

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

### FEATURE

- High  $f_T$   
17 GHz TYP.
- High gain  
 $|S_{21e}|^2 = 15.5$  dB TYP.  
@  $f = 2$  GHz,  $V_{CE} = 2$  V,  $I_C = 7$  mA
- $NF = 1.1$  dB, @  $f = 2$  GHz  $V_{CE} = 2$  V,  $I_C = 1$  mA
- 6-pin Small Mini Mold Package

### ORDERING INFORMATION

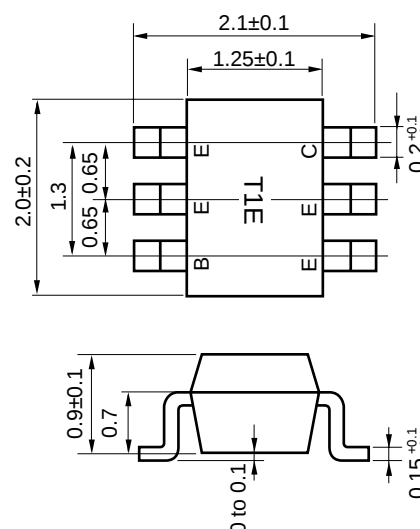
| PART NUMBER | QUANTITY    | PACKING STYLE                                                  |
|-------------|-------------|----------------------------------------------------------------|
| 2SC5408-T1  | 3 kpcs/reel | 8-mm wide emboss taping, 6-pin (collector) feed hole direction |

**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            | $I_C$     | 10          | mA   |
| Total Power Dissipation      | $P_T$     | 30          | 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.

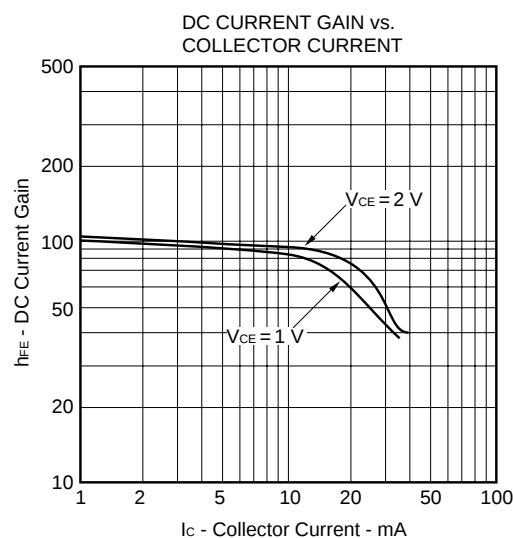
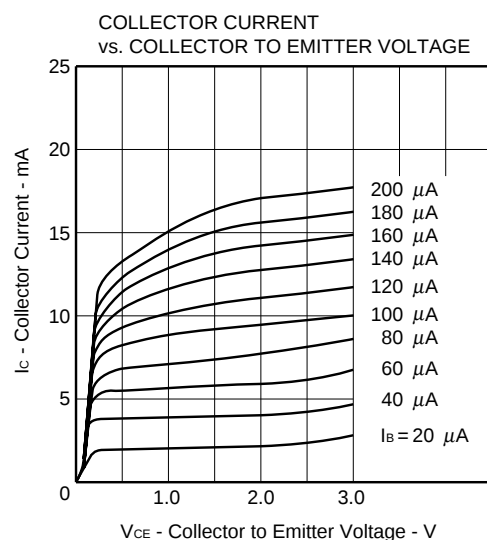
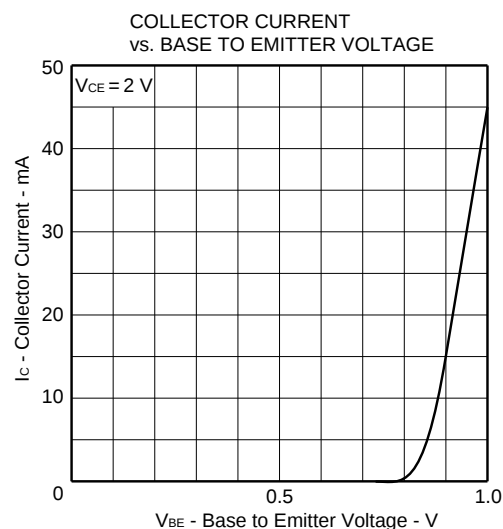
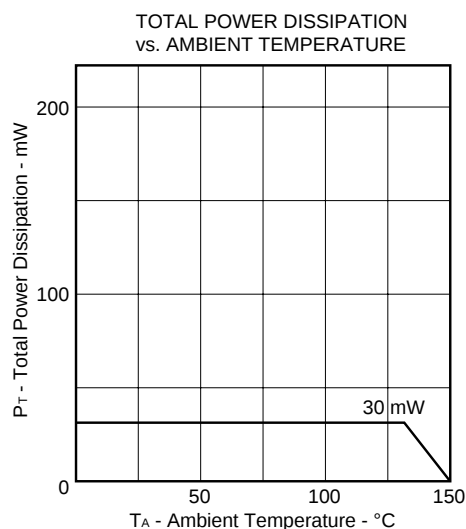
ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ )

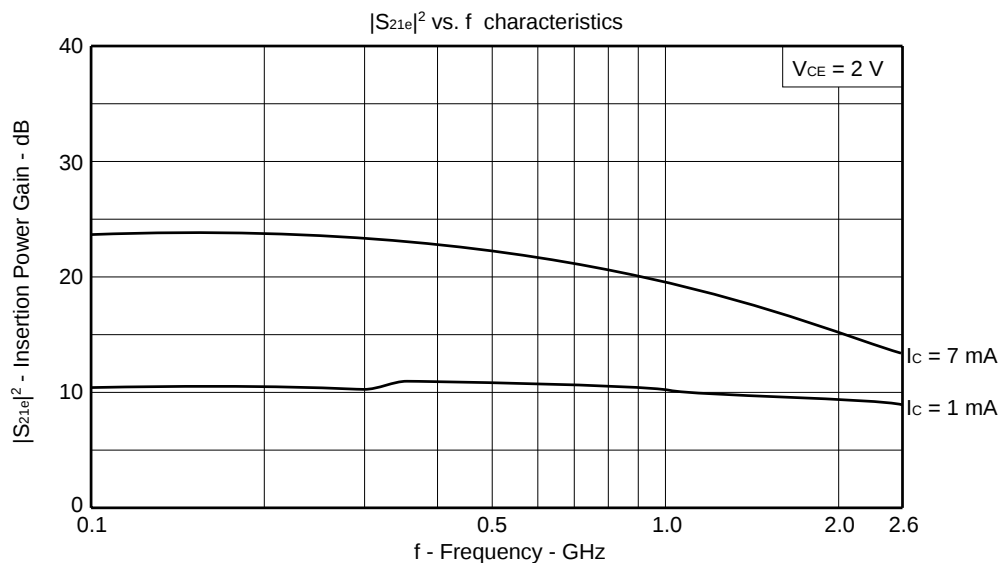
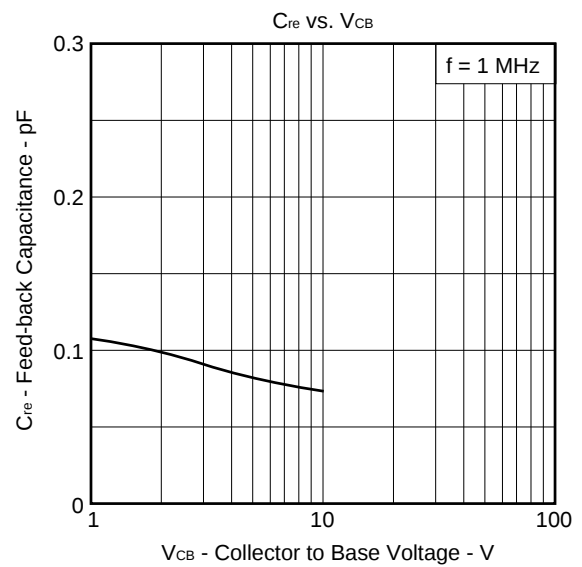
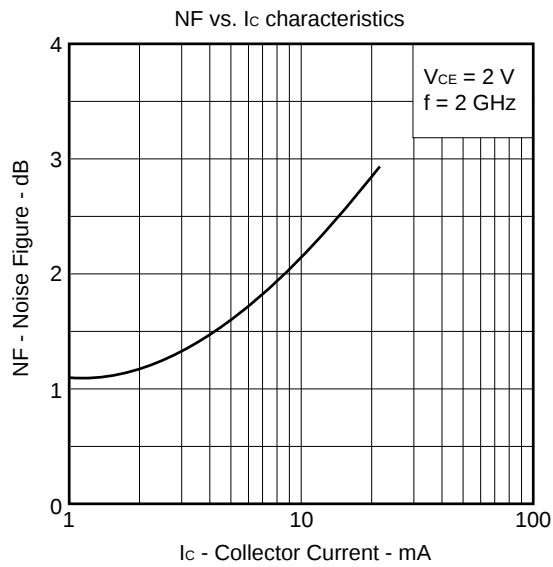
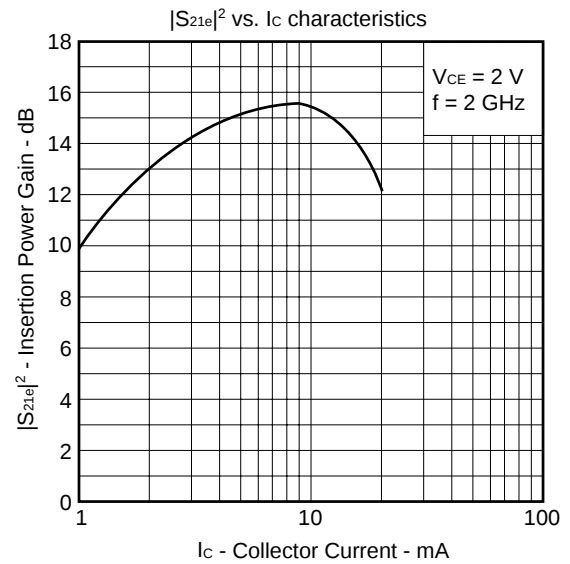
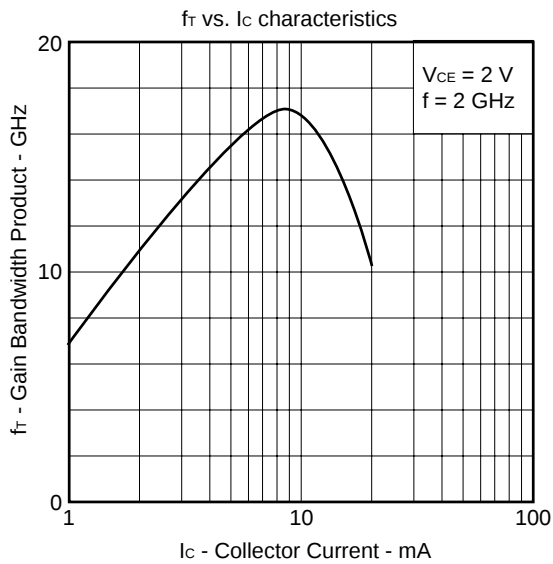
| PARAMETER                 | SYMBOL        | TEST CONDITIONS                                                      | MIN. | TYP. | MAX. | UNIT          |
|---------------------------|---------------|----------------------------------------------------------------------|------|------|------|---------------|
| Collector Cut-off Current | $I_{CBO}$     | $V_{CB} = 5\text{ V}$ , $I_E = 0$                                    |      |      | 0.1  | $\mu\text{A}$ |
| Emitter Cut-off Current   | $I_{EBO}$     | $V_{EB} = 1\text{ V}$ , $I_C = 0$                                    |      |      | 0.1  | $\mu\text{A}$ |
| DC Current Gain           | $h_{FE}$      | $V_{CE} = 2\text{ V}$ , $I_C = 7\text{ mA}$ <b>Note 1</b>            | 70   |      | 140  |               |
| Gain Bandwidth Product    | $f_T$         | $V_{CE} = 2\text{ V}$ , $I_C = 7\text{ mA}$ , $f = 2.0\text{ GHz}$   |      | 17   |      | GHz           |
| Feed-back Capacitance     | $C_{re}$      | $V_{CB} = 2\text{ V}$ , $I_E = 0$ , $f = 1\text{ MHz}$ <b>Note 2</b> |      | 0.1  | 0.15 | pF            |
| Insertion Power Gain      | $ S_{21e} ^2$ | $V_{CE} = 2\text{ V}$ , $I_C = 7\text{ mA}$ , $f = 2.0\text{ GHz}$   | 13   | 15.5 |      | dB            |
| Noise Figure              | NF            | $V_{CE} = 2\text{ V}$ , $I_C = 1\text{ mA}$ , $f = 2.0\text{ GHz}$   |      | 1.1  | 1.8  | dB            |

|          |          |
|----------|----------|
| Rank     | FB       |
| Marking  | T1E      |
| $h_{FE}$ | 70 to 40 |

**Notes** 1. Pulse measurement  $PW \leq 350\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ , pulsed

2. Measured with three-pin bridge, with emitter pin connected to the bridge guard.

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



## S PARAMETER

 $V_{CE} = 2\text{ V}$   $I_C = 1\text{ mA}$ 

| 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          | 0.969           | -4.1   | 3.345           | 174.9 | 0.006           | 84.6 | 0.991           | -3.2  |
| 200.000          | 0.967           | -8.2   | 3.287           | 170.3 | 0.012           | 82.8 | 0.993           | -6.8  |
| 300.000          | 0.959           | -12.3  | 3.334           | 165.9 | 0.018           | 79.0 | 0.990           | -10.0 |
| 400.000          | 0.952           | -16.6  | 3.361           | 161.4 | 0.024           | 75.8 | 0.990           | -13.6 |
| 500.000          | 0.943           | -20.8  | 3.280           | 156.3 | 0.031           | 71.8 | 0.980           | -17.3 |
| 600.000          | 0.931           | -25.2  | 3.307           | 151.2 | 0.036           | 68.4 | 0.971           | -20.8 |
| 700.000          | 0.919           | -29.5  | 3.286           | 146.9 | 0.042           | 64.5 | 0.963           | -24.2 |
| 800.000          | 0.903           | -34.1  | 3.278           | 141.6 | 0.047           | 61.0 | 0.952           | -28.1 |
| 900.000          | 0.883           | -38.6  | 3.268           | 136.4 | 0.052           | 57.0 | 0.940           | -31.6 |
| 1 000.000        | 0.865           | -42.9  | 3.226           | 132.3 | 0.057           | 53.4 | 0.927           | -35.3 |
| 1 100.000        | 0.842           | -47.4  | 3.197           | 127.4 | 0.060           | 49.9 | 0.913           | -38.8 |
| 1 200.000        | 0.817           | -51.9  | 3.175           | 122.4 | 0.065           | 46.0 | 0.901           | -42.6 |
| 1 300.000        | 0.796           | -56.6  | 3.127           | 118.2 | 0.067           | 42.8 | 0.885           | -46.2 |
| 1 400.000        | 0.774           | -61.3  | 3.077           | 113.1 | 0.070           | 39.4 | 0.863           | -49.6 |
| 1 500.000        | 0.748           | -66.2  | 3.059           | 108.5 | 0.072           | 36.6 | 0.852           | -53.2 |
| 1 600.000        | 0.725           | -71.1  | 3.047           | 103.9 | 0.073           | 33.5 | 0.836           | -56.8 |
| 1 700.000        | 0.702           | -76.1  | 2.978           | 99.4  | 0.074           | 30.8 | 0.824           | -60.0 |
| 1 800.000        | 0.678           | -81.1  | 2.920           | 95.4  | 0.075           | 28.1 | 0.808           | -64.0 |
| 1 900.000        | 0.653           | -86.3  | 2.920           | 90.5  | 0.074           | 25.7 | 0.794           | -67.2 |
| 2 000.000        | 0.633           | -91.5  | 2.856           | 86.3  | 0.074           | 23.5 | 0.780           | -70.8 |
| 2 100.000        | 0.611           | -97.3  | 2.834           | 82.0  | 0.074           | 21.1 | 0.771           | -74.1 |
| 2 200.000        | 0.591           | -102.9 | 2.795           | 77.6  | 0.073           | 19.0 | 0.756           | -77.6 |
| 2 300.000        | 0.571           | -108.8 | 2.751           | 73.0  | 0.072           | 16.9 | 0.748           | -81.4 |
| 2 400.000        | 0.554           | -114.9 | 2.713           | 68.6  | 0.071           | 15.0 | 0.744           | -85.0 |
| 2 500.000        | 0.535           | -120.7 | 2.656           | 64.2  | 0.068           | 13.6 | 0.733           | -88.5 |
| 2 600.000        | 0.520           | -127.0 | 2.619           | 59.7  | 0.065           | 12.7 | 0.727           | -91.6 |

 $V_{CE} = 2\text{ V}$   $I_C = 7\text{ mA}$ 

| 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          | 0.828           | -9.4   | 15.424          | 169.5 | 0.005           | 82.0 | 0.969           | -5.9  |
| 200.000          | 0.806           | -18.5  | 14.864          | 160.4 | 0.011           | 77.6 | 0.951           | -11.9 |
| 300.000          | 0.765           | -27.2  | 14.467          | 151.7 | 0.016           | 72.4 | 0.920           | -17.2 |
| 400.000          | 0.722           | -35.7  | 13.904          | 143.2 | 0.020           | 67.5 | 0.892           | -22.0 |
| 500.000          | 0.675           | -43.3  | 12.879          | 135.6 | 0.024           | 62.8 | 0.846           | -26.7 |
| 600.000          | 0.625           | -50.8  | 12.259          | 127.9 | 0.028           | 59.6 | 0.809           | -30.5 |
| 700.000          | 0.575           | -57.8  | 11.555          | 121.5 | 0.030           | 56.6 | 0.772           | -33.9 |
| 800.000          | 0.527           | -64.6  | 10.806          | 115.1 | 0.033           | 54.4 | 0.738           | -37.6 |
| 900.000          | 0.481           | -70.9  | 10.151          | 109.2 | 0.035           | 52.6 | 0.708           | -40.2 |
| 1 000.000        | 0.439           | -77.0  | 9.573           | 104.2 | 0.037           | 51.0 | 0.678           | -42.9 |
| 1 100.000        | 0.400           | -82.9  | 8.988           | 99.2  | 0.038           | 50.0 | 0.650           | -45.4 |
| 1 200.000        | 0.364           | -89.1  | 8.510           | 94.4  | 0.039           | 49.3 | 0.628           | -47.9 |
| 1 300.000        | 0.335           | -95.3  | 8.017           | 90.2  | 0.041           | 48.9 | 0.611           | -50.3 |
| 1 400.000        | 0.309           | -101.6 | 7.572           | 85.8  | 0.042           | 48.9 | 0.589           | -52.4 |
| 1 500.000        | 0.284           | -108.2 | 7.203           | 82.0  | 0.043           | 48.7 | 0.575           | -54.8 |
| 1 600.000        | 0.264           | -115.1 | 6.876           | 78.1  | 0.044           | 49.5 | 0.563           | -57.4 |
| 1 700.000        | 0.249           | -122.5 | 6.569           | 74.1  | 0.046           | 49.4 | 0.553           | -59.5 |
| 1 800.000        | 0.239           | -129.9 | 6.225           | 70.9  | 0.047           | 50.1 | 0.541           | -62.4 |
| 1 900.000        | 0.226           | -138.1 | 6.019           | 67.4  | 0.048           | 50.8 | 0.532           | -64.7 |
| 2 000.000        | 0.222           | -145.1 | 5.728           | 63.8  | 0.050           | 50.9 | 0.525           | -68.0 |
| 2 100.000        | 0.220           | -154.2 | 5.541           | 60.6  | 0.052           | 51.9 | 0.519           | -70.5 |
| 2 200.000        | 0.220           | -161.9 | 5.326           | 57.0  | 0.054           | 52.3 | 0.511           | -73.1 |
| 2 300.000        | 0.223           | -169.9 | 5.112           | 53.7  | 0.056           | 52.5 | 0.511           | -76.3 |
| 2 400.000        | 0.230           | -176.7 | 4.951           | 50.6  | 0.059           | 53.1 | 0.510           | -79.8 |
| 2 500.000        | 0.235           | 176.3  | 4.761           | 47.3  | 0.062           | 53.1 | 0.510           | -83.1 |
| 2 600.000        | 0.245           | 169.7  | 4.602           | 43.9  | 0.065           | 53.0 | 0.513           | -86.4 |

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