

Specification MOS/CV. 6015 Issue 1, dated 6th June, 1959. To be read in conjunction with K1006 (see note A)	<u>Security</u> <u>Specification</u> <u>Valve</u> UNCLASSIFIED UNCLASSIFIED
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Type of Valve: Hydrogen Thyatron, Tetrode, Rugged, with Flying Leads.	<u>Marking</u> See K1001/4.
Cathode: Unipotential, Indirectly Heated	<u>Base</u>
Envelope: Glass.	<u>NONE</u>
Prototype: VX 8205	

<u>Rating & Operating Conditions</u>					<u>Flying Lead Connections</u>											
Ratings (Note B)	Units	Min.	Max.	Notes	See Page: 12											
Ef	V rms	5.7	6.6	C	<div>DISPERSED</div> <u>Dimensions</u> See Page 12.											
If	A rms	4.5	5.5	D												
Ers	V rms	5.7	6.6	C												
Irs	A rms	1.3	1.7	D												
tk	sec.	120														
Temp Ambient	°C	- 55	+90	E												
Temp bulb	°C		250	F												
Altitude	Ft.		10,000													
egy1	V	200	350	G	<table><tr><th>Dimension</th><th>Min.</th><th>Max.</th></tr><tr><td>Bulb Overall Length excluding seal-off pips</td><td>95</td><td>115</td></tr><tr><td>Diameter</td><td>59</td><td>61</td></tr></table>			Dimension	Min.	Max.	Bulb Overall Length excluding seal-off pips	95	115	Diameter	59	61
Dimension	Min.	Max.														
Bulb Overall Length excluding seal-off pips	95	115														
Diameter	59	61														
egy2	V	300		H												
egx1	V		200													
egx2	V		200													
Ecl	V	- 10	+5	I	<u>Mounting Position</u> Any.											
Ec2	V	-100	-40	I												
tgd	us	1.5	4	J												
Ebb	kV	2.0														
epy	kV		8.0	K												
epx	kV		8.0	L												
Ib	mA dc		100													
ib	Amps		90													
dib/dt	A/uS		1500	M												
epy x prr xib	MWkc/s		2.0													

NOTES

- A. Copies of "Inspection Instructions for Electron Tubes" referred to in K1006 and in this specification may be obtained from: The Secretary, T.L. 5(b), Ministry of Supply, Castlewood House, 77-91 New Oxford Street, London W.C. 1.

Notes (Cont'd)

- B. Paragraphs 3.2 and 6.5 of K1006 apply.
- C. Reservoir and Heater should normally be connected to a common supply with tolerance $\pm 5\%$, $\pm 10\%$.
- D. Measured at $E_f = E_{res} = 6.3$ V rms.
- E. T.A. shall be measured at a point three inches from the tube in the plane through the base. If the tube is inclined to the vertical, T.A. shall be measured at the lowest point consistent with the above. The surroundings of the tube must be such as to permit free convection of air over the bulb. Cooling of the leads is permissible, but there shall be no direct air blast on the bulb.

The valve should not be run with H.T. on for long periods under conditions such that the bulb temperature measured opposite the grid cylinder is less than 80°C . The thermal inertia of the valve and mounting should not be excessive.

- F. This is measured opposite the grid cylinder.
- G. The primer drive pulse, measured at the tube socket with the primer grid disconnected shall be:

Amplitude (egy 1)	200-350V (relative to cathode)
Rate of Rise	200-1500V/ μSec . (26%-70.7% amplitude)
Duration	2 μSec . min (70.7% amplitude)
Overlap of Trigger Pulse	0.5 μSec . min. (70.7% amplitude)
Impedance	1200-2000 ohms (for the duration of the pulse)
D.C. Resistance	3000 ohms max.

The characteristics of the pulse shall be measured in accordance with paragraph 5.13.2 of I.I.E.T.

- H. The trigger drive pulse, measured at the tube socket with the trigger grid disconnected shall be:

Amplitude (egy2)	300V min (relative to cathode)
Rate of Rise	1000V/ μSec . min (26%-70.7% amplitude)
Duration	0.5 μSec . min. (70.7% amplitude)
Impedance	1500 ohms max.

D.C. resistance, calculated from the reduction in bias voltage at the grid terminal when a direct current of 5mA is being drawn shall not exceed 3 Kohms.

In cases where the shortest recovery time is required, it is important that the impedance of the trigger pulse generator be low throughout the recovery period.

This impedance is defined as: $\frac{eg2 - Eco2}{ic2}$.

eg2 is the value of the g2 voltage at any instant during the recovery period; ic2 is the value of the g2 current at the same instant and Eco2 is the g2 bias voltage.

- I. The limits apply to the potential of the grid during the period between the completion of recovery and the start of the succeeding grid pulse. Recovery time will be increased at less negative bias voltages.
- J. tgd is defined as the time delay of the g2 pulse after the g1 pulse, measured at the 50 volt levels of the leading edges of the g1 and g2 pulses. The measurements shall be made with respect to cathode at the tube socket with the grids disconnected.
- K. The maximum peak anode voltage for instantaneous starting applications is 7.0kv and it shall not be attained in less than 40ms.
- L. For pulsed operations, the peak inverse anode voltage, exclusive of a spike of 0.05uS maximum duration shall not exceed 2.5kv during the first 25uS after the pulse.
- M. dib/dt is defined as the maximum instantaneous value of the rate of rise of ib.

The circuit must be such that no tube can have an instantaneous rate of rise exceeding the limit given. The measurement shall be made by means of a mutual inductor in the anode lead of the thyatron.

SUPERSEDED

TESTS

To be read in conjunction with K1006.

K1006 Ref.	Test	Conditions	Symbol	Limits		Units	Notes
				Min.	Max.		
	<u>Qualification Approval Tests</u> (Notes 1, 2, and 11).						
	Operation 3	epy = 8kv TA = 90°C t = 5hrs.					12,13
	Anode Delay Time	epy= 8kv	tad		300	muS	14,15
	Anode Delay Time Drift		Δtad		50	muS	14,16
	Resonance Search Fatigue	No voltages					17,18
	Operation 2	epy = 7kv t = 300 secs.					13,19
	Microphony	Op. 2.	Δtj	To be agreed later		muS	17,20,21
	Recovery Time		tR		20	uS	22
	<u>Measurements Acceptance Tests</u> Part 1 (Notes 1, 2 and 23).						
4.5.	Holding Period	96 hrs. min					
4.10.8.	Heater Current	Ef=E res. = 6.3V rms	If	4.5	5.5	Amps	
4.10.8.	Reservoir Current	Ef=E res. = 6.3V rms	I res	1.3	1.7	Amps	
	Instantaneous Start	epy = 7kv min tk = 120 sec					24,25
	G1 Strike		tgl		0.8	uS	26
	Operation 1	epy = 9kv t = 300 sec					13
4.10.17.2.	dc Anode Voltage		Ebb		1500	Volts	27
	<u>Measurements Acceptance Tests</u> Part II (Notes 1, 2 and 28).						
	Instantaneous Start	epy = 7kv min tk = 120 sec					24
	Operation 2	epy = 7kv					13
	Anode Delay Time	Op. 2.	tad		300	muS	14,29
	Anode Delay Time Drift	Op. 2.	Δtad		50	muS	14,16
	Jitter 1 (7kv)	Op. 2.	tj7		10	muS	21,30
	Jitter 2 (7kv)	Op. 2.	tj7		3	muS	21,30
	Jitter 3 (3kv)	epy = 3kv	tj3		10	muS	21,31
	Max. Primer Amplitude	epy= 7kv Ecc2 = -30V	egyl	400		Volts	32
	Short Circuit	Op. 2.					33

K1006 Ref.	Tests	Conditions	Symbol	Limits		Units	Notes
				Min	Max.		
4.9.20.6.	<u>Degradation Rate Acceptance Tests</u> (Notes 1 and 2).						
	Fatigue	Ef = Eres = 6.3Vrms No other voltages f = 500/s Aoo. = 2.5g t = 30+30+30 hrs.					34
4.9.20.5.	Shook	No voltages Hammer Angle = 24°					34
	<u>Post Shook and Fatigue Tests</u>						
	Instantaneous Starting	epy = 7kv min. tk = 120secs.					24
	Operation 2	epy = 7kv t = 300secs.					13
	<u>Life Tests</u> (Note 35)						
	Life Test A						36,37
	Life Test B						36,37
	Life Test C						38
	Life Test End Points (Notes 1 & 2)						
	Instantaneous Starting	epy = 7kv min.					24,39
	Operation 2	epy = 7kv					13
	Anode Delay Time	Op. 2.	tad		400	muS	14,29
	Anode Delay Time Drift	Op 2.	Δtad		50	muS	14,16
	Jitter 2 (7kv)	Op. 2.	tj7		3	muS	21,30
	D.C. Anode Voltage		Ebb		2000	Volts	40
	Max. Primer Amplitude	epy = 7kv Ecc2 = -40V	egy1	400		Volts	32
	Rate of Rise	epy = 7kv	dia/dt			Amps/ uS	41
	<u>Packaging Requirements</u>						42
	Operation 1	epy = 9kv t = 300 sec					1,2,13 24,3

NOTES

1. Tests are to be performed in the test circuit in Fig 1., with charging inductance chosen for resonant charging at 3Kc/s.

The test circuit parameters shall be as tabulated below, except where otherwise stated for individual tests.

Where a particular test specifies a change in one or more of the parameters, the limits applying to all independent parameters shall be unchanged, but proportional changes shall be made to the limits applying to those parameters subject to consequential variation.

Measurement of all grid parameters shall be made at the socket with the grid disconnected.

Feature	Symbol	Conditions	Units	Notes
Heater Supply	Ef	6.3	Volts rms	2
	E res	6.3	Volts rms	2
	tk	120 max.	sec.	
Grid 1 (Primer) Circuit	egy 1	200 max.	Volts	3
	tr 1	0.15min.	uS	4
	tp 1	2.0max.	uS	5
	Zg 1	1200 \pm 10%	ohms	6
	Ecc 1	0	Volts	
Grid 2 (Trigger) Circuit	egy 2	260max.	Volts	3
	tr 2	0.13min.	uS	7
	tp 2	2.0max.	uS	5
	Zg 2	1500min.	ohms	6, 8
	Ecc 2	-40	Volts	
Anode Circuit	egd	1.0-1.5	uS	9
	epy	7.0	kv	
	ib	80 \pm 5%	Amps	
	dib/dt	1500 min	A/uS	10
	Ib	75 min	mi	
	tp	0.25 \pm 10%	uS	
	prr	4000	pps	
Mounting Position	TA	10 - 40	°C	
		Vertical		

2. The heater and reservoir voltages shall be 6.3V rms for all tests except those grouped as Measurement Acceptance Tests Part II. All tests grouped as Measurement Acceptance Tests Part II shall be performed in the order stated once with Ef = E res = 5.7V rms, and then with Ef = E res = 6.6V rms.

3. This is measured relative to cathode in accordance with ILET 5.13.2.2.
4. This is measured on the leading edge of the pulse between 26% and 70.7% of the amplitude, when the amplitude is 200V, in accordance with ILET 5.13.2.2.
5. This is measured at 70.7% of the pulse amplitude, in accordance with ILET 5.13.2.2.
6. The impedance during the post-pulse period, defined as $\frac{e_g - E_{cc}}{i_c}$, shall not be less than the value given for Z_g where e_g and i_g are the values of the grid voltage and current at any instant and E_{cc} is the value of the grid bias supply voltage.
7. This is measured between 26% and 70.7% of the total pulse amplitude (not relative to cathode) when the total amplitude is 300V.
8. The D.C. resistance, calculated as $\frac{\Delta E_g}{\Delta I_g}$ at the grid terminal when a direct current of 5mA is being drawn, shall not be less than 3000 ohms.
9. t_{gd} is defined as the time delay of the g_2 pulse after the g_1 pulse, measured at the 50 volt levels of the leading edges of the g_1 and g_2 pulses. When a large t_{gd} is used, the length of the G_1 pulse must be such that its 70.7% level overlaps by at least 0.5 μ s the 70.7% level of the g_2 pulse.
10. di_b/dt is defined as the maximum instantaneous value of the rate of rise of i_b and is to be measured by means of a mutual inductor in the anode lead of the thyatron.
11. Tests in this group are to be performed as Qualification Approval tests only, though in assessing valves for approval, some or all of the other tests may be performed in addition.

For Q.A. purposes, all tests are deemed to bear an AQL of 10% except for those grouped as Measurements Acceptance Tests Part I, which are deemed to bear an AQL of 6.5%.

A sample of valves may be selected at random from submissions during any period determined by the Inspecting Authority. (The samples might consist of consecutive valves submitted). The size of the sample shall be at least such that for the AQL specified, two defectives are required for rejection using table 4A of MIL-STD-105A at normal inspection. The results of tests on the sample, which will be carried out at the Inspecting Authority's expense, will be deemed to constitute evidence of non-compliance, if the number of defectives found exceeds that allowed for the specified AQL and the sample size using table 4A of MIL-STD-105A at normal inspection.

12. The valve shall be operated in an insulating container about 450cu.ins. in volume and of such dimensions that temperature can be measured in accordance with Note E of the ratings.
13. The valve shall operate continuously at the voltage and for the time specified without evidence of arc-back and without the anode becoming red-hot.
14. The anode delay time (tad) is defined as the time interval between the instant when the rising trigger grid potential is equal to the cathode potential and the instant when the rate of rise of anode current pulse reaches its peak amplitude.
15. This test shall be performed 5 minutes after equilibrium has been reached at 90°C and at the end of the 5 hour run.
16. The change in anode delay time between the two readings shall not exceed the limit stated.
17. The valve shall be vibrated in each of three mutually perpendicular planes at a continuously varying frequency from 20 to 500 c/s and peak acceleration of 2g throughout the frequency range. The rate of sweep shall not exceed one octave per minute over the frequency range 20 to 200 c/s., and shall not exceed 100 c/s per minute over the range 200 to 500 c/s.
18. If any resonances are observed, the valve shall be vibrated for 10 hours or 10⁷ cycles, whichever is the less, at each resonant frequency, at a peak acceleration of 2g and in the direction which gave the greatest resonance.
19. This test is to be performed after the resonance search fatigue test. A valve failing this test is deemed to have failed the resonance search fatigue test.
20. The valve shall be run under operation 2 conditions (epy = 7kv) for at least 5 minutes before, and during the vibration. Time jitter shall be measured immediately before the start of vibration and shall be observed throughout the frequency sweep. Any increase in time jitter shall be within the limit specified.
21. The measurement of time jitter (tj) shall preferably be made on the rising front of the rate of rise waveform at 50% amplitude by means of a mutual inductor in the anode lead of the thyatron.
22. This shall be measured in the circuit shown in Fig 2., and under the conditions stated below by varying the time between the instant when the peak current has fallen to 45A and the instant when probe pulse conduction occurs. The recovery time is defined as the maximum value of this period for which probe pulse conduction will occur under the given conditions:-

Pulse Repetition Rate (prp)	50 c/s \pm 2c/s
Peak Cathode Current (ib)	90A min.
Current Pulse Duration (tp)	1.7uS \pm 10%
Ef = E res	6.3V rms
Trigger Bias Voltage (Ec82)	-40V max.
Probe Pulse Amplitude	2kv peak min.
Probe Pulse Rise Time	3 to 4 uS measured between 26% and 70.7% of full amplitude.

SUPERSEDED

23. All tests in this group shall be performed 100% in the order stated.
24. Grid-cathode breakdown must occur within the period before the application of anode voltage. The valve shall operate satisfactorily on push-button starting within three attempts, when the anode voltage (epy) is applied at the end of the preheat period in such a manner as to rise from 0 to 7kv within 0.03 secs. The intervals between successive attempts to start the tube shall not be less than 10 seconds nor more than 30 seconds. Any valve failing to start within three attempts shall be considered a failure.
25. This shall be the first test after the holding period.
26. The gl voltage shall start to fall within 0.8uS of the 26%(52V) level first being reached by the unloaded grid pulse. The measurement shall be made within 10 seconds of the instantaneous start test and before raising epy to 9kv for the Operation 1 test.
27. This test shall be performed within 60 seconds of the Operation 1 test.
28. The test in this group shall be performed on a sampling basis. A lot shall consist of one month's production and the sampling scheme shall be that specified in MIL-STD-105A in conjunction with Appendix C of IIEI for Inspection Level IA and AQL of 10% for each test. Only normal inspection shall be used. In the event of failure on any test, the remainder of the lot shall be inspected 100% for that characteristic on which failure occurred.
29. This test shall be performed immediately after the instantaneous start test. Readings shall be taken 10 seconds and 5 minutes after the application of epy. Neither value shall exceed the limit stated.
30. Time jitter 1 and 2 (7kv) shall be measured respectively 10 seconds and 5 minutes after the application of epy, and shall be within the limits specified.
31. After Operation 2, adjust epy to 3kv and measure time jitter 3 (3kv).
32. With the trigger bias supply (Ecc2) as specified, the primer drive amplitude (egyl) of 40KV, and rise time (26% - 70.7% amplitude) 0.12uS max., there shall be no evidence of primer break through. For this test, the primer grid shall be capacitance loaded (with coaxial cable or otherwise) by at least 60pF.

33. The valve shall be run under Operation 2 conditions, during which the dummy load shall be short circuited for three periods of 1 to 2 seconds, each separated by approximately 10 seconds. The charging circuit shall be such that epy with the load short circuited is not less than the value specified for normal operation. The valve shall not arc through more than once.
34. One valve shall be subjected to this test each month. All results shall be recorded and made available to inspection and approving authorities as required.
35. One valve shall be running under each condition concurrently during the production period. Records of all life tests shall be available for examination by inspection and approving authorities as required.
36. Life Test Conditions shall be as follows:-

	<u>Life Test A</u>	<u>Life Test B</u>
epy (kv)	8	6.5
tp (uS)	$0.5 \pm 10\%$	$0.25 \pm 10\%$
ib (A)	90	60
dia/dt (A/uS)	1500 min	1500 min.
prp (pps)	2800	4000
t (hrs)	500	2000
Mounting Position	Vertical	Horizontal

37. The valve shall be tested before and at intervals during the life test to the end point tests stated (in the specified order)
38. The conditions for Life Test C (standby life test) are: $E_f = E_{res} = 6.3V$ rms (+5%, -10%). The valve may be operated for 5 minutes each day under life test B conditions, but the transfer time between standby and operation conditions shall be 3 mins. max. If this time is exceeded, the valve shall be preheated with only E_f and E_{res} applied, for 10 minutes before H.T. operation takes place. The valve shall be tested to the end point tests stated (in the specified order) initially, after approximately 250, 500 and 1000 hours, and then after every 1000 hours until failure occurs.
39. For life Test A and B, t_k shall be 120 seconds. For life Test C, t_k shall be 30 minutes minimum. The transfer time between standby and test conditions may be ignored if it is less than 20secs.
40. This test shall be performed within 60 seconds of the Operation 2 Test.
41. The maximum decrease in rate of rise shall be 25% of the initial value.
42. Valves shall be packaged according to K1005 in a carton size H.
43. This shall be the sole test for packaging requirements.

FIG.1. GENERAL OPERATION TEST CIRCUIT.

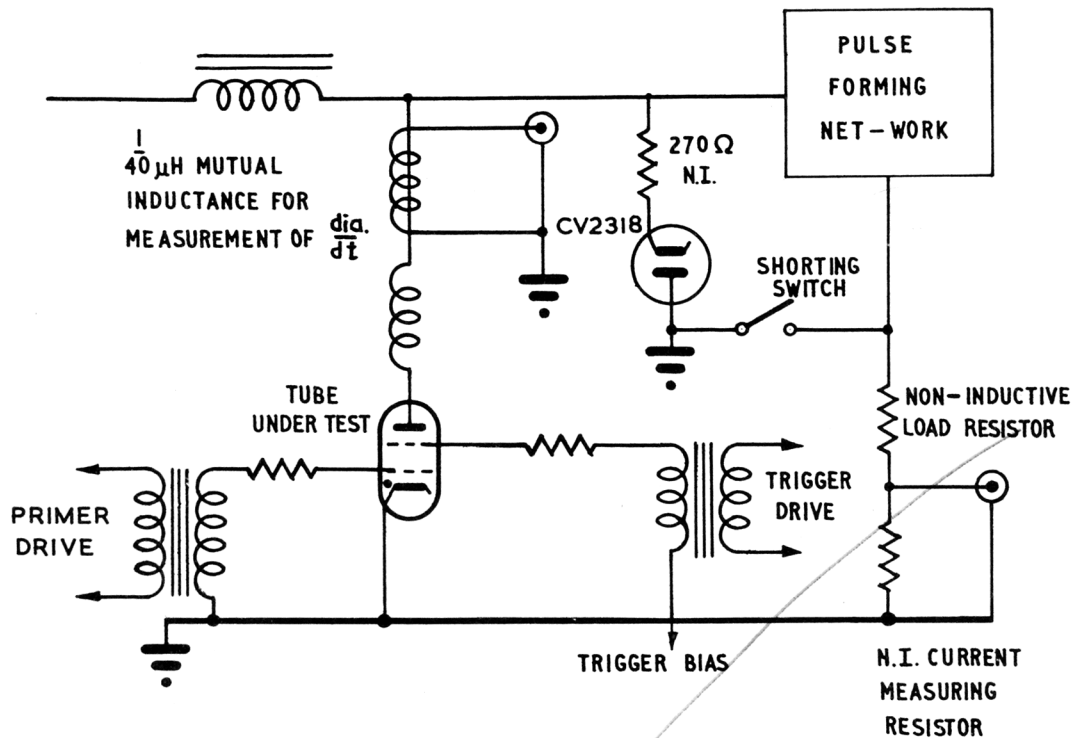
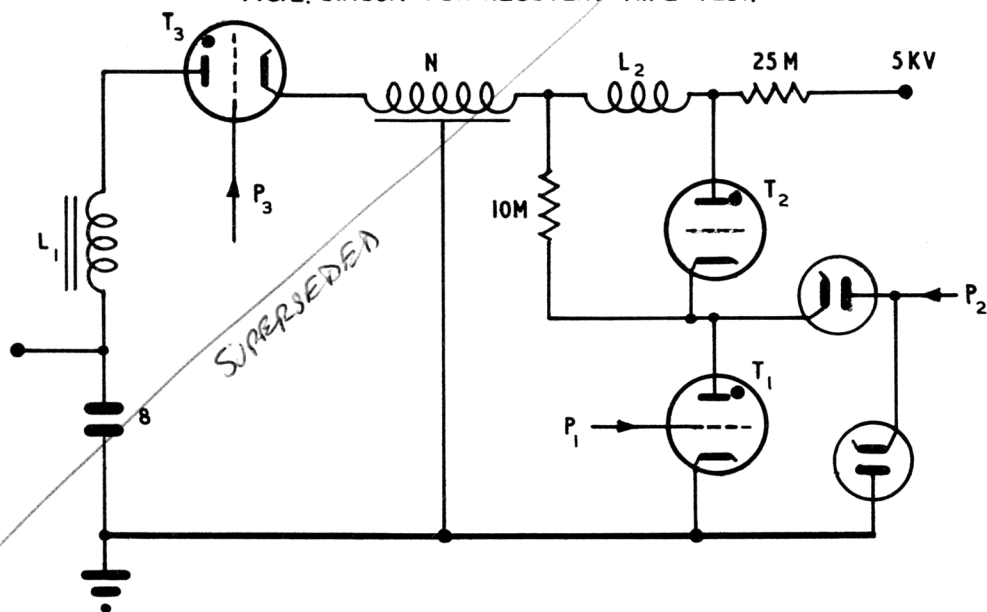
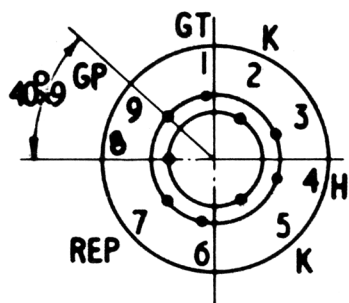


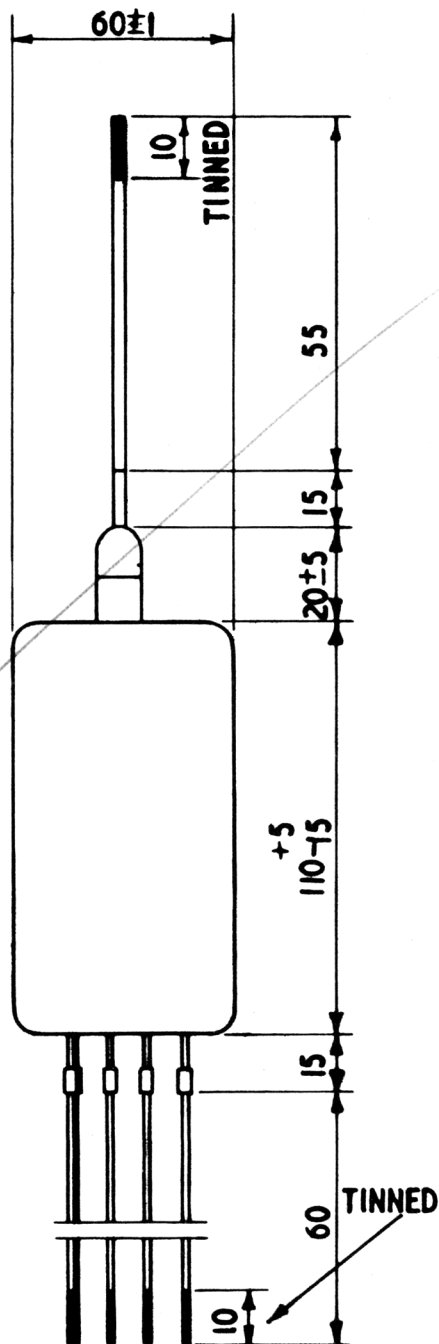
FIG.2. CIRCUIT FOR RECOVERY TIME TEST.



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