MOTOROLA

2N5109

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTOR

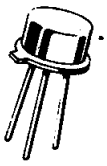
. . . designed specifically for broadband applications requiring good linearity. Useable as a high frequency current mode switch to 200 mA.

- Low Noise Figure – @ f = 200 MHz
  NF = 3.0 dB (Typ)
- High Current-Gain – Bandwidth Product –
  f_T = 1200 MHz (Min) @ I_C = 50 mAdc

1.2 GHz @ 50 mAdc

HIGH FREQUENCY TRANSISTOR

NPN SILICON

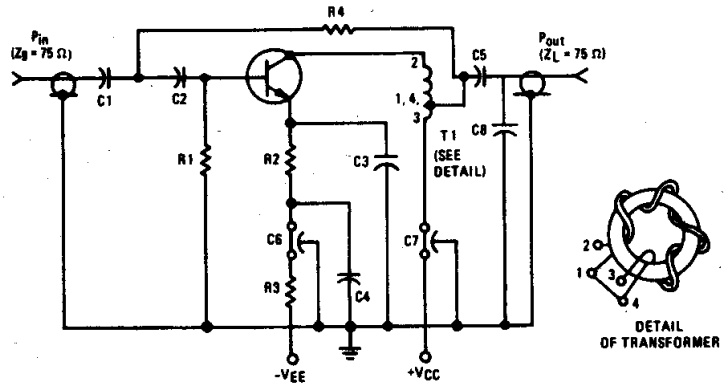


*MAXIMUM RATINGS

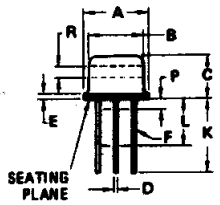
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	40	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Base Current – Continuous	I_B	400	mAdc
Collector Current – Continuous	I_C	400	mAdc
Total Device Dissipation @ T_C = 75°C (1) Derate above 25°C	P_D	2.5 20	Watt mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

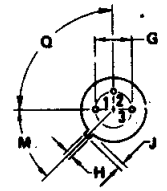
(1) Total Device Dissipation at T_A = 25°C is 1.0 Watt.
* Indicates JEDEC Registered Data.

FIGURE 1 – RF AMPLIFIER FOR VOLTAGE GAIN TEST CIRCUIT



C1, C2, C3, C5 0.002 μF
C4 0.03 μF
C6, C7 1500 pF
C8 18 pF
R1 4.7 k, 1/4 W
R2 6.8 Ω, 1/2 W
*R3 330 Ω, 1 W
R4 200 Ω, 1/4 W
T1 4 Turns #30 Wire
Bifilar wound on "Indiana General" Core #CF-102-Q1, or equivalent





STYLE 1
PIN 1. EMITTER
2. BASE
3. COLLECTOR

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.89	9.40	0.350	0.370
B	8.00	8.51	0.315	0.335
C	6.10	6.60	0.240	0.260
D	0.406	0.533	0.016	0.021
E	0.229	3.18	0.009	0.125
F	0.406	0.483	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.711	0.864	0.028	0.034
J	0.737	1.02	0.029	0.040
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
Q	90° NOM		90° NOM	
R	2.54	–	0.100	–

All JEDEC dimensions and notes apply.

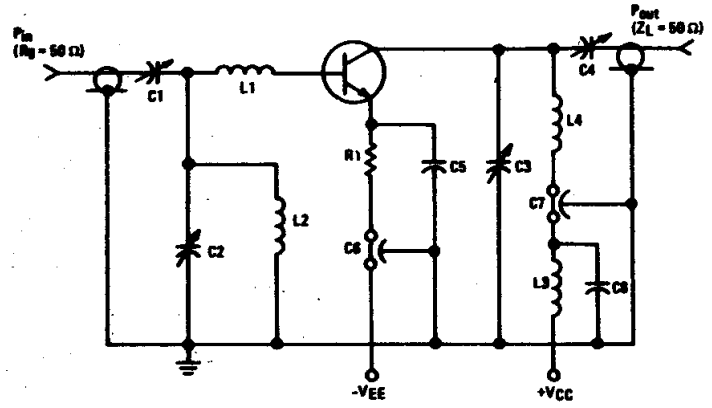
CASE 79-02
TO-39

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
*OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{CEO(sus)}$	20	–	–	Vdc
Collector-Emitter Sustaining Voltage (1) (I_C = 5.0 mAdc, R_{BE} = 10 Ω)	$V_{CER(sus)}$	40	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, I_B = 0)	I_{CEO}	–	–	20	μAdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = -1.5 V, T_C = 150°C) (V_{CE} = 35 Vdc, V_{BE} = -1.5 V)	I_{CEX}	– –	– –	5.0 5.0	mAdc mAdc
Emitter Cutoff Current (V_{BE} = 3.0 Vdc, I_C = 0)	I_{EBO}	–	–	100	μAdc
*ON CHARACTERISTICS					
DC Current Gain (I_C = 360 mAdc, V_{CE} = 5.0 Vdc) (I_C = 50 mAdc, V_{CE} = 15 Vdc)	h_{FE}	 5.0 40	 – –	 – 120	 – –
DYNAMIC CHARACTERISTICS					
*Current-Gain – Bandwidth Product (I_C = 50 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)	f_T	1200	–	–	MHz
*Collector-Base Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	1.8	3.5	pF
Noise Figure (I_C = 10 mAdc, V_{CE} = 15 Vdc, f = 200 MHz) (Figure 2)	NF	–	3.0	–	dB
FUNCTIONAL TEST					
*Common-Emitter Amplifier Voltage Gain (Figure 1) (I_C = 50 mAdc, V_{CC} = 15 Vdc, f = 50 to 216 MHz)	G_{ve}	11	–	–	dB
*Power Input (Figure 2) (I_C = 50 mAdc, V_{CC} = 15 Vdc, R_S = 50 ohms, P_{out} = 1.26 mW, f = 200 MHz)	P_{in}	–	–	0.1	mW

*Indicates JEDEC Registered Data.
(1) Pulsed thru a 25 mH Inductor; 50% Duty Cycle

FIGURE 2 – 200 MHz TEST CIRCUIT



C1, C2, C3 1.0 – 30 pF
C4 1.8 – 20 pF
C5 10,000 pF
C6, C7 1,000 pF
C8 0.01 μF

L1 4-1/2 turns, No. 22 wire, 3/16" I.D.
L4 3-1/2 turns, No. 22 wire, 3/16" I.D.
L2, L3 0.82 μH RFC
R1 240 OHMS, 2 WATTS

FIGURE 3 – CURRENT-GAIN – BANDWIDTH PRODUCT

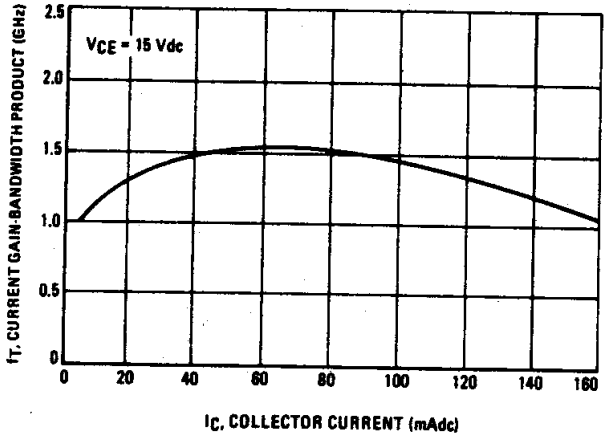


FIGURE 4 – COLLECTOR-BASE TIME CONSTANT

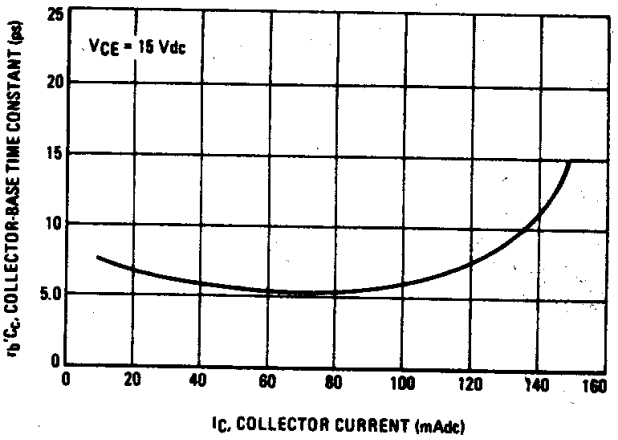


FIGURE 5 – SATURATION VOLTAGES

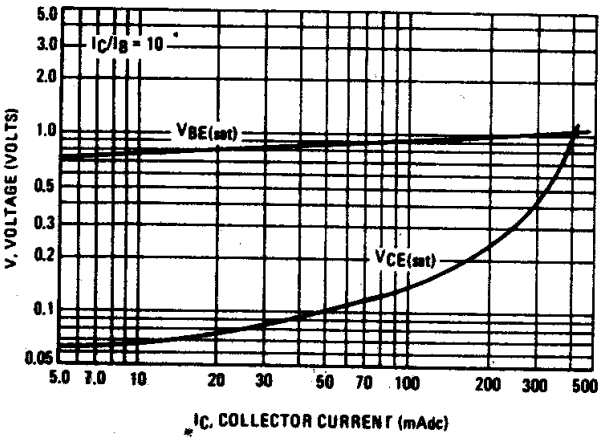


FIGURE 6 – CAPACITANCES versus REVERSE VOLTAGE

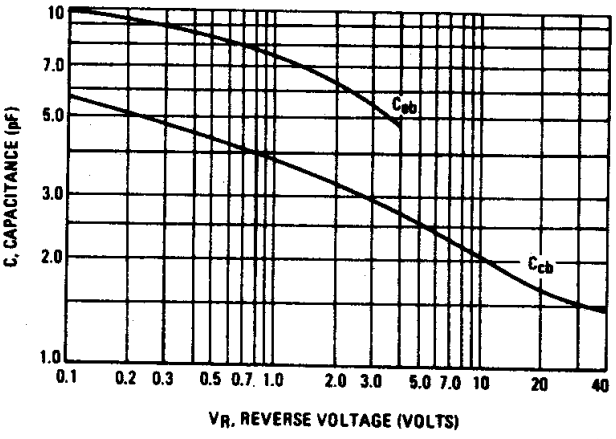


FIGURE 7 – INPUT ADMITTANCE versus FREQUENCY

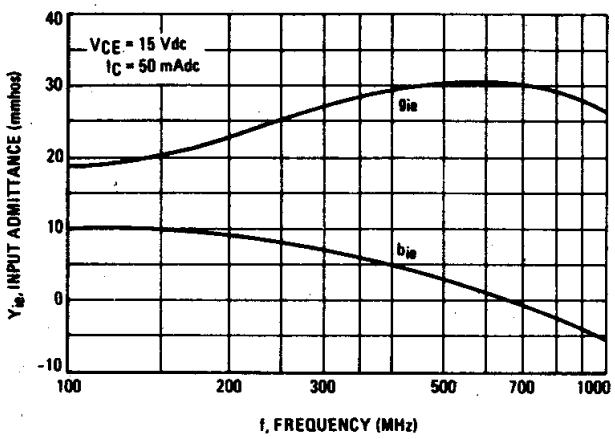


FIGURE 8 – INPUT ADMITTANCE versus COLLECTOR CURRENT

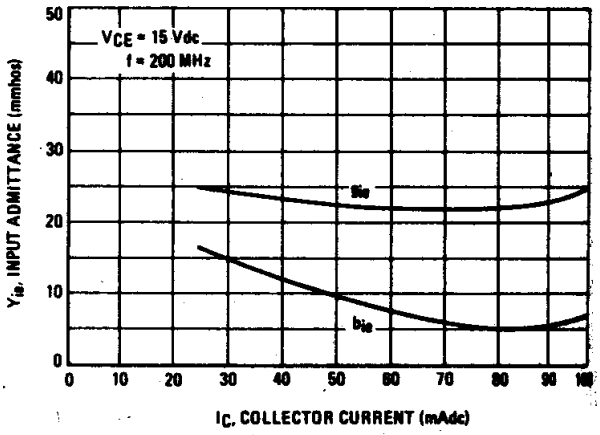


FIGURE 9 – REVERSE TRANSFER ADMITTANCE versus FREQUENCY

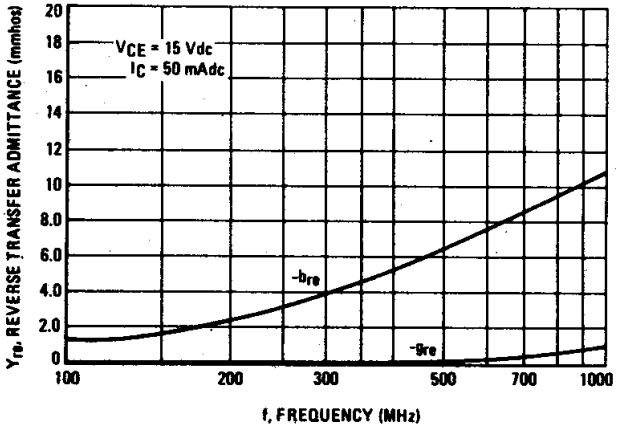


FIGURE 10 – REVERSE TRANSFER ADMITTANCE versus COLLECTOR CURRENT

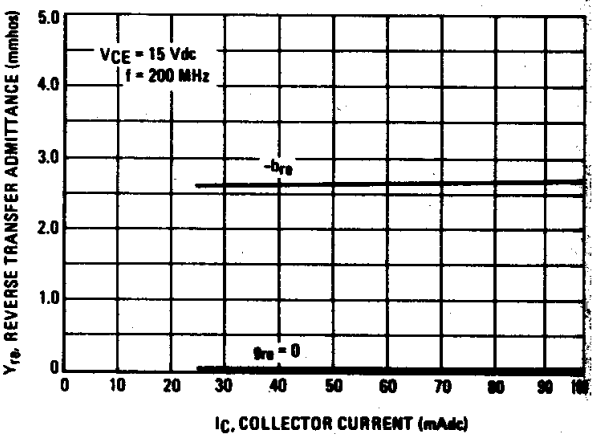


FIGURE 11 – FORWARD TRANSFER ADMITTANCE versus FREQUENCY

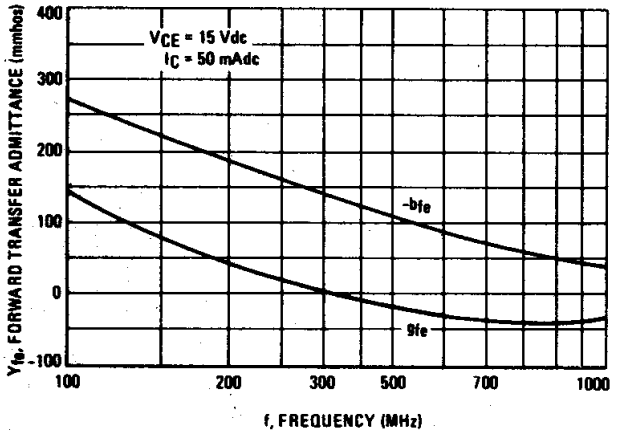


FIGURE 12 – FORWARD TRANSFER ADMITTANCE versus COLLECTOR CURRENT

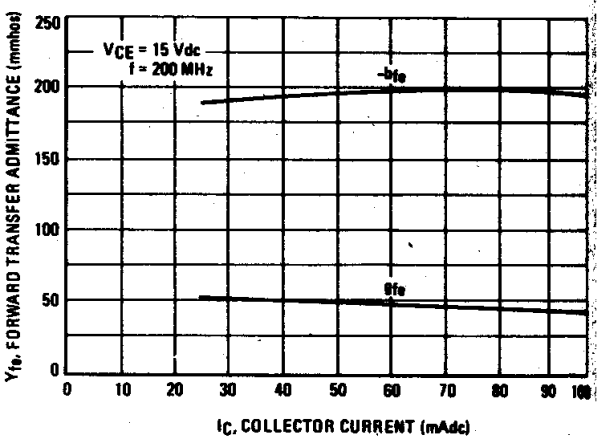


FIGURE 13 – OUTPUT ADMITTANCE versus FREQUENCY

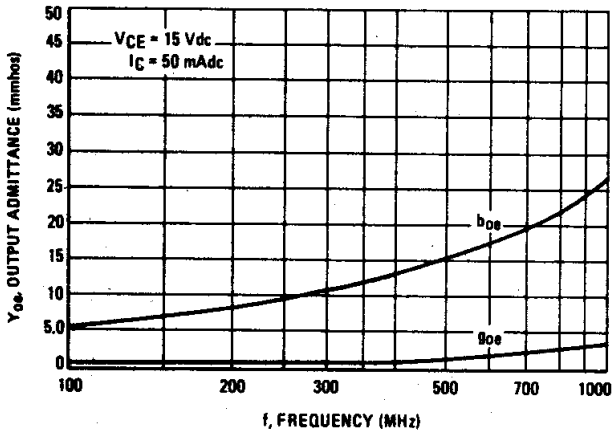


FIGURE 14 – OUTPUT ADMITTANCE versus COLLECTOR CURRENT

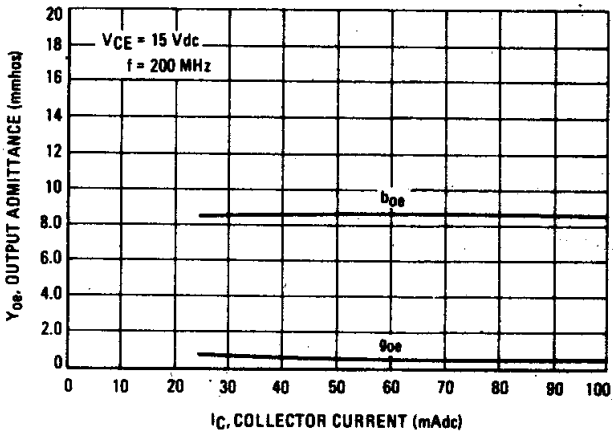


FIGURE 15 – INPUT REFLECTION COEFFICIENT versus FREQUENCY

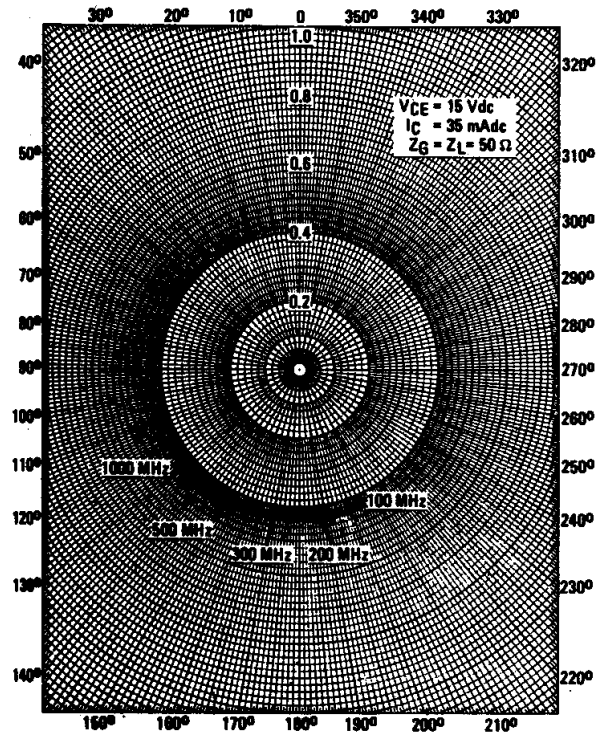


FIGURE 16 – OUTPUT REFLECTION COEFFICIENT versus FREQUENCY

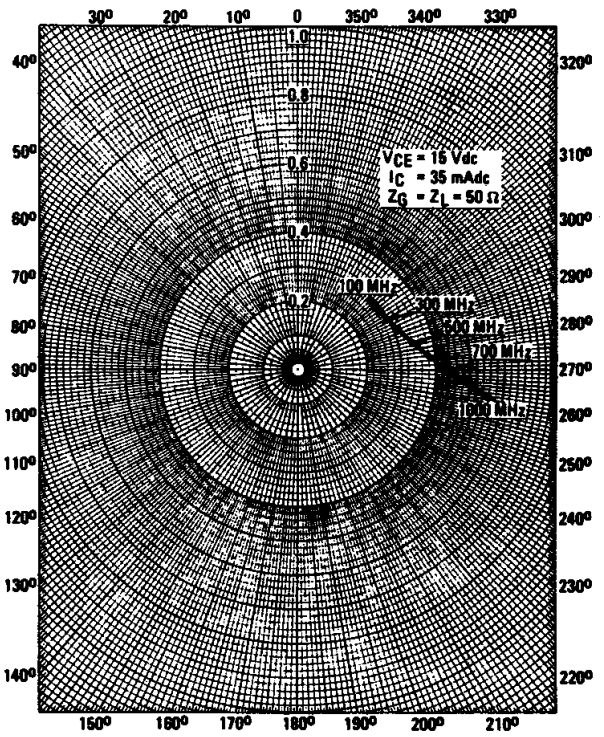


FIGURE 17 – REVERSE TRANSMISSION COEFFICIENT versus FREQUENCY

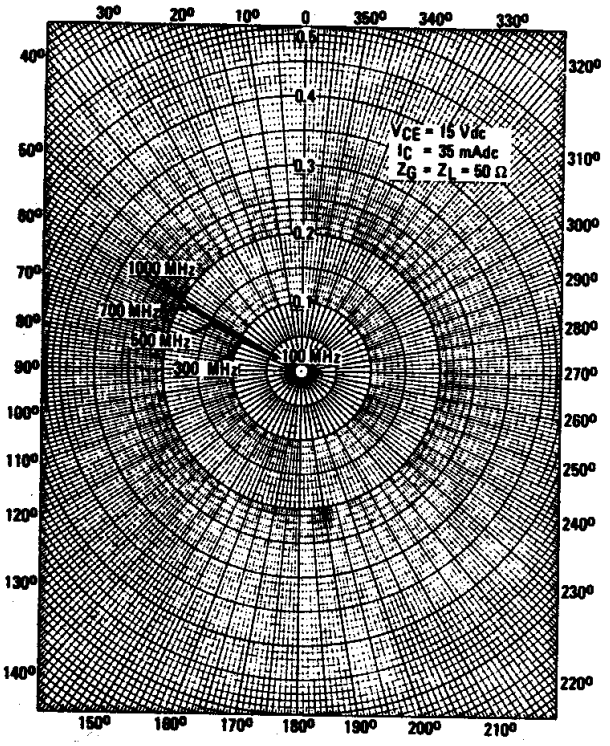


FIGURE 18 – FORWARD TRANSMISSION COEFFICIENT versus FREQUENCY

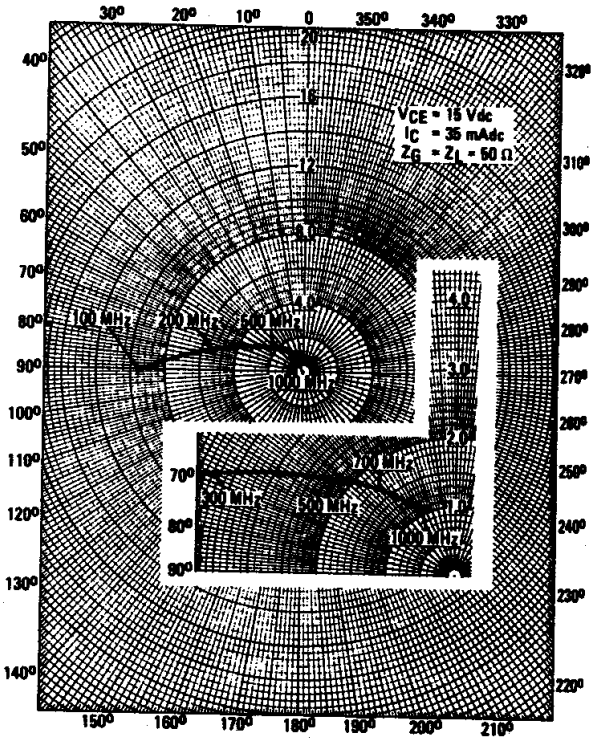


FIGURE 19 – INPUT REFLECTION COEFFICIENT AND OUTPUT REFLECTION COEFFICIENT versus FREQUENCY