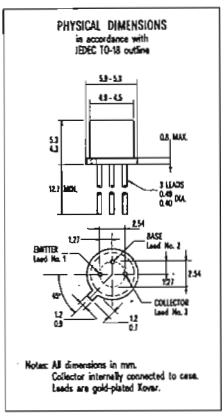
BSX87-BSX87A

HIGH SPEED SATURATED SWITCHES

NPN DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

GENERAL DESCRIPTION - The BSX87 is an NPN silicon PLANAR epitaxial transistor designed for high saturated switch up to 500 mA collector current. It features high speed, high gain, low saturation voltages.

For improved performance use the BSX87A.



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

T_{STG}	Storage Temperature	-55°C to +200°C
T_J	Operating Junction Temperature	+200°C Maximum
T_L	Lead Temperature (Soldering, 10 sec. time limit)	+260°C Maximum

Maximum Power Dissipations (Notes 2 and 3)

P_D	Total Dissipation at 25°C Case Temperature	1.2 Watt
	at 100°C Case Temperature	0.68 Watt
	at 25°C Ambient Temperature	0.36 Watt

Maximum Voltages (T_A = 25°C unless otherwise noted)		BSX87	BSX87A
V_{CBO}	Collector to Base Voltage	40 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts	15 Volts
V_{CER}	Collector to Emitter Voltage (R_{BE} = 10 Ω) (Note 4)	20 Volts	
V_{EBO}	Emitter to Base Voltage	5 Volts	5 Volts

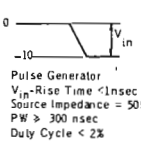
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

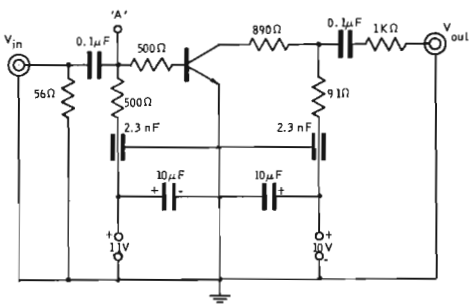
		BSX87			BSX87A				
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)				18	35			I_C = 1 mA, V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	55	120	34	55			I_C = 10 mA, V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)				30	65			I_C = 30 mA, V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)				25	55			I_C = 100 mA, V_{CE} = 1 V
h_{FE}	DC Pulse Current Gain (Note 5)	10	17		10	30			I_C = 500 mA, V_{CE} = 5 V
h_{FE} (-55°C)	DC Pulse Current Gain (Note 5)	12	28						I_C = 10 mA, V_{CE} = 1 V
V_{BE} (sat)	Base Saturation Voltage (Note 5)	0.7	0.75	0.8	0.7	0.75	0.8	V	I_C = 10 mA, I_B = 1 mA
V_{BE} (sat)	Base Saturation Voltage (Note 5)		0.8	0.87		0.85	1	V	I_C = 30 mA, I_B = 3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.15	0.2		0.16	0.2	V	I_C = 10 mA, I_B = 1 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.17	0.22		0.17	0.22	V	I_C = 30 mA, I_B = 3 mA
V_{CE} (sat)	Collector Saturation Voltage (Note 5)		0.4	0.7		0.3	0.5	V	I_C = 200 mA, I_B = 20 mA
I_{CES}	Collector Cutoff Current					0.02	0.3	μA	V_{CE} = 20 V, V_{EB} = 0
I_{CES} (125°C)	Collector Cutoff Current						30	μA	V_{CE} = 20 V, V_{EB} = 0
I_{CEX} (125°C)	Collector Cutoff Current		3	10				μA	V_{CE} = 20 V, V_{BE} = 0.25 V
I_{EBO}	Emitter Cutoff Current		7	100				nA	V_{EB} = 4 V, I_C = 0
I_{CBO}	Collector Cutoff Current		4	25			300	nA	V_{CB} = 20 V, I_E = 0
I_{CBO} (125°C)	Collector Cutoff Current		3	15			30	μA	V_{CB} = 20 V, I_E = 0

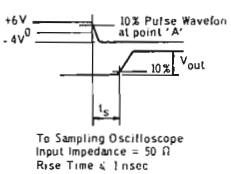
ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	BSX87 MIN.	BSX87 TYP.	BSX87 MAX.	BSX87A MIN.	BSX87A TYP.	BSX87A MAX.	UNIT	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	40						V	I_C = 1 μA I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage				40			V	I_C = 100 μA I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5						V	I_E = 10 μA I_C = 0
BV_{EBO}	Emitter to Base Breakdown Voltage				5			V	I_E = 100 μA I_C = 0
V_{CER} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	20						V	I_C = 30 mA (pulsed) R_{BE} ≤ 10 Ω
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15						V	I_C = 30 mA (pulsed) I_B = 0
V_{CEO} (sust)	Collector to Emitter Sustaining Voltage (Notes.4 and 5)				15			V	I_C = 10 mA (pulsed) I_B = 0
h_{fe}	High Frequency Current Gain (f = 100MHz)	3	3.7		3.5	6			V_{CE} = 10 V I_C = 20 mA
C_{ob}	Output Capacitance		4.5	6				pF	V_{CB} = 10 V I_E = 0
C_{ob}	Output Capacitance					2.5	5	pF	V_{CB} = 5 V I_E = 0
C_{TE}	Emitter Transition Capacitance			9		7	8	pF	V_{EB} = 0.5 V I_C = 0
τ_s	Charge Storage Time Constant (Notes 6-7)		13	20				ns	I_C = I_{B1} = I_{B2} = 20 mA
τ_s	Charge Storage Time Constant (Notes 6-7)					8	18	ns	I_C = I_{B1} = I_{B2} = 10 mA
t_{on}	Turn On Time (Note 7)		25	40				ns	I_C = 200 mA I_{B1} = 40 mA
t_{on}	Turn On Time (Note 7)					9	20	ns	I_C = 300 mA I_{B1} = 30 mA
t_{aff}	Turn Off Time (Note 7)		25	40				ns	I_C = 200 mA I_{B1} = 40 mA I_{B2} = 20 mA
t_{off}	Turn Off Time (Note 7)					15	30	ns	I_C = 300 mA I_{B1} = 30 mA I_{B2} = 30 mA

BSX87A CHARGE STORAGE TIME CONSTANT TEST CIRCUIT







NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 200°C and junction-to-case thermal resistance of 145°C/watt (derating factor of 6.9 mW/°C); junction-to-ambient thermal resistance of 486°C/watt (derating factor of 2.09 mW/°C).

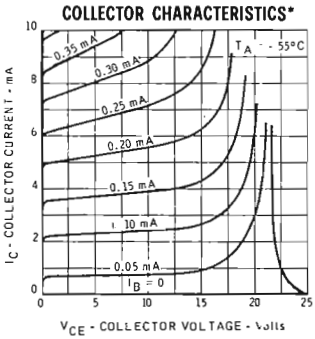
(4) These ratings refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for SGS-AR 5.

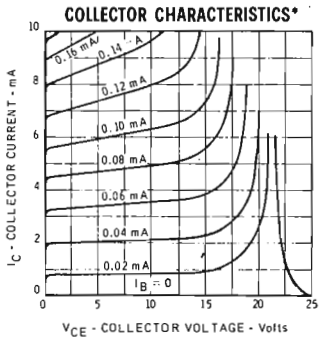
(5) Pulse Conditions: length = 300 μsec; duty cycle = 1%.

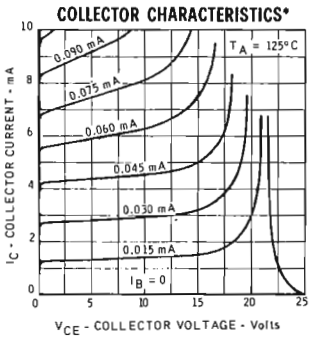
(6) Measured on sampling scope PW = 200 ns.

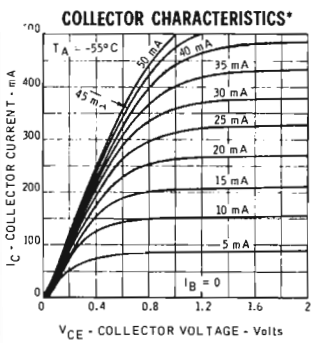
(7) See switching circuit for exact values of I_C, I_{B1} and I_{B2}.

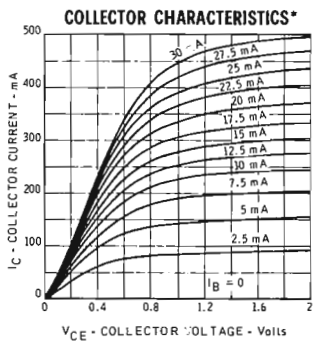
TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

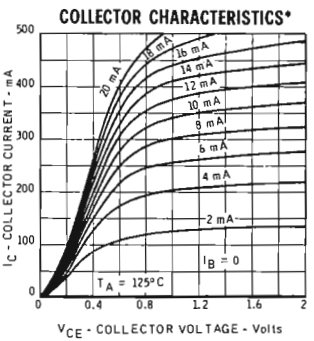


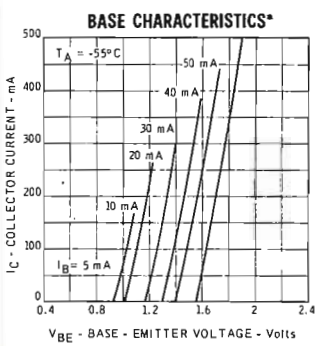


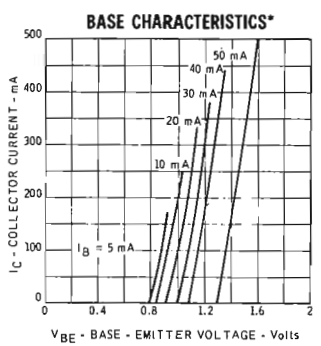


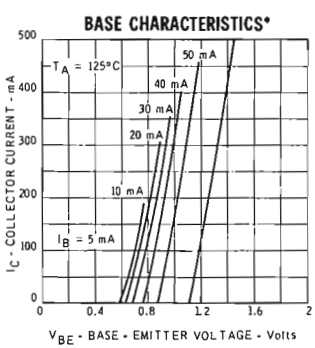








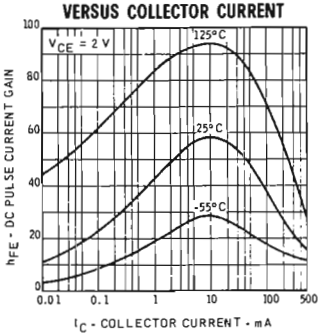




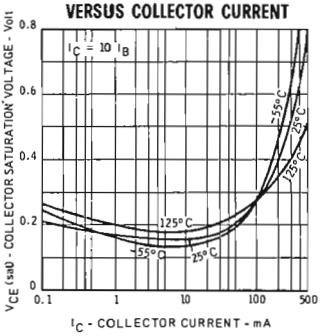
*Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

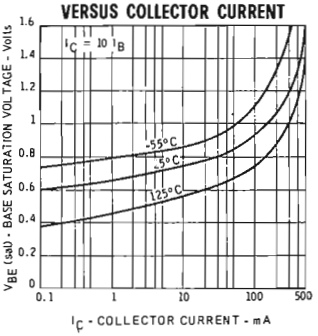
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



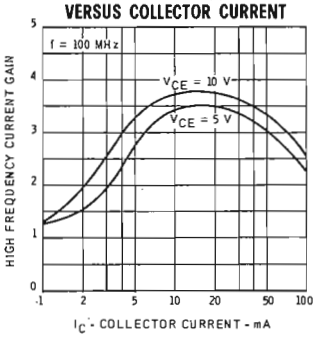
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



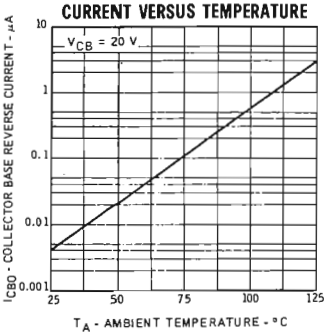
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



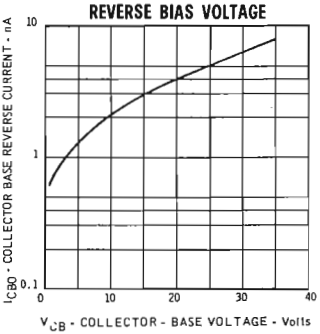
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



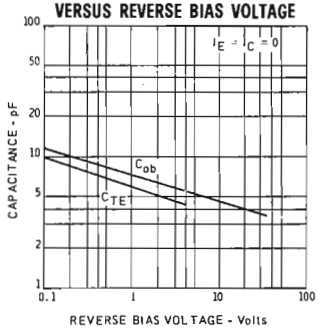
COLLECTOR-BASE REVERSE CURRENT VERSUS TEMPERATURE



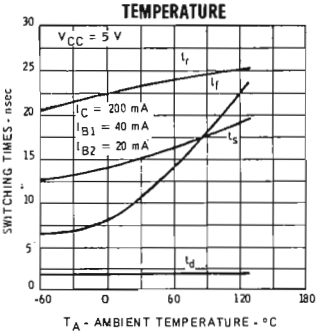
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



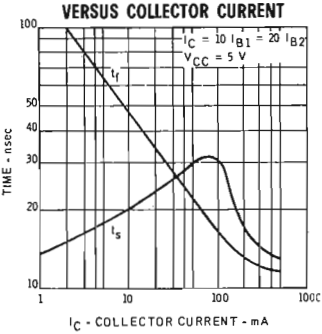
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS TEMPERATURE

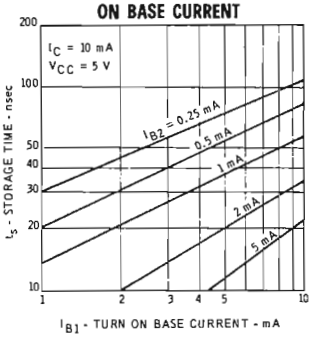


STORAGE AND FALL TIMES VERSUS COLLECTOR CURRENT

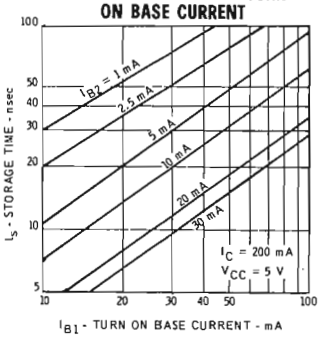


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

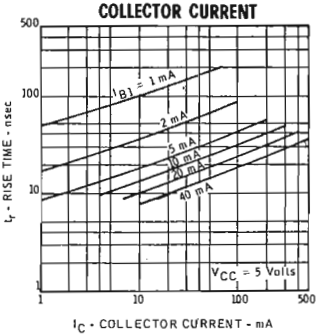
STORAGE TIME VERSUS TURN ON BASE CURRENT



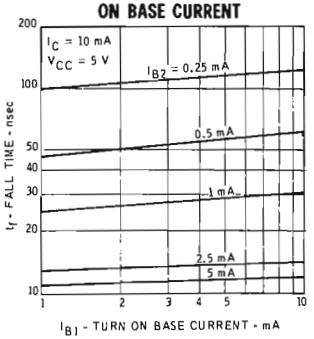
STORAGE TIME VERSUS TURN ON BASE CURRENT



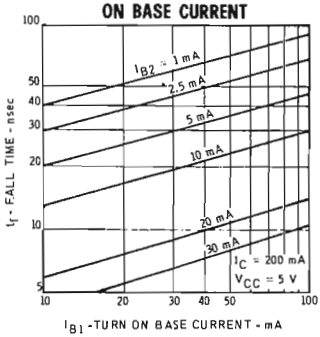
RISE TIME VERSUS COLLECTOR CURRENT



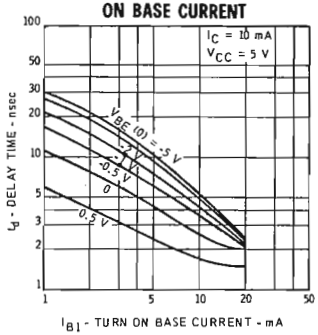
FALL TIME VERSUS TURN ON BASE CURRENT



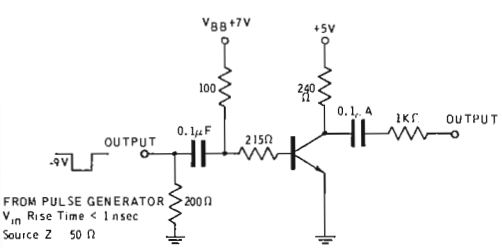
FALL TIME VERSUS TURN ON BASE CURRENT



DELAY TIME VERSUS TURN ON BASE CURRENT

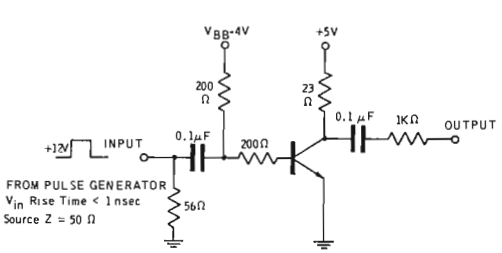


CHARGE STORAGE TIME CONSTANT TEST CIRCUIT



TO SAMPLING OSCILLOSCOPE
Input Z 50 Ω
Rise Time = 1 nsec

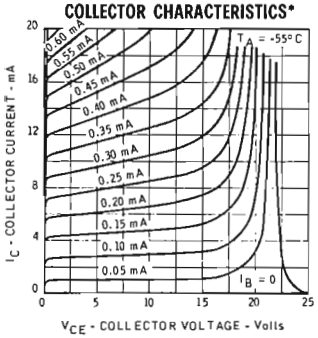
TURN ON AND TURN OFF TIMES TEST CIRCUIT



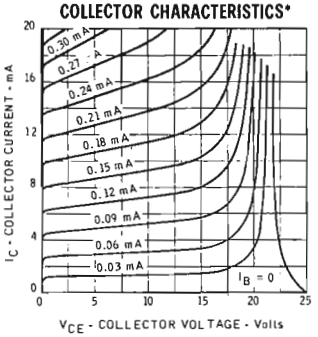
TO SAMPLING OSCILLOSCOPE
Input Z = 50 Ω
Rise Time = 1 nsec

TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

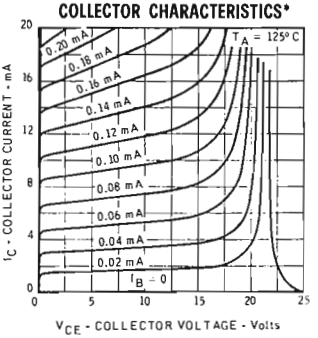
COLLECTOR CHARACTERISTICS*



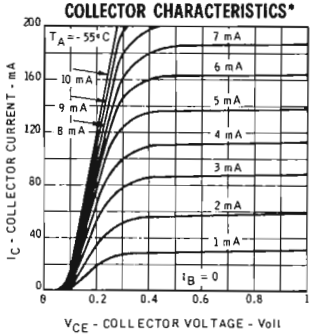
COLLECTOR CHARACTERISTICS*



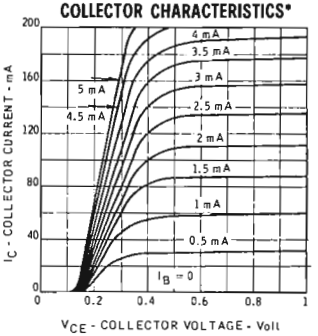
COLLECTOR CHARACTERISTICS*



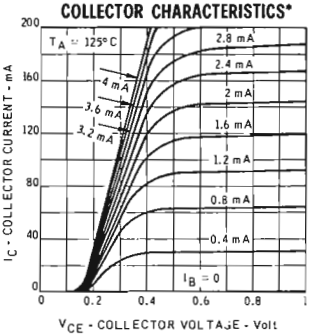
COLLECTOR CHARACTERISTICS*



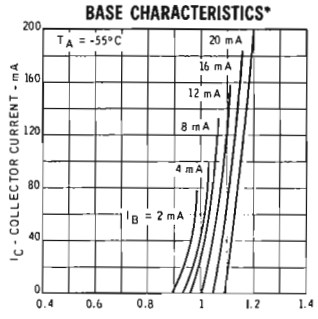
COLLECTOR CHARACTERISTICS*



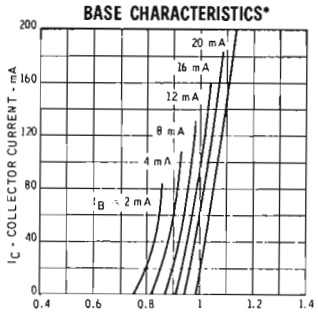
COLLECTOR CHARACTERISTICS*



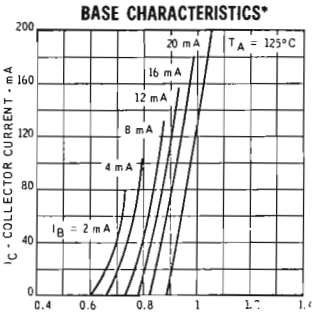
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*



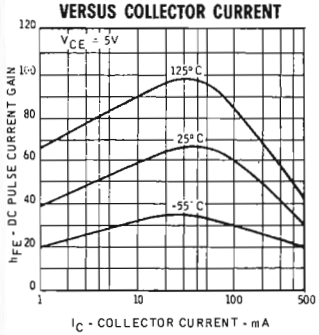
BASE CHARACTERISTICS*



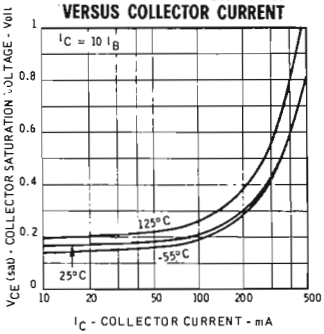
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

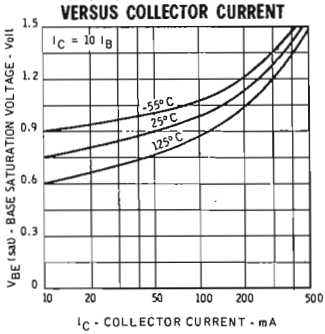
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



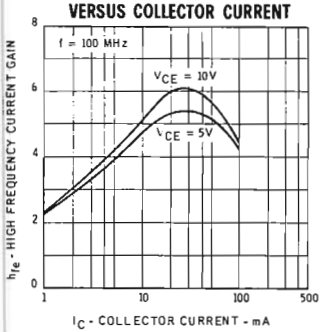
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



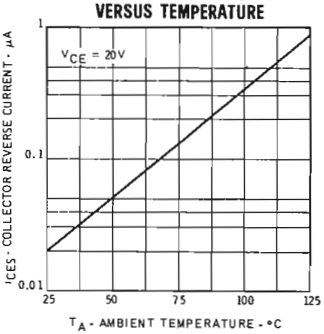
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



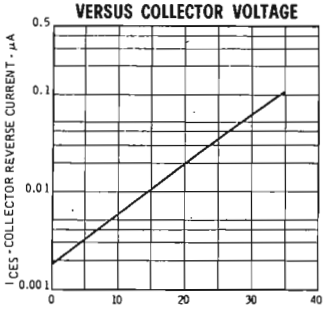
HIGH FREQUENCY CURRENT GAIN VERSUS COLLECTOR CURRENT



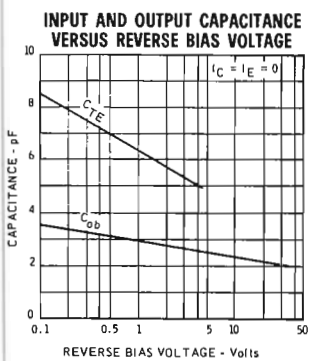
COLLECTOR REVERSE CURRENT VERSUS TEMPERATURE



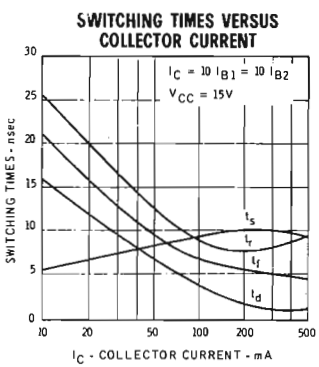
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR VOLTAGE



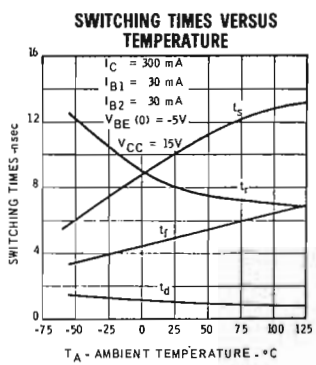
INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



SWITCHING TIMES VERSUS COLLECTOR CURRENT

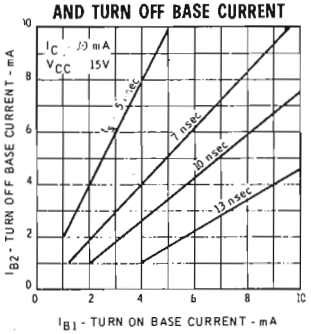


SWITCHING TIMES VERSUS TEMPERATURE

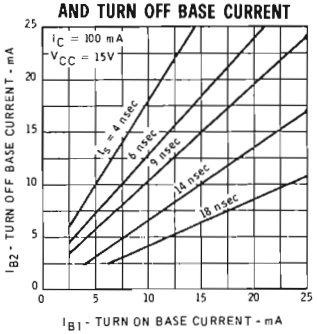


TYPICAL ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

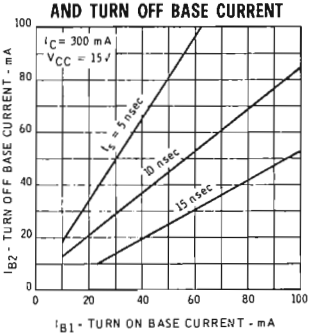
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



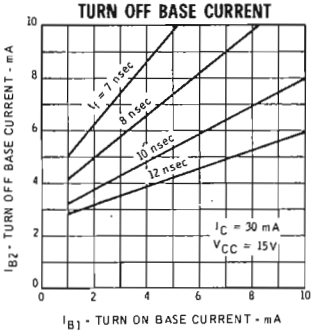
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



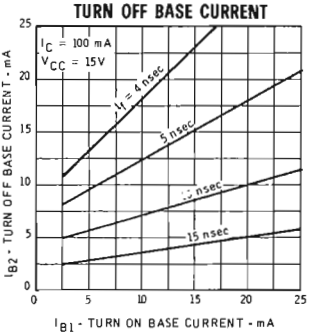
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



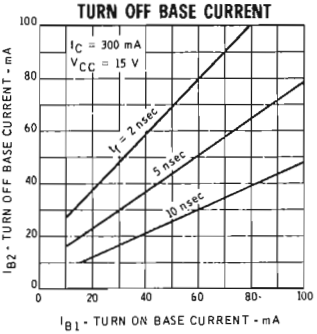
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



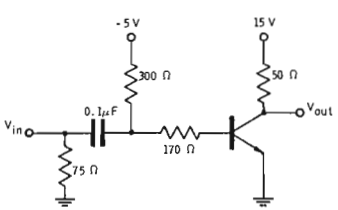
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENT



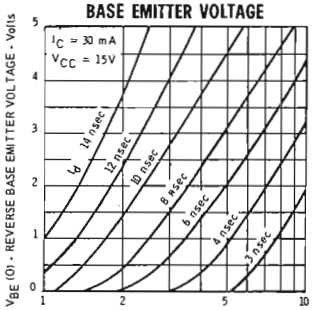
TURN ON AND TURN OFF TIMES TEST CIRCUIT



Pulse Source
Rise and Fall Times
<1 nsec
Pulse Width > 100 nsec
Z_{IN} = 50 Ω

To Sampling Scope
Rise Time < 1 nsec
Input Z = 100 KΩ

DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENT