MOTOROLA Semiconductors
BOX 20912 • PHOENIX, ARIZONA 85036

2N2857
2N3839

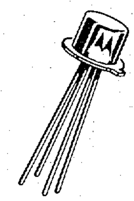
The RF Line

NPN SILICON RF SMALL-SIGNAL TRANSISTORS

NPN SILICON RF SMALL-SIGNAL TRANSISTORS

. . . designed primarily for use in high-gain, low-noise amplifier, oscillator, and mixer applications. Can also be used in UHF converter applications.

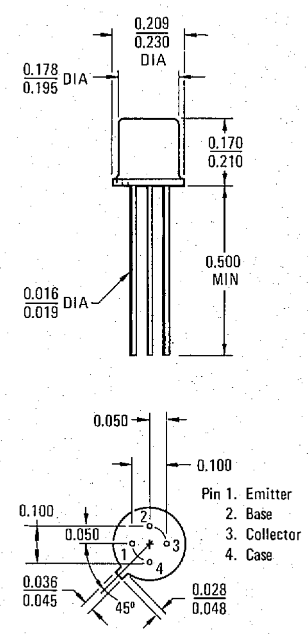
- High Current-Gain—Bandwidth Product — f_T = 1.6 GHz (Typ) @ I_C = 8.0 mAdc
- Low Noise Figure — NF = 3.9 dB (Max) @ f = 450 MHz — 2N3839
- Low Collector-Base Time Constant — $r_b{}'C_c$ = 15 ps (Max) @ I_E = 2.0 mAdc
- Characterized with Scattering Parameters
- Ideal for Micro-Power Applications



*MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CB}	30	Vdc
Emitter-Base Voltage	V_{EB}	2.5	Vdc
Collector Current — Continuous	I_C	40	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	200 1.14	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	300 1.72	mW mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

*Indicates JEDEC Registered Data.



CASE 20 (10)
TO-72 PACKAGE

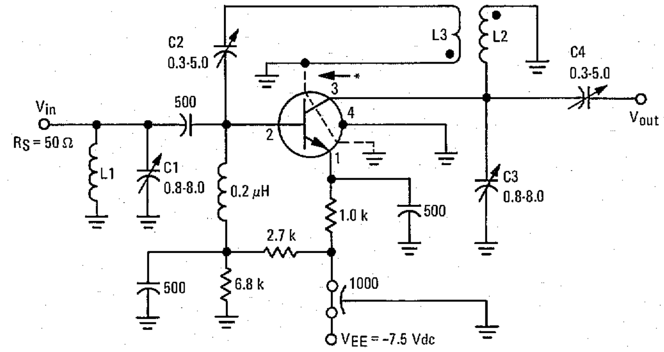
Active Elements Isolated from Case

*ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage** (I_C = 3.0 mAdc, I_B = 0)	BV_{CEO}	15	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 1.0 μAdc, I_E = 0)	BV_{CBO}	30	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	BV_{EBO}	2.5	–	–	Vdc
Collector Cutoff Current	I_{CBO}				μAdc
(V_{CB} = 15 Vdc, I_E = 0) Both Types		–	–	0.01	
(V_{CB} = 15 Vdc, I_E = 0, T_A = 150°C) 2N3839		–	–	1.0	
ON CHARACTERISTICS					
DC Current Gain (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc)	h_{FE}	30	–	150	–
DYNAMIC CHARACTERISTICS					
Current-Gain—Bandwidth Product ① (I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 100 MHz) 2N2857	f_T	1000	–	1900	MHz
2N3839		1000	–	2000	
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 to 1.0 MHz)	C_{cb}	–	0.7	1.0	pF
Small-Signal Current Gain (I_C = 2.0 mAdc, V_{CE} = 6.0 Vdc, f = 1.0 kHz)	h_{fe}	50	–	220	–
Collector-Base Time Constant (I_E = 2.0 mAdc, V_{CB} = 6.0 Vdc, f = 31.9 MHz) 2N2857	$r_b'C_c$	4.0	–	15	ps
2N3839		1.0	–	15	
Noise Figure (Figure 1)	NF				dB
(I_E = 0.1 mAdc, V_{CE} = 1.0 Vdc, R_S = 50 ohms, f = 450 MHz) ② Both Types		–	5.8	–	
(I_C = 1.5 mAdc, V_{CE} = 6.0 Vdc, R_S = 50 ohms, f = 450 MHz) 2N2857		–	4.1	4.5	
2N3839		–	–	3.9	
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain (Figure 1)	G_{pe}				dB
(I_E = 0.1 mAdc, V_{CE} = 1.0 Vdc, f = 450 MHz) ②		–	11	–	
(I_C = 1.5 mAdc, V_{CE} = 6.0 Vdc, f = 450 MHz)		12.5	–	19	
Power Output (Figure 2) (I_E = 12 mAdc, V_{CB} = 10 Vdc, f = 500 MHz)	P_{out}	30	–	–	mW

*Indicates JEDEC Registered Data.
**Motorola guarantees this data in addition to JEDEC Registered Data.
① f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.
② Micro-Power Specifications.

FIGURE 1 – TEST CIRCUIT FOR NOISE FIGURE AND POWER GAIN



Capacitance values in pF

L1, L2 – Silver-plated brass rod, 1-1/2" long and 1/4" dia. Install at least 1/2" from nearest vertical chassis surface.

L3 – 1/2 turn #16 AWG wire, located 1/4" from and parallel to L2.

* – External interlead shield to isolate collector lead from emitter and base leads.

Neutralization Procedure:

(A) Connect 450-MHz signal generator (with $R_S = 50$ ohms) to input terminals of amplifier.

(B) Connect 50-ohm RF voltmeter across output terminals of amplifier.

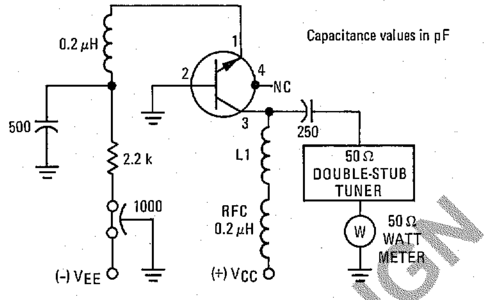
(C) Apply V_{EE}, and with signal generator adjusted for 5 mV output from amplifier, tune C1, C3, and C4 for maximum output.

(D) Interchange connections to signal generator and RF voltmeter.

(E) With sufficient signal applied to output terminals of amplifier, adjust C2 for minimum indication at input.

(F) Repeat steps (A), (B), and (C) to determine if retuning is necessary.

FIGURE 2 – TEST CIRCUIT FOR OSCILLATOR POWER OUTPUT



L1 – 3 turns #16 AWG wire, 3/8" O.D. 1-1/4" long.

FIGURE 3 – NOISE FIGURE versus FREQUENCY

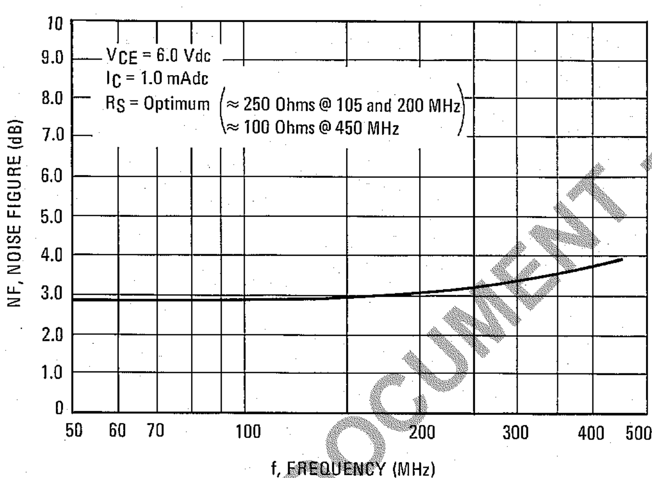


FIGURE 4 – NOISE FIGURE versus SOURCE RESISTANCE AND COLLECTOR CURRENT

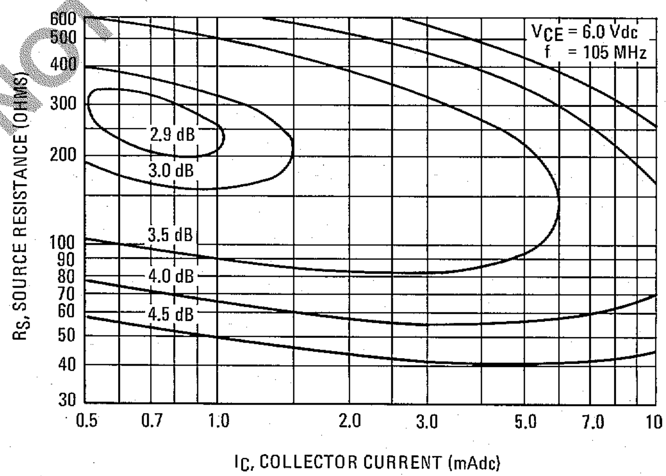


FIGURE 5 – NOISE FIGURE versus SOURCE RESISTANCE AND COLLECTOR CURRENT

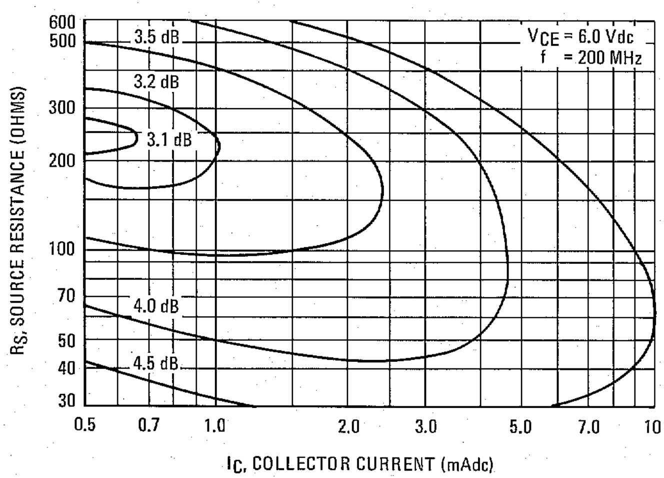


FIGURE 6 — CURRENT-GAIN—BANDWIDTH PRODUCT

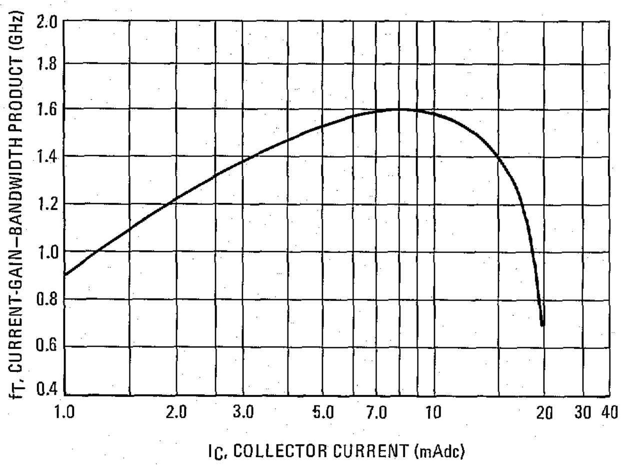


FIGURE 7 — NOISE FIGURE AND POWER GAIN versus COLLECTOR CURRENT

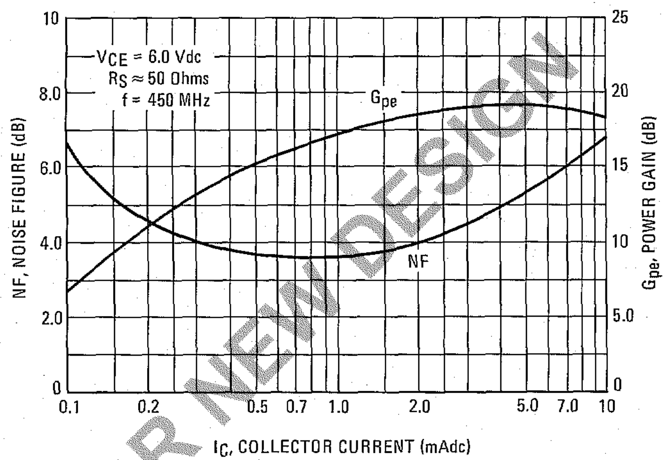


FIGURE 8 — INPUT ADMITTANCE versus FREQUENCY

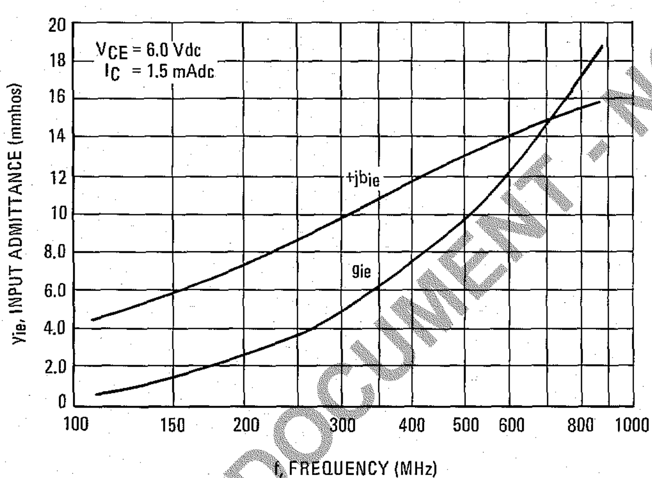


FIGURE 9 — OUTPUT ADMITTANCE versus FREQUENCY

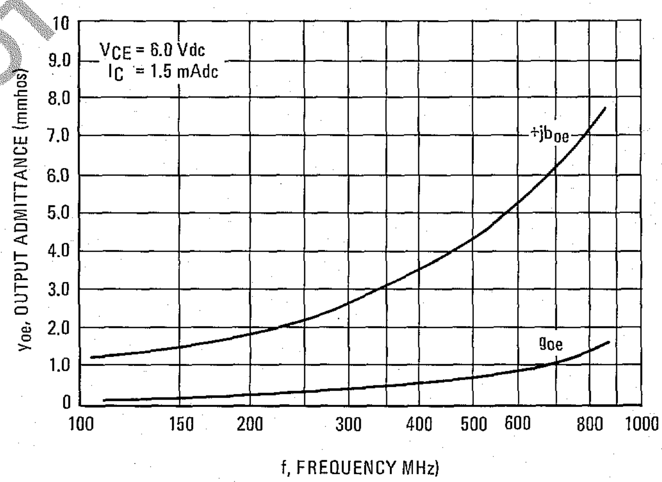


FIGURE 10 — FORWARD TRANSFER ADMITTANCE versus FREQUENCY

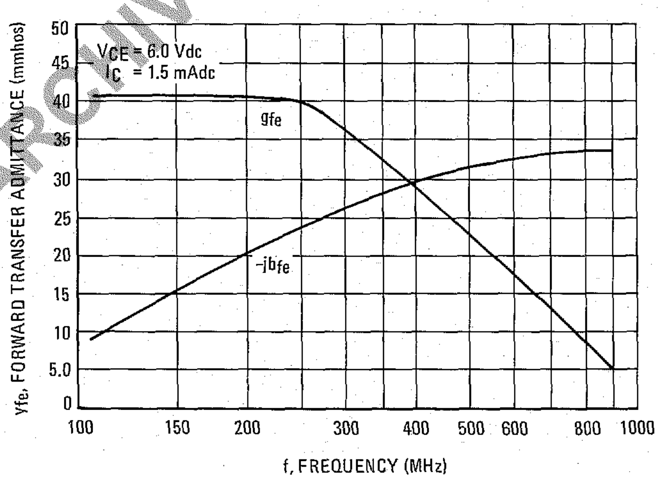


FIGURE 11 — REVERSE TRANSFER ADMITTANCE versus FREQUENCY

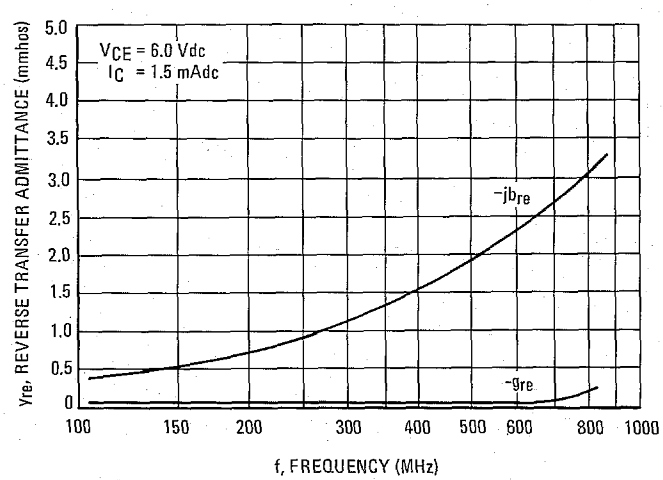


FIGURE 12 — S_{11}, INPUT REFLECTION COEFFICIENT

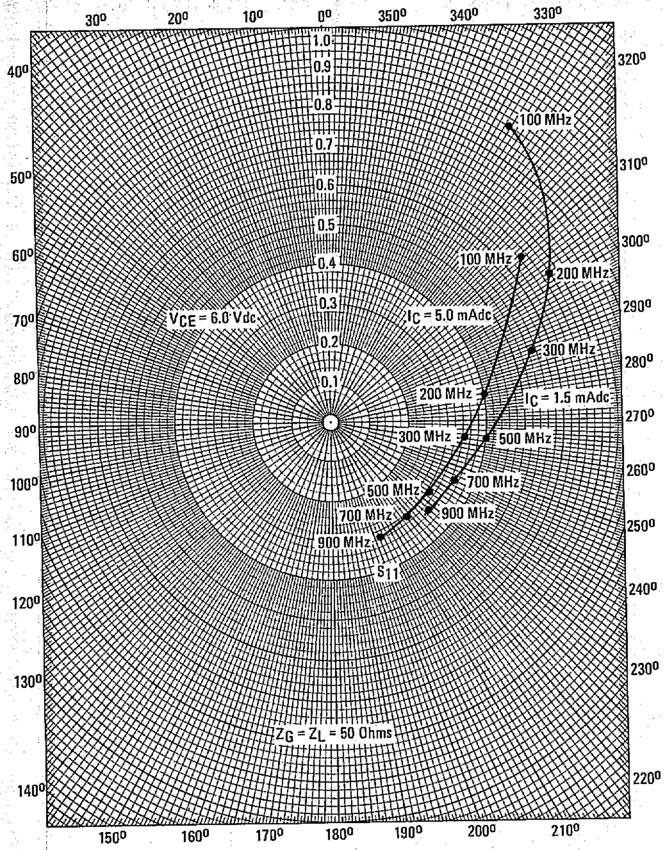


FIGURE 13 — S_{22}, OUTPUT REFLECTION COEFFICIENT

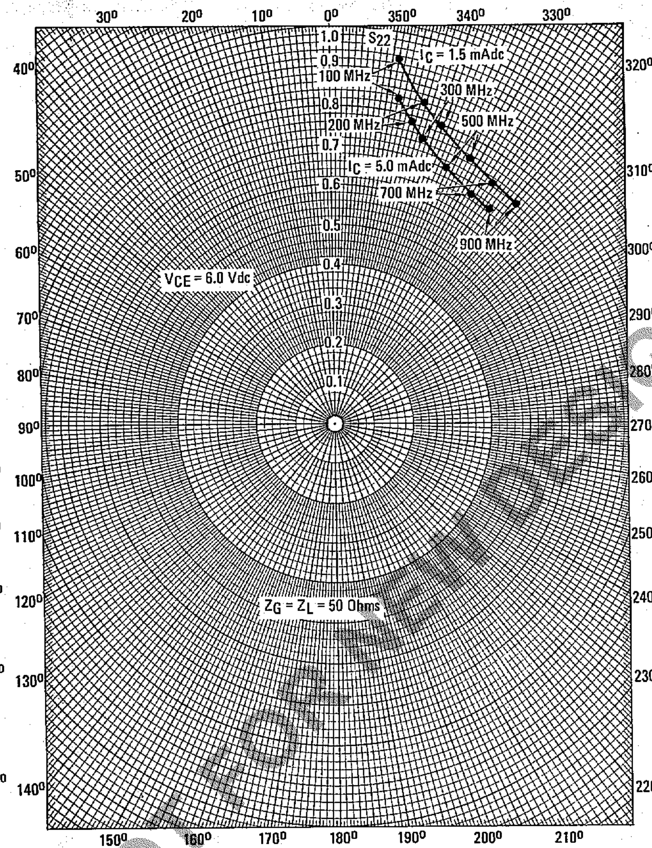


FIGURE 14 — S_{12}, REVERSE TRANSMISSION COEFFICIENT

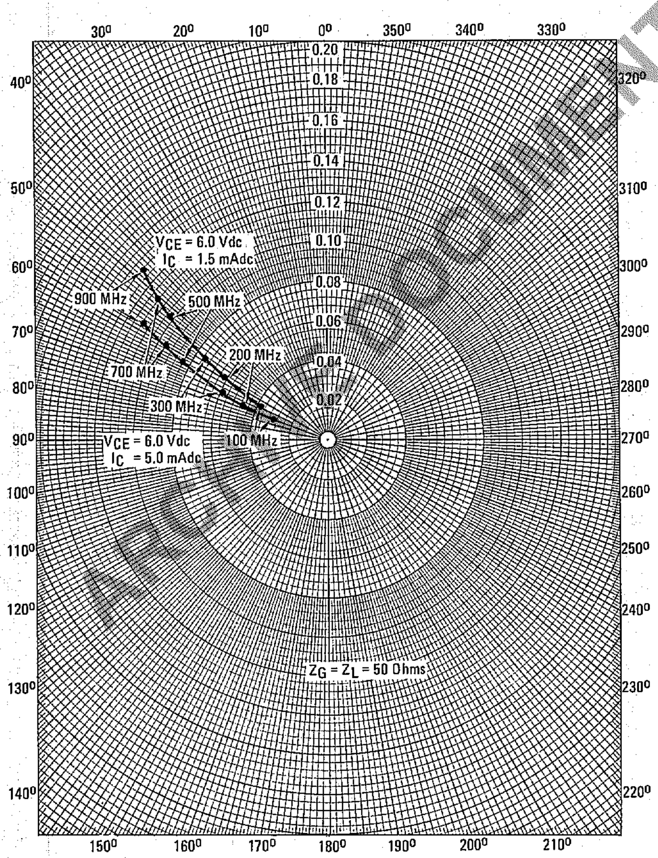


FIGURE 15 — S_{21}, FORWARD TRANSMISSION COEFFICIENT

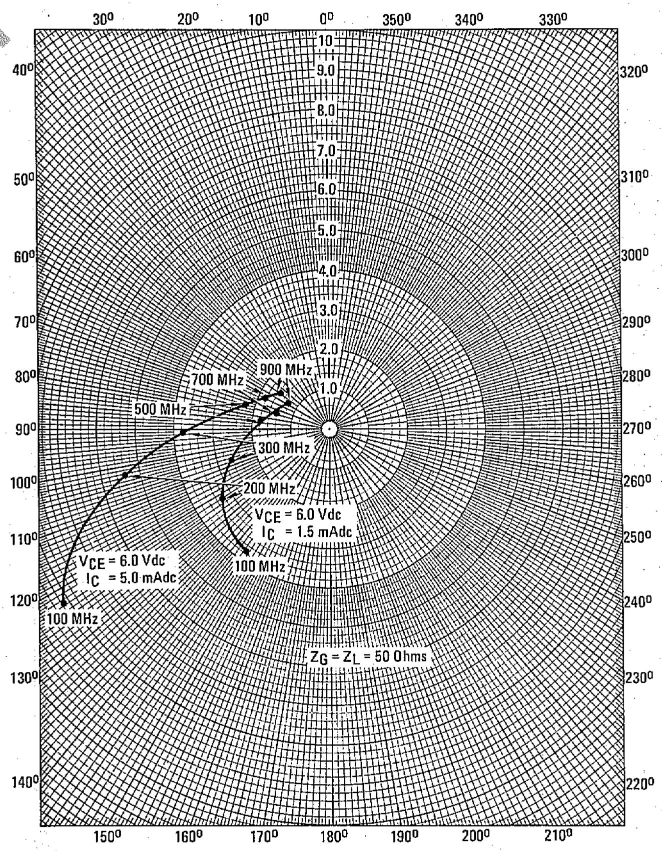
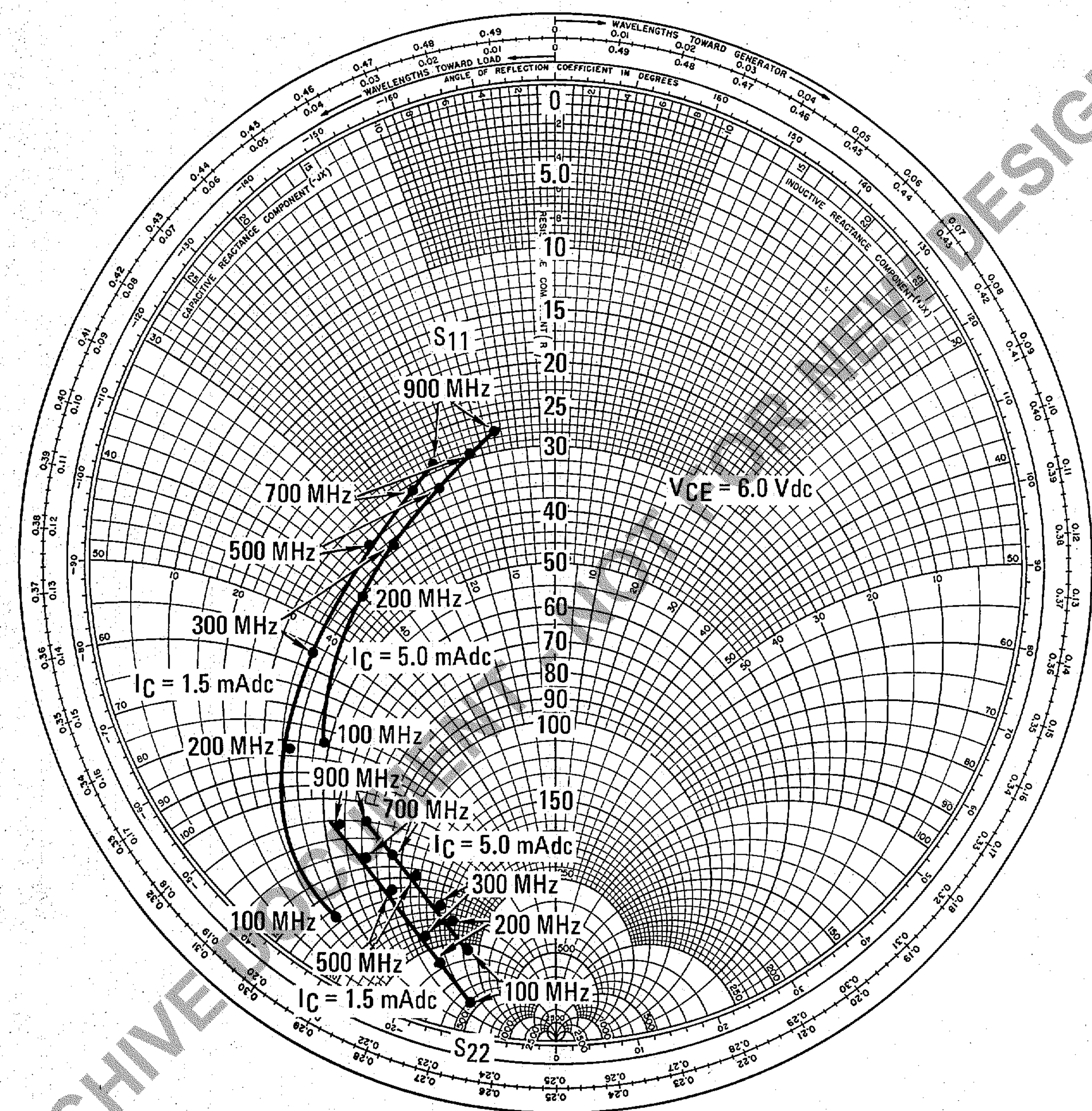


FIGURE 16 – S_{11}, INPUT REFLECTION COEFFICIENT AND S_{22}, OUTPUT REFLECTION COEFFICIENT



MOTOROLA Semiconductor Products Inc.

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