

MICROWAVE LOW NOISE AMPLIFIER  
NPN SILICON EPITAXIAL TRANSISTOR  
4 PINS MINI MOLD

## FEATURES

- Low Voltage Operation, Low Phase Distortion
- Low Noise  
 $NF = 1.5 \text{ dB TYP. @ } V_{CE} = 3 \text{ V, } I_c = 7 \text{ mA, } f = 2 \text{ GHz}$   
 $NF = 1.7 \text{ dB TYP. @ } V_{CE} = 1 \text{ V, } I_c = 3 \text{ mA, } f = 2 \text{ GHz}$
- Large Absolute Maximum Collector Current  
 $I_c = 100 \text{ mA}$
- 4-Pin Mini Mold Package  
EIAJ: SC-61

## ORDERING INFORMATION

| PART NUMBER | QUANTITY    | PACKING STYLE                                                                                        |
|-------------|-------------|------------------------------------------------------------------------------------------------------|
| 2SC5192-T1  | 3 Kpcs/Reel | Embossed tape 8 mm wide.<br>Pin 3 (Base), Pin 4 (Emitter) face to perforation side of the tape.      |
| 2SC5192-T2  | 3 Kpcs/Reel | Embossed tape 8 mm wide.<br>Pin 1 (Collector), Pin 2 (Emitter) face to perforation side of the tape. |

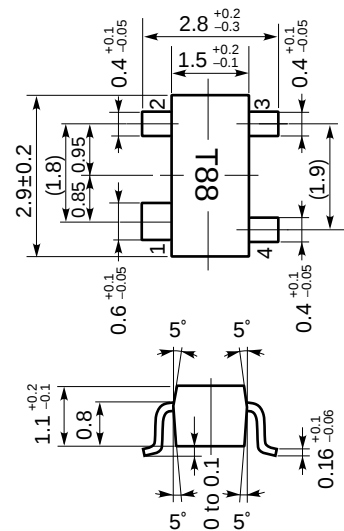
**Remark** If you require an evaluation sample, please contact an NEC Sales Representative. (Unit sample quantity is 50 pcs.)

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

| PARAMETER                    | SYMBOL    | RATING      | UNIT             |
|------------------------------|-----------|-------------|------------------|
| 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            | $I_c$     | 100         | mA               |
| Total Power Dissipation      | $P_T$     | 200         | mW               |
| Junction Temperature         | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage Temperature          | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$ |

## PACKAGE DRAWINGS

(Unit: mm)



## PIN CONNECTIONS

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

This device uses radio frequency technology. Take due precautions to protect it from excessive input levels such as static electricity.

**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

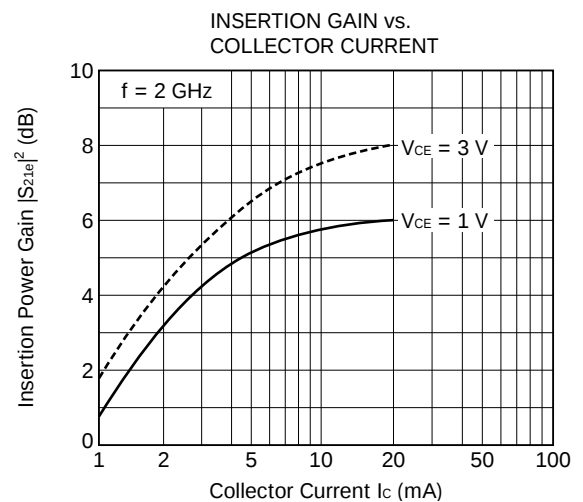
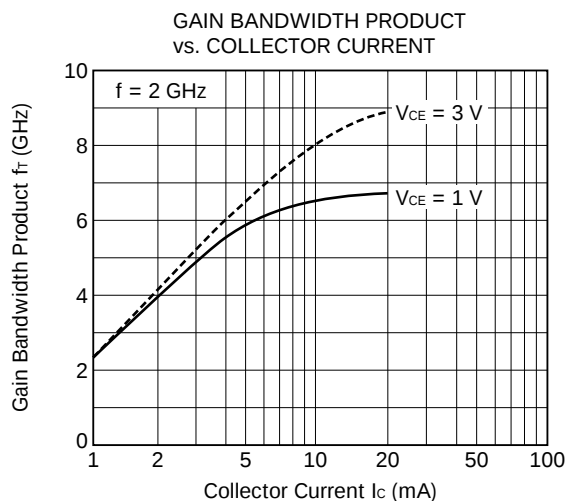
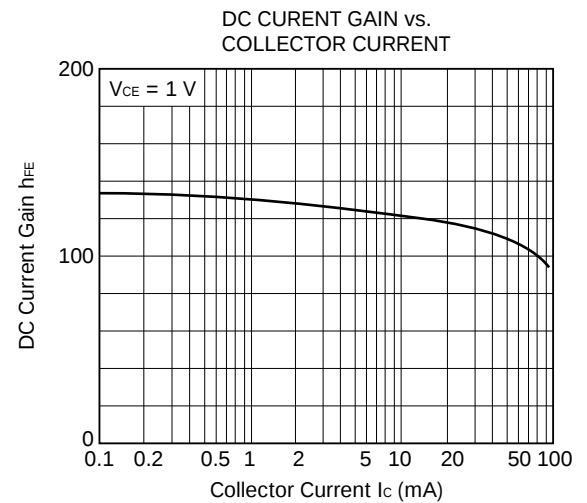
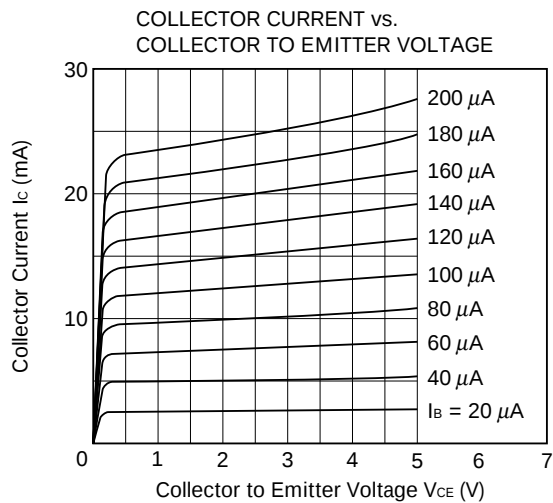
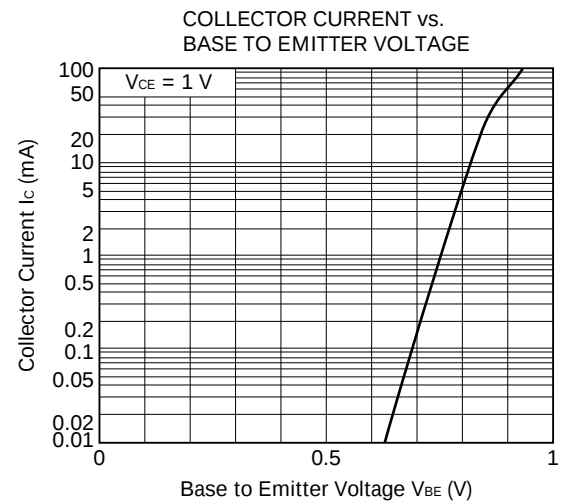
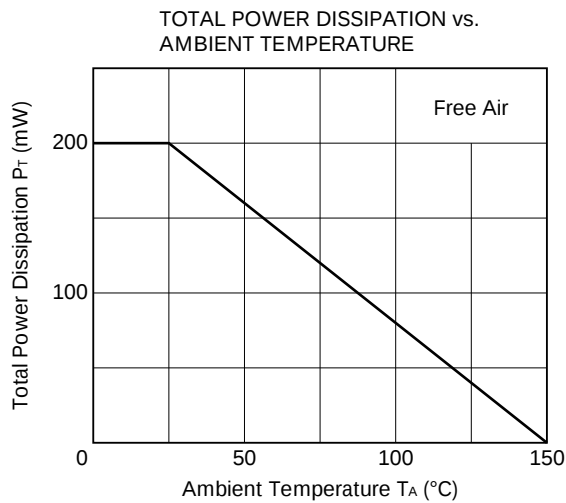
| PARAMETER                  | SYMBOL                          | CONDITION                                                            | MIN. | TYP. | MAX. | UNIT |
|----------------------------|---------------------------------|----------------------------------------------------------------------|------|------|------|------|
| Collector Cutoff Current   | I <sub>CBO</sub>                | V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0                            |      |      | 100  | nA   |
| Emitter Cutoff Current     | I <sub>EBO</sub>                | V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0                            |      |      | 100  | nA   |
| DC Current Gain            | h <sub>FE</sub>                 | V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA <b>Note 1</b>           | 80   |      | 160  |      |
| Insertion Power Gain (1)   | S <sub>21e</sub>   <sup>2</sup> | V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz            | 3    | 4.0  |      | dB   |
| Insertion Power Gain (2)   | S <sub>21e</sub>   <sup>2</sup> | V <sub>CE</sub> = 3 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz           |      | 8    |      | dB   |
| Noise Figure (1)           | NF                              | V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz            |      | 1.7  | 2.5  | dB   |
| Noise Figure (2)           | NF                              | V <sub>CE</sub> = 3 V, I <sub>C</sub> = 7 mA, f = 2.0 GHz            |      | 1.5  |      | dB   |
| Gain Bandwidth Product (1) | f <sub>T</sub>                  | V <sub>CE</sub> = 1 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz            | 4    | 4.5  |      | GHz  |
| Gain Bandwidth Product (2) | f <sub>T</sub>                  | V <sub>CE</sub> = 3 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz           |      | 9    |      | GHz  |
| Collector Capacitance      | C <sub>re</sub>                 | V <sub>CB</sub> = 1 V, I <sub>E</sub> = 0, f = 1.0 MHz <b>Note 2</b> |      | 0.65 | 0.8  | pF   |

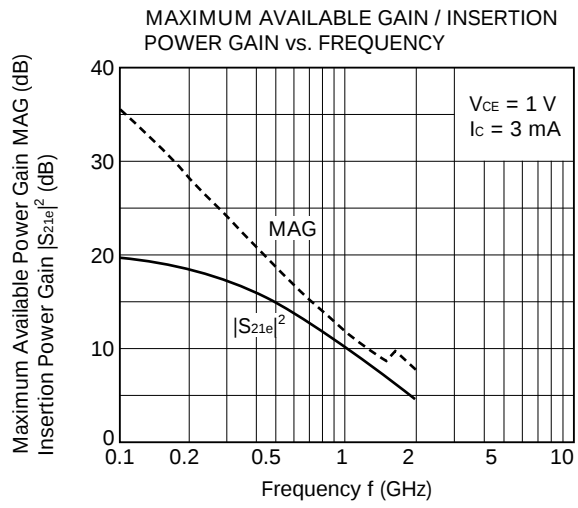
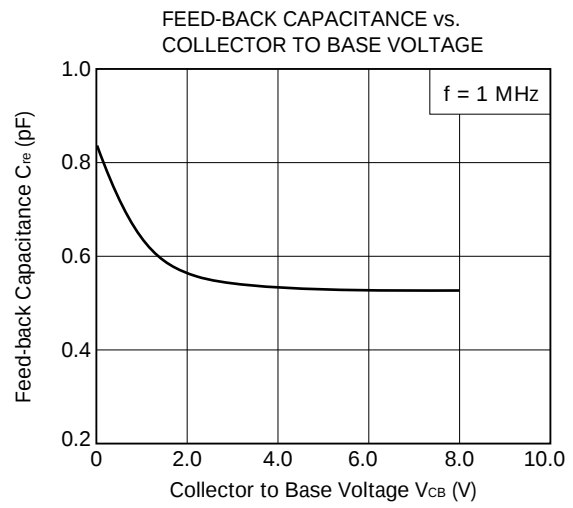
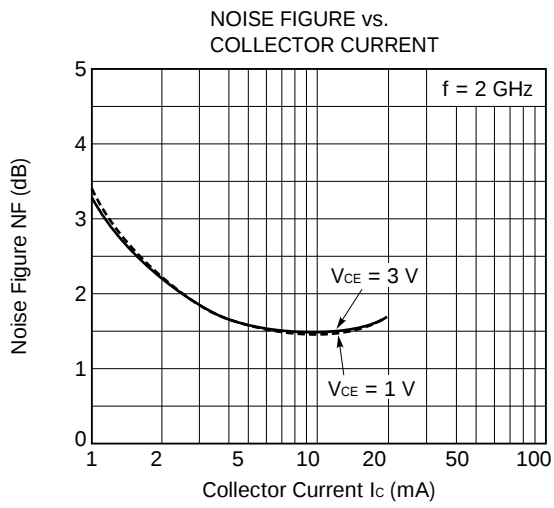
**Notes 1.** Pulse Measurement: PW ≤ 350 μs, Duty cycle ≤ 2 %, Pulsed

**2.** Measured with 3-pin bridge, emitter and case should be connected to guard pin of bridge.

**h<sub>FE</sub> Classification**

|                 |           |
|-----------------|-----------|
| Rank            | FB        |
| Marking         | T88       |
| h <sub>FE</sub> | 80 to 160 |

TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )



**S-PARAMETERS** $V_{CE} = 1 \text{ V}$ ,  $I_C = 1 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY |       | S <sub>11</sub> |       | S <sub>21</sub> |       | S <sub>12</sub> |       | S <sub>22</sub> |  |
|-----------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|--|
| (MHz)     | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             |  |
| 100.00    | 0.963 | -17.1           | 3.502 | 166.5           | 0.048 | 79.4            | 0.983 | -8.7            |  |
| 200.00    | 0.934 | -34.1           | 3.413 | 154.0           | 0.087 | 69.6            | 0.957 | -17.1           |  |
| 300.00    | 0.890 | -49.7           | 3.238 | 142.6           | 0.130 | 60.0            | 0.906 | -25.2           |  |
| 400.00    | 0.850 | -65.3           | 3.026 | 131.1           | 0.156 | 50.7            | 0.851 | -31.8           |  |
| 500.00    | 0.806 | -79.9           | 2.825 | 120.8           | 0.178 | 41.8            | 0.801 | -38.3           |  |
| 600.00    | 0.760 | -92.6           | 2.598 | 111.3           | 0.198 | 37.0            | 0.744 | -43.5           |  |
| 700.00    | 0.722 | -104.8          | 2.419 | 103.0           | 0.209 | 31.0            | 0.702 | -47.8           |  |
| 800.00    | 0.695 | -116.4          | 2.238 | 95.5            | 0.221 | 25.2            | 0.646 | -51.5           |  |
| 900.00    | 0.670 | -127.6          | 2.102 | 87.9            | 0.223 | 20.9            | 0.615 | -55.8           |  |
| 1000.00   | 0.643 | -137.1          | 1.932 | 81.4            | 0.224 | 18.6            | 0.575 | -58.7           |  |
| 1100.00   | 0.631 | -147.2          | 1.820 | 75.3            | 0.230 | 14.2            | 0.544 | -62.1           |  |
| 1200.00   | 0.626 | -155.6          | 1.695 | 69.8            | 0.222 | 10.8            | 0.520 | -66.3           |  |
| 1300.00   | 0.627 | -164.2          | 1.611 | 64.4            | 0.222 | 8.4             | 0.497 | -69.0           |  |
| 1400.00   | 0.623 | -172.5          | 1.518 | 58.6            | 0.217 | 7.0             | 0.482 | -72.9           |  |
| 1500.00   | 0.628 | -179.3          | 1.432 | 54.0            | 0.217 | 2.9             | 0.468 | -75.9           |  |
| 1600.00   | 0.630 | 175.7           | 1.364 | 49.7            | 0.212 | 2.0             | 0.450 | -80.1           |  |
| 1700.00   | 0.625 | 168.3           | 1.280 | 45.0            | 0.202 | 1.0             | 0.442 | -82.8           |  |
| 1800.00   | 0.629 | 162.8           | 1.223 | 41.3            | 0.201 | 0.0             | 0.433 | -88.1           |  |
| 1900.00   | 0.629 | 157.5           | 1.168 | 37.2            | 0.190 | -1.6            | 0.417 | -89.2           |  |
| 2000.00   | 0.634 | 152.4           | 1.112 | 33.4            | 0.189 | -0.7            | 0.419 | -94.2           |  |

 $V_{CE} = 1 \text{ V}$ ,  $I_C = 3 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY |       | S <sub>11</sub> |       | S <sub>21</sub> |       | S <sub>12</sub> |       | S <sub>22</sub> |  |
|-----------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|--|
| (MHz)     | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             |  |
| 100.00    | 0.886 | -28.0           | 9.515 | 159.3           | 0.044 | 74.9            | 0.943 | -17.6           |  |
| 200.00    | 0.809 | -54.2           | 8.567 | 141.9           | 0.078 | 64.0            | 0.847 | -32.1           |  |
| 300.00    | 0.734 | -75.4           | 7.425 | 128.1           | 0.103 | 52.3            | 0.734 | -44.8           |  |
| 400.00    | 0.661 | -94.8           | 6.367 | 116.2           | 0.122 | 44.4            | 0.630 | -53.5           |  |
| 500.00    | 0.608 | -110.6          | 5.529 | 106.7           | 0.130 | 39.1            | 0.547 | -61.0           |  |
| 600.00    | 0.568 | -124.2          | 4.813 | 98.7            | 0.136 | 35.6            | 0.484 | -66.5           |  |
| 700.00    | 0.544 | -136.4          | 4.278 | 92.0            | 0.144 | 33.4            | 0.434 | -70.6           |  |
| 800.00    | 0.531 | -147.4          | 3.841 | 86.0            | 0.145 | 30.7            | 0.381 | -76.2           |  |
| 900.00    | 0.520 | -157.3          | 3.473 | 80.1            | 0.152 | 30.1            | 0.350 | -78.8           |  |
| 1000.00   | 0.517 | -165.2          | 3.151 | 75.3            | 0.160 | 29.5            | 0.316 | -83.6           |  |
| 1100.00   | 0.506 | 174.0           | 2.905 | 70.6            | 0.163 | 27.3            | 0.293 | -89.0           |  |
| 1200.00   | 0.511 | 179.5           | 2.670 | 66.4            | 0.166 | 26.0            | 0.270 | -92.9           |  |
| 1300.00   | 0.520 | 172.5           | 2.506 | 61.9            | 0.168 | 26.8            | 0.253 | -98.5           |  |
| 1400.00   | 0.526 | 166.5           | 2.330 | 57.6            | 0.170 | 26.3            | 0.250 | -101.9          |  |
| 1500.00   | 0.533 | 161.0           | 2.181 | 53.8            | 0.173 | 25.8            | 0.233 | -106.6          |  |
| 1600.00   | 0.532 | 157.2           | 2.054 | 50.6            | 0.177 | 26.1            | 0.228 | -112.2          |  |
| 1700.00   | 0.543 | 151.0           | 1.921 | 47.0            | 0.181 | 23.7            | 0.219 | -117.6          |  |
| 1800.00   | 0.553 | 146.8           | 1.834 | 43.6            | 0.187 | 22.5            | 0.223 | -124.8          |  |
| 1900.00   | 0.563 | 143.0           | 1.734 | 40.4            | 0.191 | 24.6            | 0.201 | -127.3          |  |
| 2000.00   | 0.566 | 138.0           | 1.661 | 37.2            | 0.192 | 24.9            | 0.208 | -133.2          |  |

$V_{CE} = 1 \text{ V}$ ,  $I_C = 5 \text{ mA}$ ,  $Z_O = 50 \Omega$

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |        |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG    |
| 100.00             | 0.823           | -37.1  | 13.981          | 153.6 | 0.044           | 70.4 | 0.904           | -25.0  |
| 200.00             | 0.715           | -68.3  | 11.672          | 133.5 | 0.073           | 56.9 | 0.762           | -43.3  |
| 300.00             | 0.633           | -92.2  | 9.511           | 119.4 | 0.086           | 48.9 | 0.612           | -58.0  |
| 400.00             | 0.566           | -112.0 | 7.794           | 108.2 | 0.103           | 43.7 | 0.508           | -66.4  |
| 500.00             | 0.525           | -127.9 | 6.574           | 99.7  | 0.106           | 41.1 | 0.427           | -74.9  |
| 600.00             | 0.504           | -141.1 | 5.620           | 92.7  | 0.114           | 39.9 | 0.367           | -81.4  |
| 700.00             | 0.487           | -152.3 | 4.927           | 86.7  | 0.121           | 39.5 | 0.331           | -86.5  |
| 800.00             | 0.483           | -161.7 | 4.373           | 81.5  | 0.132           | 37.8 | 0.286           | -93.8  |
| 900.00             | 0.477           | -171.1 | 3.928           | 76.6  | 0.132           | 36.2 | 0.261           | -99.0  |
| 1000.00            | 0.482           | -177.9 | 3.550           | 72.3  | 0.141           | 37.9 | 0.240           | -101.7 |
| 1100.00            | 0.483           | 174.7  | 3.252           | 68.1  | 0.144           | 36.4 | 0.222           | -110.7 |
| 1200.00            | 0.487           | 169.3  | 2.984           | 64.5  | 0.153           | 36.8 | 0.210           | -115.2 |
| 1300.00            | 0.496           | 163.0  | 2.794           | 60.3  | 0.161           | 36.4 | 0.190           | -121.5 |
| 1400.00            | 0.504           | 157.9  | 2.590           | 56.4  | 0.169           | 35.1 | 0.199           | -127.7 |
| 1500.00            | 0.521           | 152.8  | 2.420           | 52.8  | 0.175           | 35.4 | 0.188           | -132.5 |
| 1600.00            | 0.524           | 150.2  | 2.282           | 49.9  | 0.181           | 33.1 | 0.184           | -139.9 |
| 1700.00            | 0.529           | 144.0  | 2.127           | 46.6  | 0.191           | 32.0 | 0.174           | -146.3 |
| 1800.00            | 0.540           | 141.0  | 2.031           | 43.5  | 0.201           | 30.6 | 0.199           | -152.2 |
| 1900.00            | 0.547           | 137.1  | 1.913           | 40.5  | 0.204           | 30.3 | 0.180           | -161.7 |
| 2000.00            | 0.551           | 133.2  | 1.829           | 37.7  | 0.202           | 31.4 | 0.184           | -163.4 |

$V_{CE} = 1 \text{ V}$ ,  $I_C = 7 \text{ mA}$ ,  $Z_O = 50 \Omega$

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |        |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG    |
| 100.00             | 0.741           | -46.4  | 17.962          | 148.1 | 0.038           | 63.9 | 0.844           | -31.3  |
| 200.00             | 0.630           | -81.9  | 13.958          | 126.6 | 0.064           | 55.5 | 0.671           | -53.0  |
| 300.00             | 0.554           | -106.4 | 10.862          | 112.9 | 0.077           | 47.6 | 0.524           | -68.1  |
| 400.00             | 0.506           | -126.3 | 8.635           | 102.7 | 0.087           | 44.3 | 0.416           | -77.7  |
| 500.00             | 0.475           | -141.7 | 7.161           | 95.2  | 0.096           | 43.7 | 0.352           | -86.7  |
| 600.00             | 0.465           | -153.6 | 6.072           | 88.9  | 0.105           | 43.5 | 0.303           | -95.3  |
| 700.00             | 0.462           | -163.4 | 5.283           | 83.6  | 0.111           | 43.4 | 0.267           | -100.2 |
| 800.00             | 0.458           | -172.3 | 4.672           | 78.9  | 0.121           | 43.2 | 0.233           | -108.2 |
| 900.00             | 0.462           | -179.7 | 4.168           | 74.3  | 0.127           | 42.7 | 0.214           | -113.6 |
| 1000.00            | 0.465           | 173.6  | 3.769           | 70.5  | 0.135           | 44.4 | 0.199           | -120.9 |
| 1100.00            | 0.466           | 167.5  | 3.443           | 66.6  | 0.139           | 41.7 | 0.190           | -129.1 |
| 1200.00            | 0.477           | 162.8  | 3.161           | 63.2  | 0.156           | 42.0 | 0.195           | -136.0 |
| 1300.00            | 0.490           | 156.6  | 2.954           | 59.3  | 0.161           | 42.1 | 0.181           | -142.3 |
| 1400.00            | 0.501           | 152.0  | 2.728           | 55.6  | 0.171           | 40.3 | 0.181           | -147.5 |
| 1500.00            | 0.509           | 147.8  | 2.551           | 52.4  | 0.184           | 38.7 | 0.190           | -153.3 |
| 1600.00            | 0.516           | 145.1  | 2.398           | 49.4  | 0.183           | 39.4 | 0.188           | -162.7 |
| 1700.00            | 0.520           | 140.0  | 2.235           | 46.3  | 0.198           | 36.7 | 0.188           | -165.2 |
| 1800.00            | 0.530           | 137.3  | 2.133           | 43.4  | 0.202           | 36.3 | 0.205           | -173.6 |
| 1900.00            | 0.547           | 133.1  | 2.014           | 40.4  | 0.208           | 34.6 | 0.196           | -178.2 |
| 2000.00            | 0.546           | 129.5  | 1.912           | 37.6  | 0.212           | 34.8 | 0.199           | -179.5 |

$V_{CE} = 1 \text{ V}$ ,  $I_C = 10 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY |       | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |       | S <sub>22</sub> |  |
|-----------|-------|-----------------|--------|-----------------|-------|-----------------|-------|-----------------|--|
| (MHz)     | MAG   | ANG             | MAG    | ANG             | MAG   | ANG             | MAG   | ANG             |  |
| 100.00    | 0.676 | -56.3           | 21.704 | 142.6           | 0.038 | 66.7            | 0.798 | -38.5           |  |
| 200.00    | 0.561 | -95.4           | 15.685 | 120.5           | 0.058 | 54.2            | 0.593 | -62.6           |  |
| 300.00    | 0.498 | -120.2          | 11.740 | 107.7           | 0.069 | 50.1            | 0.443 | -78.3           |  |
| 400.00    | 0.467 | -138.8          | 9.163  | 98.5            | 0.077 | 46.5            | 0.350 | -88.7           |  |
| 500.00    | 0.453 | -152.8          | 7.523  | 91.7            | 0.085 | 48.5            | 0.304 | -99.0           |  |
| 600.00    | 0.452 | -163.7          | 6.335  | 86.0            | 0.094 | 48.3            | 0.260 | -107.8          |  |
| 700.00    | 0.449 | -172.6          | 5.494  | 81.2            | 0.106 | 49.4            | 0.231 | -114.9          |  |
| 800.00    | 0.452 | 179.8           | 4.847  | 76.8            | 0.119 | 47.6            | 0.213 | -123.1          |  |
| 900.00    | 0.451 | 172.9           | 4.318  | 72.6            | 0.123 | 47.7            | 0.194 | -131.3          |  |
| 1000.00   | 0.458 | 167.1           | 3.891  | 69.1            | 0.136 | 47.0            | 0.188 | -135.6          |  |
| 1100.00   | 0.467 | 161.4           | 3.550  | 65.3            | 0.146 | 46.9            | 0.189 | -145.9          |  |
| 1200.00   | 0.476 | 157.5           | 3.251  | 62.2            | 0.155 | 45.1            | 0.187 | -152.3          |  |
| 1300.00   | 0.482 | 152.5           | 3.045  | 58.5            | 0.164 | 45.0            | 0.185 | -158.8          |  |
| 1400.00   | 0.502 | 148.6           | 2.809  | 54.8            | 0.173 | 44.0            | 0.198 | -161.4          |  |
| 1500.00   | 0.507 | 144.6           | 2.638  | 51.8            | 0.181 | 43.0            | 0.194 | -170.2          |  |
| 1600.00   | 0.512 | 142.1           | 2.471  | 49.0            | 0.191 | 41.3            | 0.205 | -174.3          |  |
| 1700.00   | 0.527 | 137.6           | 2.310  | 45.9            | 0.197 | 39.2            | 0.212 | -178.3          |  |
| 1800.00   | 0.527 | 133.8           | 2.196  | 43.6            | 0.209 | 38.1            | 0.228 | 177.2           |  |
| 1900.00   | 0.543 | 130.8           | 2.065  | 40.6            | 0.217 | 37.3            | 0.224 | 169.1           |  |
| 2000.00   | 0.545 | 126.7           | 1.974  | 38.1            | 0.223 | 35.5            | 0.234 | 168.6           |  |

 $V_{CE} = 3 \text{ V}$ ,  $I_C = 1 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY |       | S <sub>11</sub> |       | S <sub>21</sub> |       | S <sub>12</sub> |       | S <sub>22</sub> |  |
|-----------|-------|-----------------|-------|-----------------|-------|-----------------|-------|-----------------|--|
| (MHz)     | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             | MAG   | ANG             |  |
| 100.00    | 0.965 | -14.8           | 3.499 | 168.1           | 0.034 | 82.6            | 0.987 | -6.7            |  |
| 200.00    | 0.944 | -29.7           | 3.439 | 157.3           | 0.066 | 72.1            | 0.969 | -13.1           |  |
| 300.00    | 0.916 | -43.8           | 3.305 | 147.1           | 0.093 | 64.7            | 0.940 | -19.3           |  |
| 400.00    | 0.868 | -57.8           | 3.130 | 136.5           | 0.116 | 55.3            | 0.898 | -24.8           |  |
| 500.00    | 0.831 | -71.2           | 2.978 | 126.8           | 0.136 | 48.8            | 0.855 | -29.8           |  |
| 600.00    | 0.785 | -83.5           | 2.769 | 117.8           | 0.150 | 41.7            | 0.816 | -34.8           |  |
| 700.00    | 0.742 | -95.4           | 2.610 | 109.8           | 0.167 | 37.0            | 0.778 | -37.8           |  |
| 800.00    | 0.712 | -106.8          | 2.435 | 102.4           | 0.172 | 32.5            | 0.728 | -41.7           |  |
| 900.00    | 0.685 | -117.6          | 2.307 | 95.0            | 0.180 | 26.4            | 0.703 | -44.6           |  |
| 1000.00   | 0.656 | -127.8          | 2.133 | 88.3            | 0.183 | 22.1            | 0.667 | -47.4           |  |
| 1100.00   | 0.641 | -137.8          | 2.029 | 82.3            | 0.182 | 19.2            | 0.637 | -50.3           |  |
| 1200.00   | 0.631 | -146.7          | 1.881 | 76.7            | 0.180 | 16.9            | 0.609 | -53.6           |  |
| 1300.00   | 0.625 | -155.8          | 1.801 | 71.4            | 0.179 | 13.1            | 0.592 | -56.1           |  |
| 1400.00   | 0.622 | -164.7          | 1.703 | 65.7            | 0.176 | 9.9             | 0.577 | -59.2           |  |
| 1500.00   | 0.627 | -172.0          | 1.605 | 61.0            | 0.176 | 9.6             | 0.561 | -61.7           |  |
| 1600.00   | 0.622 | -177.2          | 1.520 | 56.3            | 0.170 | 9.2             | 0.543 | -64.7           |  |
| 1700.00   | 0.623 | 174.5           | 1.434 | 51.9            | 0.167 | 6.5             | 0.531 | -67.1           |  |
| 1800.00   | 0.615 | 168.2           | 1.369 | 48.1            | 0.166 | 7.6             | 0.516 | -71.0           |  |
| 1900.00   | 0.621 | 162.9           | 1.310 | 44.2            | 0.159 | 6.4             | 0.505 | -73.2           |  |
| 2000.00   | 0.618 | 157.0           | 1.257 | 39.8            | 0.157 | 6.8             | 0.505 | -74.4           |  |

$V_{CE} = 3 \text{ V}$ ,  $I_C = 3 \text{ mA}$ ,  $Z_O = 50 \Omega$

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |       |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|-------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG   |
| 100.00             | 0.898           | -23.3  | 9.607           | 162.0 | 0.033           | 75.5 | 0.956           | -13.1 |
| 200.00             | 0.834           | -45.3  | 8.890           | 146.4 | 0.059           | 65.2 | 0.892           | -24.3 |
| 300.00             | 0.758           | -64.2  | 7.932           | 133.5 | 0.081           | 54.5 | 0.801           | -33.8 |
| 400.00             | 0.682           | -82.0  | 6.964           | 121.9 | 0.095           | 49.4 | 0.711           | -40.6 |
| 500.00             | 0.623           | -97.2  | 6.174           | 112.4 | 0.105           | 44.9 | 0.636           | -46.5 |
| 600.00             | 0.570           | -110.9 | 5.436           | 104.2 | 0.110           | 41.7 | 0.573           | -50.9 |
| 700.00             | 0.533           | -122.3 | 4.874           | 97.3  | 0.120           | 37.4 | 0.522           | -54.1 |
| 800.00             | 0.511           | -134.8 | 4.398           | 91.2  | 0.122           | 35.7 | 0.474           | -56.7 |
| 900.00             | 0.493           | -145.1 | 4.012           | 85.4  | 0.127           | 33.8 | 0.443           | -59.2 |
| 1000.00            | 0.477           | -153.9 | 3.648           | 80.2  | 0.132           | 31.9 | 0.407           | -61.6 |
| 1100.00            | 0.477           | -163.5 | 3.380           | 75.5  | 0.136           | 33.6 | 0.383           | -64.3 |
| 1200.00            | 0.471           | -170.6 | 3.099           | 71.2  | 0.137           | 31.5 | 0.357           | -66.9 |
| 1300.00            | 0.479           | -178.8 | 2.915           | 66.9  | 0.141           | 32.2 | 0.337           | -69.8 |
| 1400.00            | 0.486           | 174.1  | 2.724           | 62.7  | 0.149           | 30.1 | 0.325           | -72.3 |
| 1500.00            | 0.492           | 167.4  | 2.554           | 58.6  | 0.149           | 30.6 | 0.311           | -75.4 |
| 1600.00            | 0.493           | 164.1  | 2.399           | 55.3  | 0.152           | 29.4 | 0.298           | -79.1 |
| 1700.00            | 0.498           | 156.6  | 2.247           | 51.7  | 0.164           | 31.3 | 0.290           | -80.7 |
| 1800.00            | 0.503           | 152.4  | 2.144           | 48.2  | 0.165           | 29.4 | 0.274           | -89.1 |
| 1900.00            | 0.513           | 148.8  | 2.032           | 44.9  | 0.169           | 30.0 | 0.253           | -88.2 |
| 2000.00            | 0.519           | 143.3  | 1.944           | 41.8  | 0.170           | 29.8 | 0.250           | -91.9 |

$V_{CE} = 3 \text{ V}$ ,  $I_C = 5 \text{ mA}$ ,  $Z_O = 50 \Omega$

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |        |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG    |
| 100.00             | 0.839           | -29.8  | 14.278          | 157.2 | 0.031           | 77.2 | 0.935           | -17.7  |
| 200.00             | 0.736           | -56.5  | 12.457          | 138.9 | 0.053           | 65.0 | 0.819           | -31.9  |
| 300.00             | 0.651           | -77.6  | 10.528          | 125.1 | 0.071           | 56.2 | 0.694           | -42.5  |
| 400.00             | 0.568           | -96.3  | 8.837           | 113.9 | 0.081           | 48.5 | 0.594           | -48.9  |
| 500.00             | 0.515           | -111.8 | 7.559           | 105.1 | 0.091           | 46.6 | 0.515           | -54.8  |
| 600.00             | 0.471           | -125.7 | 6.524           | 97.8  | 0.094           | 44.8 | 0.452           | -58.9  |
| 700.00             | 0.445           | -137.6 | 5.768           | 91.7  | 0.101           | 41.4 | 0.408           | -61.3  |
| 800.00             | 0.436           | -148.3 | 5.134           | 86.4  | 0.107           | 41.0 | 0.363           | -64.6  |
| 900.00             | 0.422           | -158.6 | 4.637           | 81.3  | 0.112           | 40.5 | 0.335           | -66.8  |
| 1000.00            | 0.421           | -166.4 | 4.199           | 76.8  | 0.120           | 40.8 | 0.308           | -69.0  |
| 1100.00            | 0.416           | 175.0  | 3.864           | 72.8  | 0.123           | 40.9 | 0.281           | -71.7  |
| 1200.00            | 0.422           | 178.6  | 3.540           | 68.9  | 0.136           | 41.3 | 0.263           | -75.9  |
| 1300.00            | 0.430           | 171.7  | 3.320           | 64.9  | 0.142           | 40.1 | 0.245           | -80.3  |
| 1400.00            | 0.439           | 165.9  | 3.085           | 61.1  | 0.145           | 40.3 | 0.241           | -81.6  |
| 1500.00            | 0.451           | 159.6  | 2.888           | 57.6  | 0.154           | 40.3 | 0.227           | -86.3  |
| 1600.00            | 0.457           | 156.3  | 2.718           | 54.6  | 0.157           | 38.4 | 0.211           | -90.4  |
| 1700.00            | 0.464           | 149.7  | 2.539           | 51.2  | 0.164           | 37.3 | 0.202           | -92.0  |
| 1800.00            | 0.467           | 145.7  | 2.410           | 48.2  | 0.170           | 36.8 | 0.194           | -102.8 |
| 1900.00            | 0.483           | 141.5  | 2.286           | 45.1  | 0.173           | 36.1 | 0.172           | -102.5 |
| 2000.00            | 0.485           | 137.6  | 2.183           | 42.0  | 0.181           | 35.6 | 0.173           | -107.3 |

$V_{CE} = 3 \text{ V}$ ,  $I_C = 7 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |        |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG    |
| 100.00             | 0.769           | -35.8  | 18.610          | 152.6 | 0.026           | 73.9 | 0.890           | -22.5  |
| 200.00             | 0.658           | -66.3  | 15.310          | 132.5 | 0.051           | 59.8 | 0.743           | -38.5  |
| 300.00             | 0.561           | -88.8  | 12.331          | 118.8 | 0.061           | 53.2 | 0.604           | -49.4  |
| 400.00             | 0.485           | -107.9 | 10.032          | 108.3 | 0.071           | 51.0 | 0.504           | -55.6  |
| 500.00             | 0.444           | -124.0 | 8.438           | 100.3 | 0.076           | 48.0 | 0.423           | -60.5  |
| 600.00             | 0.411           | -137.7 | 7.186           | 93.6  | 0.084           | 49.0 | 0.371           | -64.1  |
| 700.00             | 0.397           | -148.5 | 6.299           | 88.2  | 0.093           | 46.8 | 0.327           | -66.8  |
| 800.00             | 0.395           | -158.2 | 5.583           | 83.4  | 0.101           | 47.6 | 0.290           | -70.2  |
| 900.00             | 0.386           | -167.9 | 5.020           | 78.8  | 0.106           | 48.0 | 0.268           | -73.3  |
| 1000.00            | 0.389           | -175.7 | 4.526           | 74.7  | 0.118           | 44.9 | 0.245           | -75.7  |
| 1100.00            | 0.392           | 176.0  | 4.151           | 70.8  | 0.126           | 44.6 | 0.226           | -79.4  |
| 1200.00            | 0.396           | 170.9  | 3.801           | 67.5  | 0.131           | 45.8 | 0.203           | -83.8  |
| 1300.00            | 0.404           | 164.8  | 3.555           | 63.7  | 0.140           | 44.1 | 0.195           | -87.1  |
| 1400.00            | 0.417           | 158.7  | 3.304           | 60.1  | 0.150           | 45.1 | 0.189           | -92.1  |
| 1500.00            | 0.426           | 153.6  | 3.091           | 56.6  | 0.157           | 45.6 | 0.177           | -96.9  |
| 1600.00            | 0.432           | 151.9  | 2.906           | 53.9  | 0.162           | 42.7 | 0.168           | -103.4 |
| 1700.00            | 0.443           | 145.2  | 2.712           | 50.6  | 0.173           | 41.8 | 0.160           | -106.6 |
| 1800.00            | 0.446           | 141.4  | 2.588           | 48.1  | 0.179           | 41.6 | 0.157           | -115.7 |
| 1900.00            | 0.466           | 137.6  | 2.435           | 45.2  | 0.182           | 41.7 | 0.141           | -120.9 |
| 2000.00            | 0.470           | 133.4  | 2.339           | 42.2  | 0.192           | 37.3 | 0.146           | -125.3 |

 $V_{CE} = 3 \text{ V}$ ,  $I_C = 10 \text{ mA}$ ,  $Z_O = 50 \Omega$ 

| FREQUENCY<br>(MHz) | S <sub>11</sub> |        | S <sub>21</sub> |       | S <sub>12</sub> |      | S <sub>22</sub> |        |
|--------------------|-----------------|--------|-----------------|-------|-----------------|------|-----------------|--------|
|                    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG  | MAG             | ANG    |
| 100.00             | 0.698           | -42.9  | 22.901          | 147.9 | 0.025           | 67.3 | 0.849           | -26.9  |
| 200.00             | 0.570           | -77.2  | 17.709          | 126.7 | 0.042           | 60.5 | 0.666           | -44.8  |
| 300.00             | 0.482           | -100.1 | 13.726          | 113.5 | 0.055           | 53.5 | 0.527           | -55.1  |
| 400.00             | 0.424           | -119.5 | 10.922          | 103.8 | 0.066           | 52.4 | 0.424           | -60.8  |
| 500.00             | 0.391           | -134.8 | 9.033           | 96.5  | 0.073           | 52.7 | 0.359           | -66.2  |
| 600.00             | 0.370           | -147.6 | 7.653           | 90.6  | 0.083           | 52.2 | 0.307           | -69.7  |
| 700.00             | 0.364           | -158.4 | 6.669           | 85.5  | 0.090           | 53.4 | 0.276           | -72.5  |
| 800.00             | 0.361           | -167.4 | 5.894           | 81.1  | 0.097           | 52.7 | 0.243           | -75.0  |
| 900.00             | 0.363           | -176.0 | 5.278           | 76.9  | 0.107           | 51.5 | 0.223           | -79.0  |
| 1000.00            | 0.366           | 177.1  | 4.764           | 73.1  | 0.113           | 50.6 | 0.201           | -79.3  |
| 1100.00            | 0.368           | 170.5  | 4.356           | 69.6  | 0.123           | 50.9 | 0.182           | -85.7  |
| 1200.00            | 0.378           | 165.3  | 3.992           | 66.4  | 0.129           | 50.8 | 0.174           | -94.5  |
| 1300.00            | 0.391           | 159.7  | 3.733           | 62.8  | 0.138           | 49.8 | 0.156           | -96.1  |
| 1400.00            | 0.402           | 154.4  | 3.461           | 59.4  | 0.151           | 47.6 | 0.158           | -101.5 |
| 1500.00            | 0.417           | 150.4  | 3.221           | 56.2  | 0.162           | 47.2 | 0.149           | -107.4 |
| 1600.00            | 0.420           | 147.3  | 3.035           | 53.6  | 0.164           | 46.2 | 0.138           | -117.4 |
| 1700.00            | 0.431           | 142.1  | 2.831           | 50.6  | 0.172           | 44.9 | 0.135           | -120.2 |
| 1800.00            | 0.434           | 138.4  | 2.703           | 47.7  | 0.179           | 44.2 | 0.142           | -130.9 |
| 1900.00            | 0.454           | 135.4  | 2.547           | 45.0  | 0.189           | 43.0 | 0.126           | -137.6 |
| 2000.00            | 0.461           | 130.8  | 2.434           | 42.1  | 0.196           | 40.8 | 0.127           | -143.0 |

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