

**2SC5228**

VHF to UHF Wide-Band Low-Noise Amplifier Applications

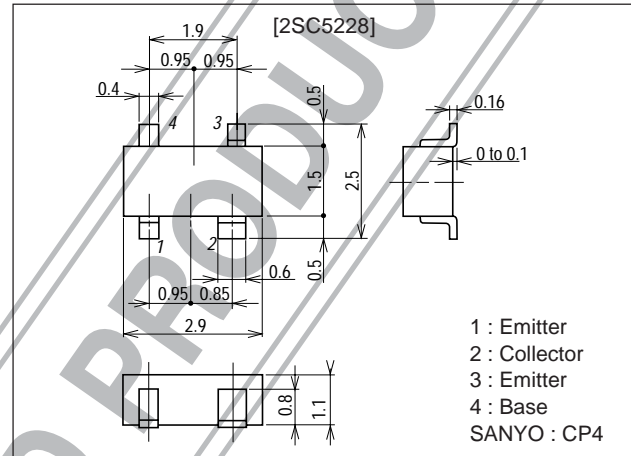
Features

- Low noise : $NF=1.0\text{dB}$ typ ($f=1\text{GHz}$).
- High gain : $|S_{21e}|^2=13.5\text{dB}$ typ ($f=1\text{GHz}$).
- High cutoff frequency : $f_T=7\text{GHz}$ typ.

Package Dimensions

unit:mm

2110A



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_{CE0} | | 10 | V |
| Emitter-to-Base Voltage | V_{EB0} | | 2 | V |
| Collector Current | I_C | | 70 | mA |
| Collector Dissipation | P_C | | 200 | mW |
| Junction Temperature | T_J | | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | | -55 to +150 | $^\circ\text{C}$ |

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

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|------------------------------|-----------|-------------------------------------|---------|------|------|---------------|
| | | | min | typ | max | |
| Collector Cutoff Current | I_{CB0} | $V_{CB}=10\text{V}, I_E=0$ | | | 1.0 | μA |
| Emitter Cutoff Current | I_{EB0} | $V_{EB}=1\text{V}, I_C=0$ | | | 10 | μA |
| DC Current Gain | h_{FE} | $V_{CE}=5\text{V}, I_C=20\text{mA}$ | 60* | | 270* | |
| Gain-Bandwidth Product | f_T | $V_{CE}=5\text{V}, I_C=20\text{mA}$ | 5 | 7 | | GHz |
| Output Capacitance | C_{ob} | $V_{CB}=10\text{V}, f=1\text{MHz}$ | | 0.75 | 1.2 | pF |
| Reverse Transfer Capacitance | C_{re} | $V_{CB}=10\text{V}, f=1\text{MHz}$ | | 0.4 | | pF |

* : The 2SC5228 is classified by 20mA h_{FE} as follows :Marking : LN
 h_{FE} rank : 3, 4, 5

| Rank | 3 | 4 | 5 |
|----------|-----------|-----------|------------|
| h_{FE} | 60 to 120 | 90 to 180 | 135 to 270 |

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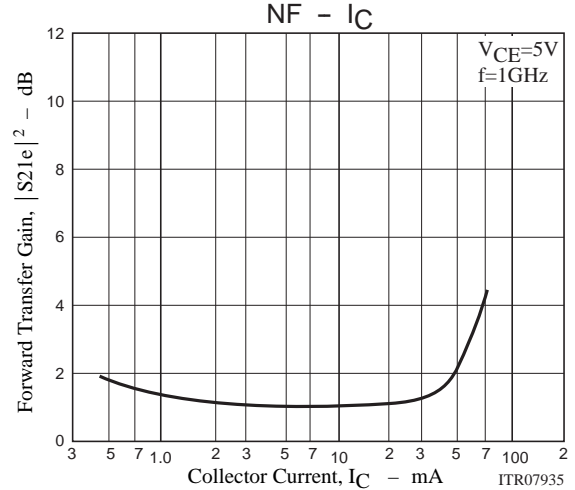
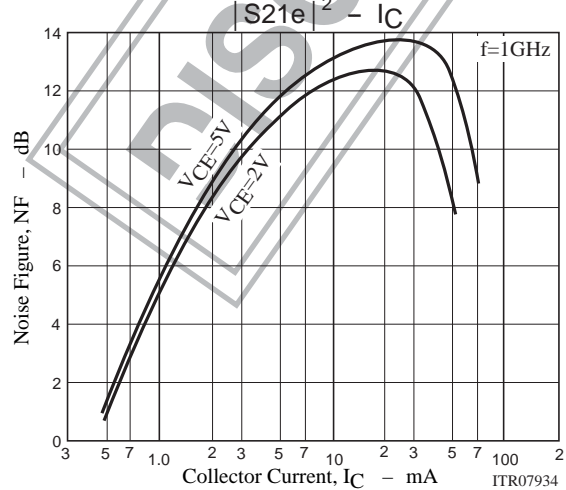
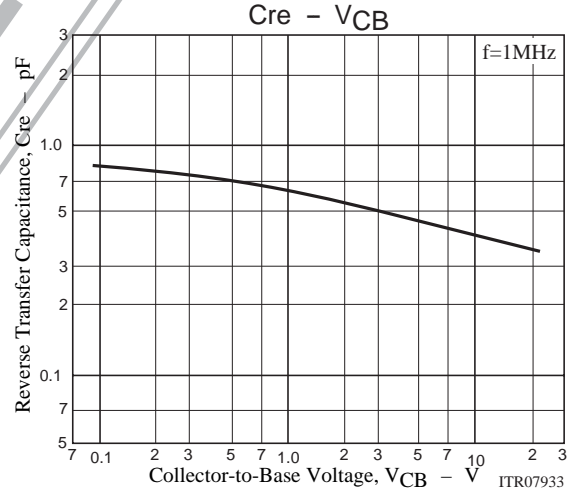
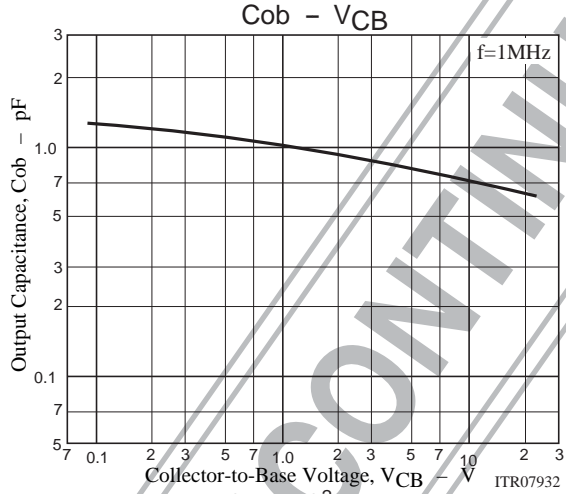
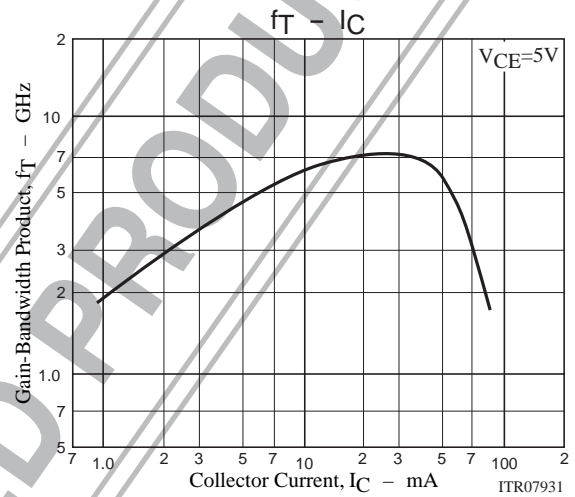
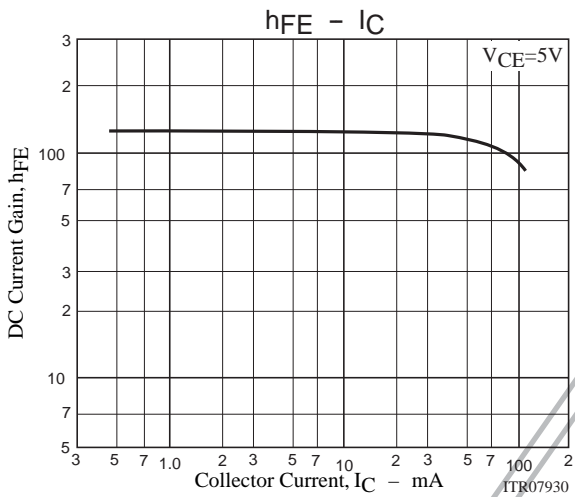
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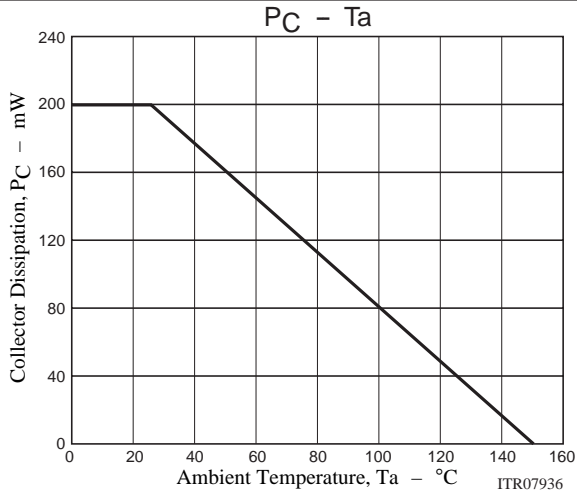
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| Parameter | Symbol | Conditions | Ratings | | | Unit |
|-----------------------|-------------------|-------------------------------|---------|------|-----|------|
| | | | min | typ | max | |
| Forward Transfer Gain | $ S_{21e} ^2 - 1$ | $V_{CE}=5V, I_C=20mA, f=1GHz$ | 11 | 13.5 | | dB |
| | $ S_{21e} ^2 - 2$ | $V_{CE}=2V, I_C=3mA, f=1GHz$ | | 9 | | dB |
| Noise Figure | NF | $V_{CE}=5V, I_C=7mA, f=1GHz$ | | 1.0 | 1.8 | dB |

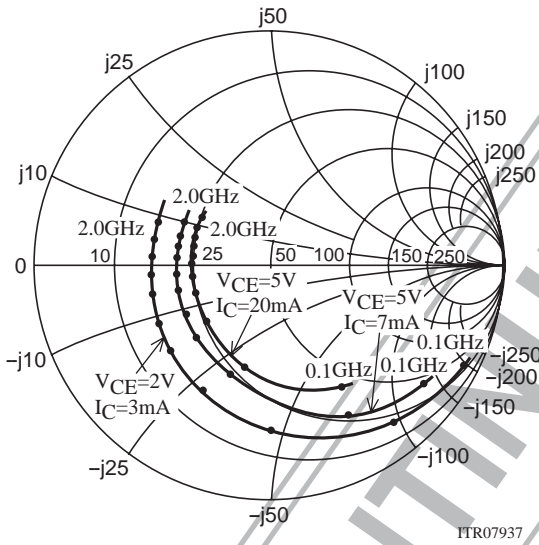


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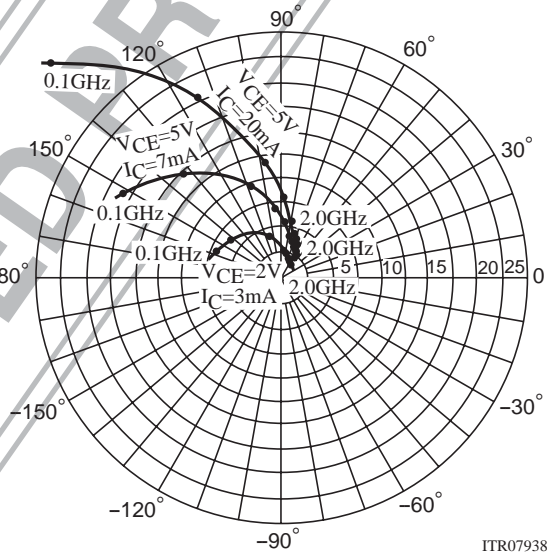


S Parameters

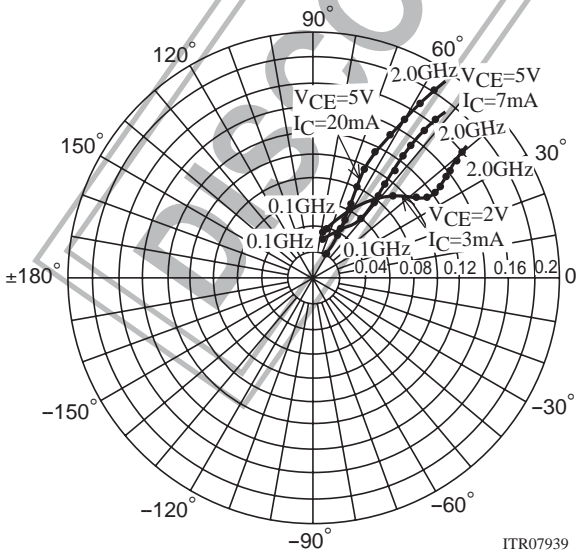
$f=100\text{MHz}, 200\text{MHz to }2000\text{MHz}(200\text{MHz Step})$



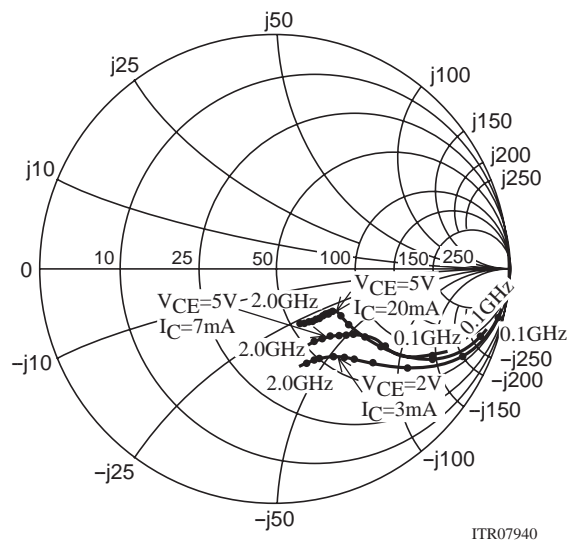
$f=100\text{MHz}, 200\text{MHz to }2000\text{MHz}(200\text{MHz Step})$



$f=100\text{MHz}, 200\text{MHz to }2000\text{MHz}(200\text{MHz Step})$



$f=100\text{MHz}, 200\text{MHz to }2000\text{MHz}(200\text{MHz Step})$



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S parameters (Common emitter)

$V_{CE}=5V, I_C=7mA, Z_O=50\Omega$

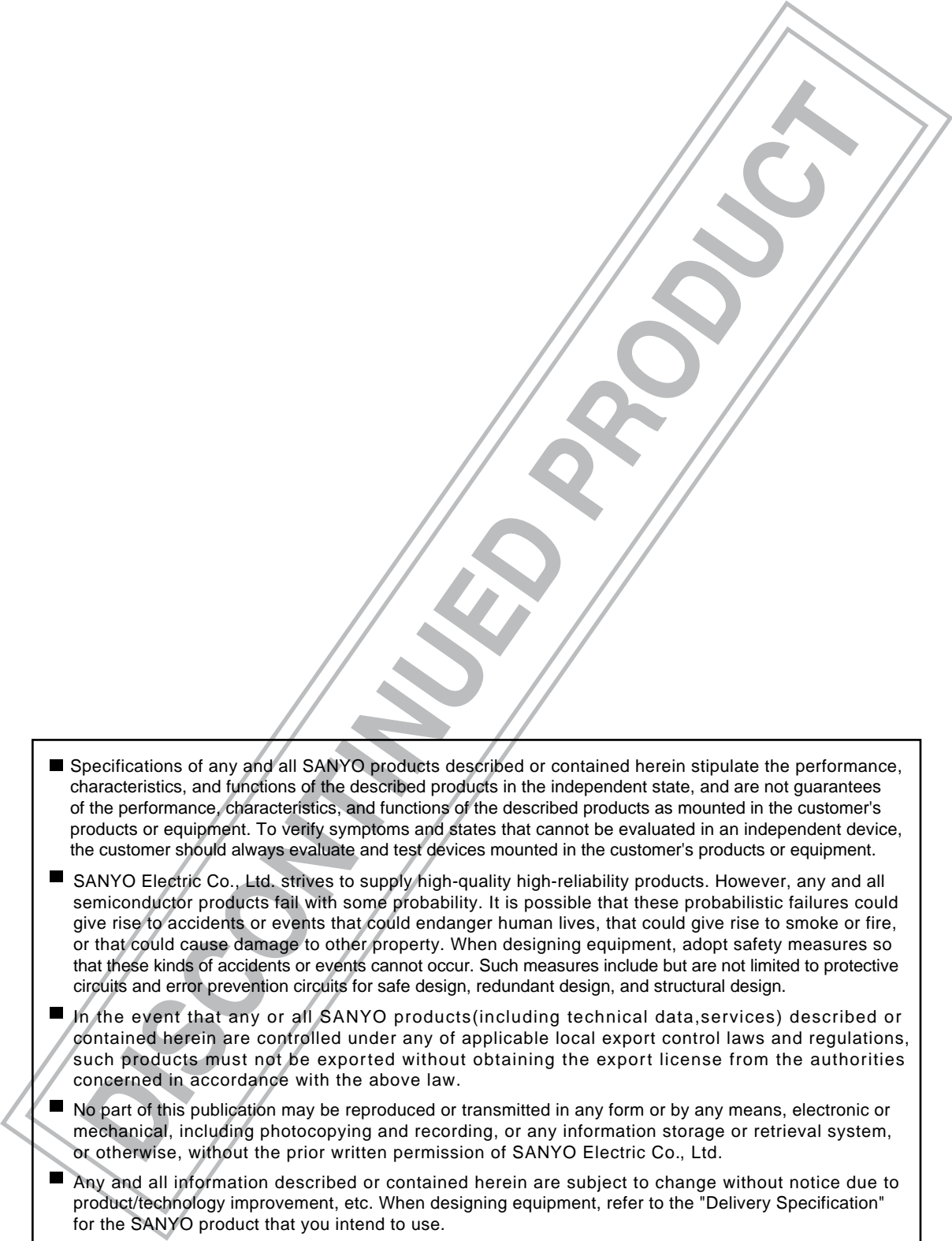
| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.803 | -38.2 | 18.190 | 151.5 | 0.026 | 71.3 | 0.903 | -19.3 |
| 200 | 0.677 | -68.5 | 14.614 | 131.5 | 0.042 | 59.3 | 0.753 | -31.5 |
| 400 | 0.508 | -132.7 | 9.484 | 108.0 | 0.061 | 51.6 | 0.549 | -41.1 |
| 600 | 0.442 | -132.7 | 6.775 | 95.1 | 0.073 | 50.9 | 0.453 | -44.2 |
| 800 | 0.407 | -151.0 | 5.256 | 85.7 | 0.086 | 52.1 | 0.406 | -46.4 |
| 1000 | 0.393 | -163.5 | 4.285 | 78.5 | 0.098 | 53.1 | 0.383 | -48.9 |
| 1200 | 0.386 | -174.5 | 3.628 | 71.7 | 0.111 | 53.8 | 0.373 | -51.1 |
| 1400 | 0.386 | 175.3 | 3.161 | 65.9 | 0.125 | 53.8 | 0.363 | -53.6 |
| 1600 | 0.387 | 168.3 | 2.786 | 60.2 | 0.138 | 53.5 | 0.354 | -56.9 |
| 1800 | 0.393 | 161.0 | 2.517 | 55.1 | 0.152 | 53.2 | 0.348 | -60.7 |
| 2000 | 0.402 | 152.6 | 2.298 | 49.9 | 0.166 | 52.1 | 0.345 | -64.5 |

$V_{CE}=5V, I_C=20mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.592 | -62.6 | 30.943 | 136.5 | 0.021 | 66.1 | 0.753 | -31.2 |
| 200 | 0.458 | -99.8 | 20.624 | 115.6 | 0.032 | 59.8 | 0.541 | -41.9 |
| 400 | 0.367 | -138.1 | 11.531 | 97.4 | 0.048 | 61.6 | 0.370 | -45.0 |
| 600 | 0.347 | -157.3 | 7.914 | 88.0 | 0.064 | 63.6 | 0.310 | -45.5 |
| 800 | 0.338 | -171.6 | 6.036 | 80.6 | 0.081 | 64.2 | 0.287 | -47.0 |
| 1000 | 0.336 | 179.1 | 4.880 | 74.7 | 0.098 | 64.0 | 0.276 | -49.7 |
| 1200 | 0.337 | 170.8 | 4.113 | 69.2 | 0.116 | 63.2 | 0.274 | -52.4 |
| 1400 | 0.342 | 163.6 | 3.558 | 64.0 | 0.133 | 61.7 | 0.268 | -55.4 |
| 1600 | 0.346 | 157.4 | 3.134 | 59.2 | 0.150 | 60.0 | 0.262 | -59.3 |
| 1800 | 0.352 | 151.2 | 2.824 | 54.4 | 0.167 | 58.5 | 0.259 | -63.8 |
| 2000 | 0.361 | 145.6 | 2.575 | 50.0 | 0.182 | 56.4 | 0.256 | -68.2 |

$V_{CE}=2V, I_C=3mA, Z_O=50\Omega$

| Freq (MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 100 | 0.903 | -28.0 | 9.365 | 159.3 | 0.035 | 74.8 | 0.955 | -14.2 |
| 200 | 0.826 | -53.3 | 8.413 | 142.1 | 0.063 | 62.2 | 0.865 | -25.8 |
| 400 | 0.672 | -92.0 | 6.269 | 117.1 | 0.094 | 46.7 | 0.684 | -39.7 |
| 600 | 0.589 | -118.0 | 4.748 | 101.4 | 0.109 | 39.7 | 0.565 | -46.8 |
| 800 | 0.540 | -138.3 | 3.789 | 89.6 | 0.117 | 36.7 | 0.497 | -51.4 |
| 1000 | 0.515 | -152.4 | 3.141 | 80.8 | 0.125 | 36.0 | 0.459 | -55.1 |
| 1200 | 0.503 | -165.2 | 2.687 | 72.2 | 0.131 | 36.2 | 0.438 | -58.3 |
| 1400 | 0.495 | -175.9 | 2.353 | 65.4 | 0.138 | 37.2 | 0.420 | -61.6 |
| 1600 | 0.494 | 175.2 | 2.088 | 58.8 | 0.146 | 38.0 | 0.411 | -65.0 |
| 1800 | 0.495 | 166.4 | 1.894 | 52.7 | 0.155 | 39.4 | 0.400 | -69.2 |
| 2000 | 0.502 | 158.1 | 1.732 | 46.9 | 0.163 | 40.0 | 0.396 | -73.6 |

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