

## 2SC5820

Silicon NPN Epitaxial  
High Frequency Low Noise Amplifier / Oscillator

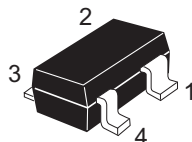
REJ03G0758-0200  
(Previous ADE-208-1604A)  
Rev.2.00  
Aug.10.2005

### Application

- High gain bandwidth product  
 $f_T = 20 \text{ GHz typ.}$
- High power gain and low noise figure;  
 $PG = 17.5 \text{ dB typ.}, NF = 1.15 \text{ dB typ. at } f = 1.8 \text{ GHz}$

### Outline

RENESAS Package code: PTSP0004ZA-A  
(Package name: CMPAK-4)



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

Note: Marking is "WU-".

### Absolute Maximum Ratings

( $T_a = 25^\circ\text{C}$ )

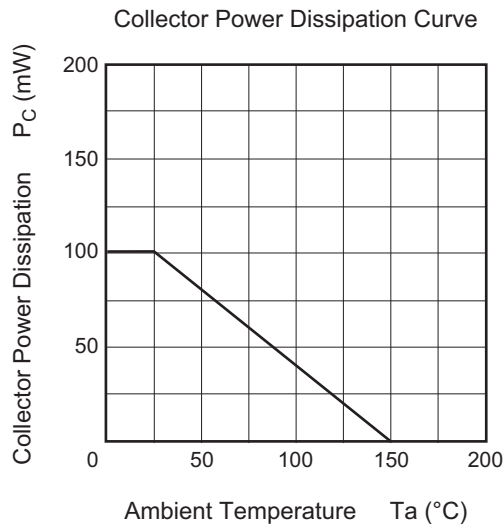
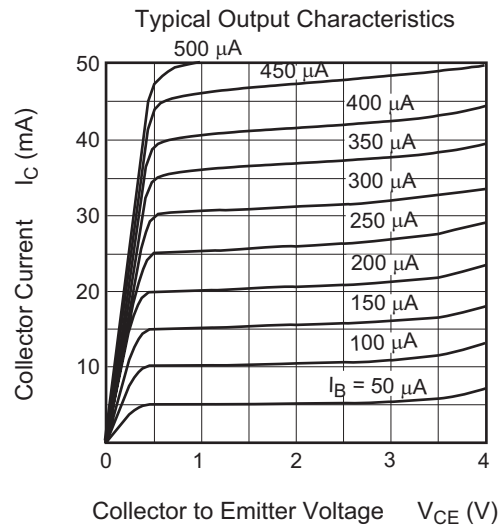
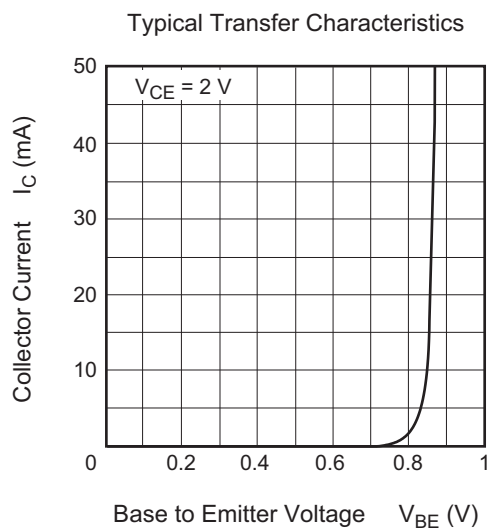
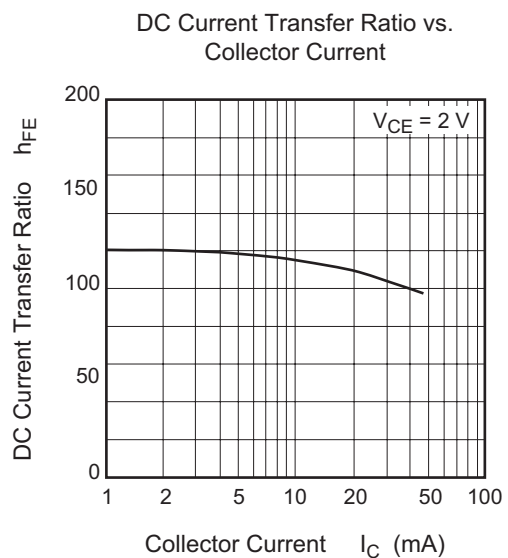
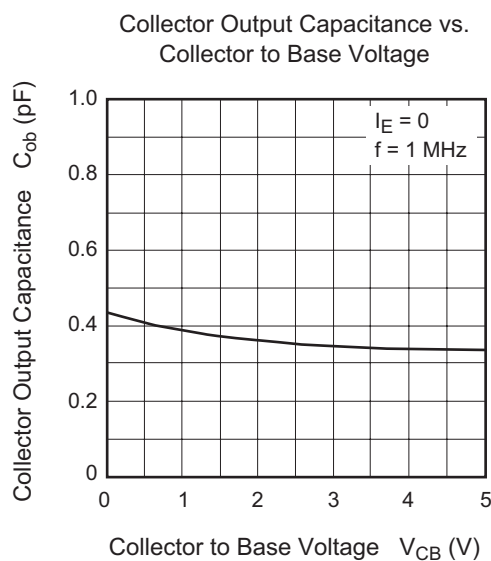
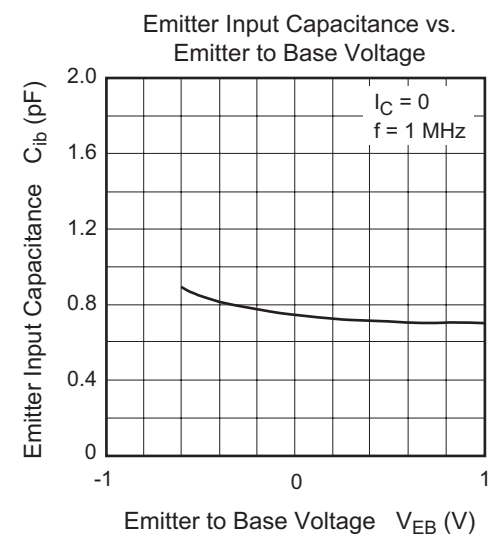
| Item                         | Symbol    | Ratings     | Unit             |
|------------------------------|-----------|-------------|------------------|
| Collector to base voltage    | $V_{CBO}$ | 12          | V                |
| Collector to emitter voltage | $V_{CEO}$ | 4.0         | V                |
| Emitter to base voltage      | $V_{EBO}$ | 1.5         | V                |
| Collector current            | $I_C$     | 35          | mA               |
| Collector power dissipation  | $P_c$     | 100         | mW               |
| Junction temperature         | $T_j$     | 150         | $^\circ\text{C}$ |
| Storage temperature          | $T_{stg}$ | -55 to +150 | $^\circ\text{C}$ |

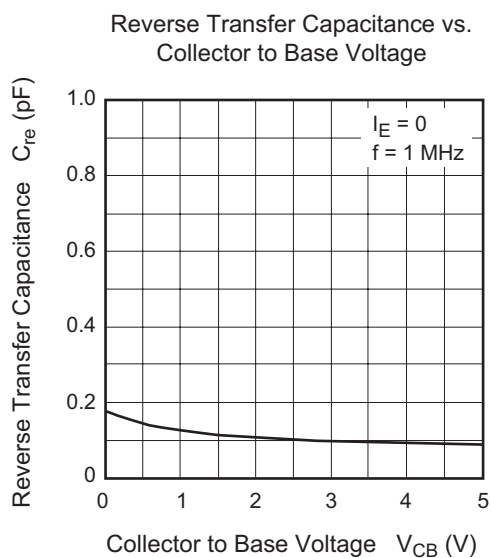
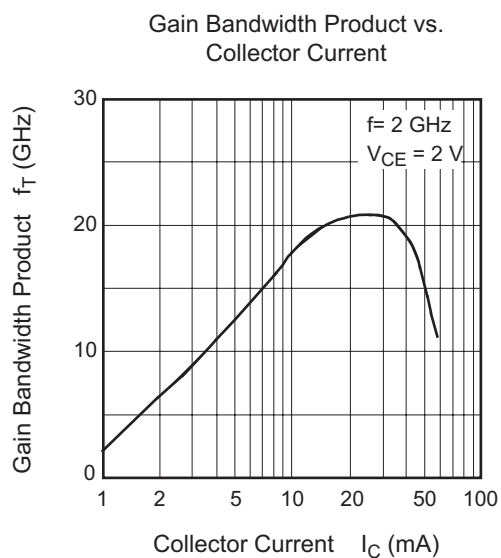
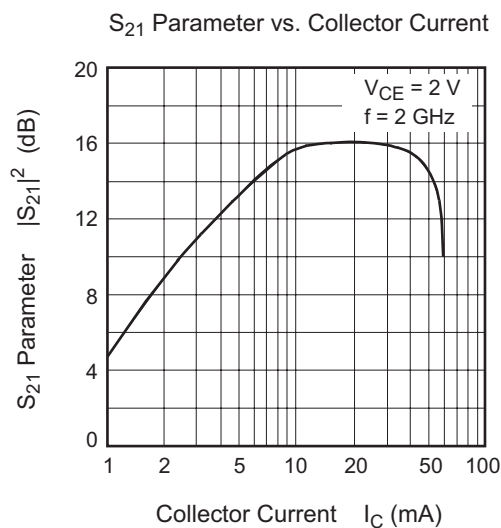
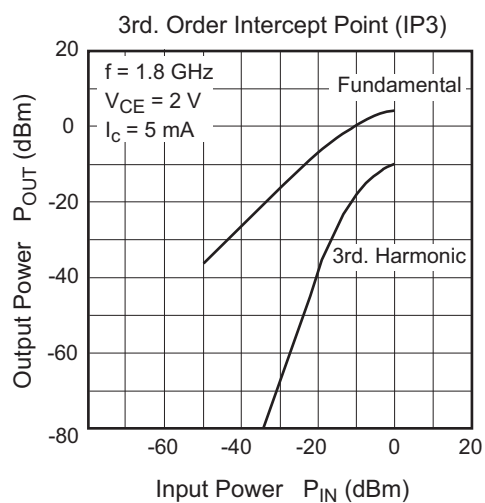
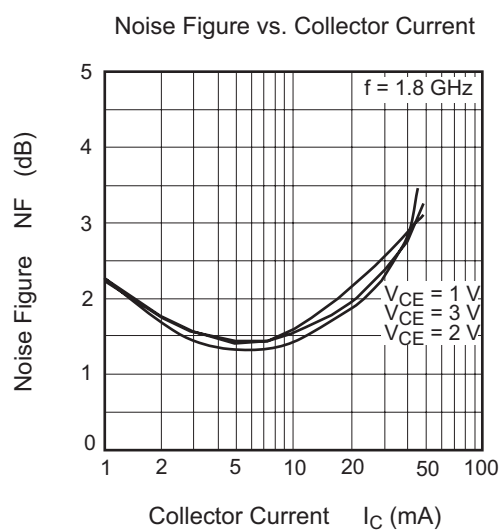
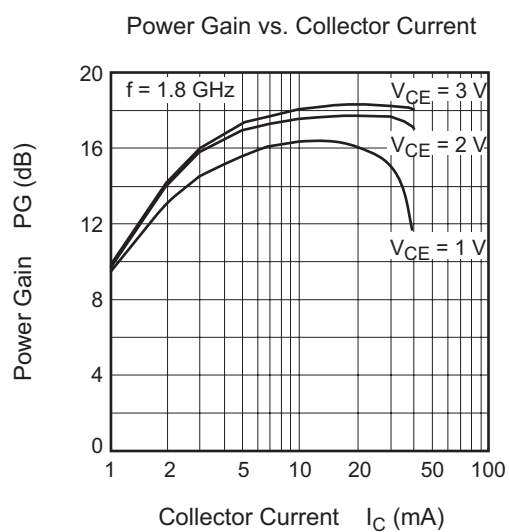
## Electrical Characteristics

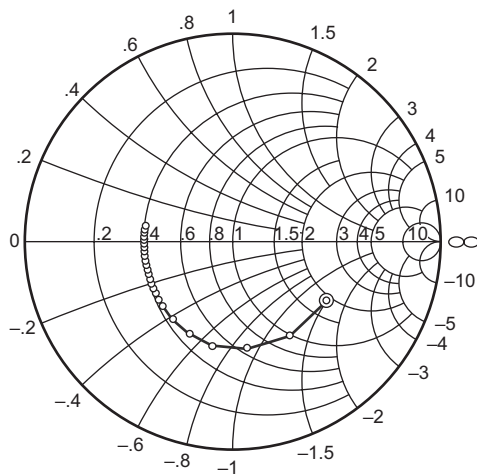
(Ta = 25°C)

| Item                         | Symbol    | Min | Typ  | Max | Unit    | Test conditions                                |
|------------------------------|-----------|-----|------|-----|---------|------------------------------------------------|
| Collector cutoff current     | $I_{CBO}$ | —   | —    | 1   | $\mu A$ | $V_{CB} = 12 V, I_E = 0$                       |
| Collector cutoff current     | $I_{CEO}$ | —   | —    | 1   | $\mu A$ | $V_{CE} = 4 V, R_{BE} = \infty$                |
| Emitter cutoff current       | $I_{EBO}$ | —   | —    | 10  | $\mu A$ | $V_{EB} = 1.5 V, I_C = 0$                      |
| DC current transfer ratio    | $h_{FE}$  | 70  | 110  | 150 | —       | $V_{CE} = 2 V, I_C = 20 mA$                    |
| Collector output capacitance | $C_{ob}$  | —   | 0.3  | 0.6 | pF      | $V_{CB} = 2 V, I_E = 0, f = 1 MHz$             |
| Gain bandwidth product       | $f_T$     | 17  | 20   | —   | GHz     | $V_{CE} = 2 V, I_C = 30 mA$<br>$f = 2 GHz$     |
| Power gain                   | PG        | 13  | 17.5 | —   | dB      | $V_{CE} = 2 V, I_C = 30 mA$ ,<br>$f = 1.8 GHz$ |
| Noise figure                 | NF        | —   | 1.15 | 1.7 | dB      | $V_{CE} = 2 V, I_C = 5 mA$ ,<br>$f = 1.8 GHz$  |
| 3rd. Order Intercept Point   | IP3       | —   | 10   | —   | dBm     | $V_{CE} = 2 V, I_C = 5 mA$ ,<br>$f = 1.8 GHz$  |

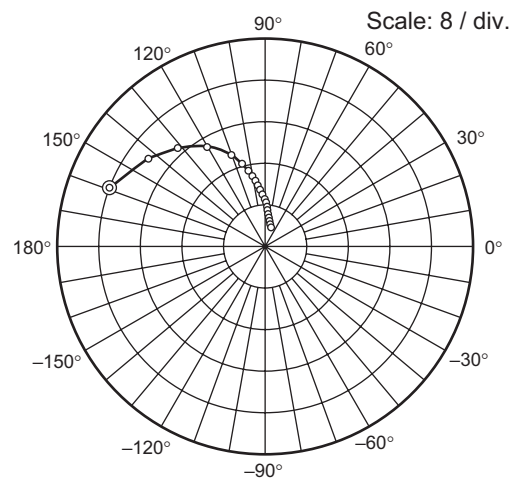
## Main Characteristics



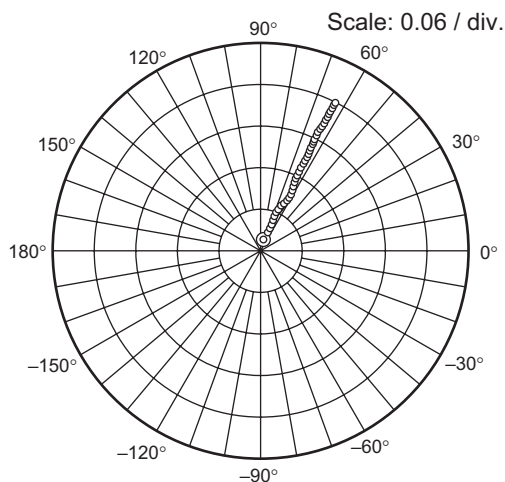


$S_{11}$  Parameter vs. Frequency

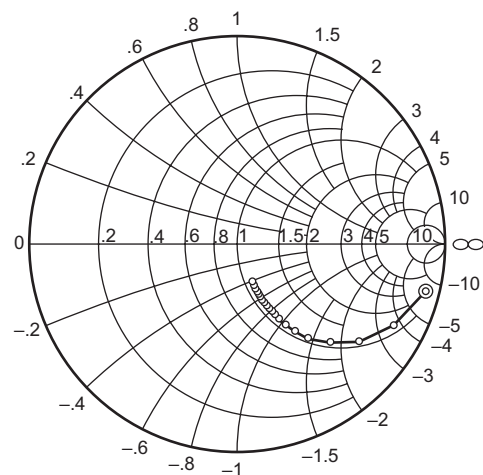
Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 ◎—○ ( $I_C = 30\text{ mA}$ )

 $S_{21}$  Parameter vs. Frequency

Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 ◎—○ ( $I_C = 30\text{ mA}$ )

 $S_{12}$  Parameter vs. Frequency

Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 ◎—○ ( $I_C = 30\text{ mA}$ )

 $S_{22}$  Parameter vs. Frequency

Condition:  $V_{CE} = 2\text{ V}$ ,  $Z_O = 50\ \Omega$   
 100 to 3000 MHz (100 MHz Step)  
 ◎—○ ( $I_C = 30\text{ mA}$ )

## S Parameter

(V<sub>CE</sub> = 2 V, I<sub>C</sub> = 5 mA, Z<sub>O</sub> = 50 Ω)

| f (MHz) | S11   |        | S21   |       | S12    |      | S22   |       |
|---------|-------|--------|-------|-------|--------|------|-------|-------|
|         | MAG   | ANG    | MAG   | ANG   | MAG    | ANG  | MAG   | ANG   |
| 100     | 0.844 | -24.6  | 15.26 | 159.9 | 0.0124 | 78.9 | 0.976 | -16.4 |
| 200     | 0.835 | -23.1  | 15.07 | 162.9 | 0.0153 | 84.0 | 0.973 | -11.7 |
| 300     | 0.838 | -34.2  | 14.59 | 154.8 | 0.0236 | 80.2 | 0.953 | -17.5 |
| 400     | 0.809 | -45.7  | 13.94 | 147.1 | 0.0311 | 72.5 | 0.919 | -23.6 |
| 500     | 0.781 | -56.2  | 13.16 | 139.9 | 0.0387 | 67.5 | 0.879 | -29.0 |
| 600     | 0.745 | -66.8  | 12.39 | 133.1 | 0.0441 | 61.6 | 0.828 | -33.9 |
| 700     | 0.710 | -76.0  | 11.71 | 127.7 | 0.0506 | 56.2 | 0.779 | -38.6 |
| 800     | 0.688 | -85.5  | 10.89 | 121.8 | 0.0537 | 52.0 | 0.728 | -41.9 |
| 900     | 0.659 | -93.5  | 10.16 | 117.0 | 0.0579 | 47.7 | 0.682 | -45.4 |
| 1000    | 0.639 | -101.0 | 9.47  | 112.8 | 0.0610 | 46.8 | 0.641 | -47.4 |
| 1100    | 0.633 | -107.3 | 8.77  | 108.6 | 0.0643 | 41.1 | 0.601 | -49.8 |
| 1200    | 0.596 | -115.4 | 8.40  | 105.2 | 0.0640 | 40.4 | 0.560 | -51.8 |
| 1300    | 0.578 | -121.8 | 7.92  | 101.5 | 0.0665 | 37.6 | 0.528 | -54.0 |
| 1400    | 0.570 | -128.0 | 7.47  | 98.3  | 0.0675 | 37.4 | 0.499 | -55.4 |
| 1500    | 0.556 | -133.1 | 7.04  | 95.6  | 0.0685 | 32.9 | 0.473 | -57.1 |
| 1600    | 0.548 | -138.8 | 6.68  | 92.5  | 0.0691 | 32.9 | 0.449 | -58.0 |
| 1700    | 0.541 | -143.6 | 6.37  | 90.1  | 0.0693 | 32.5 | 0.422 | -59.0 |
| 1800    | 0.532 | -149.0 | 6.08  | 87.5  | 0.0699 | 30.2 | 0.400 | -60.6 |
| 1900    | 0.529 | -153.1 | 5.77  | 85.0  | 0.0716 | 30.6 | 0.384 | -60.7 |
| 2000    | 0.523 | -157.1 | 5.53  | 83.2  | 0.0735 | 28.8 | 0.370 | -62.1 |
| 2100    | 0.520 | -162.0 | 5.29  | 80.4  | 0.0719 | 30.4 | 0.349 | -62.5 |
| 2200    | 0.521 | -164.7 | 5.03  | 79.1  | 0.0733 | 28.1 | 0.345 | -63.6 |
| 2300    | 0.521 | -168.8 | 4.86  | 76.4  | 0.0752 | 26.6 | 0.326 | -64.0 |
| 2400    | 0.521 | -172.0 | 4.67  | 74.4  | 0.0748 | 26.8 | 0.312 | -64.8 |
| 2500    | 0.520 | -175.7 | 4.53  | 72.3  | 0.0752 | 26.8 | 0.297 | -65.6 |
| 2600    | 0.522 | -178.4 | 4.33  | 70.6  | 0.0765 | 26.2 | 0.292 | -66.7 |
| 2700    | 0.525 | -178.2 | 4.21  | 68.6  | 0.0771 | 27.6 | 0.280 | -67.8 |
| 2800    | 0.526 | -175.6 | 4.05  | 67.2  | 0.0775 | 27.4 | 0.275 | -68.9 |
| 2900    | 0.529 | -172.4 | 3.91  | 64.8  | 0.0785 | 25.5 | 0.260 | -69.5 |
| 3000    | 0.532 | -169.7 | 3.82  | 62.7  | 0.0772 | 24.6 | 0.249 | -70.5 |

(V<sub>CE</sub> = 2 V, I<sub>C</sub> = 10 mA, Z<sub>O</sub> = 50 Ω)

| f (MHz) | S11   |        | S21   |       | S12    |      | S22   |       |
|---------|-------|--------|-------|-------|--------|------|-------|-------|
|         | MAG   | ANG    | MAG   | ANG   | MAG    | ANG  | MAG   | ANG   |
| 100     | 0.717 | -17.3  | 25.92 | 167.8 | 0.0073 | 84.9 | 0.967 | -8.4  |
| 200     | 0.712 | -34.2  | 24.87 | 156.2 | 0.0137 | 81.4 | 0.941 | -17.1 |
| 300     | 0.699 | -50.1  | 23.25 | 145.5 | 0.0205 | 73.7 | 0.896 | -25.1 |
| 400     | 0.667 | -65.5  | 21.32 | 136.0 | 0.0266 | 66.0 | 0.833 | -32.8 |
| 500     | 0.635 | -78.9  | 19.27 | 127.6 | 0.0319 | 62.0 | 0.766 | -39.1 |
| 600     | 0.600 | -91.5  | 17.37 | 120.5 | 0.0349 | 56.4 | 0.694 | -44.3 |
| 700     | 0.572 | -102.0 | 15.73 | 115.1 | 0.0403 | 52.7 | 0.632 | -48.6 |
| 800     | 0.553 | -112.1 | 14.26 | 109.6 | 0.0402 | 51.2 | 0.574 | -51.7 |
| 900     | 0.533 | -120.1 | 12.97 | 105.3 | 0.0445 | 46.0 | 0.525 | -54.8 |
| 1000    | 0.522 | -127.4 | 11.90 | 101.6 | 0.0472 | 47.2 | 0.484 | -56.2 |
| 1100    | 0.515 | -133.7 | 10.90 | 98.1  | 0.0476 | 43.4 | 0.446 | -58.4 |
| 1200    | 0.499 | -140.9 | 10.16 | 95.3  | 0.0477 | 44.4 | 0.410 | -59.4 |
| 1300    | 0.492 | -146.8 | 9.46  | 92.2  | 0.0505 | 43.3 | 0.381 | -61.0 |
| 1400    | 0.490 | -152.1 | 8.84  | 89.6  | 0.0509 | 43.8 | 0.357 | -61.9 |
| 1500    | 0.484 | -156.6 | 8.27  | 87.4  | 0.0520 | 39.7 | 0.335 | -62.9 |
| 1600    | 0.484 | -161.3 | 7.79  | 84.8  | 0.0533 | 41.0 | 0.316 | -63.4 |
| 1700    | 0.482 | -165.3 | 7.38  | 82.8  | 0.0540 | 41.4 | 0.295 | -64.0 |
| 1800    | 0.481 | -169.8 | 6.99  | 80.7  | 0.0548 | 40.0 | 0.277 | -65.0 |
| 1900    | 0.481 | -173.1 | 6.63  | 78.7  | 0.0578 | 41.6 | 0.265 | -65.1 |
| 2000    | 0.481 | -176.4 | 6.33  | 76.9  | 0.0601 | 39.9 | 0.252 | -66.1 |
| 2100    | 0.483 | 179.9  | 6.02  | 74.8  | 0.0603 | 42.3 | 0.238 | -66.1 |
| 2200    | 0.484 | 177.3  | 5.75  | 73.4  | 0.0610 | 39.9 | 0.232 | -66.9 |
| 2300    | 0.488 | 174.4  | 5.52  | 71.4  | 0.0641 | 39.3 | 0.219 | -67.2 |
| 2400    | 0.489 | 171.8  | 5.29  | 69.6  | 0.0646 | 39.5 | 0.209 | -67.7 |
| 2500    | 0.491 | 169.0  | 5.10  | 67.8  | 0.0664 | 40.2 | 0.197 | -68.0 |
| 2600    | 0.495 | 166.5  | 4.89  | 66.2  | 0.0678 | 39.7 | 0.194 | -69.7 |
| 2700    | 0.501 | 164.3  | 4.73  | 64.6  | 0.0693 | 40.4 | 0.185 | -71.0 |
| 2800    | 0.503 | 161.9  | 4.55  | 63.2  | 0.0705 | 40.2 | 0.181 | -71.9 |
| 2900    | 0.508 | 159.6  | 4.39  | 61.4  | 0.0715 | 39.5 | 0.170 | -72.9 |
| 3000    | 0.510 | 157.3  | 4.27  | 59.6  | 0.0717 | 37.3 | 0.162 | -74.0 |

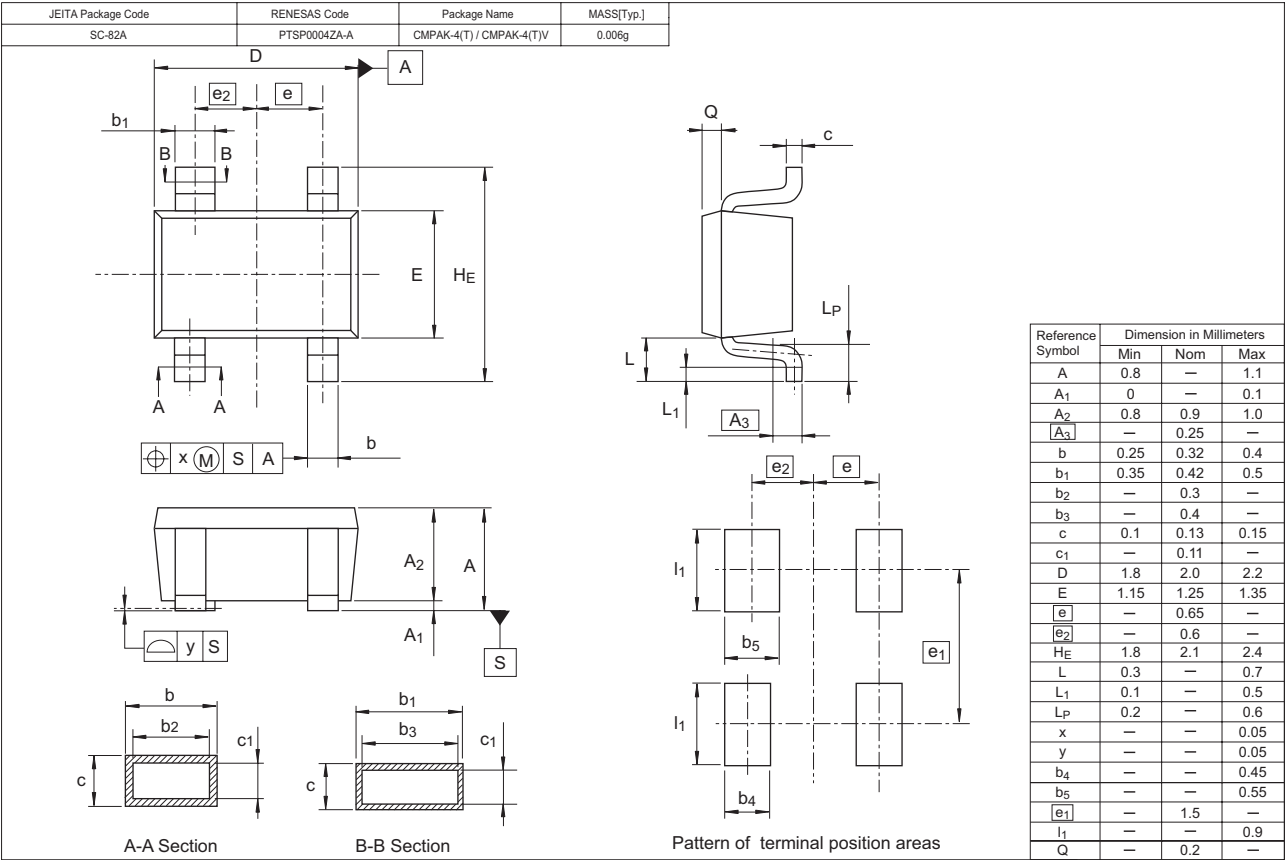
(V<sub>CE</sub> = 2 V, I<sub>C</sub> = 20 mA, Z<sub>O</sub> = 50 Ω)

| f (MHz) | S11   |        | S21   |       | S12    |      | S22   |       |
|---------|-------|--------|-------|-------|--------|------|-------|-------|
|         | MAG   | ANG    | MAG   | ANG   | MAG    | ANG  | MAG   | ANG   |
| 100     | 0.556 | -26.3  | 38.68 | 163.4 | 0.0065 | 88.2 | 0.937 | -11.6 |
| 200     | 0.550 | -50.8  | 35.60 | 148.3 | 0.0117 | 78.3 | 0.882 | -23.2 |
| 300     | 0.537 | -72.0  | 31.52 | 135.5 | 0.0174 | 71.3 | 0.805 | -32.9 |
| 400     | 0.519 | -90.7  | 27.37 | 125.0 | 0.0215 | 63.3 | 0.716 | -41.4 |
| 500     | 0.501 | -105.4 | 23.66 | 116.7 | 0.0252 | 62.0 | 0.633 | -47.6 |
| 600     | 0.485 | -118.3 | 20.55 | 110.2 | 0.0276 | 57.0 | 0.556 | -52.3 |
| 700     | 0.475 | -128.1 | 18.10 | 105.3 | 0.0310 | 54.2 | 0.495 | -55.9 |
| 800     | 0.470 | -137.3 | 16.09 | 100.7 | 0.0312 | 54.1 | 0.441 | -58.4 |
| 900     | 0.462 | -144.3 | 14.43 | 97.1  | 0.0352 | 51.7 | 0.397 | -60.8 |
| 1000    | 0.460 | -150.4 | 13.12 | 94.1  | 0.0369 | 53.1 | 0.362 | -61.7 |
| 1100    | 0.460 | -155.8 | 11.95 | 91.2  | 0.0389 | 50.4 | 0.330 | -63.6 |
| 1200    | 0.458 | -161.4 | 11.00 | 88.9  | 0.0397 | 52.5 | 0.302 | -63.5 |
| 1300    | 0.457 | -166.3 | 10.20 | 86.4  | 0.0425 | 51.5 | 0.280 | -64.7 |
| 1400    | 0.460 | -170.1 | 9.48  | 84.2  | 0.0441 | 53.3 | 0.260 | -65.2 |
| 1500    | 0.457 | -173.9 | 8.85  | 82.2  | 0.0452 | 49.4 | 0.242 | -66.3 |
| 1600    | 0.462 | -177.4 | 8.31  | 80.0  | 0.0469 | 50.7 | 0.227 | -65.9 |
| 1700    | 0.462 | 179.3  | 7.84  | 78.4  | 0.0478 | 52.0 | 0.210 | -66.4 |
| 1800    | 0.466 | 175.9  | 7.41  | 76.6  | 0.0496 | 49.7 | 0.198 | -66.8 |
| 1900    | 0.467 | 173.3  | 7.02  | 74.8  | 0.0532 | 51.5 | 0.187 | -67.2 |
| 2000    | 0.469 | 170.6  | 6.70  | 73.2  | 0.0548 | 50.1 | 0.178 | -67.2 |
| 2100    | 0.474 | 167.8  | 6.36  | 71.4  | 0.0572 | 52.8 | 0.167 | -67.3 |
| 2200    | 0.476 | 165.5  | 6.09  | 70.0  | 0.0574 | 50.9 | 0.161 | -68.3 |
| 2300    | 0.480 | 163.3  | 5.82  | 68.3  | 0.0610 | 48.6 | 0.152 | -68.2 |
| 2400    | 0.483 | 161.2  | 5.58  | 66.7  | 0.0616 | 49.0 | 0.143 | -69.2 |
| 2500    | 0.486 | 159.0  | 5.37  | 65.0  | 0.0638 | 49.8 | 0.135 | -69.8 |
| 2600    | 0.490 | 156.9  | 5.15  | 63.4  | 0.0661 | 48.6 | 0.131 | -70.8 |
| 2700    | 0.497 | 155.3  | 4.97  | 62.1  | 0.0699 | 48.9 | 0.123 | -72.9 |
| 2800    | 0.499 | 153.1  | 4.78  | 60.8  | 0.0715 | 49.3 | 0.122 | -74.1 |
| 2900    | 0.505 | 151.4  | 4.61  | 59.2  | 0.0714 | 48.0 | 0.114 | -75.4 |
| 3000    | 0.506 | 149.6  | 4.48  | 57.6  | 0.0713 | 46.7 | 0.106 | -77.2 |

(V<sub>CE</sub> = 2 V, I<sub>C</sub> = 30 mA, Z<sub>O</sub> = 50 Ω)

| f (MHz) | S11   |        | S21   |       | S12    |      | S22   |       |
|---------|-------|--------|-------|-------|--------|------|-------|-------|
|         | MAG   | ANG    | MAG   | ANG   | MAG    | ANG  | MAG   | ANG   |
| 100     | 0.441 | -34.8  | 45.76 | 160.6 | 0.0061 | 84.2 | 0.913 | -13.6 |
| 200     | 0.449 | -65.1  | 40.75 | 143.5 | 0.0110 | 78.8 | 0.838 | -26.7 |
| 300     | 0.455 | -88.7  | 34.81 | 129.9 | 0.0153 | 69.4 | 0.741 | -37.1 |
| 400     | 0.455 | -107.9 | 29.32 | 119.4 | 0.0185 | 63.3 | 0.641 | -45.5 |
| 500     | 0.451 | -122.1 | 24.83 | 111.5 | 0.0223 | 61.5 | 0.558 | -51.2 |
| 600     | 0.450 | -133.9 | 21.25 | 105.6 | 0.0238 | 58.6 | 0.485 | -55.6 |
| 700     | 0.449 | -142.5 | 18.53 | 101.1 | 0.0280 | 55.9 | 0.428 | -58.5 |
| 800     | 0.451 | -150.6 | 16.36 | 97.0  | 0.0284 | 57.8 | 0.378 | -60.4 |
| 900     | 0.449 | -156.4 | 14.62 | 93.7  | 0.0321 | 55.5 | 0.340 | -62.8 |
| 1000    | 0.449 | -161.7 | 13.25 | 91.1  | 0.0347 | 57.7 | 0.308 | -63.1 |
| 1100    | 0.453 | -166.3 | 12.05 | 88.4  | 0.0360 | 55.5 | 0.279 | -64.9 |
| 1200    | 0.455 | -171.0 | 11.05 | 86.3  | 0.0364 | 58.0 | 0.256 | -64.1 |
| 1300    | 0.457 | -175.0 | 10.23 | 84.0  | 0.0399 | 56.7 | 0.236 | -65.2 |
| 1400    | 0.460 | -178.3 | 9.50  | 82.0  | 0.0413 | 58.5 | 0.220 | -65.5 |
| 1500    | 0.460 | 178.5  | 8.86  | 80.2  | 0.0438 | 54.8 | 0.204 | -66.2 |
| 1600    | 0.466 | 175.5  | 8.32  | 78.1  | 0.0437 | 55.1 | 0.190 | -65.9 |
| 1700    | 0.466 | 172.7  | 7.84  | 76.5  | 0.0465 | 56.5 | 0.176 | -65.8 |
| 1800    | 0.471 | 169.8  | 7.41  | 74.8  | 0.0481 | 55.4 | 0.165 | -66.4 |
| 1900    | 0.472 | 167.4  | 7.02  | 73.2  | 0.0517 | 56.0 | 0.157 | -66.9 |
| 2000    | 0.476 | 165.0  | 6.69  | 71.6  | 0.0540 | 54.4 | 0.149 | -66.8 |
| 2100    | 0.480 | 162.7  | 6.35  | 69.9  | 0.0560 | 56.9 | 0.139 | -67.3 |
| 2200    | 0.483 | 160.5  | 6.08  | 68.5  | 0.0573 | 55.2 | 0.134 | -67.8 |
| 2300    | 0.487 | 158.7  | 5.81  | 66.9  | 0.0604 | 52.3 | 0.126 | -67.7 |
| 2400    | 0.489 | 156.8  | 5.56  | 65.4  | 0.0617 | 53.6 | 0.117 | -68.2 |
| 2500    | 0.493 | 154.9  | 5.35  | 63.8  | 0.0633 | 53.4 | 0.110 | -68.8 |
| 2600    | 0.497 | 153.0  | 5.14  | 62.2  | 0.0659 | 51.6 | 0.107 | -70.8 |
| 2700    | 0.504 | 151.6  | 4.96  | 60.9  | 0.0690 | 52.2 | 0.101 | -72.8 |
| 2800    | 0.507 | 149.5  | 4.77  | 59.6  | 0.0711 | 52.9 | 0.099 | -73.4 |
| 2900    | 0.511 | 148.0  | 4.59  | 58.1  | 0.0714 | 50.9 | 0.091 | -76.1 |
| 3000    | 0.515 | 146.3  | 4.47  | 56.5  | 0.0717 | 49.4 | 0.085 | -78.0 |

Package Dimensions



Ordering Information

| Part Name      | Quantity | Shipping Container                |
|----------------|----------|-----------------------------------|
| 2SC5820WU-TL-E | 3000     | φ 178 mm Reel, 8 mm Emboss Taping |

Note: For some grades, production may be terminated. Please contact the Renesas sales office to check the state of production before ordering the product.

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Unit2607 Ruijing Building, No.205 Maoming Road (S), Shanghai 200020, China  
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1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

#### **Renesas Technology Korea Co., Ltd.**

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea  
Tel: <82> 2-796-3115, Fax: <82> 2-796-2145

#### **Renesas Technology Malaysia Sdn. Bhd.**

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: <603> 7955-9390, Fax: <603> 7955-9510