RCA VHF TRANSISTORS

General-Purpose Types for RF and IF Applications

2N5181
2N5182

RCA-2N5181 and 2N5182* are high-frequency general-purpose transistors of the silicon n-p-n type. They are intended primarily for use in rf and if amplifier circuits at frequencies up to 250MHz.

These types feature a New Terminal Arrangement in which the emitter and base connections are interchangd to provide maximum isolation between the output (collector) and the input (base) terminals. Although this new basing configuration does not appreciably change the measured device feedback capacitance, it permits the use of external inter-terminal shields to reduce feedback due to external capacitances, particularly on printed circuit boards. This feature makes it possible to achieve greater circuit stability or higher useable gain per stage in critical circuit designs.

The 2N5181 and 2N5182 also feature very low feedback capacitance, low noise, high useful power gains in their recommended applications, and a high-temperature capability permitting operation up to 175°C.

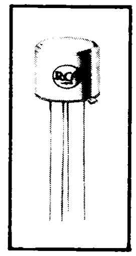
RCA-2N5181 and 2N5182 utilize a hermetically sealed JEDEC TO-104 metal package in which the case is electrically isolated from the transistor electrodes. The case is provided with a separate lead which may be grounded to minimize collector-to-base interlead capacitance and coupling to other circuit components.

* Formerly Dev. Nos. TA7304 and TA7305 respectively.

Absolute Maximum Ratings:

	2N5181	*2N5182*	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	45	45 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3	3 max.	V
COLLECTOR CURRENT, I_C	50	4 max.	mA
TRANSISTOR DISSIPATION, P_T:			
At ambient temperatures up to 25°C	180	180 max.	mW
At ambient temperatures above 25°C	derate at 1.2 mW/°C		
TEMPERATURE RANGE:			
Storage and Operating (Junction)	−65 to +175		°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32″ from seating surface for 10 seconds max.	255	255 max.	°C

SILICON N-P-N HIGH-FREQUENCY TRANSISTORS

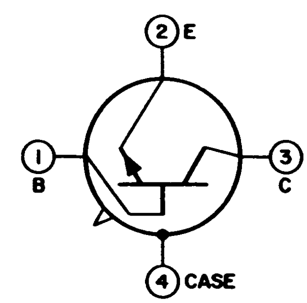


JEDEC TO-104

General-Purpose Types For RF- and IF-Amplifier Applications

Features

- **New Terminal Arrangement For Superior High-Frequency Performance**



1 - Base
2 - Emitter
3 - Collector
4 - Case

- **low collector-to-base feedback capacitance — C_{cb} = 0.32pF max.**
- **high gain-bandwidth product — f_T = 700MHz typ.**
- **low device noise figure — NF = 3.5dB typ. at 200MHz for 2N5181; 4.5dB typ. at 200MHz for 2N5182**
- **high useful power gain (neutralized) — MUG — 24.2 26dB typ. for 2N5181; — 24.2 28dB typ. for 2N5182 } at 200MHz**
- **high operating temperature capability — to 175°C**
- **hermetically sealed 4-lead TO-104 metal package**

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
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Printed in U.S.A.
2N5181, 2N5182 8-67

ELECTRICAL CHARACTERISTICS, at T_A = 25°C

Characteristics	Symbols	TEST CONDITIONS			LIMITS						Units
		Frequency f	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter Current I_E	Type 2N5181			Type 2N5182			
		MHz	Volts	mA	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}	- -	(V_{CB})= I (V_{CB})=45 V_{CB} =35	0 0 0	- -	- -	0.02 1 -	- -	- -	0.03 1	µA µA µA
Emitter-Cutoff Current	I_{EBO}	-	(V_{EB})=3	(I_C)=0	-	-	1	-	-	1	µA
Static Forward Current-Transfer Ratio	h_{FE}	-	6	-1	27		275	27		275	-
Gain-Bandwidth Product	f_T	100	6	-2	-	700	-	-	700	-	MHz
Collector-to-Base Feedback Capacitance	C_{cb}	0.1 to 1	10	-3	-	0.22	0.34	-	0.22	0.34	pF
Max. Available Amplifier Gain	MAG	200	10	-2	-	29.9	-	-	29.5	-	dB
Max. Usable Amplifier Gain (Unneutralized)	MUG	200	10	-2	-	20.4	-	-	20.4	-	dB
Max. Usable Amplifier Gain (Neutralized)	MUG	200	10	-2	-	24.2	-	-	24.2	-	dB

TYPICAL y-PARAMETER CHARACTERISTICS at 100MHz for RCA-2N5181

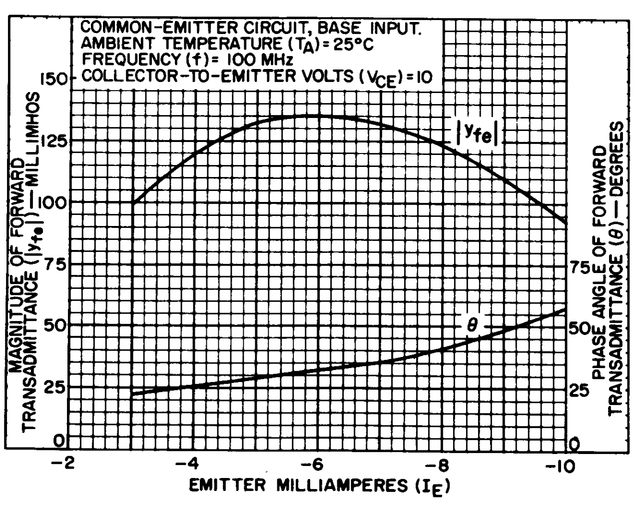
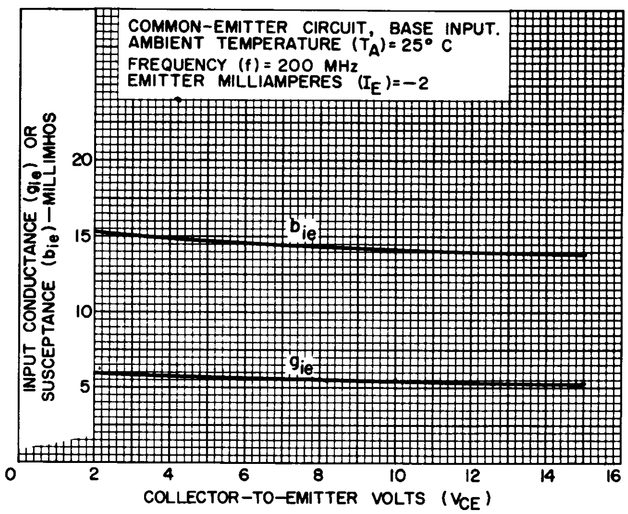


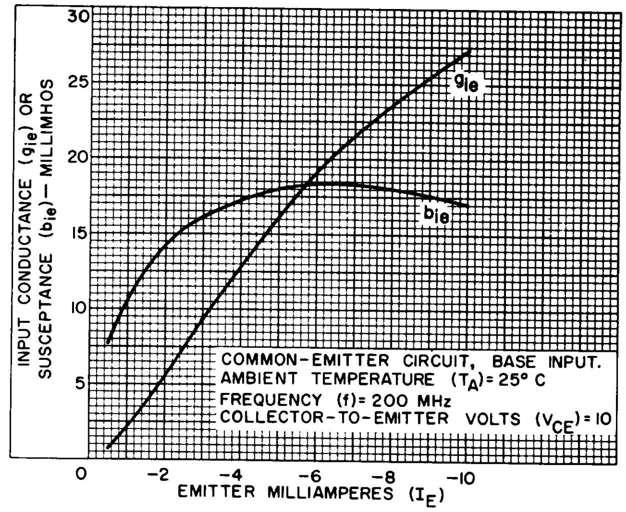
Fig. 1 — Y_{fe} vs I_E

TYPICAL y-PARAMETER CHARACTERISTICS at 200MHz for RCA-2N5181



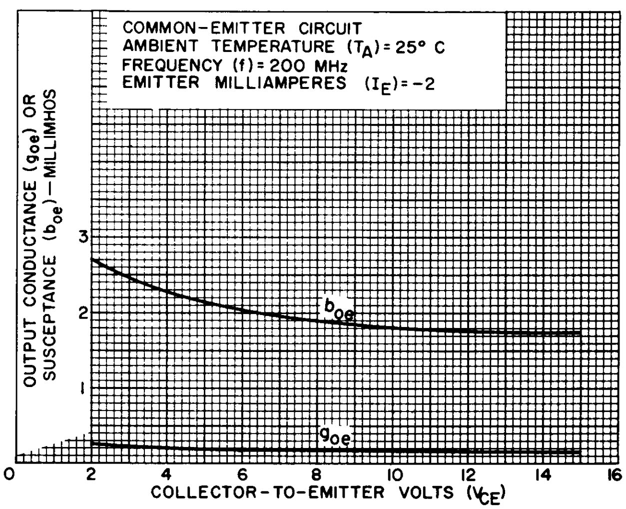
92CS-14549

Fig. 2 — Y_{ie} vs V_{CE}



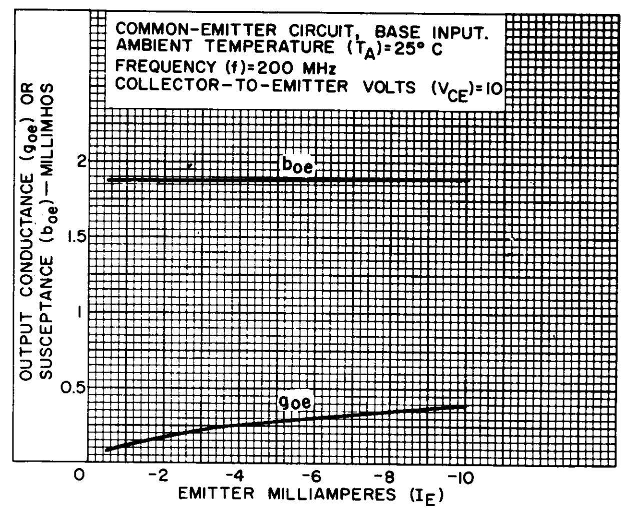
92CS-14552

Fig. 5 — Y_{ie} vs I_E



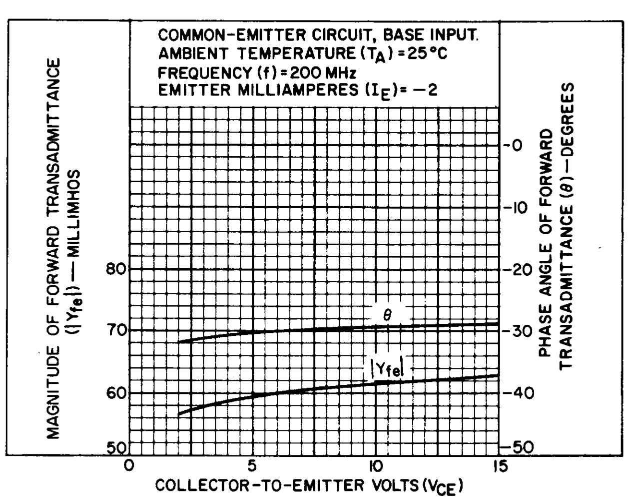
92CS-14550

Fig. 3 — Y_{oe} vs V_{CE}



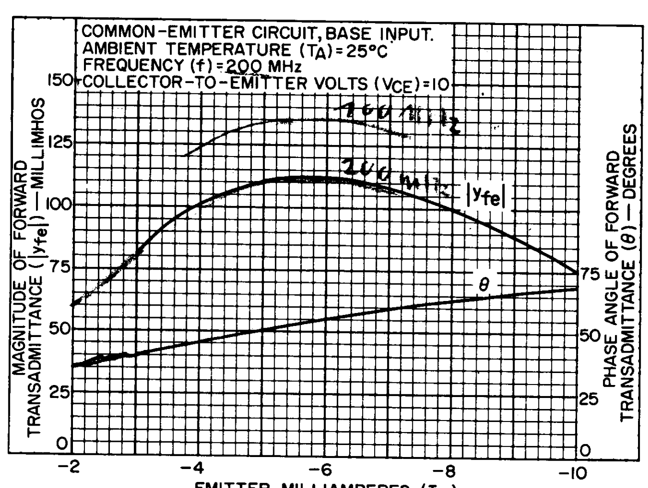
92CS-14553

Fig. 6 — Y_{oe} vs I_E



92CS-14551

Fig. 4 — Y_{fe} vs V_{CE}



92CS-14746

Fig. 7 — Y_{fe} vs I_E

TYPICAL y-PARAMETER CHARACTERISTICS at 44MHz for 2N5181

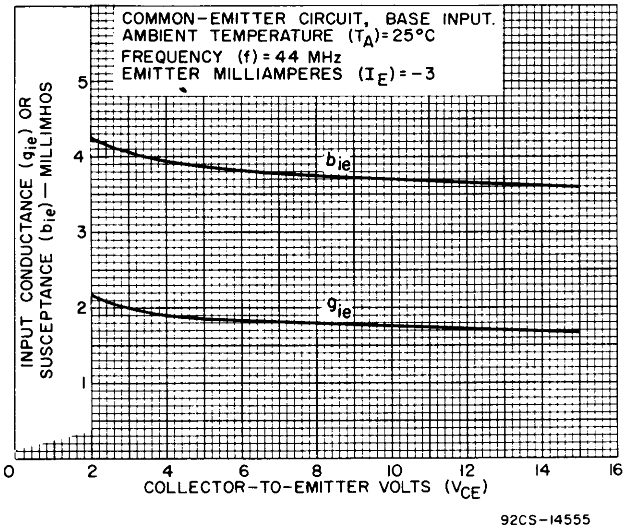


Fig. 8 — Y_{ie} vs V_{CE}

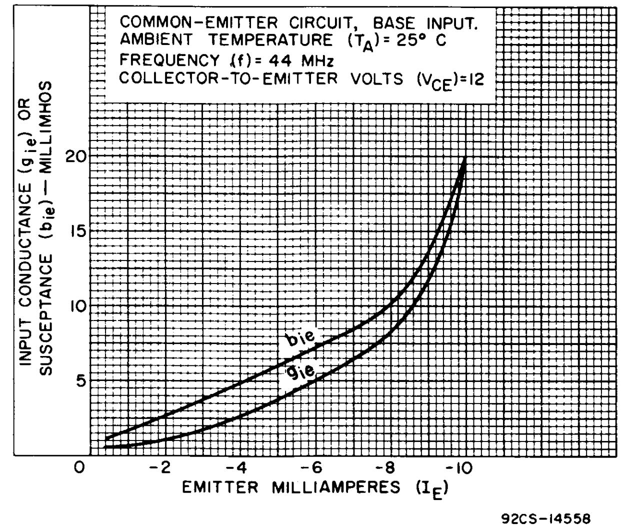


Fig. 11 — Y_{ie} vs I_E

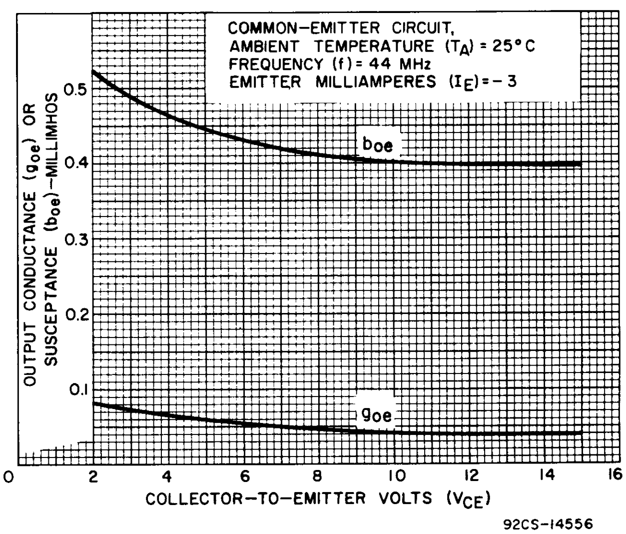


Fig. 9 — Y_{oe} vs V_{CE}

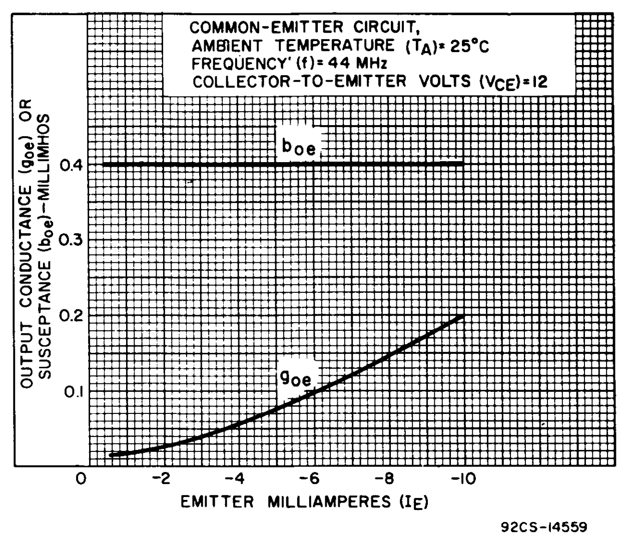


Fig. 12 — Y_{oe} vs I_E

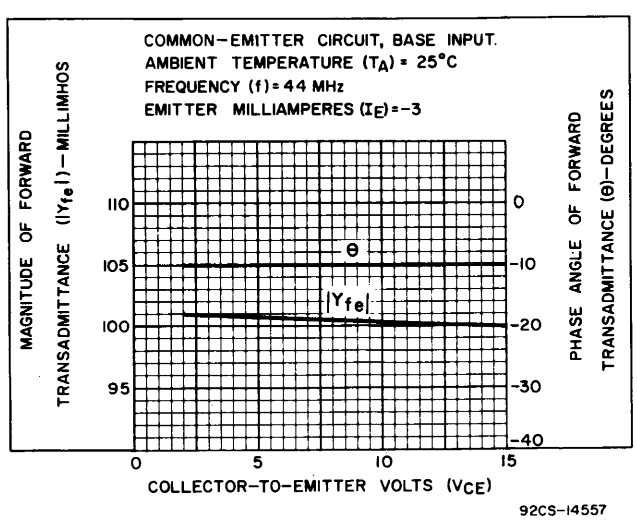


Fig. 10 — Y_{fe} vs V_{CE}

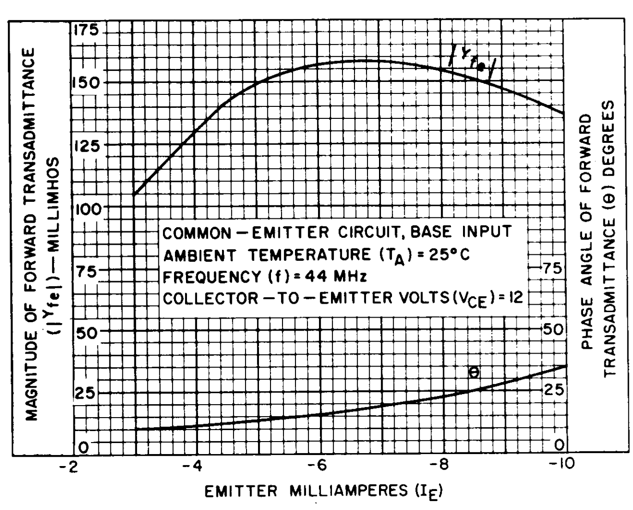


Fig. 13 — Y_{fe} vs I_E

TYPICAL y-PARAMETER CHARACTERISTICS at 200MHz for 2N5182

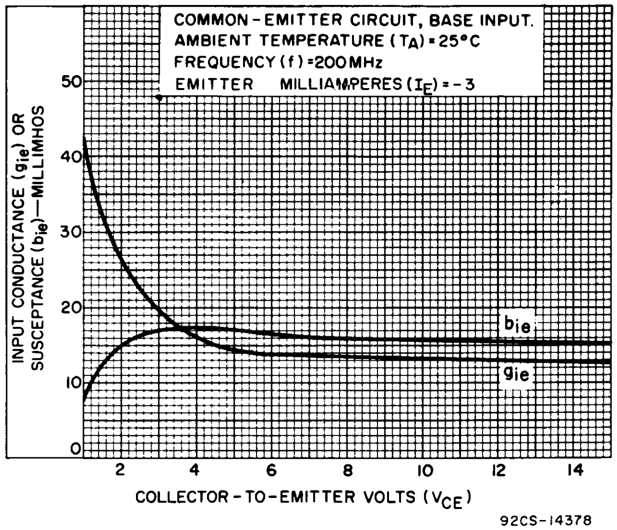


Fig. 14 — Y_{ie} vs V_{CE}

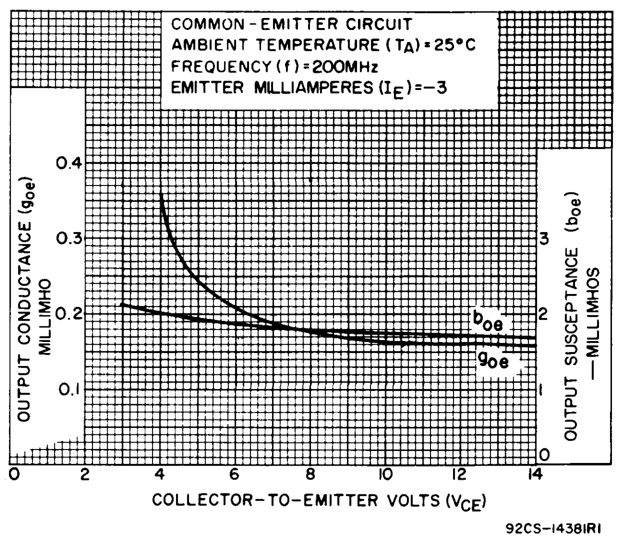


Fig. 15 — Y_{oe} vs V_{CE}

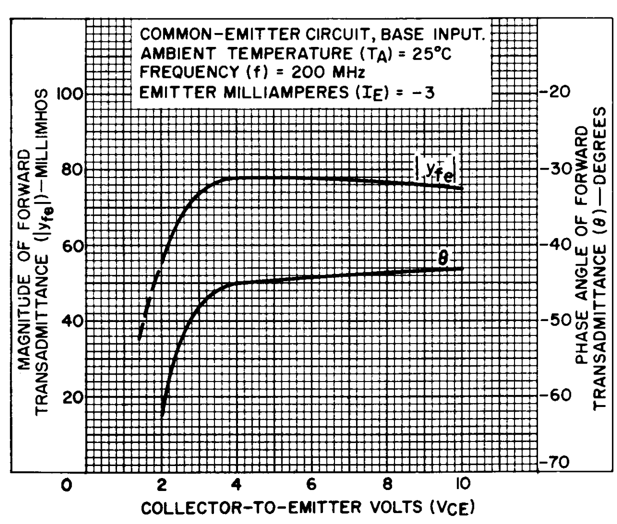


Fig. 16 — Y_{fe} vs V_{CE}

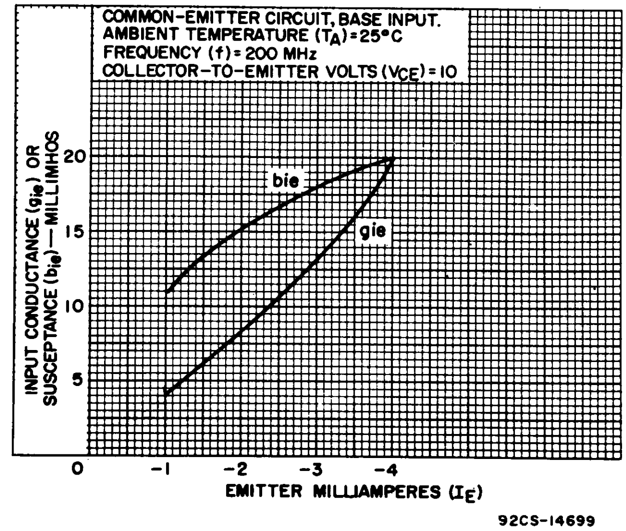


Fig. 17 — Y_{ie} vs I_E

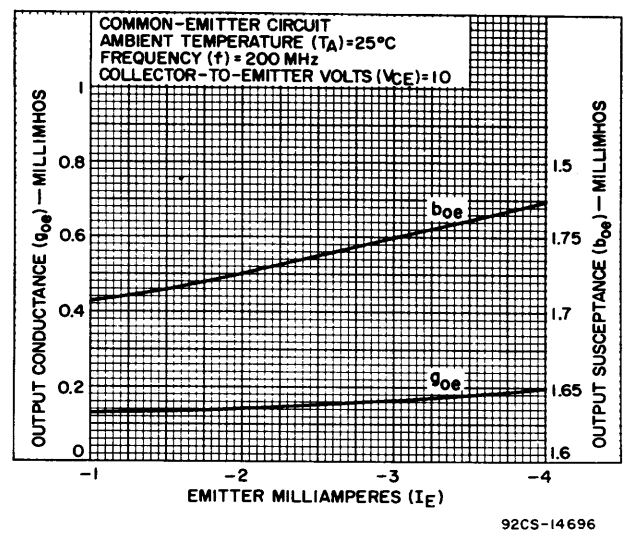


Fig. 18 — Y_{oe} vs I_E

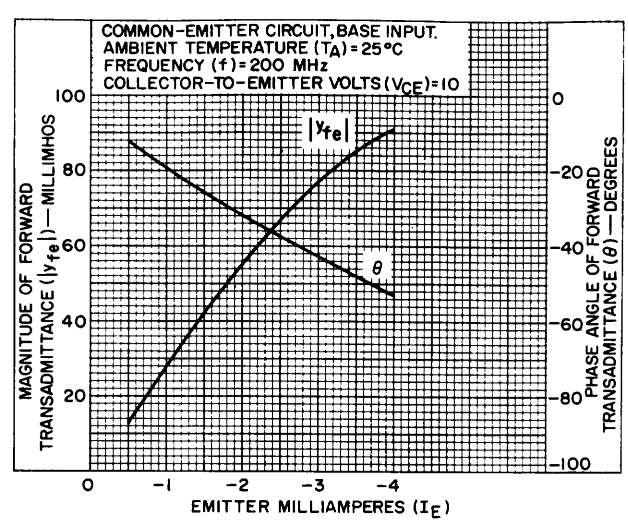


Fig. 19 — Y_{fe} vs I_E

TYPICAL y-PARAMETER CHARACTERISTICS at 44MHz for 2N5182

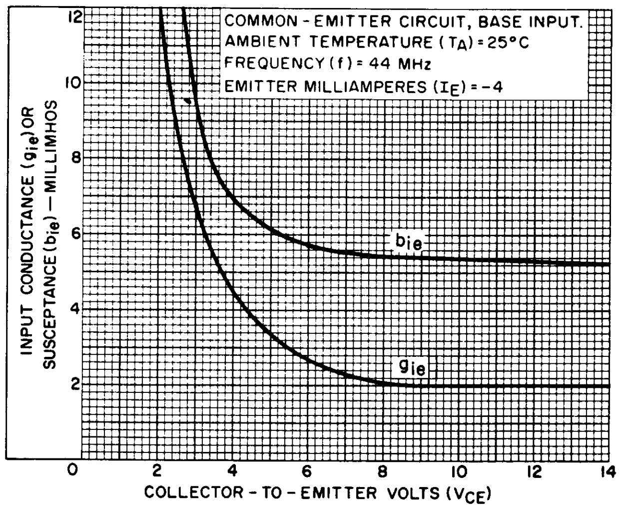


Fig. 20 – Y_{ie} vs V_{CE}

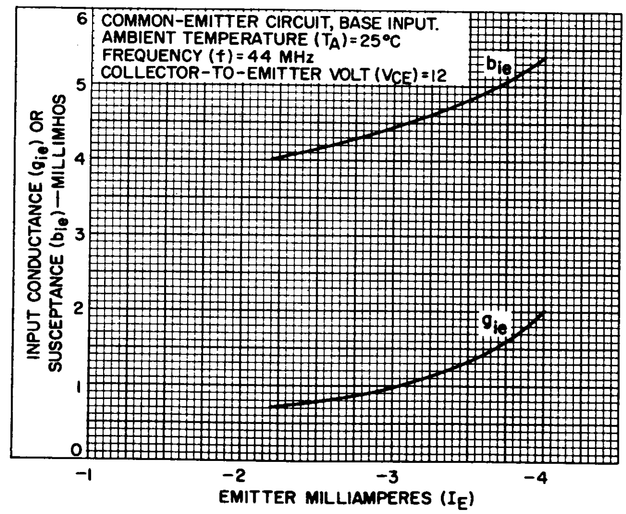


Fig. 23 – Y_{ie} vs I_E

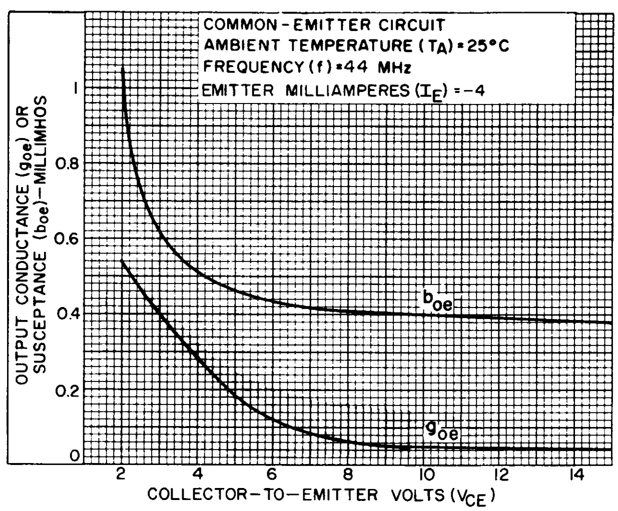


Fig. 21 – Y_{oe} vs V_{CE}

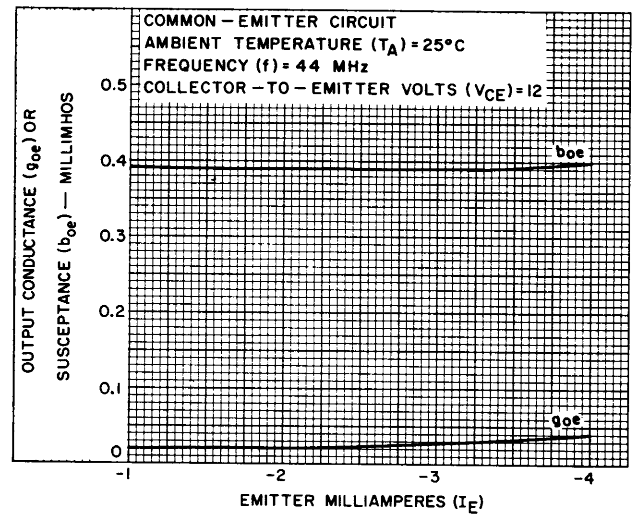


Fig. 24 – Y_{oe} vs I_E

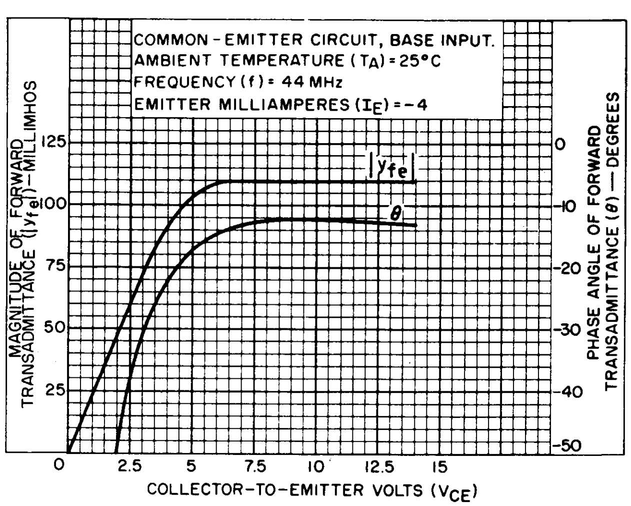


Fig. 22 – Y_{fe} vs V_{CE}

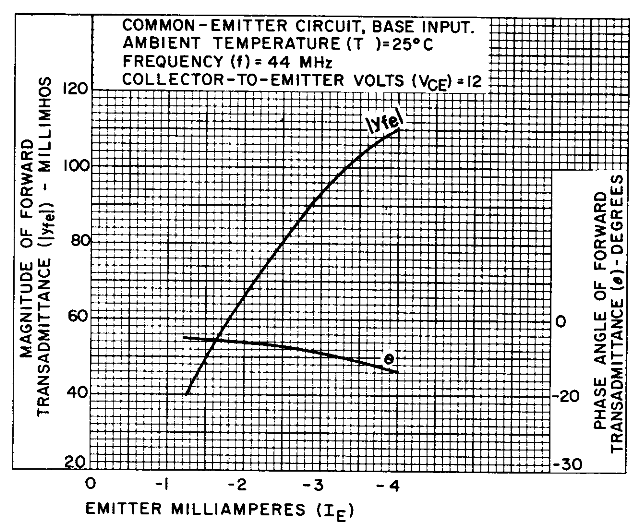


Fig. 25 – Y_{fe} vs I_E

TYPICAL CHARACTERISTICS FOR RCA-2N5181

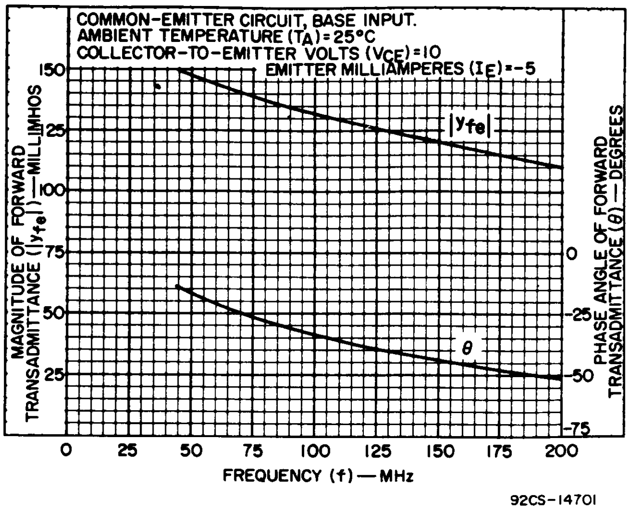


Fig. 26 – Y_{fe} vs f

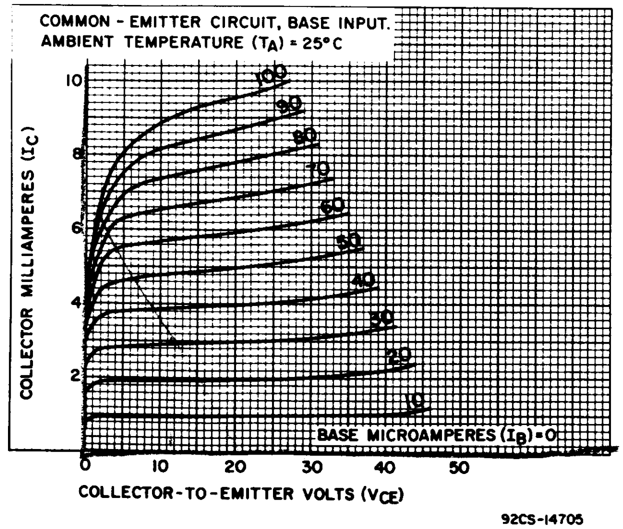


Fig. 29 – I_c vs V_{CE}

TYPICAL CHARACTERISTICS FOR RCA-2N5182

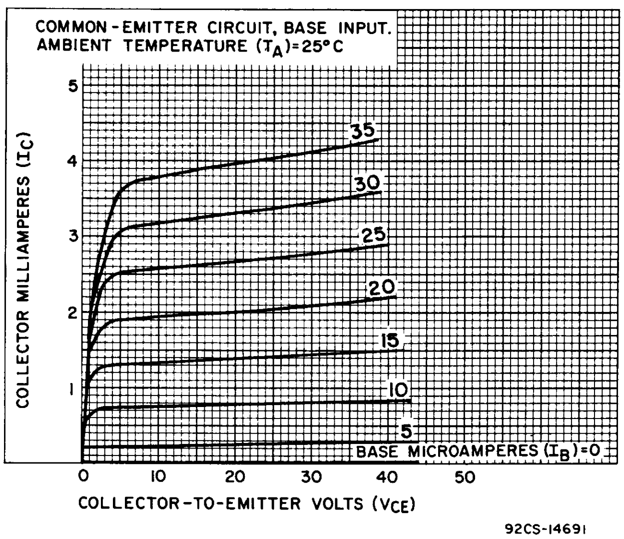


Fig. 27 – I_c vs V_{CE}

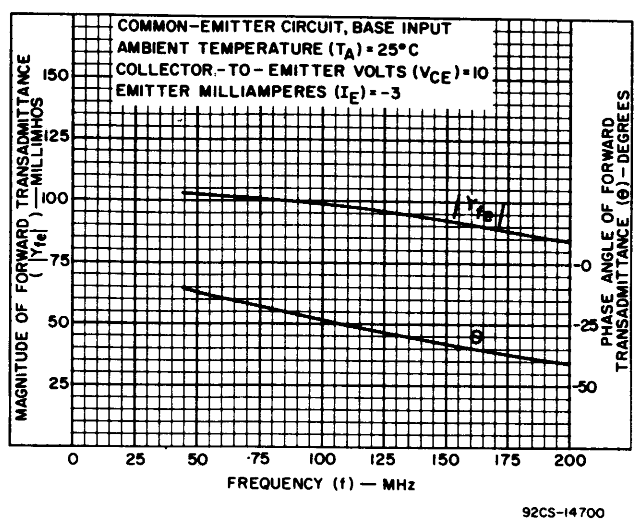


Fig. 30 – Y_{fe} vs f

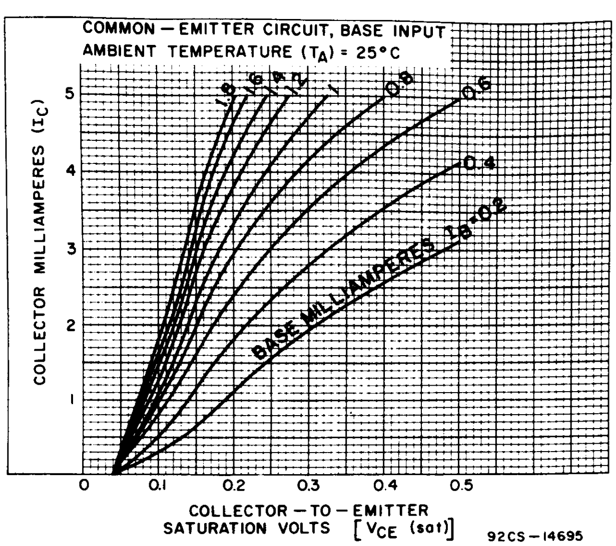


Fig. 28 – I_c vs $V_{CE}(sat)$

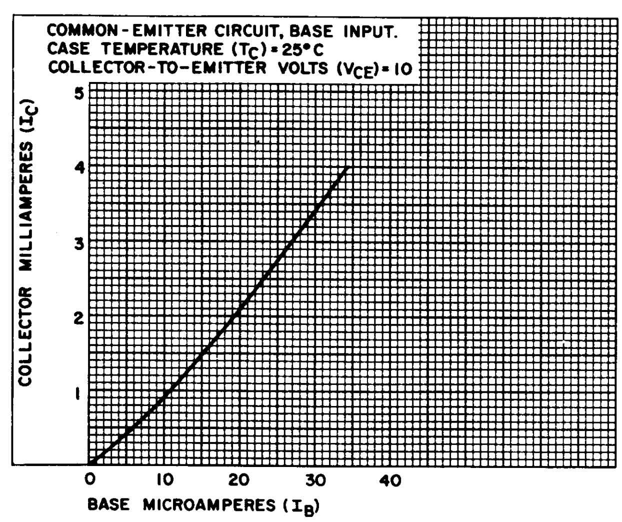


Fig. 31 – I_c vs I_B

TYPICAL CHARACTERISTICS FOR RCA 2N5181 AND 2N5182

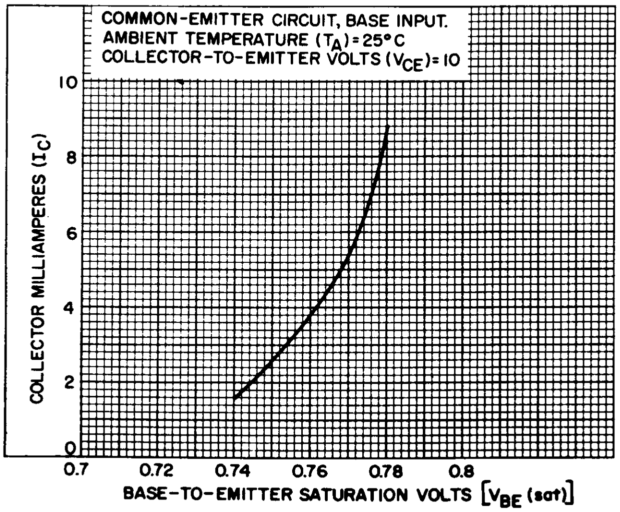


Fig. 32 – I_c vs $V_{BE}(sat)$

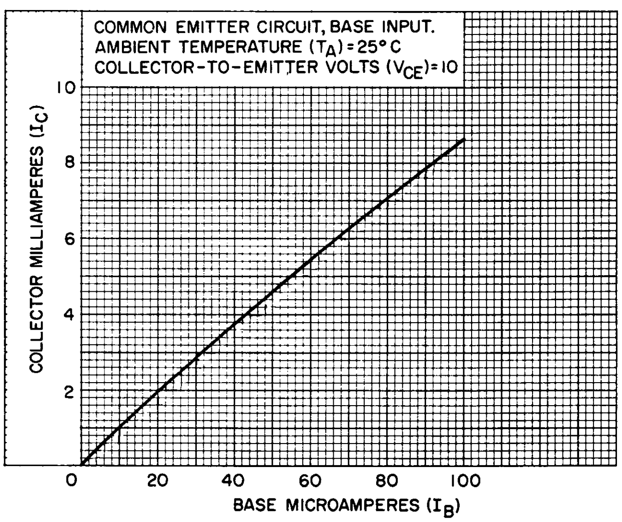


Fig. 33 – I_c vs I_B

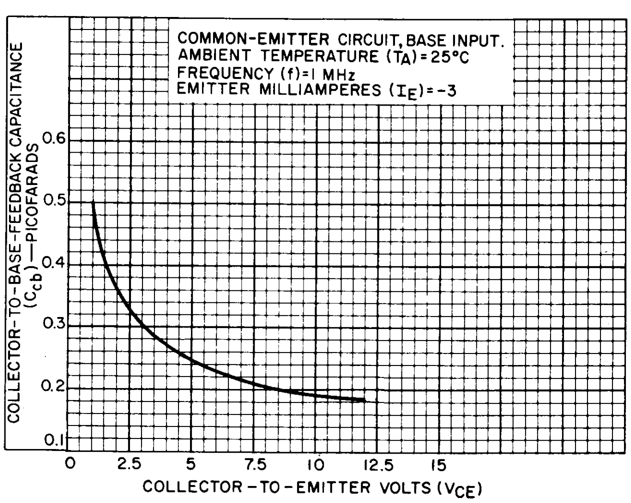
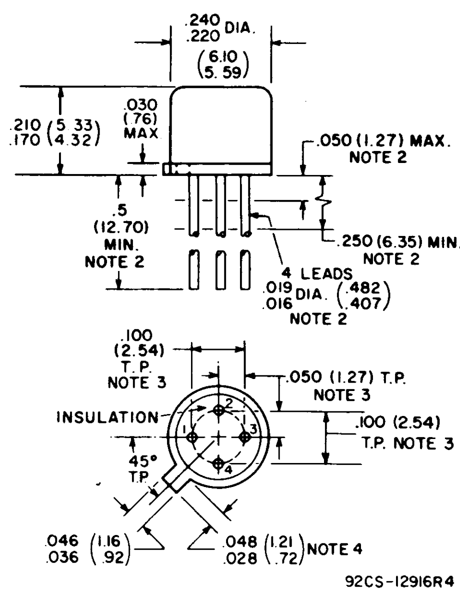


Fig. 34 – C_{cb} vs V_{CE}

DIMENSIONAL OUTLINE FOR TO-104



DIMENSIONS IN INCHES AND MILLIMETERS

Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maxi-width of tab.

Note 4: Measured from actual maximum diameter.

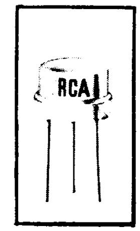
RCA TRANSISTOR
High-Voltage General-Purpose Type

2N5188

3.30

(2.50)

SILICON N-P-N HIGH-VOLTAGE TRANSISTOR



JEDEC TO-39

RCA-2N5188* is a double-diffused epitaxial planar transistor of the silicon n-p-n type.

This transistor features high breakdown voltages, low saturation voltages, and high switching speeds over a wide range of collector current. These features make this device well suited for core-driver and line-driver service in high-performance computers and in other critical industrial applications, and in class C service in mobile and portable equipment.

The 2N5188 is hermetically sealed in a JEDEC TO-39 package designed to provide very low thermal resistance. This construction permits this device to dissipate substantial amounts of power internally in high-duty-factor or non-saturating applications.

* Formerly Dev. No. TA7184A.

For Core-Driver and Line-Driver Service in Data-Processing Equipment and Other Critical Applications in Military and Industrial Equipment

Maximum Ratings, Absolute-Maximum Values:

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}		60 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}		25 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}		5 max.	V
COLLECTOR CURRENT, I_C		Limited by dissipation	
TRANSISTOR DISSIPATION, P_T:			
For case temperatures[a]	up to 25°C	4 max.	W
	above 25°C	derate at 22.8mW/°C	
For ambient temperatures	up to 25°C	0.8 max.	W
	above 25°C	derate at 4.6mW/°C	
TEMPERATURE RANGE:			
Storage and Operating (Junction)		−65 to +200	°C
LEAD TEMPERATURE (During Soldering):			
At distances ≥ 1/32″ from seating surface for 10 seconds max.		265 max.	°C

[a] Measured at center of seating surface.

Features

- **excellent power handling capability —**
  4W max. at T_C = 25°C
- **high gain-bandwidth product —**
  f_T = 325MHz typ.
- **high switching speeds —**
  t_{on} = 20ns typ., t_{off} = 30ns typ. at I_C = 150mA
- **low output capacitance —**
  C_{ob} = 8pF typ.
- **high reliability —**
  production lots of RCA-2N5188 are subjected to and meet the minimum mechanical, environmental, and life-test requirements of the basic MILITARY specification MIL-S-19500. See Page 7 for a description of the Group A and Group B Tests.

ELECTRICAL CHARACTERISTICS, at T_A = 25°C

Characteristics	Symbols	TEST CONDITIONS					LIMITS			
		Collector-to-Emitter Voltage V_{CE}	Emitter-to-Base Voltage V_{EB}	Collector Current I_C	Emitter Current I_E	Base Current I_B	Type 2N5188			Units
		V	V	mA	mA	mA	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}		V_{CB}=30		0		-	-	0.5	μA
Collector-to-Emitter Breakdown Voltage	BV_{CEO}			30		0	25	-	-	V
Collector-to-Base Breakdown Voltage	BV_{CBO}			0.01	0		60	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}			0	−0.01		5	-	-	V
Collector-to-Emitter Saturation Voltage	V_{CE}(sat)			150 500		7.5 50	- -	- -	0.5 1*	V V
Base-to-Emitter Voltage	V_{BE}			150 500		7.5 50	- -	- -	1.1 1.5*	V V
Static Forward-Current Transfer Ratio	h_{FE}	1 0.5		500 150			20* 25	bei V_{ce}=1V! -	- -	
Magnitude of Small-Signal Forward Current-Transfer Ratio at f = 100 MHz	$\|h_{fe}\|$	10		50			2.5	-	-	
Output Capacitance at f = 140 kHz	C_{ob}		V_{CB}=10		0		-	8	10	pF
			V_{CC}			I_{B1} = $-I_{B2}$				
Storage Time See Fig. 21	t_s		6.4	150		15	-	-	35	ns
Turn-On-Time See Fig. 22	t_{on}		6.4	150		15	-	-	35	ns
Turn-Off-Time See Fig. 21	t_{off}		6.4	150		15	-	-	50	ns

*Pulsed conditions - Pulse duration < 400 μs; duty factor < 0.03.

TYPICAL CHARACTERISTICS

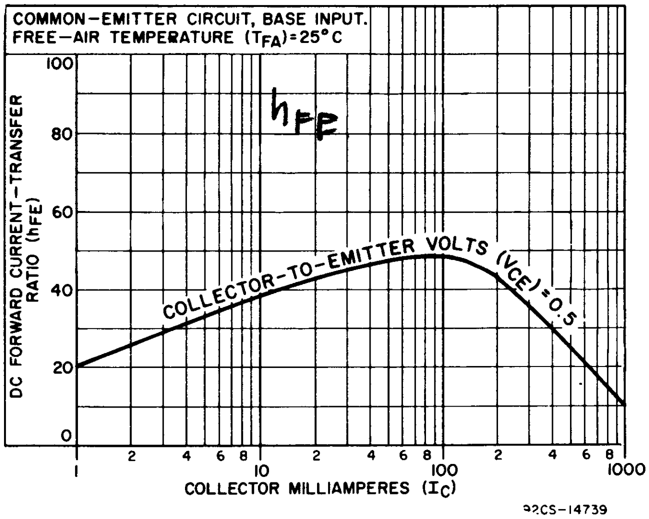


Fig. 1 – Static-Forward-Current Transfer-Ratio Characteristic

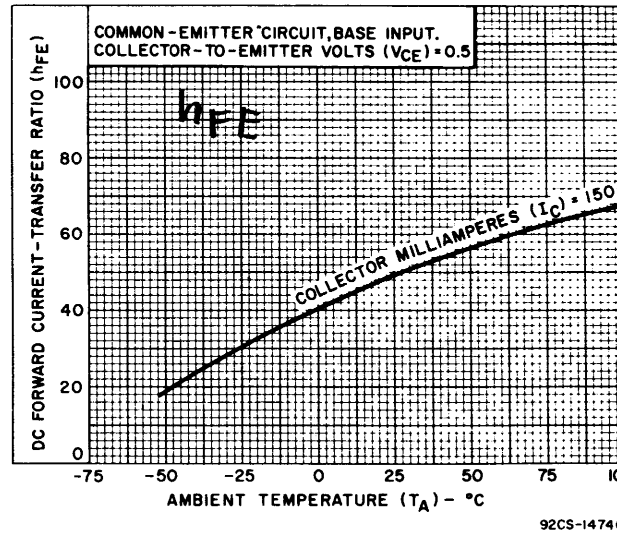


Fig. 2 – Static-Forward-Current Transfer-Ratio vs Temperature

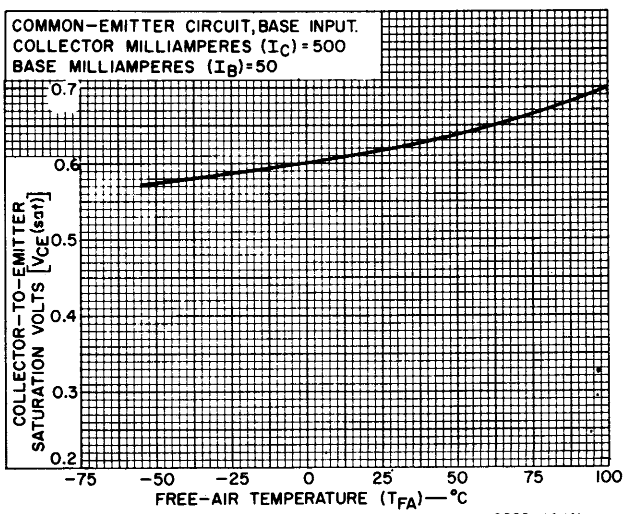


Fig. 3 – Collector-to-Emitter Saturation-Voltage vs Temperature

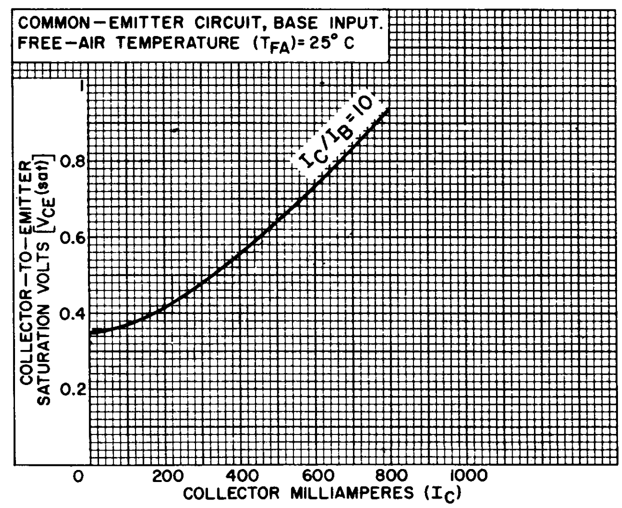


Fig. 4 – Collector-to-Emitter Saturation-Voltage Characteristic

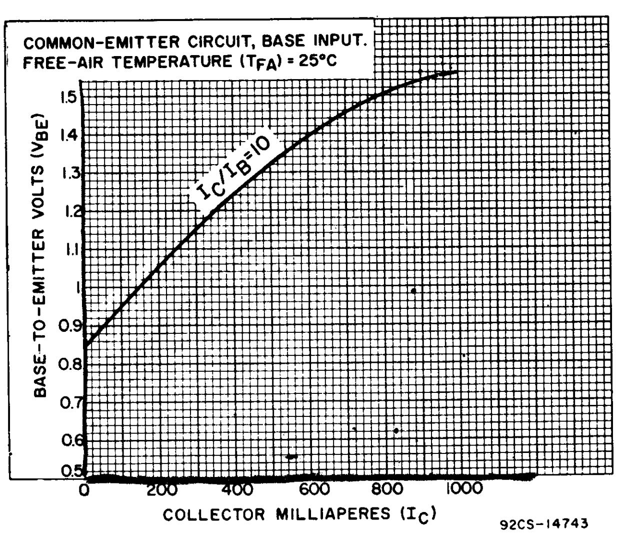


Fig. 5 – Base-to-Emitter Voltage Characteristic

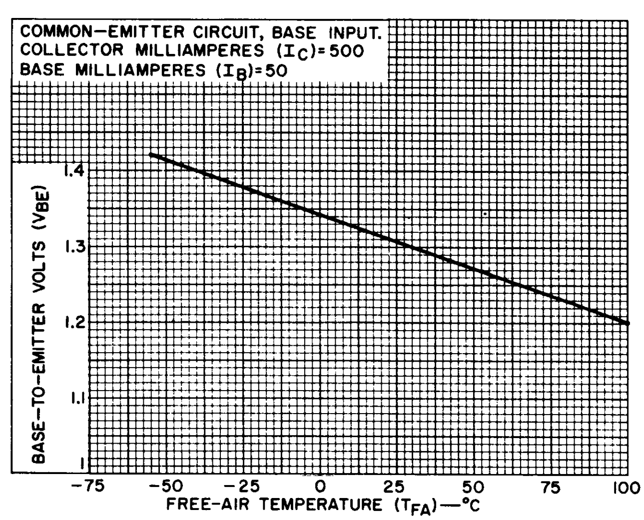


Fig. 6 – Base-to-Emitter Voltage vs Temperature

TYPICAL CHARACTERISTICS

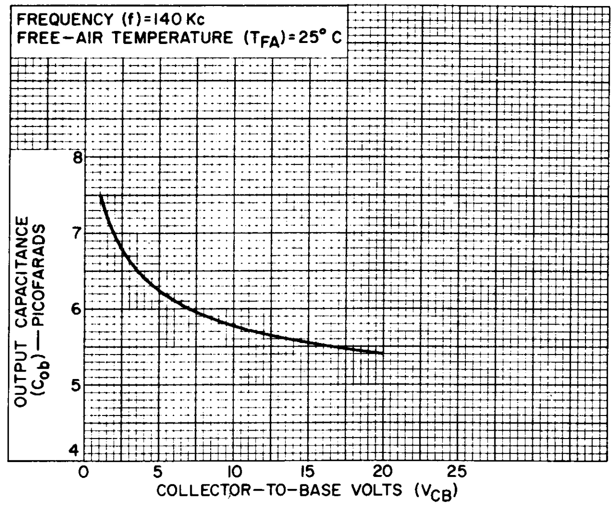


Fig. 7 – Output Capacitance Characteristic

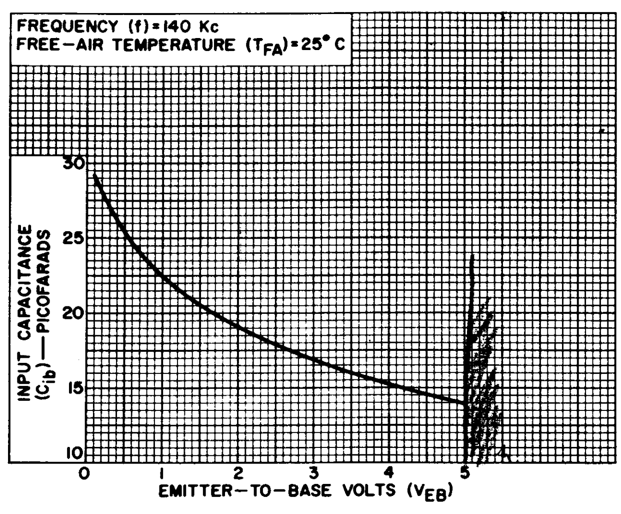


Fig. 8 – Input Capacitance Characteristic

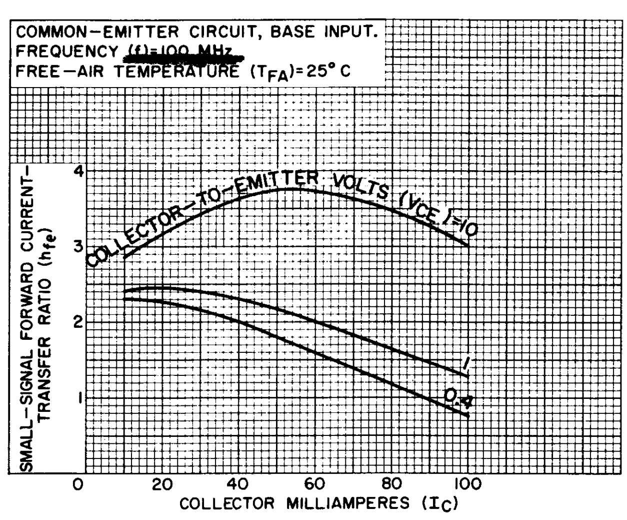


Fig. 9 – Small-Signal Forward-Current Transfer-Ratio

TYPICAL FALL-TIME (t_f) CHARACTERISTICS

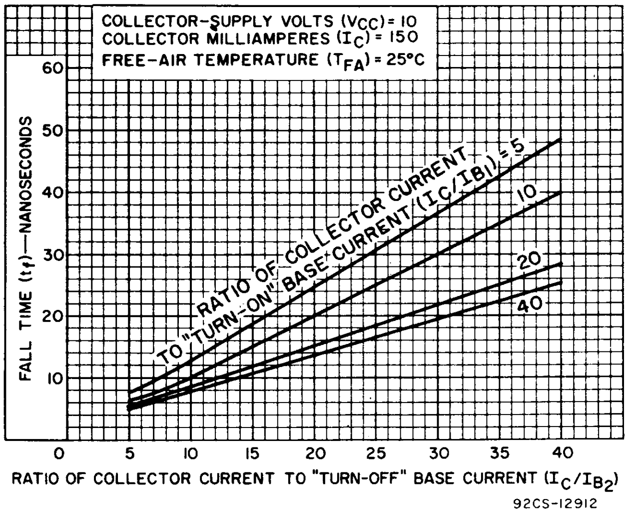


Fig. 10

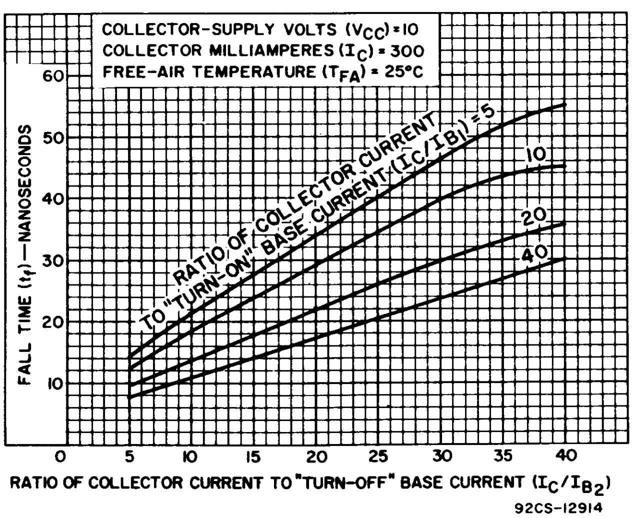


Fig. 11

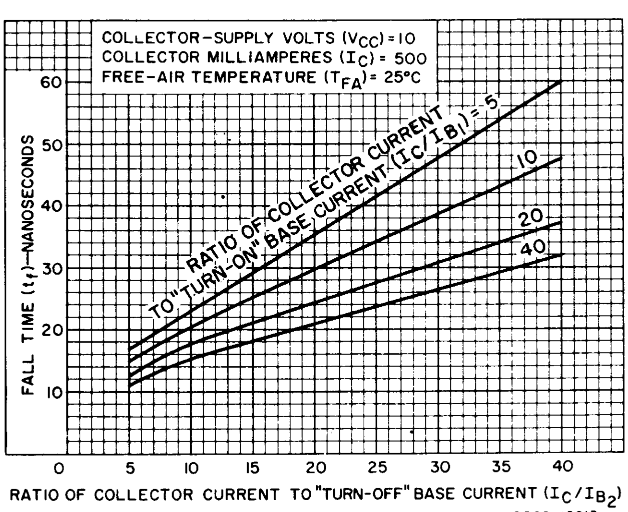


Fig. 12

TYPICAL STORAGE TIME (t_s) CHARACTERISTICS

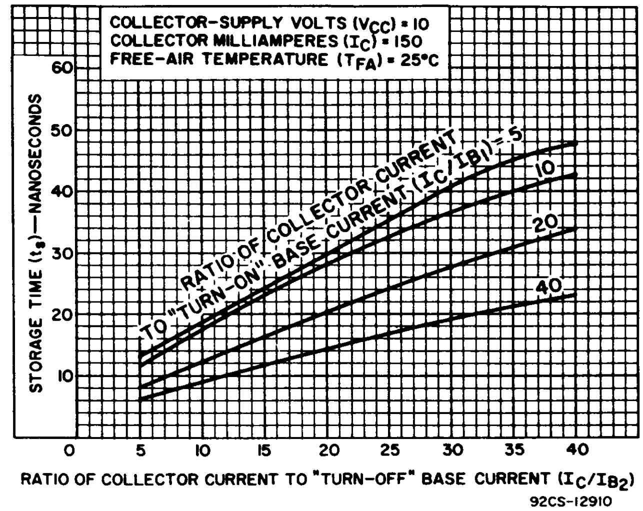


Fig. 13

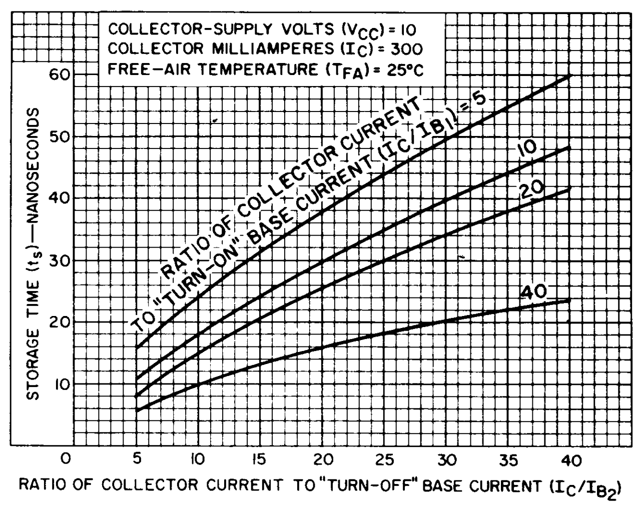


Fig. 14

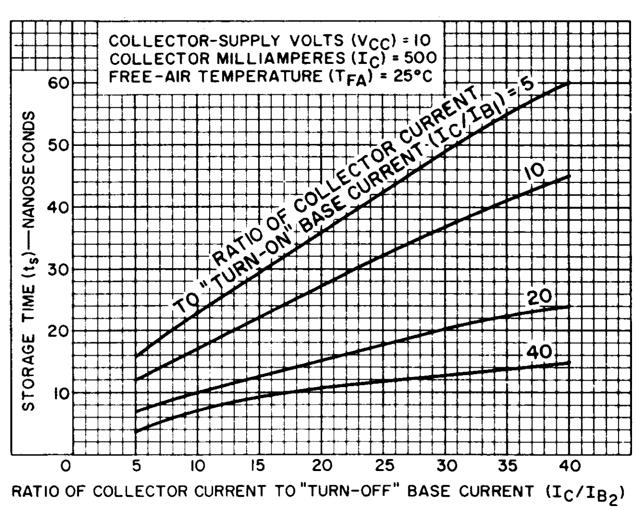


Fig. 15

TYPICAL RISE TIME (t_r) CHARACTERISTICS

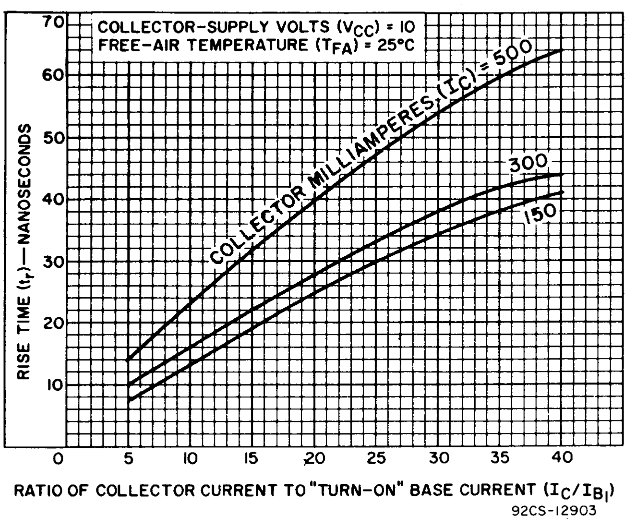


Fig. 16

TYPICAL "TURN-ON" TIME (t_{on}) CHARACTERISTICS

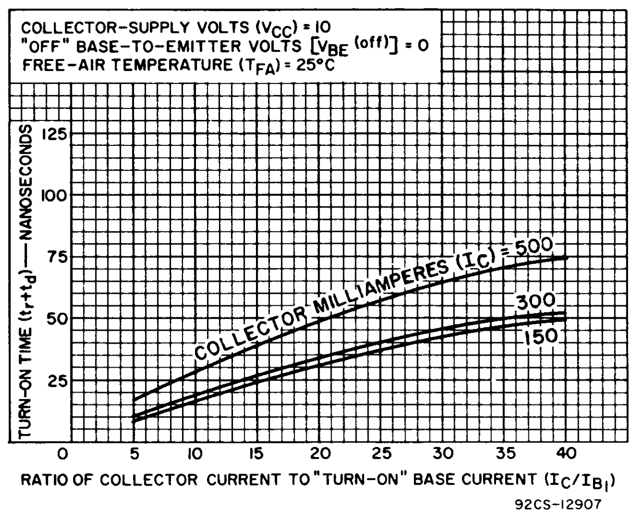
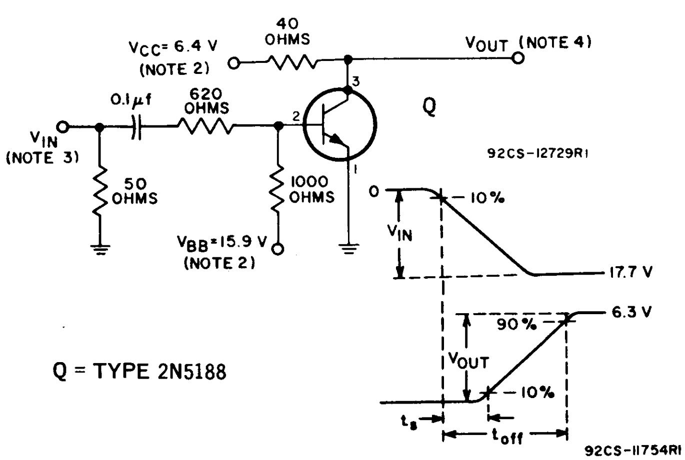


Fig. 17

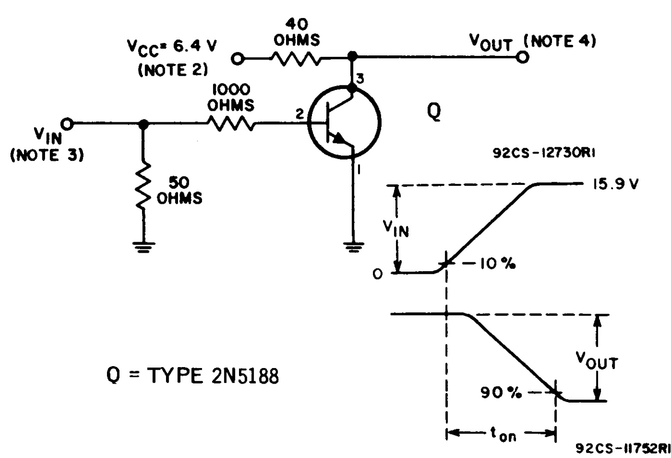
CIRCUIT USED TO MEASURE TURN-OFF TIME (t_{off}) AND STORAGE TIME (t_s)



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.
NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-µf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.
NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 2 NSEC; PULSE DURATION > 150 NSEC; AND DUTY FACTOR < 2%.
NOTE 4: INPUT AND OUTPUT WAVE FORMS MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NSEC; INPUT CAPACITANCE OF PROBE < 2.5pf WITH SHUNT RESISTANCE OF 1 MEGOHM.

Fig. 18

CIRCUIT USED TO MEASURE TUNE-ON TIME (t_{on})



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.
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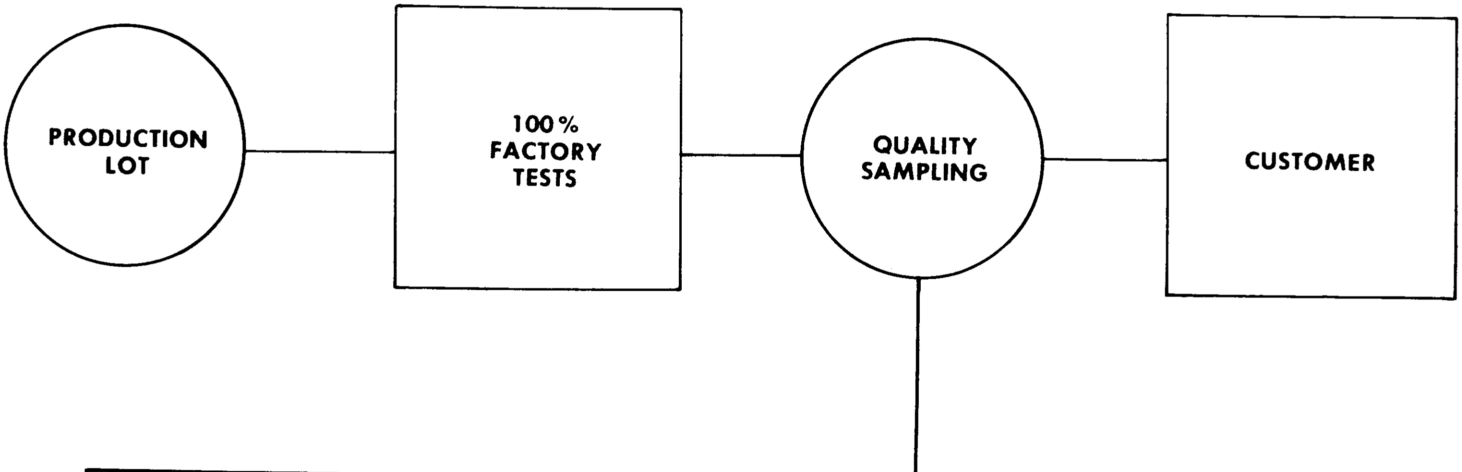
Fig. 19

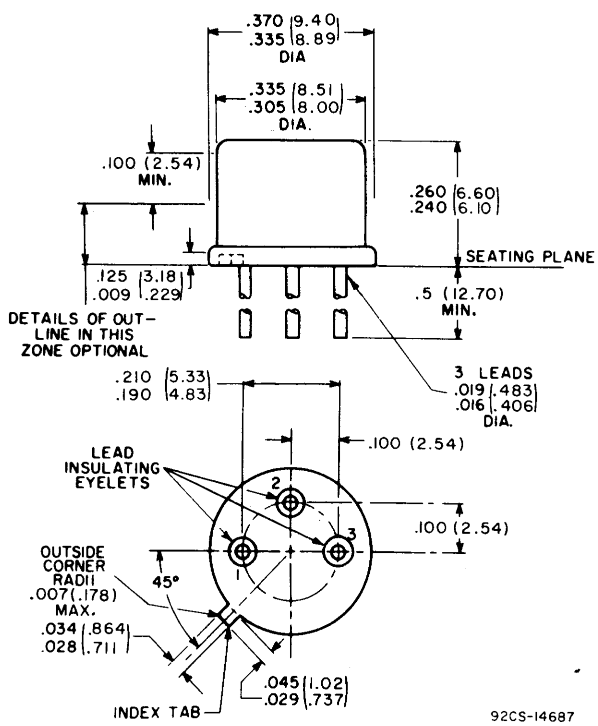
GROUP A AND GROUP B QUALITY SAMPLING TESTS



ITEM	TEST DESCRIPTION	LTPD
GROUP A TESTS		
Subgroup 1.	Visual and Mechanical Examination	10%
Subgroup 2.	Electrical	5%
GROUP B TESTS		
Subgroup 1.	Physical Dimensions	20%
Subgroup 2.	Solderability, Temperature Cycling, Thermal Shock, Moisture Resistance	20%
Subgroup 3.	Shock, Vibration Fatigue, Vibration Variable Frequency, Constant Acceleration	20%
Subgroup 4.	Terminal Strength	20%
Subgroup 5.	Salt Atmosphere	20%
Subgroup 6.	High-Temperature Life, Non-Operating (T_A = 200°C)	λ = 10%
Subgroup 7.	Steady-State-Operation Life (P_D = 800 mW, T_A = 25°C)	λ = 10%

DIMENSIONAL OUTLINE

JEDEC TO-39

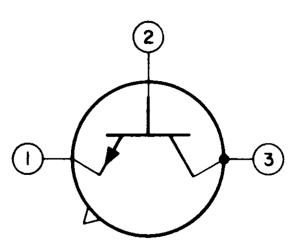


Dimensions in inches and millimeters

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.

TERMINAL DIAGRAM

Bottom View



LEAD 1 — EMITTER

LEAD 2 — BASE

LEAD 3 — COLLECTOR, CASE