 3 V, I_c = 1 mA

| FREQUENCY f (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .971 | -7.4 | 3.546 | 173.5 | .019 | 84.5 | .998 | -3.3 |
| 200.00 | .950 | -15.4 | 3.498 | 166.3 | .031 | 75.8 | .986 | -6.9 |
| 300.00 | .937 | -22.4 | 3.464 | 159.7 | .045 | 76.2 | .983 | -9.9 |
| 400.00 | .910 | -29.7 | 3.348 | 153.4 | .058 | 67.5 | .962 | -13.2 |
| 500.00 | .877 | -36.9 | 3.321 | 146.0 | .071 | 67.2 | .946 | -16.6 |
| 600.00 | .858 | -44.0 | 3.232 | 140.7 | .082 | 62.3 | .928 | -19.3 |
| 700.00 | .822 | -51.3 | 3.187 | 134.4 | .090 | 58.1 | .909 | -21.9 |
| 800.00 | .792 | -58.1 | 3.054 | 128.3 | .102 | 56.1 | .884 | -25.5 |
| 900.00 | .751 | -65.0 | 2.949 | 122.9 | .110 | 50.7 | .852 | -27.2 |
| 1000.00 | .718 | -71.4 | 2.867 | 117.5 | .116 | 48.6 | .845 | -29.7 |
| 1100.00 | .686 | -78.2 | 2.750 | 112.7 | .122 | 45.0 | .813 | -32.3 |
| 1200.00 | .649 | -84.4 | 2.620 | 107.1 | .131 | 42.7 | .793 | -34.2 |
| 1300.00 | .623 | -91.2 | 2.543 | 102.7 | .128 | 42.4 | .767 | -36.0 |
| 1400.00 | .592 | -97.1 | 2.449 | 98.2 | .137 | 37.2 | .758 | -38.7 |
| 1500.00 | .565 | -104.0 | 2.362 | 93.5 | .136 | 33.7 | .729 | -40.0 |
| 1600.00 | .542 | -110.2 | 2.259 | 89.2 | .140 | 32.8 | .715 | -41.5 |
| 1700.00 | .524 | -117.6 | 2.219 | 85.9 | .147 | 29.5 | .703 | -43.2 |
| 1800.00 | .508 | -122.9 | 2.117 | 81.6 | .148 | 28.3 | .692 | -45.5 |
| 1900.00 | .483 | -127.9 | 2.043 | 78.3 | .140 | 30.1 | .674 | -47.2 |
| 2000.00 | .481 | -135.3 | 1.989 | 74.0 | .147 | 28.4 | .667 | -49.0 |
| 2100.00 | .453 | -141.6 | 1.901 | 70.1 | .145 | 25.9 | .652 | -51.0 |
| 2200.00 | .445 | -147.4 | 1.850 | 65.9 | .145 | 25.6 | .642 | -52.6 |
| 2300.00 | .445 | -152.3 | 1.791 | 63.4 | .154 | 24.4 | .636 | -54.4 |
| 2400.00 | .425 | -157.1 | 1.722 | 60.3 | .145 | 25.6 | .630 | -56.3 |
| 2500.00 | .436 | -163.5 | 1.691 | 56.6 | .148 | 25.9 | .619 | -58.8 |
| 2600.00 | .419 | -169.2 | 1.642 | 53.7 | .148 | 22.1 | .609 | -58.5 |
| 2700.00 | .430 | -172.0 | 1.577 | 51.8 | .143 | 22.3 | .610 | -61.9 |
| 2800.00 | .416 | -176.9 | 1.552 | 47.7 | .146 | 22.6 | .606 | -64.8 |
| 2900.00 | .433 | 178.9 | 1.488 | 45.5 | .145 | 23.0 | .596 | -64.8 |
| 3000.00 | .408 | 173.9 | 1.450 | 42.1 | .155 | 22.8 | .597 | -67.4 |

[MEMO]

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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.

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Datasheets for electronics components.