

**NPN SILICON EPITAXIAL TRANSISTOR  
3 PINS ULTRA SUPER MINI MOLD****DESCRIPTION**

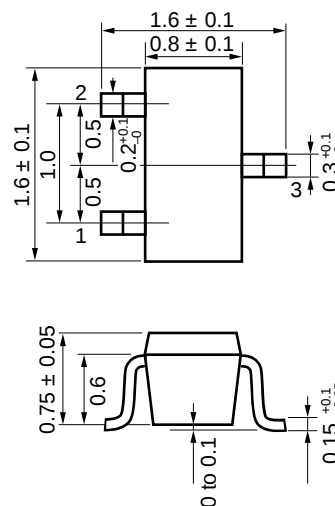
The 2SC5009 is an NPN epitaxial silicon transistor designed for use in low noise and small signal amplifiers from VHF band to L band. Low noise figure, high gain, and high current capability achieve a very wide dynamic range and excellent linearity. This is achieved by direct nitride passivated base surface process (NEST3 process) which is an NEC proprietary new fabrication technique.

**FEATURES**

- Low Voltage Use.
- High  $f_T$  : 12.0 GHz TYP. (@  $V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $f = 2\text{ GHz}$ )
- Low  $C_{re}$  : 0.3 pF TYP. (@  $V_{CE} = 3\text{ V}$ ,  $I_E = 0$ ,  $f = 1\text{ MHz}$ )
- Low NF : 2.5 dB TYP. (@  $V_{CE} = 3\text{ V}$ ,  $I_C = 3\text{ mA}$ ,  $f = 2\text{ GHz}$ )
- High  $|S_{21e}|^2$  : 8.5 dB TYP. (@  $V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $f = 2\text{ GHz}$ )
- Ultra Super Mini Mold Package.

**ORDERING INFORMATION**

| PART NUMBER | QUANTITY     | PACKING STYLE                                                                       |
|-------------|--------------|-------------------------------------------------------------------------------------|
| 2SC5009     | 50 pcs./Unit | Embossed tape 8 mm wide.<br>Pin 3 (Collector) face to perforation side of the tape. |
| 2SC5009-T1  | 3 kpcs./Reel |                                                                                     |

**PACKAGE DIMENSIONS**  
in millimeters

1. Emitter
2. Base
3. Collector

\* 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            | $I_C$     | 10          | mA               |
| Total Power Dissipation      | $P_T$     | 60          | mW               |
| Junction Temperature         | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage Temperature          | $T_{stg}$ | -65 to +150 | $^\circ\text{C}$ |

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

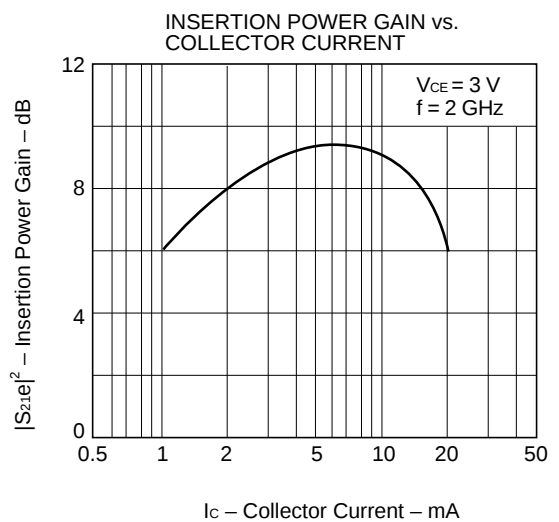
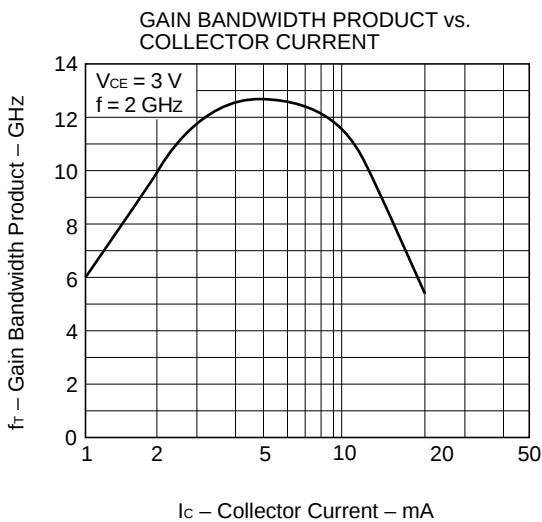
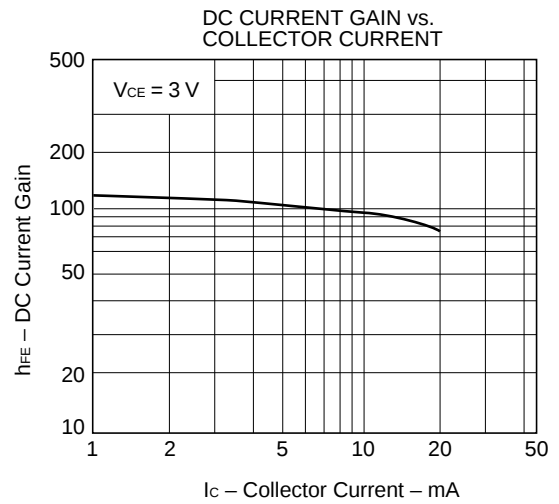
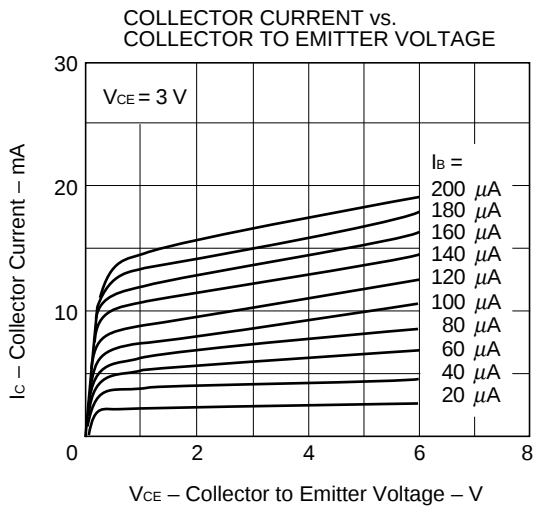
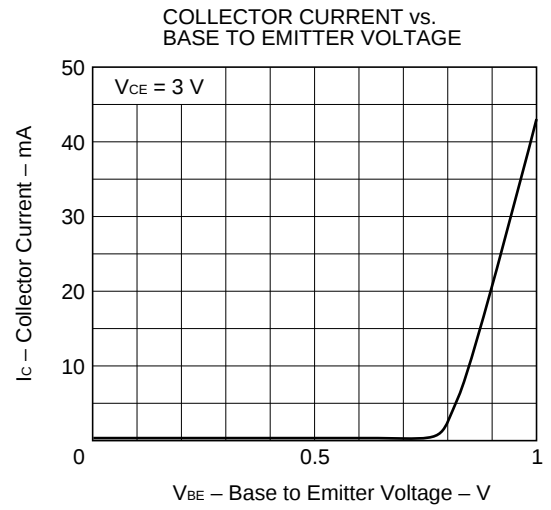
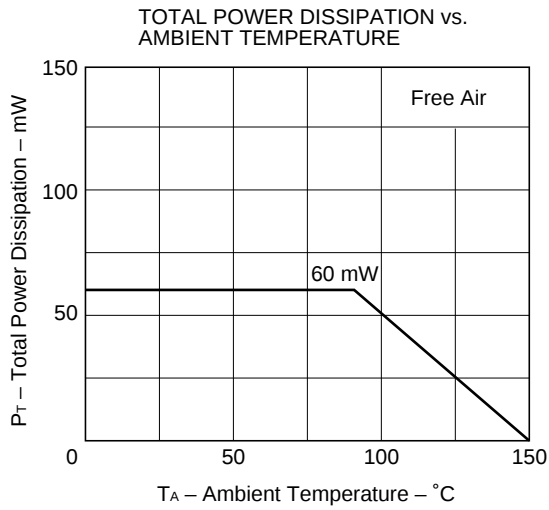
| CHARACTERISTIC           | SYMBOL        | MIN. | TYP. | MAX. | UNIT          | TEST CONDITIONS                                            |
|--------------------------|---------------|------|------|------|---------------|------------------------------------------------------------|
| Collector Cutoff Current | $I_{CBO}$     |      |      | 0.1  | $\mu\text{A}$ | $V_{CB} = 5\text{ V}, I_E = 0$                             |
| Emitter Cutoff Current   | $I_{EBO}$     |      |      | 0.1  | $\mu\text{A}$ | $V_{EB} = 1\text{ V}, I_C = 0$                             |
| DC Current Gain          | $h_{FE}$      | 75   |      | 150  |               | $V_{CE} = 3\text{ V}, I_C = 5\text{ mA}^{*1}$              |
| Gain Bandwidth Product   | $f_T$         |      | 12.0 |      | GHz           | $V_{CE} = 3\text{ V}, I_C = 5\text{ mA}, f = 2\text{ GHz}$ |
| Feed-back Capacitance    | $C_{re}$      |      | 0.3  | 0.5  | pF            | $V_{CB} = 3\text{ V}, I_E = 0, f = 1\text{ MHz}^{*2}$      |
| Insertion Power Gain     | $ S_{21e} ^2$ | 7.0  | 8.5  |      | dB            | $V_{CE} = 3\text{ V}, I_C = 5\text{ mA}, f = 2\text{ GHz}$ |
| Noise Figure             | NF            |      | 2.5  | 4.0  | dB            | $V_{CE} = 3\text{ V}, I_C = 3\text{ mA}, f = 2\text{ GHz}$ |

**\*1** Pulse Measurement  $PW \leq 350\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\text{ }\%$

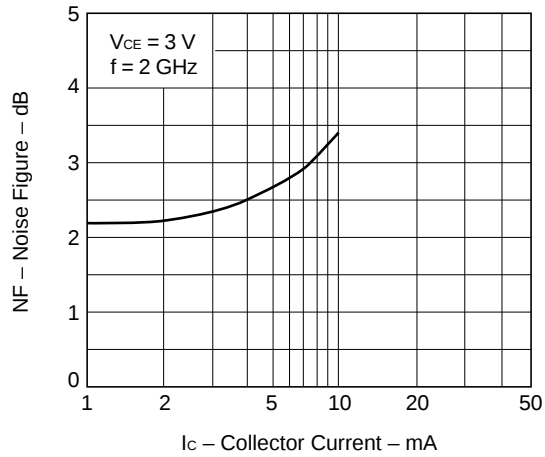
**\*2** The emitter terminal and the case shall be connected to the guard terminal of the three-terminal capacitance bridge.

 **$h_{FE}$  Classification**

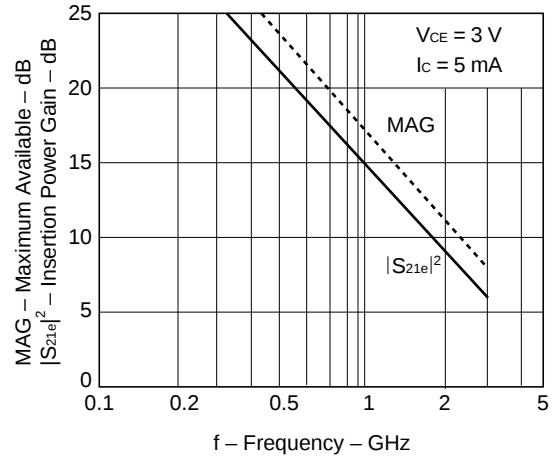
|          |           |
|----------|-----------|
| RANK     | FB        |
| Marking  | 82        |
| $h_{FE}$ | 75 to 150 |

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

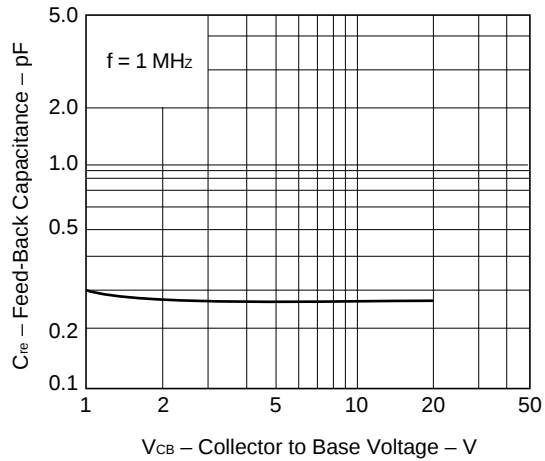
NOISE FIGURE vs.  
COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN,  
INSERTION POWER GAIN vs. FREQUENCY



FEED-BACK CAPACITANCE vs.  
COLLECTOR TO BASE VOLTAGE



**S-PARAMETER**(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 7 mA, Z<sub>O</sub> = 50 Ω)

| 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           | .823            | -7.1   | 8.540           | 153.6 | .014            | 86.5 | .979            | -6.6  |
| 200.00           | .791            | -16.4  | 8.151           | 150.6 | .028            | 77.4 | .950            | -12.5 |
| 300.00           | .749            | -24.5  | 7.885           | 144.1 | .041            | 74.4 | .904            | -17.8 |
| 400.00           | .701            | -32.0  | 7.524           | 136.7 | .051            | 70.2 | .857            | -22.2 |
| 500.00           | .648            | -38.6  | 7.149           | 129.8 | .061            | 67.4 | .810            | -25.5 |
| 600.00           | .596            | -44.6  | 6.672           | 123.2 | .069            | 65.1 | .768            | -28.4 |
| 700.00           | .545            | -49.6  | 6.267           | 117.1 | .077            | 63.0 | .728            | -30.7 |
| 800.00           | .499            | -54.7  | 5.890           | 111.3 | .084            | 61.3 | .693            | -32.5 |
| 900.00           | .453            | -58.8  | 5.505           | 106.4 | .092            | 60.5 | .662            | -34.4 |
| 1000.00          | .413            | -62.5  | 5.185           | 101.6 | .099            | 59.6 | .636            | -35.6 |
| 1100.00          | .375            | -66.1  | 4.873           | 97.2  | .106            | 58.7 | .612            | -36.9 |
| 1200.00          | .341            | -69.3  | 4.595           | 93.2  | .113            | 57.4 | .590            | -38.2 |
| 1300.00          | .308            | -72.3  | 4.335           | 89.2  | .120            | 56.9 | .574            | -39.2 |
| 1400.00          | .280            | -75.6  | 4.088           | 85.7  | .126            | 56.0 | .556            | -40.5 |
| 1500.00          | .254            | -78.3  | 3.882           | 82.1  | .134            | 55.3 | .540            | -41.5 |
| 1600.00          | .230            | -81.2  | 3.691           | 78.9  | .141            | 54.6 | .526            | -42.9 |
| 1700.00          | .207            | -84.3  | 3.521           | 75.8  | .147            | 53.8 | .515            | -44.1 |
| 1800.00          | .186            | -87.4  | 3.366           | 72.9  | .154            | 53.2 | .503            | -45.5 |
| 1900.00          | .166            | -90.7  | 3.222           | 70.0  | .161            | 52.3 | .491            | -46.8 |
| 2000.00          | .151            | -95.2  | 3.093           | 67.1  | .169            | 51.3 | .470            | -47.7 |
| 2100.00          | .134            | -99.4  | 2.980           | 64.5  | .177            | 50.3 | .457            | -49.1 |
| 2200.00          | .119            | -104.0 | 2.870           | 62.0  | .184            | 49.3 | .445            | -50.6 |
| 2300.00          | .105            | -110.4 | 2.772           | 59.3  | .191            | 48.5 | .434            | -52.1 |
| 2400.00          | .091            | -118.3 | 2.686           | 56.8  | .198            | 47.3 | .421            | -53.8 |
| 2500.00          | .080            | -127.7 | 2.594           | 54.2  | .206            | 46.3 | .411            | -55.4 |
| 2600.00          | .073            | -139.6 | 2.521           | 52.0  | .214            | 45.2 | .398            | -57.5 |
| 2700.00          | .067            | -152.7 | 2.447           | 49.5  | .222            | 44.2 | .386            | -59.3 |
| 2800.00          | .065            | -168.2 | 2.379           | 47.1  | .227            | 43.3 | .374            | -61.1 |
| 2900.00          | .067            | -178.3 | 2.317           | 44.7  | .235            | 42.1 | .361            | -62.8 |
| 3000.00          | .071            | -166.7 | 2.253           | 42.6  | .242            | 40.7 | .349            | -64.8 |

(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 5 mA, Z<sub>O</sub> = 50 Ω)

| 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           | .866            | -5.7   | 6.885           | 155.4 | .015            | 83.5 | .985            | -5.8  |
| 200.00           | .844            | -13.2  | 6.690           | 154.2 | .029            | 79.3 | .966            | -11.2 |
| 300.00           | .816            | -20.0  | 6.614           | 149.0 | .041            | 75.3 | .932            | -16.2 |
| 400.00           | .780            | -26.5  | 6.457           | 142.7 | .053            | 72.0 | .896            | -20.7 |
| 500.00           | .740            | -32.8  | 6.310           | 136.7 | .064            | 68.2 | .855            | -24.4 |
| 600.00           | .698            | -38.5  | 5.990           | 130.4 | .074            | 65.8 | .816            | -27.9 |
| 700.00           | .650            | -44.0  | 5.766           | 124.5 | .083            | 63.5 | .777            | -30.8 |
| 800.00           | .607            | -49.3  | 5.537           | 118.6 | .092            | 61.5 | .740            | -33.3 |
| 900.00           | .560            | -53.8  | 5.266           | 113.2 | .098            | 59.9 | .706            | -35.6 |
| 1000.00          | .513            | -58.4  | 5.033           | 108.0 | .105            | 58.9 | .674            | -37.4 |
| 1100.00          | .471            | -62.4  | 4.800           | 103.2 | .113            | 57.1 | .647            | -39.0 |
| 1200.00          | .430            | -66.2  | 4.571           | 98.5  | .120            | 55.6 | .621            | -40.7 |
| 1300.00          | .395            | -69.7  | 4.345           | 94.5  | .126            | 55.1 | .599            | -41.9 |
| 1400.00          | .361            | -73.3  | 4.123           | 90.5  | .133            | 53.8 | .578            | -43.3 |
| 1500.00          | .330            | -76.4  | 3.924           | 86.7  | .139            | 52.9 | .561            | -44.7 |
| 1600.00          | .300            | -79.6  | 3.751           | 83.1  | .146            | 52.2 | .543            | -46.1 |
| 1700.00          | .274            | -82.8  | 3.592           | 79.7  | .152            | 51.2 | .526            | -47.1 |
| 1800.00          | .250            | -85.9  | 3.435           | 76.5  | .159            | 50.4 | .514            | -48.7 |
| 1900.00          | .226            | -89.3  | 3.300           | 73.5  | .166            | 49.9 | .499            | -50.1 |
| 2000.00          | .208            | -92.9  | 3.178           | 70.6  | .174            | 48.7 | .476            | -51.1 |
| 2100.00          | .188            | -97.0  | 3.055           | 67.7  | .181            | 47.9 | .460            | -52.5 |
| 2200.00          | .170            | -101.1 | 2.946           | 64.9  | .188            | 47.1 | .448            | -54.1 |
| 2300.00          | .151            | -105.7 | 2.849           | 62.1  | .195            | 46.1 | .434            | -55.6 |
| 2400.00          | .136            | -111.3 | 2.757           | 59.4  | .201            | 44.9 | .419            | -57.3 |
| 2500.00          | .121            | -118.4 | 2.670           | 56.8  | .210            | 43.9 | .408            | -58.9 |
| 2600.00          | .109            | -126.0 | 2.594           | 54.3  | .216            | 43.0 | .395            | -60.9 |
| 2700.00          | .099            | -135.3 | 2.521           | 51.8  | .223            | 41.9 | .382            | -62.9 |
| 2800.00          | .090            | -145.5 | 2.450           | 49.4  | .229            | 40.8 | .368            | -64.4 |
| 2900.00          | .086            | -156.8 | 2.381           | 46.9  | .236            | 40.1 | .355            | -66.1 |
| 3000.00          | .083            | -168.1 | 2.317           | 44.6  | .243            | 38.7 | .341            | -68.1 |

**S-PARAMETER**(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 3 mA, Z<sub>0</sub> = 50 Ω)

| 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           | .907            | -4.4   | 4.749           | 157.0 | .015            | 86.0 | .990            | -4.8  |
| 200.00           | .891            | -9.9   | 4.677           | 157.3 | .029            | 80.9 | .979            | -9.4  |
| 300.00           | .877            | -15.1  | 4.716           | 153.6 | .042            | 77.6 | .956            | -13.9 |
| 400.00           | .855            | -20.5  | 4.696           | 148.3 | .056            | 74.2 | .933            | -18.1 |
| 500.00           | .828            | -25.7  | 4.688           | 143.6 | .068            | 70.9 | .903            | -21.9 |
| 600.00           | .800            | -30.4  | 4.513           | 138.2 | .079            | 67.7 | .875            | -25.5 |
| 700.00           | .767            | -35.4  | 4.450           | 132.9 | .089            | 64.7 | .842            | -28.8 |
| 800.00           | .736            | -40.4  | 4.370           | 127.5 | .099            | 62.2 | .810            | -31.8 |
| 900.00           | .697            | -44.8  | 4.233           | 122.5 | .107            | 60.2 | .776            | -34.8 |
| 1000.00          | .656            | -49.9  | 4.195           | 117.2 | .115            | 57.5 | .745            | -37.0 |
| 1100.00          | .610            | -54.6  | 4.117           | 112.2 | .123            | 56.3 | .715            | -39.3 |
| 1200.00          | .568            | -59.0  | 4.021           | 107.0 | .129            | 54.4 | .684            | -41.3 |
| 1300.00          | .528            | -63.1  | 3.871           | 102.5 | .137            | 52.7 | .661            | -43.1 |
| 1400.00          | .489            | -67.1  | 3.749           | 98.0  | .143            | 51.8 | .637            | -44.8 |
| 1500.00          | .454            | -70.6  | 3.612           | 93.8  | .151            | 50.5 | .615            | -46.5 |
| 1600.00          | .419            | -73.9  | 3.484           | 89.8  | .156            | 49.6 | .594            | -48.1 |
| 1700.00          | .386            | -77.7  | 3.369           | 86.0  | .162            | 48.7 | .575            | -49.7 |
| 1800.00          | .356            | -81.0  | 3.232           | 82.5  | .169            | 47.6 | .558            | -51.3 |
| 1900.00          | .328            | -84.2  | 3.127           | 79.0  | .175            | 46.7 | .540            | -52.9 |
| 2000.00          | .302            | -88.1  | 3.029           | 75.7  | .184            | 45.5 | .514            | -54.3 |
| 2100.00          | .279            | -91.5  | 2.928           | 72.6  | .189            | 44.4 | .497            | -55.9 |
| 2200.00          | .256            | -95.1  | 2.832           | 69.5  | .197            | 43.4 | .482            | -57.5 |
| 2300.00          | .233            | -99.3  | 2.755           | 66.4  | .203            | 42.5 | .466            | -59.2 |
| 2400.00          | .213            | -103.7 | 2.669           | 63.5  | .209            | 41.6 | .449            | -61.0 |
| 2500.00          | .193            | -108.2 | 2.588           | 60.6  | .216            | 40.6 | .436            | -62.6 |
| 2600.00          | .178            | -114.1 | 2.526           | 58.0  | .222            | 39.8 | .421            | -63.9 |
| 2700.00          | .160            | -119.7 | 2.455           | 55.2  | .229            | 38.4 | .405            | -66.5 |
| 2800.00          | .146            | -126.7 | 2.390           | 52.5  | .235            | 37.6 | .389            | -68.4 |
| 2900.00          | .134            | -134.5 | 2.331           | 49.8  | .241            | 36.6 | .376            | -70.1 |
| 3000.00          | .123            | -142.0 | 2.269           | 47.4  | .248            | 35.1 | .361            | -72.1 |

(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 1 mA, Z<sub>0</sub> = 50 Ω)

| 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           | .955            | -2.7   | 1.800           | 158.4 | .014            | 86.4 | .994            | -3.3  |
| 200.00           | .943            | -6.1   | 1.806           | 161.4 | .029            | 83.2 | .995            | -6.4  |
| 300.00           | .943            | -9.2   | 1.859           | 159.5 | .045            | 80.9 | .985            | -9.4  |
| 400.00           | .932            | -12.6  | 1.885           | 155.9 | .059            | 77.8 | .979            | -12.7 |
| 500.00           | .928            | -15.8  | 1.941           | 152.5 | .074            | 74.8 | .968            | -15.6 |
| 600.00           | .920            | -19.0  | 1.900           | 148.4 | .086            | 72.2 | .960            | -18.6 |
| 700.00           | .908            | -22.2  | 1.911           | 144.3 | .100            | 69.5 | .947            | -21.7 |
| 800.00           | .900            | -25.6  | 1.912           | 139.9 | .113            | 66.5 | .931            | -24.6 |
| 900.00           | .883            | -28.6  | 1.867           | 135.4 | .126            | 63.7 | .914            | -27.8 |
| 1000.00          | .866            | -32.2  | 1.910           | 131.6 | .136            | 61.5 | .896            | -30.5 |
| 1100.00          | .845            | -36.0  | 1.954           | 127.5 | .148            | 58.6 | .875            | -33.3 |
| 1200.00          | .822            | -40.0  | 1.989           | 123.3 | .157            | 56.1 | .851            | -35.9 |
| 1300.00          | .798            | -43.5  | 1.998           | 118.9 | .167            | 54.2 | .833            | -38.4 |
| 1400.00          | .772            | -47.5  | 2.018           | 114.9 | .175            | 51.6 | .810            | -41.0 |
| 1500.00          | .748            | -50.8  | 2.008           | 110.7 | .185            | 49.8 | .792            | -43.4 |
| 1600.00          | .722            | -54.3  | 1.974           | 106.7 | .192            | 47.5 | .770            | -45.8 |
| 1700.00          | .693            | -58.2  | 1.992           | 102.5 | .200            | 45.8 | .749            | -48.0 |
| 1800.00          | .672            | -61.2  | 1.935           | 98.8  | .207            | 44.2 | .731            | -50.5 |
| 1900.00          | .642            | -64.8  | 1.929           | 95.2  | .213            | 42.7 | .708            | -52.6 |
| 2000.00          | .610            | -69.2  | 1.946           | 91.2  | .223            | 40.8 | .683            | -54.7 |
| 2100.00          | .582            | -72.4  | 1.915           | 87.7  | .230            | 39.1 | .662            | -57.0 |
| 2200.00          | .550            | -76.5  | 1.906           | 83.8  | .238            | 37.4 | .643            | -59.1 |
| 2300.00          | .516            | -80.4  | 1.925           | 79.9  | .242            | 36.1 | .621            | -61.4 |
| 2400.00          | .493            | -84.0  | 1.887           | 76.7  | .249            | 34.4 | .602            | -63.7 |
| 2500.00          | .466            | -87.9  | 1.866           | 73.2  | .253            | 32.9 | .586            | -65.8 |
| 2600.00          | .438            | -91.6  | 1.864           | 69.7  | .259            | 32.0 | .554            | -68.1 |
| 2700.00          | .408            | -96.0  | 1.838           | 66.2  | .265            | 29.9 | .547            | -70.6 |
| 2800.00          | .380            | -100.2 | 1.815           | 62.8  | .269            | 28.5 | .530            | -73.0 |
| 2900.00          | .353            | -105.2 | 1.806           | 59.4  | .274            | 27.3 | .508            | -75.0 |
| 3000.00          | .330            | -109.4 | 1.781           | 56.4  | .279            | 25.9 | .492            | -77.4 |

**S-PARAMETER**(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 5 mA, Z<sub>O</sub> = 50 Ω)

| 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           | .848            | -7.5   | 6.214           | 154.0 | .017            | 81.7 | .976            | -6.2  |
| 200.00           | .815            | -16.8  | 5.946           | 152.2 | .033            | 78.1 | .956            | -12.0 |
| 300.00           | .783            | -25.0  | 5.820           | 146.4 | .048            | 73.3 | .922            | -17.5 |
| 400.00           | .741            | -32.7  | 5.623           | 139.7 | .062            | 68.6 | .883            | -22.4 |
| 500.00           | .698            | -40.2  | 5.466           | 133.3 | .073            | 64.7 | .837            | -26.5 |
| 600.00           | .647            | -47.1  | 5.176           | 126.5 | .083            | 61.5 | .793            | -30.1 |
| 700.00           | .596            | -53.6  | 4.962           | 120.2 | .092            | 59.5 | .752            | -33.3 |
| 800.00           | .549            | -60.0  | 4.751           | 114.1 | .101            | 56.8 | .710            | -35.9 |
| 900.00           | .501            | -65.5  | 4.506           | 108.3 | .108            | 55.4 | .673            | -38.3 |
| 1000.00          | .453            | -71.2  | 4.304           | 103.1 | .114            | 53.0 | .639            | -40.0 |
| 1100.00          | .409            | -76.2  | 4.089           | 98.0  | .121            | 52.4 | .609            | -41.6 |
| 1200.00          | .369            | -81.3  | 3.886           | 93.3  | .127            | 51.1 | .583            | -43.0 |
| 1300.00          | .332            | -85.7  | 3.680           | 89.1  | .134            | 50.5 | .559            | -44.3 |
| 1400.00          | .298            | -90.3  | 3.495           | 84.9  | .139            | 49.6 | .540            | -45.6 |
| 1500.00          | .266            | -95.2  | 3.318           | 81.1  | .146            | 49.1 | .520            | -46.6 |
| 1600.00          | .237            | -99.6  | 3.163           | 77.4  | .153            | 48.3 | .504            | -47.8 |
| 1700.00          | .213            | -104.6 | 3.024           | 74.0  | .158            | 47.5 | .487            | -49.1 |
| 1800.00          | .190            | -110.0 | 2.885           | 70.7  | .164            | 47.3 | .476            | -50.6 |
| 1900.00          | .168            | -116.0 | 2.770           | 67.6  | .171            | 46.5 | .461            | -51.8 |
| 2000.00          | .154            | -121.6 | 2.658           | 64.5  | .180            | 45.9 | .437            | -52.9 |
| 2100.00          | .139            | -129.2 | 2.557           | 61.6  | .186            | 44.9 | .423            | -54.1 |
| 2200.00          | .125            | -136.5 | 2.467           | 58.6  | .194            | 44.4 | .412            | -55.6 |
| 2300.00          | .115            | -146.2 | 2.386           | 56.0  | .200            | 43.1 | .399            | -57.1 |
| 2400.00          | .108            | -155.8 | 2.308           | 53.3  | .207            | 42.5 | .384            | -59.0 |
| 2500.00          | .104            | -166.9 | 2.231           | 50.5  | .215            | 41.7 | .375            | -60.5 |
| 2600.00          | .103            | -177.4 | 2.172           | 48.0  | .222            | 40.6 | .363            | -62.5 |
| 2700.00          | .105            | 171.6  | 2.104           | 45.5  | .228            | 39.9 | .349            | -64.6 |
| 2800.00          | .110            | 162.0  | 2.045           | 43.1  | .236            | 38.7 | .337            | -66.4 |
| 2900.00          | .117            | 154.2  | 1.990           | 40.6  | .242            | 37.8 | .324            | -68.4 |
| 3000.00          | .124            | 146.9  | 1.939           | 38.3  | .250            | 36.5 | .313            | -70.2 |

(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 3 mA, Z<sub>O</sub> = 50 Ω)

| 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           | .901            | -5.2   | 4.504           | 156.3 | .017            | 85.9 | .987            | -5.1  |
| 200.00           | .883            | -11.4  | 4.431           | 156.9 | .033            | 80.5 | .978            | -10.1 |
| 300.00           | .867            | -17.2  | 4.464           | 153.0 | .049            | 76.5 | .956            | -14.8 |
| 400.00           | .842            | -23.0  | 4.442           | 147.8 | .063            | 73.1 | .932            | -19.5 |
| 500.00           | .816            | -28.8  | 4.434           | 142.8 | .077            | 69.4 | .900            | -23.8 |
| 600.00           | .787            | -34.1  | 4.278           | 137.2 | .090            | 65.6 | .870            | -27.9 |
| 700.00           | .753            | -39.7  | 4.215           | 131.7 | .101            | 62.2 | .836            | -31.6 |
| 800.00           | .719            | -45.3  | 4.151           | 126.0 | .111            | 59.3 | .799            | -35.0 |
| 900.00           | .678            | -50.3  | 4.031           | 120.9 | .120            | 56.7 | .760            | -38.4 |
| 1000.00          | .635            | -56.2  | 3.993           | 115.3 | .128            | 54.5 | .725            | -41.1 |
| 1100.00          | .590            | -61.6  | 3.920           | 109.9 | .136            | 52.5 | .690            | -43.5 |
| 1200.00          | .544            | -66.7  | 3.816           | 104.7 | .143            | 50.5 | .659            | -45.7 |
| 1300.00          | .502            | -71.5  | 3.683           | 99.9  | .149            | 49.1 | .629            | -47.7 |
| 1400.00          | .461            | -76.2  | 3.566           | 95.2  | .156            | 47.9 | .602            | -49.6 |
| 1500.00          | .424            | -80.4  | 3.421           | 90.9  | .162            | 46.4 | .577            | -51.4 |
| 1600.00          | .387            | -84.7  | 3.293           | 86.7  | .167            | 45.6 | .554            | -53.1 |
| 1700.00          | .353            | -89.1  | 3.185           | 82.7  | .174            | 44.6 | .530            | -54.7 |
| 1800.00          | .324            | -93.2  | 3.051           | 79.1  | .179            | 43.7 | .513            | -56.5 |
| 1900.00          | .293            | -97.7  | 2.949           | 75.4  | .185            | 43.1 | .494            | -58.1 |
| 2000.00          | .270            | -102.3 | 2.850           | 72.1  | .193            | 41.7 | .465            | -59.5 |
| 2100.00          | .245            | -106.9 | 2.750           | 68.8  | .199            | 40.8 | .445            | -61.1 |
| 2200.00          | .225            | -111.8 | 2.661           | 65.8  | .206            | 40.0 | .429            | -62.9 |
| 2300.00          | .204            | -117.4 | 2.581           | 62.5  | .213            | 39.1 | .412            | -64.4 |
| 2400.00          | .186            | -123.5 | 2.500           | 59.6  | .218            | 37.8 | .395            | -66.3 |
| 2500.00          | .169            | -130.5 | 2.420           | 56.7  | .225            | 37.2 | .382            | -67.8 |
| 2600.00          | .156            | -137.7 | 2.353           | 53.9  | .231            | 36.2 | .365            | -70.2 |
| 2700.00          | .146            | -146.1 | 2.288           | 51.2  | .238            | 35.2 | .351            | -72.0 |
| 2800.00          | .137            | -155.0 | 2.223           | 48.5  | .244            | 34.4 | .336            | -74.0 |
| 2900.00          | .133            | -164.2 | 2.165           | 45.8  | .249            | 33.5 | .320            | -75.8 |
| 3000.00          | .130            | -173.1 | 2.108           | 43.4  | .257            | 32.1 | .306            | -78.1 |

**S-PARAMETER**(V<sub>CE</sub> = 3 V, I<sub>C</sub> = 1 mA, Z<sub>0</sub> = 50 Ω)

| 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           | .950            | -2.9   | 1.790           | 158.9 | .017            | 87.7 | .994            | -3.5  |
| 200.00           | .942            | -6.4   | 1.783           | 161.5 | .033            | 83.8 | .995            | -6.8  |
| 300.00           | .942            | -9.7   | 1.832           | 159.5 | .050            | 81.1 | .984            | -10.2 |
| 400.00           | .930            | -13.4  | 1.863           | 155.8 | .067            | 77.2 | .978            | -13.7 |
| 500.00           | .926            | -16.8  | 1.914           | 152.3 | .082            | 74.3 | .967            | -16.9 |
| 600.00           | .917            | -20.1  | 1.873           | 147.9 | .097            | 71.5 | .958            | -20.2 |
| 700.00           | .903            | -23.7  | 1.886           | 143.8 | .112            | 68.3 | .944            | -23.4 |
| 800.00           | .897            | -27.2  | 1.893           | 139.1 | .127            | 65.2 | .927            | -26.6 |
| 900.00           | .876            | -30.6  | 1.850           | 134.6 | .140            | 62.1 | .910            | -30.1 |
| 1000.00          | .861            | -34.4  | 1.891           | 130.3 | .152            | 59.2 | .887            | -33.2 |
| 1100.00          | .837            | -38.5  | 1.933           | 126.1 | .165            | 56.2 | .865            | -36.2 |
| 1200.00          | .815            | -42.8  | 1.979           | 121.8 | .175            | 53.7 | .837            | -39.2 |
| 1300.00          | .787            | -46.5  | 1.975           | 117.2 | .186            | 51.3 | .818            | -41.9 |
| 1400.00          | .762            | -50.7  | 1.992           | 112.9 | .195            | 48.8 | .792            | -44.7 |
| 1500.00          | .735            | -54.5  | 1.983           | 108.6 | .204            | 46.7 | .769            | -47.4 |
| 1600.00          | .707            | -58.1  | 1.953           | 104.4 | .212            | 44.6 | .747            | -50.1 |
| 1700.00          | .675            | -62.3  | 1.972           | 100.2 | .220            | 42.5 | .723            | -52.5 |
| 1800.00          | .652            | -65.6  | 1.909           | 96.3  | .227            | 40.8 | .703            | -55.2 |
| 1900.00          | .621            | -69.5  | 1.900           | 92.5  | .233            | 39.0 | .677            | -57.4 |
| 2000.00          | .587            | -74.2  | 1.919           | 88.3  | .243            | 36.9 | .650            | -59.7 |
| 2100.00          | .559            | -77.9  | 1.887           | 84.6  | .249            | 35.0 | .625            | -62.3 |
| 2200.00          | .528            | -82.4  | 1.880           | 80.7  | .256            | 33.5 | .605            | -64.5 |
| 2300.00          | .491            | -86.7  | 1.894           | 76.7  | .261            | 32.0 | .580            | -67.0 |
| 2400.00          | .465            | -90.8  | 1.856           | 73.3  | .267            | 30.4 | .561            | -69.4 |
| 2500.00          | .438            | -95.0  | 1.829           | 69.8  | .272            | 28.7 | .541            | -71.7 |
| 2600.00          | .408            | -99.7  | 1.817           | 66.2  | .277            | 27.1 | .519            | -74.6 |
| 2700.00          | .380            | -104.1 | 1.797           | 62.7  | .282            | 25.7 | .499            | -77.0 |
| 2800.00          | .353            | -109.1 | 1.769           | 59.3  | .286            | 24.3 | .479            | -79.5 |
| 2900.00          | .326            | -114.6 | 1.761           | 55.8  | .290            | 23.2 | .458            | -81.8 |
| 3000.00          | .305            | -119.8 | 1.732           | 52.8  | .295            | 21.6 | .440            | -84.3 |

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