

MILITARY SPECIFICATION

CV 7594-5

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 $T_{amb} = 25^{\circ}C$.
 - B. See derating curve on Page 14
 - C. At $T_{case} = 25^{\circ}C$.
 - D. Duration = 0.5 mS.
 - E. Commercial equivalents.

CV7594 - 2N2894.

CV7595 - 2N3209.

CV7594-5

Primary Electrical Characteristics

Characteristic	I _{CES}	I _{CES}	V _{CE}	V _{CE}	V _{CE}	V _{BE}	V _{BE}	V _{BE}	h _{FE}	r _T	C _{ob}	C _{TE}	t _{ON}	t _{OFF}
Unit	nA	μA	V	V	V	V	V	V		Ms/s	pF	pF	ns	ns
CV7594	Min.								40	400				
	Max.	80	10	-0.15	-0.2	-0.5	-0.78	-0.85	30	17				
CV7595	Min.								30	12				
	Max.	80	10	-0.15	-0.2	-0.5	-0.98	-1.2	120		5.0	6.0	60	90
Conditions	V _{CB}	V									-5.0			
	V _{CE}	V	-6	-6					-0.5	-0.5				
	V _{BE}	V	0	0								-0.5		
	I _C	mA		0.01	0	10	10	30	100	30	30	0	30	30
	I _E	mA		0	0.1						0			
	I _B	mA				0	1.0	3.0	10					
	I _{B1}	mA											1.5	1.5
	I _{B2}	mA												1.5
	f	Ms/s									1.0	1.0		
	T _{amb}	°C	25	125	25	25	25	25	25	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,
Portsmouth, Hants,
England.

GROUP A INSPECTION

Table I.

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
<u>SUB-GROUP 1</u>			0.65	I				
Visual and Mechanical Inspection	5.1.1.							
<u>SUB-GROUP 2</u>			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.	$I_C = 10 \mu A$ $I_E = 0$ CV7594 CV7595			BV_{CBO}			V
Collector-emitter Sustaining Voltage	7.2.2.2.	Pulse Test $I_B = 0$ $I_C = 10 \text{ mA}$ Pulse Duration = $300 \mu s$ Duty Cycle = 1% CV7594 CV7595			V_{CEO} (sust.)	12 20		V

GROUP A INSPECTION

Table I

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.	$I_C = 0$			BV_{EBO}	4		V
		$I_E = 100 \mu A$						
Collector-emitter Saturation Voltage (1)	7.3.3.	$I_C = 30 \text{ mA}$			$V_{CE} \text{ (sat.)}$		0.2	V
		$I_B = 3 \text{ mA}$						
Base-emitter Saturation Voltage (1)	7.3.1.	$I_C = 30 \text{ mA}$			$V_{BE} \text{ (sat.)}$	0.85	1.2	V
		$I_B = 3 \text{ mA}$						
Static Forward Current Transfer Ratio (1)	7.3.4.2.	Pulse Test			h_{FE}			
		$I_C = 30 \text{ mA}$						
		$V_{CE} = -0.5V$						
		Pulse Duration = $300 \mu s$						
		Duty Cycle = 1%						
		CV7594				40	150	
		CV7595				30	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 Static Forward Current Transfer Ratio (2)	7.3.4.2.	Pulse Test $I_C = 10 \text{ mA}$ $V_{CE} = -0.3V$ Pulse Duration = $300 \mu\text{s}$ Duty Cycle = 1% CV7594 CV7595	2.5	I	h_{FE}	30 25		
	7.3.4.2.	Pulse Test $I_C = 100 \text{ mA}$ $V_{CE} = -1.0V$ Pulse Duration = $300 \mu\text{s}$ Duty Cycle = 1% CV7594 CV7595			h_{FE}			
Common Emitter Forward Current Transfer Ratio at High Frequency	7.5.2.	$I_C = 30 \text{ mA}$ $V_{CE} = -10V$ $f = 100 \text{ Mc/s}$			$ h_{fe} $	25 15 4		

Table I

GROUP A INSPECTION

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

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

GROUP A INSPECTIONTable I

Examination or Test	K1007/ NATO Ref.	Test Conditions Specific Conditions	AQL %	Insp. Level	Symbol	Limits		Units
						Min.	Max.	
Turn-on Time		$I_C = 30 \text{ mA}$ $I_{B1} = 1.5 \text{ mA}$ See Fig. 2 on Page 15			t_{ON}		60	nS
Turn-off Time		$I_C = 30 \text{ mA}$ $I_{B1} = I_{B2} = 1.5 \text{ mA}$ 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.	
<u>SUB-GROUP 1</u> Physical Dimensions	5.1.2.	According to Drawings 10.3.2.4. and 10.4.2.4.	6.5	IC				
<u>SUB-GROUP 2</u> Solderability	5.13.		4.0	IA				
Temperature Cycling	5.5.	-65°C to +200°C						
Moisture Resistance	5.3.							
<u>SUB-GROUP 3</u> Vibration Fatigue	5.15.	Non-operating	4.0	IA				
Constant Acceleration	5.14.	Non-operating. 20,000g						
<u>SUB-GROUP 4</u> Lead Fatigue	5.10.2.	1 Cycle	6.5	IA				
<u>SUB-GROUP 5</u> Omitted								
<u>SUB-GROUP 6</u> Omitted								

GROUP B INSPECTIONTable II

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
<u>SUB-GROUP 7</u> High Temperature Life (Non-operating)	6.2.1.	$T_{amb} = 200^{\circ}\text{C}$	4.0	I				
	6.6.1.2.2.	$t = 1000$ hours						
<u>SUB-GROUP 8</u> Operating Life	6.3.	$V_{CB} = -6\text{V min. for CV7594}$	4.0	IA				
	6.5.	$-10\text{V min. for CV7595}$						
	6.6.1.1.	T_{amb} within the range 25°C to						
	6.6.1.2.2.	150°C $P_{tot} = \text{max. value given by the}$ derating curve Fig. 1, Page 14 according to the chosen T_{amb}						
<u>Post Test End Points for</u> <u>Sub-groups 2, 3 and 7</u> Collector-emitter Cut-off Current, Emitter-base Short circuited	7.2, 5.4.	As in Group A, Sub-group 2			I_{CES}		160	nA

GROUP B INSPECTION

Table II

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 CV7594 CV7595			h_{FE}	35 26	170 135	
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.	
<u>SUB-GROUP 1</u>								
Omitted								
<u>SUB-GROUP 2</u>								
Shock	5.17.	Non-operating. Five blows each orientation, Y_1 , Y_2 , X_1 and Z_1	6.5	IA				
<u>Post Test End Points for Sub-group 2</u>								
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 CV7595				35 26	170 135	
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

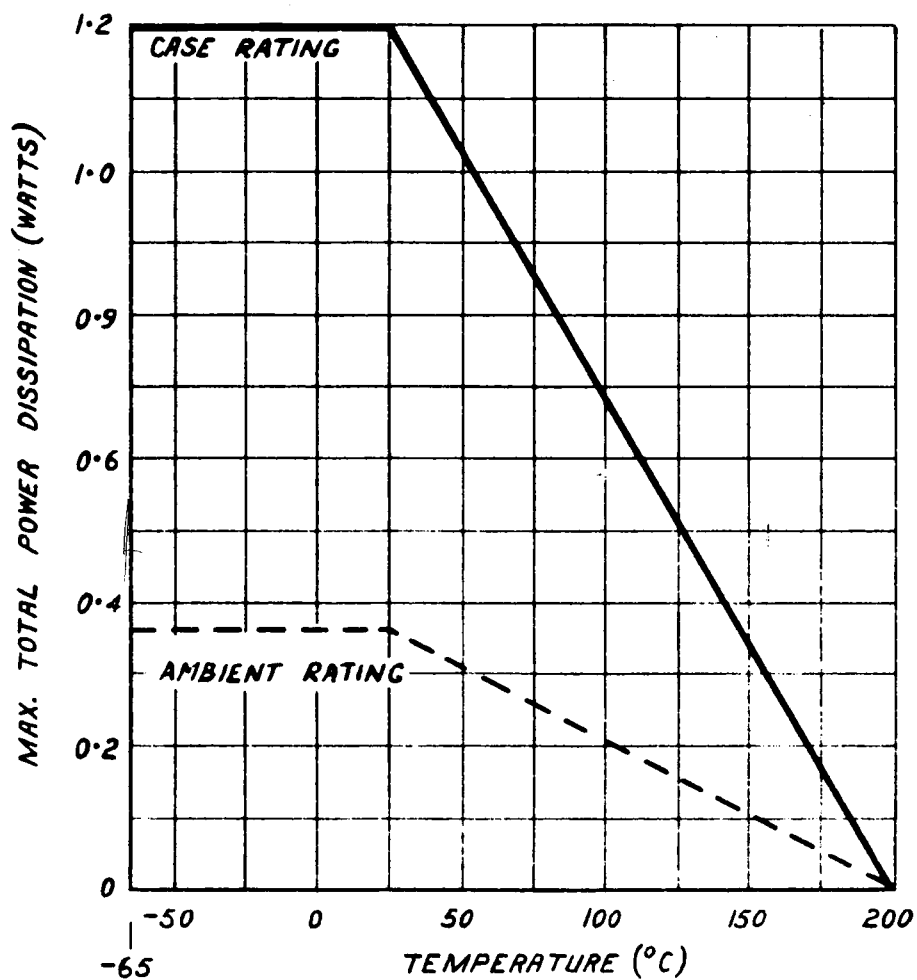
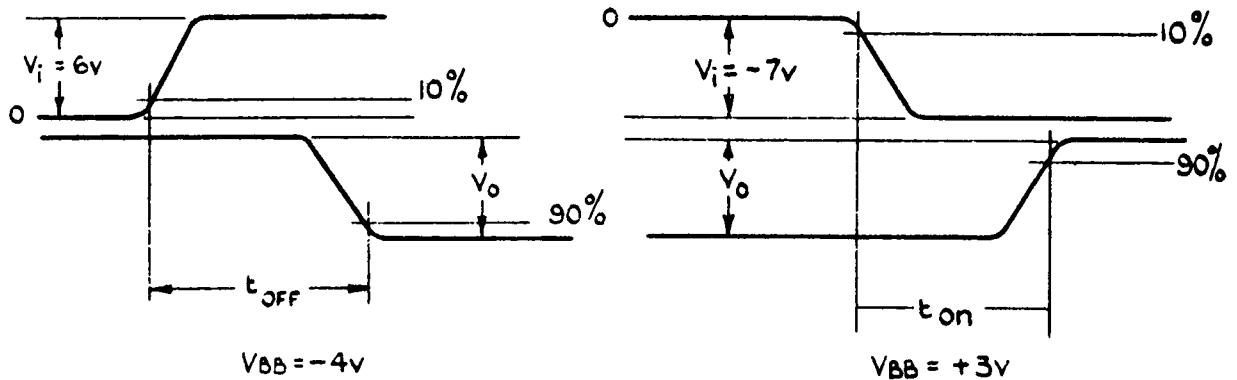


FIG. 1. DERATING CURVE

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

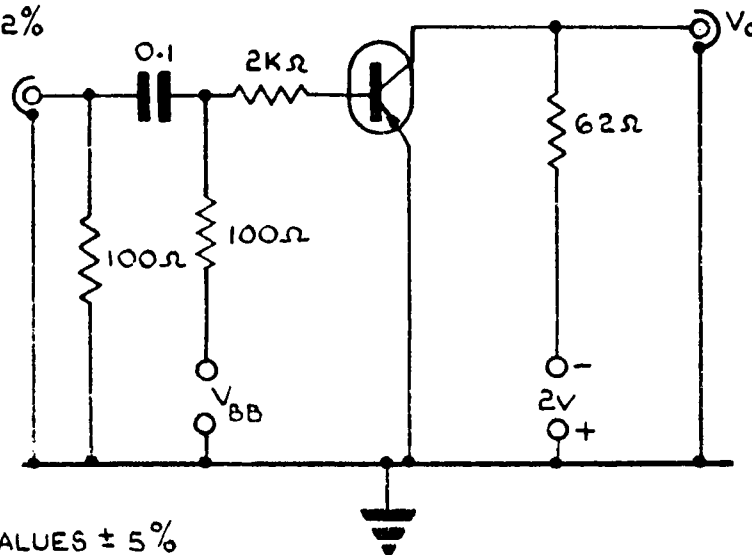


PULSE GENERATOR

$Z_g = 50$
 $t_r < 1ns$
 $t_w \gg 200ns$
 DUTY CYCLE $< 2\%$

SAMPLING OSCILLOSCOPE

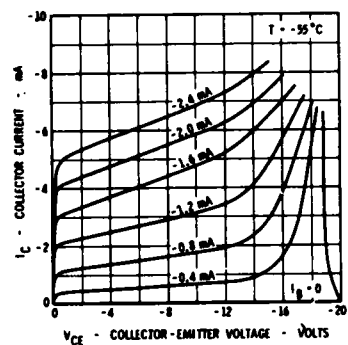
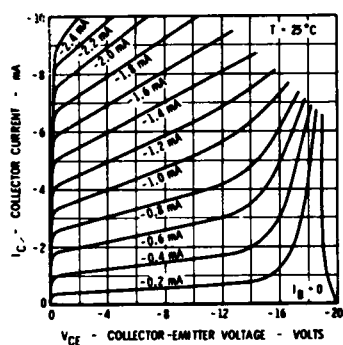
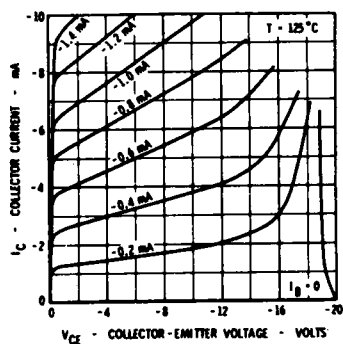
$Z_i = 100K\Omega$
 $t_r < 1ns$



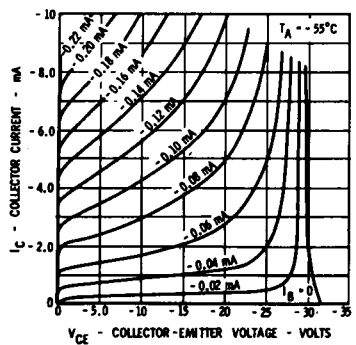
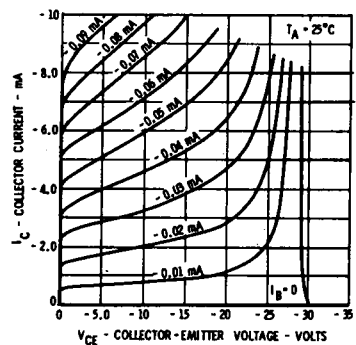
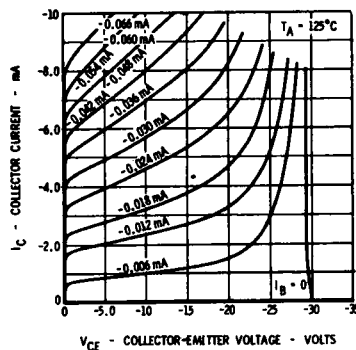
ALL RESISTOR VALUES $\pm 5\%$

TYPICAL COLLECTOR CHARACTERISTICS

CV7594

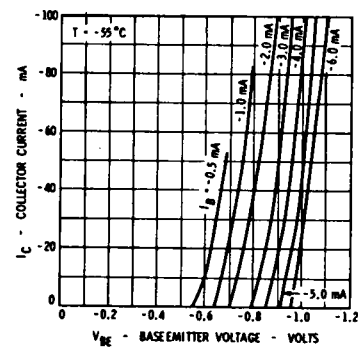
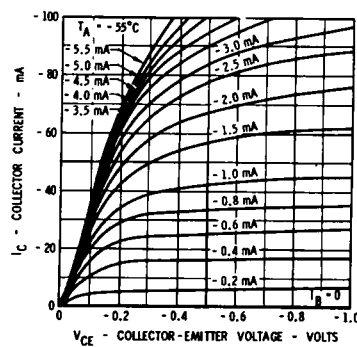
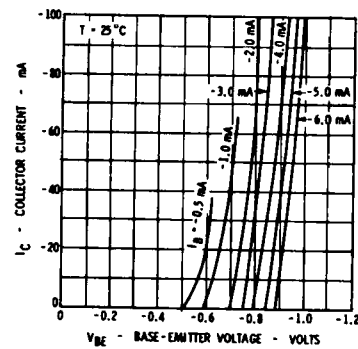
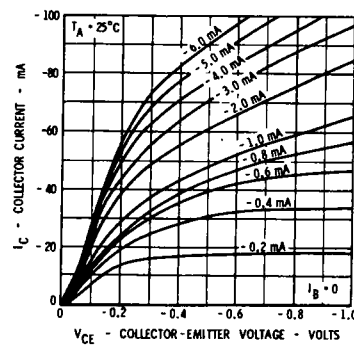
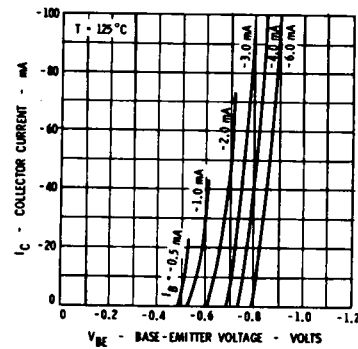
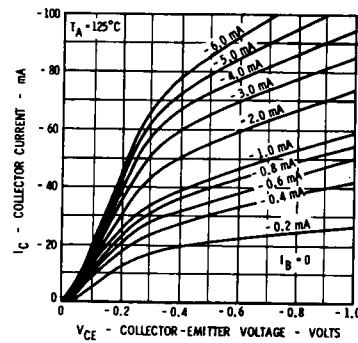


CV7595

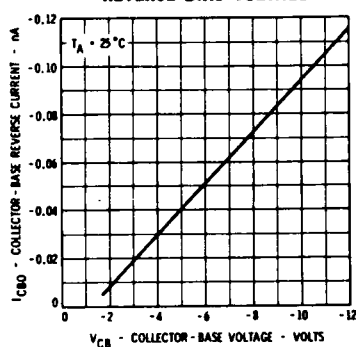
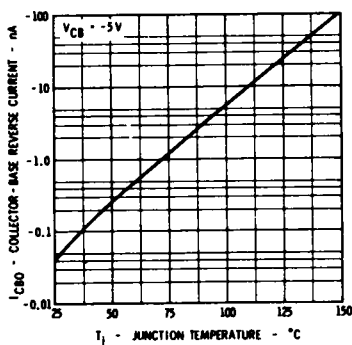
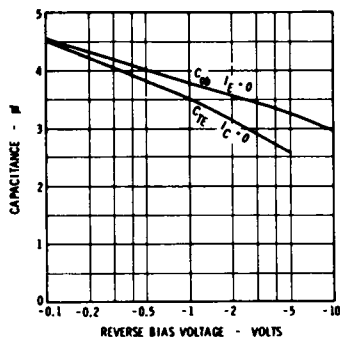
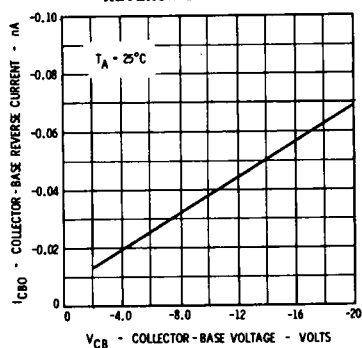
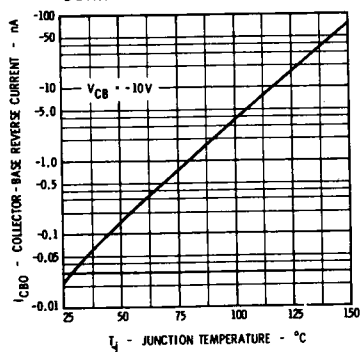
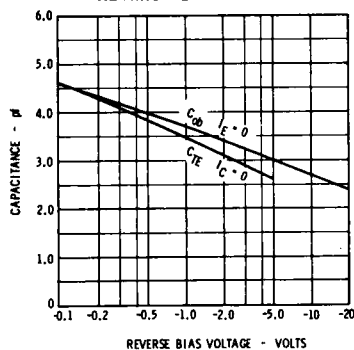


TYPICAL COLLECTOR AND BASE CHARACTERISTICS

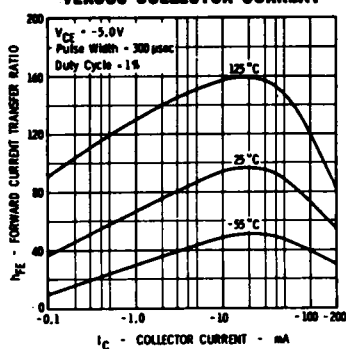
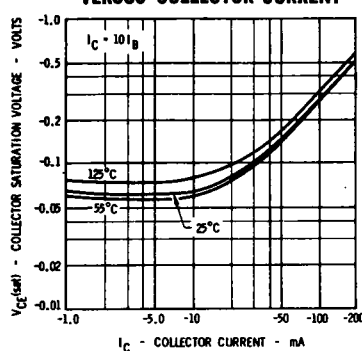
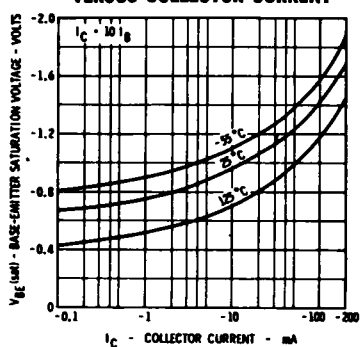
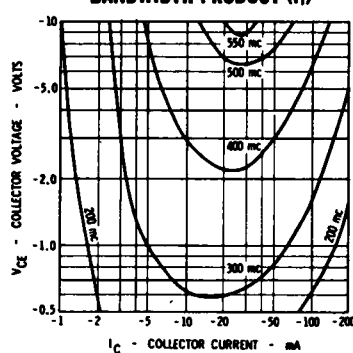
SATURATION REGION



TYPICAL ELECTRICAL CHARACTERISTICS

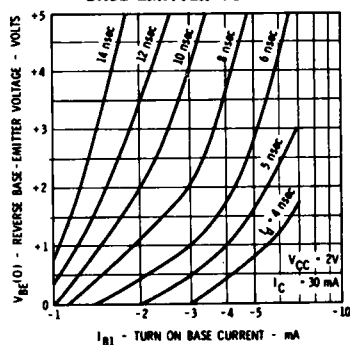
CV7594**COLLECTOR-BASE REVERSE
CURRENT VERSUS
REVERSE BIAS VOLTAGE****COLLECTOR-BASE DIODE REVERSE
CURRENT VERSUS TEMPERATURE****INPUT AND OUTPUT
CAPACITANCES VERSUS
REVERSE BIAS VOLTAGE****CV7595****COLLECTOR-BASE REVERSE
CURRENT VERSUS
REVERSE BIAS VOLTAGE****COLLECTOR-BASE DIODE REVERSE
CURRENT VERSUS TEMPERATURE****INPUT AND OUTPUT
CAPACITANCES VERSUS
REVERSE BIAS VOLTAGE**

TYPICAL ELECTRICAL CHARACTERISTICS

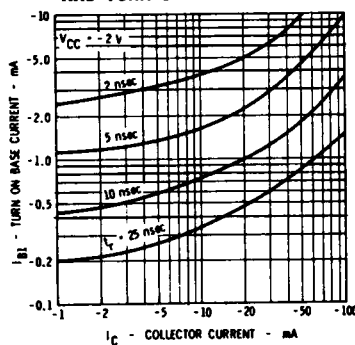
PULSED DC CURRENT GAIN
VERSUS COLLECTOR CURRENTCOLLECTOR SATURATION VOLTAGE
VERSUS COLLECTOR CURRENTBASE SATURATION VOLTAGE
VERSUS COLLECTOR CURRENTCONTOURS OF CONSTANT GAIN
BANDWIDTH PRODUCT (f_T)

TYPICAL ELECTRICAL CHARACTERISTICS

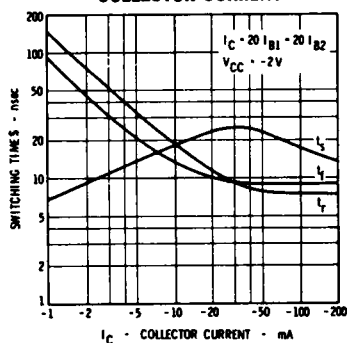
DELAY TIME VERSUS TURN ON
BASE CURRENT AND REVERSE
BASE-EMITTER VOLTAGE



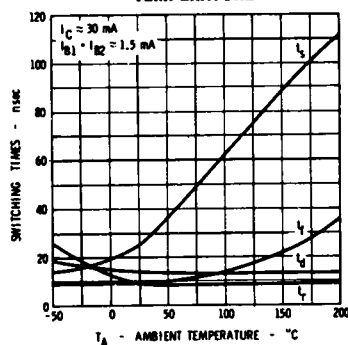
RISE TIME VERSUS COLLECTOR
AND TURN ON BASE CURRENTS



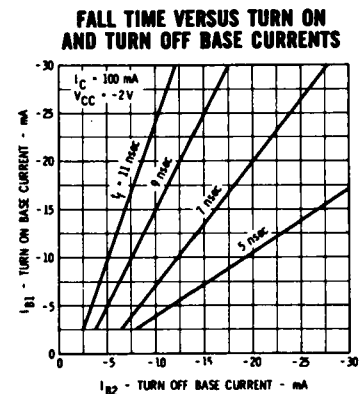
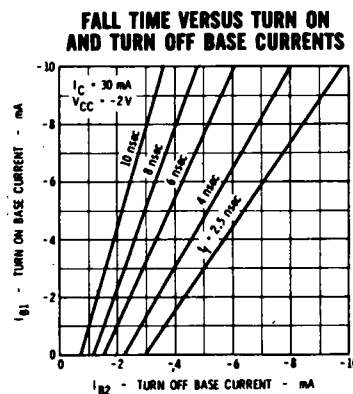
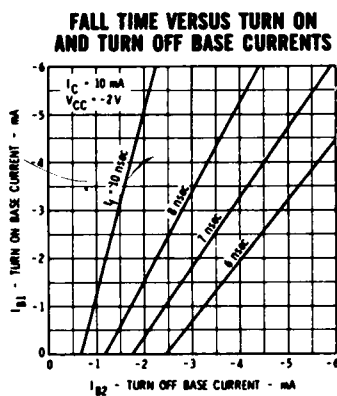
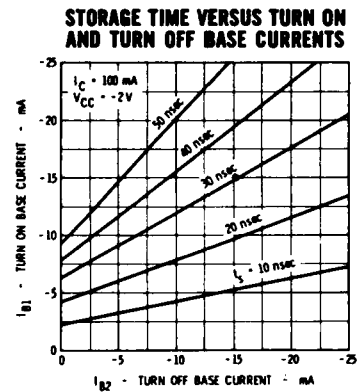
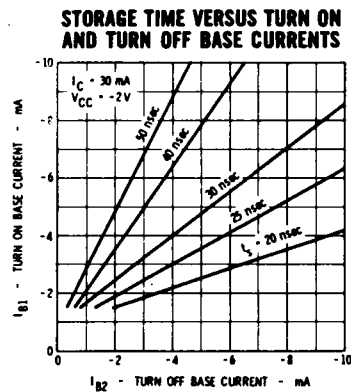
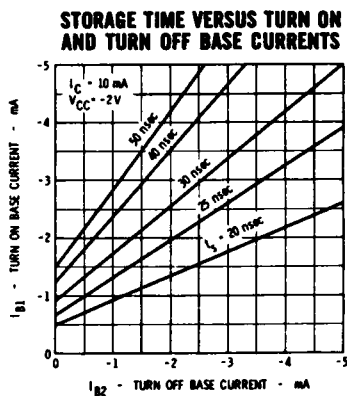
SWITCHING TIMES VERSUS
COLLECTOR CURRENT



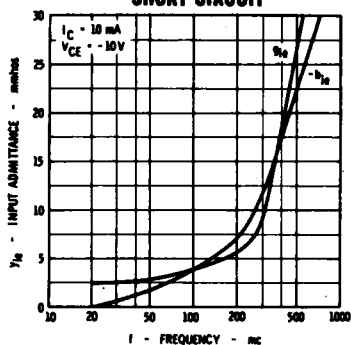
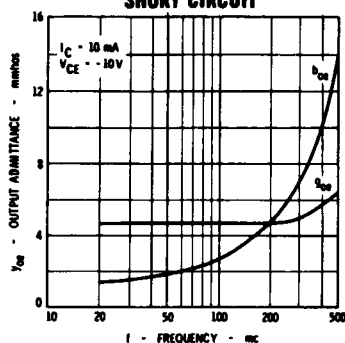
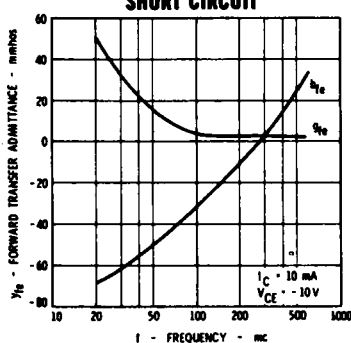
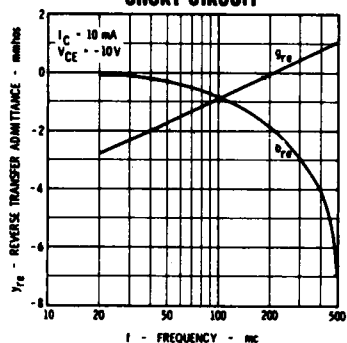
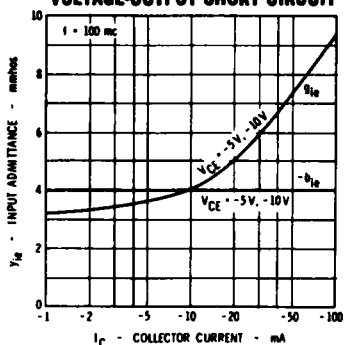
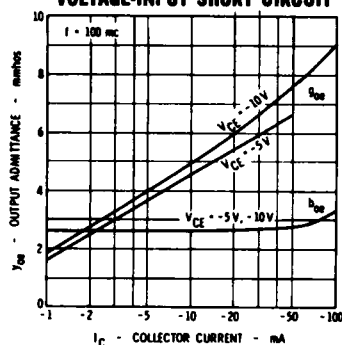
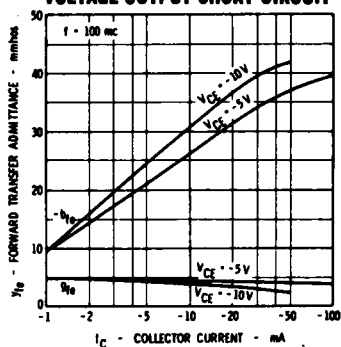
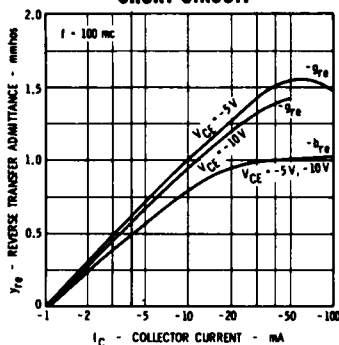
SWITCHING TIMES VERSUS
TEMPERATURE



TYPICAL ELECTRICAL CHARACTERISTICS

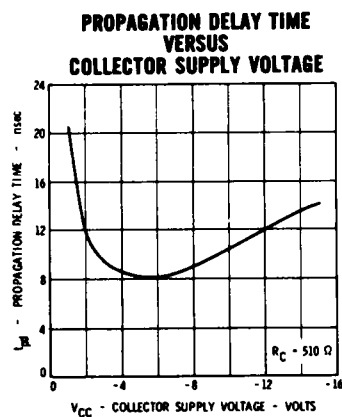
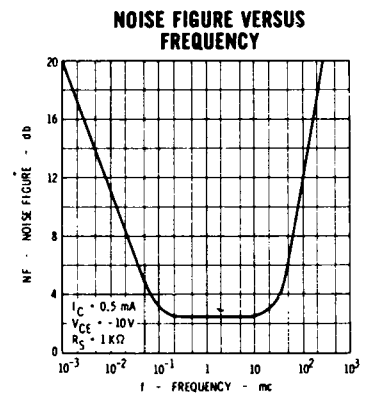
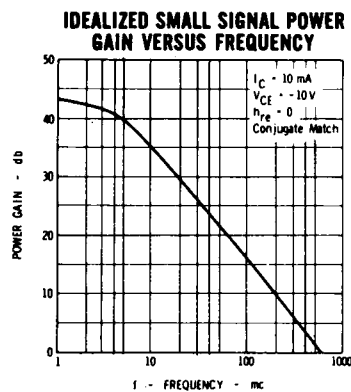
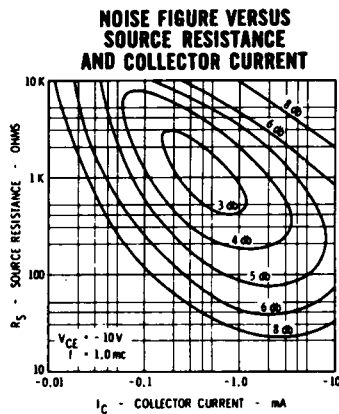
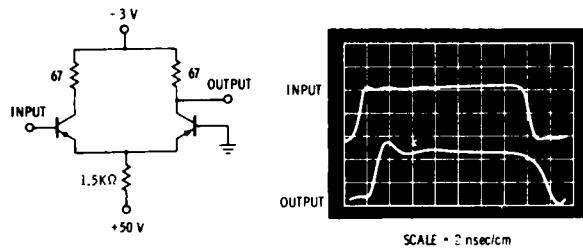


TYPICAL COMMON EMITTER "Y" PARAMETERS

INPUT ADMITTANCE VERSUS
FREQUENCY-OUTPUT
SHORT CIRCUITOUTPUT ADMITTANCE VERSUS
FREQUENCY-INPUT
SHORT CIRCUITFORWARD TRANSFER
ADMITTANCE VERSUS
FREQUENCY-OUTPUT
SHORT CIRCUITREVERSE TRANSFER
ADMITTANCE
VERSUS FREQUENCY-INPUT
SHORT CIRCUITINPUT ADMITTANCE VERSUS
COLLECTOR CURRENT AND
VOLTAGE-OUTPUT SHORT CIRCUITOUTPUT ADMITTANCE VERSUS
COLLECTOR CURRENT AND
VOLTAGE-INPUT SHORT CIRCUITFORWARD TRANSFER
ADMITTANCE VERSUS
COLLECTOR CURRENT AND
VOLTAGE-OUTPUT SHORT CIRCUITREVERSE TRANSFER
ADMITTANCE
VERSUS COLLECTOR CURRENT
AND VOLTAGE-INPUT
SHORT CIRCUIT

TYPICAL ELECTRICAL CHARACTERISTICS

NON SATURATED SWITCHING PERFORMANCE



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY

