



Silicon Transistor

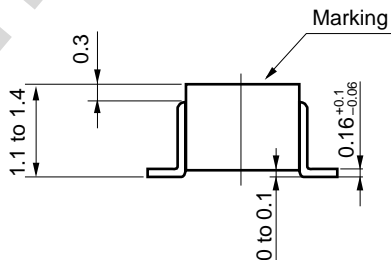
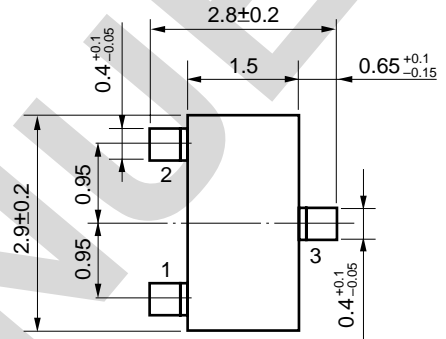
NE97733 / 2SA1977 JEITA Part No.

PNP EPITAXIAL SILICON TRANSISTOR MICROWAVE AMPLIFIER

FEATURES

- High f_T
 $f_T = 8.5$ GHz TYP.
- High gain
 $|S_{21e}|^2 = 12.0$ dB TYP. @ $f = 1.0$ GHz, $V_{CE} = -8$ V, $I_C = -20$ mA
- High-speed switching characteristics
- Equivalent NPN transistor is the NE68133 / 2SC3583.

PACKAGE DIMENSION (in millimeters)



PIN CONNECTIONS
 1: Emitter
 2: Base
 3: Collector Marking: T92

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

| Parameter | Symbol | Rating | Unit |
|------------------------------|-----------|-------------|------|
| Collector to Base Voltage | V_{CB0} | -20 | V |
| Collector to Emitter Voltage | V_{CE0} | -12 | V |
| Emitter to Base Voltage | V_{EB0} | -3.0 | V |
| Collector Current | I_C | -50 | mA |
| Total Power Dissipation | P_T | 200 | mW |
| Junction Temperature | T_j | 150 | °C |
| Storage Temperature | T_{stg} | -65 to +150 | °C |

ELECTRICAL CHARACTERISTICS ($T_A = 25$ °C)

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|--------------------------|---------------|--|------|------|------|---------|
| Collector Cutoff Current | I_{CB0} | $V_{CB} = -10$ V | | | -0.1 | μ A |
| Emitter Cutoff Current | I_{EB0} | $V_{EB} = -1$ V | | | -0.1 | μ A |
| DC Current Gain | h_{FE} | $V_{CE} = -8$ V, $I_C = -20$ mA | 20 | | 100 | |
| Gain Bandwidth Product | f_T | $V_{CE} = -8$ V, $I_C = -20$ mA, $f = 1$ GHz | 6.0 | 8.5 | | GHz |
| Collector Capacitance | C_{re}^* | $V_{CB} = -10$ V, $I_E = 0$, $f = 1$ MHz | | 0.5 | 1 | pF |
| Insertion Power Gain | $ S_{21e} ^2$ | $V_{CE} = -8$ V, $I_C = -20$ mA, $f = 1.0$ GHz | 8.0 | 12.0 | | dB |
| Noise Figure | NF | $V_{CE} = -8$ V, $I_C = -3$ mA, $f = 1$ GHz | | 1.5 | 3 | dB |

* Measured by a 3-terminal bridge. Emitter and Case should be connected to the guard terminal.

h_{FE} Classification

| | |
|----------|-----------|
| Rank | FB |
| Marking | T92 |
| h_{FE} | 20 to 100 |

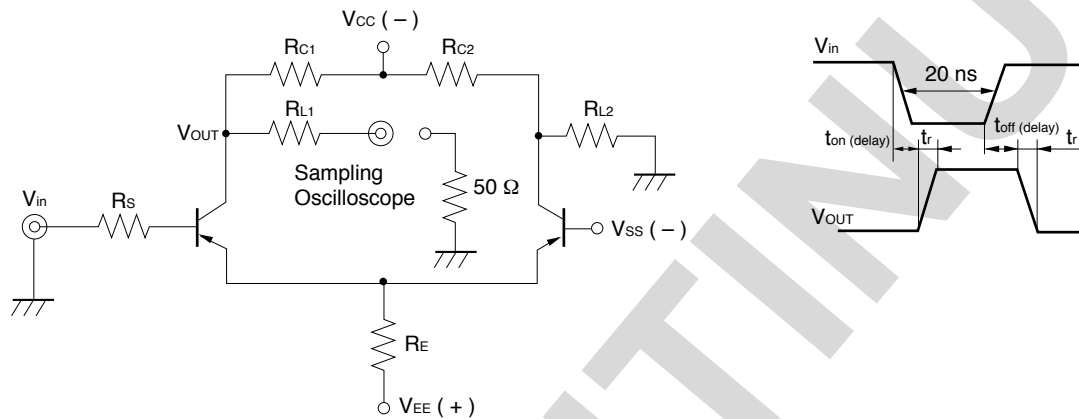
ORDERING INFORMATION

| Part Number | Order Number | Quantity |
|----------------------------|--------------------------------|-------------|
| NE97733-T1B 2SA1977-T1B | NE97733-T1B-A 2SA1977-T1B-A | 3 kpcs/Reel |

SWITCHING CHARACTERISTICS

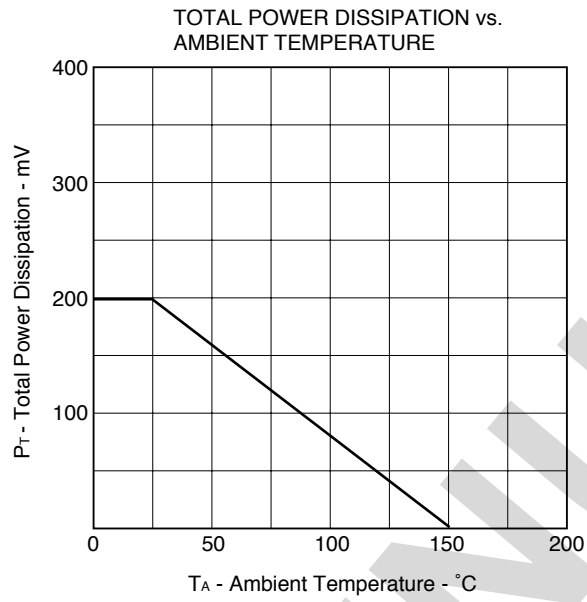
| Parameter | Symbol | $V_{in} = 1\text{ V}$ | Unit |
|---------------------|---------------------------|-----------------------|------|
| | | TYP. | |
| Turn-on Delay Time | $t_{on} \text{ (delay)}$ | 1.08 | ns |
| Rise Time | t_r | 0.66 | ns |
| Turn off Delay Time | $t_{off} \text{ (delay)}$ | 0.32 | ns |
| Fall Time | t_f | 0.78 | ns |

SWITCHING TIME MEASUREMENT CIRCUIT

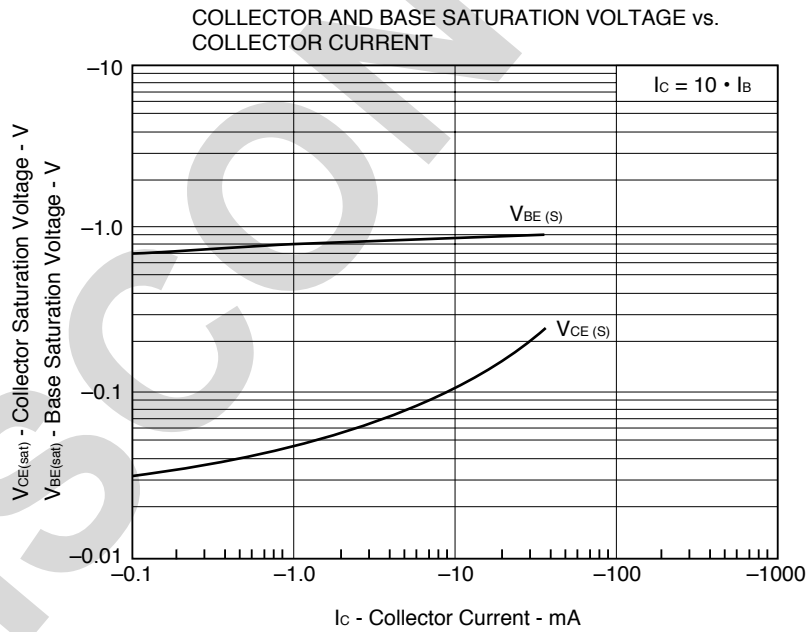
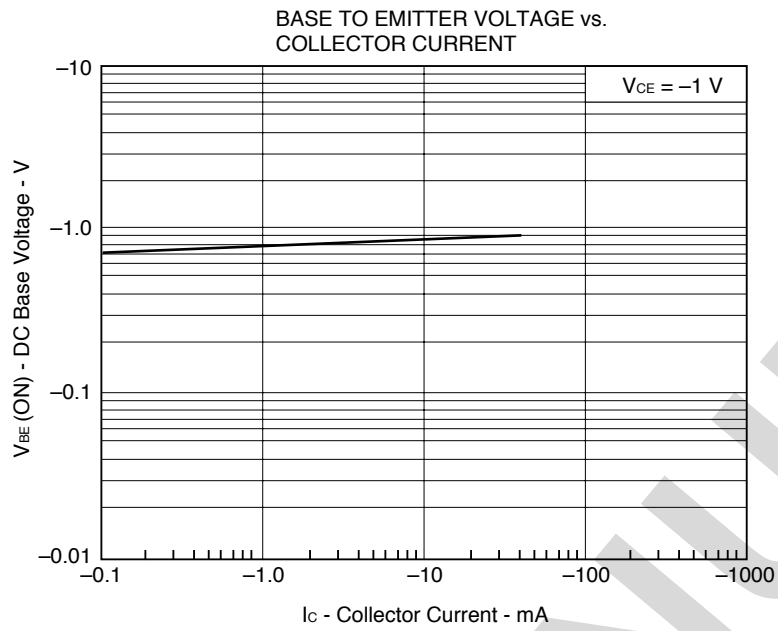


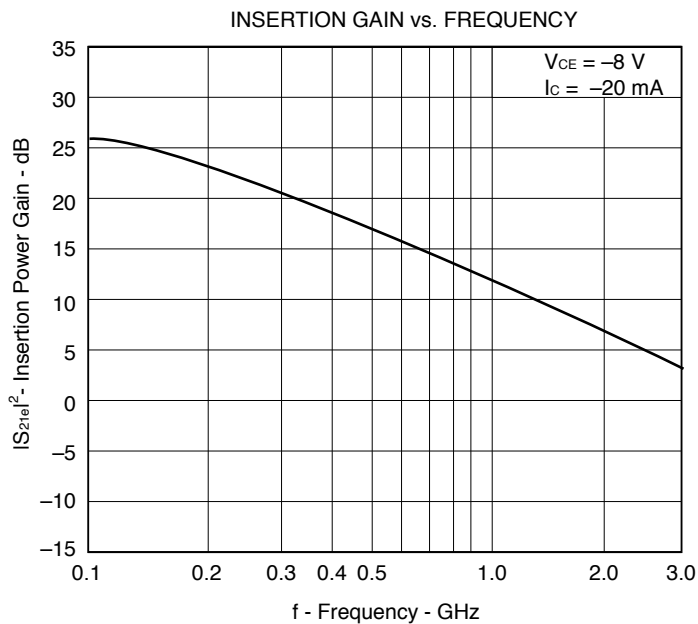
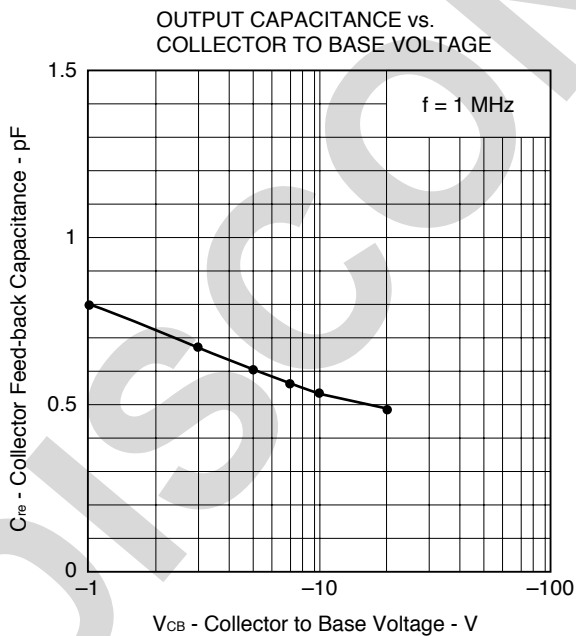
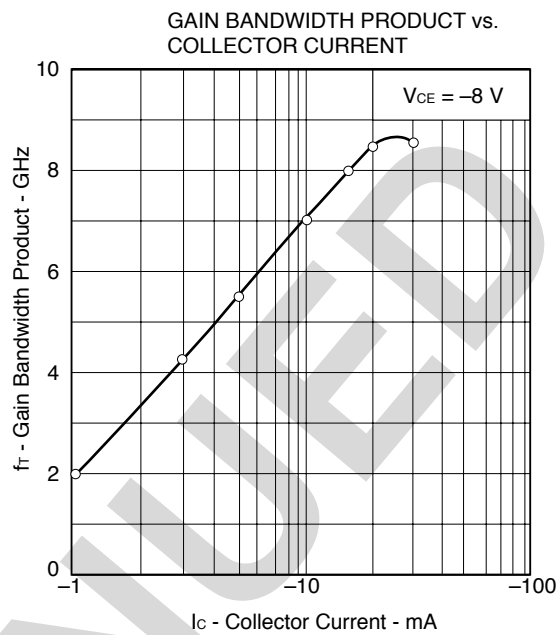
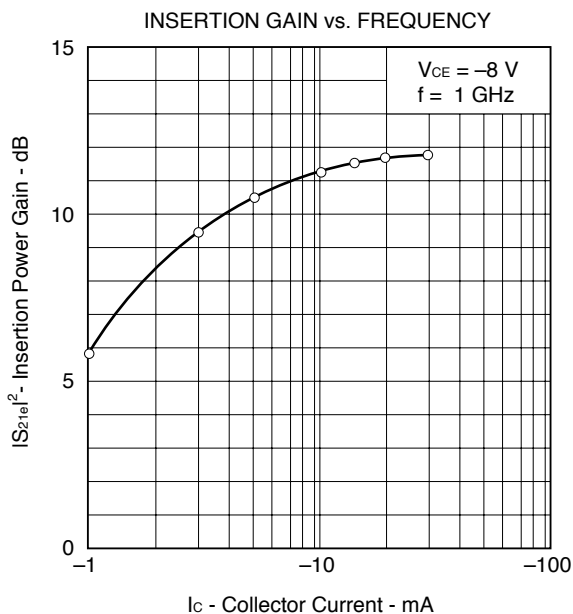
| $V_{in} = 1\text{ V}, V_{BB} = -0.5\text{ V}, R_{C1} = R_{C2}$ | | | | | | |
|--|--------------|--------------|--------------|--------------|----------|----------|
| R_s | R_C | R_{L1} | R_{L2} | R_E | V_{EE} | V_{CC} |
| (Ω) | (Ω) | (Ω) | (Ω) | (Ω) | (V) | (V) |
| 160 | 1 k | 200 | 250 | 2.7 k | 27 | 26.3 |

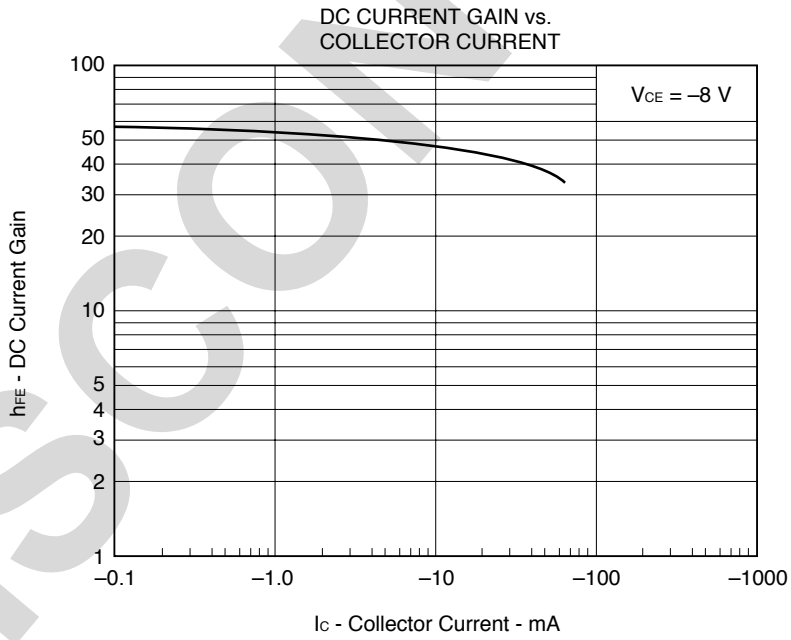
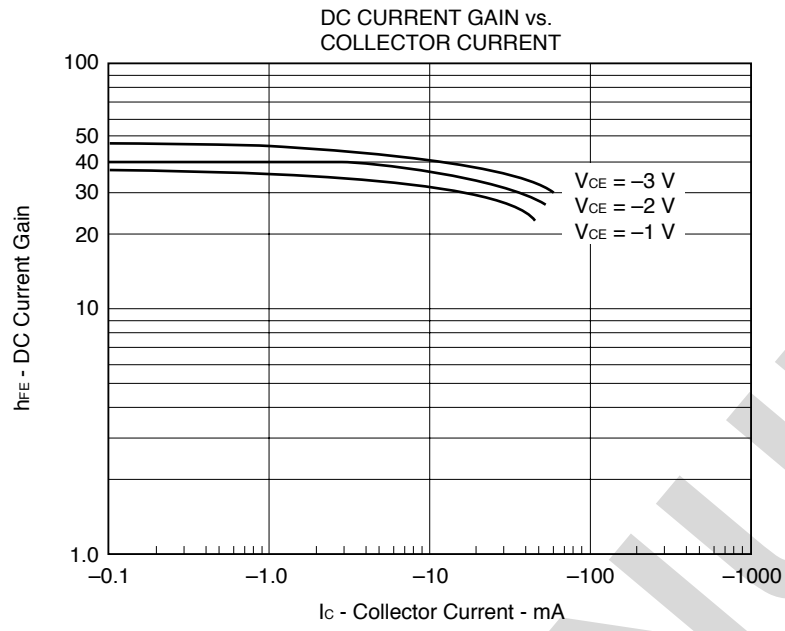
TYPICAL CHARACTERISTICS



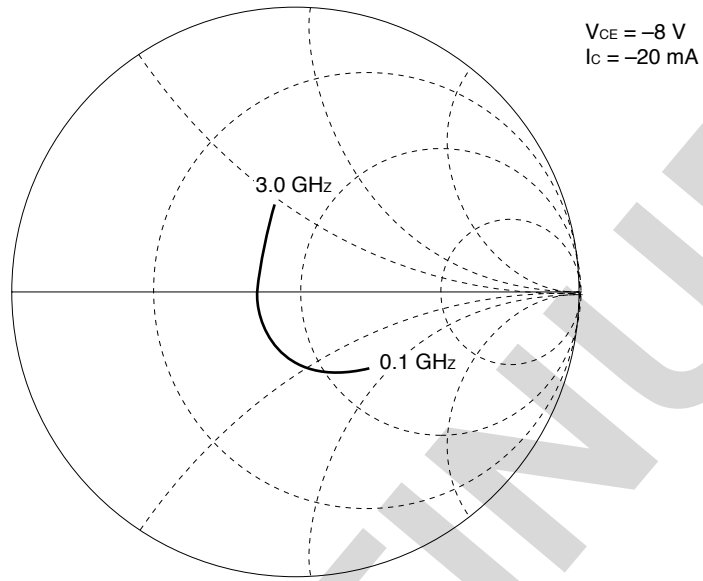
DISCONTINUED



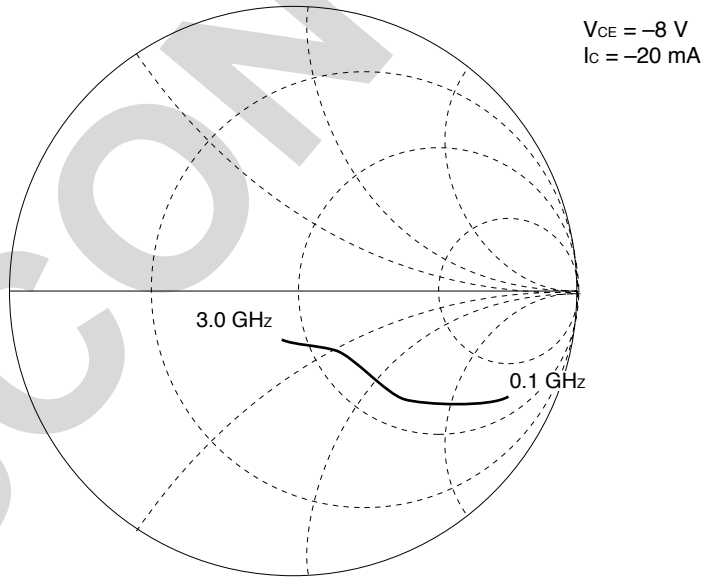




S₁₁



S₂₂



DISCONTINUED

S-PARAMETER(V_{CE} = 1 V, I_C = 5 mA, Z_o = 50 Ω)

| f MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------|-----------------|--------|-----------------|------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100 | 0.553 | - 43.7 | 11.03 | 150. | 0.423 | 71.2 | 0.666 | - 25.0 |
| 200 | 0.460 | - 78.2 | 8.780 | 129. | 0.691 | 59.4 | 0.696 | - 42.2 |
| 300 | 0.427 | - 104 | 7.003 | 115. | 0.857 | 54.4 | 0.556 | - 52.9 |
| 400 | 0.393 | - 123 | 5.700 | 105. | 0.983 | 52.7 | 0.461 | - 59.5 |
| 500 | 0.377 | - 138 | 4.74 | 97.6 | 0.109 | 52.2 | 0.392 | - 64.2 |
| 600 | 0.367 | - 149 | 4.053 | 91.2 | 0.120 | 52.5 | 0.341 | - 67.4 |
| 700 | 0.362 | - 159 | 3.549 | 85.9 | 0.131 | 52.9 | 0.307 | - 70.5 |
| 800 | 0.363 | - 168 | 3.151 | 81.3 | 0.143 | 53.1 | 0.280 | - 73.7 |
| 900 | 0.364 | - 175 | 2.847 | 77.0 | 0.154 | 53.8 | 0.258 | - 76.1 |
| 1000 | 0.365 | 178 | 2.603 | 73.0 | 0.165 | 54.0 | 0.241 | - 78.8 |
| 1100 | 0.369 | 172 | 2.391 | 69.3 | 0.176 | 54.4 | 0.227 | - 82.0 |
| 1200 | 0.375 | 166 | 2.219 | 66.8 | 0.188 | 54.2 | 0.217 | - 84.8 |
| 1300 | 0.376 | 162 | 2.070 | 62.7 | 0.200 | 54.4 | 0.207 | - 88.4 |
| 1400 | 0.384 | 157 | 1.940 | 59.4 | 0.213 | 54.1 | 0.200 | - 92.0 |
| 1500 | 0.391 | 153 | 1.838 | 56.3 | 0.225 | 53.8 | 0.192 | - 94.9 |
| 1600 | 0.399 | 149 | 1.744 | 53.5 | 0.238 | 53.4 | 0.188 | - 99.1 |
| 1700 | 0.405 | 146 | 1.659 | 50.8 | 0.250 | 52.9 | 0.184 | - 102 |
| 1800 | 0.411 | 142 | 1.584 | 48.2 | 0.264 | 52.3 | 0.184 | - 107 |
| 1900 | 0.418 | 139 | 1.520 | 45.6 | 0.277 | 51.7 | 0.182 | - 111 |
| 2000 | 0.423 | 135 | 1.461 | 43.1 | 0.290 | 51.1 | 0.181 | - 115 |
| 2100 | 0.429 | 132 | 1.408 | 40.9 | 0.302 | 50.2 | 0.180 | - 119 |
| 2200 | 0.438 | 130 | 1.361 | 38.6 | 0.314 | 49.4 | 0.182 | - 125 |
| 2300 | 0.444 | 127 | 1.316 | 36.4 | 0.328 | 48.5 | 0.181 | - 128 |
| 2400 | 0.450 | 124 | 1.276 | 34.2 | 0.341 | 47.6 | 0.187 | - 132 |
| 2500 | 0.457 | 122 | 1.239 | 32.3 | 0.353 | 46.5 | 0.188 | - 137 |

S-PARAMETER(V_{CE} = 3 V, I_C = 5 mA, Z_o = 50 Ω)

| f MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------|-----------------|--------|-----------------|------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100 | 0.595 | - 34.2 | 11.62 | 154. | 0.0328 | 74.9 | 0.902 | - 19.4 |
| 200 | 0.511 | - 62.8 | 9.618 | 134. | 0.0573 | 64.8 | 0.760 | - 33.2 |
| 300 | 0.432 | - 86.0 | 7.920 | 120. | 0.0734 | 58.5 | 0.633 | - 41.9 |
| 400 | 0.362 | - 104 | 6.575 | 110. | 0.0852 | 57.1 | 0.542 | - 47.3 |
| 500 | 0.345 | - 119 | 5.511 | 102. | 0.0964 | 55.9 | 0.471 | - 50.3 |
| 600 | 0.323 | - 132 | 4.749 | 95.9 | 0.106 | 56.4 | 0.420 | - 52.2 |
| 700 | 0.308 | - 143 | 4.177 | 90.5 | 0.116 | 56.6 | 0.383 | - 54.1 |
| 800 | 0.300 | - 153 | 3.712 | 85.8 | 0.126 | 57.1 | 0.355 | - 55.7 |
| 900 | 0.297 | - 162 | 3.359 | 81.5 | 0.137 | 57.3 | 0.332 | - 57.2 |
| 1000 | 0.295 | - 170 | 3.064 | 77.6 | 0.147 | 57.9 | 0.315 | - 58.9 |
| 1100 | 0.297 | - 177 | 2.818 | 74.0 | 0.158 | 57.9 | 0.299 | - 60.6 |
| 1200 | 0.300 | 176 | 2.617 | 70.6 | 0.169 | 58.3 | 0.287 | - 62.1 |
| 1300 | 0.303 | 170 | 2.439 | 67.4 | 0.181 | 58.1 | 0.276 | - 64.6 |
| 1400 | 0.308 | 164 | 2.284 | 64.2 | 0.192 | 58.1 | 0.266 | - 66.5 |
| 1500 | 0.314 | 160 | 2.159 | 61.2 | 0.203 | 57.8 | 0.258 | - 68.5 |
| 1600 | 0.322 | 155 | 2.046 | 58.4 | 0.215 | 57.5 | 0.250 | - 71.4 |
| 1700 | 0.328 | 151 | 1.944 | 55.7 | 0.227 | 57.3 | 0.243 | - 73.6 |
| 1800 | 0.335 | 147 | 1.855 | 53.0 | 0.240 | 56.5 | 0.241 | - 76.9 |
| 1900 | 0.341 | 143 | 1.774 | 50.5 | 0.252 | 56.1 | 0.233 | - 80.3 |
| 2000 | 0.349 | 140 | 1.705 | 48.1 | 0.264 | 55.5 | 0.230 | - 83.1 |
| 2100 | 0.355 | 136 | 1.638 | 45.7 | 0.276 | 54.7 | 0.226 | - 86.5 |
| 2200 | 0.364 | 133 | 1.583 | 43.5 | 0.289 | 54.2 | 0.222 | - 90.7 |
| 2300 | 0.372 | 130 | 1.53 | 41.2 | 0.302 | 53.2 | 0.218 | - 93.6 |
| 2400 | 0.378 | 128 | 1.479 | 39.0 | 0.314 | 52.5 | 0.218 | - 97.5 |
| 2500 | 0.386 | 125 | 1.439 | 37.0 | 0.326 | 51.7 | 0.215 | - 101. |

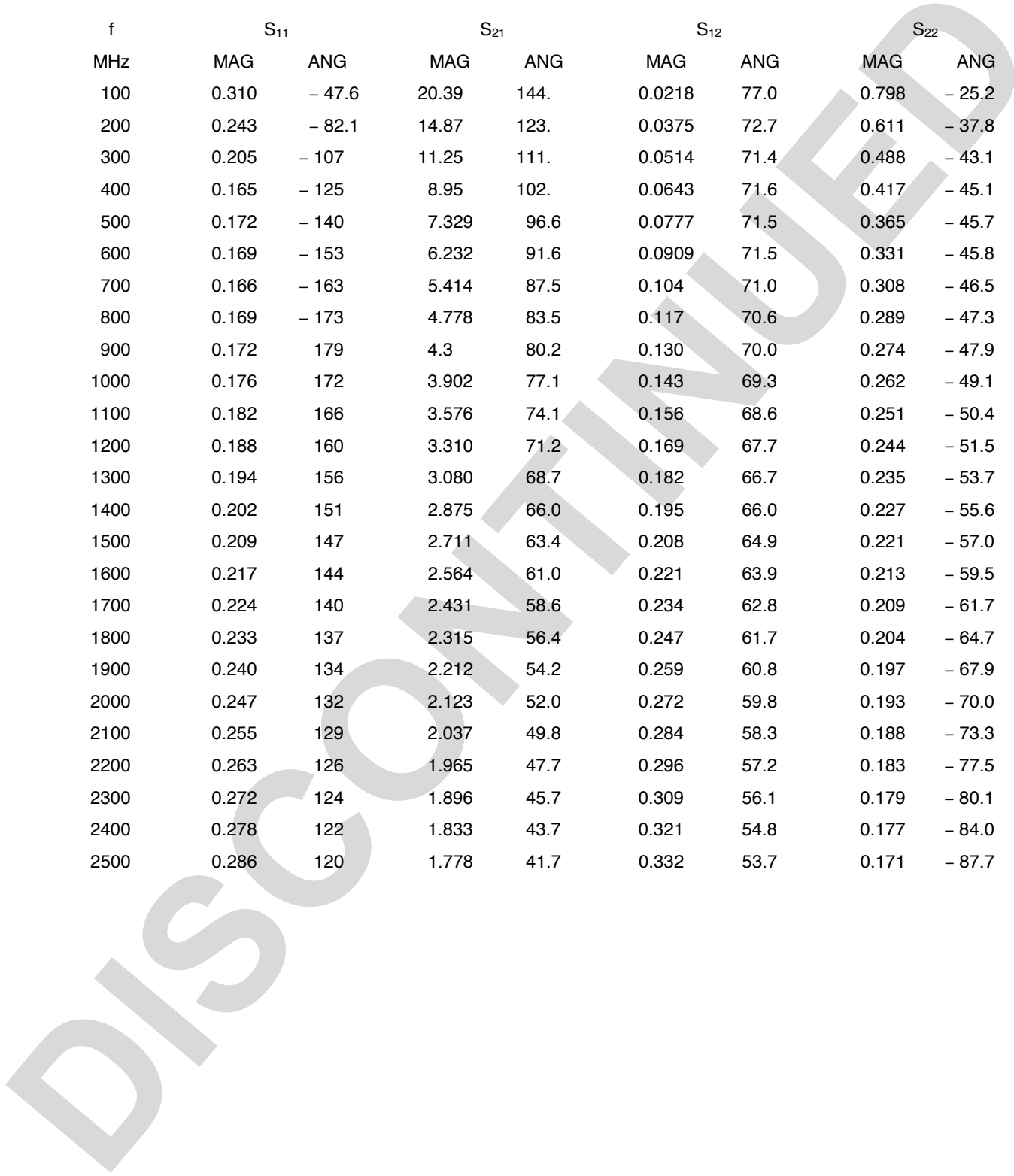
S-PARAMETER(V_{CE} = 8 V, I_C = 5 mA, Z_o = 50 Ω)

| f MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------|-----------------|--------|-----------------|------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100 | 0.679 | - 27.6 | 11.75 | 156. | 0.0289 | 76.9 | 0.918 | - 15.9 |
| 200 | 0.586 | - 51.4 | 10.01 | 138. | 0.0508 | 66.6 | 0.802 | - 27.7 |
| 300 | 0.491 | - 71.0 | 8.453 | 124. | 0.0670 | 61.8 | 0.690 | - 35.3 |
| 400 | 0.417 | - 87.3 | 7.152 | 114. | 0.0780 | 58.9 | 0.603 | - 39.9 |
| 500 | 0.362 | - 100 | 6.040 | 106. | 0.0886 | 58.3 | 0.534 | - 42.5 |
| 600 | 0.323 | - 113 | 5.245 | 99.6 | 0.0984 | 57.9 | 0.485 | - 44.0 |
| 700 | 0.293 | - 124 | 4.627 | 94.2 | 0.107 | 58.0 | 0.448 | - 45.5 |
| 800 | 0.274 | - 135 | 4.124 | 89.4 | 0.117 | 58.4 | 0.419 | - 46.6 |
| 900 | 0.261 | - 145 | 3.734 | 85.0 | 0.126 | 58.6 | 0.396 | - 47.7 |
| 1000 | 0.251 | - 154 | 3.419 | 81.2 | 0.135 | 59.4 | 0.377 | - 48.8 |
| 1100 | 0.247 | - 162 | 3.150 | 77.6 | 0.145 | 59.6 | 0.361 | - 50.2 |
| 1200 | 0.245 | - 170 | 2.919 | 74.2 | 0.155 | 59.6 | 0.350 | - 51.4 |
| 1300 | 0.245 | - 177 | 2.720 | 71.0 | 0.166 | 59.8 | 0.339 | - 53.2 |
| 1400 | 0.247 | 175 | 2.551 | 67.8 | 0.176 | 59.9 | 0.327 | - 54.6 |
| 1500 | 0.251 | 169 | 2.410 | 64.8 | 0.187 | 59.7 | 0.320 | - 56.1 |
| 1600 | 0.258 | 164 | 2.283 | 62.1 | 0.198 | 59.5 | 0.311 | - 58.2 |
| 1700 | 0.263 | 159 | 2.169 | 59.3 | 0.209 | 59.4 | 0.305 | - 59.8 |
| 1800 | 0.269 | 154 | 2.067 | 56.7 | 0.221 | 58.9 | 0.299 | - 62.4 |
| 1900 | 0.276 | 150 | 1.977 | 54.4 | 0.232 | 58.6 | 0.292 | - 64.9 |
| 2000 | 0.283 | 146 | 1.898 | 51.8 | 0.243 | 58.1 | 0.287 | - 67.0 |
| 2100 | 0.290 | 142 | 1.824 | 49.5 | 0.256 | 57.5 | 0.283 | - 69.6 |
| 2200 | 0.298 | 138 | 1.762 | 47.2 | 0.267 | 57.0 | 0.277 | - 72.9 |
| 2300 | 0.307 | 135 | 1.701 | 44.9 | 0.279 | 56.1 | 0.272 | - 75.1 |
| 2400 | 0.314 | 132 | 1.645 | 42.8 | 0.291 | 55.4 | 0.270 | - 78.7 |
| 2500 | 0.321 | 129 | 1.597 | 40.6 | 0.304 | 54.7 | 0.264 | - 81.3 |

S-PARAMETER

($V_{CE} = 8\text{ V}$, $I_C = 20\text{ mA}$, $Z_o = 50\ \Omega$)

| f MHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|----------|-----------------|--------|-----------------|------|-----------------|------|-----------------|--------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 100 | 0.310 | - 47.6 | 20.39 | 144. | 0.0218 | 77.0 | 0.798 | - 25.2 |
| 200 | 0.243 | - 82.1 | 14.87 | 123. | 0.0375 | 72.7 | 0.611 | - 37.8 |
| 300 | 0.205 | - 107 | 11.25 | 111. | 0.0514 | 71.4 | 0.488 | - 43.1 |
| 400 | 0.165 | - 125 | 8.95 | 102. | 0.0643 | 71.6 | 0.417 | - 45.1 |
| 500 | 0.172 | - 140 | 7.329 | 96.6 | 0.0777 | 71.5 | 0.365 | - 45.7 |
| 600 | 0.169 | - 153 | 6.232 | 91.6 | 0.0909 | 71.5 | 0.331 | - 45.8 |
| 700 | 0.166 | - 163 | 5.414 | 87.5 | 0.104 | 71.0 | 0.308 | - 46.5 |
| 800 | 0.169 | - 173 | 4.778 | 83.5 | 0.117 | 70.6 | 0.289 | - 47.3 |
| 900 | 0.172 | 179 | 4.3 | 80.2 | 0.130 | 70.0 | 0.274 | - 47.9 |
| 1000 | 0.176 | 172 | 3.902 | 77.1 | 0.143 | 69.3 | 0.262 | - 49.1 |
| 1100 | 0.182 | 166 | 3.576 | 74.1 | 0.156 | 68.6 | 0.251 | - 50.4 |
| 1200 | 0.188 | 160 | 3.310 | 71.2 | 0.169 | 67.7 | 0.244 | - 51.5 |
| 1300 | 0.194 | 156 | 3.080 | 68.7 | 0.182 | 66.7 | 0.235 | - 53.7 |
| 1400 | 0.202 | 151 | 2.875 | 66.0 | 0.195 | 66.0 | 0.227 | - 55.6 |
| 1500 | 0.209 | 147 | 2.711 | 63.4 | 0.208 | 64.9 | 0.221 | - 57.0 |
| 1600 | 0.217 | 144 | 2.564 | 61.0 | 0.221 | 63.9 | 0.213 | - 59.5 |
| 1700 | 0.224 | 140 | 2.431 | 58.6 | 0.234 | 62.8 | 0.209 | - 61.7 |
| 1800 | 0.233 | 137 | 2.315 | 56.4 | 0.247 | 61.7 | 0.204 | - 64.7 |
| 1900 | 0.240 | 134 | 2.212 | 54.2 | 0.259 | 60.8 | 0.197 | - 67.9 |
| 2000 | 0.247 | 132 | 2.123 | 52.0 | 0.272 | 59.8 | 0.193 | - 70.0 |
| 2100 | 0.255 | 129 | 2.037 | 49.8 | 0.284 | 58.3 | 0.188 | - 73.3 |
| 2200 | 0.263 | 126 | 1.965 | 47.7 | 0.296 | 57.2 | 0.183 | - 77.5 |
| 2300 | 0.272 | 124 | 1.896 | 45.7 | 0.309 | 56.1 | 0.179 | - 80.1 |
| 2400 | 0.278 | 122 | 1.833 | 43.7 | 0.321 | 54.8 | 0.177 | - 84.0 |
| 2500 | 0.286 | 120 | 1.778 | 41.7 | 0.332 | 53.7 | 0.171 | - 87.7 |



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