

To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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NPN SILICON EPITAXIAL TRANSISTOR
3 PINS ULTRA SUPER MINI MOLD

DESCRIPTION

The 2SC5010 is an NPN epitaxial silicon transistor designed for use in low noise and small signal amplifiers from VHF band to L band. Low noise figure, high gain, and high current capability achieve a very wide dynamic range and excellent linearity. This is achieved by direct nitride passivated base surface process (NEST3 process) which is an NEC proprietary fabrication technique.

FEATURES

- Low Voltage Use.
- High f_T : 12.0 GHz TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 10\text{ mA}$, $f = 2\text{ GHz}$)
- Low C_{re} : 0.4 pF TYP. (@ $V_{CE} = 3\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$)
- Low NF : 1.5 dB TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 3\text{ mA}$, $f = 2\text{ GHz}$)
- High $|S_{21e}|^2$: 8.5 dB TYP. (@ $V_{CE} = 3\text{ V}$, $I_C = 10\text{ mA}$, $f = 2\text{ GHz}$)
- Ultra Super Mini Mold Package.

ORDERING INFORMATION

| PART NUMBER | QUANTITY | PACKING STYLE |
|-------------|--------------|---|
| 2SC5010 | 50 pcs/Unit. | Embossed tape 8 mm wide. Pin3(Collector) face to perforation side of the tape. |
| 2SC5010-T1 | 3 kpcs/Reel. | |

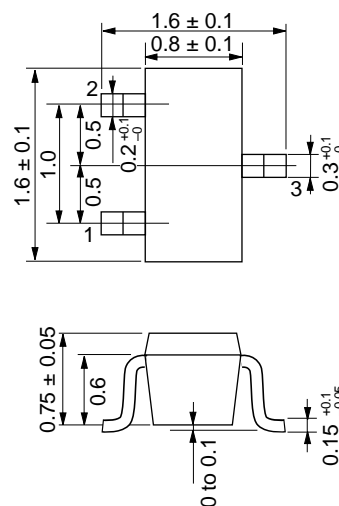
* Please contact with responsible NEC person, if you require evaluation sample. Unit sample quantity shall be 50 pcs.

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

| | | | |
|------------------------------|-----------|-------------|------------------|
| Collector to Base Voltage | V_{CBO} | 9 | V |
| Collector to Emitter Voltage | V_{CEO} | 6 | V |
| Emitter to Base Voltage | V_{EBO} | 2 | V |
| Collector Current | I_C | 30 | mA |
| Total Power Dissipation | P_T | 125 | mW |
| Junction Temperature | T_j | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -65 to +150 | $^\circ\text{C}$ |

PACKAGE DIMENSIONS

in millimeters



1. Emitter
2. Base
3. Collector

ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS |
|--------------------------|---------------------------------|------|------|------|------|--|
| Collector Cutoff Current | I _{CB0} | | | 0.1 | μA | V _{CB} = 5 V, I _E = 0 |
| Emitter Cutoff Current | I _{EB0} | | | 0.1 | μA | V _{EB} = 1 V, I _C = 0 |
| DC Current Gain | h _{FE} | 75 | | 150 | | V _{CE} = 3 V, I _C = 10 mA* ¹ |
| Gain Bandwidth Product | f _T | | 12.0 | | GHz | V _{CE} = 3 V, I _C = 10 mA, f = 2 GHz |
| Feed-Back Capacitance | C _{re} | | 0.4 | 0.7 | pF | V _{CE} = 3 V, I _E = 0, f = 1 MHz* ² |
| Insertion Power Gain | S _{21e} ² | 7.0 | 8.5 | | dB | V _{CE} = 3 V, I _C = 10 mA, f = 2 GHz |
| Noise Figure | NF | | 1.5 | 2.5 | dB | V _{CE} = 3 V, I _C = 3 mA, f = 2 GHz |

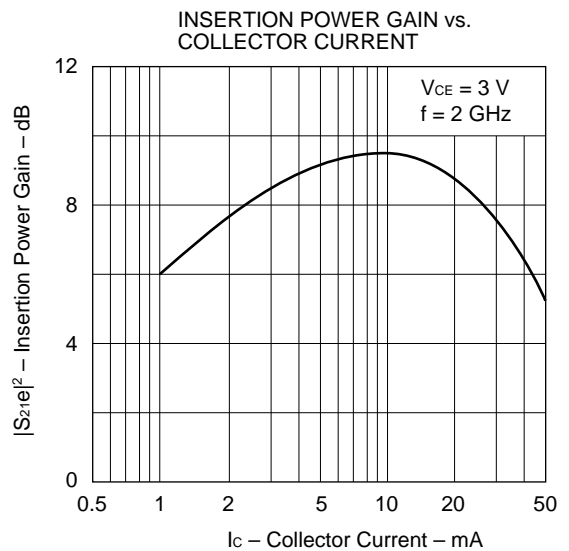
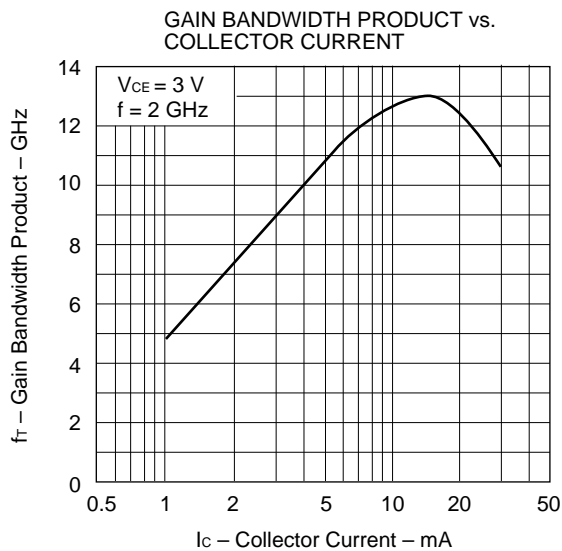
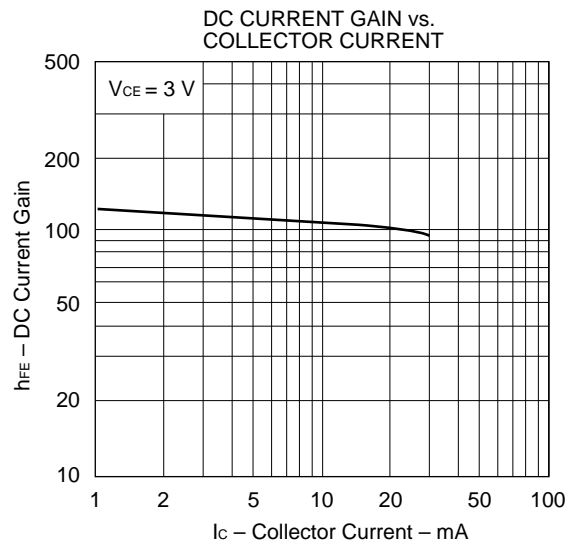
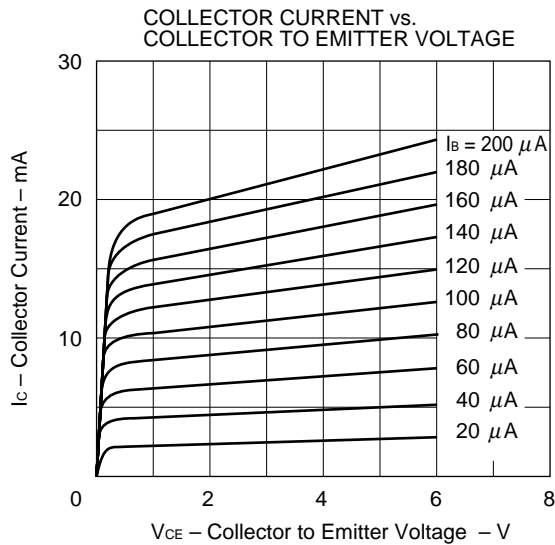
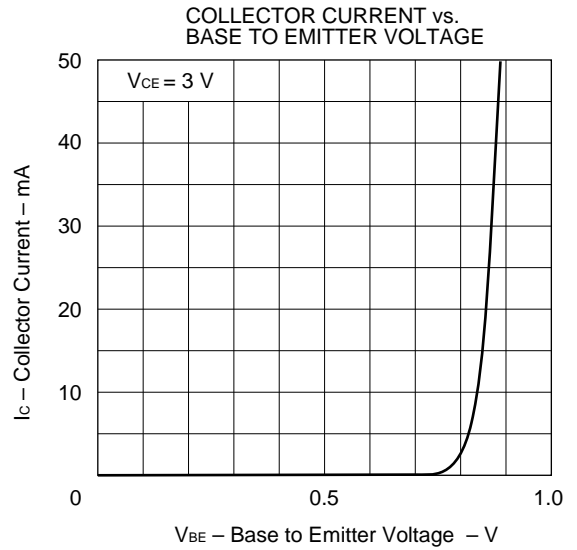
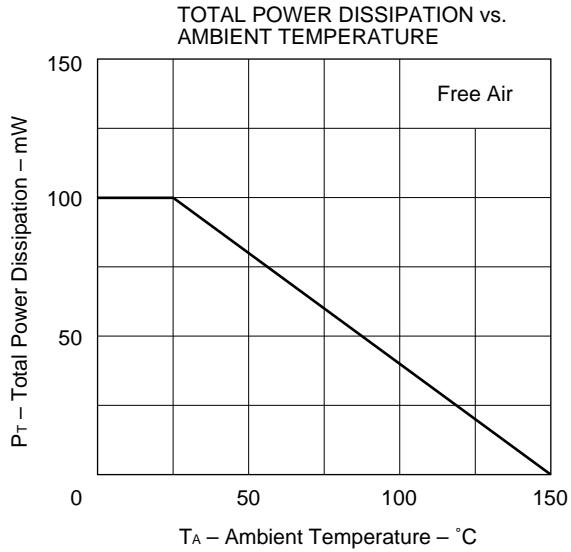
*1 Pulse Measurement PW ≤ 350 μs, Duty Cycle ≤ 2 %

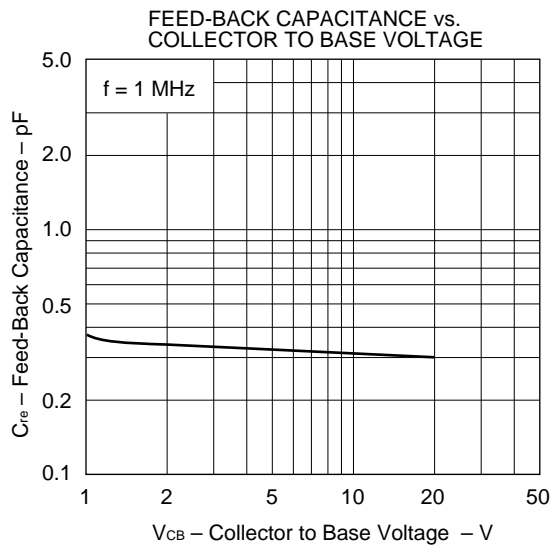
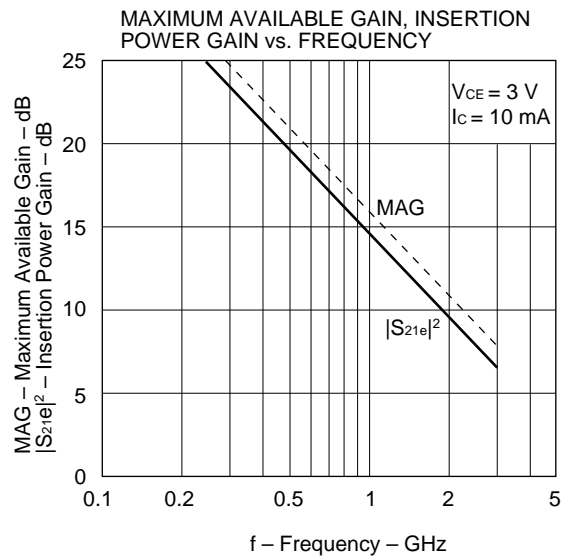
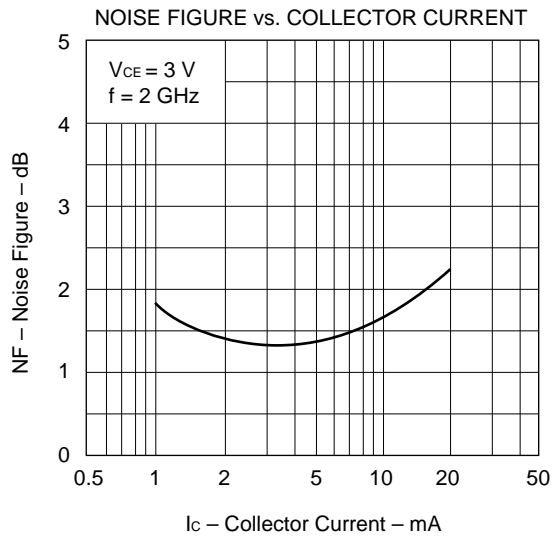
*2 The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

h_{FE} Classification

| | |
|-----------------|-----------|
| Rank | FB |
| Marking | 83 |
| h _{FE} | 75 to 150 |

TYPICAL CHARACTERISTICS (T_A = 25 °C)





S-PARAMETER

V_{CE} = 3 V, I_c = 10 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .735 | -18.7 | 15.465 | 157.7 | .017 | 78.5 | .931 | -15.0 |
| 200.00 | .640 | -37.8 | 14.330 | 142.1 | .030 | 69.7 | .810 | -25.9 |
| 300.00 | .534 | -55.7 | 13.115 | 129.2 | .040 | 66.3 | .700 | -32.4 |
| 400.00 | .438 | -71.4 | 11.574 | 118.3 | .048 | 64.5 | .612 | -36.2 |
| 500.00 | .364 | -84.9 | 10.235 | 109.9 | .057 | 63.7 | .547 | -38.2 |
| 600.00 | .311 | -96.6 | 8.943 | 103.1 | .064 | 63.3 | .499 | -39.4 |
| 700.00 | .268 | -107.0 | 7.935 | 97.7 | .072 | 62.8 | .461 | -40.4 |
| 800.00 | .241 | -116.9 | 7.105 | 92.7 | .080 | 62.7 | .430 | -40.9 |
| 900.00 | .218 | -126.4 | 6.425 | 88.7 | .088 | 62.6 | .405 | -41.7 |
| 1000.00 | .204 | -135.9 | 5.864 | 84.8 | .095 | 62.0 | .386 | -42.2 |
| 1100.00 | .192 | -144.5 | 5.397 | 81.4 | .103 | 61.0 | .370 | -42.8 |
| 1200.00 | .186 | -153.7 | 4.992 | 78.1 | .111 | 60.9 | .354 | -43.6 |
| 1300.00 | .183 | -161.8 | 4.628 | 75.1 | .119 | 60.5 | .341 | -44.5 |
| 1400.00 | .184 | -169.5 | 4.348 | 72.3 | .127 | 59.4 | .328 | -45.4 |
| 1500.00 | .185 | -176.7 | 4.072 | 69.2 | .134 | 58.4 | .317 | -46.8 |
| 1600.00 | .189 | 176.4 | 3.851 | 66.6 | .142 | 57.7 | .305 | -48.0 |
| 1700.00 | .196 | 169.9 | 3.643 | 63.8 | .151 | 56.9 | .294 | -49.1 |
| 1800.00 | .201 | 164.8 | 3.457 | 61.3 | .158 | 55.9 | .285 | -50.6 |
| 1900.00 | .208 | 159.7 | 3.311 | 59.0 | .166 | 55.1 | .271 | -52.2 |
| 2000.00 | .219 | 155.1 | 3.156 | 56.6 | .176 | 53.7 | .261 | -54.0 |
| 2100.00 | .228 | 150.6 | 3.024 | 54.1 | .183 | 52.3 | .249 | -55.6 |
| 2200.00 | .239 | 147.1 | 2.904 | 51.5 | .190 | 51.4 | .239 | -57.7 |
| 2300.00 | .248 | 143.3 | 2.790 | 49.3 | .199 | 50.3 | .229 | -59.8 |
| 2400.00 | .259 | 139.9 | 2.685 | 46.8 | .207 | 49.0 | .218 | -62.0 |
| 2500.00 | .270 | 136.9 | 2.593 | 44.7 | .215 | 47.9 | .206 | -64.6 |
| 2600.00 | .281 | 133.7 | 2.511 | 42.2 | .223 | 46.4 | .197 | -67.1 |
| 2700.00 | .293 | 131.6 | 2.425 | 40.2 | .230 | 45.5 | .185 | -70.1 |
| 2800.00 | .305 | 128.7 | 2.354 | 37.9 | .237 | 43.9 | .174 | -73.8 |
| 2900.00 | .316 | 126.3 | 2.283 | 35.6 | .246 | 43.0 | .162 | -77.0 |
| 3000.00 | .329 | 124.5 | 2.220 | 33.5 | .253 | 41.5 | .151 | -81.1 |

V_{CE} = 3 V, I_c = 7 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .855 | -14.2 | 10.699 | 164.8 | .019 | 80.2 | .968 | -10.6 |
| 200.00 | .787 | -28.4 | 10.334 | 151.4 | .035 | 73.3 | .902 | -19.8 |
| 300.00 | .715 | -41.9 | 9.924 | 140.1 | .048 | 68.5 | .825 | -27.0 |
| 400.00 | .631 | -54.9 | 9.183 | 130.2 | .059 | 63.4 | .743 | -32.5 |
| 500.00 | .561 | -66.5 | 8.559 | 121.7 | .068 | 60.9 | .678 | -36.5 |
| 600.00 | .495 | -77.0 | 7.749 | 113.9 | .077 | 58.8 | .621 | -39.4 |
| 700.00 | .434 | -86.4 | 7.090 | 107.6 | .084 | 57.5 | .572 | -41.9 |
| 800.00 | .387 | -95.8 | 6.490 | 101.5 | .092 | 56.4 | .531 | -43.4 |
| 900.00 | .346 | -104.1 | 5.972 | 96.6 | .099 | 55.5 | .496 | -45.1 |
| 1000.00 | .313 | -113.2 | 5.531 | 91.8 | .105 | 55.0 | .467 | -46.4 |
| 1100.00 | .287 | -121.1 | 5.117 | 87.8 | .113 | 54.3 | .442 | -47.3 |
| 1200.00 | .266 | -129.5 | 4.767 | 83.8 | .119 | 54.0 | .420 | -48.4 |
| 1300.00 | .251 | -137.5 | 4.442 | 80.3 | .126 | 53.3 | .399 | -49.7 |
| 1400.00 | .242 | -145.6 | 4.192 | 77.1 | .133 | 52.8 | .381 | -50.5 |
| 1500.00 | .232 | -153.7 | 3.936 | 73.7 | .140 | 52.3 | .364 | -51.9 |
| 1600.00 | .228 | -161.2 | 3.730 | 70.7 | .147 | 51.7 | .349 | -53.1 |
| 1700.00 | .227 | -169.2 | 3.537 | 67.6 | .155 | 50.8 | .336 | -54.4 |
| 1800.00 | .226 | -176.4 | 3.355 | 64.9 | .161 | 50.1 | .321 | -55.8 |
| 1900.00 | .230 | 177.5 | 3.210 | 62.1 | .169 | 49.6 | .307 | -57.3 |
| 2000.00 | .236 | 170.8 | 3.066 | 59.5 | .177 | 48.7 | .296 | -59.0 |
| 2100.00 | .243 | 164.7 | 2.944 | 56.7 | .183 | 47.7 | .282 | -60.6 |
| 2200.00 | .250 | 159.6 | 2.825 | 54.0 | .190 | 47.0 | .269 | -62.6 |
| 2300.00 | .258 | 154.8 | 2.725 | 51.8 | .198 | 46.0 | .259 | -64.6 |
| 2400.00 | .267 | 150.0 | 2.623 | 49.1 | .205 | 45.0 | .247 | -66.7 |
| 2500.00 | .277 | 145.9 | 2.534 | 46.8 | .212 | 44.0 | .235 | -68.8 |
| 2600.00 | .288 | 141.7 | 2.455 | 44.2 | .221 | 43.1 | .225 | -71.3 |
| 2700.00 | .300 | 138.8 | 2.370 | 41.9 | .228 | 42.0 | .211 | -73.9 |
| 2800.00 | .312 | 135.3 | 2.305 | 39.5 | .234 | 41.0 | .200 | -77.3 |
| 2900.00 | .321 | 132.0 | 2.230 | 37.1 | .243 | 40.0 | .189 | -80.7 |
| 3000.00 | .335 | 129.5 | 2.172 | 34.9 | .250 | 38.7 | .179 | -84.3 |

S-PARAMETER

V_{CE} = 3 V, I_c = 5 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .900 | -11.4 | 8.160 | 166.3 | .019 | 80.5 | .976 | -9.1 |
| 200.00 | .845 | -23.9 | 8.072 | 154.4 | .036 | 74.9 | .927 | -17.4 |
| 300.00 | .788 | -35.4 | 7.948 | 144.3 | .051 | 68.4 | .864 | -24.2 |
| 400.00 | .723 | -46.6 | 7.529 | 135.0 | .063 | 63.7 | .795 | -29.8 |
| 500.00 | .657 | -57.7 | 7.230 | 127.4 | .074 | 60.9 | .733 | -34.2 |
| 600.00 | .595 | -67.8 | 6.685 | 119.6 | .081 | 57.5 | .678 | -37.7 |
| 700.00 | .528 | -77.3 | 6.274 | 113.0 | .089 | 56.1 | .627 | -40.7 |
| 800.00 | .475 | -86.7 | 5.874 | 106.5 | .097 | 54.5 | .583 | -42.7 |
| 900.00 | .425 | -95.3 | 5.482 | 101.0 | .103 | 53.4 | .545 | -44.7 |
| 1000.00 | .384 | -104.3 | 5.150 | 95.7 | .110 | 52.3 | .514 | -46.4 |
| 1100.00 | .347 | -112.0 | 4.796 | 91.2 | .118 | 51.5 | .486 | -47.5 |
| 1200.00 | .321 | -120.5 | 4.512 | 87.0 | .123 | 51.3 | .460 | -48.8 |
| 1300.00 | .298 | -128.4 | 4.221 | 83.1 | .129 | 50.4 | .438 | -50.3 |
| 1400.00 | .283 | -136.2 | 3.994 | 79.4 | .137 | 49.6 | .418 | -51.4 |
| 1500.00 | .268 | -144.2 | 3.770 | 75.8 | .143 | 49.4 | .400 | -52.8 |
| 1600.00 | .258 | -151.8 | 3.568 | 72.7 | .149 | 48.6 | .382 | -54.2 |
| 1700.00 | .254 | -159.7 | 3.400 | 69.4 | .155 | 48.3 | .368 | -55.2 |
| 1800.00 | .249 | -167.2 | 3.229 | 66.6 | .162 | 47.3 | .353 | -56.7 |
| 1900.00 | .250 | -173.7 | 3.101 | 63.5 | .169 | 46.8 | .337 | -58.4 |
| 2000.00 | .253 | 179.0 | 2.957 | 60.8 | .176 | 46.1 | .324 | -59.8 |
| 2100.00 | .257 | 172.5 | 2.845 | 58.0 | .183 | 45.4 | .310 | -61.7 |
| 2200.00 | .263 | 166.7 | 2.730 | 55.2 | .189 | 44.6 | .296 | -63.6 |
| 2300.00 | .269 | 161.3 | 2.640 | 52.7 | .196 | 43.7 | .284 | -65.5 |
| 2400.00 | .277 | 156.2 | 2.539 | 49.9 | .203 | 43.1 | .272 | -67.6 |
| 2500.00 | .285 | 151.5 | 2.456 | 47.4 | .211 | 41.9 | .261 | -69.8 |
| 2600.00 | .296 | 147.0 | 2.380 | 44.8 | .217 | 41.0 | .250 | -72.2 |
| 2700.00 | .305 | 143.5 | 2.301 | 42.4 | .223 | 40.4 | .237 | -74.4 |
| 2800.00 | .318 | 139.6 | 2.234 | 39.9 | .231 | 39.3 | .225 | -77.6 |
| 2900.00 | .327 | 136.1 | 2.164 | 37.5 | .238 | 38.3 | .214 | -80.7 |
| 3000.00 | .341 | 133.2 | 2.110 | 35.2 | .244 | 37.3 | .204 | -84.1 |

V_{CE} = 3 V, I_c = 3 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .948 | -9.1 | 5.295 | 168.1 | .020 | 82.4 | .987 | -7.0 |
| 200.00 | .912 | -18.6 | 5.291 | 158.4 | .038 | 76.4 | .955 | -13.8 |
| 300.00 | .876 | -27.7 | 5.354 | 149.7 | .055 | 70.1 | .914 | -19.8 |
| 400.00 | .831 | -37.1 | 5.177 | 141.3 | .069 | 66.3 | .864 | -25.2 |
| 500.00 | .784 | -46.0 | 5.109 | 135.2 | .082 | 61.6 | .816 | -29.7 |
| 600.00 | .737 | -54.7 | 4.832 | 127.8 | .092 | 57.9 | .769 | -33.6 |
| 700.00 | .680 | -62.9 | 4.667 | 121.7 | .101 | 55.1 | .721 | -37.2 |
| 800.00 | .635 | -71.7 | 4.504 | 115.1 | .108 | 52.6 | .678 | -39.9 |
| 900.00 | .581 | -80.0 | 4.335 | 109.5 | .115 | 50.8 | .636 | -42.7 |
| 1000.00 | .530 | -89.2 | 4.226 | 103.5 | .123 | 48.8 | .602 | -44.7 |
| 1100.00 | .480 | -97.5 | 4.038 | 98.3 | .129 | 47.8 | .570 | -46.5 |
| 1200.00 | .441 | -105.8 | 3.879 | 93.3 | .135 | 46.8 | .544 | -48.2 |
| 1300.00 | .408 | -113.4 | 3.680 | 88.8 | .140 | 45.5 | .517 | -50.1 |
| 1400.00 | .382 | -121.2 | 3.528 | 84.7 | .146 | 44.3 | .493 | -51.6 |
| 1500.00 | .358 | -128.9 | 3.359 | 80.5 | .151 | 43.8 | .471 | -53.2 |
| 1600.00 | .339 | -136.3 | 3.200 | 76.9 | .156 | 43.2 | .451 | -54.8 |
| 1700.00 | .324 | -144.4 | 3.076 | 73.1 | .161 | 42.6 | .432 | -56.2 |
| 1800.00 | .311 | -151.7 | 2.932 | 70.0 | .166 | 41.9 | .416 | -57.7 |
| 1900.00 | .305 | -158.8 | 2.825 | 66.6 | .172 | 41.2 | .398 | -59.3 |
| 2000.00 | .301 | -166.7 | 2.712 | 63.4 | .178 | 40.5 | .384 | -60.9 |
| 2100.00 | .299 | -173.5 | 2.614 | 60.4 | .183 | 40.2 | .367 | -62.6 |
| 2200.00 | .300 | 180.0 | 2.508 | 57.2 | .189 | 39.5 | .354 | -64.4 |
| 2300.00 | .303 | 173.7 | 2.434 | 54.5 | .195 | 38.9 | .340 | -66.4 |
| 2400.00 | .307 | 167.8 | 2.348 | 51.5 | .201 | 38.2 | .329 | -68.3 |
| 2500.00 | .311 | 162.3 | 2.276 | 49.0 | .206 | 37.9 | .313 | -70.6 |
| 2600.00 | .320 | 156.7 | 2.209 | 45.9 | .212 | 37.0 | .303 | -72.5 |
| 2700.00 | .327 | 152.5 | 2.140 | 43.5 | .218 | 36.5 | .290 | -75.1 |
| 2800.00 | .337 | 148.0 | 2.080 | 40.8 | .223 | 35.7 | .278 | -77.8 |
| 2900.00 | .346 | 143.7 | 2.019 | 38.2 | .229 | 35.1 | .267 | -80.5 |
| 3000.00 | .359 | 140.1 | 1.967 | 35.8 | .235 | 34.3 | .256 | -83.7 |

S-PARAMETER

V_{CE} = 3 V, I_c = 1 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 1.007 | -5.9 | 1.878 | 172.3 | .020 | 83.6 | .998 | -4.2 |
| 200.00 | .988 | -12.5 | 1.925 | 164.3 | .040 | 80.5 | .986 | -8.2 |
| 300.00 | .978 | -18.3 | 2.006 | 157.9 | .059 | 75.4 | .975 | -12.3 |
| 400.00 | .953 | -25.2 | 2.012 | 150.9 | .077 | 71.4 | .955 | -16.2 |
| 500.00 | .939 | -30.9 | 2.031 | 145.7 | .095 | 66.7 | .937 | -19.8 |
| 600.00 | .921 | -37.5 | 1.974 | 139.1 | .110 | 62.8 | .916 | -23.3 |
| 700.00 | .889 | -43.2 | 1.942 | 133.9 | .125 | 58.6 | .893 | -26.9 |
| 800.00 | .871 | -49.3 | 1.914 | 127.9 | .139 | 54.9 | .865 | -30.0 |
| 900.00 | .838 | -55.6 | 1.875 | 122.8 | .149 | 50.9 | .836 | -33.6 |
| 1000.00 | .811 | -62.4 | 1.917 | 117.8 | .160 | 47.9 | .807 | -36.5 |
| 1100.00 | .770 | -69.7 | 1.925 | 112.5 | .169 | 44.6 | .781 | -38.9 |
| 1200.00 | .739 | -76.5 | 1.961 | 107.7 | .175 | 42.1 | .755 | -41.4 |
| 1300.00 | .706 | -83.5 | 1.927 | 102.7 | .182 | 39.6 | .729 | -44.0 |
| 1400.00 | .677 | -90.1 | 1.923 | 98.4 | .188 | 36.8 | .704 | -46.3 |
| 1500.00 | .646 | -97.2 | 1.886 | 93.2 | .192 | 34.9 | .679 | -48.6 |
| 1600.00 | .616 | -103.7 | 1.849 | 89.2 | .196 | 32.6 | .656 | -50.8 |
| 1700.00 | .589 | -111.3 | 1.843 | 84.4 | .200 | 30.8 | .635 | -53.0 |
| 1800.00 | .562 | -118.1 | 1.786 | 80.4 | .201 | 29.0 | .616 | -55.1 |
| 1900.00 | .538 | -125.1 | 1.786 | 76.1 | .203 | 27.7 | .593 | -57.1 |
| 2000.00 | .512 | -133.6 | 1.762 | 71.8 | .206 | 26.1 | .575 | -59.1 |
| 2100.00 | .495 | -140.2 | 1.729 | 68.0 | .207 | 25.2 | .557 | -61.2 |
| 2200.00 | .480 | -147.6 | 1.689 | 63.9 | .207 | 23.9 | .540 | -63.2 |
| 2300.00 | .468 | -154.5 | 1.676 | 60.4 | .209 | 23.0 | .522 | -65.2 |
| 2400.00 | .459 | -161.6 | 1.630 | 56.7 | .210 | 22.3 | .511 | -67.3 |
| 2500.00 | .451 | -168.1 | 1.600 | 53.4 | .210 | 21.7 | .494 | -69.5 |
| 2600.00 | .447 | -175.0 | 1.576 | 49.7 | .212 | 21.5 | .481 | -71.7 |
| 2700.00 | .443 | 179.1 | 1.538 | 46.5 | .213 | 21.1 | .467 | -74.0 |
| 2800.00 | .445 | 173.0 | 1.509 | 43.4 | .214 | 21.0 | .457 | -76.5 |
| 2900.00 | .443 | 166.8 | 1.482 | 40.1 | .216 | 20.6 | .441 | -79.1 |
| 3000.00 | .449 | 161.9 | 1.453 | 37.3 | .217 | 20.5 | .432 | -81.9 |

V_{CE} = 1 V, I_c = 5 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .862 | -14.2 | 8.672 | 160.8 | .023 | 80.2 | .956 | -13.0 |
| 200.00 | .795 | -28.9 | 8.389 | 148.6 | .042 | 70.5 | .875 | -24.2 |
| 300.00 | .718 | -43.2 | 8.162 | 137.5 | .057 | 64.0 | .778 | -32.6 |
| 400.00 | .638 | -57.7 | 7.624 | 128.2 | .070 | 59.5 | .691 | -39.0 |
| 500.00 | .573 | -71.2 | 7.259 | 119.8 | .079 | 57.7 | .618 | -43.6 |
| 600.00 | .510 | -83.2 | 6.617 | 112.0 | .088 | 55.2 | .556 | -47.2 |
| 700.00 | .447 | -95.3 | 6.154 | 105.2 | .096 | 53.5 | .504 | -50.1 |
| 800.00 | .402 | -106.5 | 5.675 | 98.7 | .103 | 52.8 | .459 | -52.2 |
| 900.00 | .364 | -117.0 | 5.254 | 93.5 | .111 | 52.4 | .423 | -54.2 |
| 1000.00 | .336 | -127.2 | 4.875 | 88.6 | .118 | 51.3 | .393 | -55.8 |
| 1100.00 | .314 | -136.0 | 4.517 | 84.4 | .126 | 50.7 | .366 | -57.1 |
| 1200.00 | .300 | -144.9 | 4.206 | 80.3 | .133 | 50.3 | .343 | -58.7 |
| 1300.00 | .289 | -153.1 | 3.922 | 76.7 | .139 | 49.5 | .323 | -60.4 |
| 1400.00 | .286 | -160.7 | 3.699 | 73.4 | .147 | 48.9 | .303 | -61.7 |
| 1500.00 | .282 | -167.9 | 3.473 | 69.9 | .155 | 48.3 | .286 | -63.7 |
| 1600.00 | .282 | -174.7 | 3.293 | 66.9 | .162 | 47.5 | .271 | -65.3 |
| 1700.00 | .286 | 178.6 | 3.128 | 63.6 | .170 | 46.8 | .255 | -67.1 |
| 1800.00 | .288 | 172.9 | 2.962 | 60.9 | .177 | 46.2 | .242 | -69.0 |
| 1900.00 | .294 | 167.6 | 2.838 | 58.1 | .186 | 45.3 | .227 | -71.6 |
| 2000.00 | .303 | 162.2 | 2.707 | 55.2 | .193 | 44.4 | .214 | -74.0 |
| 2100.00 | .310 | 157.3 | 2.599 | 52.5 | .201 | 43.5 | .200 | -76.5 |
| 2200.00 | .318 | 152.9 | 2.487 | 49.6 | .208 | 42.5 | .189 | -79.5 |
| 2300.00 | .327 | 148.8 | 2.404 | 47.4 | .215 | 41.5 | .176 | -83.1 |
| 2400.00 | .336 | 144.9 | 2.312 | 44.6 | .223 | 40.5 | .166 | -86.5 |
| 2500.00 | .347 | 141.4 | 2.234 | 42.3 | .231 | 39.5 | .154 | -90.9 |
| 2600.00 | .359 | 137.6 | 2.165 | 39.6 | .237 | 38.2 | .146 | -94.9 |
| 2700.00 | .368 | 134.9 | 2.089 | 37.3 | .245 | 37.3 | .135 | -100.8 |
| 2800.00 | .381 | 131.9 | 2.028 | 34.8 | .252 | 36.4 | .126 | -106.2 |
| 2900.00 | .390 | 128.8 | 1.962 | 32.5 | .260 | 35.1 | .118 | -113.3 |
| 3000.00 | .403 | 126.6 | 1.913 | 30.2 | .267 | 34.0 | .113 | -121.0 |

S-PARAMETER

V_{CE} = 1 V, I_c = 3 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | .932 | -10.9 | 5.529 | 165.7 | .024 | 81.3 | .977 | -9.5 |
| 200.00 | .886 | -21.6 | 5.442 | 154.3 | .045 | 73.7 | .930 | -18.3 |
| 300.00 | .838 | -32.2 | 5.475 | 144.7 | .063 | 67.9 | .869 | -25.8 |
| 400.00 | .788 | -42.9 | 5.242 | 136.1 | .079 | 61.7 | .800 | -32.3 |
| 500.00 | .733 | -53.6 | 5.156 | 129.6 | .092 | 57.3 | .739 | -37.5 |
| 600.00 | .682 | -63.5 | 4.819 | 122.0 | .102 | 53.8 | .682 | -41.9 |
| 700.00 | .620 | -73.4 | 4.644 | 115.5 | .112 | 50.8 | .628 | -45.8 |
| 800.00 | .573 | -83.7 | 4.447 | 108.7 | .119 | 49.1 | .579 | -48.8 |
| 900.00 | .520 | -93.9 | 4.276 | 103.0 | .126 | 47.2 | .535 | -51.8 |
| 1000.00 | .473 | -104.2 | 4.118 | 96.8 | .133 | 45.6 | .498 | -54.0 |
| 1100.00 | .431 | -113.9 | 3.894 | 91.7 | .140 | 44.6 | .467 | -55.9 |
| 1200.00 | .400 | -123.4 | 3.708 | 86.7 | .145 | 43.7 | .439 | -57.8 |
| 1300.00 | .376 | -131.6 | 3.495 | 82.4 | .151 | 42.9 | .412 | -59.8 |
| 1400.00 | .361 | -139.7 | 3.333 | 78.7 | .157 | 42.1 | .389 | -61.6 |
| 1500.00 | .345 | -147.7 | 3.151 | 74.5 | .163 | 41.4 | .368 | -63.5 |
| 1600.00 | .335 | -155.3 | 3.003 | 71.0 | .168 | 40.5 | .347 | -65.5 |
| 1700.00 | .330 | -163.1 | 2.872 | 67.3 | .174 | 40.3 | .329 | -67.2 |
| 1800.00 | .326 | -169.9 | 2.735 | 64.3 | .180 | 39.5 | .313 | -69.2 |
| 1900.00 | .326 | -176.4 | 2.628 | 61.1 | .186 | 39.0 | .297 | -71.3 |
| 2000.00 | .329 | 177.0 | 2.509 | 57.8 | .194 | 38.1 | .281 | -73.7 |
| 2100.00 | .333 | 171.0 | 2.419 | 54.9 | .199 | 37.4 | .266 | -76.1 |
| 2200.00 | .337 | 165.6 | 2.323 | 51.8 | .205 | 36.7 | .253 | -78.5 |
| 2300.00 | .344 | 160.5 | 2.251 | 49.2 | .211 | 36.1 | .239 | -81.6 |
| 2400.00 | .351 | 155.7 | 2.166 | 46.2 | .218 | 35.5 | .228 | -84.2 |
| 2500.00 | .359 | 151.3 | 2.097 | 43.7 | .223 | 34.5 | .214 | -87.5 |
| 2600.00 | .369 | 146.8 | 2.035 | 40.8 | .230 | 33.8 | .204 | -91.0 |
| 2700.00 | .378 | 143.2 | 1.966 | 38.4 | .237 | 33.1 | .193 | -95.1 |
| 2800.00 | .389 | 139.6 | 1.912 | 35.7 | .242 | 32.0 | .181 | -99.7 |
| 2900.00 | .399 | 135.9 | 1.853 | 33.2 | .250 | 31.3 | .172 | -104.3 |
| 3000.00 | .411 | 133.1 | 1.805 | 30.8 | .256 | 30.2 | .164 | -109.4 |

V_{CE} = 1 V, I_c = 1 mA, Z_o = 50 Ω

| FREQUENCY MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100.00 | 1.006 | -6.7 | 1.908 | 171.3 | .025 | 84.6 | .994 | -5.1 |
| 200.00 | .982 | -13.7 | 1.949 | 162.2 | .049 | 78.6 | .982 | -10.0 |
| 300.00 | .970 | -20.1 | 2.027 | 155.2 | .072 | 73.9 | .965 | -14.8 |
| 400.00 | .946 | -27.6 | 2.024 | 147.2 | .094 | 68.1 | .938 | -19.6 |
| 500.00 | .924 | -34.0 | 2.051 | 142.2 | .114 | 63.6 | .914 | -23.9 |
| 600.00 | .903 | -41.0 | 1.977 | 135.3 | .132 | 59.0 | .887 | -28.0 |
| 700.00 | .867 | -47.2 | 1.946 | 129.7 | .148 | 54.6 | .857 | -32.2 |
| 800.00 | .848 | -54.0 | 1.915 | 123.4 | .162 | 50.6 | .822 | -35.9 |
| 900.00 | .811 | -60.7 | 1.874 | 118.2 | .173 | 46.2 | .789 | -39.8 |
| 1000.00 | .783 | -68.4 | 1.908 | 112.8 | .184 | 43.0 | .754 | -43.2 |
| 1100.00 | .741 | -76.2 | 1.919 | 107.3 | .193 | 39.9 | .723 | -46.0 |
| 1200.00 | .707 | -84.1 | 1.946 | 102.3 | .201 | 37.1 | .692 | -48.6 |
| 1300.00 | .675 | -91.2 | 1.902 | 97.1 | .207 | 34.5 | .663 | -51.5 |
| 1400.00 | .647 | -98.6 | 1.888 | 92.7 | .212 | 31.8 | .634 | -54.1 |
| 1500.00 | .617 | -106.1 | 1.846 | 87.4 | .216 | 29.5 | .609 | -56.8 |
| 1600.00 | .589 | -112.9 | 1.808 | 83.0 | .220 | 27.1 | .582 | -59.4 |
| 1700.00 | .565 | -121.2 | 1.799 | 78.3 | .223 | 25.4 | .560 | -61.8 |
| 1800.00 | .542 | -128.2 | 1.741 | 74.4 | .224 | 23.6 | .538 | -64.1 |
| 1900.00 | .523 | -135.5 | 1.729 | 70.2 | .226 | 22.4 | .515 | -66.4 |
| 2000.00 | .502 | -144.0 | 1.703 | 65.7 | .228 | 20.7 | .497 | -68.6 |
| 2100.00 | .489 | -150.9 | 1.667 | 62.1 | .228 | 19.7 | .476 | -71.1 |
| 2200.00 | .479 | -158.0 | 1.625 | 58.0 | .229 | 18.6 | .459 | -73.4 |
| 2300.00 | .470 | -164.8 | 1.605 | 54.7 | .230 | 17.6 | .440 | -76.0 |
| 2400.00 | .466 | -171.5 | 1.557 | 50.8 | .230 | 16.7 | .428 | -78.3 |
| 2500.00 | .461 | -177.8 | 1.524 | 47.6 | .230 | 16.0 | .413 | -81.1 |
| 2600.00 | .462 | 175.8 | 1.497 | 44.0 | .231 | 15.7 | .399 | -83.7 |
| 2700.00 | .462 | 170.4 | 1.460 | 40.9 | .231 | 15.5 | .384 | -86.7 |
| 2800.00 | .465 | 164.8 | 1.433 | 37.8 | .232 | 14.8 | .372 | -89.8 |
| 2900.00 | .466 | 159.2 | 1.399 | 34.6 | .233 | 14.7 | .360 | -92.9 |
| 3000.00 | .474 | 154.9 | 1.374 | 31.8 | .234 | 14.5 | .351 | -96.4 |

[MEMO]

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