

## NPN EPITAXIAL SILICON TRANSISTOR FOR MICROWAVE HIGH-GAIN AMPLIFICATION

### FEATURE

- High  $f_T$   
16 GHz TYP.
- High gain  
 $|S_{21e}|^2 = 14$  dB TYP.  
@ $f = 2$  GHz,  $V_{CE} = 2$  V,  $I_c = 20$  mA
- $NF = 1.1$  dB, @ $f = 2$  GHz  $V_{CE} = 2$  V,  $I_c = 3$  mA
- 6-pin Small Mini Mold Package

### ORDERING INFORMATION

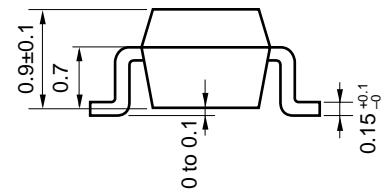
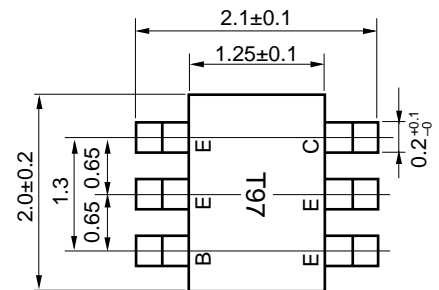
| PART NUMBER | QUANTITY    | PACKING STYLE  |
|-------------|-------------|--|
| 2SC5409-T1  | 3 kpcs/reel | 8-mm wide emboss taping, 6-pin (collector) feed hole direction |

**Remark** To order evaluation samples, consult your NEC sales personnel (supported in 50-pcs units).

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                    | SYMBOL    | RATING      | UNIT |
|------------------------------|-----------|-------------|------|
| Collector to Base Voltage    | $V_{CBO}$ | 5           | V    |
| Collector to Emitter Voltage | $V_{CEO}$ | 3           | V    |
| Emitter to Base Voltage      | $V_{EBO}$ | 2           | V    |
| Collector Current            | $I_c$     | 30          | mA   |
| Total Power Dissipation      | $P_T$     | 90          | mW   |
| Junction Temperature         | $T_j$     | 150         | °C   |
| Storage Temperature          | $T_{stg}$ | -65 to +150 | °C   |

### PACKAGE DIMENSIONS (in mm)



### PIN CONNECTIONS

E: Emitter  
C: Collector  
B: Base

Because this product uses high-frequency process, avoid excessive input of static electricity, etc.

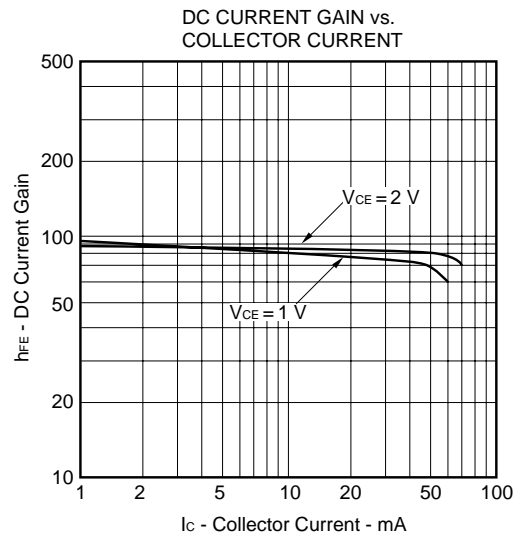
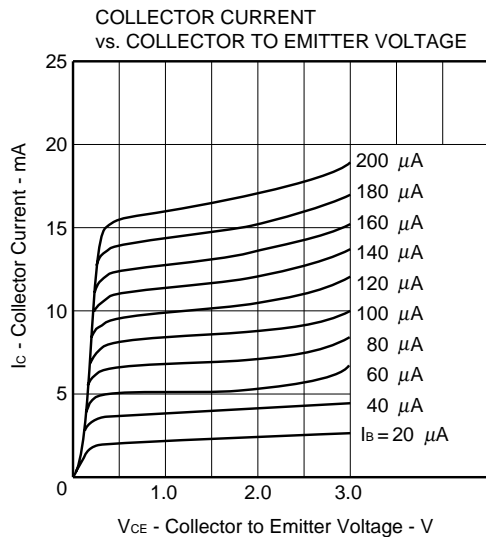
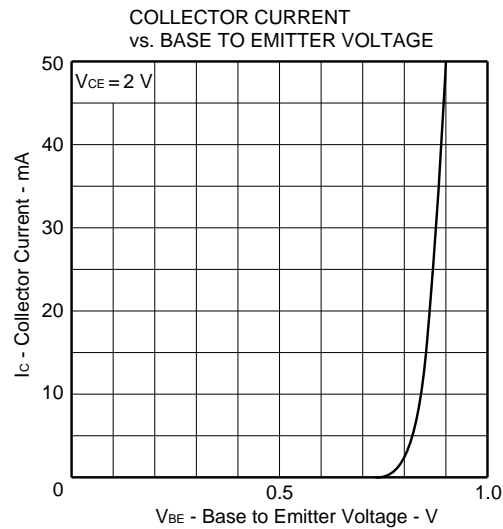
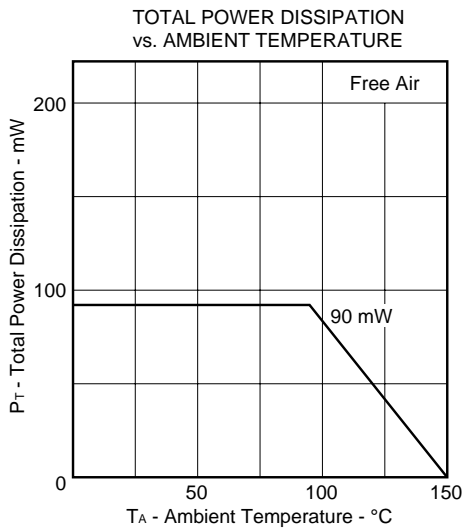
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C)**

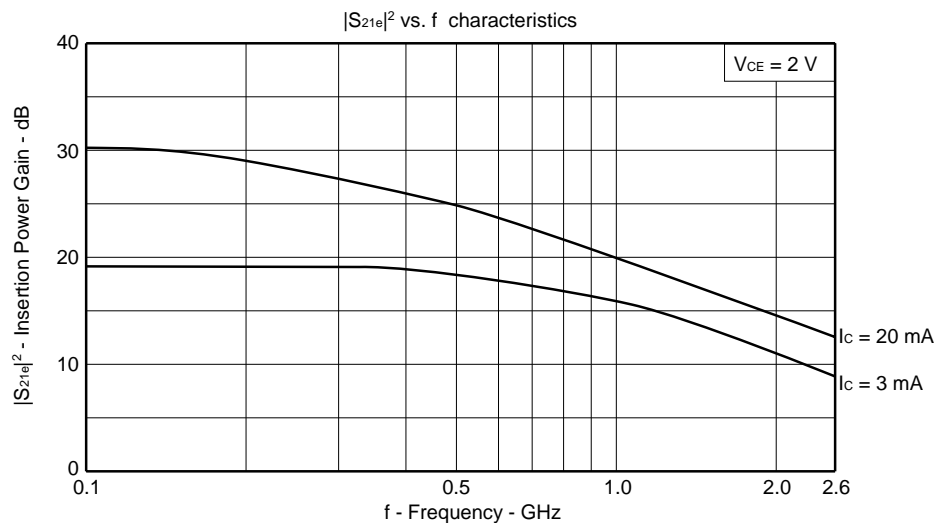
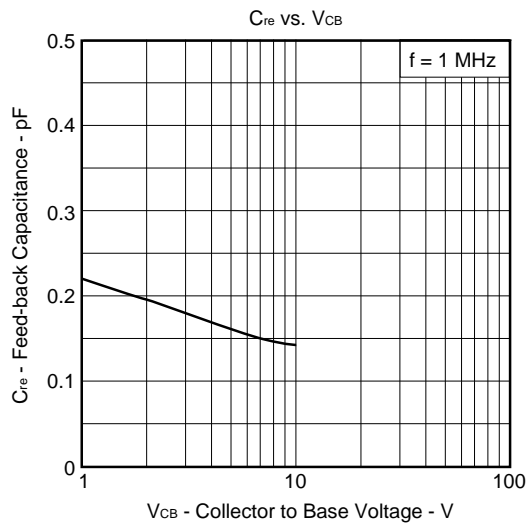
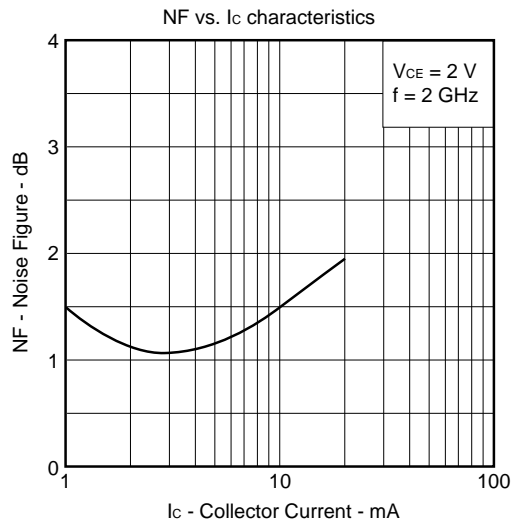
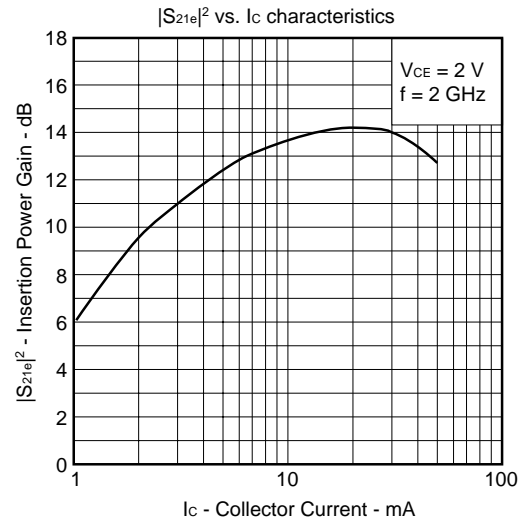
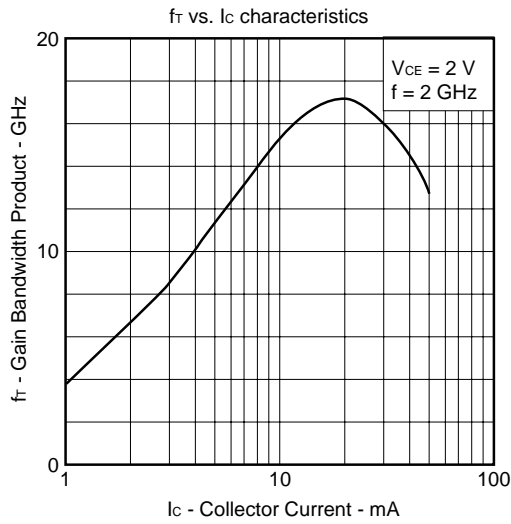
| PARAMETER                 | SYMBOL                          | TEST CONDITIONS  | MIN. | TYP. | MAX. | UNIT |
|---------------------------|---------------------------------|--|------|------|------|------|
| Collector Cut-off Current | I <sub>CB0</sub>                | V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0                          |      |      | 0.1  | μA   |
| Emitter Cut-off Current   | I <sub>EB0</sub>                | V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0                          |      |      | 0.1  | μA   |
| DC Current Gain           | h <sub>FE</sub>                 | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA <b>Note 1</b>        | 70   |      | 140  |      |
| Gain Bandwidth Product    | f <sub>T</sub>                  | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz         | 13   | 16   |      | GHz  |
| Feed-back Capacitance     | C <sub>re</sub>                 | V <sub>CB</sub> = 2 V, I <sub>E</sub> = 0, f = 1 MHz <b>Note 2</b> |      | 0.2  | 0.3  | pF   |
| Insertion Power Gain      | S <sub>21e</sub>   <sup>2</sup> | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2.0 GHz         | 12   | 14   |      | dB   |
| Noise Figure              | NF                              | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 3 mA, f = 2.0 GHz          |      | 1.1  | 1.8  | dB   |

|                 |           |
|-----------------|-----------|
| Rank            | FB        |
| Marking         | T97       |
| h <sub>FE</sub> | 70 to 140 |

- Notes**
1. Pulse measurement PW ≤ 350 μs, duty cycle ≤ 2 %, pulsed
  2. Measured with three-pin bridge, with emitter pin connected to the bridge guard.

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





S PARAMETER

V<sub>CE</sub> = 2 V I<sub>c</sub> = 3 mA

| 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    |
| 100.000          | 0.907           | -11.3  | 7.343           | 170.3 | 0.013           | 81.4 | 0.977           | -7.0   |
| 200.000          | 0.887           | -22.7  | 7.221           | 161.1 | 0.026           | 73.9 | 0.960           | -13.9  |
| 300.000          | 0.861           | -33.6  | 6.963           | 152.8 | 0.034           | 66.4 | 0.929           | -20.6  |
| 400.000          | 0.826           | -45.1  | 6.563           | 143.9 | 0.045           | 62.4 | 0.894           | -27.1  |
| 500.000          | 0.788           | -54.5  | 6.506           | 134.8 | 0.053           | 55.1 | 0.860           | -33.3  |
| 600.000          | 0.740           | -65.4  | 6.264           | 128.6 | 0.062           | 50.1 | 0.815           | -38.4  |
| 700.000          | 0.700           | -75.2  | 5.775           | 120.4 | 0.067           | 44.8 | 0.772           | -43.2  |
| 800.000          | 0.659           | -84.6  | 5.644           | 113.8 | 0.073           | 41.1 | 0.734           | -48.1  |
| 900.000          | 0.621           | -94.5  | 5.314           | 108.4 | 0.076           | 35.9 | 0.691           | -51.9  |
| 1 000.000        | 0.585           | -103.3 | 4.924           | 101.7 | 0.078           | 33.6 | 0.658           | -56.1  |
| 1 100.000        | 0.555           | -112.1 | 4.705           | 95.6  | 0.080           | 29.9 | 0.621           | -59.8  |
| 1 200.000        | 0.532           | -121.0 | 4.442           | 90.9  | 0.083           | 27.3 | 0.592           | -63.0  |
| 1 300.000        | 0.508           | -129.0 | 4.230           | 85.7  | 0.083           | 24.7 | 0.565           | -66.2  |
| 1 400.000        | 0.492           | -137.3 | 3.978           | 81.1  | 0.083           | 23.6 | 0.545           | -69.7  |
| 1 500.000        | 0.483           | -145.3 | 3.795           | 76.4  | 0.083           | 21.8 | 0.522           | -72.7  |
| 1 600.000        | 0.473           | -153.1 | 3.615           | 72.9  | 0.083           | 19.9 | 0.504           | -75.9  |
| 1 700.000        | 0.472           | -160.0 | 3.372           | 69.1  | 0.083           | 19.7 | 0.490           | -79.1  |
| 1 800.000        | 0.469           | -167.1 | 3.237           | 63.7  | 0.084           | 17.4 | 0.476           | -82.5  |
| 1 900.000        | 0.469           | -173.9 | 3.106           | 60.8  | 0.082           | 16.3 | 0.461           | -85.7  |
| 2 000.000        | 0.472           | 179.9  | 2.932           | 56.9  | 0.083           | 17.0 | 0.456           | -89.2  |
| 2 100.000        | 0.479           | 173.9  | 2.825           | 52.9  | 0.084           | 16.1 | 0.446           | -92.3  |
| 2 200.000        | 0.482           | 168.5  | 2.706           | 49.4  | 0.083           | 15.3 | 0.438           | -96.1  |
| 2 300.000        | 0.495           | 163.1  | 2.607           | 46.0  | 0.082           | 14.5 | 0.435           | -99.5  |
| 2 400.000        | 0.504           | 157.8  | 2.479           | 42.3  | 0.083           | 15.0 | 0.432           | -103.7 |
| 2 500.000        | 0.512           | 153.7  | 2.403           | 37.4  | 0.080           | 14.7 | 0.429           | -106.9 |
| 2 600.000        | 0.523           | 148.9  | 2.361           | 34.8  | 0.082           | 15.4 | 0.428           | -110.8 |

V<sub>CE</sub> = 2 V I<sub>c</sub> = 20 mA

| 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    |
| 100.000          | 0.591           | -30.8  | 33.233          | 157.5 | 0.010           | 76.4 | 0.877           | -17.3  |
| 200.000          | 0.530           | -58.2  | 28.692          | 139.8 | 0.018           | 65.2 | 0.773           | -31.4  |
| 300.000          | 0.475           | -80.8  | 24.362          | 126.3 | 0.024           | 59.7 | 0.666           | -41.4  |
| 400.000          | 0.428           | -100.1 | 20.644          | 115.9 | 0.028           | 54.2 | 0.573           | -49.6  |
| 500.000          | 0.400           | -115.3 | 17.561          | 107.9 | 0.032           | 51.9 | 0.504           | -55.1  |
| 600.000          | 0.380           | -128.9 | 15.258          | 101.2 | 0.035           | 51.0 | 0.446           | -59.4  |
| 700.000          | 0.368           | -140.5 | 13.430          | 95.6  | 0.038           | 50.1 | 0.403           | -62.8  |
| 800.000          | 0.361           | -150.7 | 11.977          | 90.7  | 0.040           | 49.1 | 0.369           | -66.2  |
| 900.000          | 0.359           | -159.9 | 10.742          | 86.1  | 0.043           | 49.4 | 0.339           | -68.9  |
| 1 000.000        | 0.359           | -167.9 | 9.780           | 82.1  | 0.046           | 49.5 | 0.319           | -72.1  |
| 1 100.000        | 0.362           | -174.9 | 8.924           | 78.4  | 0.049           | 48.7 | 0.297           | -75.2  |
| 1 200.000        | 0.368           | 178.6  | 8.211           | 74.9  | 0.051           | 48.9 | 0.281           | -77.9  |
| 1 300.000        | 0.373           | 172.9  | 7.608           | 71.4  | 0.054           | 48.8 | 0.268           | -81.0  |
| 1 400.000        | 0.381           | 167.3  | 7.103           | 68.3  | 0.058           | 48.6 | 0.260           | -84.7  |
| 1 500.000        | 0.392           | 162.4  | 6.621           | 65.1  | 0.060           | 48.1 | 0.248           | -87.9  |
| 1 600.000        | 0.401           | 157.7  | 6.229           | 61.9  | 0.064           | 47.6 | 0.242           | -91.9  |
| 1 700.000        | 0.410           | 153.9  | 5.884           | 59.2  | 0.067           | 47.2 | 0.239           | -95.6  |
| 1 800.000        | 0.422           | 150.0  | 5.555           | 56.0  | 0.070           | 46.4 | 0.234           | -99.9  |
| 1 900.000        | 0.431           | 146.1  | 5.256           | 53.0  | 0.073           | 45.9 | 0.230           | -104.0 |
| 2 000.000        | 0.442           | 142.8  | 4.992           | 50.1  | 0.075           | 45.0 | 0.234           | -108.7 |
| 2 100.000        | 0.455           | 139.7  | 4.755           | 47.3  | 0.078           | 44.3 | 0.232           | -112.7 |
| 2 200.000        | 0.466           | 136.5  | 4.540           | 44.6  | 0.082           | 43.6 | 0.233           | -118.4 |
| 2 300.000        | 0.480           | 134.0  | 4.335           | 41.7  | 0.084           | 42.8 | 0.238           | -122.5 |
| 2 400.000        | 0.492           | 131.1  | 4.139           | 38.9  | 0.087           | 41.7 | 0.243           | -128.0 |
| 2 500.000        | 0.502           | 128.6  | 3.972           | 36.1  | 0.090           | 40.6 | 0.244           | -132.0 |
| 2 600.000        | 0.516           | 126.0  | 3.796           | 33.2  | 0.093           | 39.7 | 0.252           | -136.4 |

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