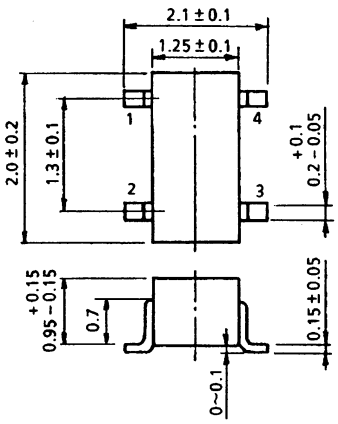
TOSHIBA Transistor Silicon NPN Epitaxial Planar Type

2SC5088

VHF~UHF Band Low Noise Amplifier Applications

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

Unit: mm



1.Emitter1
2.Collector
3.Emitter2
4.Base

USQ

JEDEC	—
JEITA	—
TOSHIBA	2-2K1A

Weight: 0.006 g (typ.)

Absolute Maximum Ratings (Ta = 25°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	°C
Storage temperature range	T_{stg}	−55~125	°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).

Microwave Characteristics (Ta = 25°C)

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

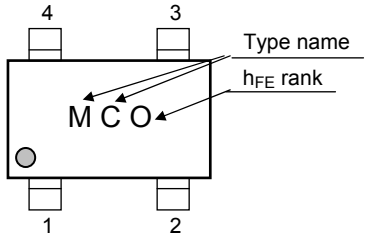
Electrical Characteristics (Ta = 25°C)

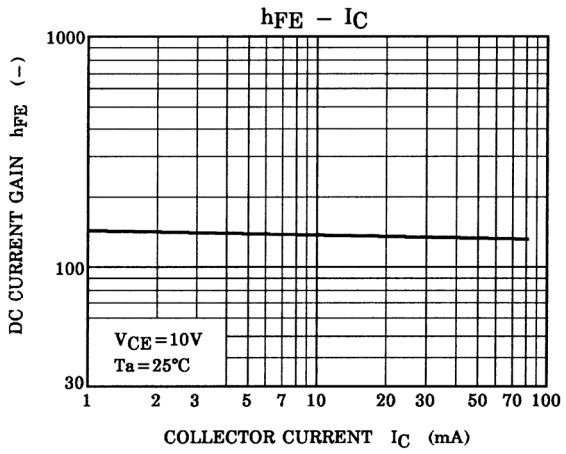
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = 10 V, I_E = 0	—	—	1	μA
Emitter cut-off current	I_{EBO}	V_{EB} = 1 V, I_C = 0	—	—	1	μA
DC current gain	h_{FE} (Note 1)	V_{CE} = 10 V, I_C = 20 mA	80	—	240	
Output capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz (Note 2)	—	1.1	1.6	pF
Reverse transfer capacitance	C_{re}		—	0.65	1.05	pF

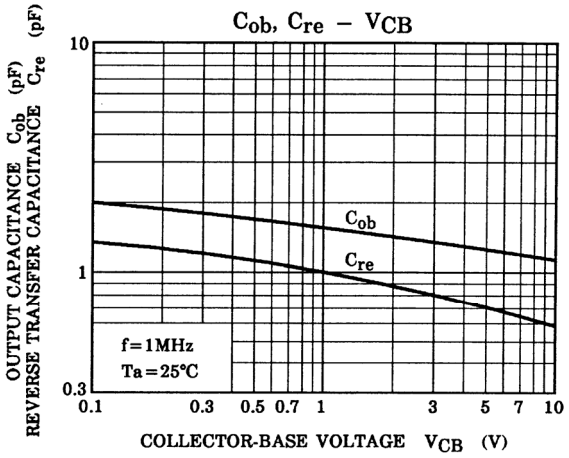
Note 1: h_{FE} classification O: 80~160, Y: 120~240

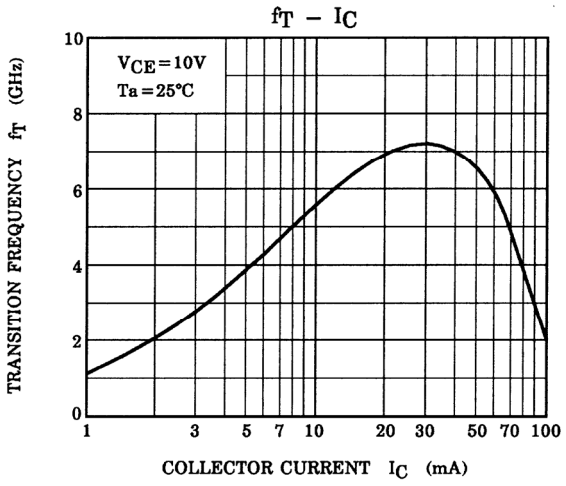
Note 2: C_{re} is measured by 3 terminal method with capacitance bridge.

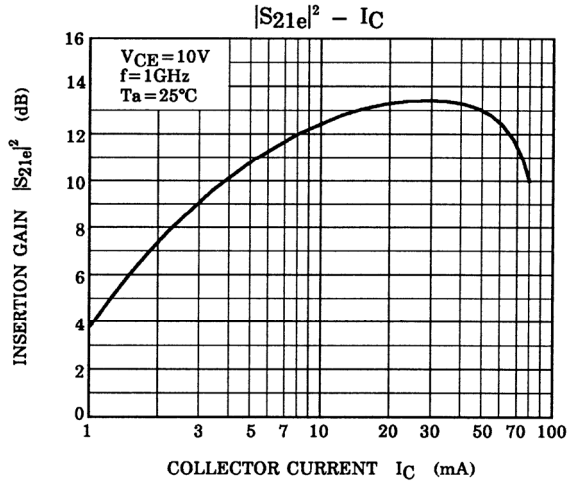
Marking

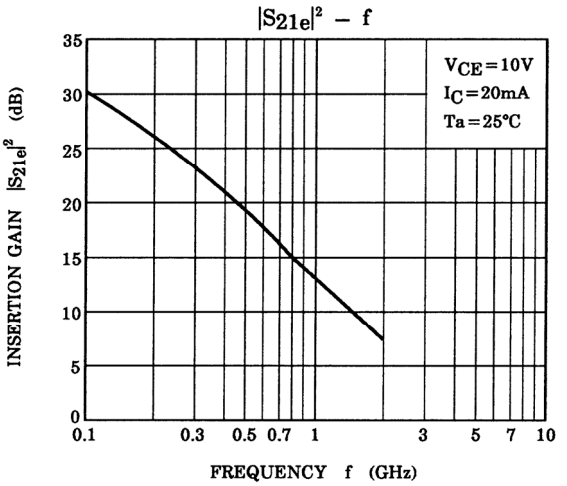


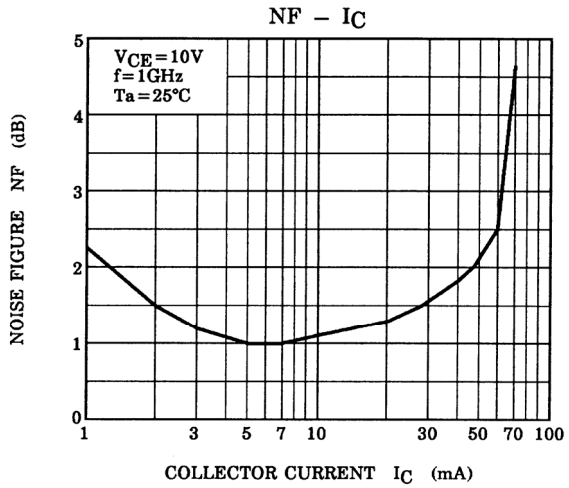

hFE – IC
DC CURRENT GAIN hFE (–)
1000
100
30
VCE = 10V
Ta = 25°C
1 2 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)

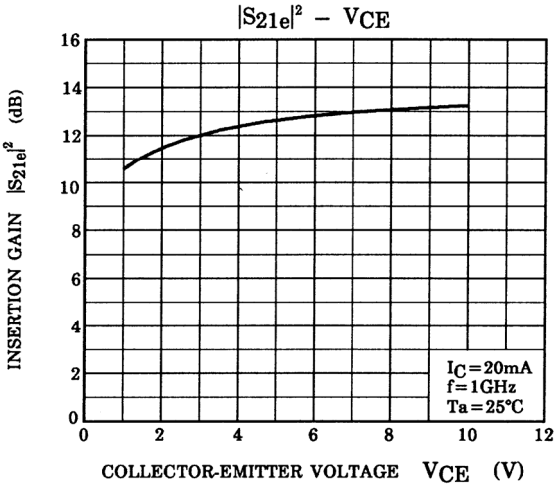

Cob, Cre – VCB
OUTPUT CAPACITANCE Cob (pF)
REVERSE TRANSFER CAPACITANCE Cre (pF)
10
1
0.3
Cob
Cre
f = 1MHz
Ta = 25°C
0.1 0.3 0.5 0.7 1 3 5 7 10
COLLECTOR-BASE VOLTAGE VCB (V)

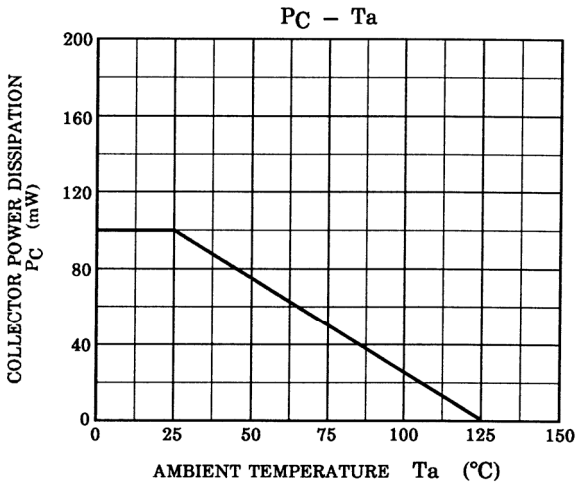

fT – IC
TRANSITION FREQUENCY fT (GHz)
10
8
6
4
2
0
VCE = 10V
Ta = 25°C
1 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)


|S21e|2 – IC
INSERTION GAIN |S21e|2 (dB)
16
14
12
10
8
6
4
2
0
VCE = 10V
f = 1GHz
Ta = 25°C
1 3 5 7 10 20 30 50 70 100
COLLECTOR CURRENT IC (mA)


|S21e|2 – f
INSERTION GAIN |S21e|2 (dB)
35
30
25
20
15
10
5
0
VCE = 10V
IC = 20mA
Ta = 25°C
0.1 0.3 0.5 0.7 1 3 5 7 10
FREQUENCY f (GHz)


NF – IC
NOISE FIGURE NF (dB)
5
4
3
2
1
0
VCE = 10V
f = 1GHz
Ta = 25°C
1 3 5 7 10 30 50 70 100
COLLECTOR CURRENT IC (mA)





S-Parameter Z_O = 50 Ω, Ta = 25°C

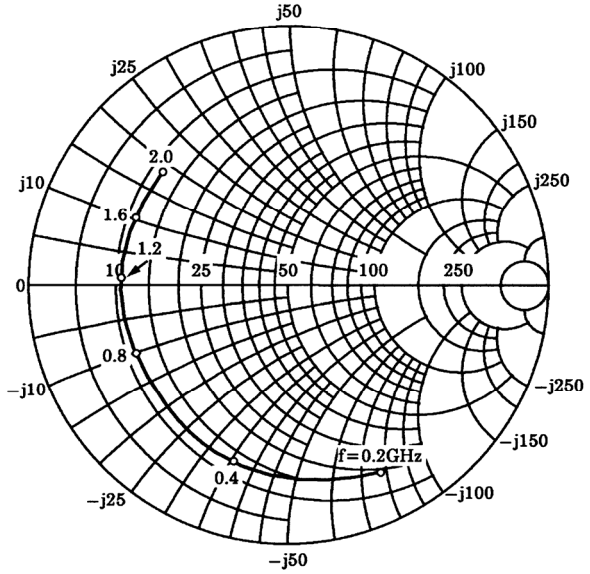
V_{CE} = 10 V, I_C = 5 mA

Frequency	S11		S21		S12		S22	
(MHz)	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

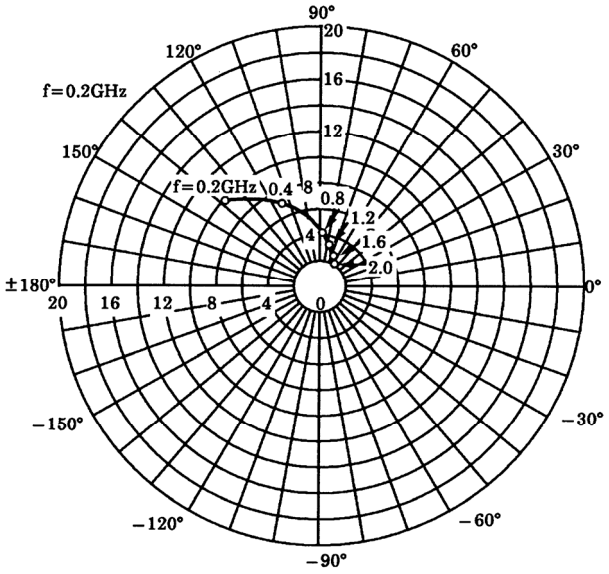
V_{CE} = 10 V, I_C = 20 mA

Frequency	S11		S21		S12		S22	
(MHz)	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

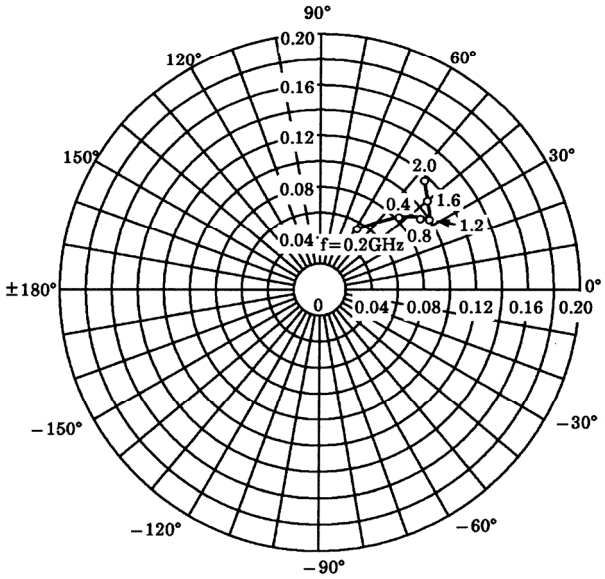
S_{11e}
V_{CE} = 10V
I_C = 5mA
Ta = 25°C
(Unit : Ω)



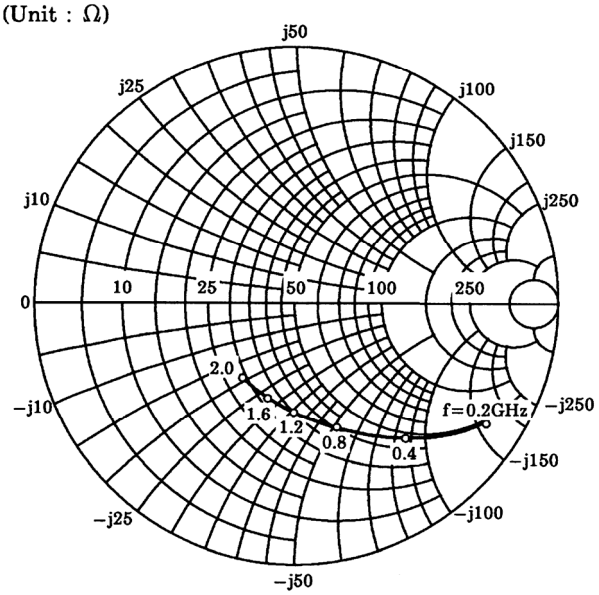
S_{21e}
V_{CE} = 10V
I_C = 5mA
Ta = 25°C



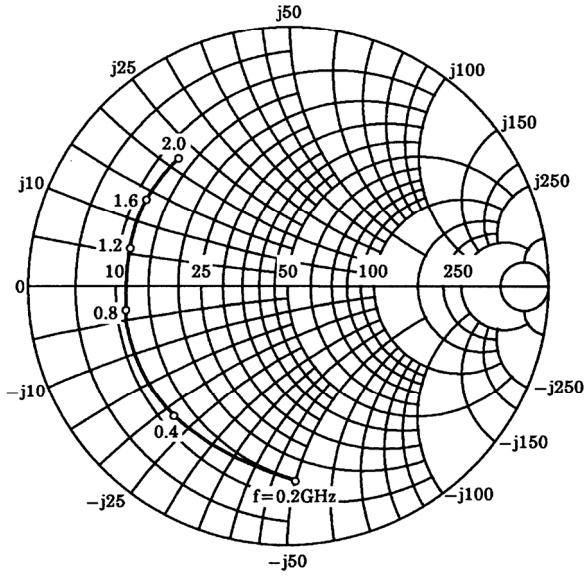
S_{12e}
V_{CE} = 10V
I_C = 5mA
Ta = 25°C



S_{22e}
V_{CE} = 10V
I_C = 5mA
Ta = 25°C
(Unit : Ω)



S_{11e}
V_{CE} = 10V
I_C = 20mA
Ta = 25°C
(Unit : Ω)



S_{21e}
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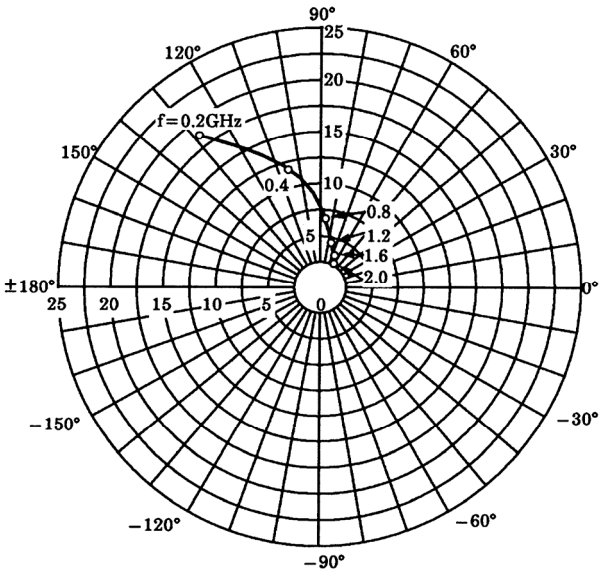
I_C = 20mA
Ta = 25°C



S_{12e}
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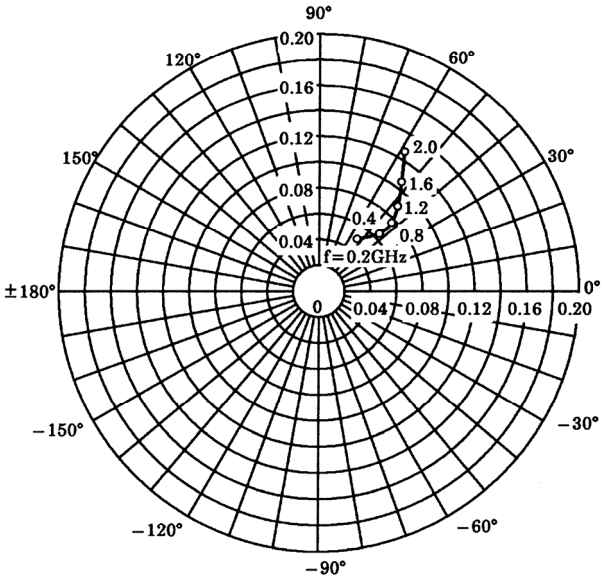
Ta = 25°C



S_{22e}
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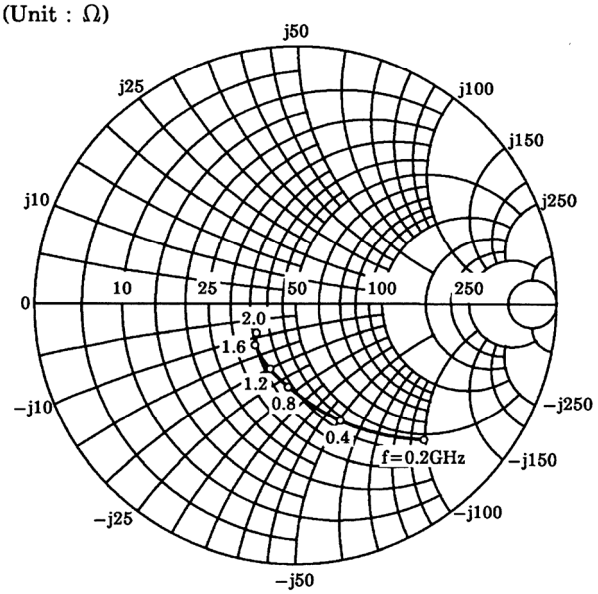
(Unit : Ω)



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