CV.6015

MINISTRY OF AVIATION - R.R.E.

VALVE ELECTRONIC

Specification MOA/CV6015 Issue 1, reprint A dated 4th Jan '65 To be read in conjunction with K1006	SECURITY Valve: Unclassified Specification: Unclassified

→ Indicates a change

Type of tube : Hydrogen thyratron, tetrode, rugged with flying leads

Non simultaneous ratings (see Note A)

		Min.	Max.	Note
RMS cathode heater voltage Ef.	Volts	5.7	6.6	B
RMS reservoir heater voltage Ers.	Volts	5.7	6.6	B
Peak forward voltage epy.	kV	-	8.0	E
Peak reverse voltage epx.	kV	-	8.0	F
Mean anode current Ib.	mA	-	100	
Peak anode current ib.	Amps	-	90	
Peak rate of rise of anode current $\frac{dib}{dt}$	A/µs	-	1500	M
Operation factor: epy x prr x ib	MW kc/s	-	2.0	
Peak forward grid 1 voltage egy 1	volts	200	350	G
→ Peak forward grid 2 voltage egy 2	volts	-	350	
Peak reverse grid 1 voltage egx 1	volts	-	300	H
Peak reverse grid 2 voltage egx 2	volts	-	200	
Tube heating time tk	secs	120	-	
Bulb temperature	°C	-	250	C
Ambient temperature	°C	-55	+90	D
Ambient pressure	Torr	500	800	

ENVELOPE
Glass

CATHODE
Unipotential, indirectly heated

PROTOTYPE
VX8205

MARKING
See K1001/4

CONNECTIONS
See page 13

DIMENSIONS
Max. bulb length, including seal off pip, 115 mm.
Max. diameter 61 mm.
See page 13 for details

MOUNTING POSITION
Any

NATO STOCK NUMBER
5960-99-037-2078

Characteristics and Operating Conditions

		Min.	Nom	Max.	Note
RMS cathode heater current If for Ef = 6.3V	Amps	4.5	-	5.5	B
RMS reservoir heater current Irs for Ers = 6.3V	Amps	1.3	-	1.7	B
Grid 1 unloaded pulse voltage	V	200	-	350	G
Grid 2 unloaded pulse voltage	V	300	-	-	H
Grid 1 potential w.r.t. cathode	V	-10	-	+5	K
Grid 2 potential w.r.t. cathode	V	-100	-	-40	L
Grid 2 pulse delay tgd	µs	1.5	-	4.0	J
Anode take over voltage	kv	2.0	-	-	
Time jitter with AC on heaters tjac	ns	-	-	3	
Time jitter with DC on heaters tjde	ns	-	-	2	G
Anode delay time tad,	ns	-	-	300	
Anode delay time drift Δtad	ns			50	
Bulb temperature	°C	80	-	250	C
Peak anode voltage, instantaneous start	kV	-	-	7	E
Peak reverse anode voltage 25 µs after pulse	kV	-	-	2.5	F
Recovery Time		-	-	-	L

NOTES

A. Paragraphs 3.2 and 6.5 of K1006 apply.

B. Reservoir and Heater should normally be connected to a common voltage supply with tolerance +5%, -10%.

→ C. The bulb temperature should be measured opposite the grid cylinder, as indicated on the outline drawing on page 12.

The bulb temperature should be allowed to exceed 80°C when the tube is running with EHT on. Excessive thermal inertia in the valve mounting should be avoided so that this temperature is rapidly reached after switch on. The life of the tube and its performance may be impaired if allowed to run for long periods with a bulb temperature of less than 80°C.

D. Ambient temperature should be measured at a point three inches from the tube in the plane through the base. When the tube is inclined to the vertical, it should be measured at the lowest point consistent with the above. The surroundings of the tube should be such as to permit free convection of air over the bulb. Cooling of the leads is permissible, but there should be no direct air blast onto the bulb.

E. For instantaneous start the peak anode voltage should not exceed 7.0 kv. The time taken to reach this voltage should exceed 40 milliseconds.

F. For pulsed operations, the peak reverse anode voltage, exclusive of a spike of 0.05μS maximum duration shall not exceed 2.5 kv during the first 25 μs after the pulse.

G. The primer drive pulse, measured at the tube socket with the primer grid 1 disconnected should be :

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

→ *In applications where a jitter of the order of 1 nanosecond or less is required it is important that the grid 1 pulse should have an amplitude within the range 290v to 350v.

The characteristics of the pulse shall be measured in accordance with K1006, Appendix E, para 20.

H. The trigger drive pulse, measured at the tube socket with the trigger grid 2 disconnected shall be :

Amplitude (egy 2)	300V min. (relative to cathode)
Rate of Rise	1000V/μSec. min. (26%-70.7% amplitude)
Duration	0.5μSec. min. (70.7% amplitude)
Impedance of source	1500 ohms max.

The bias voltage measured at the grid 2 terminal should not drop more than 15 volts when 5 mA dc is drawn from the grid terminal.

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.

NOTES (Cont'd)

K. The limits apply to the potential of the grid during the period between the completion of recovery and the start of the suceeding grid pulse.

L. The impedance seen from grid 2 during the recovery period should be kept low and negative bias should be applied to encourage fast recovery.

M. $\frac{dib}{dt}$ should be measured by means of a mutual inductor in the anode lead of the thyratron. Overheating and subsequent fire through may occur if the rated value is exceeded.

TESTS To be read in conjunction with K1006

K1006 Ref.	Test	Conditions	Symbol	LIMITS Min.	LIMITS Max.	Units	Notes
	Qualification Approval Tests						1,2,11
	Operation 3	epy = 8kv TA = 90°C t = 5 hrs.					12,13
	Anode Delay Time	epy = 8kv	tad		300	ns	14,15
	Anode Delay Time Drift		Δtad		50	ns	14,16
	Resonance Search Fatigue	No voltages					17,18
	Operation 2	epy = 7kv t = 300 secs.					13,19
	Jitter 4	Operation 2 but with direct voltage applied to cathode heater.	tj		2	ns	21
	Jitter 5	Operation 2, with direct voltages to cathode and reservoir heaters	tj		2	ns	21
	Jitter 6	As for Jitter 4 but with egy 1 = 290V max.	tj		1	ns	21
	Jitter 7	As for Jitter 5 but with egy 1 = 290V max.	tj		1	ns	21
	Microphony	Op. 2	Δtj	To be agreed later		ns	17,20,21
	Recovery Time		tR		20	µs	22
	Measurements Acceptance Tests Part I						1,2,23
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	Ires.	1.3	1.7	Amps	
	Instantaneous Start	epy = 7kV min. tk = 120 sec.					24,25
	G1 Strike		tgl		0.8	µs	26
	Operation 1	epy = 9kv t = 300 sec.					13
4.10.17.2	dc Anode Voltage		Ebb		1500	Volts	27

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K1006 Ref.	Test	Conditions	Symbol	LIMITS Min.	LIMITS Max.	Units	Notes
	Measurements Acceptance Tests Part II						1,2,28
	Instantaneous Start	epy = 7kv min. tk = 120 sec.					24
	Operation 2	epy = 7kv					13
	Anode Delay Time	Op. 2	tad		300	ns	14,29
	Anode Delay Time Drift	Op. 2	Δtad		50	ns	14,16
	Jitter 1 (7kv)	Op. 2	tj_7		10	ns	21,30
	Jitter 2 (7kv)	Op. 2	tj_7		3	ns	21,30
	Jitter 3 (3 kv)	epy = 3 kv	tj_3		10	ns	21,31
	Max. Primer Amplitude	epy = 7kv Ecc2 = -30V	egy1	400		Volts	32
	Short Circuit	Op. 2					33
	Degradation Rate Acceptance Tests						1,2
4.9.20.6	Fatigue	Ef = Eres = 6.3V rms No other voltages f = 50 c/s Acc. = 2.5g t = 30+30+30 hrs.					34
4.9.20.5	Shock	No voltages Hammer Angle = 24°					34
	Post Shock and Fatigue Tests						
	Instantaneous Starting	epy = 7kv min. tk = 120 secs.					24
	Operation 2	epy = 7kv t = 300 secs.					13

K1006 Ref.	Tests	Conditions	Symbol	LIMITS Min.	LIMITS Max.	Units	Notes
	<u>Life Tests</u>						35
	Life Test A						36,37
	Life Test B						36,37
	Life Test C						38
	Life Test End Points						1,2
	Instantaneous Starting	epy = 7kv min.					24,39
	Operation 2	epy = 7kv					13
	Anode Delay Time	Op. 2	tad		400	ns	14,29
	Anode Delay Time Drift	Op. 2	Δtad		50	ns	14,16
	Jitter 2 (7kv)	Op. 2	tj_7		3	ns	21,30
	D.C. Anode Voltage		Ebb		2000	Volts	40
	Max. Primer Amplitude	epy = 7kv Ecc_2 = -40V	egy1	400		Volts	32
	Rate of Rise	epy = 7kv	dib/dt			Amps/µs	41
	<u>Packaging Requirements</u>						42
	Operation 1	epy = 9kv					1,2, 13 & 43
		t = 300 sec.					

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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	5
	tr 1	0.15 min.	µS	4
	tp 1	2.0 max.	µS	5
	Zg 1	1200 ± 10%	ohms	6
	Ecc 1	0	Volts	
Grid 2 (Trigger) Circuit	egy 2	260 max.	Volts	3
	tr 2	0.13 min.	µS	7
	tp 2	2.0 max.	µS	5
	Zg 2	1500 min.	ohms	6, 8
	Ecc 2	-40	Volts	
	tgd	1.0 - 1.5	µS	9
Anode Circuit	epy	7.0	kv	
	ib	80 ± 5%	Amps	
	dib/dt	1500 min.	A/µS	10
	Ib	75 min.	mA	
	tp	0.25 ± 10%	µS	
	prr	4000	pps	
	TA	10 - 40	°C	
Mounting Position		Vertical		

2. The heater and reservoir voltages shall be 6.3V rms. for all tests except those grouped as Measurement Acceptance Tests Part II and the Q.A. tests Jitter 4,5,6,7. All tests grouped as Measurement Acceptance Tests Part II shall be performed in the order stated, once with Ef = Eres = 5.7 Vrms and then with Ef = Eres = 6.6 Vrms. The QA Tests Jitter 4,5,6,7 shall be performed in the order stated, once with direct or alternating voltages as specified equal to 5.7V, and then with the voltages equal to 6.6V.

NOTES

3. This is measured relative to cathode in accordance with K1006 Appendix E, paragraph 20.2.

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 K1006 Appendix E, paragraph 20.2.

5. This is measured at 70.7% of the pulse amplitude, in accordance with K1006 Appendix E, paragraph 20.2.

6. The impedance during the post-pulse period, defined as $\frac{eg - Ecc}{ic}$, shall not be less than the value given for Zg where eg and ig are the values of the grid voltage and current at any instant and Ecc 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 $\frac{\Delta Eg}{\Delta Ig}$ at the grid terminal when a direct current of 6mA is being drawn, shall not be less than 3000 ohms.

9. 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.

   When a large tgd is used, the length of the G1 pulse must be such that its 70.7% level overlaps by at least 0.5 µS the 70.7% level of the g2 pulse.

10. dib/dt is defined as the maximum instantaneous value of the rate of rise of ib and is to be measured by means of a mutual inductor in the anode lead of the thyratron.

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 III DEF-131 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 III of DEF-131 at normal inspection.

12. The valve shall be operated in an insulating container about 450 cu. ins. in volume and of such dimensions that temperature can be measured in accordance with Notes C and D 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 of 10^7 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 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 thyratron or on the trailing edge of the current pulse measured by means of a 1 ohm non-inductive resistor.

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 (prr)	50 c/s ± 2c/s
Peak Cathode Current (ib)	90A min.
Current Pulse Duration (tp)	1.7µS ± 10%
Ef = E res	6.3V rms.
Trigger Bias Voltage (Ecc2)	-40V max.
Probe Pulse Amplitude	2kv peak min.
Probe Pulse Rise Time between 26% and 70.7% of full amplitude.	3 to 4 µS measured

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 g1 voltage shall start to fall within 0.8μS of the 26% (52V) level first being reached by the unloaded grid pulse. The measurements 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 DEF-131 for Inspection Level 1A 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 (3 kv).

32. With the trigger bias supply (Ecc2) as specified, the primer drive amplitude (egy1) of 400V, and rise time (26% - 70.7% amplitude) 0.12μS 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:-

	Life Test A	Life Test B
epy (kv)	8	6.5
tp (μS)	0.5 ± 10%	0.25 ± 10%
ib (Δ)	90	60
dia/dt (Δ/μS)	1500 min	1500 min.
prr (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: Ef = 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 Ef 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, tk shall be 120 seconds.
For life Test C, tk 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.

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FIG. 1. GENERAL OPERATION TEST CIRCUIT.

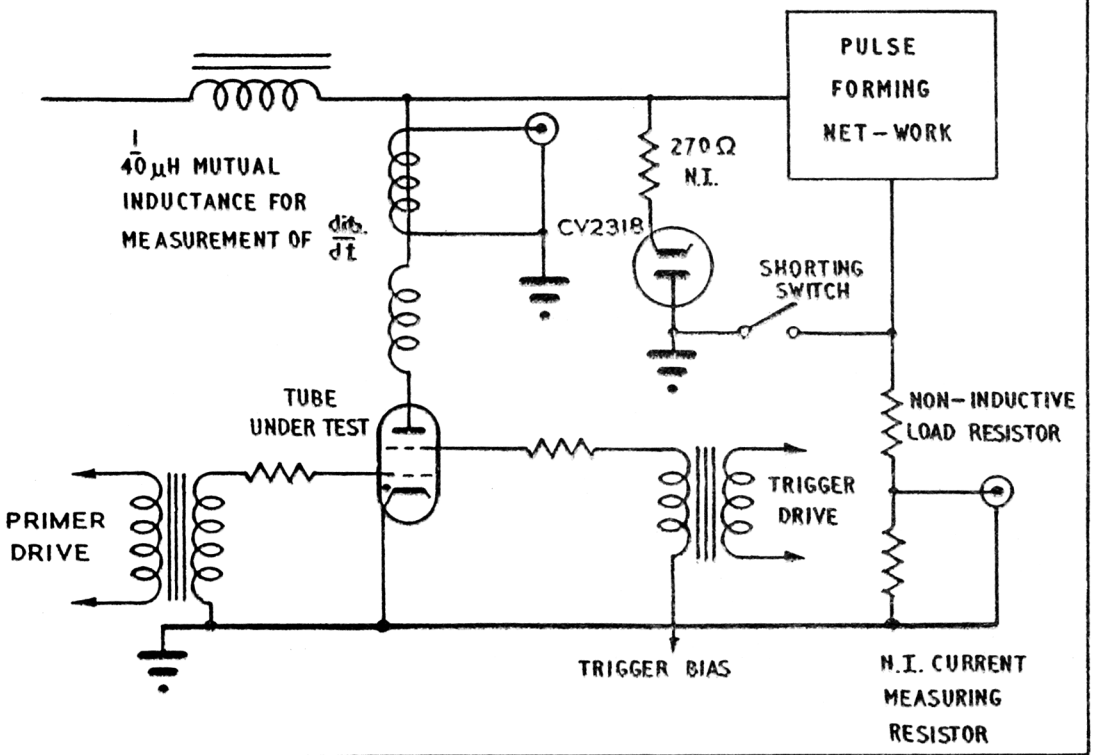
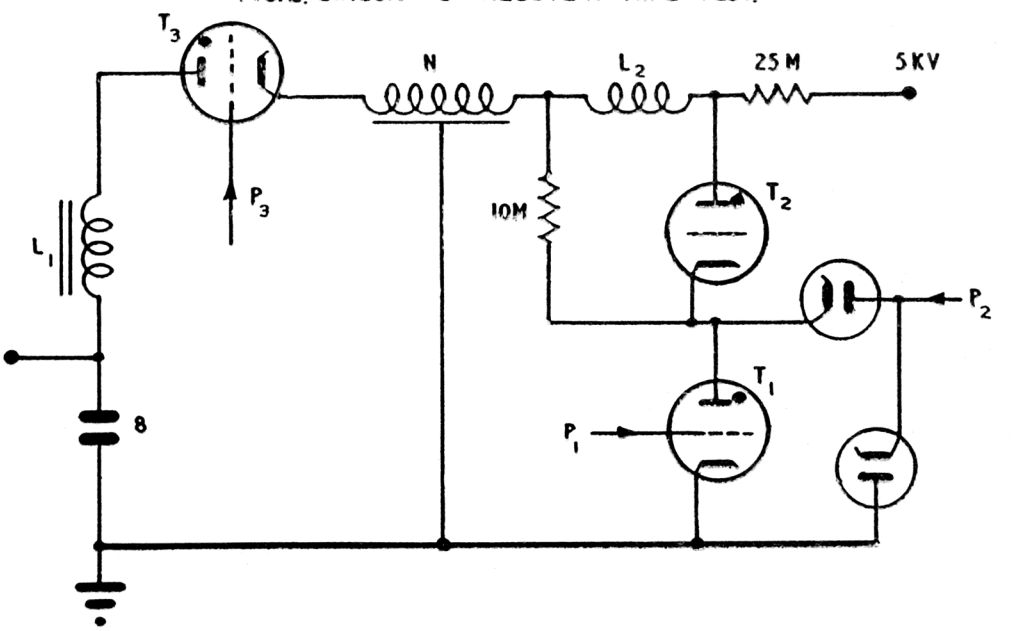
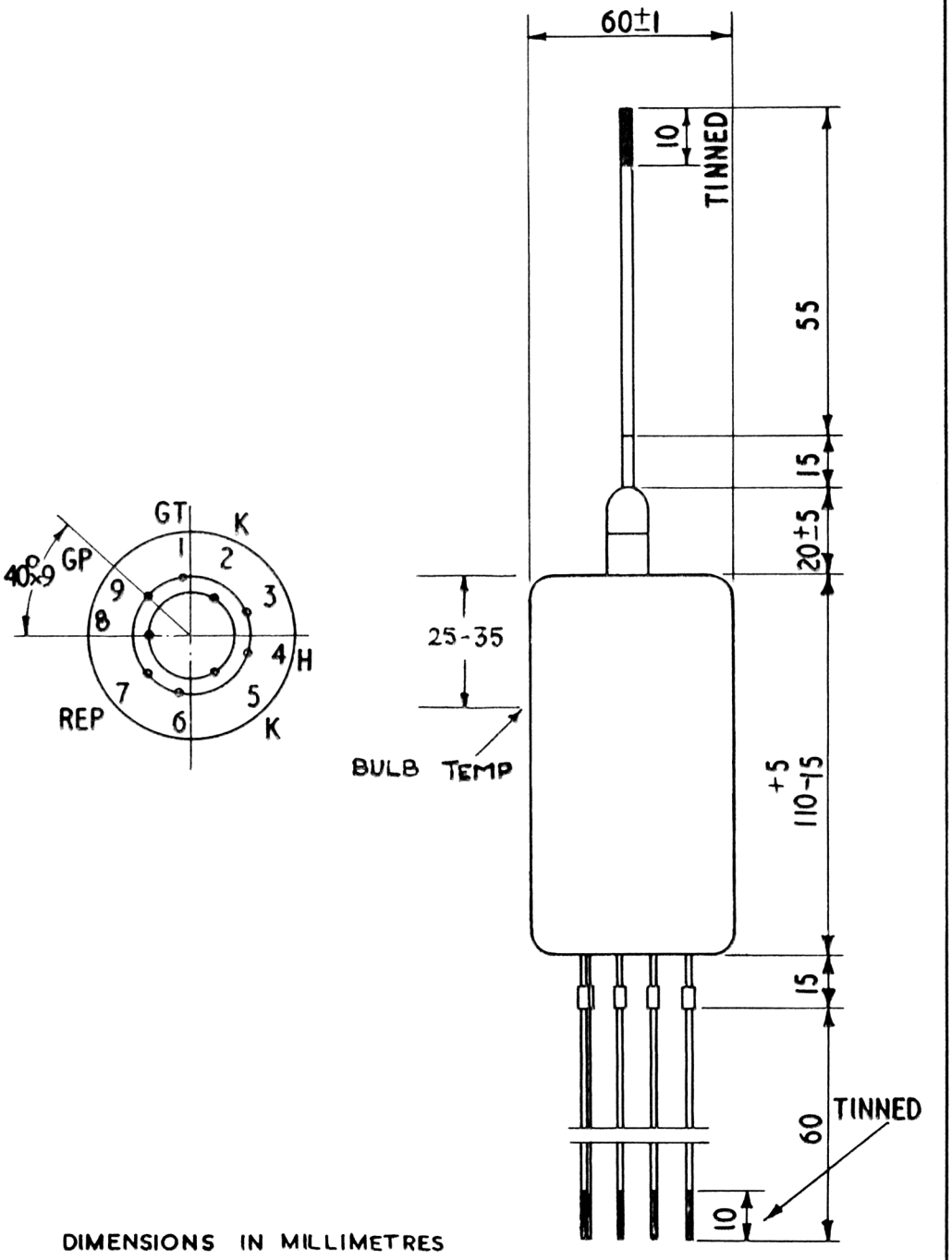


FIG. 2. CIRCUIT FOR RECOVERY TIME TEST.



OUTLINE AND FLYING LEAD INFORMATION



DIMENSIONS IN MILLIMETRES

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