MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

2N5109

2

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTOR

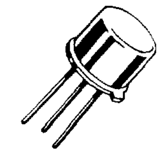
. . . designed specifically for broadband applications requiring good linearity. Useable as a high frequency current mode switch to 200 mA.

- 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

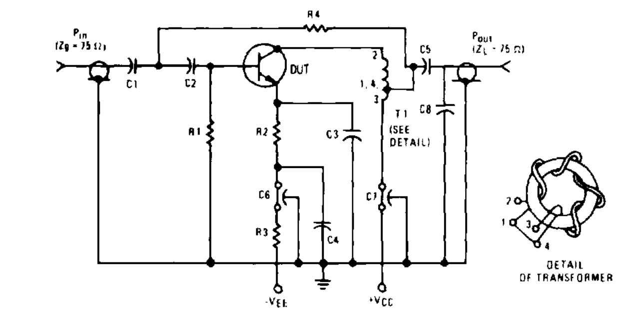


***MAXIMUM RATINGS**

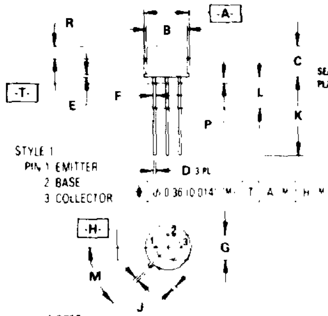
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	40	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Base Current — Continuous	I_B	400	mAdc
Collector Current — Continuous	I_C	400	mAdc
Total Device Dissipation @ T_C = 75°C (1) Derate above 25°C	P_D	2.5 20	Watt mW/°C
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	R3	330 Ω, 1 W
C4	0.03 μF	R4	200 Ω, 1/4 W
C6, C7	1500 pF	T1	4 Turns #30 Wire
C8	18 pF		Bifilar wound on 'Indiana General'
R1	4.7 k, 1/4 W		Core #CF 102 Q1 or equivalent
R2	6.8 Ω, 1/2 W		



NOTES
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2. CONTROLLING DIMENSION: INCH
3. DIMENSION J MEASURED FROM DIMENSION A MAXIMUM
4. DIMENSION B SHALL NOT VARY MORE THAN 0.25 (0.010) IN ZONE R. THIS ZONE CONTROLLED FOR AUTOMATIC HANDLING
5. DIMENSION F APPLIES BETWEEN DIMENSION P AND L. DIMENSION D APPLIES BETWEEN DIMENSION L AND K MINIMUM. LEAD DIAMETER IS UNCONTROLLED IN DIMENSION P AND BEYOND DIMENSION K MINIMUM

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.51	9.39	0.335	0.370
B	7.75	8.50	0.305	0.335
C	6.10	6.60	0.240	0.260
D	0.41	0.53	0.016	0.021
E	0.23	1.04	0.009	0.041
F	0.41	0.48	0.016	0.019
G	5.08 BSC		0.200 BSC	
H	0.72	0.86	0.028	0.034
J	0.74	1.14	0.029	0.045
K	12.70	19.05	0.500	0.750
L	6.35	-	0.250	-
M	45° BSC		45° BSC	
P	—	1.27	—	0.050
R	2.54	-	0.100	-

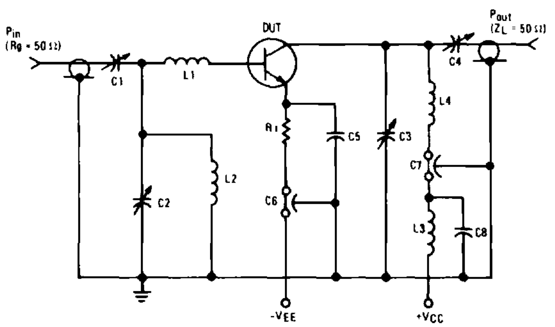
**CASE 79-04
TO-205AD
(TO-39)**

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)	I_{CEX}	–	–	5.0	mAdc
(V_{CE} = 35 Vdc, V_{BE} = -1.5 V)		–	–	5.0	mAdc
Emitter Cutoff Current (V_{BE} = 3.0 Vdc, I_C = 0)	I_{EBO}	–	–	100	μAdc
***ON CHARACTERISTICS**					
DC Current Gain	h_{FE}				
(I_C = 360 mAdc, V_{CE} = 5.0 Vdc)		5.0	–	–	–
(I_C = 50 mAdc, V_{CE} = 15 Vdc)		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 1.0 – 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

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FIGURE 3 – CURRENT-GAIN – BANDWIDTH PRODUCT

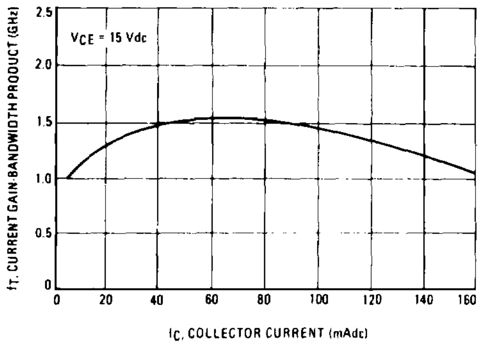

FIGURE 4 – COLLECTOR-BASE TIME CONSTANT

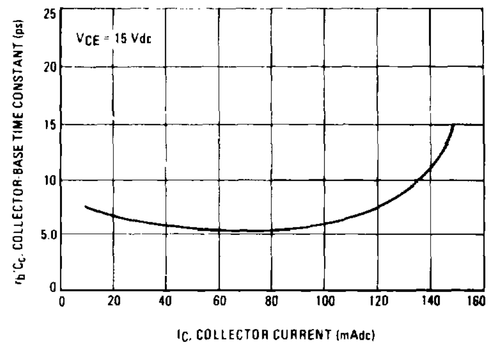

FIGURE 5 – SATURATION VOLTAGES

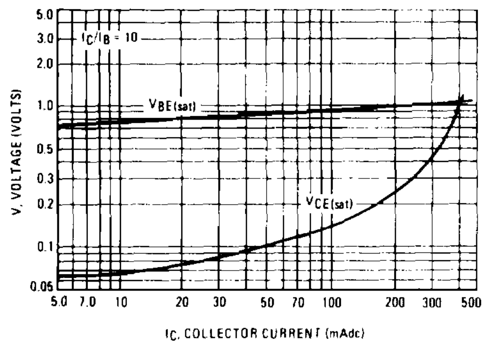

FIGURE 6 – CAPACITANCES versus REVERSE VOLTAGE

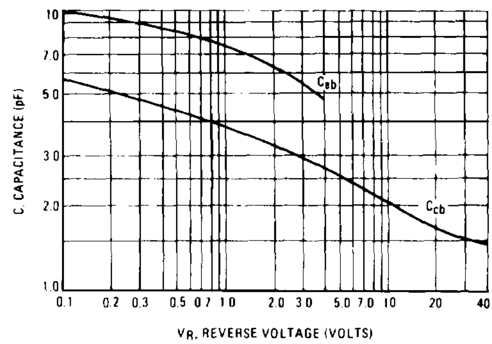

FIGURE 7 – INPUT ADMITTANCE versus FREQUENCY

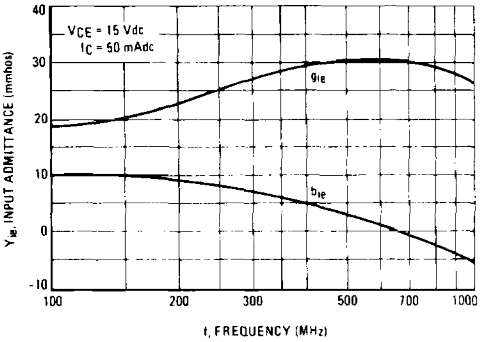

FIGURE 8 – INPUT ADMITTANCE versus COLLECTOR CURRENT

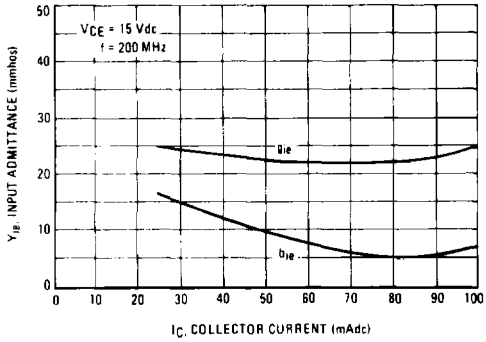

FIGURE 9 – REVERSE TRANSFER ADMITTANCE versus FREQUENCY

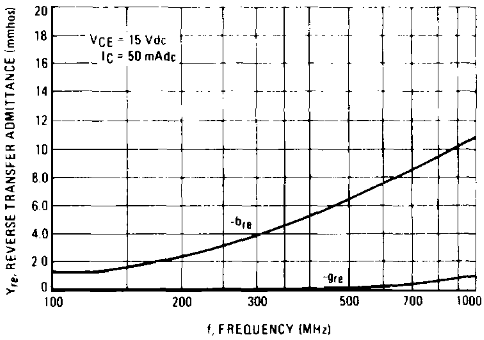

FIGURE 10 – REVERSE TRANSFER ADMITTANCE versus COLLECTOR CURRENT

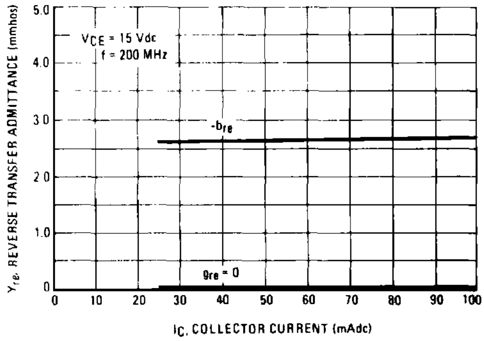

FIGURE 11 – FORWARD TRANSFER ADMITTANCE versus FREQUENCY

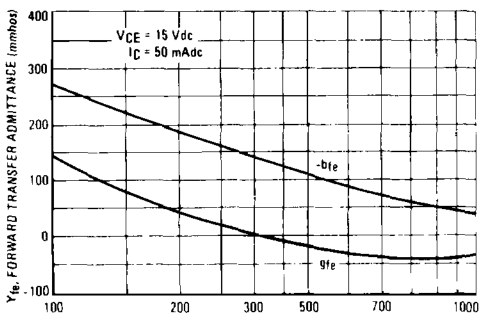

FIGURE 12 – FORWARD TRANSFER ADMITTANCE versus COLLECTOR CURRENT

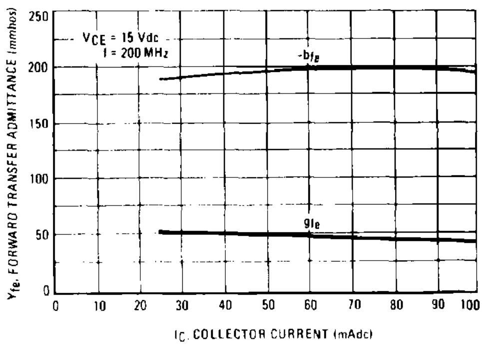

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FIGURE 13 – OUTPUT ADMITTANCE versus FREQUENCY

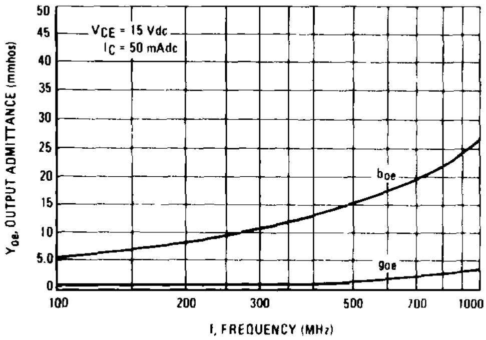

FIGURE 14 – OUTPUT ADMITTANCE versus COLLECTOR CURRENT

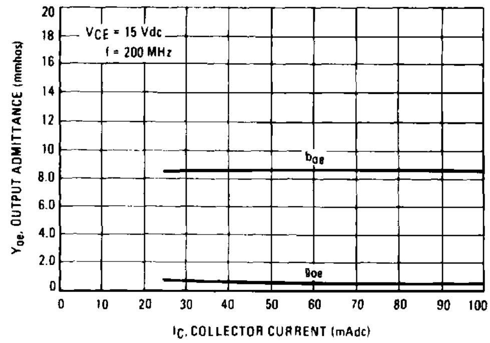

FIGURE 15 – INPUT REFLECTION COEFFICIENT versus FREQUENCY

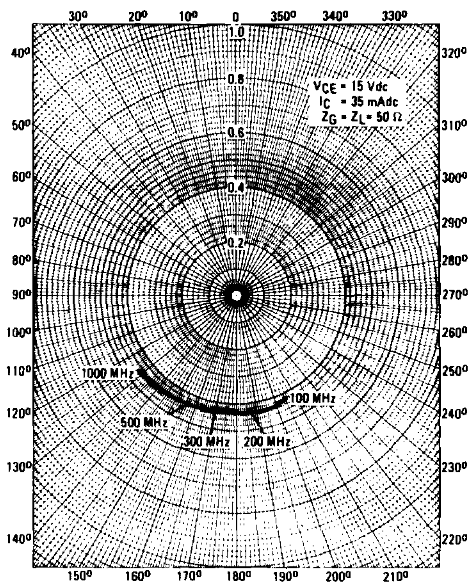

FIGURE 16 – OUTPUT REFLECTION COEFFICIENT versus FREQUENCY

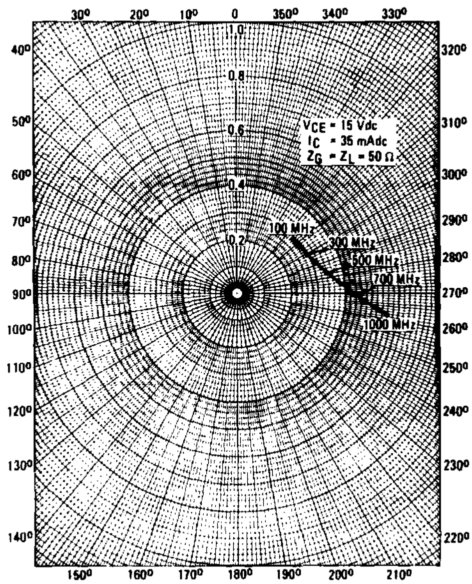

FIGURE 17 – REVERSE TRANSMISSION COEFFICIENT versus FREQUENCY

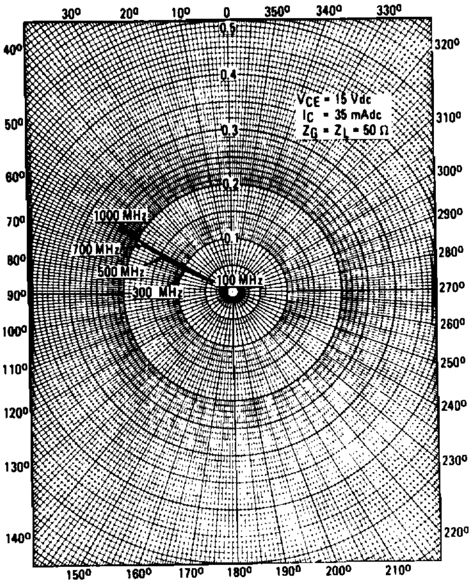

FIGURE 18 – FORWARD TRANSMISSION COEFFICIENT versus FREQUENCY

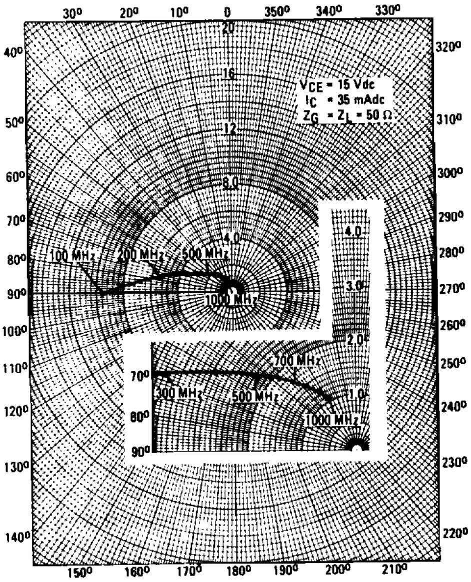

FIGURE 19 – INPUT REFLECTION COEFFICIENT AND OUTPUT REFLECTION COEFFICIENT versus FREQUENCY