



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

2SC5415A — NPN Epitaxial Planar Silicon Transistor

High-Frequency Low-Noise Amplifier Applications

Features

- High gain : $|S_{21e}|^2 = 9\text{dB typ (f=1GHz)}$.
- High cut-off frequency : $f_T = 6.7\text{GHz typ}$.

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|------------------------------|-----------|---|-------------|------|
| Collector-to-Base Voltage | V_{CB0} | | 20 | V |
| Collector-to-Emitter Voltage | V_{CEO} | | 12 | V |
| Emitter-to-Base Voltage | V_{EBO} | | 2 | V |
| Collector Current | I_C | | 100 | mA |
| Collector Dissipation | P_C | When mounted on ceramic substrate (250mm ² ×0.8mm) | 800 | mW |
| Junction Temperature | T_j | | 150 | °C |
| Storage Temperature | T_{stg} | | -55 to +150 | °C |

Electrical Characteristics at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--------------------------|-----------|---|---------|-----|------|---------------|
| | | | min | typ | max | |
| Collector Cutoff Current | I_{CBO} | $V_{CB} = 10\text{V}, I_E = 0\text{A}$ | | | 1.0 | μA |
| Emitter Cutoff Current | I_{EBO} | $V_{EB} = 1\text{V}, I_C = 0\text{A}$ | | | 10 | μA |
| DC Current Gain | h_{FE1} | $V_{CE} = 5\text{V}, I_C = 30\text{mA}$ | 90* | | 270* | |
| | h_{FE2} | $V_{CE} = 5\text{V}, I_C = 70\text{mA}$ | 70 | | | |

Continued on next page.

* : The 2SC5415A is classified by 30mA hFE as follows :

| Marking | EA E | EA F |
|---------|-----------|------------|
| Rank | E | F |
| hFE | 90 to 180 | 135 to 270 |

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2SC5415A

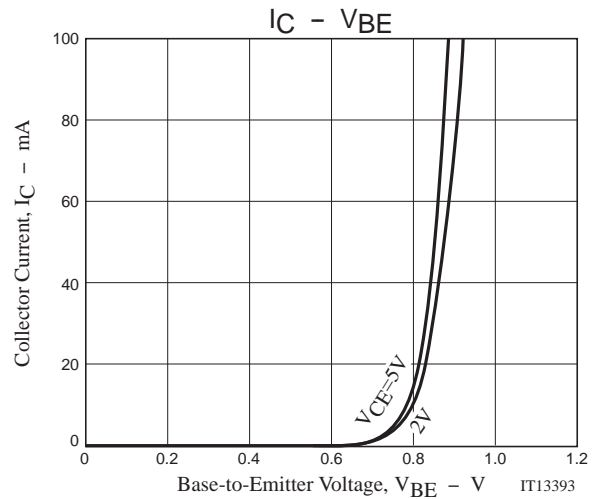
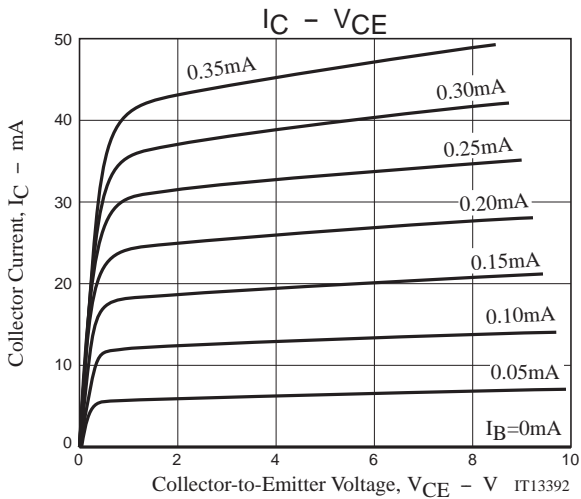
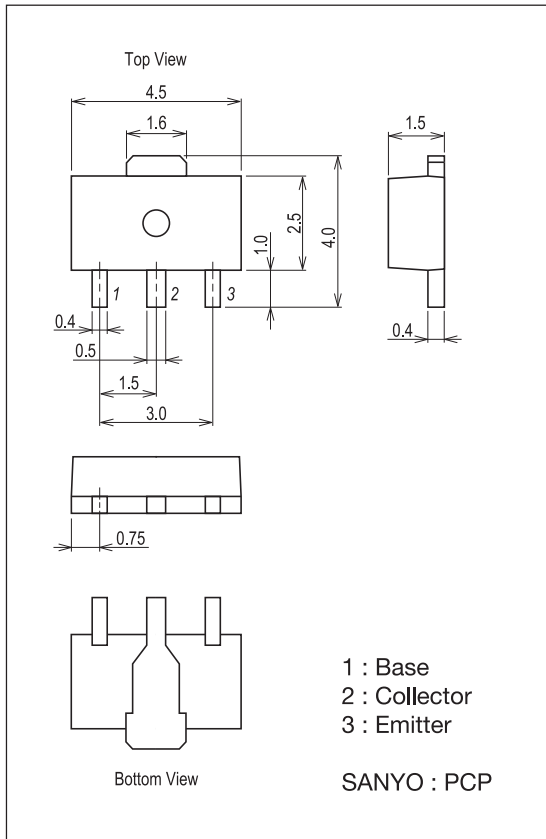
Continued from preceding page.

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|------------------------------|---------------|-------------------------------|---------|------|-----|------|
| | | | min | typ | max | |
| Gain-Bandwidth Product | f_T | $V_{CE}=5V, I_C=30mA$ | 5 | 6.7 | | GHz |
| Output Capacitance | C_{ob} | $V_{CB}=5V, f=1MHz$ | | 1.2 | 1.8 | pF |
| Reverse Transfer Capacitance | C_{re} | $V_{CB}=5V, f=1MHz$ | | 0.65 | | pF |
| Forward Transfer Gain | $ S_{21e} ^2$ | $V_{CE}=5V, I_C=30mA, f=1GHz$ | 7.5 | 9 | | dB |
| Noise Figure | NF | $V_{CE}=5V, I_C=7mA, f=1GHz$ | | 1.1 | 2.0 | dB |

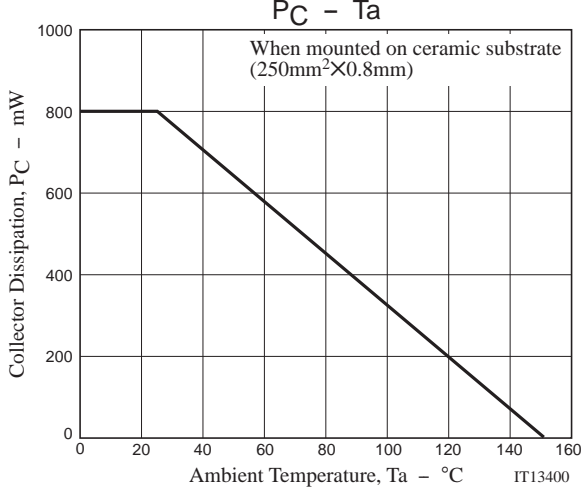
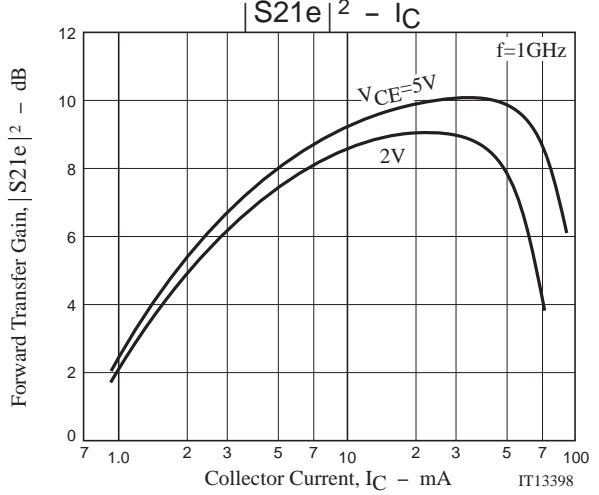
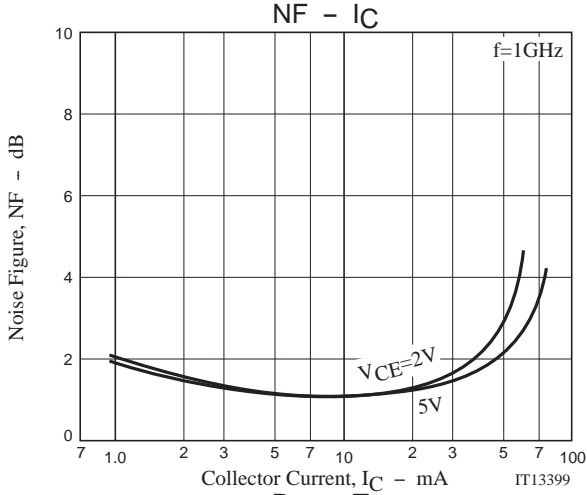
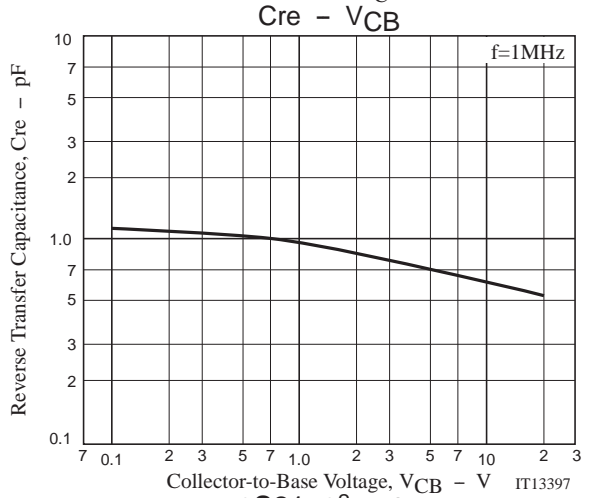
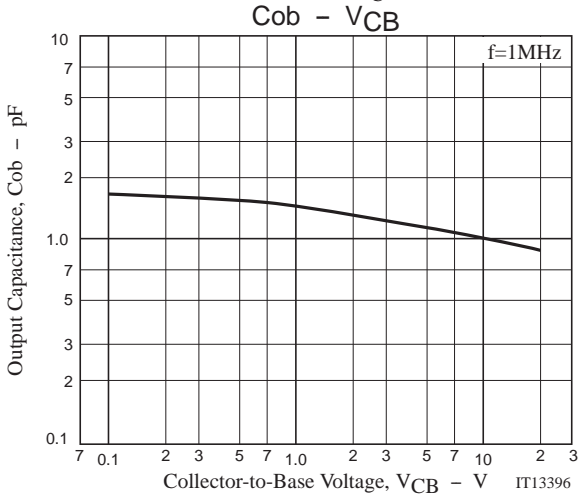
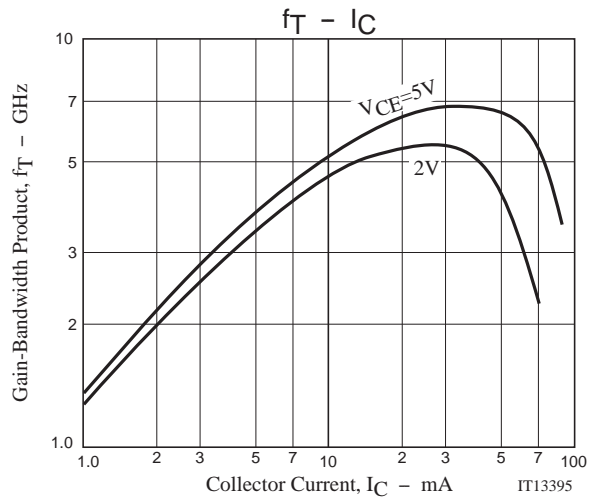
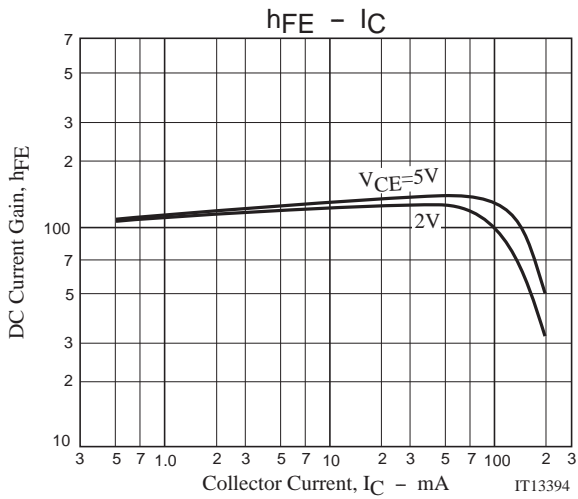
Package Dimensions

unit : mm (typ)

7007B-004



2SC5415A



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S Parameters (Common emitter)

$V_{CE}=2V, I_C=5mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.737 | -51.3 | 11.929 | 142.2 | 0.046 | 65.0 | 0.836 | -27.1 |
| 200 | 0.564 | -86.8 | 8.854 | 118.5 | 0.070 | 54.3 | 0.649 | -39.5 |
| 400 | 0.408 | -129.5 | 5.231 | 95.2 | 0.097 | 51.5 | 0.454 | -48.4 |
| 600 | 0.366 | -155.0 | 3.667 | 82.0 | 0.121 | 53.7 | 0.394 | -52.3 |
| 800 | 0.348 | -175.8 | 2.811 | 70.0 | 0.147 | 55.3 | 0.370 | -56.6 |
| 1000 | 0.338 | 169.4 | 2.332 | 62.6 | 0.175 | 56.2 | 0.368 | -60.5 |
| 1200 | 0.346 | 156.6 | 2.000 | 54.2 | 0.205 | 55.7 | 0.361 | -66.7 |
| 1400 | 0.350 | 145.7 | 1.739 | 47.3 | 0.235 | 54.9 | 0.363 | -72.2 |
| 1600 | 0.360 | 136.1 | 1.557 | 40.6 | 0.267 | 53.7 | 0.371 | -77.7 |
| 1800 | 0.365 | 126.2 | 1.428 | 34.4 | 0.300 | 51.7 | 0.383 | -83.4 |
| 2000 | 0.369 | 116.9 | 1.306 | 29.3 | 0.334 | 49.2 | 0.385 | -89.5 |

$V_{CE}=2V, I_C=10mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.580 | -67.4 | 17.590 | 130.8 | 0.040 | 62.8 | 0.715 | -36.9 |
| 200 | 0.414 | -104.9 | 11.116 | 109.3 | 0.059 | 58.5 | 0.490 | -48.3 |
| 400 | 0.311 | -145.7 | 6.099 | 90.2 | 0.091 | 60.9 | 0.338 | -53.5 |
| 600 | 0.291 | -168.2 | 4.213 | 79.2 | 0.125 | 62.4 | 0.294 | -56.9 |
| 800 | 0.286 | 172.9 | 3.212 | 69.7 | 0.159 | 61.8 | 0.279 | -61.6 |
| 1000 | 0.281 | 159.6 | 2.634 | 62.4 | 0.194 | 60.3 | 0.277 | -65.9 |
| 1200 | 0.292 | 148.3 | 2.248 | 54.9 | 0.228 | 57.7 | 0.281 | -71.7 |
| 1400 | 0.297 | 138.5 | 1.973 | 48.5 | 0.261 | 55.2 | 0.284 | -77.2 |
| 1600 | 0.305 | 129.7 | 1.767 | 42.4 | 0.295 | 52.6 | 0.290 | -82.7 |
| 1800 | 0.311 | 120.5 | 1.605 | 36.4 | 0.328 | 49.6 | 0.297 | -88.5 |
| 2000 | 0.313 | 111.7 | 1.473 | 31.2 | 0.362 | 46.3 | 0.303 | -93.9 |

$V_{CE}=2V, I_C=20mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.432 | -85.5 | 21.435 | 121.4 | 0.034 | 63.6 | 0.585 | -45.4 |
| 200 | 0.313 | -123.5 | 12.390 | 102.7 | 0.052 | 64.6 | 0.375 | -54.0 |
| 400 | 0.263 | -160.5 | 6.547 | 87.0 | 0.090 | 67.4 | 0.260 | -57.1 |
| 600 | 0.257 | -179.7 | 4.481 | 77.4 | 0.129 | 67.0 | 0.231 | -60.9 |
| 800 | 0.260 | 163.3 | 3.408 | 68.8 | 0.168 | 64.8 | 0.224 | -66.3 |
| 1000 | 0.258 | 151.6 | 2.792 | 62.1 | 0.206 | 62.3 | 0.224 | -70.9 |
| 1200 | 0.271 | 141.6 | 2.378 | 55.1 | 0.243 | 58.7 | 0.231 | -77.2 |
| 1400 | 0.270 | 133.1 | 2.085 | 49.1 | 0.278 | 55.4 | 0.236 | -82.9 |
| 1600 | 0.282 | 124.5 | 1.867 | 43.2 | 0.313 | 52.2 | 0.242 | -88.4 |
| 1800 | 0.288 | 115.4 | 1.697 | 37.5 | 0.346 | 48.7 | 0.249 | -94.2 |
| 2000 | 0.290 | 107.0 | 1.558 | 32.3 | 0.380 | 45.0 | 0.256 | -99.4 |

$V_{CE}=2V, I_C=30mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.370 | -97.4 | 22.555 | 117.0 | 0.031 | 65.1 | 0.518 | -49.0 |
| 200 | 0.288 | -135.1 | 12.614 | 99.9 | 0.051 | 67.4 | 0.326 | -55.8 |
| 400 | 0.260 | -168.5 | 6.590 | 85.5 | 0.090 | 69.9 | 0.229 | -58.1 |
| 600 | 0.259 | 174.8 | 4.499 | 76.4 | 0.131 | 68.6 | 0.207 | -62.3 |
| 800 | 0.263 | 159.3 | 3.419 | 68.1 | 0.172 | 66.0 | 0.204 | -68.3 |
| 1000 | 0.262 | 148.2 | 2.796 | 61.7 | 0.211 | 62.8 | 0.206 | -73.2 |
| 1200 | 0.275 | 138.9 | 2.382 | 54.7 | 0.248 | 59.1 | 0.215 | -79.6 |
| 1400 | 0.279 | 130.4 | 2.089 | 48.8 | 0.284 | 55.6 | 0.220 | -85.4 |
| 1600 | 0.286 | 122.5 | 1.869 | 43.0 | 0.320 | 52.1 | 0.227 | -91.1 |
| 1800 | 0.291 | 113.8 | 1.700 | 37.3 | 0.353 | 48.4 | 0.235 | -97.0 |
| 2000 | 0.293 | 105.4 | 1.562 | 32.2 | 0.387 | 44.7 | 0.242 | -102.2 |

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S Parameters (Common emitter)

$V_{CE}=5V, I_C=5mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.752 | -45.7 | 12.674 | 144.1 | 0.037 | 67.6 | 0.871 | -21.6 |
| 200 | 0.575 | -78.6 | 9.416 | 121.5 | 0.058 | 57.3 | 0.697 | -32.2 |
| 400 | 0.391 | -119.9 | 5.688 | 97.7 | 0.082 | 54.4 | 0.532 | -38.3 |
| 600 | 0.334 | -146.4 | 4.015 | 84.3 | 0.103 | 56.8 | 0.472 | -41.5 |
| 800 | 0.307 | -169.1 | 3.085 | 73.2 | 0.126 | 58.9 | 0.450 | -45.4 |
| 1000 | 0.292 | 174.7 | 2.534 | 65.1 | 0.151 | 60.2 | 0.444 | -49.5 |
| 1200 | 0.303 | 160.6 | 2.164 | 56.8 | 0.177 | 60.0 | 0.449 | -54.6 |
| 1400 | 0.305 | 148.6 | 1.896 | 499.9 | 0.204 | 59.7 | 0.453 | -59.6 |
| 1600 | 0.314 | 137.9 | 1.693 | 43.2 | 0.235 | 58.9 | 0.454 | -65.0 |
| 1800 | 0.321 | 127.3 | 1.530 | 36.9 | 0.267 | 57.1 | 0.460 | -70.0 |
| 2000 | 0.328 | 117.7 | 1.394 | 31.5 | 0.299 | 55.1 | 0.470 | -76.4 |

$V_{CE}=5V, I_C=10mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.601 | -58.4 | 18.468 | 133.9 | 0.033 | 65.7 | 0.765 | -25.1 |
| 200 | 0.413 | -92.4 | 12.043 | 112.1 | 0.049 | 61.0 | 0.603 | -30.7 |
| 400 | 0.275 | -132.7 | 6.703 | 92.4 | 0.078 | 63.3 | 0.509 | -36.8 |
| 600 | 0.240 | -157.9 | 4.641 | 81.3 | 0.107 | 64.8 | 0.470 | -45.9 |
| 800 | 0.228 | -179.9 | 3.536 | 71.9 | 0.137 | 64.6 | 0.438 | -56.8 |
| 1000 | 0.221 | 164.7 | 2.889 | 64.8 | 0.168 | 63.6 | 0.408 | -69.3 |
| 1200 | 0.232 | 151.6 | 2.462 | 57.2 | 0.199 | 61.5 | 0.371 | -83.9 |
| 1400 | 0.238 | 140.6 | 2.154 | 51.0 | 0.229 | 59.5 | 0.334 | -100.6 |
| 1600 | 0.249 | 131.1 | 1.924 | 44.8 | 0.259 | 57.3 | 0.298 | -120.1 |
| 1800 | 0.257 | 120.9 | 1.740 | 38.8 | 0.290 | 54.6 | 0.265 | -143.5 |
| 2000 | 0.262 | 111.5 | 1.589 | 33.6 | 0.322 | 51.6 | 0.246 | -170.6 |

$V_{CE}=5V, I_C=30mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.373 | -79.4 | 24.799 | 120.4 | 0.026 | 67.6 | 0.598 | -36.8 |
| 200 | 0.245 | -114.8 | 14.190 | 102.5 | 0.043 | 69.5 | 0.418 | -39.2 |
| 400 | 0.183 | -154.3 | 7.472 | 87.6 | 0.077 | 71.8 | 0.331 | -38.5 |
| 600 | 0.174 | -175.8 | 5.102 | 78.5 | 0.112 | 70.9 | 0.310 | -41.3 |
| 800 | 0.177 | 163.8 | 3.872 | 70.4 | 0.147 | 68.7 | 0.305 | -46.3 |
| 1000 | 0.177 | 150.2 | 3.158 | 64.1 | 0.181 | 66.1 | 0.308 | -51.0 |
| 1200 | 0.190 | 139.3 | 2.681 | 57.4 | 0.215 | 62.8 | 0.313 | -57.0 |
| 1400 | 0.197 | 129.5 | 2.343 | 51.6 | 0.247 | 59.6 | 0.317 | -62.4 |
| 1600 | 0.209 | 121.2 | 2.090 | 45.9 | 0.279 | 56.7 | 0.321 | -67.8 |
| 1800 | 0.217 | 111.6 | 1.892 | 40.3 | 0.309 | 53.3 | 0.327 | -73.6 |
| 2000 | 0.222 | 102.6 | 1.727 | 35.2 | 0.340 | 49.9 | 0.333 | -78.9 |

$V_{CE}=5V, I_C=50mA, Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.308 | -92.8 | 25.470 | 116.0 | 0.024 | 69.2 | 0.543 | -36.8 |
| 200 | 0.221 | -129.7 | 14.126 | 99.7 | 0.041 | 72.1 | 0.389 | -36.4 |
| 400 | 0.190 | -165.7 | 7.357 | 85.9 | 0.076 | 73.8 | 0.324 | -35.3 |
| 600 | 0.189 | 176.0 | 5.012 | 77.4 | 0.111 | 72.5 | 0.309 | -38.8 |
| 800 | 0.195 | 158.6 | 3.800 | 69.4 | 0.146 | 69.9 | 0.307 | -44.2 |
| 1000 | 0.195 | 146.5 | 3.097 | 63.2 | 0.180 | 67.2 | 0.311 | -49.3 |
| 1200 | 0.209 | 136.8 | 2.630 | 56.5 | 0.214 | 63.7 | 0.317 | -55.6 |
| 1400 | 0.216 | 127.8 | 2.300 | 50.8 | 0.246 | 60.5 | 0.321 | -61.3 |
| 1600 | 0.227 | 119.9 | 2.050 | 45.1 | 0.279 | 57.5 | 0.325 | -66.9 |
| 1800 | 0.237 | 111.0 | 1.857 | 39.4 | 0.310 | 54.1 | 0.331 | -72.8 |
| 2000 | 0.241 | 102.2 | 1.695 | 34.5 | 0.341 | 50.5 | 0.337 | -78.3 |

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