MILITARY SPECIFICATION

CV7594-5

SEMICONDUCTOR DEVICE, TRANSISTOR

Description:- This specification covers the detail requirements for Silicon PNP Planar Epitaxial High Speed Switching and R.F. Amplifying transistors and is in accordance with K1007, Issue 3, unless otherwise stated.

Mechanical Dimensions and Outlines:- K1007, Section B, 10.3.2.4. and 10.4.2.4.

Connections:- 1. Emitter - 2. Base - 3. Collector and Case.

Absolute Maximum Ratings:-

Rating	V_{CBO}		V_{CEO}		V_{EBO}	I_C	P_{tot}	P_{tot}	T_{stg}	T_{amb}	Shock	Vibration
	CV7594	CV7595	CV7594	CV7595								
Unit	V	V	V	V	V	mA	mW	mW	°C	°C	g	g
Min.	-	-	-	-	-	-	-	-	-65	-65	-	-
Max.	12	20	12	20	4	200	360	1200	200	200	1500	20
Note							A, B	B, C			D	

Notes:- A. At T_{amb} = 25°C.

B. See derating curve on Page 14

C. At T_{case} = 25°C.

D. Duration = 0.5 mS.

E. Commercial equivalents.

CV7594 - 2N2894.
CV7595 - 2N3209.

Primary Electrical Characteristics

Characteristic		I_{CES}	I_{CES}	BV_{CBO}	BV_{EBO}	V_{CEO} (sust.)	V_{CE} (sat.)			V_{BE} (sat.)			h_{FE}				f_T	C_{ob}	C_{TE}	t_{ON}	t_{OFF}
Unit		nA	μA	V	V	V	V			V							Mc/s	pF	pF	nS	nS
CV7594	Min.			-12	-4.0	-12				-0.78	-0.85		40	30	25	17	400				
	Max.	80	10				-0.15	-0.2	-0.5	-0.98	-1.2	-1.7	150					5.0	6.0	60	90
CV7595	Min.			-20	-4.0	-20				-0.78	-0.85		30	25	15	12	400				
	Max.	80	10				-0.15	-0.2	-0.5	-0.98	-1.2	-1.7	120					5.0	6.0	60	90
Conditions	V_{CB} V																	-5.0			
	V_{CE} V	-6 / -10	-6 / -10										-0.5	-0.3	-1.0	-0.5	-10				
	V_{BE} V	0	0																-0.5		
	I_C mA			0.01	0	10	10	30	100	10	30	100	30	10	100	30	30		0	30	30
	I_E mA			0	0.1													0			
	I_B mA					0	1.0	3.0	10	1.0	3.0	10									
	I_{B1} mA																			1.5	1.5
	I_{B2} mA																				1.5
	f Mc/s																	1.0	1.0		
	T_{amb} °C	25	125	25	25	25	25	25	25	25	25	25	25	25	25	-55	25	25	25	25	25

REQUIREMENTS:-

Marking: K1007, Section B, 1.3.4.

QUALITY ASSURANCE PROVISIONS:-

Destructive Tests. The tests listed in Table II, Group B Inspection, Sub-groups 2, 3 and 4 and in Table III, Group C Inspection, Sub-group 2 are considered destructive.

Group C Inspection. Inspection shall be conducted on the initial lot and thereafter every ninety days or every fifth lot whichever occurs first.

PREPARATION FOR DELIVERY:-

Packaging. The device shall be packed according to K1007, Section A, 1.2(c).

NATO STOCK NUMBERS:-

CV7594 - 5960-99-037-3954
CV7595 - 5960-99-037-3955

This specification has been prepared by and the Qualification Approval Authority is:-

Admiralty Surface Weapons Establishment,
Portsdown, Cosham,
Portsmouth, Hants,
England.

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 1			0.65	I				
Visual and Mechanical Inspection	5.1.1.							
SUB-GROUP 2			1.0	II				
Collector-emitter Cut-off Current, Emitter-base Short-circuited	7.2.5.4.	V_{CE} = -6V for CV7594 -10V for CV7595 V_{BE} = 0			I_{CES}		80	nA
Collector-base Breakdown Voltage, Emitter-base Open-circuit	7.2.1.	I_C = 10 µA I_E = 0			BV_{CBO}			V
		CV7594 CV7595				12 20		
Collector-emitter Sustaining Voltage	7.2.2.2.	Pulse Test I_B = 0 I_C = 10 mA Pulse Duration = 300 µS Duty Cycle = 1%			$V_{CEO(sust.)}$			V
		CV7594 CV7595				12 20		

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
Emitter-base Breakdown Voltage	7.2.3.	I_C = 0 I_E = 100 µA			BV_{EBO}	4		V
Collector-emitter Saturation Voltage (1)	7.3.3.	I_C = 30 mA I_B = 3 mA			V_{CE} (sat.)		0.2	V
Base-emitter Saturation Voltage (1)	7.3.1.	I_C = 30 mA I_B = 3 mA			V_{BE} (sat.)	0.85	1.2	V
Static Forward Current Transfer Ratio (1)	7.3.4.2.	Pulse Test I_C = 30 mA V_{CE} = -0.5V Pulse Duration = 300 µS Duty Cycle = 1%			h_{FE}			
		CV7594 CV7595				40 30	150 120	

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 3			2.5	I				
Static Forward Current Transfer Ratio (2)	7.3.4.2.	Pulse Test I_C = 10 mA V_{CE} = -0.3V Pulse Duration = 300 µS Duty Cycle = 1% CV7594 CV7595			h_{FE}	 30 25		
Static Forward Current Transfer Ratio (3)	7.3.4.2.	Pulse Test I_C = 100 mA V_{CE} = -1.0V Pulse Duration = 300 µS Duty Cycle = 1% CV7594 CV7595			h_{FE}	 25 15		
Common Emitter Forward Current Transfer Ratio at High Frequency	7.5.2.	I_C = 30 mA V_{CE} = -10V f = 100 Mc/s			$\lvert h_{fe} \rvert$	4		

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 4			6.5	IA				
Collector-emitter Cut-off Current, Emitter-base Short-circuited	7.2.5.4.	V_{CE} = -6V for CV7594 -10V for CV7595 V_{BE} = 0 T_{amb} = 125°C ± 3°C			I_{CES}		10	µA
Collector-emitter Saturation Voltage (2)	7.3.3.	I_C = 10 mA I_B = 1 mA			$V_{CE(sat.)}$		0.15	V
Collector-emitter Saturation Voltage (3)	7.3.3.	I_C = 100 mA I_B = 10 mA			$V_{CE(sat.)}$		0.5	V
Base-emitter Saturation Voltage (2)	7.3.1.	I_C = 10 mA I_B = 1 mA			$V_{BE(sat.)}$	0.78	0.98	V
Base-emitter Saturation Voltage (3)	7.3.1.	I_C = 100 mA I_B = 10 mA			$V_{BE(sat.)}$		1.7	V

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
Static Forward Current Transfer Ratio (4)	7.3.4.2.	Pulse Test I_C = 30 mA V_{CE} = -0.5V T_{amb} = -55°C Pulse Duration = 300 nS Duty Cycle = 1% CV7594 CV7595			h_{FE}	 17 12		
Output Capacitance	7.4.8.	V_{CB} = -5.0V I_E = 0 f = 1 Mc/s			C_{ob}		5	pF
Emitter Transition Capacitance		V_{EB} = -0.5V I_C = 0 f = 1 Mc/s			C_{TE}		6	pF

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
Turn-on Time		I_C = 30 mA I_{B1} = 1.5 mA See Fig. 2 on Page 15			t_{ON}		60	nS
Turn-off Time		I_C = 30 mA $I_{B1} = I_{B2}$ = 1.5 mA See Fig. 2 on Page 15			t_{OFF}		90	nS

Table II

GROUP B INSPECTION

(See Page 3. Quality Assurance Provisions, Destructive Tests)

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 1			6.5	IC				
Physical Dimensions	5.1.2.	According to Drawings 10.3.2.4. and 10.4.2.4.						
SUB-GROUP 2			4.0	IA				
Solderability	5.13.							
Temperature Cycling	5.5.	-65°C to +200°C						
Moisture Resistance	5.3.							
SUB-GROUP 3			4.0	IA				
Vibration Fatigue	5.15.	Non-operating						
Constant Acceleration	5.14.	Non-operating. 20,000g						
SUB-GROUP 4			6.5	IA				
Lead Fatigue	5.10.2.	1 Cycle						
SUB-GROUP 5								
Omitted								
SUB-GROUP 6								
Omitted								

Table II

GROUP B INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 7			4.0	I				
High Temperature Life	6.2.1.	T_{amb} = 200°C						
(Non-operating)	6.6.1.2.2.	t = 1000 hours						
SUB-GROUP 8			4.0	IA				
Operating Life	6.3.	V_{CB} = -6V min. for CV7594						
	6.5.	-10V min. for CV7595						
	6.6.1.1.	T_{amb} within the range 25°C to 150°C						
	6.6.1.2.2.	P_{tot} = max. value given by the derating curve Fig. 1, Page 14 according to the chosen T_{amb}						
Post Test End Points for Sub-groups 2, 3 and 7								
Collector-emitter Cut-off Current, Emitter-base Short circuited	7.2.5.4.	As in Group A, Sub-group 2			I_{CES}		160	nA

Table II

GROUP B INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
Static Forward Current Transfer Ratio (1)	7.3.1.	As in Group A, Sub-group 2			h_{FE}			
		CV7594				35	170	
		CV7595				26	135	
Collector-emitter Saturation Voltage (1)	7.3.3.	As in Group A, Sub-group 2			$V_{CE(sat.)}$		0.22	V
Base-emitter Saturation Voltage (1)	7.3.1.	As in Group A, Sub-group 2			$V_{BE(sat.)}$		1.32	V
Post Test End Points for Sub-group 8								
Collector-emitter Cut-off Current, Emitter-base Short-circuited	7.2.5.4.	As in Group A, Sub-group 2			I_{CES}		160	nA
Change of Static Forward Current Transfer Ratio (1)	7.3.1.	As in Group A, Sub-group 2			Δh_{FE}		± 15	%
Collector-emitter Saturation Voltage (1)	7.3.3.	As in Group A, Sub-group 2			$V_{CE(sat.)}$		0.22	V
Base-emitter Saturation Voltage (1)	7.3.1.	As in Group A, Sub-group 2			$V_{BE(sat.)}$		1.32	V

Table III

GROUP C INSPECTION

(See Page 3. Quality Assurance Provisions)

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUB-GROUP 1								
Omitted								
SUB-GROUP 2			6.5	IA				
Shock	5.17.	Non-operating. Five blows each orientation, Y_1, Y_2, X_1 and Z_1						
Post Test End Points for Sub-group 2								
Collector-emitter Cut-off Current, Emitter-base Short-circuit	7.2.5.4.	As in Group A, Sub-group 2			I_{CES}		160	nA
Static Forward Current Transfer Ratio (1)	7.3.1.	As in Group A, Sub-group 2			h_{FE}			
		CV7594				35	170	
		CV7595				26	135	
Collector-emitter Saturation Voltage (1)	7.3.3.	As in Group A, Sub-group 2			$V_{CE(sat.)}$		0.22	V
Base-emitter Saturation Voltage (1)	7.3.1.	As in Group A, Sub-group 2			$V_{BE(sat.)}$		1.32	V

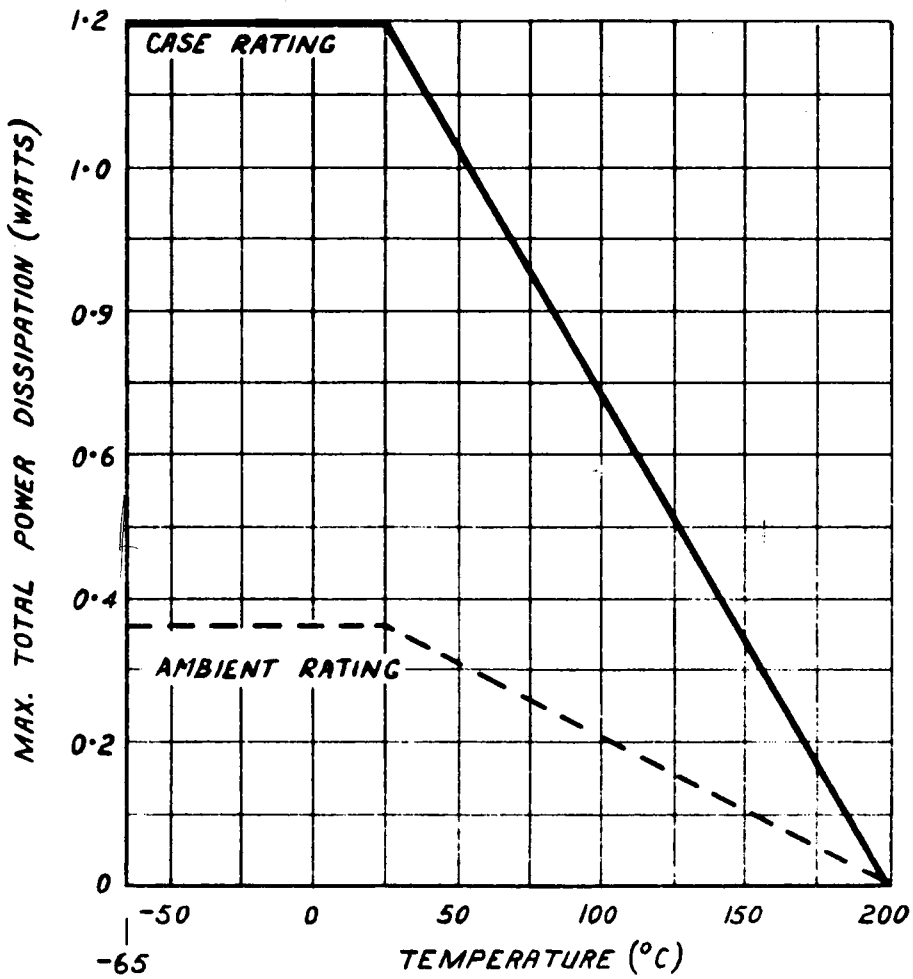
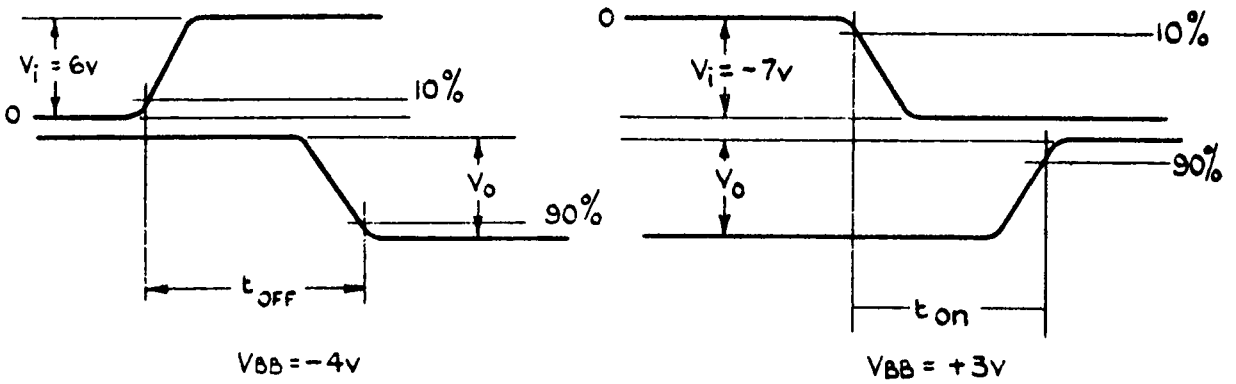


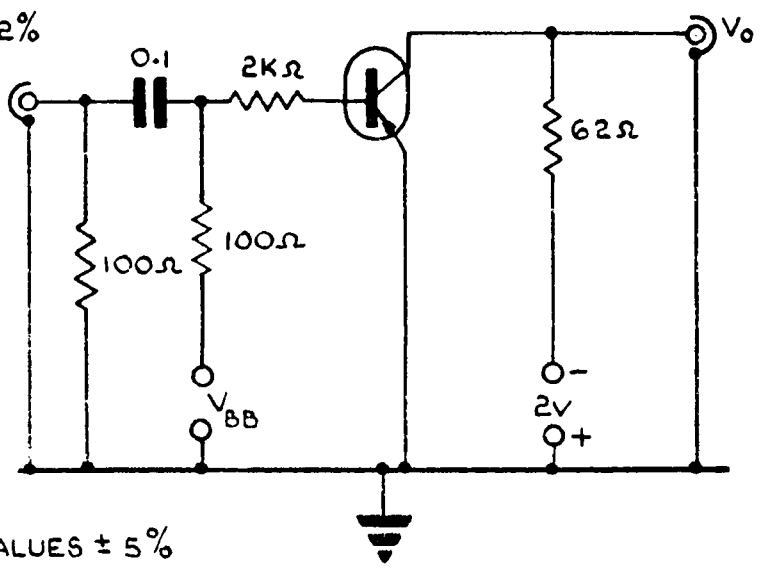
FIG. 1. DERATING CURVE

FIG. 2. t_{ON} AND t_{OFF} MEASUREMENT CIRCUIT



PULSE GENERATOR
Z_g = 50
t_r < 1ns
t_w ≫ 200ns.
DUTY CYCLE < 2%

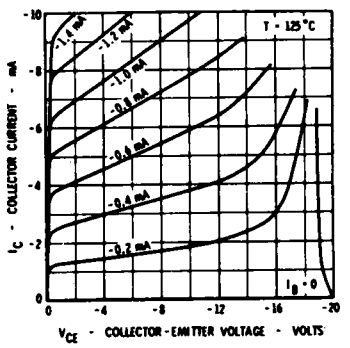
SAMPLING OSCILLOSCOPE
Z_i = 100KΩ
t_r < 1ns.

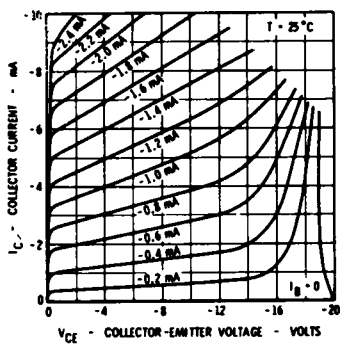


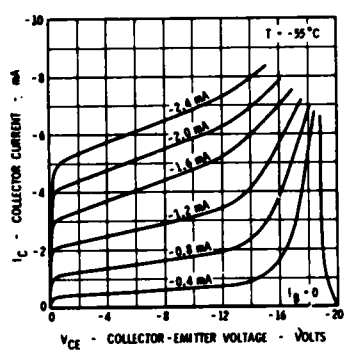
ALL RESISTOR VALUES ± 5%

TYPICAL COLLECTOR CHARACTERISTICS

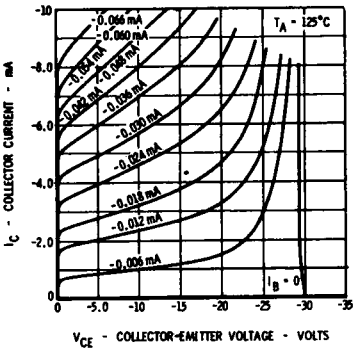
CV7594

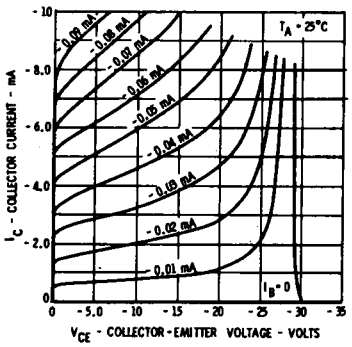


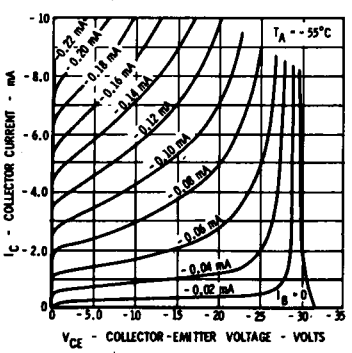




CV7595

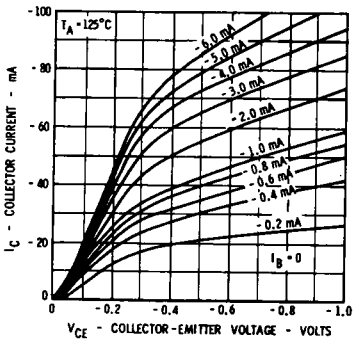


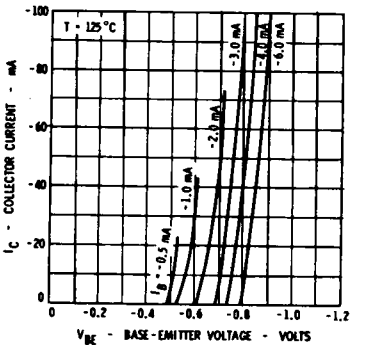


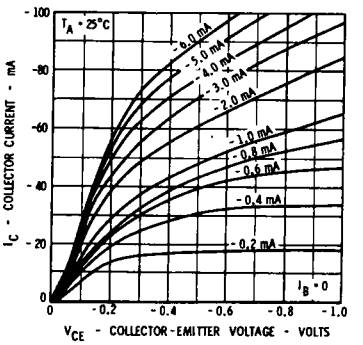


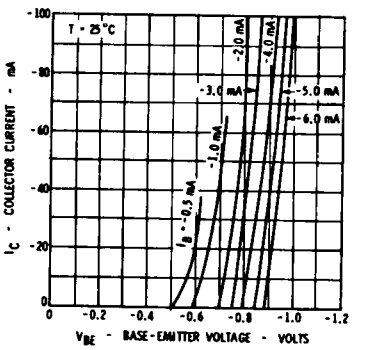
TYPICAL COLLECTOR AND BASE CHARACTERISTICS

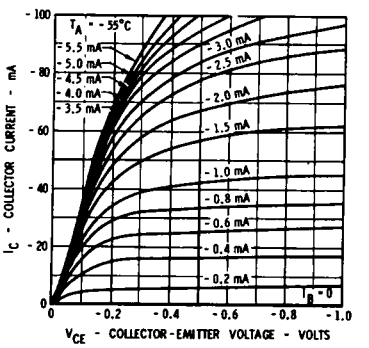
SATURATION REGION

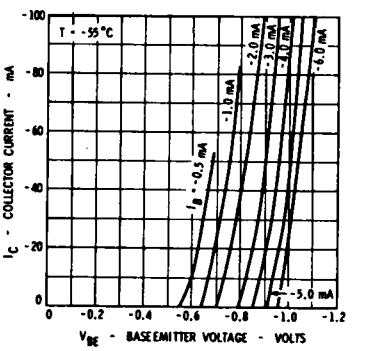








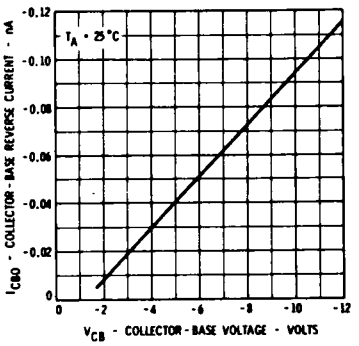




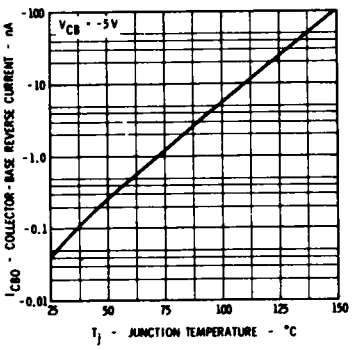
TYPICAL ELECTRICAL CHARACTERISTICS

CV7594

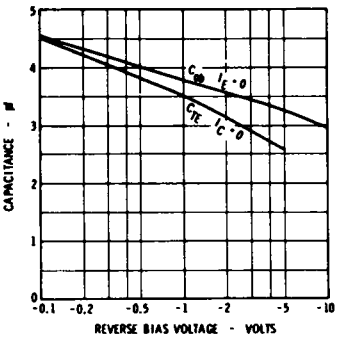
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

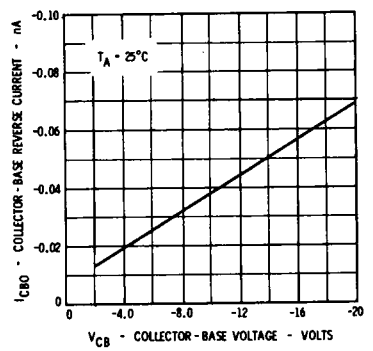


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

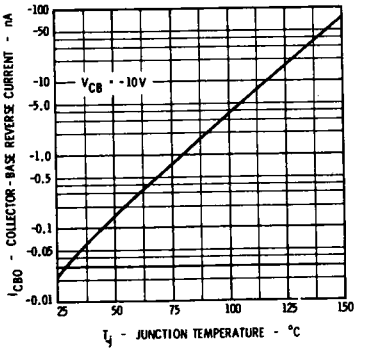


CV7595

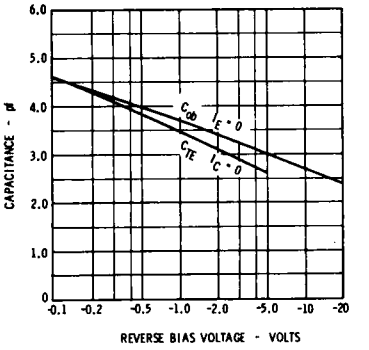
COLLECTOR-BASE REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE

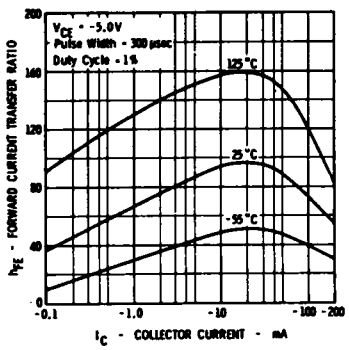


INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

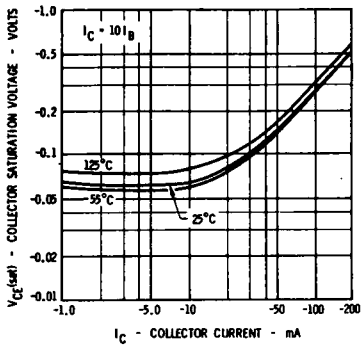


TYPICAL ELECTRICAL CHARACTERISTICS

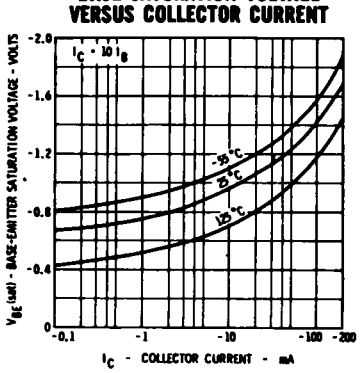
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



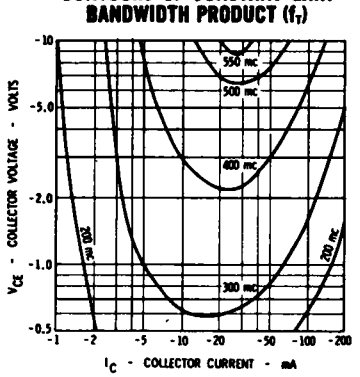
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

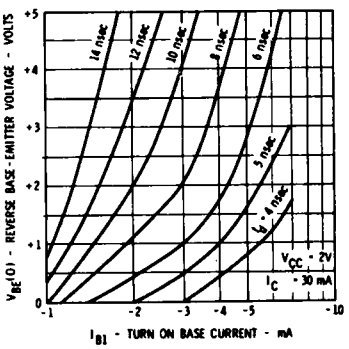


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

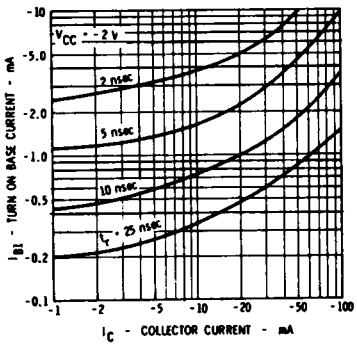


TYPICAL ELECTRICAL CHARACTERISTICS

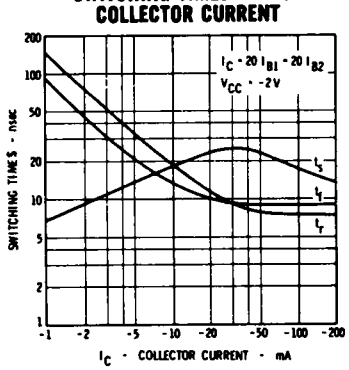
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



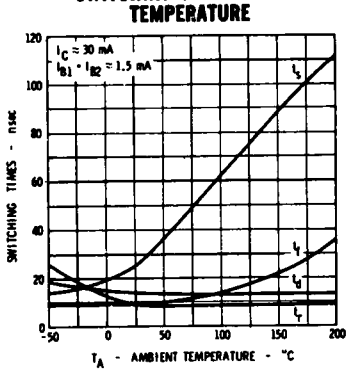
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



SWITCHING TIMES VERSUS COLLECTOR CURRENT

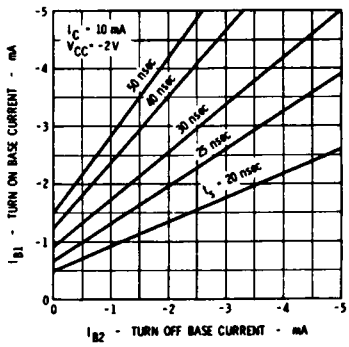


SWITCHING TIMES VERSUS TEMPERATURE

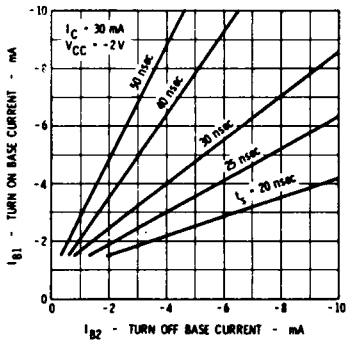


TYPICAL ELECTRICAL CHARACTERISTICS

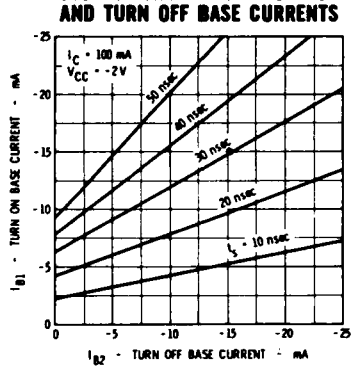
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



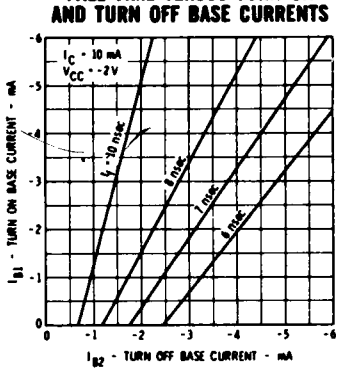
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



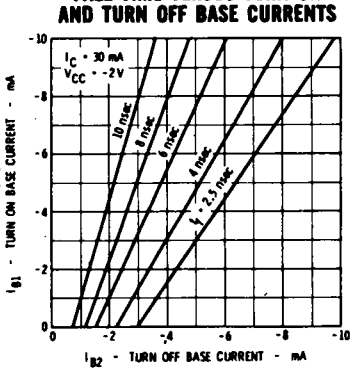
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



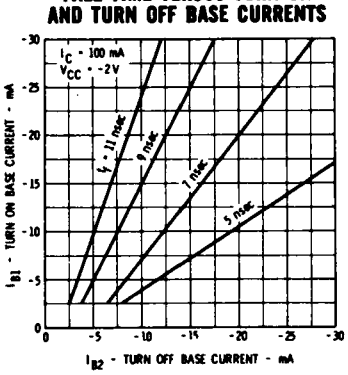
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

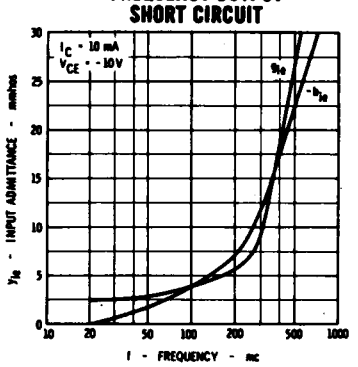


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

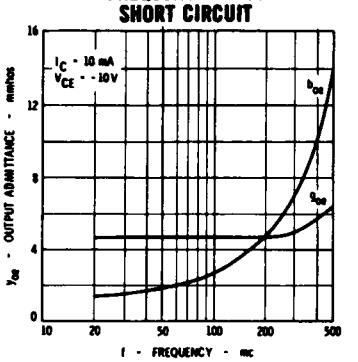


TYPICAL COMMON EMITTER "Y" PARAMETERS

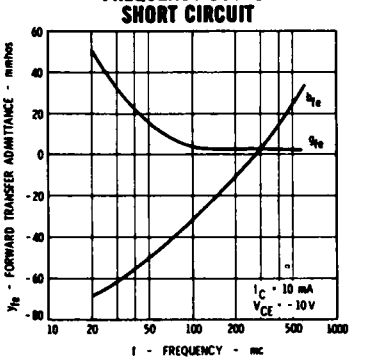
INPUT ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



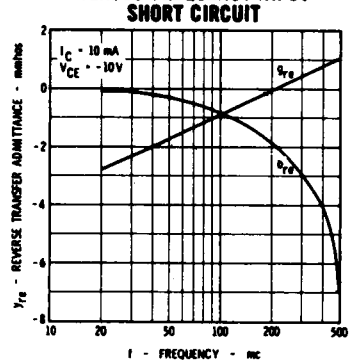
OUTPUT ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



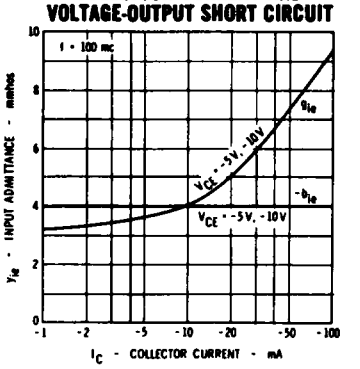
FORWARD TRANSFER ADMITTANCE VERSUS FREQUENCY-OUTPUT SHORT CIRCUIT



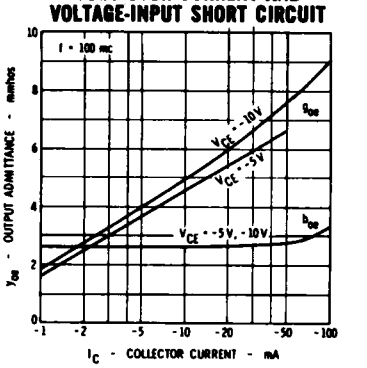
REVERSE TRANSFER ADMITTANCE VERSUS FREQUENCY-INPUT SHORT CIRCUIT



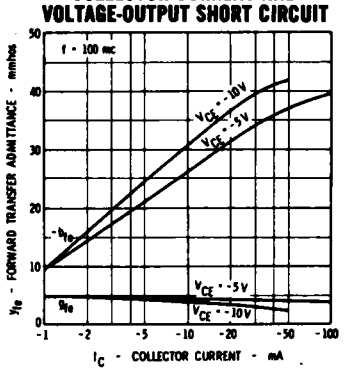
INPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT



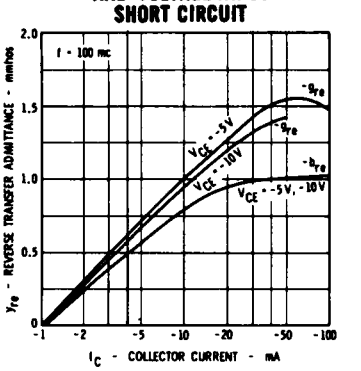
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT



FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-OUTPUT SHORT CIRCUIT

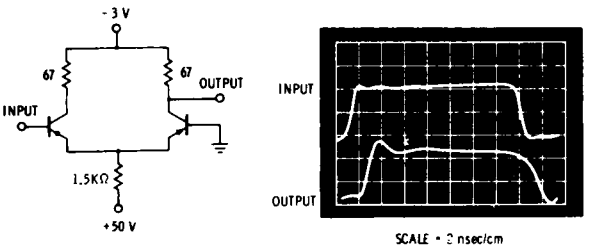


REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT AND VOLTAGE-INPUT SHORT CIRCUIT

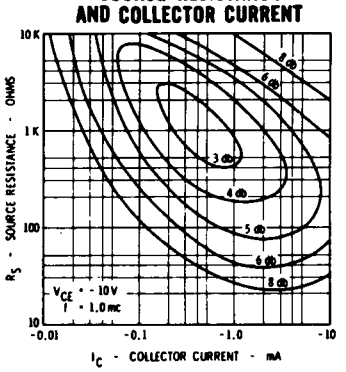


TYPICAL ELECTRICAL CHARACTERISTICS

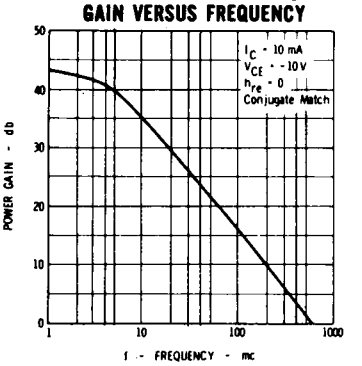
NON SATURATED SWITCHING PERFORMANCE



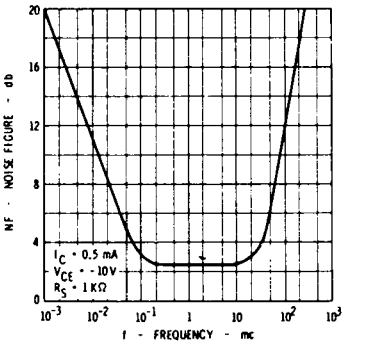
NOISE FIGURE VERSUS SOURCE RESISTANCE AND COLLECTOR CURRENT



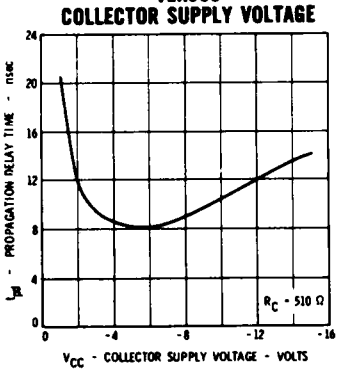
IDEALIZED SMALL SIGNAL POWER GAIN VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY