

TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

# 2SC5088

## VHF~UHF Band Low Noise Amplifier Applications

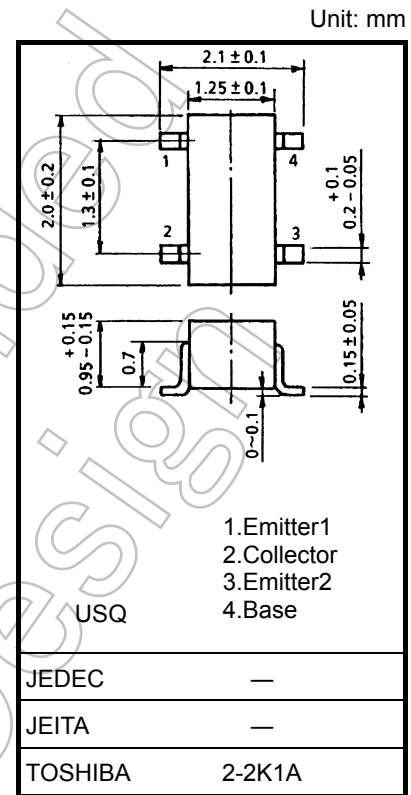
- Low noise figure, high gain.
- $NF = 1.1\text{dB}$ ,  $|S_{21e}|^2 = 13\text{dB}$  ( $f = 1\text{GHz}$ )

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

| Characteristics             | Symbol    | Rating     | Unit             |
|-----------------------------|-----------|------------|------------------|
| Collector-base voltage      | $V_{CBO}$ | 20         | V                |
| Collector-emitter voltage   | $V_{CEO}$ | 12         | V                |
| Emitter-base voltage        | $V_{EBO}$ | 3          | V                |
| Base current                | $I_B$     | 40         | mA               |
| Collector current           | $I_C$     | 80         | mA               |
| Collector power dissipation | $P_C$     | 100        | mW               |
| Junction temperature        | $T_j$     | 125        | $^\circ\text{C}$ |
| Storage temperature range   | $T_{stg}$ | -55 to 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: 0.006 g (typ.)

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

| Characteristics      | Symbol            | Test Condition  | Min | Typ. | Max | Unit |
|----------------------|-------------------|---|-----|------|-----|------|
| Transition frequency | $f_T$             | $V_{CE} = 10\text{V}$ , $I_C = 20\text{mA}$                       | 5   | 7    | —   | GHz  |
| Insertion gain       | $ S_{21e} ^2 (1)$ | $V_{CE} = 10\text{V}$ , $I_C = 20\text{mA}$ , $f = 500\text{MHz}$ | —   | 18   | —   | dB   |
|                      | $ S_{21e} ^2 (2)$ | $V_{CE} = 10\text{V}$ , $I_C = 20\text{mA}$ , $f = 1\text{GHz}$   | 9.5 | 13   | —   |      |
| Noise figure         | NF (1)            | $V_{CE} = 10\text{V}$ , $I_C = 5\text{mA}$ , $f = 500\text{MHz}$  | —   | 1    | —   | dB   |
|                      | NF (2)            | $V_{CE} = 10\text{V}$ , $I_C = 5\text{mA}$ , $f = 1\text{GHz}$    | —   | 1.1  | 2   |      |

Start of commercial production  
1993-10

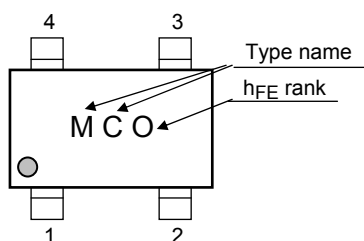
**Electrical Characteristics (Ta = 25°C)**

| 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) | $V_{CE} = 10\text{ V}, I_C = 20\text{ mA}$                 | 80  | —    | 240  |               |
| Output capacitance           | $C_{ob}$             | $V_{CB} = 10\text{ V}, I_E = 0, f = 1\text{ MHz}$ (Note 2) | —   | 1.1  | 1.6  | pF            |
| Reverse transfer capacitance | $C_{re}$             |  | —   | 0.65 | 1.05 | pF            |

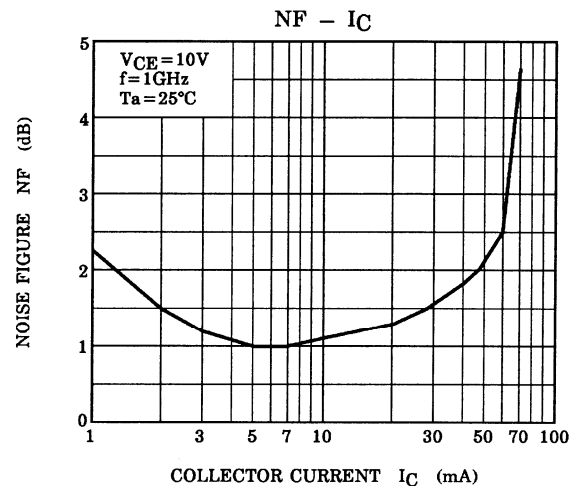
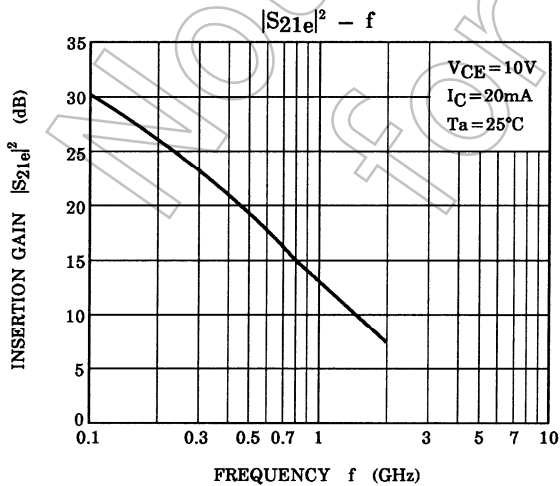
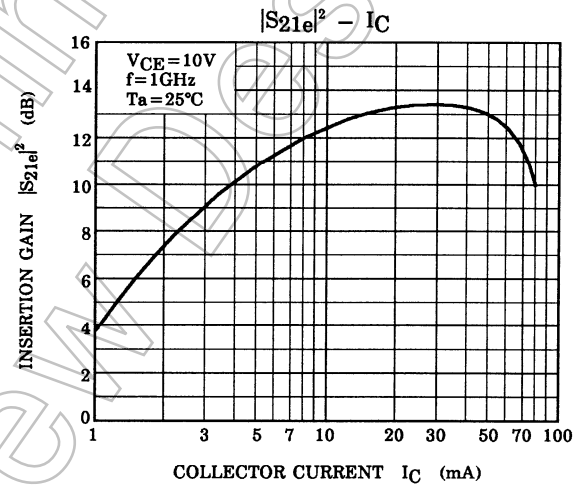
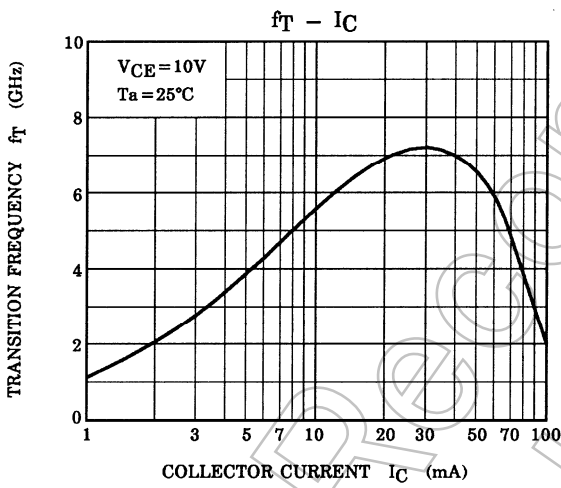
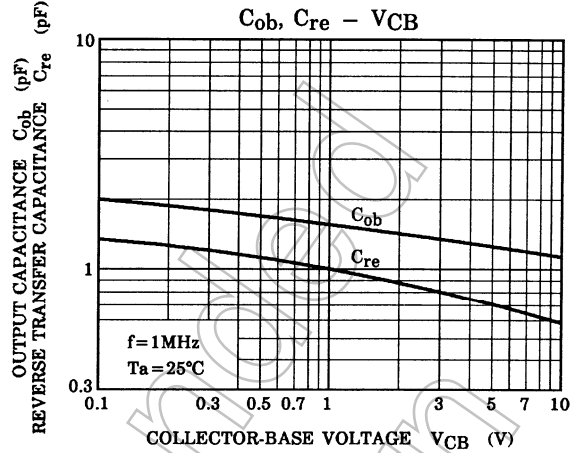
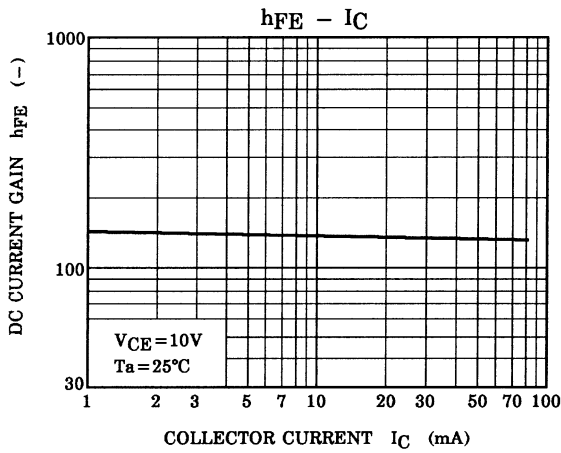
Note 1:  $h_{FE}$  classification O: 80 to 160, Y: 120 to 240

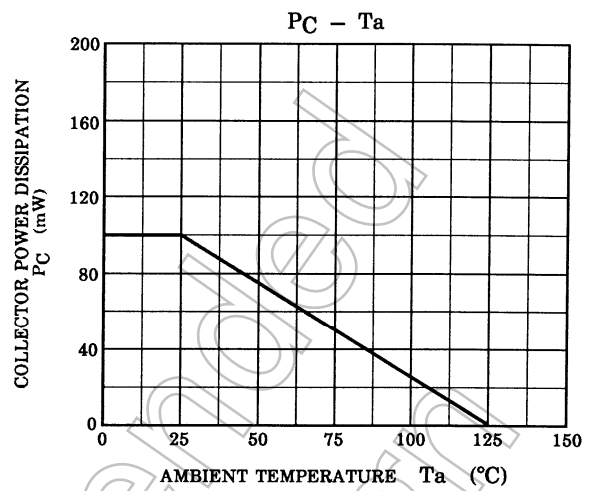
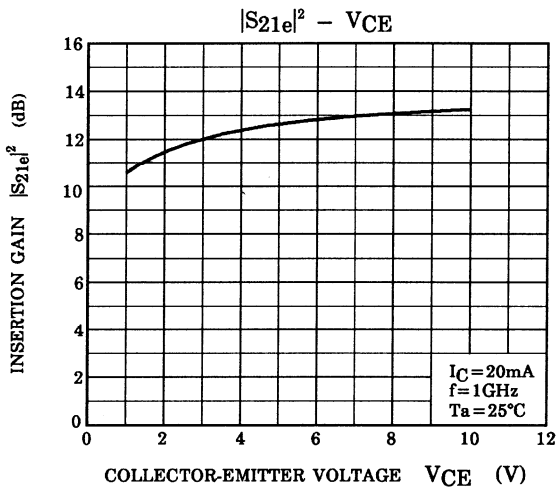
Note 2:  $C_{re}$  is measured by 3 terminal method with capacitance bridge.

**Marking**



Not Recommended for New Design





**S-Parameter  $Z_0 = 50 \Omega, T_a = 25^\circ\text{C}$**

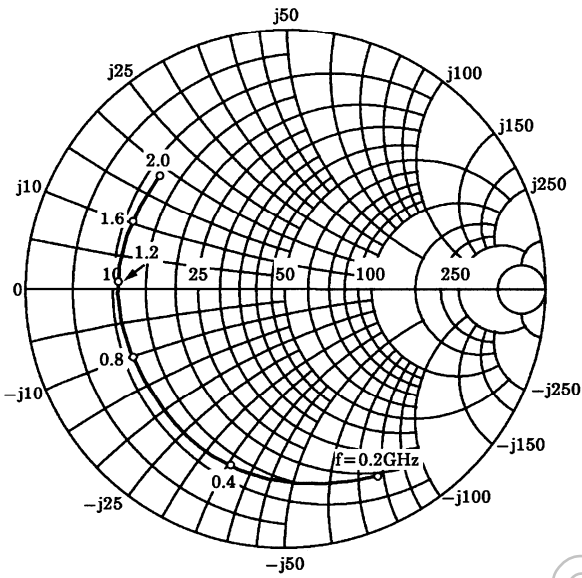
**$V_{CE} = 10 \text{ V}, I_C = 5 \text{ mA}$**

| Frequency<br>(MHz) | S11   |        | S21   |       | S12   |      | S22   |        |
|--------------------|-------|--------|-------|-------|-------|------|-------|--------|
|                    | Mag.  | Ang.   | Mag.  | Ang.  | Mag.  | Ang. | Mag.  | Ang.   |
| 200                | 0.826 | -64.3  | 9.839 | 139.2 | 0.056 | 59.2 | 0.844 | -31.7  |
| 400                | 0.735 | -106.8 | 7.058 | 115.2 | 0.083 | 43.8 | 0.663 | -50.1  |
| 600                | 0.692 | -134.4 | 5.233 | 99.5  | 0.094 | 36.8 | 0.558 | -62.3  |
| 800                | 0.666 | -154.3 | 4.106 | 88.1  | 0.100 | 33.3 | 0.496 | -72.6  |
| 1000               | 0.656 | -170.0 | 3.315 | 78.9  | 0.102 | 32.7 | 0.458 | -81.8  |
| 1200               | 0.653 | 178.0  | 2.768 | 71.3  | 0.103 | 33.4 | 0.429 | -90.6  |
| 1400               | 0.649 | 167.7  | 2.353 | 65.4  | 0.104 | 36.0 | 0.407 | -99.4  |
| 1600               | 0.655 | 158.2  | 2.061 | 59.6  | 0.107 | 39.1 | 0.393 | -107.8 |
| 1800               | 0.653 | 149.0  | 1.818 | 55.3  | 0.111 | 42.6 | 0.378 | -115.3 |
| 2000               | 0.654 | 139.9  | 1.650 | 50.7  | 0.116 | 46.7 | 0.367 | -121.9 |

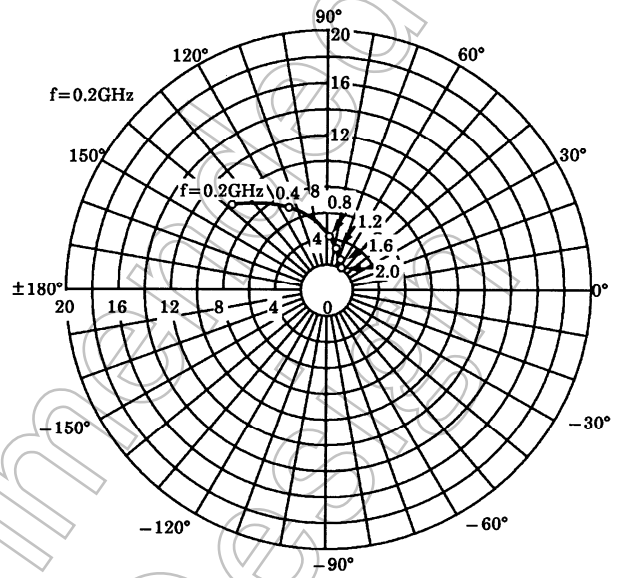
**$V_{CE} = 10 \text{ V}, I_C = 20 \text{ mA}$**

| Frequency<br>(MHz) | S11   |        | S21    |       | S12   |      | S22   |        |
|--------------------|-------|--------|--------|-------|-------|------|-------|--------|
|                    | Mag.  | Ang.   | Mag.   | Ang.  | Mag.  | Ang. | Mag.  | Ang.   |
| 200                | 0.747 | -87.0  | 16.492 | 129.8 | 0.048 | 52.1 | 0.717 | -47.1  |
| 400                | 0.675 | -130.5 | 10.431 | 106.5 | 0.063 | 41.8 | 0.486 | -69.1  |
| 600                | 0.648 | -154.8 | 7.298  | 93.5  | 0.070 | 40.8 | 0.379 | -82.0  |
| 800                | 0.636 | -170.9 | 5.547  | 84.4  | 0.076 | 42.0 | 0.324 | -93.0  |
| 1000               | 0.630 | 176.7  | 4.423  | 77.5  | 0.083 | 44.7 | 0.291 | -102.7 |
| 1200               | 0.634 | 166.4  | 3.660  | 71.7  | 0.089 | 47.7 | 0.266 | -112.1 |
| 1400               | 0.634 | 157.1  | 3.125  | 67.0  | 0.097 | 50.8 | 0.249 | -120.8 |
| 1600               | 0.639 | 148.8  | 2.741  | 62.4  | 0.105 | 53.2 | 0.233 | -128.9 |
| 1800               | 0.645 | 139.9  | 2.451  | 58.8  | 0.115 | 55.6 | 0.220 | -135.8 |
| 2000               | 0.642 | 131.4  | 2.233  | 54.9  | 0.126 | 58.1 | 0.205 | -141.2 |

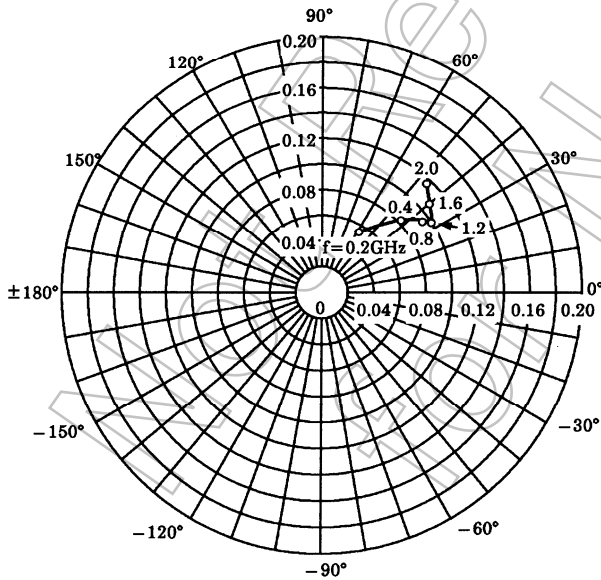
S11e  
 VCE=10V  
 IC=5mA  
 Ta=25°C  
 (Unit : Ω)



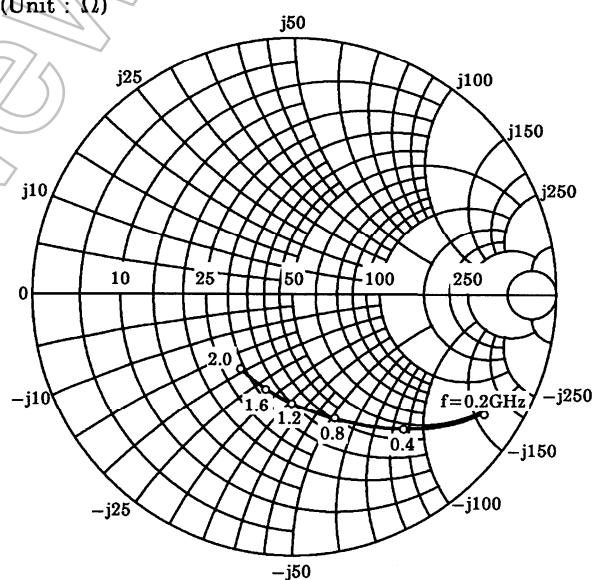
S21e  
 VCE=10V  
 IC=5mA  
 Ta=25°C



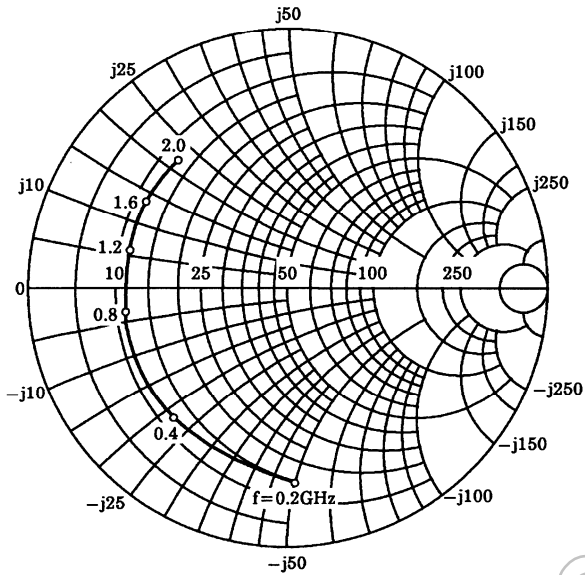
S12e  
 VCE=10V  
 IC=5mA  
 Ta=25°C



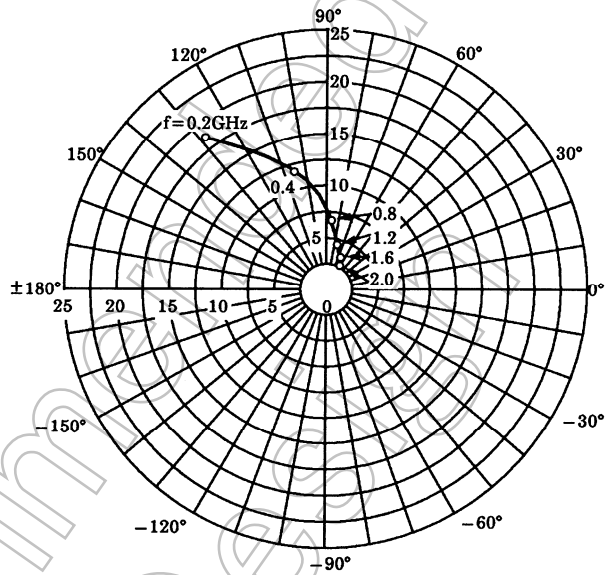
S22e  
 VCE=10V  
 IC=5mA  
 Ta=25°C  
 (Unit : Ω)



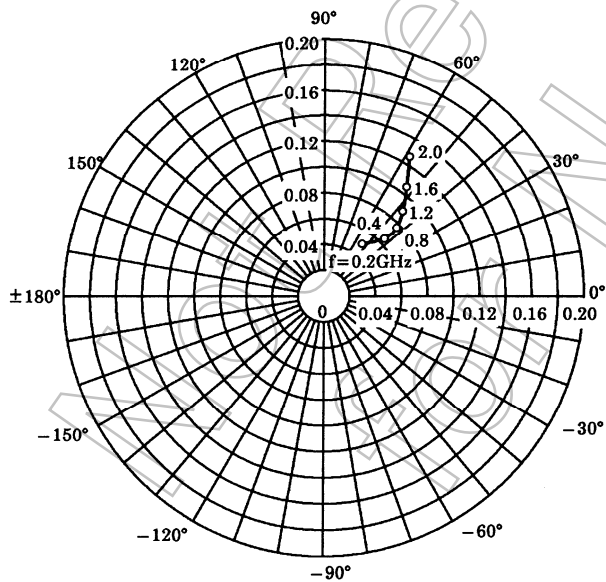
**S11e**  
 VCE=10V  
 IC=20mA  
 Ta=25°C  
 (Unit : Ω)



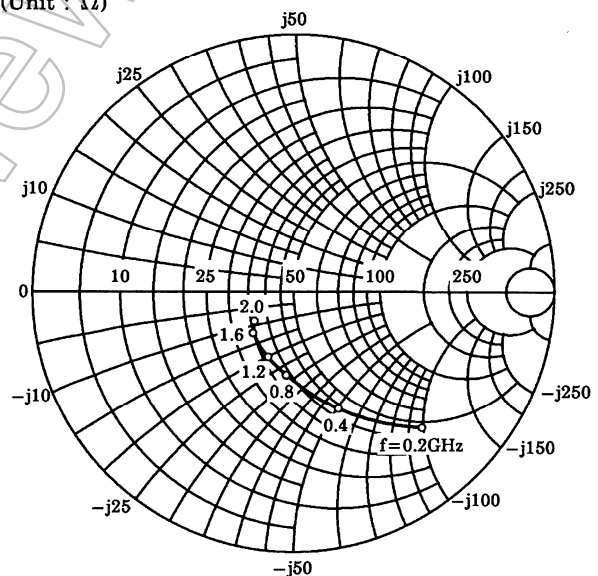
**S21e**  
 VCE=10V  
 IC=20mA  
 Ta=25°C



**S12e**  
 VCE=10V  
 IC=20mA  
 Ta=25°C



**S22e**  
 VCE=10V  
 IC=20mA  
 Ta=25°C  
 (Unit : Ω)



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