Ordering number : ENN7328

NPN Epitaxial Planar Silicon Transistor

# 2SC5847

## High-Frequency Low-Noise Amplifier and OSC Applications

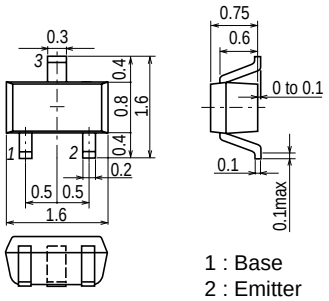
### Features

- Low noise : NF=1.5dB typ (f=2GHz).
- High cutoff frequency : $f_T$=6.0GHz typ ($V_{CE}$=1V).
  : $f_T$=10.5GHz typ ($V_{CE}$=3V).
- Low operating voltage.

### Package Dimensions

unit : mm
2106A

[2SC5847]




1 : Base
2 : Emitter
3 : Collector

SANYO : SMCP

### Specifications

**Absolute Maximum Ratings** at Ta=25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Collector-to-Base Voltage | $V_{CBO}$ | | 9 | V |
| Collector-to-Emitter Voltage | $V_{CEO}$ | | 4 | V |
| Emitter-to-Base Voltage | $V_{EBO}$ | | 2 | V |
| Collector Current | $I_C$ | | 80 | mA |
| Collector Dissipation | $P_C$ | | 100 | mW |
| Junction Temperature | Tj | | 150 | °C |
| Storage Temperature | Tstg | | −55 to +150 | °C |

Marking : NL

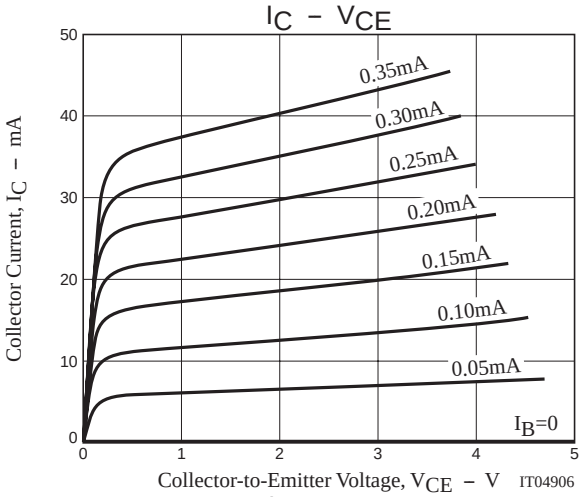
Pay attention to handling since it is liable to be affected by static electricity due to the high-frequency process adopted.

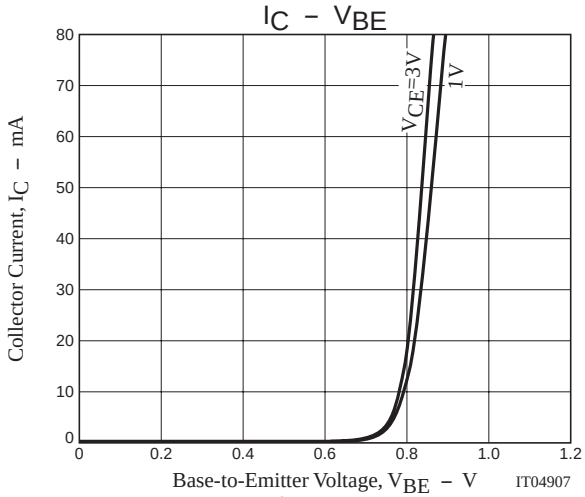


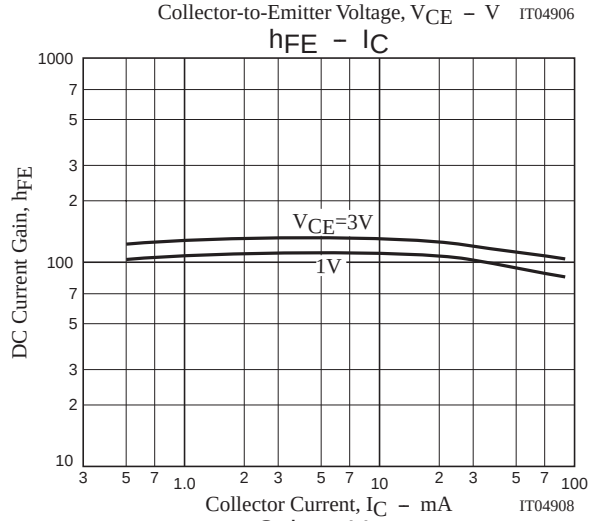

**SANYO Electric Co.,Ltd. Semiconductor Company**
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

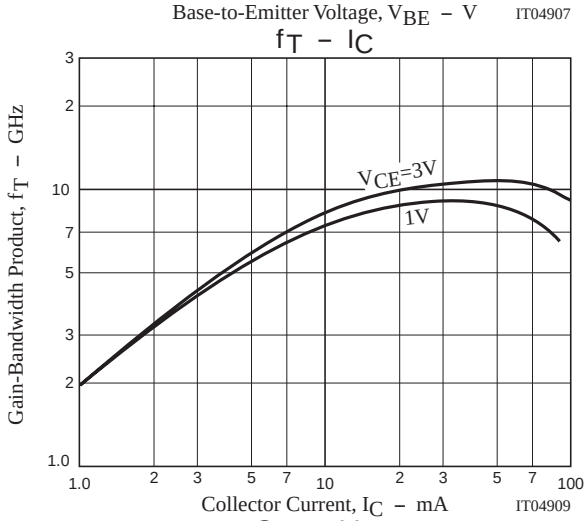
## Electrical Characteristics at Ta=25°C

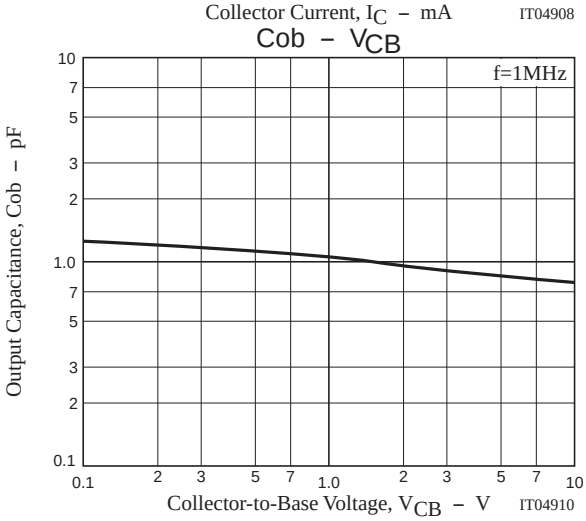
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Collector Cutoff Current | $I_{CBO}$ | $V_{CB}$=5V, $I_E$=0 | | | 1.0 | μA |
| Emitter Cutoff Current | $I_{EBO}$ | $V_{EB}$=1V, $I_C$=0 | | | 10 | μA |
| DC Current Gain | $h_{FE}$ | $V_{CE}$=1V, $I_C$=5mA | 100 | | 160 | |
| Gain-Bandwidth Product | $f_T1$ | $V_{CE}$=1V, $I_C$=5mA | 4.5 | 6.0 | | GHz |
| | $f_T2$ | $V_{CE}$=3V, $I_C$=40mA | 8.5 | 10.5 | | GHz |
| Output Capacitance | Cob | $V_{CB}$=1V, f=1MHz | | 1.05 | 1.3 | pF |
| Reverse Transfer Capacitance | Cre | $V_{CB}$=1V, f=1MHz | | 0.8 | 1.0 | pF |
| Forward Transfer Gain | $\|S21e\|^2$1 | $V_{CE}$=1V, $I_C$=5mA, f=2GHz | 4 | 5 | | dB |
| | $\|S21e\|^2$2 | $V_{CE}$=3V, $I_C$=40mA, f=2GHz | 6.5 | 8.0 | | dB |
| Noise Figure | NF | $V_{CE}$=1V, $I_C$=7mA, f=2GHz | | 1.5 | 2.3 | dB |

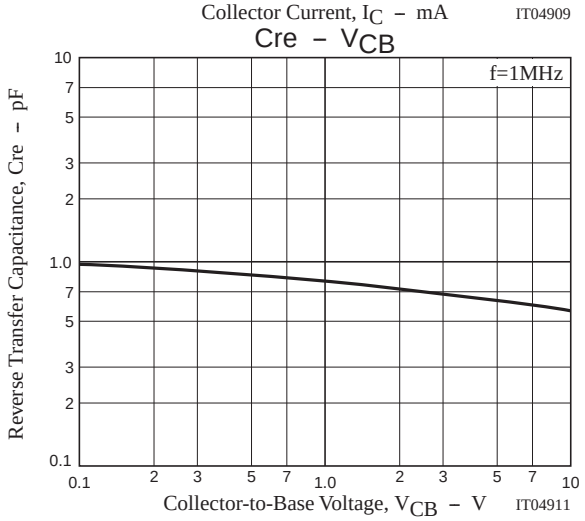


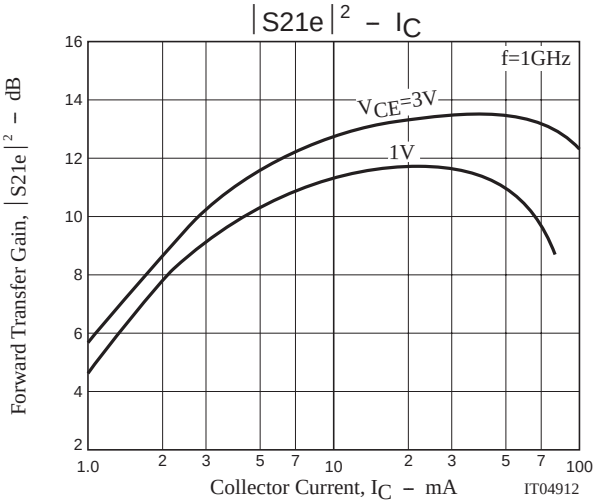



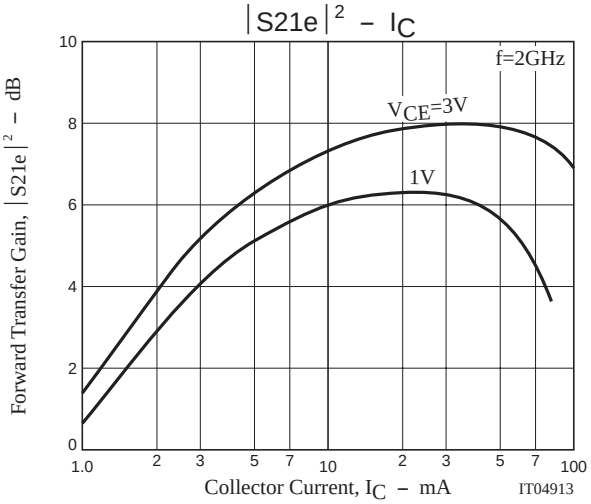



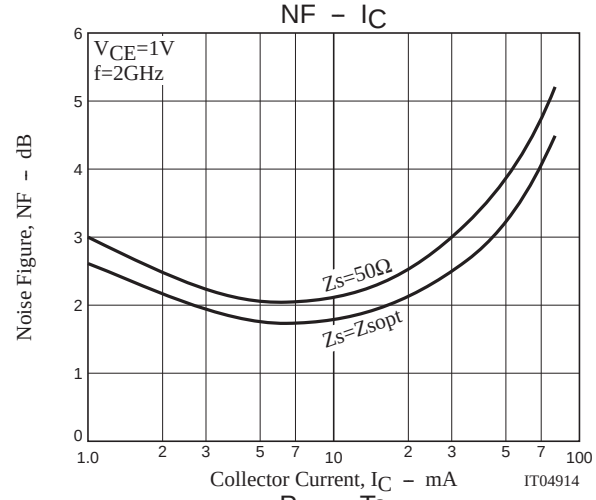



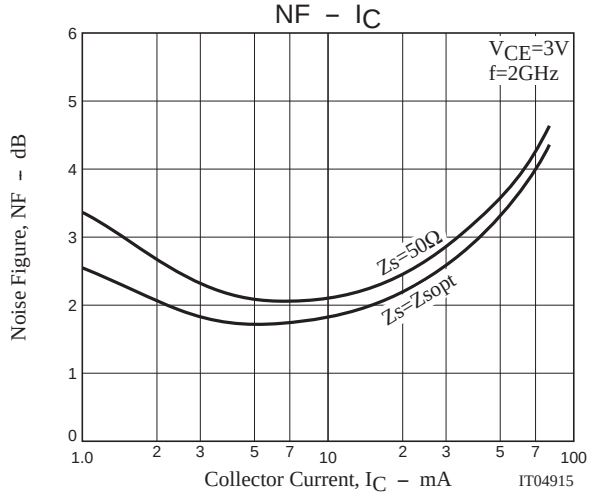



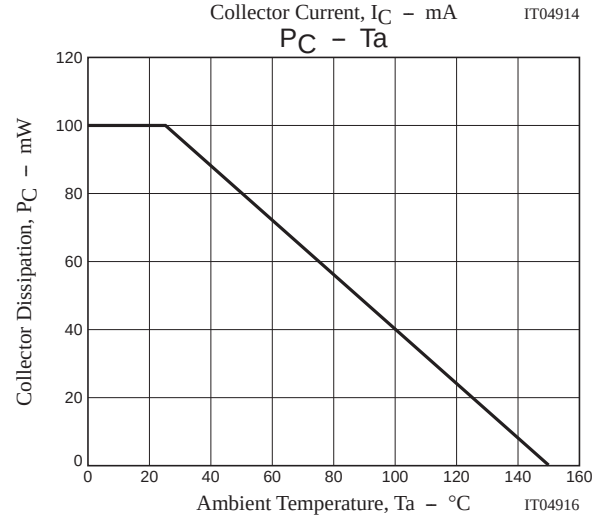




|S21e|² – IC
f=1GHz
VCE=3V
1V
Forward Transfer Gain, |S21e|² – dB
Collector Current, IC – mA
IT04912


|S21e|² – IC
f=2GHz
VCE=3V
1V
Forward Transfer Gain, |S21e|² – dB
Collector Current, IC – mA
IT04913


NF – IC
VCE=1V
f=2GHz
Zs=50Ω
Zs=Zsopt
Noise Figure, NF – dB
Collector Current, IC – mA
IT04914


NF – IC
VCE=3V
f=2GHz
Zs=50Ω
Zs=Zsopt
Noise Figure, NF – dB
Collector Current, IC – mA
IT04915


PC – Ta
Collector Dissipation, PC – mW
Ambient Temperature, Ta – °C
IT04916

## S Parameters (Common emitter)

$V_{CE}$=1V, $I_C$=1mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.958 | −18.69 | 3.545 | 165.60 | 0.059 | 78.07 | 0.970 | −11.10 |
| 200 | 0.933 | −36.23 | 3.407 | 152.62 | 0.111 | 67.24 | 0.931 | −21.25 |
| 400 | 0.861 | −67.16 | 2.940 | 129.99 | 0.188 | 50.32 | 0.816 | −37.70 |
| 600 | 0.796 | −92.11 | 2.511 | 111.52 | 0.229 | 37.35 | 0.704 | −49.62 |
| 800 | 0.734 | −109.81 | 2.109 | 97.31 | 0.246 | 29.55 | 0.622 | −57.64 |
| 1000 | 0.709 | −125.88 | 1.870 | 85.16 | 0.255 | 23.00 | 0.573 | −64.33 |
| 1200 | 0.675 | −138.13 | 1.648 | 74.68 | 0.256 | 18.56 | 0.532 | −70.70 |
| 1400 | 0.650 | −148.61 | 1.468 | 65.69 | 0.252 | 15.81 | 0.510 | −74.91 |
| 1600 | 0.631 | −157.93 | 1.334 | 57.83 | 0.248 | 14.79 | 0.502 | −79.34 |
| 1800 | 0.611 | −165.92 | 1.234 | 50.87 | 0.240 | 14.56 | 0.497 | −83.58 |
| 2000 | 0.596 | −173.33 | 1.135 | 44.54 | 0.233 | 15.44 | 0.497 | −87.67 |
| 2200 | 0.581 | 179.85 | 1.061 | 38.67 | 0.230 | 16.94 | 0.493 | −92.07 |
| 2400 | 0.568 | 173.89 | 0.983 | 34.03 | 0.225 | 18.88 | 0.497 | −95.37 |
| 2600 | 0.565 | 167.51 | 0.931 | 29.96 | 0.227 | 23.73 | 0.504 | −100.33 |
| 2800 | 0.556 | 161.65 | 0.871 | 25.85 | 0.233 | 26.78 | 0.509 | −104.20 |
| 3000 | 0.552 | 155.57 | 0.845 | 22.57 | 0.243 | 30.72 | 0.510 | −109.23 |

$V_{CE}$=1V, $I_C$=5mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.835 | −38.08 | 12.462 | 153.77 | 0.051 | 69.17 | 0.877 | −27.54 |
| 200 | 0.747 | −69.45 | 10.411 | 134.02 | 0.086 | 55.99 | 0.724 | −48.11 |
| 400 | 0.629 | −110.22 | 6.984 | 110.08 | 0.122 | 43.78 | 0.508 | −72.79 |
| 600 | 0.576 | −134.23 | 5.073 | 95.78 | 0.139 | 41.30 | 0.394 | −87.67 |
| 800 | 0.544 | −148.42 | 3.924 | 86.44 | 0.153 | 41.45 | 0.332 | −97.57 |
| 1000 | 0.539 | −159.32 | 3.258 | 78.03 | 0.169 | 41.66 | 0.305 | −104.86 |
| 1200 | 0.524 | −168.23 | 2.758 | 71.46 | 0.183 | 42.04 | 0.287 | −113.00 |
| 1400 | 0.516 | −175.55 | 2.386 | 65.24 | 0.201 | 42.69 | 0.275 | −117.01 |
| 1600 | 0.509 | 178.13 | 2.140 | 59.66 | 0.217 | 42.49 | 0.272 | −121.75 |
| 1800 | 0.498 | 172.03 | 1.932 | 54.39 | 0.233 | 42.68 | 0.266 | −125.74 |
| 2000 | 0.489 | 166.37 | 1.763 | 49.66 | 0.250 | 42.49 | 0.270 | −128.82 |
| 2200 | 0.485 | 160.79 | 1.635 | 45.22 | 0.270 | 42.06 | 0.269 | −133.03 |
| 2400 | 0.469 | 156.36 | 1.514 | 41.05 | 0.284 | 40.86 | 0.262 | −134.93 |
| 2600 | 0.469 | 150.95 | 1.435 | 37.62 | 0.303 | 40.82 | 0.269 | −138.65 |
| 2800 | 0.461 | 146.31 | 1.353 | 33.39 | 0.322 | 39.95 | 0.268 | −142.35 |
| 3000 | 0.463 | 142.14 | 1.292 | 30.09 | 0.341 | 38.98 | 0.272 | −145.60 |

$V_{CE}$=1V, $I_C$=10mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.716 | −55.56 | 19.025 | 144.11 | 0.046 | 64.12 | 0.782 | −40.11 |
| 200 | 0.620 | −92.98 | 13.902 | 122.78 | 0.071 | 52.44 | 0.583 | −65.91 |
| 400 | 0.543 | −131.90 | 8.246 | 101.93 | 0.097 | 49.12 | 0.388 | −93.48 |
| 600 | 0.522 | −151.26 | 5.754 | 90.37 | 0.116 | 49.02 | 0.316 | −109.80 |
| 800 | 0.505 | −162.22 | 4.391 | 82.68 | 0.136 | 50.79 | 0.277 | −121.22 |
| 1000 | 0.506 | −170.68 | 3.606 | 75.59 | 0.159 | 51.59 | 0.267 | −128.29 |
| 1200 | 0.498 | −177.78 | 3.034 | 69.84 | 0.180 | 51.69 | 0.261 | −135.64 |
| 1400 | 0.491 | 176.11 | 2.622 | 64.44 | 0.202 | 51.53 | 0.258 | −139.90 |
| 1600 | 0.489 | 170.57 | 2.333 | 59.33 | 0.224 | 50.13 | 0.258 | −143.95 |
| 1800 | 0.481 | 165.30 | 2.108 | 54.70 | 0.245 | 49.34 | 0.257 | −147.81 |
| 2000 | 0.476 | 160.00 | 1.912 | 50.36 | 0.267 | 48.05 | 0.259 | −150.21 |
| 2200 | 0.471 | 154.66 | 1.783 | 46.31 | 0.286 | 46.48 | 0.261 | −154.78 |
| 2400 | 0.454 | 150.77 | 1.648 | 42.51 | 0.305 | 44.78 | 0.253 | −156.88 |
| 2600 | 0.457 | 145.86 | 1.556 | 39.26 | 0.327 | 43.71 | 0.263 | −159.74 |
| 2800 | 0.451 | 141.35 | 1.471 | 35.25 | 0.347 | 42.02 | 0.262 | −164.02 |
| 3000 | 0.453 | 137.17 | 1.402 | 32.03 | 0.365 | 40.56 | 0.264 | −166.39 |

$V_{CE}$=1V, $I_C$=40mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.494 | −102.52 | 26.600 | 126.78 | 0.034 | 59.36 | 0.546 | −69.55 |
| 200 | 0.506 | −136.91 | 16.053 | 108.02 | 0.050 | 58.94 | 0.390 | −101.67 |
| 400 | 0.512 | −161.23 | 8.633 | 93.04 | 0.077 | 61.64 | 0.308 | −131.35 |
| 600 | 0.516 | −172.32 | 5.839 | 84.20 | 0.104 | 62.52 | 0.291 | −144.91 |
| 800 | 0.509 | −178.39 | 4.415 | 78.39 | 0.132 | 62.88 | 0.287 | −153.50 |
| 1000 | 0.517 | 175.86 | 3.600 | 72.08 | 0.161 | 61.71 | 0.290 | −157.66 |
| 1200 | 0.512 | 170.68 | 3.022 | 67.14 | 0.186 | 60.40 | 0.298 | −162.65 |
| 1400 | 0.507 | 165.95 | 2.609 | 62.48 | 0.214 | 58.95 | 0.297 | −165.66 |
| 1600 | 0.506 | 161.62 | 2.321 | 57.91 | 0.240 | 56.12 | 0.301 | −168.28 |
| 1800 | 0.500 | 157.24 | 2.094 | 53.57 | 0.262 | 54.15 | 0.304 | −170.81 |
| 2000 | 0.496 | 152.56 | 1.899 | 49.62 | 0.287 | 52.10 | 0.307 | −172.63 |
| 2200 | 0.493 | 147.77 | 1.771 | 46.02 | 0.311 | 49.89 | 0.313 | −176.27 |
| 2400 | 0.474 | 144.08 | 1.636 | 42.34 | 0.332 | 47.31 | 0.302 | −178.93 |
| 2600 | 0.478 | 139.72 | 1.550 | 39.47 | 0.352 | 45.70 | 0.312 | 179.07 |
| 2800 | 0.469 | 135.36 | 1.467 | 35.65 | 0.375 | 43.26 | 0.313 | 175.27 |
| 3000 | 0.473 | 131.70 | 1.399 | 32.42 | 0.395 | 41.42 | 0.314 | 172.94 |

$V_{CE}$=3V, $I_C$=1mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.972 | −15.82 | 3.205 | 167.57 | 0.047 | 79.38 | 0.976 | −8.53 |
| 200 | 0.952 | −31.07 | 3.106 | 156.17 | 0.092 | 70.52 | 0.948 | −16.69 |
| 400 | 0.892 | −58.57 | 2.786 | 135.28 | 0.162 | 54.55 | 0.862 | −30.29 |
| 600 | 0.834 | −81.93 | 2.456 | 117.78 | 0.203 | 42.19 | 0.766 | −40.80 |
| 800 | 0.771 | −100.04 | 2.112 | 103.49 | 0.224 | 33.80 | 0.693 | −47.92 |
| 1000 | 0.742 | −115.97 | 1.901 | 91.11 | 0.238 | 26.95 | 0.643 | −54.29 |
| 1200 | 0.702 | −128.95 | 1.684 | 80.47 | 0.239 | 22.02 | 0.602 | −59.59 |
| 1400 | 0.672 | −140.14 | 1.504 | 70.90 | 0.236 | 18.88 | 0.579 | −63.43 |
| 1600 | 0.649 | −150.10 | 1.383 | 62.82 | 0.233 | 16.88 | 0.564 | −67.75 |
| 1800 | 0.624 | −158.54 | 1.273 | 55.58 | 0.224 | 16.20 | 0.555 | −71.49 |
| 2000 | 0.604 | −166.48 | 1.181 | 49.11 | 0.216 | 17.07 | 0.554 | −75.43 |
| 2200 | 0.591 | −173.84 | 1.098 | 42.71 | 0.212 | 19.01 | 0.552 | −79.70 |
| 2400 | 0.572 | 179.58 | 1.014 | 37.82 | 0.205 | 20.84 | 0.554 | −82.80 |
| 2600 | 0.565 | 172.73 | 0.971 | 33.63 | 0.205 | 25.69 | 0.555 | −87.59 |
| 2800 | 0.556 | 166.58 | 0.908 | 29.12 | 0.210 | 29.68 | 0.562 | −91.70 |
| 3000 | 0.553 | 160.23 | 0.869 | 25.93 | 0.221 | 34.11 | 0.564 | −95.96 |

$V_{CE}$=3V, $I_C$=5mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.861 | −32.01 | 12.675 | 156.76 | 0.043 | 73.41 | 0.891 | −22.10 |
| 200 | 0.776 | −59.30 | 10.914 | 138.55 | 0.074 | 59.95 | 0.764 | −39.30 |
| 400 | 0.635 | −97.83 | 7.678 | 114.67 | 0.108 | 48.47 | 0.551 | −60.23 |
| 600 | 0.565 | −122.73 | 5.697 | 99.96 | 0.127 | 44.03 | 0.431 | −72.42 |
| 800 | 0.520 | −137.87 | 4.459 | 90.16 | 0.141 | 43.87 | 0.355 | −80.37 |
| 1000 | 0.508 | −150.24 | 3.707 | 81.75 | 0.155 | 43.74 | 0.320 | −86.59 |
| 1200 | 0.489 | −160.10 | 3.157 | 74.87 | 0.171 | 44.35 | 0.295 | −93.19 |
| 1400 | 0.477 | −168.27 | 2.727 | 68.66 | 0.184 | 45.40 | 0.277 | −96.71 |
| 1600 | 0.470 | −175.03 | 2.432 | 63.04 | 0.204 | 44.95 | 0.269 | −100.69 |
| 1800 | 0.459 | 178.66 | 2.206 | 57.81 | 0.215 | 45.01 | 0.265 | −104.74 |
| 2000 | 0.451 | 171.85 | 2.003 | 52.98 | 0.234 | 44.76 | 0.263 | −108.28 |
| 2200 | 0.445 | 166.37 | 1.860 | 48.42 | 0.251 | 44.99 | 0.259 | −112.40 |
| 2400 | 0.429 | 161.49 | 1.715 | 44.21 | 0.267 | 43.75 | 0.250 | −113.95 |
| 2600 | 0.432 | 156.03 | 1.620 | 40.78 | 0.285 | 43.82 | 0.257 | −117.79 |
| 2800 | 0.423 | 150.90 | 1.526 | 36.42 | 0.303 | 42.80 | 0.250 | −121.83 |
| 3000 | 0.426 | 146.29 | 1.455 | 33.18 | 0.321 | 42.07 | 0.252 | −125.12 |

$V_{CE}$=3V, $I_C$=10mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.756 | −45.05 | 19.529 | 148.46 | 0.039 | 69.09 | 0.808 | −32.29 |
| 200 | 0.641 | −78.52 | 15.063 | 127.70 | 0.062 | 57.94 | 0.632 | −53.48 |
| 400 | 0.521 | −118.14 | 9.345 | 106.01 | 0.089 | 52.69 | 0.415 | −75.98 |
| 600 | 0.479 | −139.80 | 6.609 | 93.78 | 0.106 | 51.19 | 0.321 | −89.28 |
| 800 | 0.455 | −152.16 | 5.059 | 85.92 | 0.127 | 52.62 | 0.270 | −98.82 |
| 1000 | 0.453 | −161.92 | 4.161 | 78.83 | 0.148 | 53.76 | 0.249 | −105.45 |
| 1200 | 0.445 | −170.21 | 3.503 | 72.88 | 0.167 | 53.20 | 0.235 | −113.22 |
| 1400 | 0.437 | −177.07 | 3.034 | 67.62 | 0.188 | 53.28 | 0.225 | −117.51 |
| 1600 | 0.436 | 177.08 | 2.694 | 62.56 | 0.208 | 51.99 | 0.222 | −121.90 |
| 1800 | 0.429 | 171.47 | 2.430 | 57.93 | 0.228 | 51.64 | 0.219 | −126.07 |
| 2000 | 0.424 | 165.72 | 2.206 | 53.56 | 0.247 | 50.28 | 0.225 | −129.16 |
| 2200 | 0.420 | 159.89 | 2.047 | 49.40 | 0.269 | 49.10 | 0.221 | −133.98 |
| 2400 | 0.404 | 155.57 | 1.887 | 45.57 | 0.286 | 47.31 | 0.210 | −136.35 |
| 2600 | 0.407 | 150.53 | 1.778 | 42.31 | 0.307 | 46.34 | 0.219 | −139.18 |
| 2800 | 0.400 | 145.68 | 1.674 | 38.25 | 0.326 | 45.05 | 0.214 | −144.44 |
| 3000 | 0.406 | 141.56 | 1.598 | 34.95 | 0.346 | 43.20 | 0.218 | −147.88 |

$V_{CE}$=3V, $I_C$=40mA, $Z_O$=50Ω

| Freq(MHz) | $\|S_{11}\|$ | $\angle S_{11}$ | $\|S_{21}\|$ | $\angle S_{21}$ | $\|S_{12}\|$ | $\angle S_{12}$ | $\|S_{22}\|$ | $\angle S_{22}$ |
|---|---|---|---|---|---|---|---|---|
| 100 | 0.516 | −76.98 | 30.239 | 132.79 | 0.031 | 65.77 | 0.614 | −52.07 |
| 200 | 0.454 | −114.96 | 19.239 | 112.91 | 0.045 | 59.98 | 0.413 | −77.55 |
| 400 | 0.426 | −146.78 | 10.582 | 96.57 | 0.072 | 61.88 | 0.273 | −103.47 |
| 600 | 0.421 | −161.27 | 7.221 | 87.56 | 0.096 | 63.62 | 0.231 | −117.73 |
| 800 | 0.415 | −169.26 | 5.469 | 81.48 | 0.120 | 63.75 | 0.212 | −128.32 |
| 1000 | 0.422 | −175.88 | 4.462 | 75.58 | 0.146 | 63.26 | 0.211 | −134.59 |
| 1200 | 0.420 | 178.19 | 3.745 | 70.44 | 0.172 | 62.05 | 0.212 | −141.46 |
| 1400 | 0.418 | 172.79 | 3.227 | 65.90 | 0.196 | 60.43 | 0.212 | −144.97 |
| 1600 | 0.419 | 168.17 | 2.870 | 61.48 | 0.220 | 58.01 | 0.218 | −148.87 |
| 1800 | 0.415 | 163.53 | 2.582 | 57.23 | 0.243 | 55.92 | 0.221 | −151.66 |
| 2000 | 0.412 | 158.20 | 2.338 | 53.54 | 0.265 | 54.25 | 0.226 | −153.73 |
| 2200 | 0.410 | 152.69 | 2.166 | 49.54 | 0.289 | 52.37 | 0.229 | −158.88 |
| 2400 | 0.393 | 148.94 | 1.995 | 45.99 | 0.307 | 49.63 | 0.218 | −161.67 |
| 2600 | 0.400 | 144.34 | 1.874 | 43.16 | 0.328 | 48.43 | 0.229 | −164.18 |
| 2800 | 0.393 | 139.97 | 1.771 | 39.28 | 0.350 | 46.04 | 0.230 | −168.80 |
| 3000 | 0.399 | 136.21 | 1.680 | 36.16 | 0.368 | 44.16 | 0.233 | −171.88 |