MILITARY SPECIFICATION

CV7555

SEMICONDUCTOR DEVICE, TRANSISTOR 2N2369A

Description:- This specification covers the detail requirements for Silicon NPN Planar Epitaxial High Speed Switching 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_{CES}	V_{EBO}	I_C	I_{CM}	P_{tot}	P_{tot}	T_{stg}	T_{amb}	Shock	Vibration
Unit	V	V	V	V	mA	mA	mW	mW	°C	°C	g	g
Min.	-	-	-	-	-	-	-	-	-65	-65	-	-
Max.	40	15	40	4.5	200	500	360	1200	+200	+200	1500	20
Note						1	2, 4	3, 4			5	

Notes:- 1 Duration = 10 µS max.

2 At T_{amb} = 25°C.

3 At T_{case} = 25°C.

4 See derating curve on page 13.

5 Duration = 0.5 mS

CV7555

Primary Electrical Characteristics

Characteristics	I_{CES}	I_{CBO}	BV_{CES}	BV_{CBO}	$V_{CEO(sust)}$	BV_{EBO}	$V_{CE(sat)}$				$V_{BE(sat)}$				h_{FE}				f_T	C_{ob}	t_{ON}	t_{OFF}	t_s
Unit	/uA	/uA	V	V	V	V	V				V								Mc/s	pF	nS	nS	nS
Minimum	-	-	40	40	15	4.5	-	-	-	-	0.7	-	-	0.59	40	30	20	20	500	-	-	-	-
Typical	0.05	10	-	-	-	-	0.14	0.17	0.28	0.19	0.8	0.9	1.1	-	66	71	*	40	675	2.3	9	13	6.0
Maximum	0.4	30	-	-	-	-	0.2	0.25	0.5	0.3	0.85	1.15	1.6	1.02	120	-	-	-	-	4.0	12	18	13
Conditions																							
V_{CB} V		20																		5.0			
V_{CE} V	20														1.0	0.4	1.0	0.35	10				
V_{BE} V	0		0																				
I_C mA			0.01	0.01	10	0	10	30	100	10	10	30	100	10	10	30	100	10	10		10	10	10
I_E mA		0		0		0.01														0			
I_B mA					0		1.0	3.0	10	1.0	1.0	3.0	10	1.0									
I_{B1} mA																					3.0	3.0	10
I_{B2} mA																						-1.5	-10
f Mc/s																			100	1.0			
T_{amb} °C	25	150	25	25	25	25	25	25	25	125	25	25	25	-55 to +125	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, Subgroups 2, 3 and 4 and in Table III, Group C Inpsection, Subgroup 2 are considered destructive.

Group C Inspection Inspection shall be conducted on the initial lot and thereafter every 90 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 NUMBER

5960-99-037-3808.

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

Admiralty Surface Weapons Establishment,
Portsdown, Cosham,
PORTSMOUTH, Hants.

Table I — **GROUP A INSPECTION**

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUBGROUP 1			0.65	I				
Visual and Mechanical Inspection	5.1.1.							
SUBGROUP 2			1.0	II				
Collector-emitter cut-off current, emitter-base short-circuited.	7.2.5.4.	V_{CE} = 20V V_{BE} = 0			I_{CES}	-	0.4	µA
Collector-base breakdown voltage emitter-base open-circuit	7.2.1.	I_C = 10 µA I_E = 0			BV_{CBO}	40	-	V
Collector-emitter breakdown voltage emitter-base short-circuit	7.2.2.1.1.	I_C = 10 µA V_{BE} = 0			BV_{CES}	40	-	V
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)	15	-	V

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 = 10 μA			BV_{EBO}	4.5	-	V
Collector-emitter saturation voltage (1)	7.3.3.	I_C = 10 mA I_B = 1 mA			$V_{CE(sat)}$	-	0.2	V
Base-emitter saturation voltage (1)	7.3.1.	I_C = 10 mA I_B = 1 mA			$V_{BE(sat)}$	0.7	0.85	V
Static forward current transfer ratio (1)	7.3.4.2.	Pulse test I_C = 10 mA V_{CE} = 1.0V Pulse duration = 300 μS Duty cycle ≤1%			h_{FE}	40	120	

Table I

GROUP A INSPECTION

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUBGROUP 3			2.5	I				
Static forward current transfer ratio (2)	7.3.4.2.	Pulse test I_C = 100 mA V_{CE} = 1.0V Pulse duration = 300 µS Duty cycle 1%			h_{FE}	20	-	
Static forward current transfer ratio (3)	7.3.4.2.	Pulse test I_C = 30 mA V_{CE} = 0.4V Pulse duration = 300 µS Duty cycle 1%			h_{FE}	30	-	
Common emitter forward current transfer ratio at high frequency.	7.5.2.	I_C = 10 mA V_{CE} = 10V f = 100 Mc/s			$\lvert h_{fe} \rvert$	5	-	

Table I

GROUP A INSPECTION

Examination on Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUBGROUP 4			6.5	IA				
Collector-base cut-off current	7.2.5.1.	V_{CB} = 20V I_E = 0 T_{amb} = 150°C ± 3°C			I_{CBO}	-	30	µA
Collector-emitter saturation voltage (2)	7.3.3.	I_C = 30 mA I_B = 3 mA			V_{CE} (sat)	-	0.25	V
Collector-emitter saturation voltage (2)	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 = 30 mA I_B = 3 mA			V_{BE} (sat)	-	1.15	V
Base-emitter saturation voltage (3)	7.3.1.	I_C = 100 mA I_B = 10 mA			V_{BE} (sat)	-	1.6	V

Table I — **GROUP A INSPECTION**

Examination or Test	Test Conditions: K1007/ NATO Ref.	Test Conditions: Specific Conditions	AQL %	Insp. Level	Symbol	Limits: Min.	Limits: Max.	Units
Static forward current transfer ratio (4)	7.3.4.2.	I_C = 10 mA V_{CE} = 0.35V T_{amb} = -55°C			h_{FE}	20	-	
Output capacitance	7.4.8.	V_{CB} = 5V I_C = 0 f = 1 Mc/s			C_{ob}	-	4	pF
Storage time		$I_C = I_{B1}$ = 10 mA I_{B2} = -10 mA See Fig. 2, page 14			t_s	-	13	nS
Turn-on time		I_C = 10 mA I_{B1} = 3 mA See Fig. 3, page 15			t_{ON}	-	12	nS
Turn-off time		I_C = 10 mA I_{B1} = 3 mA I_{B2} = -1.5 mA See Fig. 3, page 15			t_{OFF}	-	18	nS

Table II

GROUP B INSPECTION

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

Examination or Test	Test Conditions		AQL %	Insp.	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
SUBGROUP 1			6.5	IC				
Physical Dimensions	5.1.	According to Drawings 10.3.2.4. and 10.4.2.4.						
SUBGROUP 2			4.0	IA				
Solderability	5.13.							
Tempetature Cycling	5.5.	-65°C to +200°C						
Moisture Resistance	5.3.							
SUBGROUP 3			4.0	I				
Vibration Fatigue	5.15.	Non-operating						
Constant Acceleration	5.14.	Non-operating 20,000g.						
SUBGROUP 4			6.5	IA				
Lead Fatigue	5.10.2.	1 cycle						
SUBGROUP 5								
Omitted								
SUBGROUP 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.	
SUBGROUP 7			4.0	I				
High Temperature Life (non-operating)	6.2.1. 6.6.1.2.2.	T_{amb} = 200°C t = 1000 hours						
SUBGROUP 8			4.0	IA				
Operating Life	6.3. 6.5. 6.6.1.1. 6.6.1.2.2.	V_{CB} = 9V min. T_{amb} with the range 25°C to 150°C. P_{tot} = max. value given by derating curve Fig. 1, page 13 according to the chosen T_{amb}.						
Post Test End Points For Subgroups 2, 3 and 7								
Collector-emitter cut-off current, emitter base short circuited	7.2.5.4.	As in Group A, Subgroup 2			I_{CES}	-	0.6	µA
Static Forward Current Transfer Ratio (1)	7.3.4.2.	As in Group A, Subgroup 2			h_{FE}	35	135	
Collector-emitter saturation voltage (1)	7.3.3.	As in Group A Subgroup 2			$V_{CE(sat)}$	-	0.21	V
Base-emitter saturation voltage (1)	7.3.1.	As in Group A Subgroup 2			$V_{BE(sat)}$	0.6	0.95	V

Table II — **GROUP B INSPECTION**

Examination or Test	Test Conditions		AQL %	Insp. Level	Symbol	Limits		Units
	K1007/ NATO Ref.	Specific Conditions				Min.	Max.	
Post Test End Points for Subgroup 8								
Collector-emitter cut-off current, emitter base short circuited	7.2.5.4.	As in Group A, Subgroup 2			I_{CES}		0.6	µA
Change in Static Forward Current Transfer Ratio (1)	7.3.4.2.	As in Group A, Subgroup 2			Δh_{FE}		±15%	
Collector-Emitter saturation voltage (1)	7.3.3.	As in Group A, Subgroup 2			V_{CE} (sat)		0.21	V
Base-emitter saturation voltage (1)	7.3.1.	As in Group A, Subgroup 2			V_{BE} (sat)	0.6	0.95	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.	
SUBGROUP 1								
Omitted								
SUBGROUP 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 Subgroup 2								
Collector-emitter cut-off current emitter base short circuited	7.2.5.4.	As in Group A			I_{CES}		0.6	µA
Static forward current transfer ratio (1)	7.3.4.2.	As in Group A Subgroup 2			h_{FE}	35	135	
Collector-emitter saturation voltage (1)	7.3.3.	As in Group A Subgroup 2			$V_{CE(sat)}$	-	0.21	V
Base-emitter saturation voltage (1)		As in Group A Subgroup 2			$V_{BE(sat)}$	0.6	0.95	V

FIG. 1 DERATING CURVE

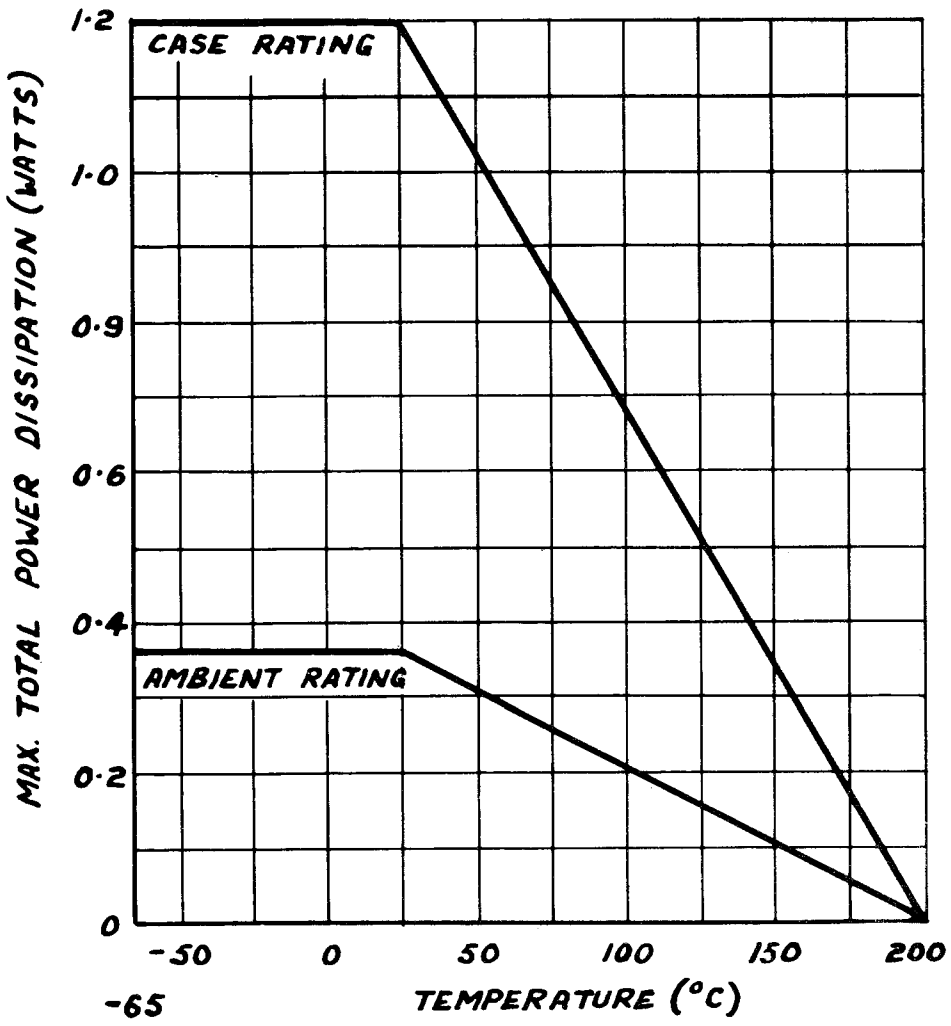
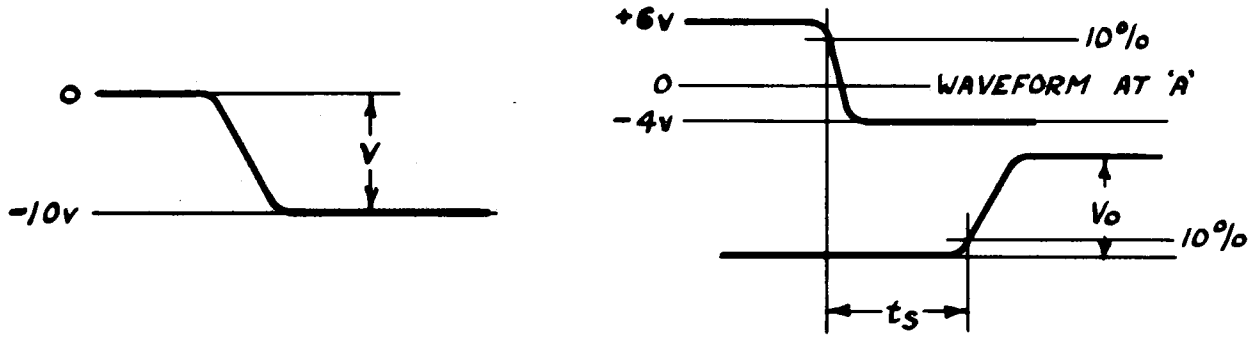
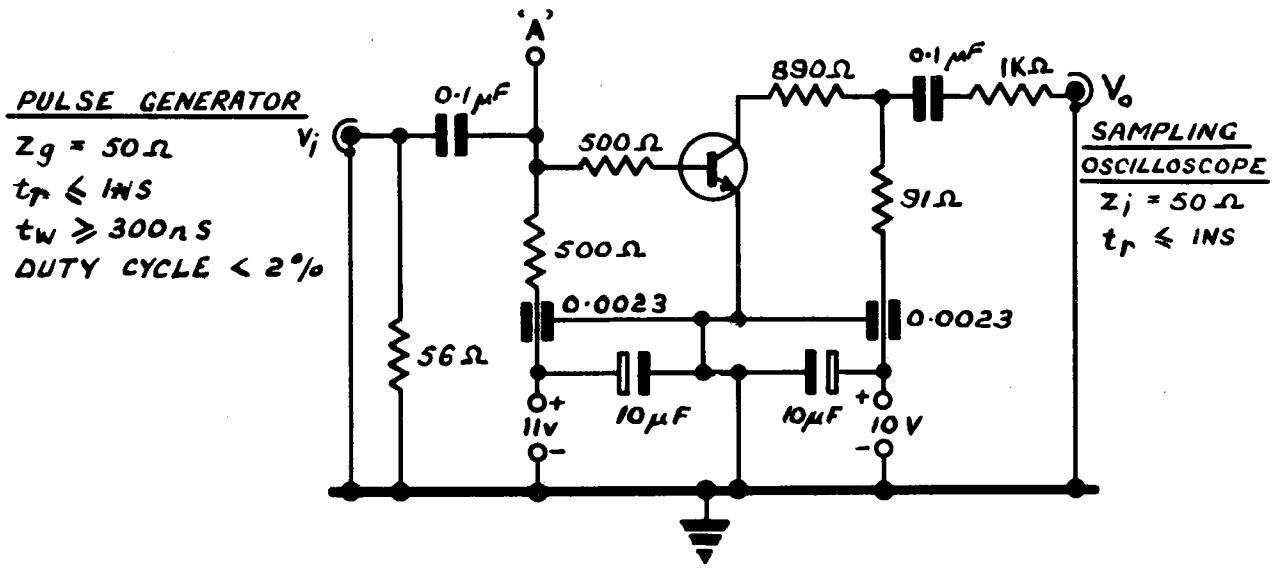


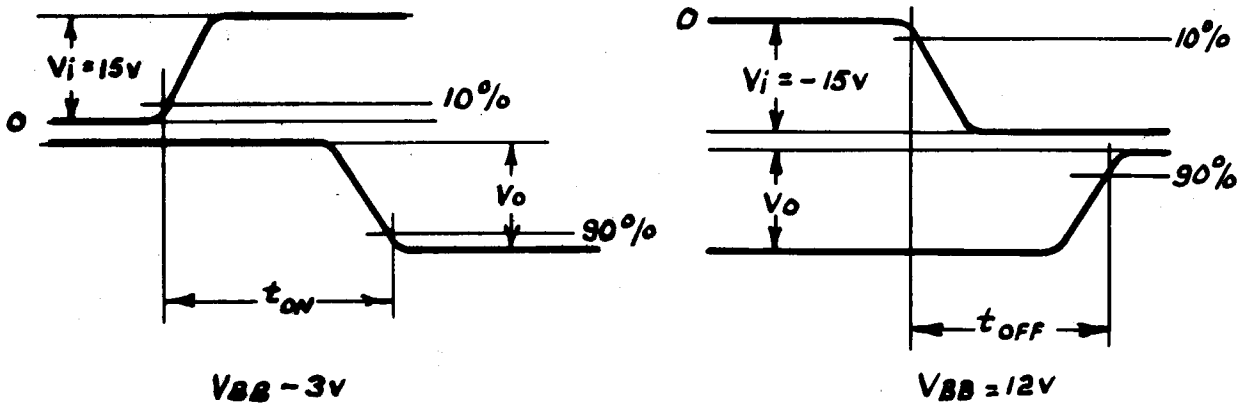
FIG. 2 CHARGE STORAGE TIME MEASUREMENT CIRCUIT

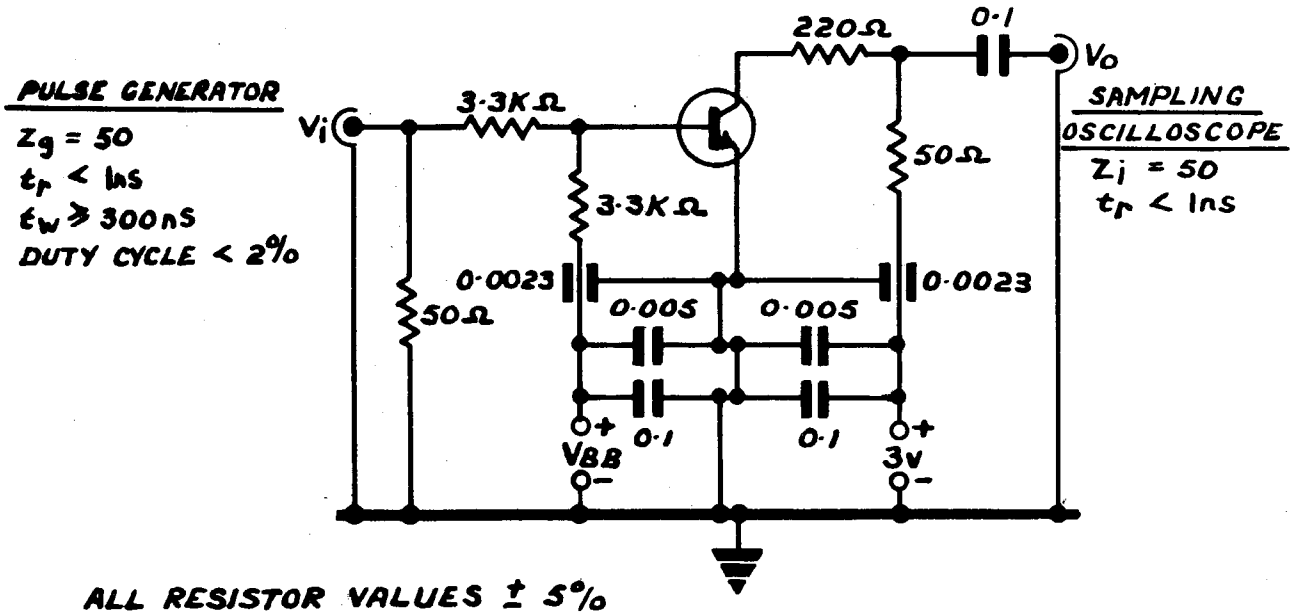




ALL RESISTOR VALUES ± 5%

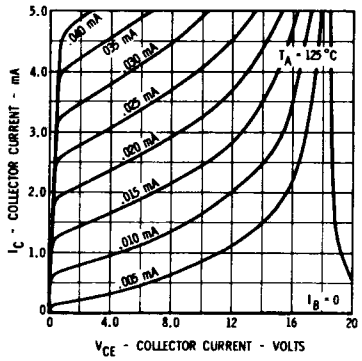
FIG. 3 t_{ON} AND t_{OFF} MEASUREMENT CIRCUIT

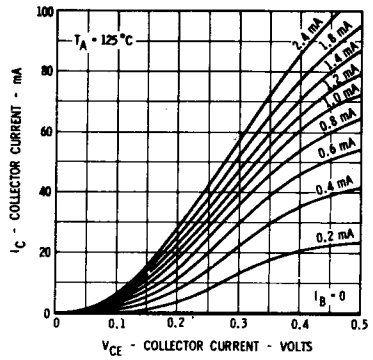


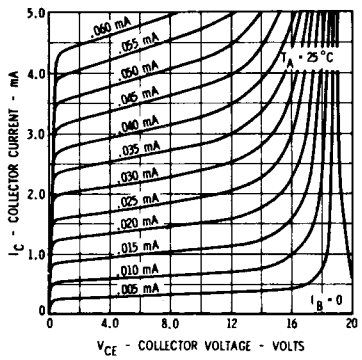


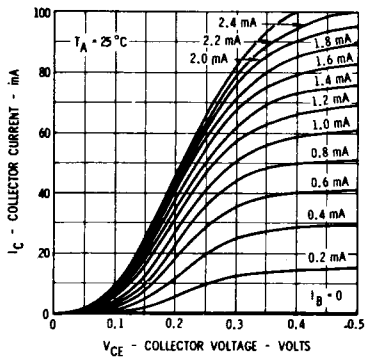
ALL RESISTOR VALUES ± 5%

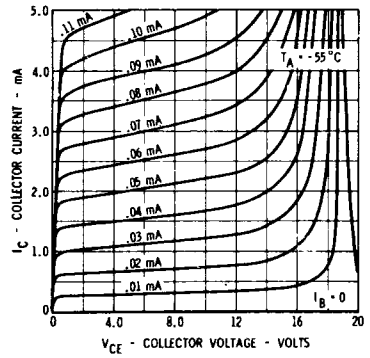
TYPICAL COLLECTOR CHARACTERISTICS*

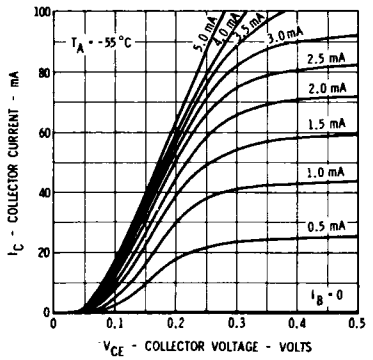




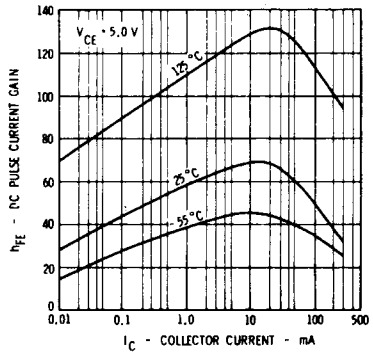




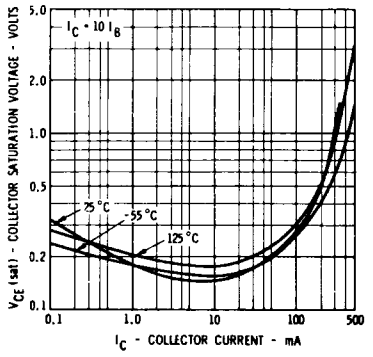




PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



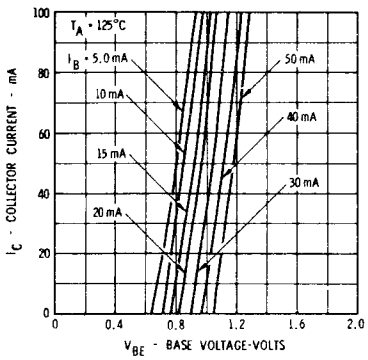
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

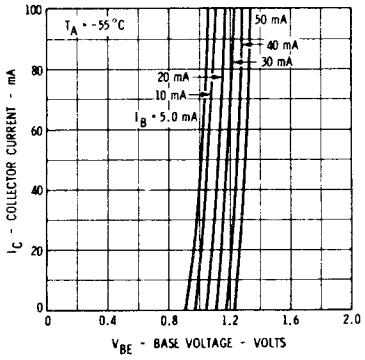


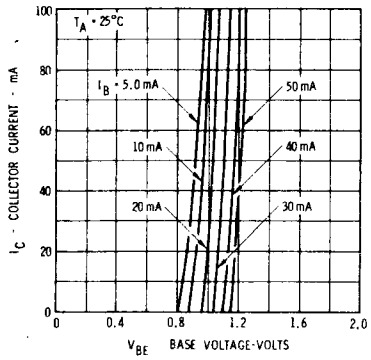
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

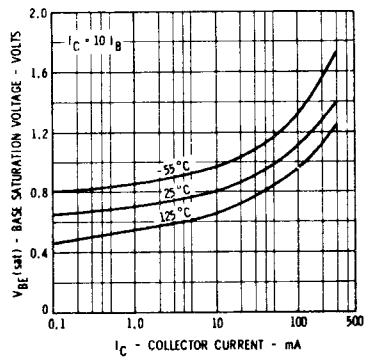
BASE CHARACTERISTICS*







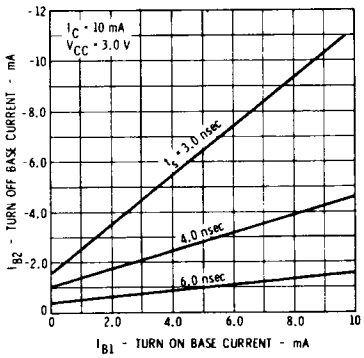
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



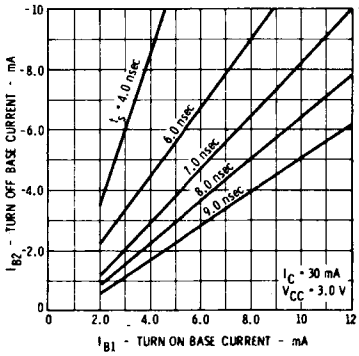
*** Single family characteristics on Transistor Curve Tracer.**

TYPICAL ELECTRICAL CHARACTERISTICS

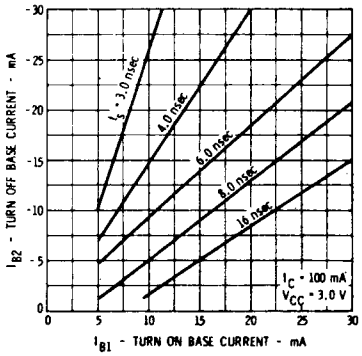
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



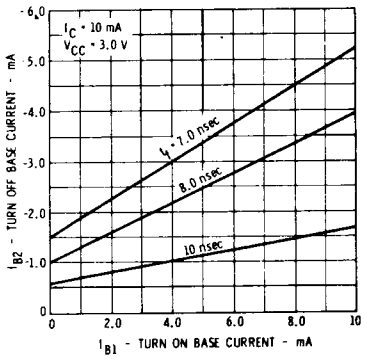
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



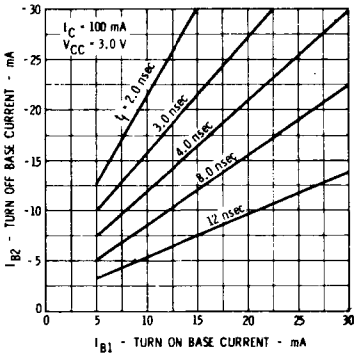
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



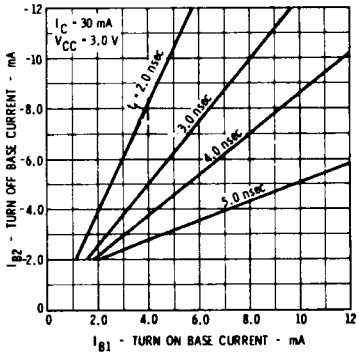
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

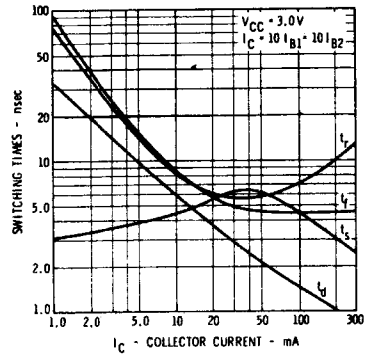


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

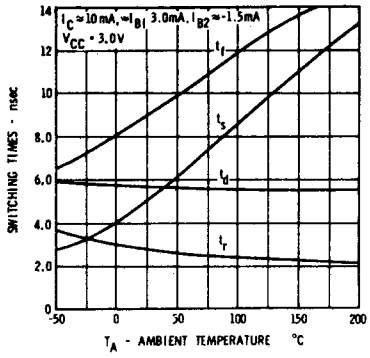


TYPICAL ELECTRICAL CHARACTERISTICS

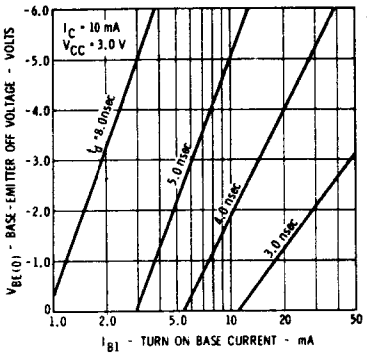
SWITCHING TIMES VERSUS COLLECTOR CURRENT



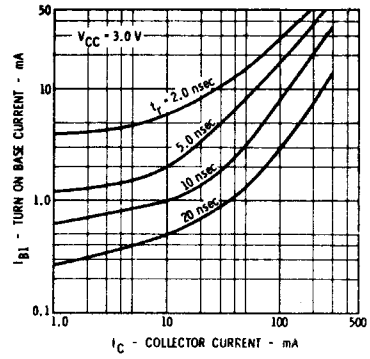
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



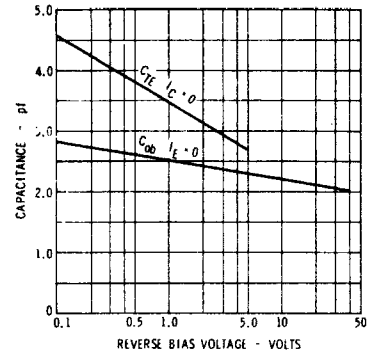
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



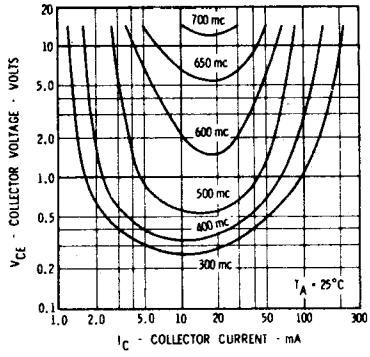
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

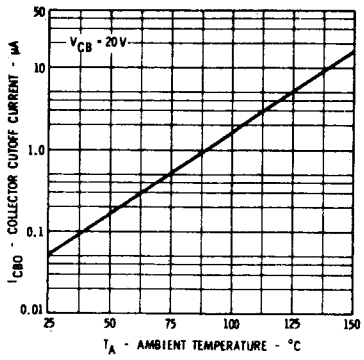


CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

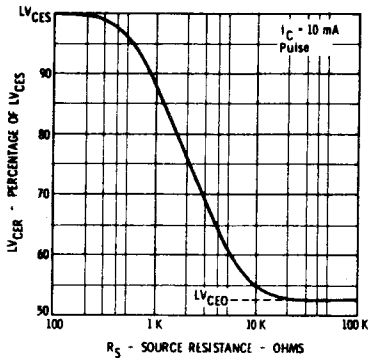


TYPICAL ELECTRICAL CHARACTERISTICS

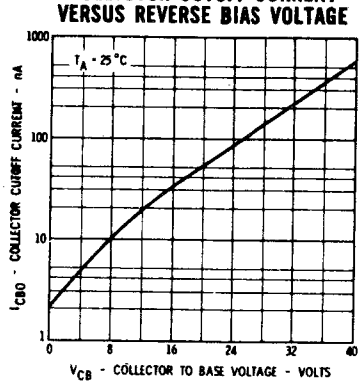
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



LOWER LIMITING VOLTAGE VERSUS SOURCE RESISTANCE

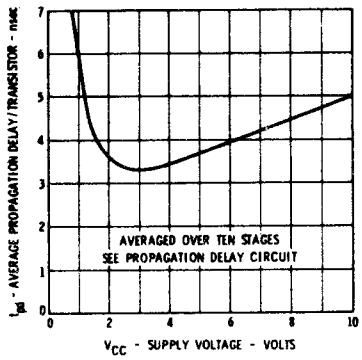


COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE

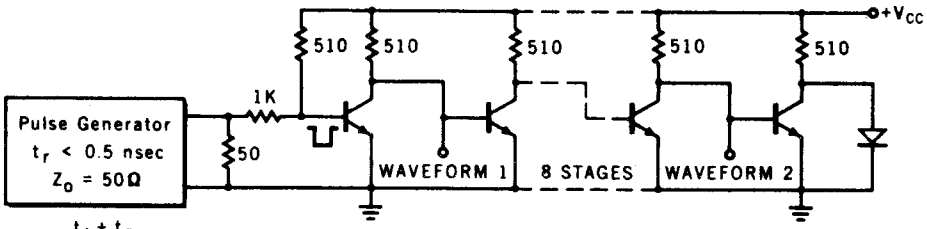


TYPICAL ELECTRICAL CHARACTERISTICS

AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

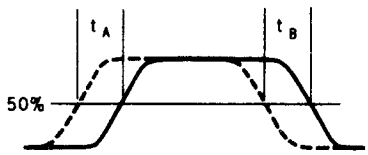


CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY



$$\bar{t}pd = \frac{t_A + t_B}{20}$$

$\bar{t}pd$ = Average Propagation per Transistor



Waveforms 1 and 2 Superimposed