

**EC3H04B**

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

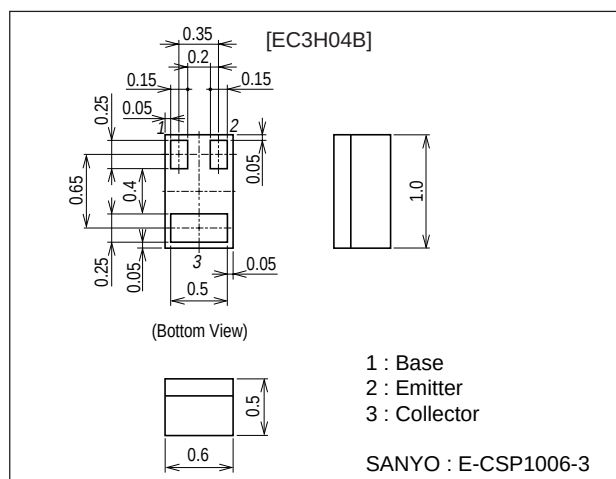
### Features

- Low noise : NF=1.7dB typ (f=2GHz).
- High cut-off frequency :  $f_T$ =8GHz typ ( $V_{CE}$ =1V).
- Low operating voltage.
- Ultraminiature (1006 size) and thin (0.5mm) leadless package.

### Package Dimensions

unit : mm

2183



### Specifications

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

| Parameter                    | Symbol    | Conditions | Ratings     | Unit             |
|------------------------------|-----------|------------|-------------|------------------|
| Collector-to-Base Voltage    | $V_{CBO}$ |            | 9           | V                |
| Collector-to-Emitter Voltage | $V_{CEO}$ |            | 6           | V                |
| Emitter-to-Base Voltage      | $V_{EBO}$ |            | 2           | V                |
| Collector Current            | $I_C$     |            | 100         | mA               |
| Collector 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 at  $T_a=25^\circ\text{C}$ 

| Parameter                    | Symbol           | Conditions                                         | Ratings |      |     | Unit          |
|------------------------------|------------------|----------------------------------------------------|---------|------|-----|---------------|
|                              |                  |                                                    | min     | typ  | max |               |
| Collector Cutoff Current     | $I_{CBO}$        | $V_{CB}=5\text{V}, I_E=0$                          |         |      | 1.0 | $\mu\text{A}$ |
| Emitter Cutoff Current       | $I_{EBO}$        | $V_{EB}=1\text{V}, I_C=0$                          |         |      | 10  | $\mu\text{A}$ |
| DC Current Gain              | $h_{FE}$         | $V_{CE}=1\text{V}, I_C=10\text{mA}$                | 100     |      | 180 |               |
| Gain-Bandwidth Product       | $f_T$            | $V_{CE}=1\text{V}, I_C=10\text{mA}$                | 6       | 8    |     | GHz           |
| Output Capacitance           | $C_{ob}$         | $V_{CB}=1\text{V}, f=1\text{MHz}$                  |         | 1.1  | 1.5 | pF            |
| Reverse Transfer Capacitance | $C_{re}$         | $V_{CB}=1\text{V}, f=1\text{MHz}$                  |         | 0.85 |     | pF            |
| Forward Transfer Gain        | $ S_{21e} _{21}$ | $V_{CE}=1\text{V}, I_C=10\text{mA}, f=2\text{GHz}$ | 4       | 5    |     | dB            |
|                              | $ S_{21e} _{22}$ | $V_{CE}=3\text{V}, I_C=20\text{mA}, f=1\text{GHz}$ |         | 12   |     | dB            |
| Noise Figure                 | NF               | $V_{CE}=1\text{V}, I_C=10\text{mA}, f=2\text{GHz}$ |         | 1.7  | 2.5 | dB            |

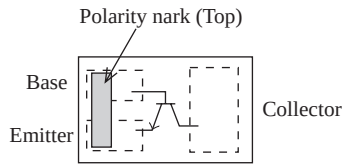
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Type No. Indication (Top view)

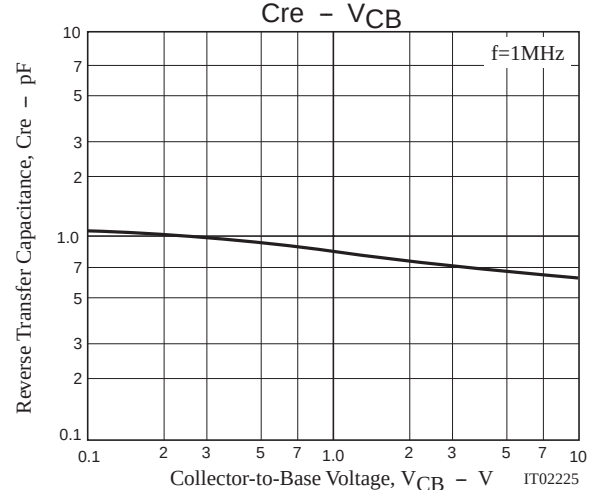
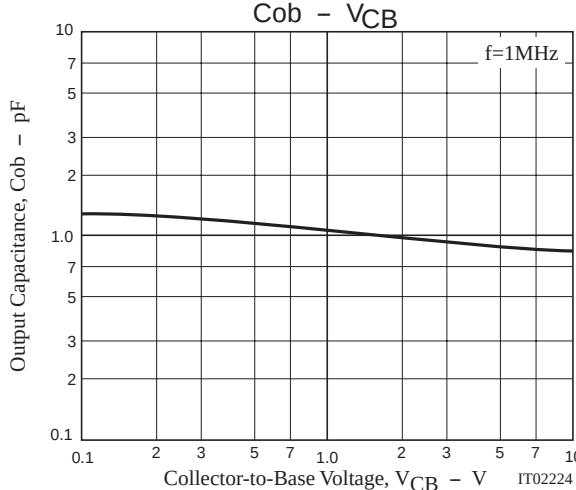
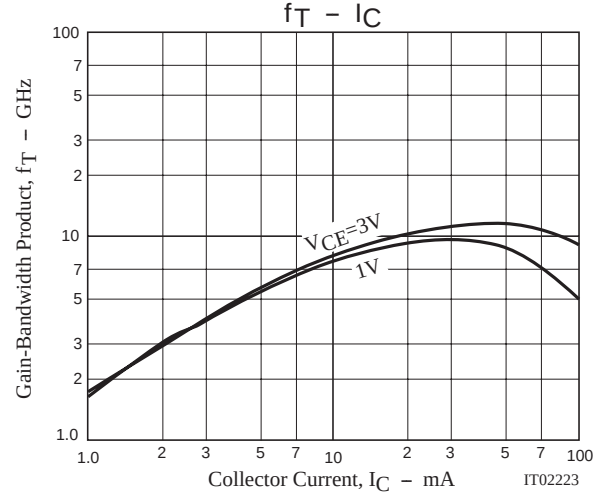
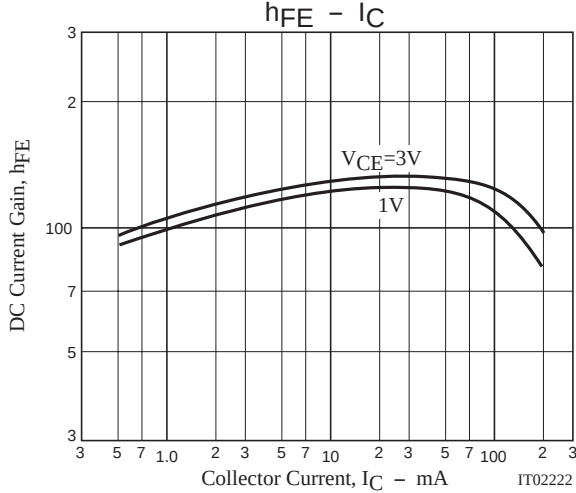
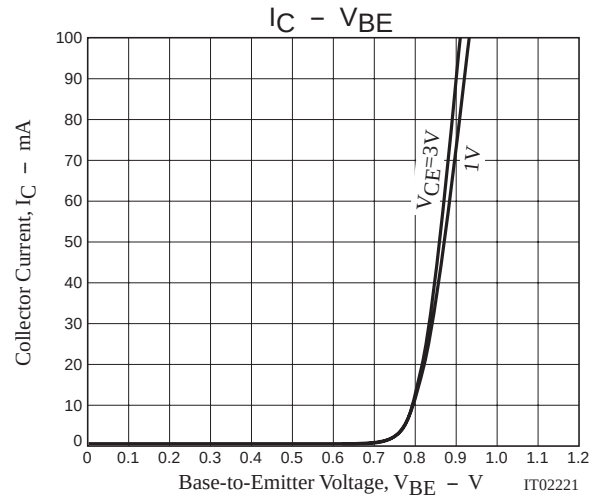
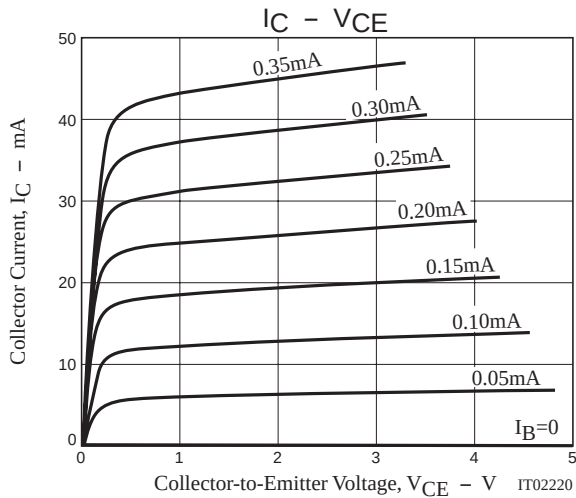
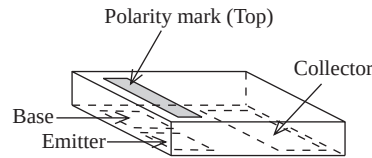


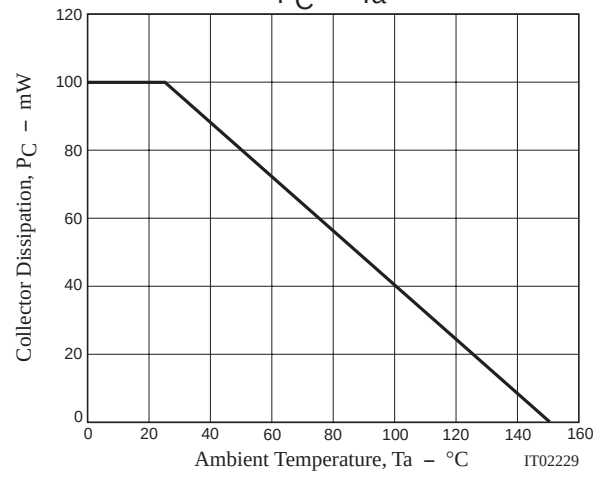
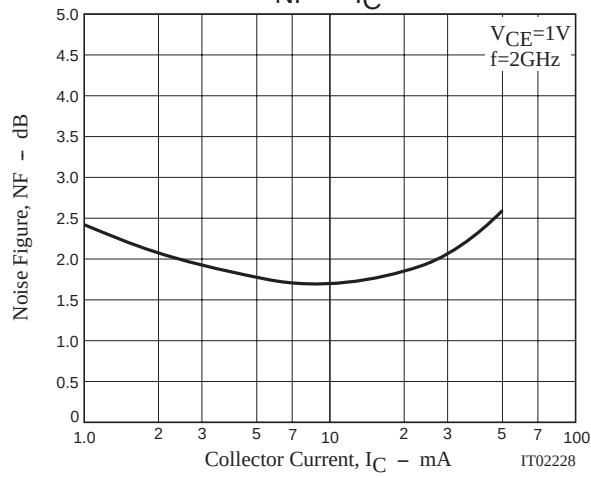
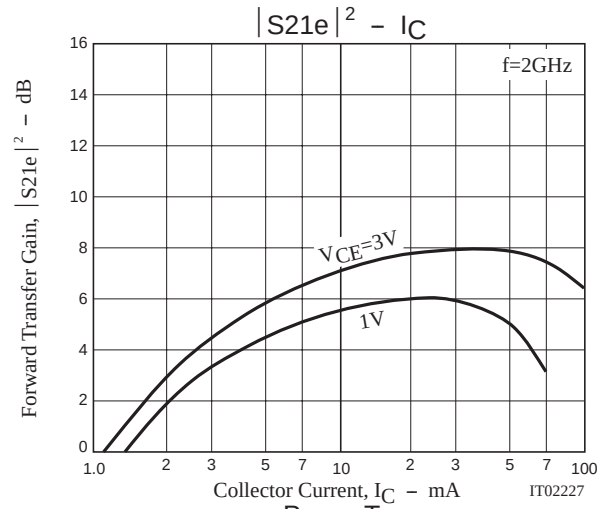
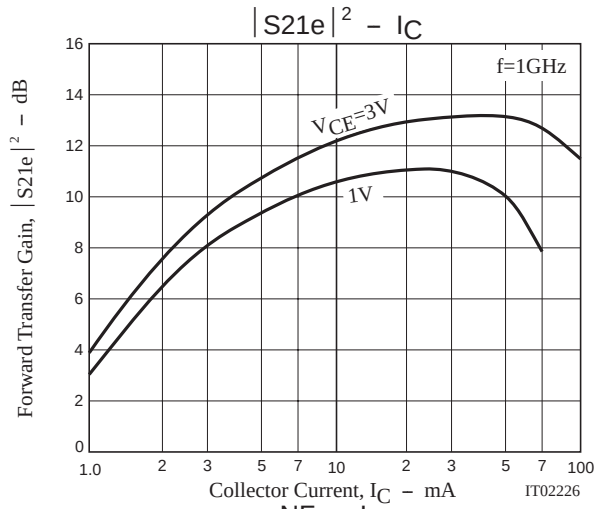
This product adopts a high-frequency process. Please be careful when handling it because it is susceptible to static electricity.

Electrical Connection (Top view)



\*Electrodes : on the bottom





## S Parameters (Common emitter)

$V_{CE}=1\text{V}$ ,  $I_C=1\text{mA}$ ,  $Z_0=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.925      | -41.9           | 2.875      | 149.0           | 0.113      | 63.2            | 0.913      | -21.9           |
| 400       | 0.835      | -78.1           | 2.702      | 124.4           | 0.180      | 43.8            | 0.780      | -36.1           |
| 600       | 0.758      | -101.3          | 2.125      | 106.7           | 0.201      | 31.3            | 0.660      | -44.2           |
| 800       | 0.716      | -115.7          | 1.584      | 97.7            | 0.218      | 21.4            | 0.613      | -50.5           |
| 1000      | 0.729      | -129.3          | 1.443      | 83.8            | 0.224      | 16.9            | 0.560      | -58.6           |
| 1200      | 0.706      | -140.2          | 1.328      | 74.8            | 0.217      | 13.4            | 0.550      | -62.4           |
| 1400      | 0.707      | -146.9          | 1.142      | 67.8            | 0.209      | 9.9             | 0.569      | -66.0           |
| 1600      | 0.716      | -151.9          | 0.980      | 61.1            | 0.203      | 7.2             | 0.548      | -72.5           |
| 1800      | 0.698      | -157.2          | 0.871      | 53.1            | 0.196      | 4.9             | 0.529      | -77.0           |
| 2000      | 0.702      | -164.2          | 0.877      | 52.1            | 0.177      | 9.6             | 0.560      | -84.6           |
| 2200      | 0.700      | -167.0          | 0.759      | 42.9            | 0.173      | 5.7             | 0.536      | -87.6           |
| 2400      | 0.704      | -172.3          | 0.744      | 43.0            | 0.156      | 13.7            | 0.588      | -94.5           |
| 2600      | 0.704      | -175.5          | 0.673      | 35.5            | 0.150      | 12.7            | 0.553      | -98.5           |
| 2800      | 0.708      | -179.8          | 0.652      | 35.8            | 0.143      | 23.7            | 0.615      | -104.0          |
| 3000      | 0.709      | 177.0           | 0.604      | 30.5            | 0.142      | 25.3            | 0.575      | -109.0          |

## EC3H04B

$V_{CE}=1V$ ,  $I_C=5mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.744      | -82.8           | 10.317     | 130.5           | 0.083      | 49.0            | 0.696      | -53.9           |
| 400       | 0.670      | -122.0          | 6.592      | 108.4           | 0.105      | 36.0            | 0.462      | -79.7           |
| 600       | 0.618      | -141.5          | 4.594      | 98.8            | 0.112      | 32.7            | 0.344      | -93.5           |
| 800       | 0.624      | -152.3          | 3.565      | 90.3            | 0.122      | 32.6            | 0.297      | -104.0          |
| 1000      | 0.627      | -160.5          | 2.967      | 82.3            | 0.126      | 34.6            | 0.278      | -111.7          |
| 1200      | 0.623      | -165.9          | 2.504      | 76.9            | 0.132      | 37.0            | 0.265      | -118.5          |
| 1400      | 0.621      | -170.1          | 2.167      | 72.1            | 0.140      | 39.1            | 0.258      | -124.4          |
| 1600      | 0.621      | -174.2          | 1.932      | 67.6            | 0.148      | 40.3            | 0.261      | -127.6          |
| 1800      | 0.614      | -177.8          | 1.731      | 64.0            | 0.158      | 42.3            | 0.263      | -131.6          |
| 2000      | 0.619      | 179.2           | 1.590      | 60.1            | 0.165      | 44.1            | 0.269      | -133.5          |
| 2200      | 0.615      | 176.1           | 1.464      | 56.3            | 0.175      | 45.6            | 0.278      | -137.0          |
| 2400      | 0.618      | 173.8           | 1.367      | 52.9            | 0.186      | 47.0            | 0.284      | -138.7          |
| 2600      | 0.616      | 170.6           | 1.283      | 49.4            | 0.197      | 48.1            | 0.300      | -141.1          |
| 2800      | 0.619      | 168.7           | 1.209      | 46.5            | 0.209      | 48.6            | 0.302      | -143.1          |
| 3000      | 0.619      | 165.8           | 1.150      | 43.2            | 0.221      | 49.2            | 0.319      | -144.9          |

$V_{CE}=1V$ ,  $I_C=10mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.661      | -108.8          | 13.770     | 119.9           | 0.064      | 44.3            | 0.568      | -77.3           |
| 400       | 0.631      | -141.8          | 7.901      | 101.6           | 0.078      | 39.0            | 0.383      | -108.6          |
| 600       | 0.610      | -156.0          | 5.378      | 94.8            | 0.088      | 40.0            | 0.311      | -125.2          |
| 800       | 0.610      | -164.7          | 4.111      | 87.7            | 0.099      | 44.1            | 0.288      | -136.7          |
| 1000      | 0.616      | -170.2          | 3.376      | 81.1            | 0.109      | 47.8            | 0.283      | -144.2          |
| 1200      | 0.615      | -174.4          | 2.848      | 76.4            | 0.122      | 50.3            | 0.280      | -149.7          |
| 1400      | 0.613      | -177.9          | 2.468      | 72.3            | 0.134      | 52.1            | 0.280      | -154.3          |
| 1600      | 0.613      | 179.0           | 2.191      | 68.5            | 0.148      | 53.1            | 0.281      | -156.9          |
| 1800      | 0.608      | 176.0           | 1.967      | 65.4            | 0.162      | 53.6            | 0.284      | -159.6          |
| 2000      | 0.608      | 173.6           | 1.791      | 61.9            | 0.175      | 54.2            | 0.286      | -161.4          |
| 2200      | 0.607      | 170.9           | 1.659      | 58.6            | 0.188      | 54.7            | 0.294      | -163.0          |
| 2400      | 0.606      | 168.8           | 1.540      | 55.3            | 0.202      | 54.4            | 0.296      | -164.8          |
| 2600      | 0.606      | 166.2           | 1.450      | 52.4            | 0.217      | 54.1            | 0.303      | -165.3          |
| 2800      | 0.605      | 164.3           | 1.365      | 49.2            | 0.231      | 53.9            | 0.306      | -167.0          |
| 3000      | 0.607      | 162.0           | 1.297      | 46.5            | 0.245      | 53.2            | 0.313      | -167.6          |

$V_{CE}=1V$ ,  $I_C=20mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.623      | -131.3          | 15.796     | 111.7           | 0.048      | 43.6            | 0.484      | -100.8          |
| 400       | 0.623      | -156.5          | 8.545      | 96.9            | 0.061      | 45.9            | 0.370      | -132.7          |
| 600       | 0.613      | -166.4          | 5.750      | 91.9            | 0.074      | 50.6            | 0.333      | -147.4          |
| 800       | 0.615      | -172.4          | 4.375      | 86.0            | 0.089      | 54.4            | 0.326      | -156.2          |
| 1000      | 0.620      | -176.6          | 3.571      | 80.0            | 0.103      | 58.0            | 0.328      | -162.1          |
| 1200      | 0.619      | -180.0          | 3.011      | 75.9            | 0.120      | 59.8            | 0.328      | -166.1          |
| 1400      | 0.617      | 177.0           | 2.609      | 72.2            | 0.136      | 60.8            | 0.329      | -169.3          |
| 1600      | 0.616      | 174.5           | 2.311      | 68.8            | 0.152      | 60.9            | 0.330      | -171.7          |
| 1800      | 0.613      | 171.9           | 2.072      | 66.0            | 0.168      | 60.3            | 0.332      | -174.0          |
| 2000      | 0.611      | 169.7           | 1.889      | 62.8            | 0.183      | 60.0            | 0.334      | -175.5          |
| 2200      | 0.609      | 167.4           | 1.745      | 59.6            | 0.199      | 59.5            | 0.335      | -176.8          |
| 2400      | 0.608      | 165.3           | 1.624      | 56.6            | 0.215      | 58.6            | 0.337      | -178.2          |
| 2600      | 0.608      | 163.0           | 1.524      | 53.8            | 0.230      | 57.8            | 0.341      | -179.0          |
| 2800      | 0.605      | 161.2           | 1.439      | 50.9            | 0.246      | 56.7            | 0.342      | 179.8           |
| 3000      | 0.606      | 159.3           | 1.365      | 48.2            | 0.261      | 55.6            | 0.344      | 179.1           |

## EC3H04B

$V_{CE}=3V$ ,  $I_C=1mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.932      | -38.6           | 3.040      | 152.2           | 0.088      | 65.7            | 0.943      | -16.1           |
| 400       | 0.868      | -69.7           | 2.804      | 129.9           | 0.143      | 47.6            | 0.845      | -27.4           |
| 600       | 0.767      | -92.6           | 2.258      | 113.8           | 0.166      | 33.5            | 0.733      | -33.9           |
| 800       | 0.750      | -111.5          | 1.795      | 101.5           | 0.187      | 27.4            | 0.671      | -43.1           |
| 1000      | 0.736      | -125.2          | 1.690      | 89.7            | 0.189      | 21.1            | 0.649      | -47.0           |
| 1200      | 0.731      | -134.4          | 1.409      | 80.9            | 0.182      | 17.0            | 0.631      | -50.2           |
| 1400      | 0.734      | -141.5          | 1.161      | 73.6            | 0.181      | 14.2            | 0.605      | -55.7           |
| 1600      | 0.720      | -148.8          | 1.098      | 66.8            | 0.179      | 10.9            | 0.587      | -61.7           |
| 1800      | 0.708      | -154.8          | 1.000      | 60.3            | 0.166      | 11.7            | 0.590      | -65.4           |
| 2000      | 0.707      | -160.8          | 0.926      | 57.7            | 0.154      | 12.4            | 0.598      | -70.5           |
| 2200      | 0.704      | -164.9          | 0.868      | 49.7            | 0.146      | 14.0            | 0.594      | -75.1           |
| 2400      | 0.711      | -170.0          | 0.784      | 49.1            | 0.137      | 18.1            | 0.612      | -80.3           |
| 2600      | 0.703      | -173.6          | 0.775      | 41.7            | 0.129      | 22.6            | 0.607      | -85.1           |
| 2800      | 0.715      | -177.9          | 0.677      | 41.8            | 0.127      | 29.7            | 0.629      | -89.8           |
| 3000      | 0.702      | 178.8           | 0.703      | 36.0            | 0.126      | 36.4            | 0.627      | -95.1           |

$V_{CE}=3V$ ,  $I_C=5mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.762      | -71.5           | 11.124     | 135.7           | 0.068      | 53.9            | 0.752      | -41.9           |
| 400       | 0.670      | -111.1          | 7.524      | 113.1           | 0.090      | 40.4            | 0.516      | -61.8           |
| 600       | 0.604      | -132.1          | 5.338      | 102.6           | 0.100      | 35.6            | 0.379      | -70.5           |
| 800       | 0.605      | -145.2          | 4.172      | 93.9            | 0.108      | 36.0            | 0.320      | -78.9           |
| 1000      | 0.604      | -154.3          | 3.488      | 85.6            | 0.113      | 37.6            | 0.286      | -84.5           |
| 1200      | 0.601      | -160.4          | 2.943      | 80.0            | 0.118      | 39.7            | 0.264      | -88.7           |
| 1400      | 0.599      | -165.3          | 2.535      | 75.2            | 0.125      | 41.7            | 0.251      | -93.6           |
| 1600      | 0.597      | -169.8          | 2.265      | 70.8            | 0.133      | 43.7            | 0.247      | -98.3           |
| 1800      | 0.590      | -173.6          | 2.027      | 67.0            | 0.140      | 45.8            | 0.244      | -101.4          |
| 2000      | 0.594      | -177.1          | 1.853      | 63.4            | 0.150      | 47.8            | 0.250      | -105.1          |
| 2200      | 0.590      | 179.9           | 1.711      | 59.2            | 0.158      | 49.5            | 0.253      | -108.4          |
| 2400      | 0.594      | 177.0           | 1.584      | 56.1            | 0.168      | 50.8            | 0.264      | -111.4          |
| 2600      | 0.593      | 174.1           | 1.493      | 52.3            | 0.179      | 51.9            | 0.270      | -114.9          |
| 2800      | 0.597      | 171.7           | 1.393      | 49.5            | 0.191      | 53.0            | 0.281      | -117.2          |
| 3000      | 0.594      | 169.0           | 1.333      | 46.1            | 0.203      | 53.6            | 0.290      | -120.8          |

$V_{CE}=3V$ ,  $I_C=10mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.660      | -94.3           | 15.608     | 125.5           | 0.054      | 49.6            | 0.618      | -60.0           |
| 400       | 0.603      | -131.8          | 9.377      | 105.6           | 0.069      | 42.5            | 0.389      | -84.8           |
| 600       | 0.572      | -148.7          | 6.448      | 97.9            | 0.079      | 43.2            | 0.284      | -97.7           |
| 800       | 0.570      | -158.0          | 4.947      | 90.6            | 0.089      | 46.3            | 0.242      | -108.4          |
| 1000      | 0.576      | -164.8          | 4.073      | 83.7            | 0.099      | 49.9            | 0.223      | -116.7          |
| 1200      | 0.575      | -169.6          | 3.433      | 78.9            | 0.110      | 52.4            | 0.211      | -122.8          |
| 1400      | 0.572      | -173.7          | 2.965      | 74.9            | 0.121      | 54.5            | 0.205      | -128.1          |
| 1600      | 0.571      | -177.1          | 2.628      | 71.0            | 0.134      | 55.7            | 0.205      | -131.6          |
| 1800      | 0.568      | 179.7           | 2.353      | 67.9            | 0.146      | 56.4            | 0.205      | -135.1          |
| 2000      | 0.569      | 177.2           | 2.141      | 64.5            | 0.158      | 56.9            | 0.208      | -137.3          |
| 2200      | 0.568      | 174.4           | 1.977      | 61.1            | 0.172      | 57.3            | 0.214      | -139.7          |
| 2400      | 0.568      | 172.2           | 1.828      | 57.9            | 0.185      | 57.6            | 0.219      | -141.3          |
| 2600      | 0.569      | 169.5           | 1.718      | 54.8            | 0.198      | 57.4            | 0.228      | -143.1          |
| 2800      | 0.569      | 167.6           | 1.611      | 51.8            | 0.212      | 57.4            | 0.233      | -144.4          |
| 3000      | 0.572      | 165.4           | 1.530      | 49.0            | 0.226      | 56.9            | 0.242      | -145.8          |

$V_{CE}=3V$ ,  $I_C=20mA$ ,  $Z_O=50\Omega$

| Freq(MHz) | $ S_{11} $ | $\angle S_{11}$ | $ S_{21} $ | $\angle S_{21}$ | $ S_{12} $ | $\angle S_{12}$ | $ S_{22} $ | $\angle S_{22}$ |
|-----------|------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|
| 200       | 0.587      | -116.9          | 18.878     | 117.0           | 0.042      | 48.5            | 0.505      | -78.6           |
| 400       | 0.571      | -147.6          | 10.531     | 100.4           | 0.055      | 48.9            | 0.325      | -107.8          |
| 600       | 0.556      | -160.0          | 7.129      | 94.6            | 0.068      | 52.3            | 0.256      | -123.6          |
| 800       | 0.558      | -167.1          | 5.430      | 88.4            | 0.081      | 55.9            | 0.234      | -135.0          |
| 1000      | 0.564      | -172.2          | 4.435      | 82.3            | 0.094      | 60.1            | 0.227      | -143.1          |
| 1200      | 0.563      | -175.9          | 3.735      | 78.1            | 0.108      | 61.6            | 0.224      | -148.6          |
| 1400      | 0.561      | -179.2          | 3.225      | 74.5            | 0.123      | 62.8            | 0.222      | -152.9          |
| 1600      | 0.561      | 178.1           | 2.853      | 71.1            | 0.138      | 62.9            | 0.223      | -155.7          |
| 1800      | 0.558      | 175.3           | 2.549      | 68.3            | 0.153      | 62.6            | 0.224      | -158.4          |
| 2000      | 0.558      | 173.1           | 2.320      | 65.2            | 0.167      | 62.3            | 0.227      | -160.2          |
| 2200      | 0.558      | 170.8           | 2.136      | 62.1            | 0.183      | 62.0            | 0.230      | -161.5          |
| 2400      | 0.556      | 168.7           | 1.981      | 59.0            | 0.197      | 61.3            | 0.234      | -163.0          |
| 2600      | 0.558      | 166.4           | 1.854      | 56.2            | 0.212      | 60.6            | 0.241      | -163.6          |
| 2800      | 0.557      | 164.7           | 1.743      | 53.3            | 0.226      | 59.7            | 0.243      | -164.5          |
| 3000      | 0.559      | 162.6           | 1.648      | 50.7            | 0.240      | 58.6            | 0.249      | -165.2          |

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