

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

# 2SC5092

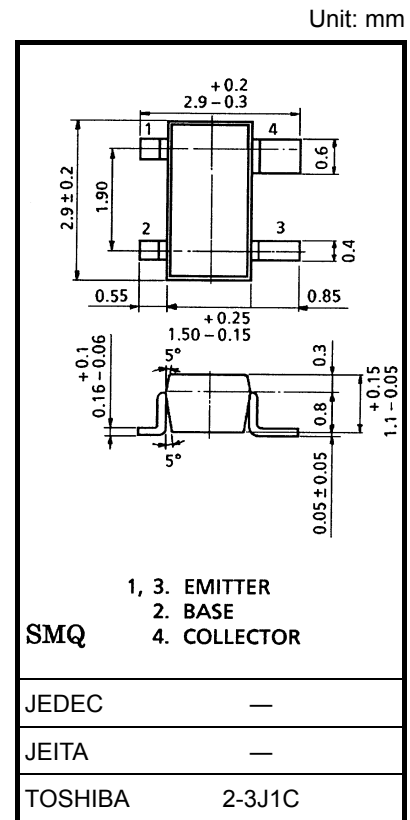
## VHF~UHF Band Low Noise Amplifier Applications

- Low noise figure, high gain.
- $NF = 1.8\text{dB}$ ,  $|S_{21e}|^2 = 9.5\text{dB}$  ( $f = 2\text{ GHz}$ )

### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics             | Symbol    | Rating  | Unit             |
|-----------------------------|-----------|---------|------------------|
| Collector-base voltage      | $V_{CBO}$ | 20      | V                |
| Collector-emitter voltage   | $V_{CEO}$ | 10      | V                |
| Emitter-base voltage        | $V_{EBO}$ | 1.5     | V                |
| Base current                | $I_B$     | 20      | mA               |
| Collector current           | $I_C$     | 40      | mA               |
| Collector power dissipation | $P_C$     | 150     | mW               |
| Junction temperature        | $T_j$     | 125     | $^\circ\text{C}$ |
| Storage temperature range   | $T_{stg}$ | -55~125 | $^\circ\text{C}$ |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).



Weight: 0.012 g (typ.)

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

| Characteristics      | Symbol            | Test Condition  | Min | Typ. | Max | Unit |
|----------------------|-------------------|---|-----|------|-----|------|
| Transition frequency | $f_T$             | $V_{CE} = 8\text{ V}$ , $I_C = 20\text{ mA}$                      | 7   | 10   | —   | GHz  |
| Insertion gain       | $ S_{21e} ^2$ (1) | $V_{CE} = 8\text{ V}$ , $I_C = 20\text{ mA}$ , $f = 1\text{ GHz}$ | 12  | 15   | —   | dB   |
|                      | $ S_{21e} ^2$ (2) | $V_{CE} = 8\text{ V}$ , $I_C = 20\text{ mA}$ , $f = 2\text{ GHz}$ | 6.5 | 9.5  | —   |      |
| Noise figure         | NF (1)            | $V_{CE} = 8\text{ V}$ , $I_C = 5\text{ mA}$ , $f = 1\text{ GHz}$  | —   | 1.4  | 2.5 | dB   |
|                      | NF (2)            | $V_{CE} = 8\text{ V}$ , $I_C = 5\text{ mA}$ , $f = 2\text{ GHz}$  | —   | 1.8  | 3   |      |

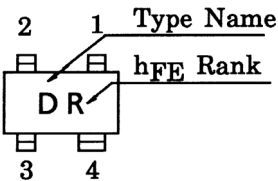
### Electrical Characteristics ( $T_a = 25^\circ\text{C}$ )

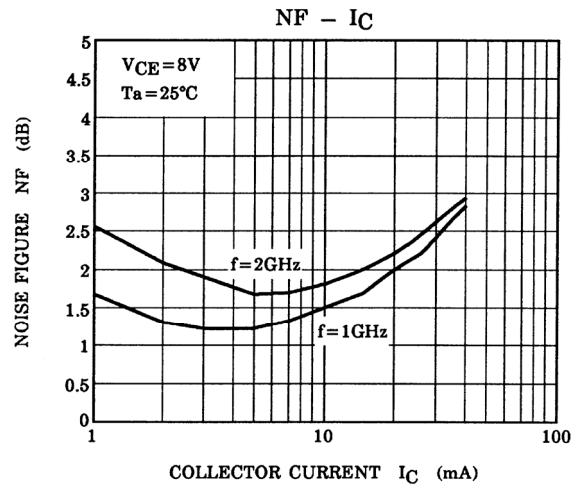
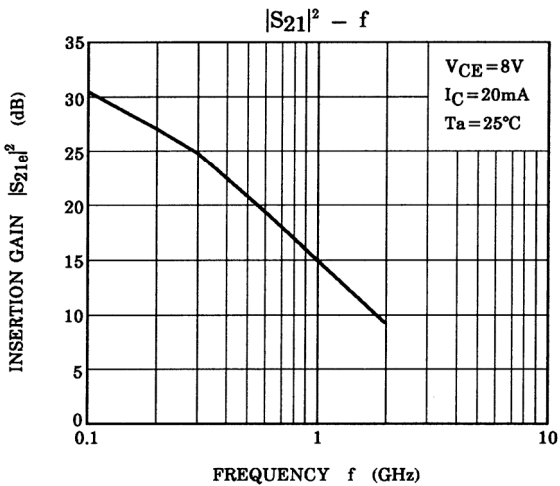
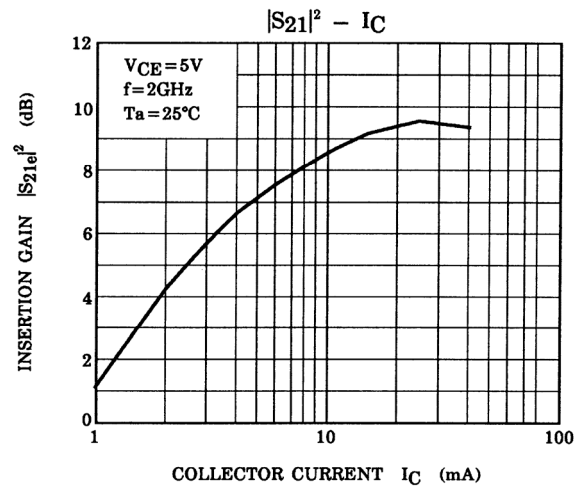
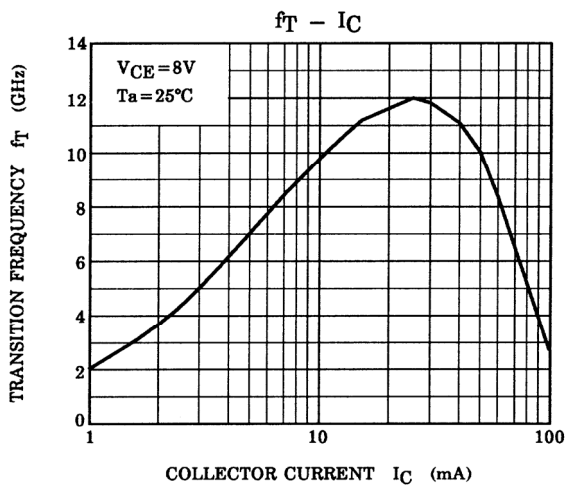
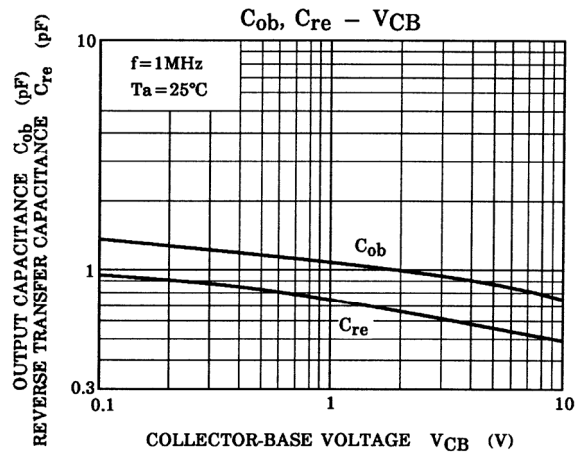
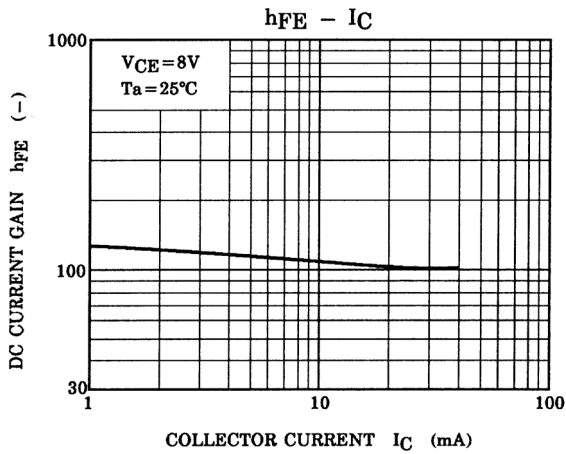
| Characteristics              | Symbol               | Test Condition   | Min | Typ. | Max  | Unit          |
|------------------------------|----------------------|--|-----|------|------|---------------|
| Collector cut-off current    | $I_{CBO}$            | $V_{CB} = 10\text{ V}$ , $I_E = 0$                               | —   | —    | 1    | $\mu\text{A}$ |
| Emitter cut-off current      | $I_{EBO}$            | $V_{EB} = 1\text{ V}$ , $I_C = 0$                                | —   | —    | 1    | $\mu\text{A}$ |
| DC current gain              | $h_{FE}$<br>(Note 1) | $V_{CE} = 8\text{ V}$ , $I_C = 20\text{ mA}$                     | 50  | —    | 160  |               |
| Output capacitance           | $C_{ob}$             | $V_{CB} = 10\text{ V}$ , $I_E = 0$ , $f = 1\text{ MHz}$ (Note 2) | —   | 0.7  | 1.1  | pF            |
| Reverse transfer capacitance | $C_{re}$             |  | —   | 0.45 | 0.95 | pF            |

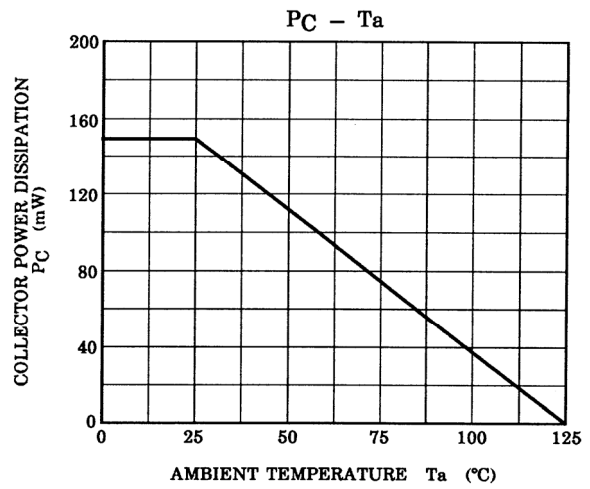
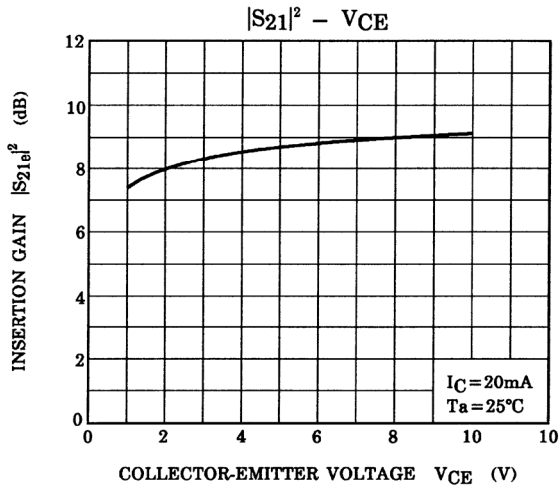
Note 1:  $h_{FE}$  classification R: 50~100, O: 80~160

Note 2:  $C_{re}$  is measured by 3 terminal method with capacitance bridge.

**Marking**







**S-Parameter  $Z_O = 50 \Omega, T_a = 25^\circ\text{C}$**

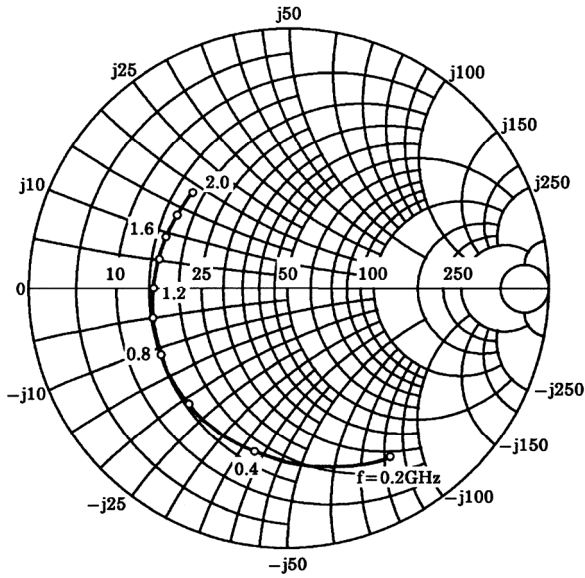
**$V_{CE} = 8 \text{ V}, I_C = 5 \text{ mA}$**

| Frequency<br>(MHz) | S11   |        | S21    |       | S12   |      | S22   |        |
|--------------------|-------|--------|--------|-------|-------|------|-------|--------|
|                    | Mag.  | Ang.   | Mag.   | Ang.  | Mag.  | Ang. | Mag.  | Ang.   |
| 200                | 0.767 | -58.9  | 12.888 | 143.5 | 0.049 | 62.8 | 0.856 | -34.5  |
| 400                | 0.655 | -102.2 | 9.480  | 119.3 | 0.073 | 48.7 | 0.663 | -57.5  |
| 600                | 0.605 | -130.0 | 7.087  | 104.6 | 0.086 | 43.1 | 0.535 | -72.7  |
| 800                | 0.567 | -150.4 | 5.577  | 93.9  | 0.093 | 40.7 | 0.456 | -84.3  |
| 1000               | 0.547 | -166.4 | 4.548  | 86.0  | 0.098 | 41.1 | 0.407 | -93.8  |
| 1200               | 0.533 | -179.7 | 3.798  | 79.3  | 0.103 | 42.5 | 0.373 | -102.4 |
| 1400               | 0.528 | 169.1  | 3.268  | 76.9  | 0.109 | 44.1 | 0.346 | -110.3 |
| 1600               | 0.519 | 158.4  | 2.856  | 69.3  | 0.116 | 46.6 | 0.328 | -117.4 |
| 1800               | 0.520 | 148.3  | 2.551  | 65.1  | 0.124 | 48.9 | 0.314 | -123.0 |
| 2000               | 0.524 | 138.7  | 2.290  | 61.1  | 0.133 | 51.1 | 0.303 | -128.3 |

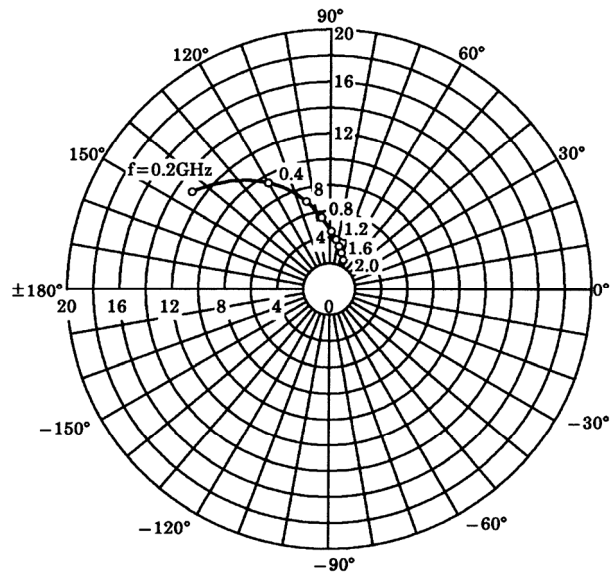
**$V_{CE} = 8 \text{ V}, I_C = 20 \text{ mA}$**

| Frequency<br>(MHz) | S11   |        | S21    |       | S12   |      | S22   |        |
|--------------------|-------|--------|--------|-------|-------|------|-------|--------|
|                    | Mag.  | Ang.   | Mag.   | Ang.  | Mag.  | Ang. | Mag.  | Ang.   |
| 200                | 0.540 | -106.8 | 23.009 | 123.0 | 0.033 | 56.9 | 0.605 | -57.8  |
| 400                | 0.521 | -147.5 | 13.445 | 102.7 | 0.045 | 54.9 | 0.392 | -81.2  |
| 600                | 0.521 | -167.1 | 9.277  | 92.8  | 0.057 | 57.9 | 0.309 | -95.5  |
| 800                | 0.525 | -178.9 | 7.029  | 85.7  | 0.069 | 60.0 | 0.271 | -107.3 |
| 1000               | 0.526 | -168.8 | 5.651  | 80.0  | 0.082 | 62.5 | 0.250 | -117.9 |
| 1200               | 0.529 | -158.7 | 4.688  | 75.6  | 0.094 | 63.4 | 0.236 | -127.6 |
| 1400               | 0.531 | -148.5 | 4.011  | 71.6  | 0.106 | 64.5 | 0.225 | -136.2 |
| 1600               | 0.536 | -140.4 | 3.531  | 68.1  | 0.119 | 65.1 | 0.214 | -143.8 |
| 1800               | 0.539 | -131.7 | 3.159  | 64.7  | 0.133 | 65.5 | 0.201 | -149.8 |
| 2000               | 0.540 | -122.8 | 2.842  | 61.8  | 0.147 | 65.7 | 0.190 | -154.8 |

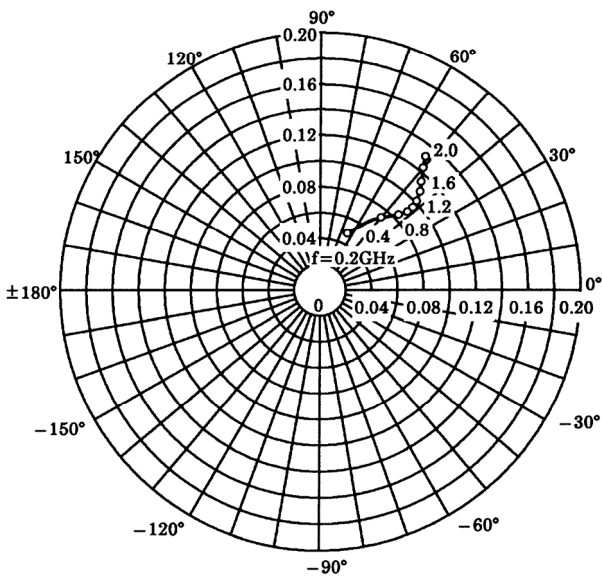
S11e  
 VCE=8V  
 IC=5mA  
 Ta=25°C  
 (Unit : Ω)



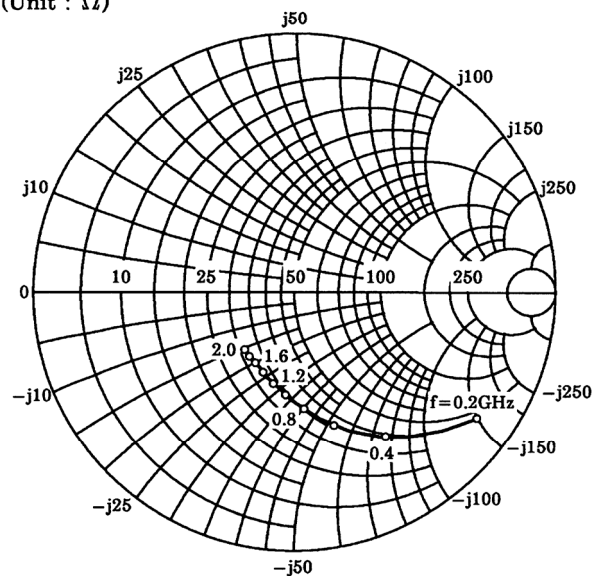
S21e  
 VCE=8V  
 IC=5mA  
 Ta=25°C



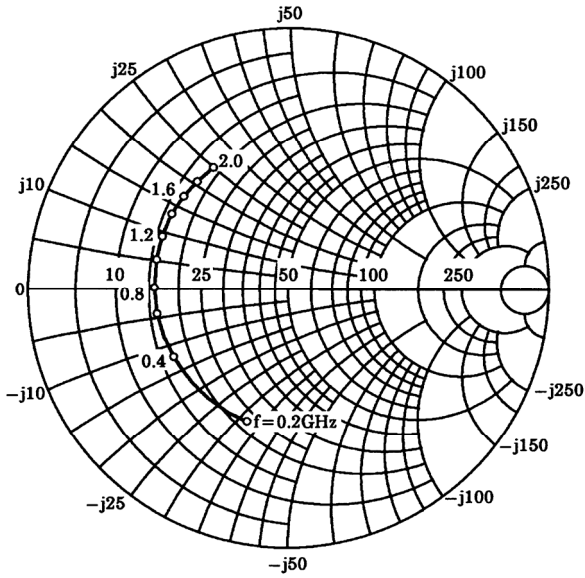
S12e  
 VCE=8V  
 IC=5mA  
 Ta=25°C



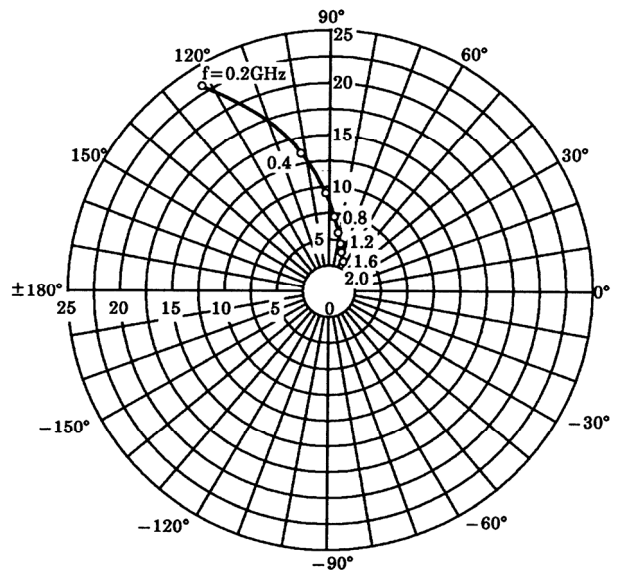
S22e  
 VCE=8V  
 IC=5mA  
 Ta=25°C  
 (Unit : Ω)



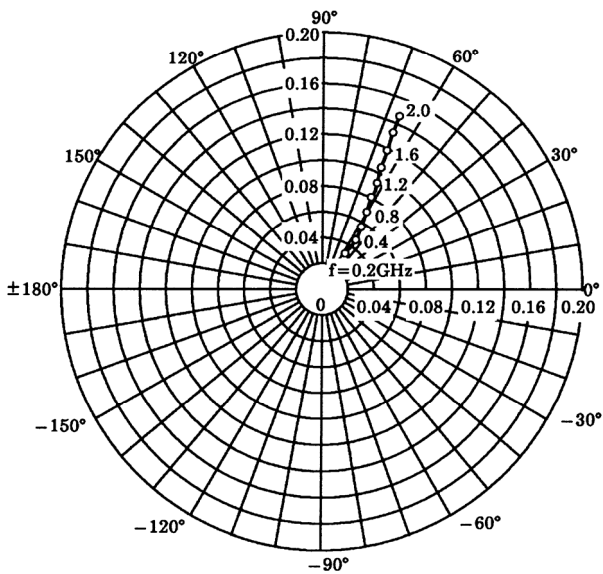
**S11e**  
 $V_{CE} = 8V$   
 $I_C = 20mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



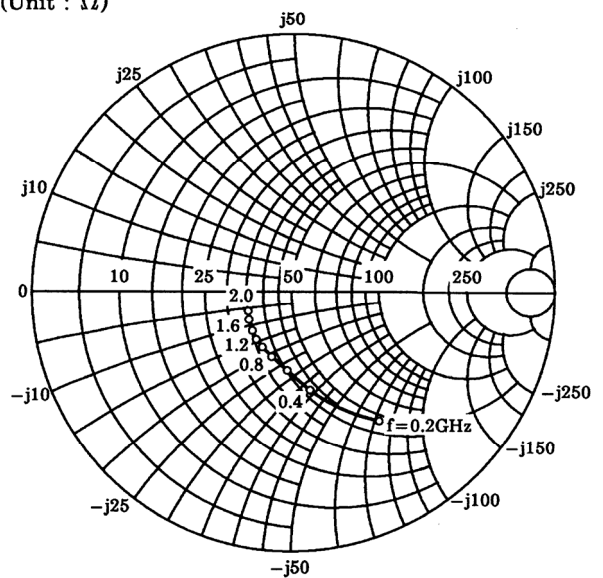
**S21e**  
 $V_{CE} = 8V$   
 $I_C = 20mA$   
 $T_a = 25^\circ C$



**S12e**  
 $V_{CE} = 8V$   
 $I_C = 20mA$   
 $T_a = 25^\circ C$



**S22e**  
 $V_{CE} = 8V$   
 $I_C = 20mA$   
 $T_a = 25^\circ C$   
 (Unit :  $\Omega$ )



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20070701-EN GENERAL

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