 VALVE ELECTRONIC

ADMIRALTY SURFACE WEAPONS ESTABLISHMENT

Specification AD/CV2393 Issue 4 Dated 31-8-61 To be read in conjunction with K1001, BS.448 and BS.1409	SECURITY Specification: Unclassified Valve: Unclassified

TYPE OF VALVE: Voltage Tuned Oscillator, (X-band) with Permanent Magnet.

CATHODE: Indirectly heated.

ENVELOPE: Glass enclosed in a metal shell.

PROTOTYPE: VX2507, C043

MARKING

See K1001 Issue 5. The serial number shall be clearly included on the shell of the valve.

BASE

A7-13 (NOTE H)

RATINGS

(All limiting values are absolute)

			Note
Heater Voltage (Nom.)	(V)	6.3	A
Max. Heater Current	(A)	2.5	
Surge Heater Current	(A)	4.0	
Min. Delay line Voltage	(V)	300	B
Max. Delay line Voltage	(V)	1500	B
Max. Delay line Current	(mA)	35	C
Max. Delay line Dissipation	(W)	50	
Max. Anode Voltage	(V)	300	
Max. Anode Current	(mA)	10	
Max. Negative Grid Voltage	(V)	250	D
Min. Total Tuning Range	(Mc/s)	7000 to 11500	G
Min. Power Output	(mW)		

CONNECTIONS

PIN	ELECTRODE	
1	Heater	h.
2	Cathode	k.
3	Anode	a.
4	Grid	g.
5	Delay line and Collector	dl.
6	as for pin 5	dl.
7	Heater	h.

The power output terminal at the valve is an approved Type N socket for connection to a 50 ohm co-axial line plug J.S.No.5935-99-940-1095 See Note J on page 2.

DIMENSIONS

See drawing on page 8

NOTES

A. The heater voltage shall be applied at least two minutes before the application of the H.T. voltages.

B. In all cases the delay line voltage must be applied before the anode voltage.

C. The delay line and collector are connected inside the valve, and therefore the "delay line current" includes collector current

NOTES (Cont'd.)

D. For normal operation the grid is set at zero volts. At V_g = -100 volts oscillations are cut-off.

E. The magnetic field required to focus the electron beam is provided by a permanent magnet, which is an integral part of the valve. External magnetic fields or ferro-magnetic objects may distort the focusing field and cause noise and modulation. The valve should be kept at least 8" away from other magnets or ferrous objects to prevent damage to the magnet, and should not be operated within 18" of such objects if low noise output is required. It is recommended that the valve be stored in its crate or in a similar stowage when it is not required to be in its associated equipment.

F. The temperature at any point on the external surface of the metal shell must not be allowed to exceed 120°C. Minimum air flow directed on to the radiating fins and side of the valve should be 20 cu. ft./min.

G. The valve is tuned by varying the delay line voltage (V_{dl}). The relationship between frequency and V_{dl} is approximately given by the curve shown on page 9. The valve oscillates at a frequency of 7000 Mc/s at V_{dl} not lower than 300V, and at a frequency of 11,500 Mc/s at V_{dl} not higher than 1,500V.

H. The base is rigidly attached to the metal shell and its pins are connected to the valve terminals by flexible leads.

J. The output terminal magnet, and shell of the valve are intended to be operated at earth potential, and are isolated from the delay line, other electrodes and leads. The insulation resistance with 2kV d.c. applied is greater than 100 Megohm.

K. The Joint Services Catalogue No. is:-

5960-99-000-2393

CV2393

TESTS

To be performed in addition to those applicable in K1001.

Tests are to be performed in the specified order unless otherwise agreed with the Inspecting Authority.

Test conditions - unless otherwise stated:-

V_h (V)	V_g (V)	V_a (V)	Cooling	v.s.w.r.
6.3	a.c. 0	V_o (Note 1)	(Note 2)	<1.2:1 (Note 3)

Test	Test Conditions	AQL %	Insp. Level	Symbol	Limits Min.	Limits Max.	Units
a Heater Current (After two minutes)	No voltages except V_h		100%	I_h	1.75	2.5	A
b Vibration	Adjust V_{dl} for 9000 Mc/s Notes 4, 5 and 6		T.A. and 10%				
(i) Frequency Deviation	Note 7			$\pm\Delta F$	-	1	Mc/s
(ii) Power Output Deviation				$\pm\Delta P_o$	-	5	%
(iii) Carrier to Noise Ratio	Note 8			C/N	150	-	dB/c.p.s.
c Vibration	Adjust V_{dl} for 7000 and 11500 Mc/s Notes 4, 5 and 9		T.A.				
Frequency Deviation				$\pm\Delta F$	-	1	Mc/s
d Oscillation at 7000 Mc/s	Adjust V_{dl} for 7000 Mc/s Notes 4 and 10		100%				
(i) Delay line Voltage				V_{dl}	300	350	V
(ii) Delay line Current				I_{dl}	-	25	mA
(iii) Anode Current				I_a	-	10	mA
(iv) Power Output				P_o	20	-	mW
e Oscillation at 9000 Mc/s	Adjust V_{dl} for 9000 Mc/s Notes 4 and 10		100%				
(i) Delay line voltage				V_{dl}	580	700	V
(ii) Power Output				P_o	20	-	mW
f Oscillation at 11500 Mc/s	Adjust V_{dl} for 11500 Mc/s Notes 4 and 10		100%				
(i) Delay line Voltage				V_{dl}	1300	1500	V
(ii) Delay line Current				I_{dl}	-	35	mA
(iii) Anode Current				I_a	-	10	mA
(iv) Power Output				P_o	20	-	mW
g Anode Modulation	Adjust V_{dl} for 7000, 9000 and 11500 Mc/s. Adjust V_a from V_o to V_o-100V. Notes 4 and 11		100%				
Ratio of max. to min. Values of Power Output				$\frac{P_{o(max)}}{P_{o(min)}}$	3.5	-	

TESTS

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Test conditions - unless otherwise stated:-

V_h	V_g	V_a	Cooling	v.s.w.r.
(V)	(V)	(V)		
6.3 a.c.	0	V_o (Note 1)	(Note 2)	< 1.2:1 (Note 3)

	Test	Test Conditions	AQL %	Insp. Level	Symbol	Limits Min.	Limits Max.	Units
h	Grid Characteristics							
	(i) Cut-off	V_g = -100V V_{dl} = Adjust from 300V to 1500V		100%	P_o	-	0	mW
	(ii) Power Output	V_g = -60V V_{dl} = Adjust from 300V to 1500V			P_o	-	20	mW
	(iii) Slope	V_g = varied from -100V to 0V V_{dl} = 1500V			$\frac{\Delta P_o}{\Delta V_g}$	Must always be positive		mW/V
j	Grid Insulation Grid Current Record	V_g = Adjust for $I_{dl} + I_a$ = 10mA. Then reduce V_a to zero. V_{dl} = 1500V		100%	$I_g(1)$	-	30	µA
k	Vacuum Test	V_g = as for test j V_{dl} = 1500V Note grid current $[I_g(2)]$ $I_g(2) - I_g(1)$		100%	ΔI_g	-	10	µA
l	Grid Pulse Modulation Peak Power Output Record C.W. Power Output Record $\frac{P_o(1) - P(pk)}{P_o(1)}$	V_{dl} adjust for 9000 Mc/s (Note 4) V_g pulsed from cut-off value to zero volts Pulse length = 0.2 µsecs (Nom) at 1000 p.p.s.		T.A.		-	20	%
m	Valve Noise Carrier to Noise Ratio	Adjust V_{dl} for all frequencies 7000-11500 Mc/s. Notes 8 and 12		100%	C/N	150	-	dB/c.p.s.

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TESTS

To be performed in addition to those applicable in K1001.

Tests are to be performed in the specified order unless otherwise agreed with the Inspecting Authority.

Test conditions - unless otherwise stated:-

V_h	V_g	V_a	Cooling	v.s.w.r.
(V)	(V)	(V)		
6.3 a.c.	0	V_o (Note 1)	(Note 2)	< 1.2:1 (Note 3)

	Test	Test Conditions	AQL %	Insp. Level	Symbol	Limits Min.	Limits Max.	Units
n	**Frequency Pulling** At 7000, 9000 and 11500 Mc/s.	Adjust V_{dl} for test frequencies Notes 4 and 13		100%	ΔF	-	8	Mc/s
p	**Insulation Resistance**	No operating Voltages. 2kV d.c. applied between test electrode pin and shell.		100%				
	(i) Shell to Delay-line and Collector.				R_{dl}	100	-	Meg-ohms
	(ii) Shell to Cathode/ Heater				R_k	100	-	Meg-ohms
	(iii) Shell to grid				R_g	100	-	Meg-ohms
	(iv) Shell to Anode				R_a	100	-	Meg-ohms
q	**Leakage Current** Heater/Cathode Current	No operating Voltages. Note 14		100%	I_{hk}	-	750	μA
r	**Life**	Adjust V_{dl} for 9000 Mc/s Notes 4 and 15		T.A. and 2%	t P_o	500 10	- -	Hours mW

NOTES

1. V_o which must be within the limits 100-200 volts d.c. must be quoted on the data sheets supplied with each valve. V_o is a single fixed value of V_a which is compatible with tests (d), (e) and (f).

2. The valve must be air-cooled, the air at ambient temperature being directed on to the side of the metal shell and radiator. Air flow to be not greater than 20 cu. ft./min.

3. The input v.s.w.r. of the power and frequency measuring equipment must be less than 1.2 over the full μ-wave frequency range of 7000-11500 Mc/s.

4. The frequency shall be set to within $\pm \frac{1}{2}\%$.

/5. ....

NOTES (Cont'd)

5. The valve shall be mounted rigidly on a vibration table and while operating shall be vibrated with simple harmonic motion, in the direction of each of the three mutually perpendicular axes successively, at the following vibration frequencies and amplitudes:-

Vibration Frequency Range (c.p.s.)	Amplitude of Vibration (inches)
1 - 15	± 1/16
15 - 30	± 0.010
30 - 50	± 0.005
50 - 80	± 0.002
80 - 100	± 0.001

The vibration frequency range shall be continuously explored once. The rate of change of this frequency shall not exceed 20 c/s per minute.

6. One valve in ten shall be tested. In the event of failure, a second valve shall be vibrated. If this valve proves satisfactory, the batch shall be accepted; if unsatisfactory, the batch shall normally be rejected. At the discretion of the Government Authority concerned however, a rejected batch may be resubmitted for acceptance following a joint investigation by the contractor and the Government Authority. Valves satisfying this test, which is considered to be non-destructive, may be accepted as part of the order.

7. The test requirement is that frequency modulation of the RF output by the vibration shall not exceed ± 1 Mc/s at any frequency in the tuning range for the range of vibration frequencies tabulated under Note 5.

8. The heater supply shall be d.c. or rectified and smoothed a.c.

A broadband (non-balanced) mixer shall be used throughout noise tests. The noise output shall be indicated on a visual display. The following tests are to be made:-

(a) The ratio of signal to average noise over 10 Mc/s bandwidth centred at 60 Mc/s and 120 Mc/s shall not be less than 150 dB/c.p.s.

(b) The ratio of signal to average noise over a 20 kc/s bandwidth centred at 1.0 Mc/s shall be measured for record purposes only, and test results for all valves made available to the specifying authority. These measurements to be made at 7000, 9000 and 11,500 Mc/s only.

For all noise measurements the load v.s.w.r. shall be less than 1.5.

9. Additionally, if necessary valves shall be vibrated over the full carrier frequency range at any vibration frequency at which mechanical resonances are observed to occur. The value of ΔF must not, with these vibration frequencies, exceed ± 1 Mc/s at any carrier frequency in the range 7000 to 11,500 Mc/s.

/10. .....

NOTES (Cont'd)

10. The manufacturer is to supply with each valve:-

(i) A power output versus delay line voltage characteristic covering the range of frequencies 7000-11,500 Mc/s. The power output shall not be less than 20 mW at any frequency in this range.

(ii) A frequency versus delay line voltage characteristic covering the range of frequencies 7000-11,500 Mc/s. There must be no frequency discontinuities over this tuning range.

11. With each valve, the manufacturer is to supply anode modulation characteristics showing power output versus anode voltage for each test frequency.

12. The time taken in this test for each sweep over the carrier range of 7000-11,500 Mc/s shall not be less than two minutes.

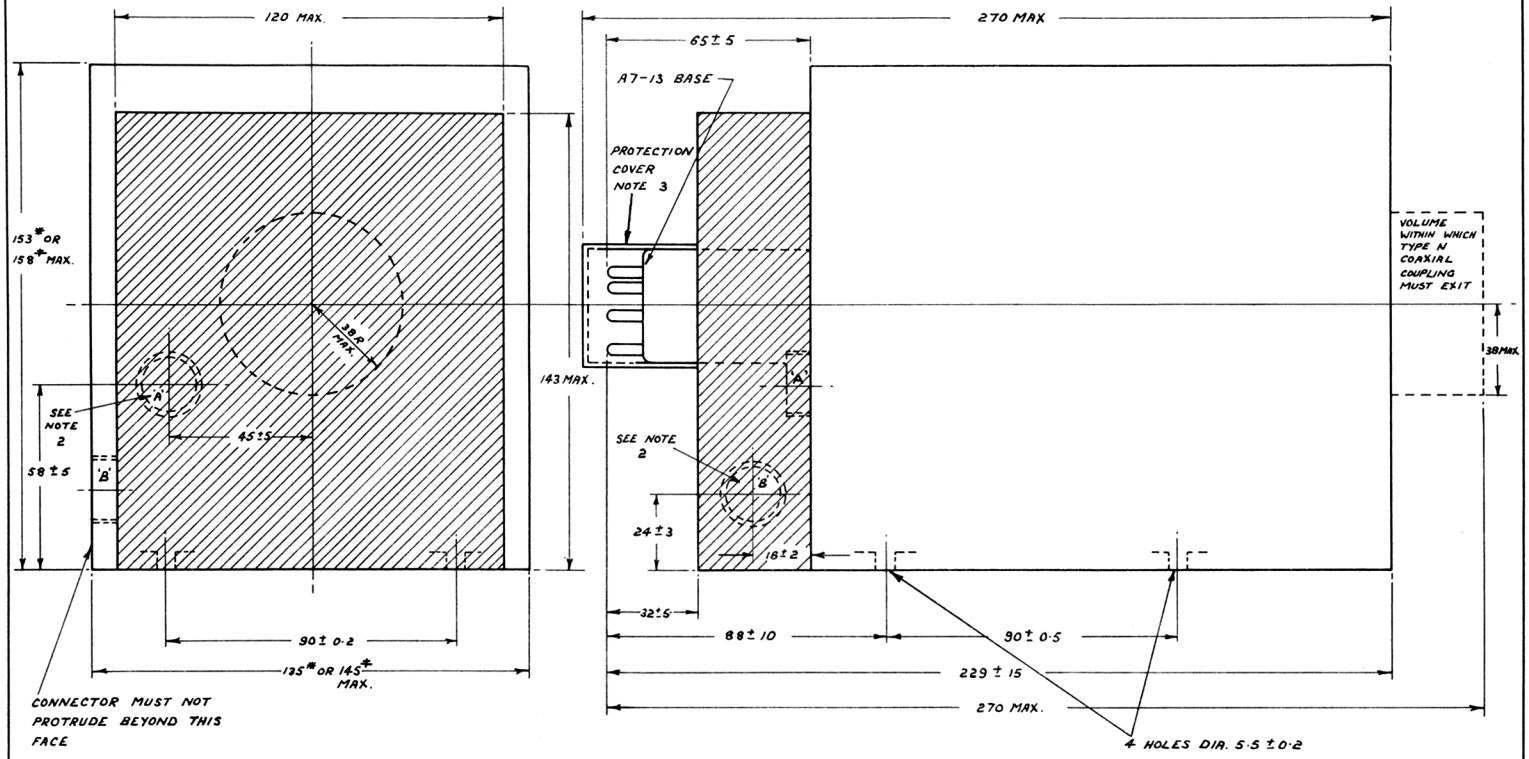
13. The pulling frequency is the difference between the max. and min. frequencies recorded when a mismatch placed in the output section is varied through all phases. The v.s.w.r. of the mismatch shall normally lie between 1.5-1.6 at each μ wave frequency, but the manufacturer may, at his discretion exceed a v.s.w.r. of 1.6, during this test.

A curve showing variations in frequency pulling over the tuning range shall be recorded for each valve. Measurements shall be made at delay line voltages separated by intervals of 40V from V_{dl} = 300 to V_{dl} = 700V, and by intervals of 60 volts from V_{dl} = 700V to V_{dl} = 1420V. This information must be made available to the specifying authority.

14. The maximum permissible leakage current to apply in this case for the Heater/Cathode Leakage Test (K1001 para. 5.3) shall be 750 μA.

15. The life of a valve shall be considered to be terminated when, at any frequency in the range 7000-11,500 Mc/s, the power output falls below 10mW, and the performance of the valve falls outside any of the limits specified in all other tests except test (b).

The test and release sequence, and the procedure to be adopted in the event of failure in life testing, will be decided by the purchasing authority. For production contract orders of less than 50 valves, the quantity of valves for life tests shall be decided by the purchasing authority.



NOTES

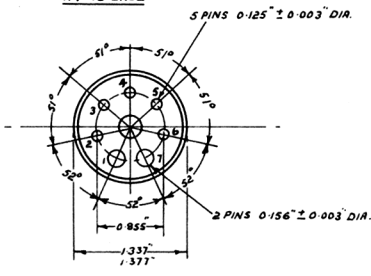
1. THE FIXING HOLES ARE AS SHOWN TO INDICATE THAT THERE MUST BE EASE OF ACCESS TO FIXINGS.

2. FOR CV 6024 ONLY. IF IT IS CONVENIENT TO THE MANUFACTURER TO INCLUDE A RESISTANCE IN SERIES WITH THE SOLENOID IN ORDER TO MEET THE REQUIREMENTS OF THE SPECIFICATION, THIS RESISTANCE MAY BE INCLUDED WITHIN THE EXTRA VOLUME OF THE HATCHED AREAS SHOWN. ALTERNATIVE POSITIONS ARE SHOWN FOR MOUNTING THE SOLENOID CONNECTOR (A.P. 208600). IF NO SERIES RESISTOR IS USED THE CONNECTOR CAN BE FITTED IN POSITION 'A'. IF, WITH A RESISTOR, POSITION 'A' CANNOT BE EMPLOYED, THEN POSITION 'B' MUST BE USED.

3. CONSTRUCTED OF METAL OR OTHER APPROVED MATERIAL, THIS COVER MUST FIT FIRMLY OVER THE BASE, AND BE EASILY REMOVED WHEN THE VALVE IS REQUIRED TO BE USED. THE PROTECTIVE COVER MAY BE OMITTED IF THE BASE OF THE VALVE DOES NOT FORM PART OF THE VACUUM ENVELOPE.

* FOR CV 2393
† FOR CV 6024
ALL DIMENSIONS IN M.M.'S

A7-13 BASE



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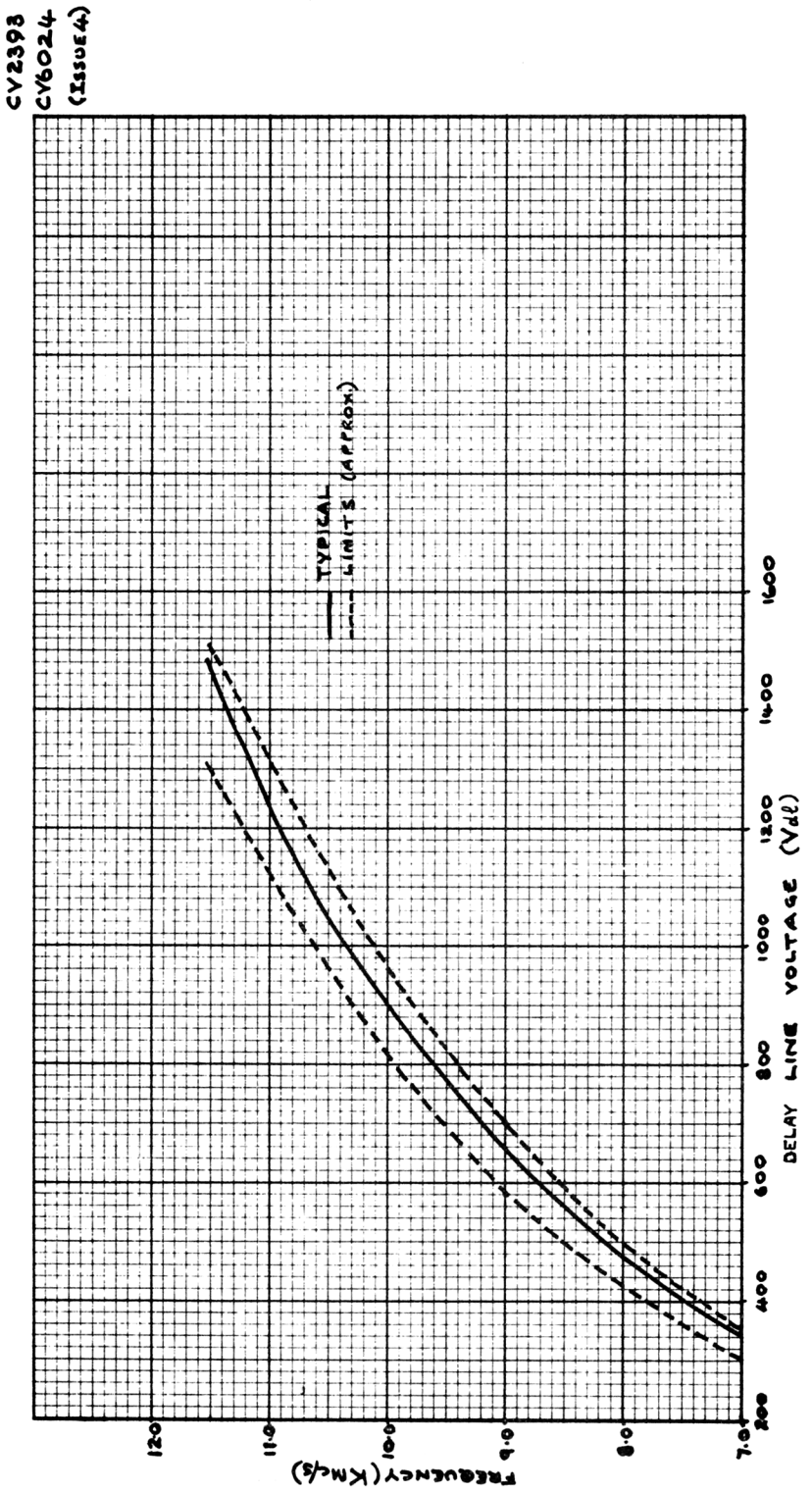
CV2393
CV6024
(Issue 4)
TYPICAL
LIMITS (APPROX.)
FREQUENCY (KMc/s)
12.0
11.0
10.0
9.0
8.0
7.0
200
400
600
800
1000
1200
1400
1600
DELAY LINE VOLTAGE (Vdl)

ELECTRONIC VALVE SPECIFICATIONS

SPECIFICATION AD/CV2393 ISSUE No.4 DATED 31.8.61

AMENDMENT No. 1

Page 8 Note 3

Add to the end of Note 3 the following:-

'The protective cover may be omitted if the base of the valve does not form part of the vacuum envelope'.

January 1964 T.V.C. for A.S.W.E.

(213533)

AAS
28/5/64