MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR,

PNP, GERMANIUM, HIGH-POWER

TYPE 2N2079A

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detailed requirements for a high-power, germanium, PNP, transistor (see 6.3).

1.2 Physical dimensions. See figure 1 (TO-36).

1.3 Maximum ratings.

P_C 1/ T_{MB} = 25° C	V_{CBO}	V_{EBO}	V_{CES}	V_{CEO}	I_E	I_B	T_{stg}
W	Vdc	Vdc	Vdc	Vdc	Adc	Adc	°C
150	-80	-40	-80	-65	15	4	-65 to +100

1/ Derate linearly 2.0 W/° C for $T_{MB} > 25°$ C.

1.4 Primary electrical characteristics.

	h_{FE}	h_{FE}	f_{hfe}	V_{CE}(sat)	V_{BE}
	V_{CE} = -2Vdc I_C = -5Adc	V_{CE} = -2Vdc I_C = -12Adc	V_{CE} = -6Vdc I_C = -5Adc	I_B = -2Adc I_C = -12Adc	V_{CB} = -2Vdc I_C = -5Adc
			kc	Vdc	Vdc
Min	35	12	5	---	---
Max	70	--	--	-0.7	-0.9

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for

FSC 5960

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS
Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500, and as follows:

T_{MB} - - - - - - - Temperature of the mounting surface of the device.
V_{CEO} - - - - - - Collector to emitter voltage (static), base open.
V_{CES} - - - - - - Collector to emitter voltage (static) base shorted.

3.3 Design and construction. Transistor shall be of the design, construction, and physical dimensions shown on figure 1.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(a) Country of origin.
(b) Manufacturer's identification.

4. QUALITY ASSURANCE PROVISIONS

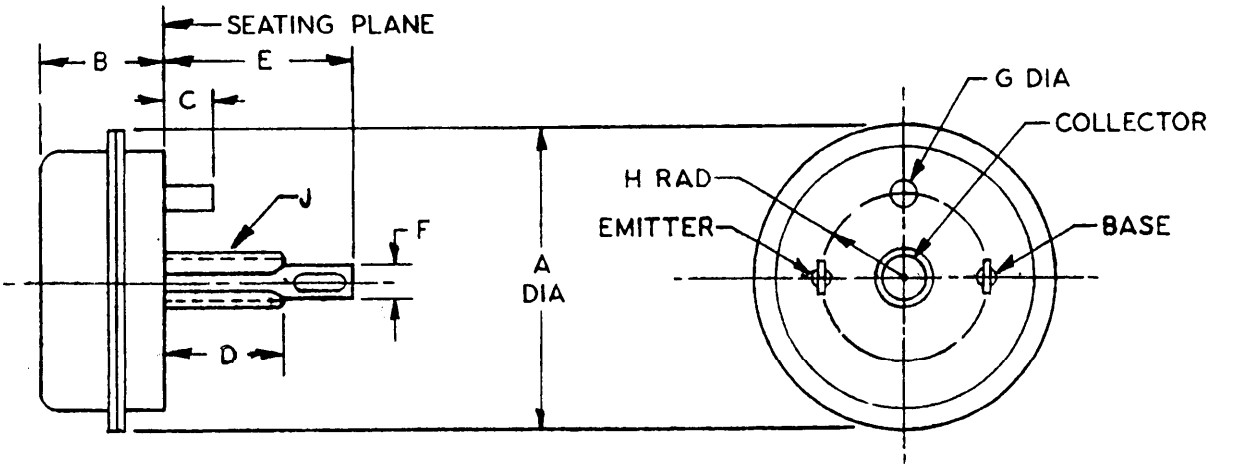
4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A		1.250		31.75	
B		.520		13.21	
C	.125	.312	3.18	7.92	
D	.375	.500	9.53	12.70	
E	.610	.710	15.49	18.03	3
F		.190		4.83	3
G		.140		3.56	5
H	.335	.355	8.51	9.02	
J					2

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. 10-32 UNF-2A, according to Handbook H28.
3. Two leads.
4. The collector shall be internally connected to the mounting base.
5. Cylindrical surface of the locating pin shall be insulated so that electrical contact is not made with the heat sink. Dimension G shall include this insulation. Figure 1a preferred measurement method.

FIGURE 1. Physical dimensions of transistor type 2N2079A (TO-36).

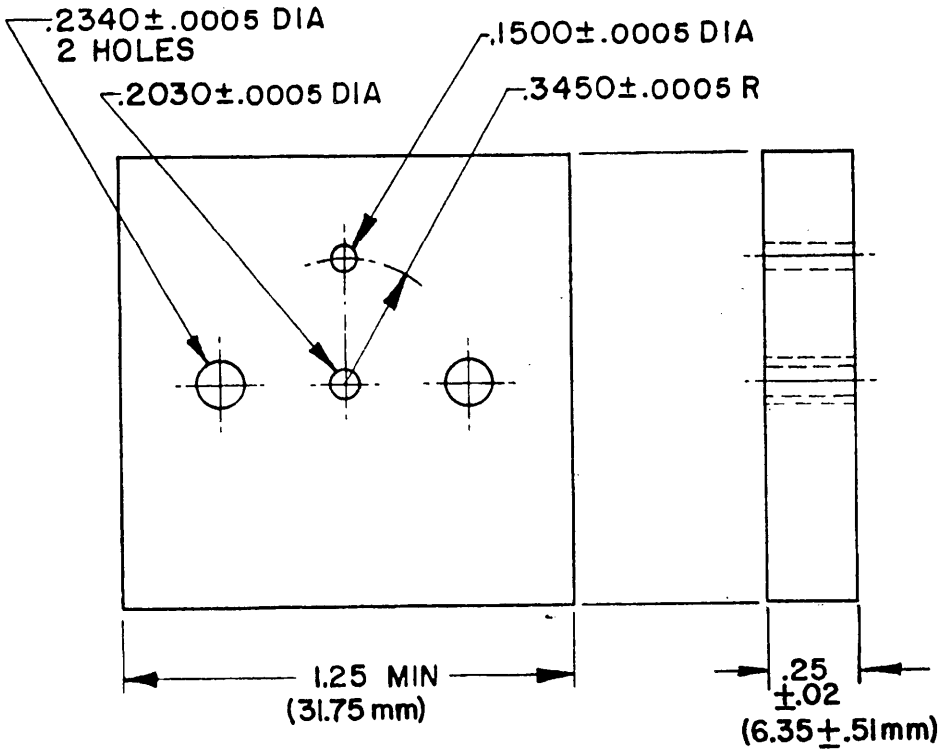


FIGURE 1a. Alinement gage for transistor type 2N2079A.

4.3.3 Group C inspection. Group C inspection shall consist of the examination and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, III, and as follows:

4.4.1 Inspection conditions. All measurements are to be made at T_{MB} = 25° C unless otherwise specified.

4.4.2 Solderability. The solderability test shall apply to the two lug terminals only. The depth of immersion is to be within 1/4 inch of the seating plane. Acceptance criteria shall be that each termination is 95 percent covered by a continuous new solder coating to within 3/8 inch ± 1/32 inch of the seating plane.

4.4.3 Terminal strength (stud torque). Acceptance criteria after the stud torque test for external threaded parts (dimension J of figure 1) shall be in accordance with handbook H28.

4.4.4 Safe area test procedure. The collector safe area shall be tested for three conditions which fall on the boundaries of safe area, using the circuit of figure 4 or equivalent and as follows:

Test 1 The collector current shall be pulsed to -3.75 A at -70 V collector to emitter for 100 μsec. The frequency shall be 200 cps.

Test 2 The collector current shall be pulsed to -20 A at -38 V collector to emitter for 100 μsec. The frequency shall be 200 cps.

Test 3 The collector current will be set at -0.6 A continuous (5 minutes or longer) at -75 volts collector to emitter with the device mounted on a heat sink capable of maintaining T_{MB} temperature below 75° C maximum.

4.5 Inspection lot. Inspection lot shall be as defined in MIL-S-19500 except that lot accumulation period requirements shall be thirteen weeks in lieu of six weeks.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 1			10				
Visual and mechanical examination	2071			---	---	---	---
Subgroup 2			5				
Emitter to base cutoff current	3061	Bias cond. D; V_{EB} = -2 Vdc		I_{EBO}	---	-200	μAdc
Emitter to base cutoff current	3061	Bias cond. D; V_{EB} = -40 Vdc		I_{EBO}	---	-4	mAdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -2 Vdc		I_{CBO}	---	-200	μAdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -80 Vdc		I_{CBO}	---	-4	mAdc
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -1.2 Adc		h_{FE}	40	160	---

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 2 - Continued							
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -5 Adc; t_p = 1 sec max; duty cycle = 1 to 2%		h_{FE}	35	70	---
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -12 Adc; t_p = 1 sec max; duty cycle = 1 to 2%		h_{FE}	12	---	---
Base to emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = -2 Vdc; I_C = -5 Adc; t_p = 1 sec max; duty cycle = 1 to 2%		V_{BE}	---	-0.9	Vdc
Floating potential	3020	V_{CB} = -80 Vdc; voltmeter input resistance = 10 megohms min		V_{EBF}	---	0.5	Vdc
Collector to emitter voltage (saturated)	3071	I_C = -12 Adc; I_B = -2 Adc; t_p = 1 sec max; duty cycle = 1 to 2%		$V_{CE}(sat)$	---	-0.7	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. D; 60 cps sweep; I_C = -1 Adc		BV_{CEO}	-65	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. C; 60 cps sweep; I_C = -300 mAdc		BV_{CES}	-80	---	Vdc
Subgroup 3			5				
Small-signal short-circuit forward-current transfer-ratio cutoff frequency	3301	V_{CE} = -6 Vdc; I_C = -5 Adc		f_{hfe}	5	---	kc
High-temperature operation: Emitter to base cutoff current	3061	T_{MB} = 71° C Bias cond. D; V_{EB} = -40 Vdc		I_{EBO}	---	-15	mAdc
Collector to base cutoff current	3036	Bias cond. D V_{CB} = -80 Vdc		I_{CBO}	---	-15	mAdc
Low-temperature operation: Forward-current transfer ratio	3076	T_{MB} = -55° C V_{CE} = -2 Vdc; I_C = -5 Adc		h_{FE}	25	---	---
Subgroup 4			15				
Pulse response	---	I_C = -12 Adc; I_B = -2 Adc; V_{CC} = -12 Vdc (see fig. 5)		t_r	---	25	µsec
Pulse response	---	I_C = 0; V_{BB} = +6 Vdc; R_{BB} = 10 ohm (see fig 5)		t_f	---	25	µsec

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 5			10				
Safe area test 1	---	Test 1 (see 4.4.4, 6.2 and figure 4) I_C = -3.75 A; t_p = 100 μsec f = 200 cps; 10 cycles min.		V_{CE}	-70	---	Vdc

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 1			20				
Physical dimensions	2066	(See figure 1)		---	---	---	---
Subgroup 2			15				
Solderability	2026	(See 4.4.2)		---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. B except in step 3; $T_A = 100\ ^{+3}_{-0}$ °C		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. A		---	---	---	---
Terminal strength (tension)	2036	Test cond. A; weight = 10 lbs. ± 1 oz.; application time = 15 sec. to each terminal		---	---	---	---
Terminal strength (terminal torque)	2036	Test cond. D1; torque = 18 oz.-in. to be applied to flat of each terminal for t = 15 sec.		---	---	---	---
Terminal strength (stud torque)	2036	Test cond. D2; torque = 12 lb.-in. for t = 15 sec (see 4.4.3)		---	---	---	---
Seal (leak rate)	---	Method 112 of MIL-STD-202, test cond. C., procedure III; test cond. B for gross leaks.		---	---	$5x10^{-7}$	atm cc/sec
Moisture resistance	1021	Omit initial conditioning		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -80 Vdc		I_{CBO}	---	-4	mAdc
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -5 Adc; t_p = 1 sec. max; duty cycle = 1 to 2%		h_{FE}	35	70	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 3			15				
Shock	2016	Nonoperating; 1500 G; for 0.5 msec; 5 blows in each orientation: X_1, Y_1, Y_2, and Z1		---	---	---	---
Vibration fatigue	2046	Nonoperating		---	---	---	---
Vibration, variable frequency	2056	Nonoperating		---	---	---	---
Constant acceleration	2006	2000 G; in each orientation: X_1, Y_1, Y_2, and Z_1		---	---	---	---
End points: (Same as for subgroup 2)							
Subgroup 4			20				
Salt atmosphere(corrosion)	1041			---	---	---	---
End points: (Same as for subgroup 2)							
Subgroup 5			$\lambda = 10$				
High-temperature life (nonoperating)	1031	T_{stg} = 100° C		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -80 Vdc		I_{CBO}	---	8	mAdc
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -5 Adc; t_p = 1 sec. max; duty cycle = 1 to 2%		h_{FE}	30	75	---
Subgroup 6			$\lambda = 10$				
Steady state operation life	1026	T_{MB} = 90° C P_C = 20 W V_{CB} = -15 Vdc min		---	---	---	---
End points: (Same as for subgroup 5)							

TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 1			20				
Barometric pressure, reduced (altitude operation)	1001	Normal mounting; pressure = 8 mm Hg, for 60 sec. min.		---	---	---	---
Measurement during test:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -80 Vdc		I_{CBO}	---	-4	mAdc
Thermal resistance	3151			θ_{J-C}	---	0.5	°C/W
Subgroup 2			20				
Burnout by pulsing	3005	I_B = -4 Adc; I_E = 15 Adc; t_p = 60 sec. min; 1 cycle		---	---	---	---
End points:							
Forward-current transfer ratio	3076	V_{CE} = -2 Vdc; I_C = -5 Adc; t_p = 1 sec. max; duty cycle = 1 to 2%		h_{FE}	35	70	---
Subgroup 3			15				
Safe area test 2	---	Test 2 (see 4.4.4, 6.2 and figure 4); V_{CE} = -38 V; I_C = -20 A; t_p = 100 µsec; f = 200 cps; 10 cycles min.		---	---	---	---
Safe area test 3	---	Test 3 (see 4.4.4, 6.2 and figure 4); V_{CE} = -75V; I_C = -0.6 A; t = 5 minutes min. continuous; T_{MB} = 75° C max.		---	---	---	---
End points: (Same as subgroup 2)							

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. See MIL-S-19500, section 5.

6. NOTES

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Power-temperature derating vs. safe area. Figure 3 shows pulse safe areas. Figure 2 represents the allowable average power which could be dissipated at a given T_{MB}. The design must consider both control curves. The collector-emitter voltage, collector current, and pulse width combination must fall within the pulse safe area control curve. In addition, the calculation of average power and T_{MB} must result in an operating point within the control curve of figure 2. In some instances, the allowable power at 25° C (T_{MB}) is beyond the allowable safe area. However, at higher T_{MB}'s, this would not be true. In any event, both average power-temperature derating and pulse safe areas must be observed. (See 6.2.1.)

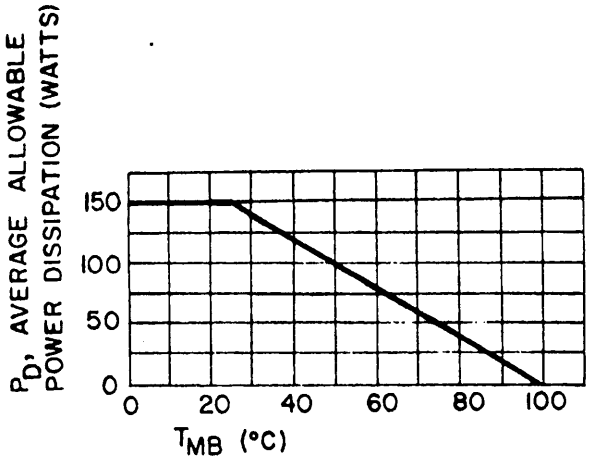


FIGURE 2. Power-temperature derating curve.

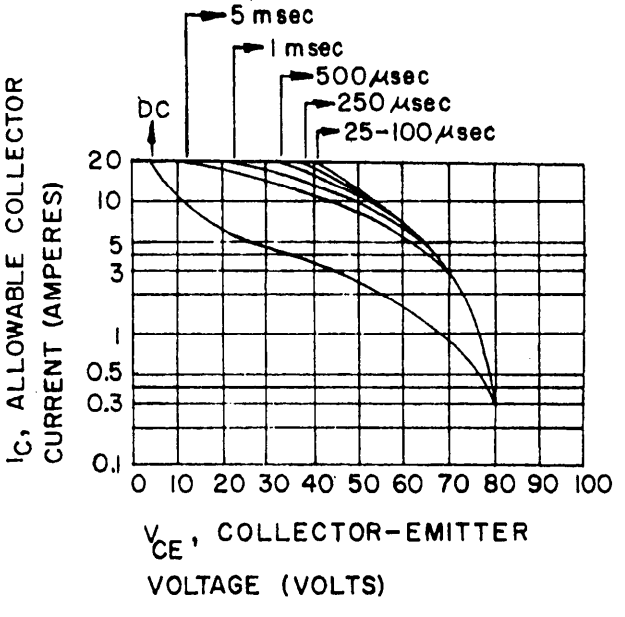
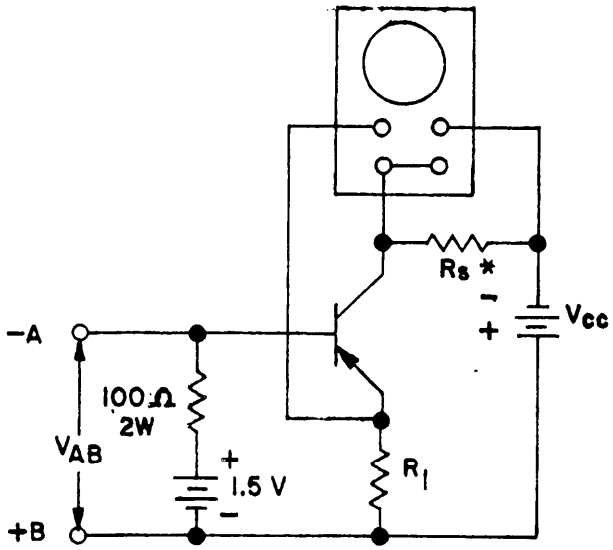


FIGURE 3. Pulse safe-area control curve for transistor type 2N2079A.

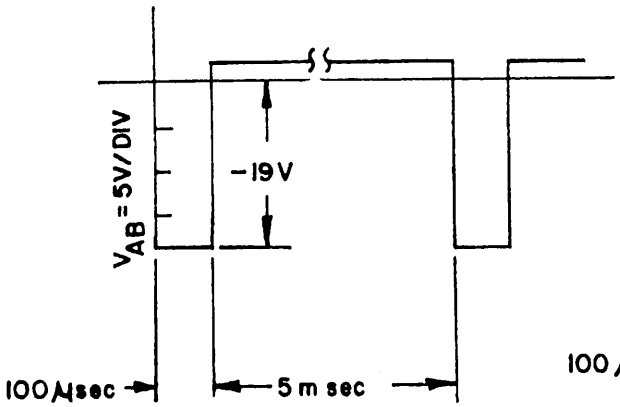


V_{CC} and V_{AB} are regulated power supplies (±1% both line and load).

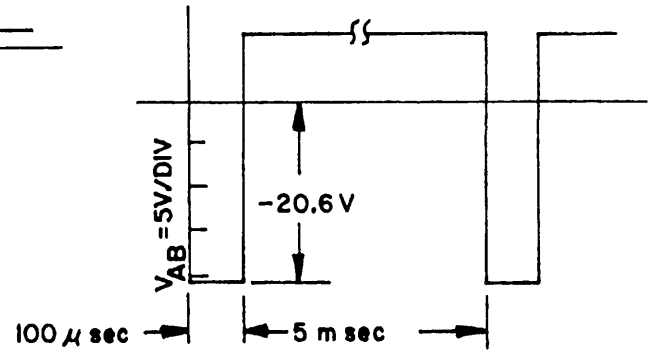
*R_S is 0.1Ω non inductive 2 watt. A current probe may be used in lieu of this sense resistor.

Test 1/	R_1	V_{AB}	V_{CC}
1	5Ω 5 W	(See test condition No. 1)	89V
2	1Ω 10 W	(See test condition No. 2)	60V
3	10Ω 5 W	6.3 V (See test condition No. 3)	82V

1/ Adjustment will be necessary to set the exact current and voltage points specified in test 1, 2, and 3.



TEST CONDITION NO. 1



TEST CONDITION NO. 2

Test condition No. 3 -A D.C. regulated supply is connected to points A, B (minus to point 'A').

FIGURE 4. Safe area test circuit for transistor type 2N2079A.

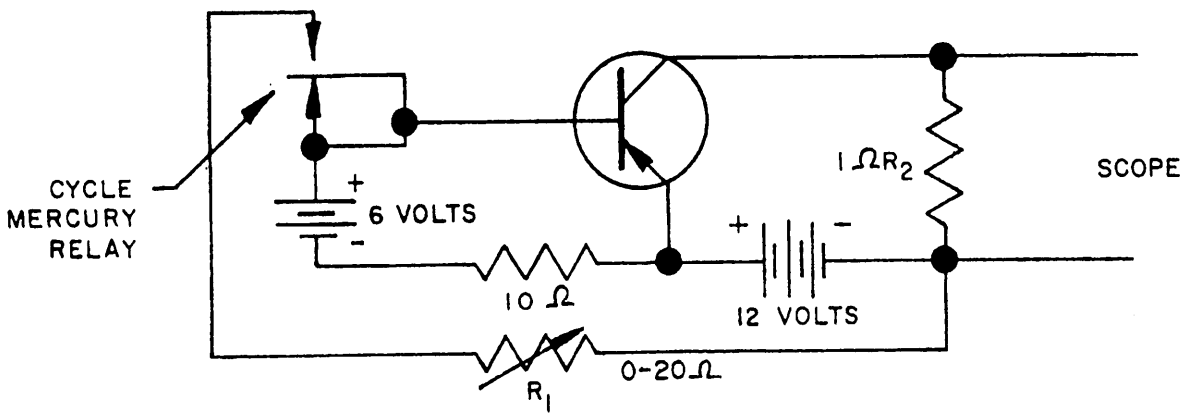


FIGURE 5. Pulse response time test circuit for transistor type 2N2079A.

6.2.1 The proper control of temperature rise and peak power will insure that the maximum junction temperature is not exceeded. In addition, the proper control of pulse load line to stay within the applicable safe area curve will insure that a collector to emitter short will not be caused.

6.3 (JAN) Type Transistor 2N2079A is recommended as electrical and mechanical replacement for the following transistor types:

2N173	2N2079
2N277	2N2080, 2N2080A
2N278	2N2081, 2N2081A
2N1099	2N2082, 2N2082A

Custodians:
Army - EL
Navy - SH
Air Force - 11

Preparing activity:
Navy - SH

(Project 5960-2161)

Review activities:
Army - EL, MU
Navy - SH
Air Force - 11, 17, 85

User activities:
Army - EL, MI, SM
Navy - CG, MC, WP
Air Force -