MIL-S-19500/139B
28 MARCH 1963
SUPERSEDING
MIL-S-19500/139A(SigC)
21 April 1961

MILITARY SPECIFICATION

TRANSISTOR, PNP, SILICON

TYPE JAN-2N1119

This specification has been approved by the Department of Defense, and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for silicon, PNP transistors for use in chopper & high-speed-switching circuitry.

1.2 Mechanical dimensions. See figure 1.

1.3 Absolute-maximum ratings:

1/ P_T (mW)	T_{stg} (°C)	V_{CBO} (Vdc)	V_{RT} (Vdc)	V_{EBO} (Vdc)
150	-65 to +140	-12	-10	-12

1/ Derate 1.33 mW/°C for TA > 25° C.

1.4 Primary electrical characteristics:

	C_{ob} (pf)	f_t (mc)	V_{ECF} (mVdc)
Minimum	---	7.2	---
Maximum	9	---	4

1.5 Reliability ratings.

Steady-state operation life	High temperature life (nonoperating)
(P_T = 150 mW)	(T_A = 140° C)
λ	λ
10%	5%

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, forms a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-S-19491 - Semiconductor Devices, Preparation for Delivery of.

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

STANDARD

Military

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

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

3. REQUIREMENTS

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

3.2 Abbreviations and symbols.

K's . . . . . Hole storage

P_T . . . . . Total power dissipation - sum of collector and emitter power dissipation:

$$P_T = (V_{CB}I_C) + (V_{EB}I_E)$$

rb'Cc . . . . . Extrinsic base-resistance collector-capacitance product.

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

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

3.4.1 Salt atmosphere (corrosion). The marking shall be legible at the conclusion of the test. (See 4.4.1.)

3.4.2 Barometric pressure, reduced (altitude operation). Transistors shall operate satisfactorily without voltage derating. (See table III)

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

(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 Specification 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 Acceptance inspection. Acceptance inspection shall consist of groups A, B, and C.

4.3.1 Group A inspection. Group A inspection shall consist of the examination 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.

4.3.3 Group C inspection. Group C inspection shall consist of the tests specified in table III.

4.3.4 Acceptance procedure. When a second sample is chosen, the total sample shall be associated with the minimum rejection numbers specified in Tables I, II, and III.

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

4.4.1 Salt atmosphere (corrosion). Transistors shall be examined for legibility of marking before the specified measurements are made. (See 3.4.1 and table II.)

4.4.2 Voltage, reach-through, collector to emitter. An adequate forward dc current shall be applied to the emitter terminal and a reverse dc voltage shall be applied between collector and base, starting at zero and increasing until the emitter to base voltage has reached the specified reverse value. The dc voltage between the collector and the base terminals shall then be measured. The V_{RT} will be equal to the reverse collector to base dc voltage less the reverse emitter to base dc voltage. (See table I, subgroup 3.)

4.4.3 Inverted offset voltage. Inverted offset voltage is the voltage between the emitter and collector at the specified forward base current with the emitter open circuited. (See table I, subgroup 2.)

Table I. Group A Inspection

Examination or test	Symbol	MIL-STD-750		LTPD	Limits		Units	Min rej no
		Method	Details		Min	Max		
Subgroup 1 Visual and mechanical inspection.		2071		5				4
Subgroup 2 Emitter to base cutoff current.	I_{EBO}	3061	Cond D; V_{EB} = -10 Vdc	5		-0.1	uAdc	4
Emitter to base cutoff current.	I_{EBO}	3061	Cond D; V_{EB} = -12 Vdc			-1.0	uAdc	
Collector to base cutoff current.	I_{CBO}	3036	Cond D; V_{CB} = -10 Vdc			-0.1	uAdc	
Collector to base cutoff current.	I_{CBO}	3036	Cond D; V_{CB} = -12 Vdc			-1.0	uAdc	
Nonsaturated voltage.	V_{BE}	3066	Cond B; I_C = -5mAdc; I_B = -0.8mAdc		-0.75	-1.0	Vdc	
Saturation voltage and resistance.	$V_{CE}(SAT)$	3071	I_C = -5mAdc; I_B = -0.8mAdc			-0.15	Vdc	
Forward-current transfer ratio.	h_{FE}	3076	V_{CE} = -0.5Vdc; I_C = -15mAdc		15			
Inverted offset voltage.	V_{ECF}		I_B = -1 mAdc; I_E = 0 (See 4.4.3)			4	mVdc	

Table I. Group A Inspection. (contd)

Examination or test	Symbol	MIL-STD-750		LTPD	Limits		Units	Min rej no
		Method	Details		Min	Max		
Subgroup 3				5				4
Voltage, reach-through, collector to emitter.	V_{RT}		V_{EB} = -1Vdc (See 4.4.2)		-10		Vdc	
Extrinsic base resistance collector capacitance product	$rb'C_c$		V_{CB} = -6 Vdc; I_E = 1 mAdc (See figure 3)			5000	psec	
Extraplated unity-gain frequency.	f_t	3261	V_{CE} = -6 Vdc; I_E = 1 mAdc; f = 4 mc		7.2		mc	
Collector to emitter cutoff current.	I_{CE}	3041	Bias Cond A; V_{CE} = -4.5 Vdc; V_{BE} = -0.45 Vdc			-25	uAdc	
Subgroup 4				5				4
Hole storage	K's		I_B = -1 mAdc (See figure 4)			175	nsec	
Open circuit output capacitance	C_{ob}	3236	V_{CB} = -6 Vdc; I_C = -1 mAdc; f = 4 mc			9	pf	
Subgroup 5				10				5
Pulse response	$t_d + t_r$ $t_s + t_f$	3251	(See figure 5) (See figure 6)			270 370	nsec nsec	
Subgroup 6				15				5
Collector to base cutoff current.	I_{CBO}	3036	V_{CB} = -10Vdc; T_A = +125° C min			15	uAdc	
Forward-current transfer ratio.	h_{FE}	3076	V_{CE} = -0.5Vdc; I_C = -15 mAdc		10			

Table II. Group B Inspection.

Examination or test	Symbol	MIL-STD-750		LTPD	Limits		Units	Min rej no
		Method	Details		Min	Max		
Subgroup 1				5				4
Physical dimensions		2066			(See fig. 1)			
1/ Subgroup 2				15				5
Solderability		2026						
Temperature cycling		1051	Cond C; except, T_{max} = +140° C					
Thermal shock (glass strain)		1056	Cond B					
Moisture resistance		1021						
End point tests:								
Collector to base cutoff current	I_{CBO}	3036	Cond D; V_{CB} = -10Vdc			-0.3	uAdc	
Forward-current transfer ratio	h_{FE}	3076	V_{CE} = -0.5Vdc; I_C = -15 mAdc		12			

Table II. Group B Inspection. Contd

Examination or test	Symbol	MIL-STD-750		LTPD	Limits		Units	Min rej no
		Method	Details		Min	Max		
1/ Subgroup 3				15				5
Shock		2016	nonoperating 500 G; 1 msec (approx) 5 blows each in orientations X, Y_1, Y_2, and Z (total) 20 blows)					
Vibration fatigue		2046	Nonoperating; 10 G					
Vibration, variable frequency		2056	10 G					
Constant acceleration		2006	10,000 G					
End point tests: Same as subgroup 2								
1/ 2/ Subgroup 4				15				5
Terminal strength		2036	Cond E					
Subgroup 5				15	(See 3.4.1)			5
Salt atmosphere (corrosion)		1041	(See 4.4.1)					
End point tests: Same as subgroup 2								
Subgroup 6				c= 5				4
High temperature life - Nonoperating		1031	T_A = 140° C min					
End point tests:								
Collector to base cutoff current	I_{CBO}	3036	Cond D; V_{CB} = -12 Vdc			-2	uAdc	
Forward-current transfer ratio	h_{FE}	3076	V_{CE} = -0.5 Vdc; I_C = -15 mAdc		12			
Subgroup 7				c=10				5
Steady state operation life		1026	V_{CB} = -10 Vdc; P_T = 150 mW					
End point tests: Same as subgroup 6								

1/ Destructive tests.
2/ Rejects from electrical test samples may be used for this test.

Table III. Group C Inspection.

Examination or test	Symbol	MIL-STD-750		LTPD	Limits		Units	Min rej no
		Method	Details		Min	Max		
Barometric pressure 1/ reduced (altitude operation)	I_{CBO}	1001	Pressure 15±2 mm Hg; Normal mounting t = 60 sec min V_{CBO} = -12Vdc;	20	(See 3.4.2)	1.0	uAdc	4

1/ This test shall be conducted on the initial lot and every three months thereafter.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery shall be in accordance with Specification MIL-S-19491.

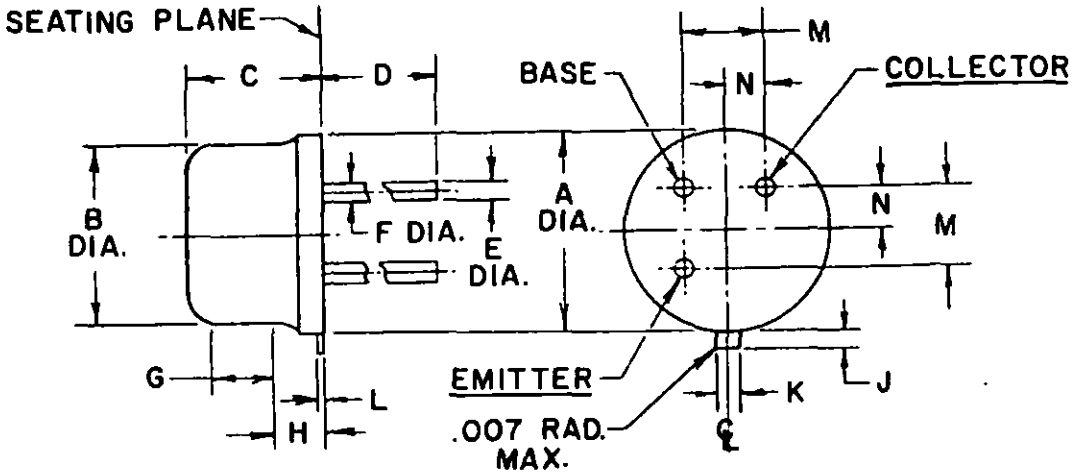
6. NOTES

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

Custodians:
Army - EL
Navy - Ships
Air Force - ASD

Preparing activity:
Army - EL

(Project No. 5960-1475)

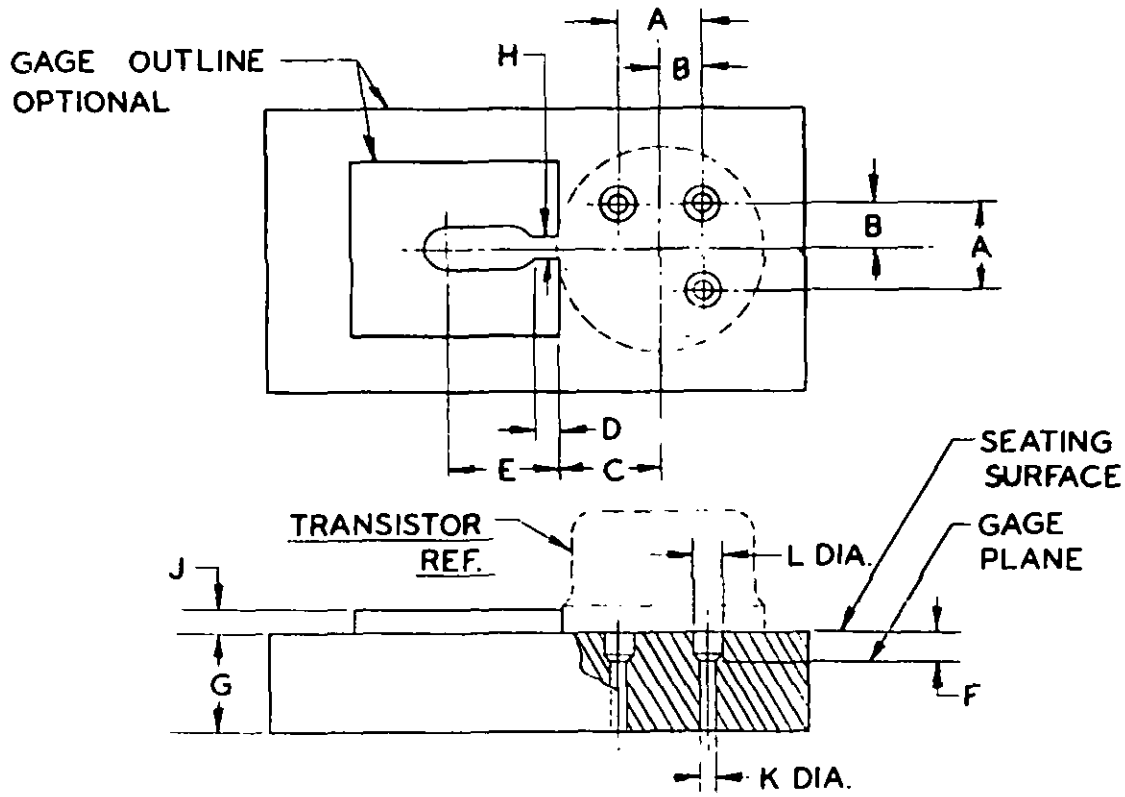


DIMENSIONS							
	INCHES			MILLIMETERS			NOTES
	MIN.	NOM.	MAX.	MIN.	NOM	MAX.	
A	.335		.370	8.51		9.40	
B	.305		.335	7.75		8.51	
C	.240		.260	6.10		6.60	
D	1.500			38.10			
E	.016		.019	0.41		0.48	1
F	.016		.021	0.41		0.53	2
G	.100			2.54			3
H							4
J	.029		.045	0.74		1.14	
K	.028		.034	0.71		0.86	
L	.009		.125	0.23		3.18	
M		.1414			3.59		5
N		.0707			1.80		5

NOTES:

1. Measured in the zone beyond .250(6.35) from the seating plane. 3 leads.
2. Measured in the zone .050 (1.25) and .250(6.35) from the seating plane. 3 leads.
3. Variations on Dim. B in this zone shall not exceed .010(0.25).
4. Outline in this zone is not controlled.
5. When measured in a gaging plane .054 $^{+.001}_{-.000}$(1.37$^{+.03}_{-.00}$) below the seating plane of the transistor max. dia. leads shall be within .007 (0.18) of their true location. Smaller dia. leads shall fall within the outline of the max. dia. lead tolerance. Fig. 2. preferred measured method.
6. All leads electrically isolated from case.

FIGURE 1. Physical dimensions (TO5) transistor type.



	DIMENSIONS			
	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	.1409	.1419	3.58	3.60
B	.0702	.0712	1.78	1.81
C	.182	.199	4.62	5.05
D	.009	.011	0.23	0.28
E	.125 NOM.		3.18 NOM.	
F	.054	.055	1.37	1.40
G	.372	.378	9.45	9.60
H	.0350	.0355	0.89	0.90
J	.150 NOM.		3.81 NOM.	
K	.0325	.0335	0.83	0.85
L	.0595	.0605	1.51	1.54

Note:
The following gaging procedure shall be used:
The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is 0.125±.010 from the seating surface of the gage. A spacer may be used to obtain the .125 distance from the gage seat prior to force application. A force of 8 oz. ±0.5 shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.

FIGURE 2. Gage for lead and tab location of TO-5 envelope.

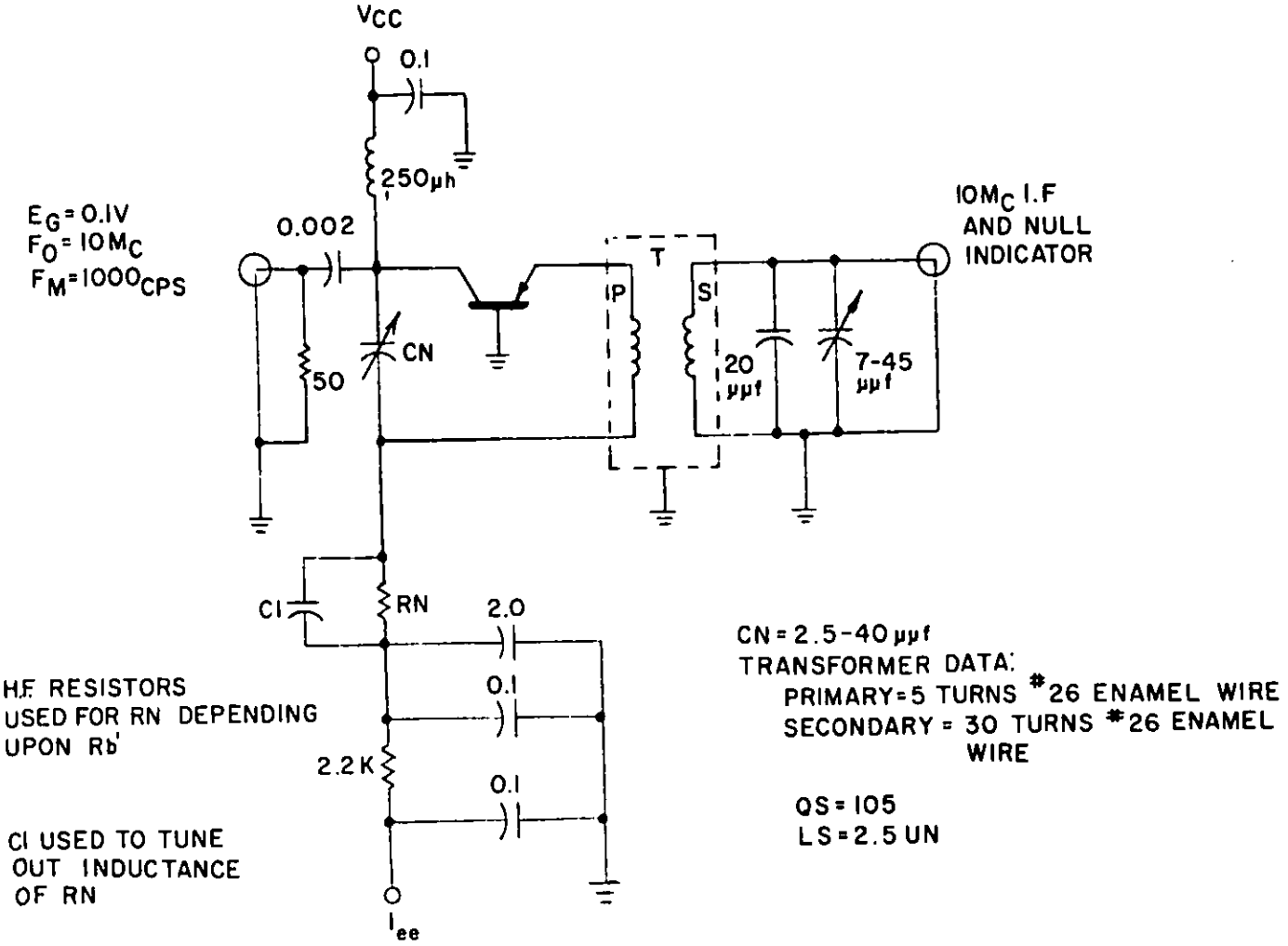
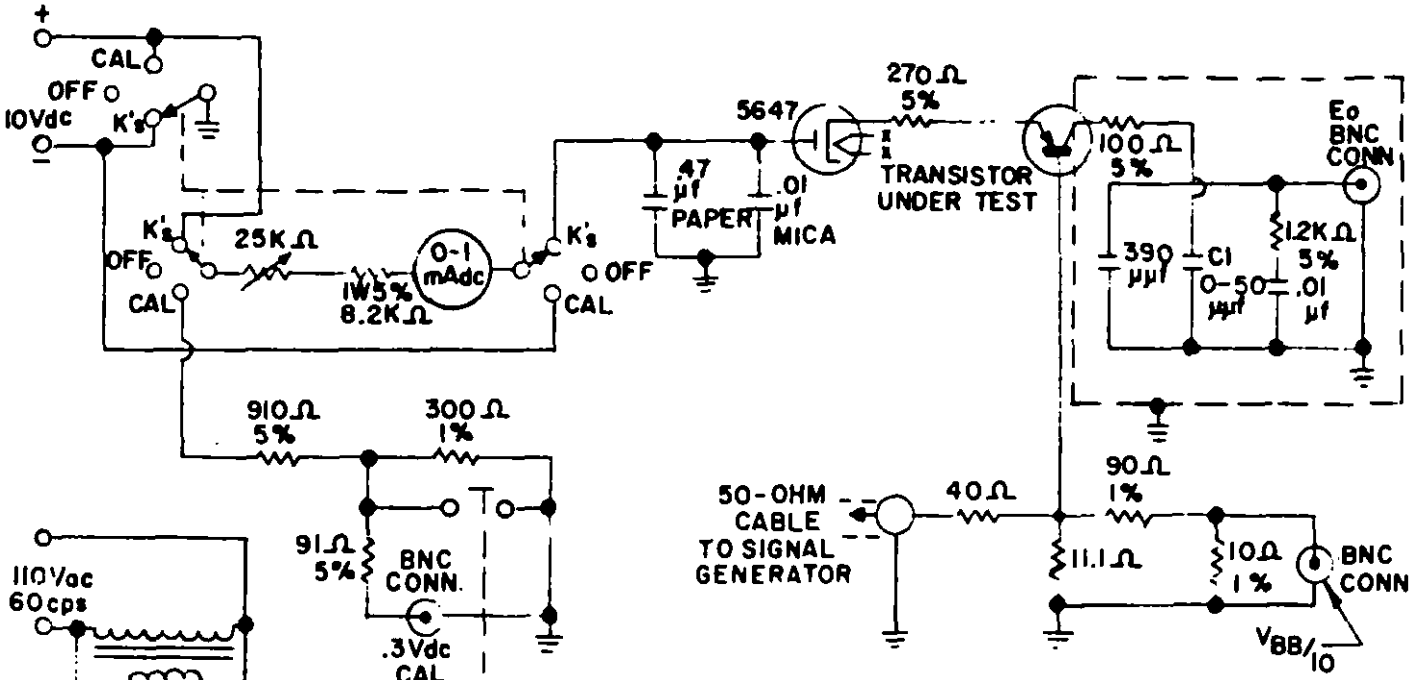


FIGURE 3. R_b, C_c test circuit.



1. Set current for 1 mAdc and adjust signal generator for 0.3 Vdc on scope connected to $V_{BB}/10$ jack.
2. Adjust C_1 so that total C, including probe, is 500 uuf.
3. Set I_E to 1 mAdc (where $I_E = I_B$).

$$K's = \frac{Q}{I_B} = \frac{EoC}{I_B} \qquad \text{Where: } C = 500 \text{ uuf.}, \quad I_B = -1 \text{ mAdc.}$$

FIGURE 4. Hole-storage test circuit.

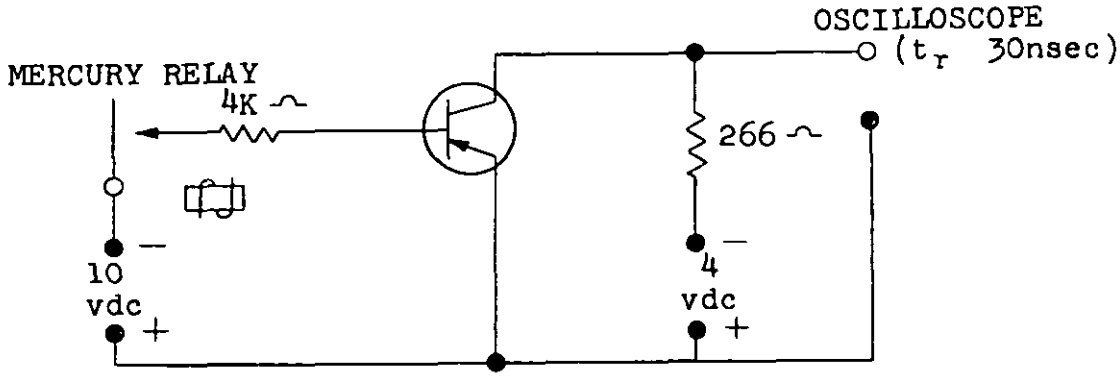


FIGURE 5. Delay + rise time test circuit.

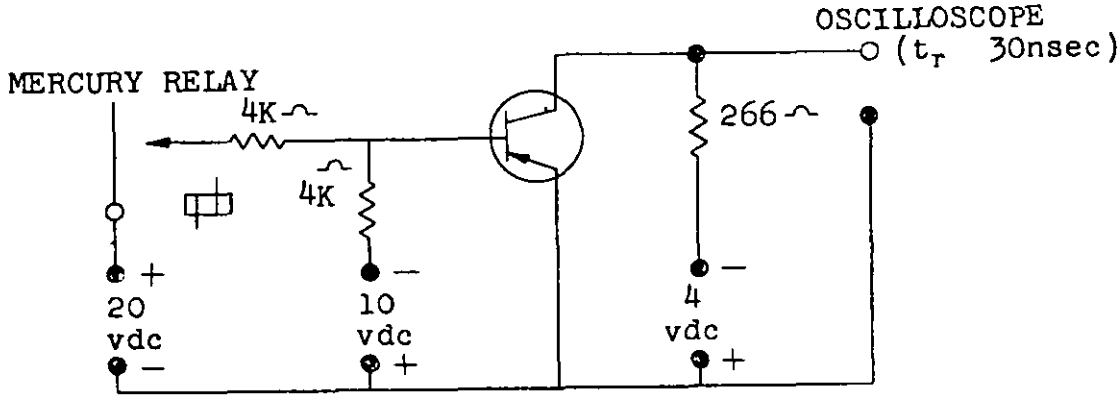


FIGURE 6. Storage + fall time test circuit.