2N4957
2N4958
2N4959

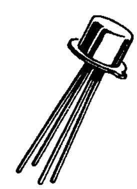
The RF Line

PNP SILICON HIGH FREQUENCY TRANSISTORS

... designed for high-gain, low-noise amplifier, oscillator and mixer applications.

- Low Noise Figure @ 450 MHz —
  NF = 3.0 dB (Max) — 2N4957
  = 3.3 dB (Max) — 2N4958
  = 3.8 dB (Max) — 2N4959
- High Power Gain @ 450 MHz —
  G_{pe} = 17 dB (Min) — 2N4957
  = 16 dB (Min) — 2N4958
  = 15 dB (Min) — 2N4959
- High Current-Gain — Bandwidth Product —
  f_T = 1.2 GHz (Min) @ I_E = −2.0 mAdc — 2N4957
  = 1.0 GHz (Min) @ I_E = −2.0 mAdc — 2N4958, 2N4959

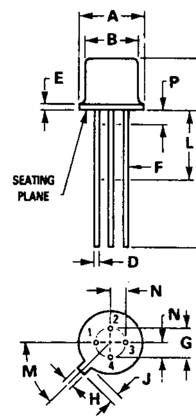
I_C = −30 mA
HIGH FREQUENCY TRANSISTORS
PNP SILICON



***MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	−30	Vdc
Collector-Base Voltage	V_{CBO}	−30	Vdc
Emitter-Base Voltage	V_{EBO}	−3.0	Vdc
Collector Current — Continuous	I_C	−30	mAdc
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	200 1.14	mW mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

*Indicates JEDEC Registered Data.



STYLE 10:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
4. CASE

NOTE: ALL RULES AND NOTES ASSOCIATED WITH TO-72 OUTLINE SHALL APPLY.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.31	5.84	0.209	0.230
B	4.52	4.95	0.178	0.195
C	4.32	5.33	0.170	0.210
D	0.41	0.53	0.016	0.021
E	—	0.76	—	0.030
F	0.41	0.48	0.016	0.019
G	2.54 BSC		0.100 BSC	
H	0.91	1.17	0.036	0.046
J	0.71	1.22	0.028	0.048
K	12.70	—	0.500	—
L	6.35	—	0.250	—
M	45° BSC		45° BSC	
N	1.27 BSC		0.050 BSC	
P	—	1.27	—	0.050

**CASE 20-03
TO-206AF
(TO-72)**

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = −1.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	−30	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = −100 μAdc, I_E = 0)	$V_{(BR)CBO}$	−30	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = −100 μAdc, I_C = 0)	$V_{(BR)EBO}$	−3.0	—	—	Vdc
Collector Cutoff Current	I_{CBO}				μAdc
(V_{CB} = −10 Vdc, I_E = 0)		—	—	−0.1	
(V_{CB} = −10 Vdc, I_E = 0, T_A = 150°C)		—	—	−100	
ON CHARACTERISTICS					
DC Current Gain (I_C = −2.0 mAdc, V_{CE} = −10 Vdc)	h_{FE}	20	40	150	—
DYNAMIC CHARACTERISTICS					
Current-Gain — Bandwidth Product (1)	f_T				MHz
(I_E = −2.0 mAdc, V_{CE} = −10 Vdc, f = 100 MHz) 2N4957		1200	1600	2500	
2N4958, 2N4959		1000	1500	2500	
Collector-Base Capacitance (V_{CB} = −10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	—	0.4	0.8	pF
Small-Signal Current Gain (I_C = −2.0 mAdc, V_{CE} = −10 Vdc, f = 1.0 kHz)	h_{fe}	20	—	200	—
Collector-Base Time Constant (I_E = −2.0 mAdc, V_{CB} = −10 Vdc, f = 63.6 MHz)	$r_b'C_c$	1.0	—	8.0	ps
Noise Figure	NF				dB
(I_C = −2.0 mAdc, V_{CE} = −10 Vdc, f = 450 MHz) 2N4957		—	2.6	3.0	
2N4958		—	2.9	3.3	
2N4959		—	3.2	3.8	
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain	G_{pe}				dB
(V_{CE} = −10 Vdc, I_C = −2.0 mAdc, f = 450 MHz) 2N4957		17	—	25	
2N4958		16	—	25	
2N4959		15	—	25	

*Indicates JEDEC Registered Data.

(1) f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

FIGURE 1 — NOISE FIGURE AND POWER GAIN TEST CIRCUIT

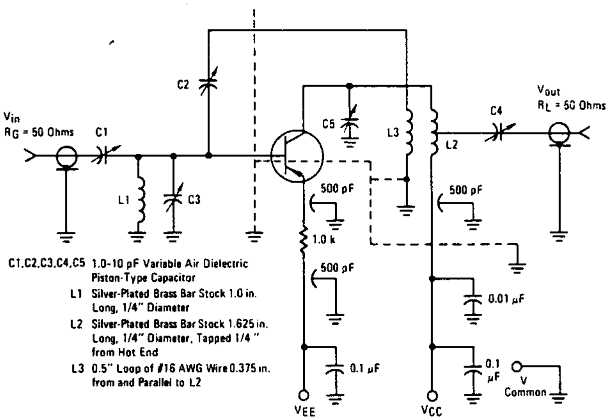


FIGURE 2 — UNILATERALIZED POWER GAIN versus FREQUENCY

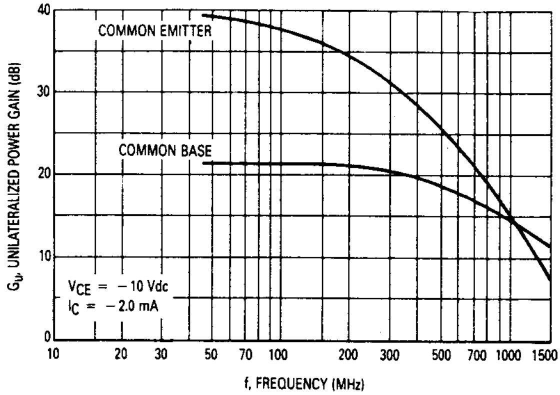


FIGURE 3 — NOISE FIGURE versus FREQUENCY

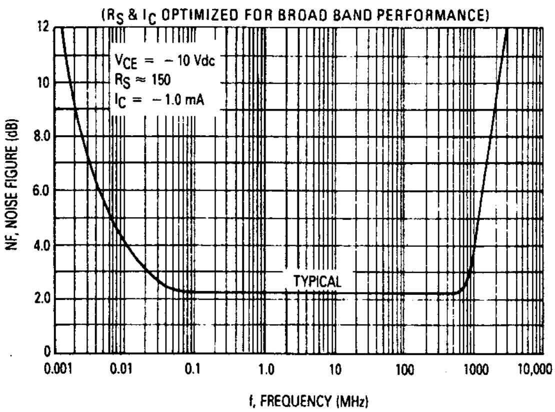


FIGURE 4 — NOISE FIGURE AND POWER GAIN versus COLLECTOR CURRENT

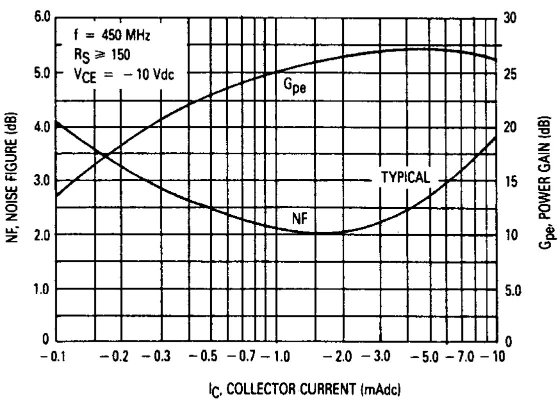


FIGURE 5 — CONTOURS OF NOISE FIGURE versus SOURCE RESISTANCE AND COLLECTOR CURRENT

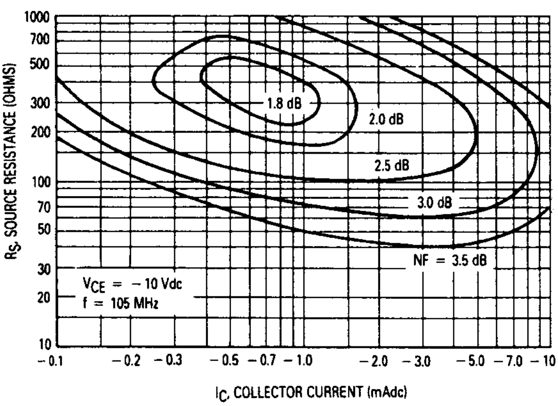
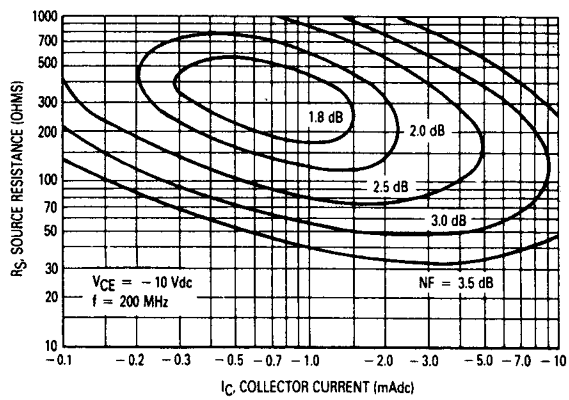


FIGURE 6 — CONTOURS OF NOISE FIGURE versus SOURCE RESISTANCE AND COLLECTOR CURRENT



COMMON EMITTER CIRCUIT DESIGN DATA

V_{CE} = −10 Vdc I_C = −2.0 mA

FIGURE 7 – TRANSDUCER GAIN versus FREQUENCY

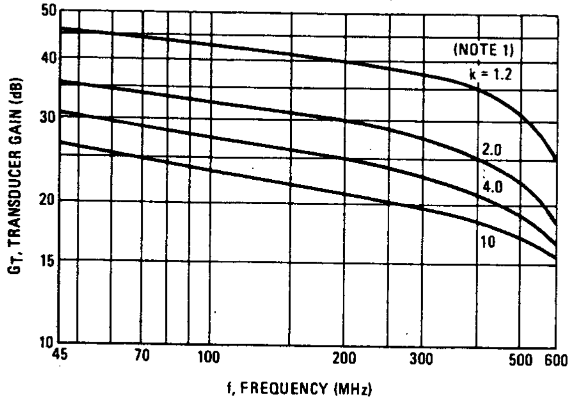


FIGURE 8 – LINVILL STABILITY FACTOR versus FREQUENCY

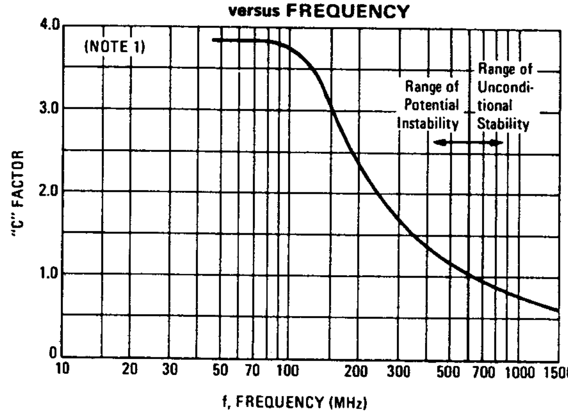


FIGURE 9 – LOAD ADMITTANCE versus FREQUENCY (REAL)

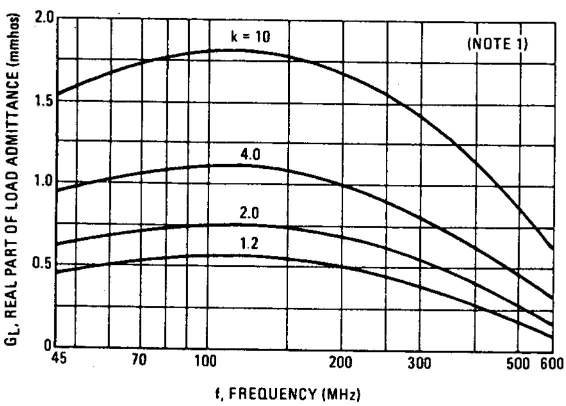


FIGURE 10 – LOAD ADMITTANCE versus FREQUENCY (IMAGINARY)

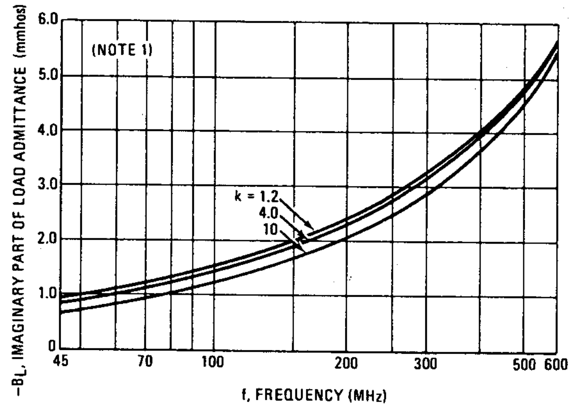


FIGURE 11 – SOURCE ADMITTANCE versus FREQUENCY (REAL)

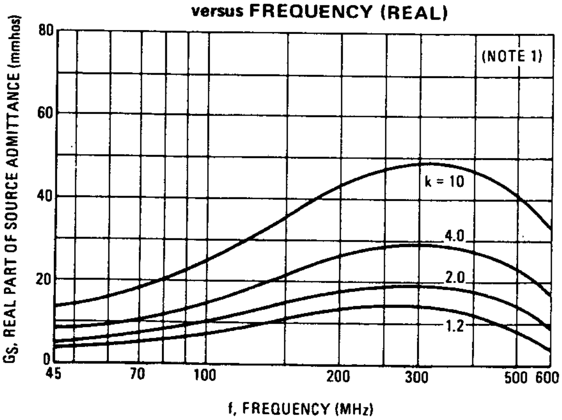
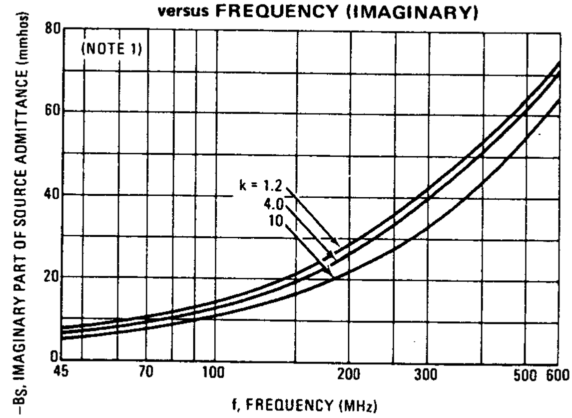


FIGURE 12 – SOURCE ADMITTANCE versus FREQUENCY (IMAGINARY)



NOTE 1

Figures 7 through 18 are included to assist the circuit designer in determining the stability of his particular circuit. Two stability criteria are given in these figures.

The Linvill "C" factor* is a measure of transistor stability when the input and output are terminated in the worst-case (open circuit) condition. When "C" is less than 1.0, the circuit is unconditionally stable. When "C" is greater than 1.0, the circuit is potentially unstable.

The Stern "K" factor† has been defined to determine the stability of a practical amplifier terminated in finite load and source admittances. If "K" is greater than 1.0, the circuit will be stable. If less than 1.0, the circuit will be unstable. For further details, see Application Note AN-215A

* "Transistors and Active Circuits," Linvill and Gibbons, McGraw-Hill, 1961.

† "Stability and Power Gain of Tuned Transistor Amplifiers," Arthur P. Stern, Proc. I.R.E., March 1967.

COMMON BASE CIRCUIT DESIGN DATA

V_{CE} = −10 Vdc I_C = −2.0 mA

FIGURE 13 – TRANSDUCER GAIN versus FREQUENCY

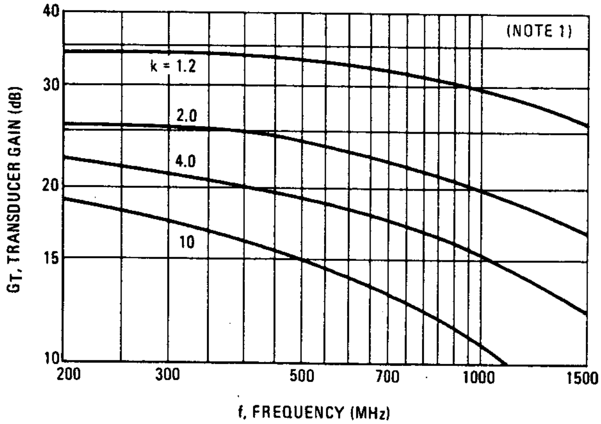


FIGURE 14 – LINVILL STABILITY FACTOR versus FREQUENCY

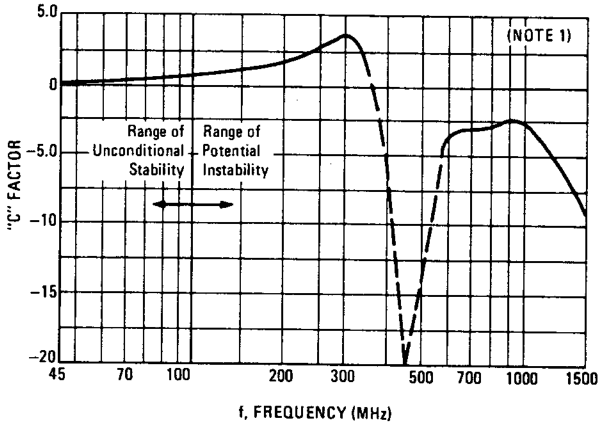


FIGURE 15 – LOAD ADMITTANCE versus FREQUENCY (REAL)

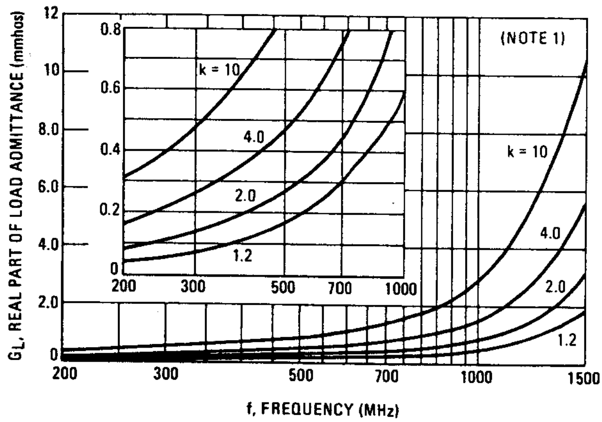


FIGURE 16 – LOAD ADMITTANCE versus FREQUENCY (IMAGINARY)

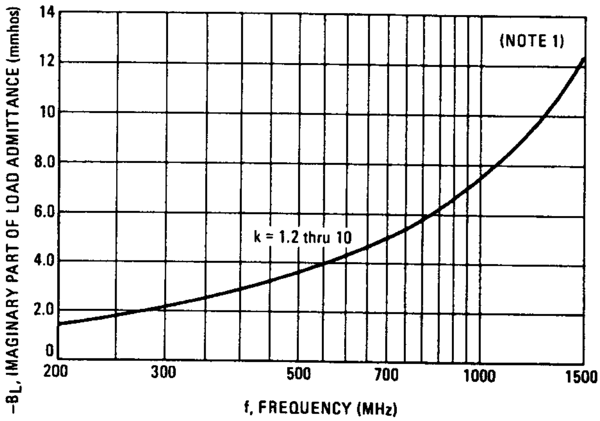


FIGURE 17 – SOURCE ADMITTANCE versus FREQUENCY (REAL)

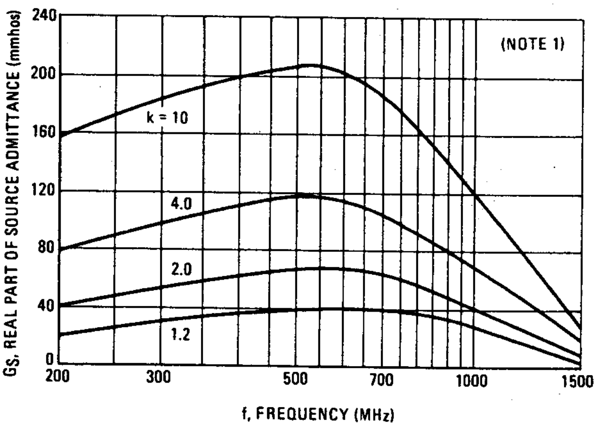
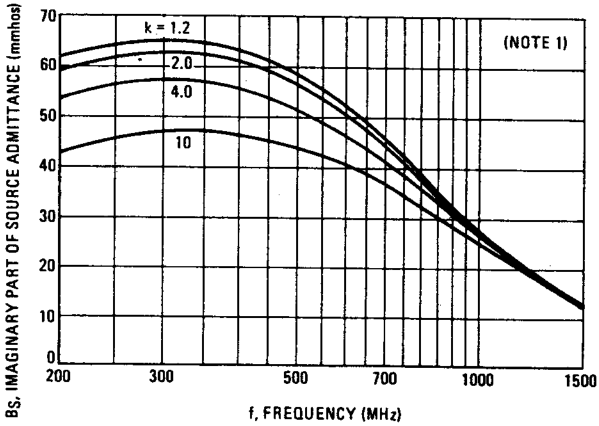


FIGURE 18 – SOURCE ADMITTANCE versus FREQUENCY (IMAGINARY)



2N4957, 2N4958, 2N4959

FIGURE 19 — SMALL-SIGNAL CURRENT GAIN versus FREQUENCY

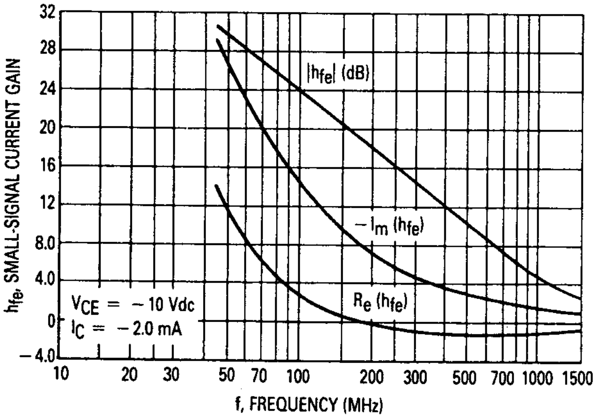


FIGURE 20 — POLAR h_{fe}

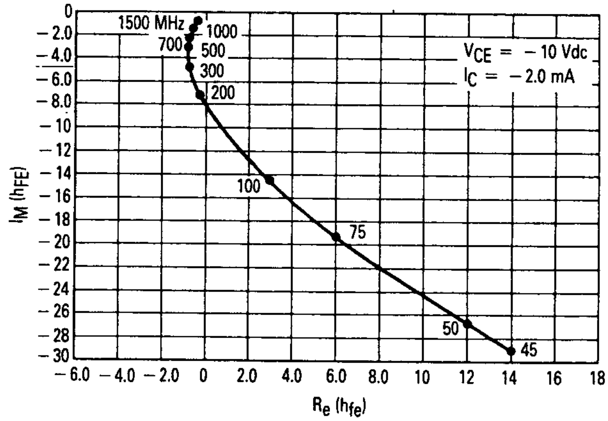


FIGURE 21 — f_T versus COLLECTOR CURRENT

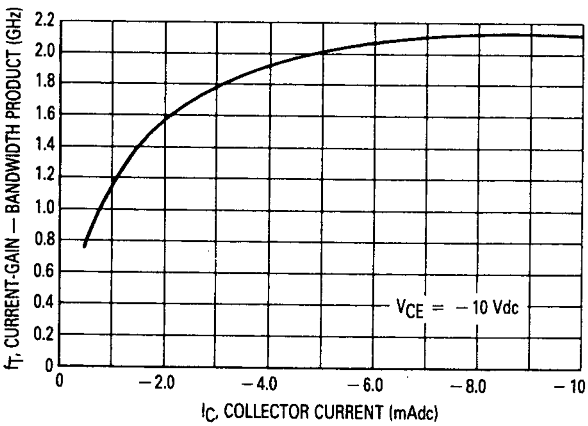


FIGURE 22 — DC CURRENT GAIN

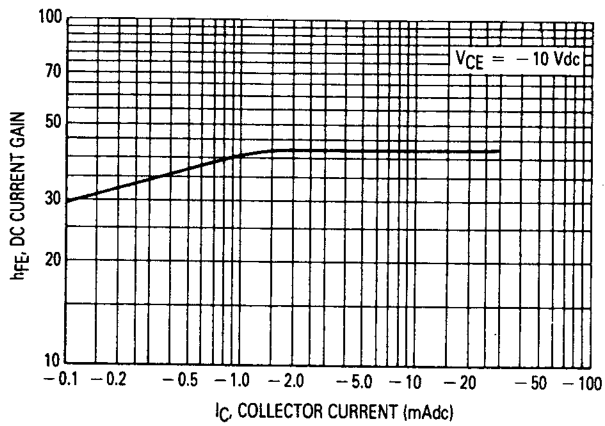


FIGURE 23 — CAPACITANCE

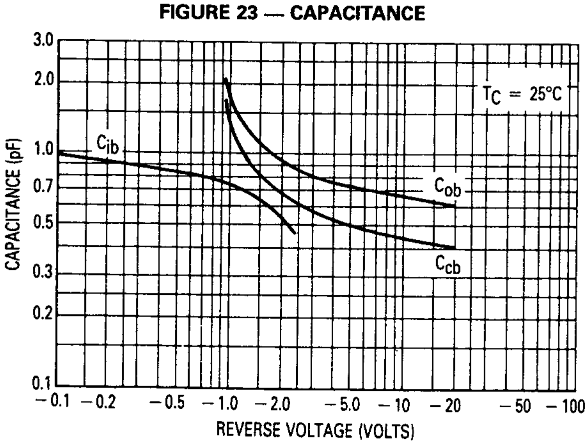
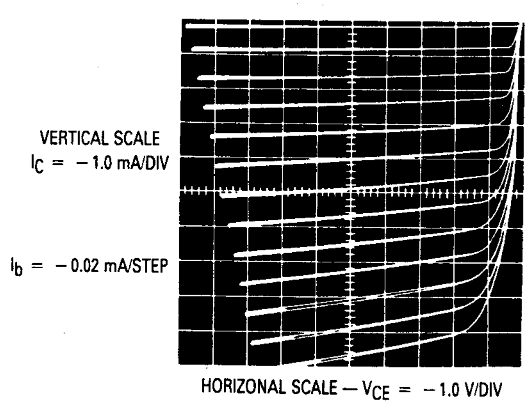
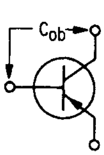
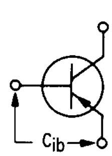


FIGURE 24 — COLLECTOR CHARACTERISTICS

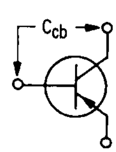




Apply reverse bias between collector and base and measure capacitance between these terminals. Emitter is open.



Apply reverse bias between emitter and base and measure capacitance between these terminals. Collector is open.



Apply reverse bias between collector and base and measure capacitance between these terminals. Emitter is guarded.

Y PARAMETERS versus CURRENT
(f = 450 MHz)

COMMON BASE

V_{CB} = −10 Vdc ——— V_{CB} = −15 Vdc - - -

COMMON EMITTER

V_{CE} = −10 Vdc ——— V_{CE} = −15 Vdc - - -

FIGURE 25 – INPUT ADMITTANCE

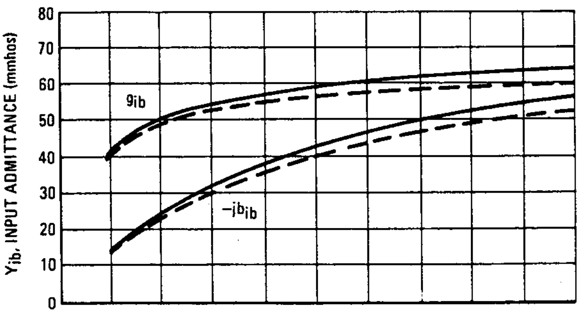


FIGURE 26 – INPUT ADMITTANCE

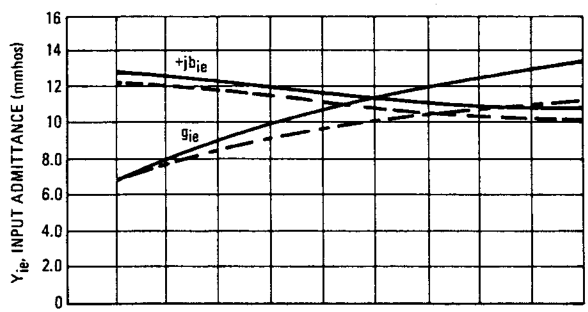


FIGURE 27 – FORWARD TRANSFER ADMITTANCE

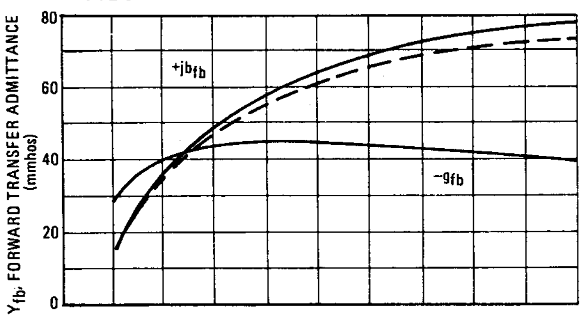


FIGURE 28 – FORWARD TRANSFER ADMITTANCE

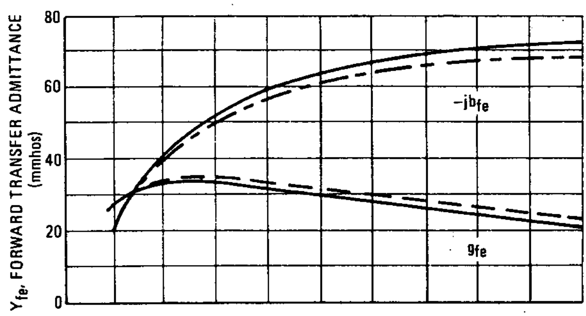


FIGURE 29 – OUTPUT ADMITTANCE

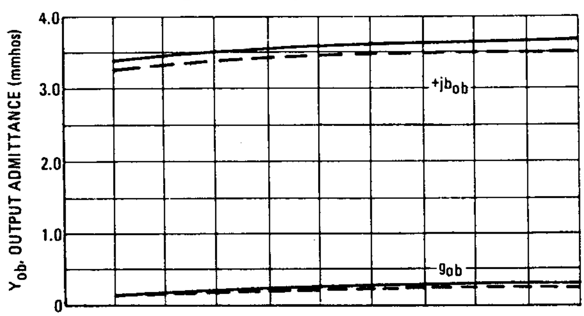


FIGURE 30 – OUTPUT ADMITTANCE

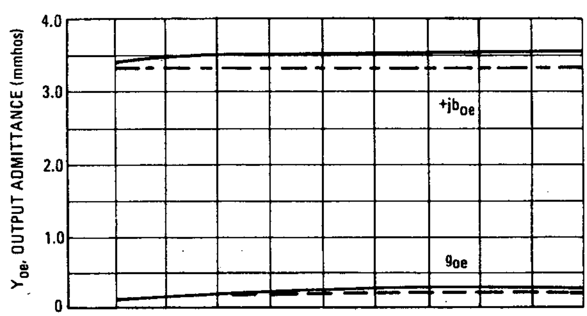


FIGURE 31 – REVERSE TRANSFER ADMITTANCE

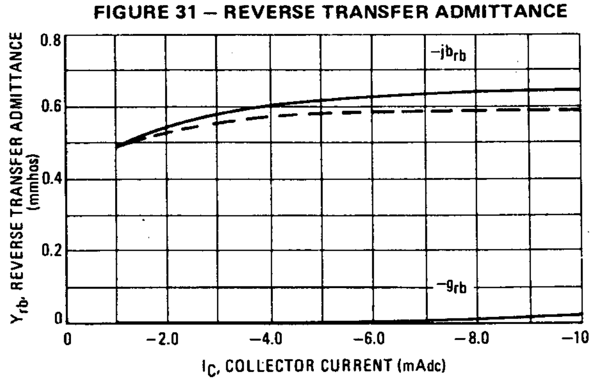
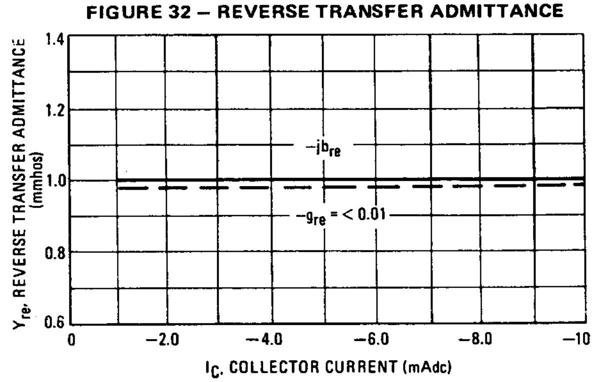


FIGURE 32 – REVERSE TRANSFER ADMITTANCE



COMMON BASE y PARAMETER VARIATIONS

(V_{CB} = −10 Vdc, I_C = −2.0 mAdc)

y PARAMETERS versus FREQUENCY

FIGURE 33 – y_{ib} INPUT ADMITTANCE

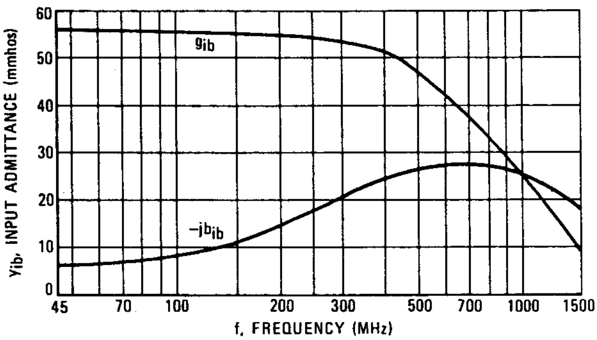


FIGURE 35 – y_{fb} FORWARD TRANSFER ADMITTANCE

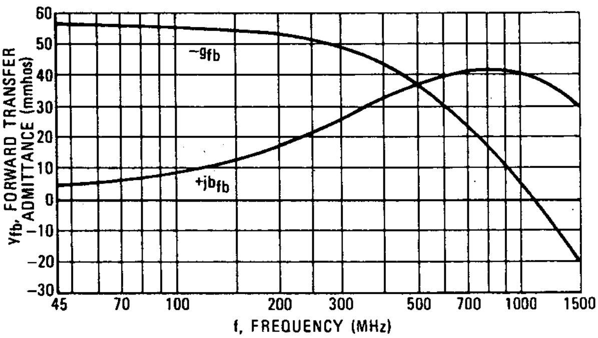


FIGURE 37 – y_{ob} OUTPUT ADMITTANCE

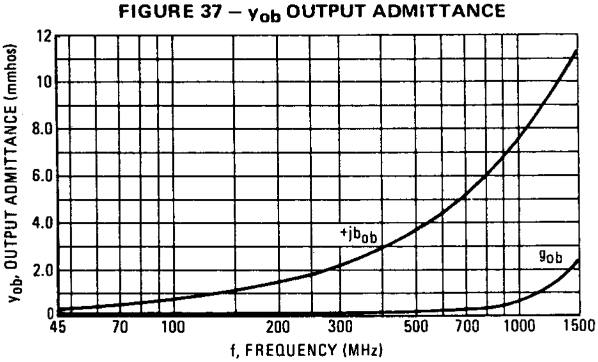
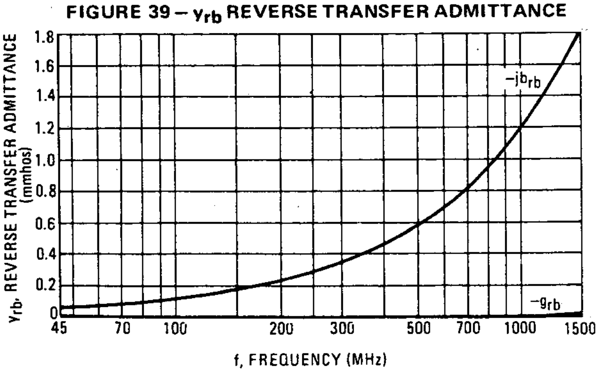


FIGURE 39 – y_{rb} REVERSE TRANSFER ADMITTANCE



POLAR y PARAMETERS versus FREQUENCY

FIGURE 34 – y_{ib} INPUT ADMITTANCE

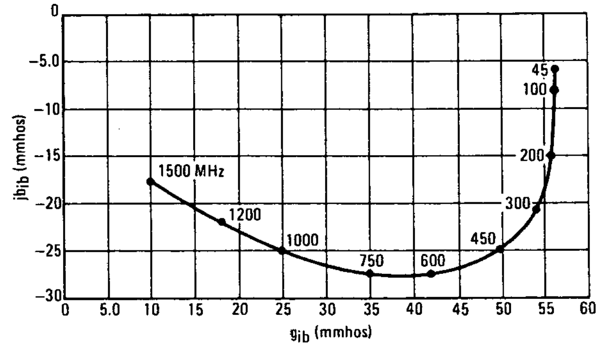


FIGURE 36 – y_{fb} FORWARD TRANSFER ADMITTANCE

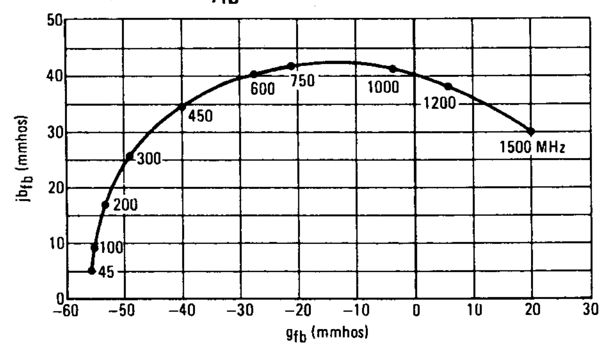


FIGURE 38 – y_{ob} OUTPUT ADMITTANCE

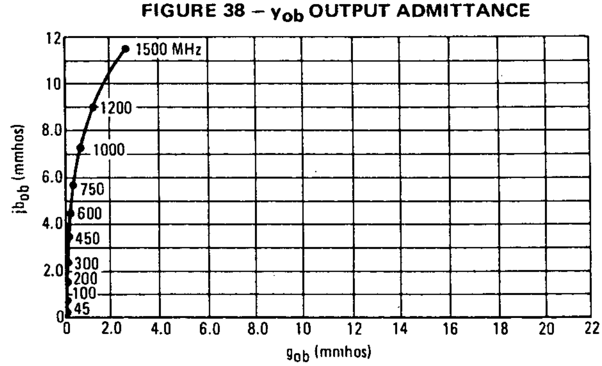
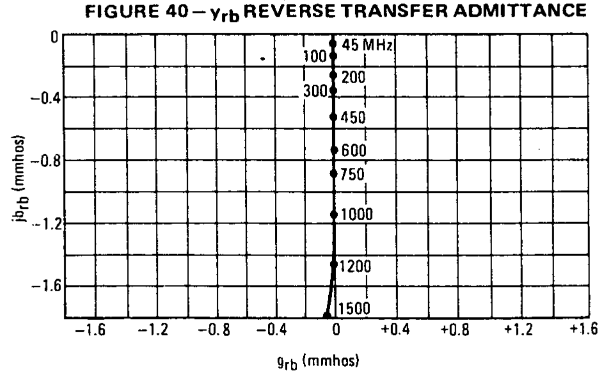


FIGURE 40 – y_{rb} REVERSE TRANSFER ADMITTANCE



COMMON EMITTER y PARAMETER VARIATIONS

(V_{CE} = −10 Vdc, I_C = −2.0 mAdc)

y PARAMETERS versus FREQUENCY

FIGURE 41 – y_{ie} INPUT ADMITTANCE

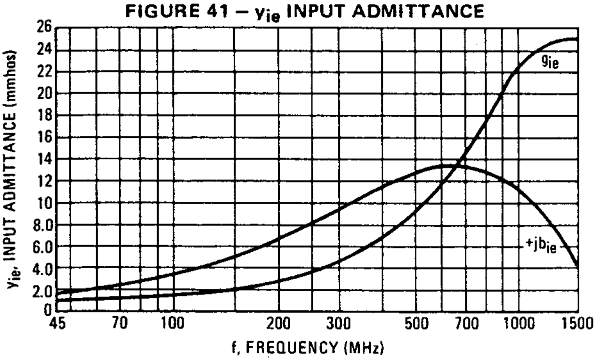


FIGURE 43 – y_{fe} FORWARD TRANSFER ADMITTANCE

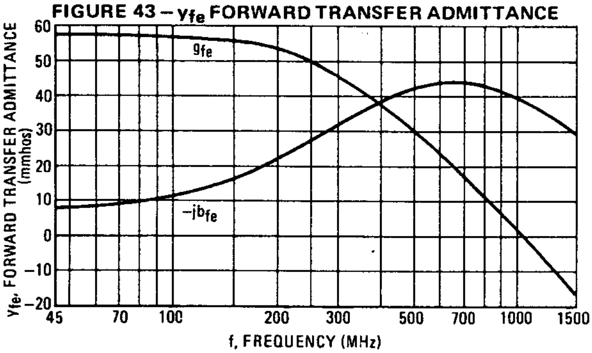


FIGURE 45 – y_{oe} OUTPUT ADMITTANCE

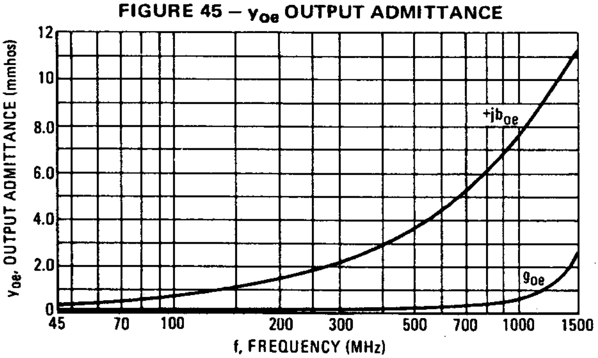
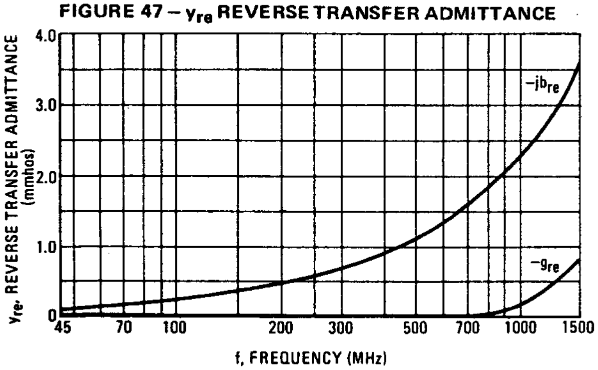


FIGURE 47 – y_{re} REVERSE TRANSFER ADMITTANCE



POLAR y PARAMETERS versus FREQUENCY

FIGURE 42 – y_{ie} INPUT ADMITTANCE

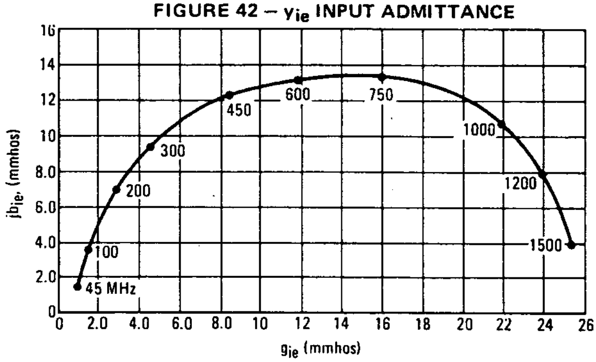


FIGURE 44 – y_{fe} FORWARD TRANSFER ADMITTANCE

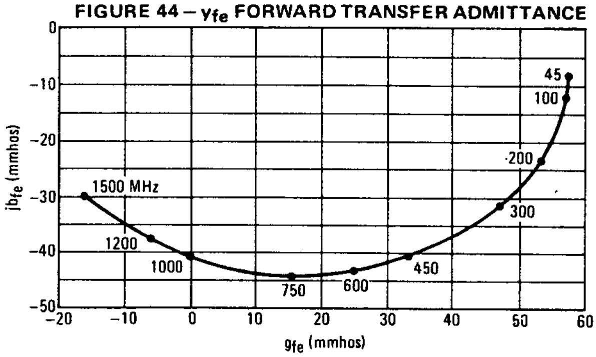


FIGURE 46 – y_{oe} OUTPUT ADMITTANCE

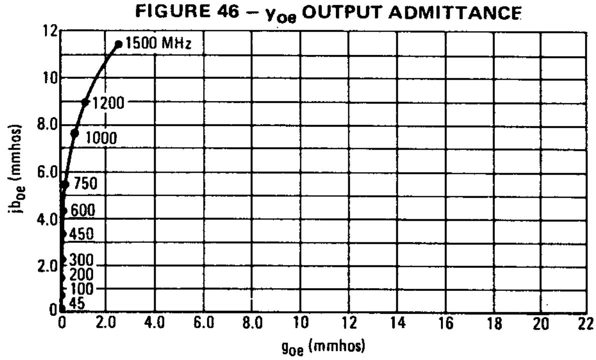


FIGURE 48 – y_{re} REVERSE TRANSFER ADMITTANCE