VALVE ELECTRONIC

# CV6205

ADMIRALTY SURFACE WEAPONS ESTABLISHMENT

Specification AD/CV6205
Issue No. 1 dated July, 1967
To be read in conjunction with K1001

| SECURITY | |
|---|---|
| Specification | Valve |
| Unclassified | Unclassified |

TYPE OF VALVE Forward Wave Tube Limiter, Packaged in metal and ceramic focusing mount.
CATHODE Indirectly heated
ENVELOPE Glass
PROTOTYPE VX7162

MARKING

K1001/4
See Outline Drawing, Page 10

CONNECTOR

Flying lead, attached plug
NATO Stock No.
5935-99-949-3853
See Outline Drawing, Page 10

RATINGS (All limiting values are absolute and non-simultaneous)

| | Symbol | | Unit | Note |
|---|---|---|---|---|
| Heater Voltage | $V_h$ | 6.3 ±1% | V | A,D |
| Heater Current | $I_h$ | 0.6 | A | |
| Heater Current (Surge) | $I_{h,s}$ | 3.5 | A | |
| Cathode-body Voltage (max) | $V_{K-B}$ | 800 | V | |
| Grid 1 Voltage (max) | $V_{g1}$ | ±100 | V | A,B,D |
| Grid 2 Voltage (max) | $V_{g2}$ | 375 | V | A,B,D |
| Helix Voltage (max) | $V_{hel}$ | 700 | V | A,B,D |
| Collector Voltage (max) | $V_{col}$ | 800 | V | A,B,D |
| Helix Current (max) | $I_{hel}$ | 150 | uA | |
| Collector Current (max) | $I_{col}$ | 500 | uA | |

CONNECTIONS

| Pin | Electrode |
|---|---|
| A | Heater |
| B | Heater-Cathode |
| C | Grid 1 |
| D | Grid 2 |
| E | Helix |
| F | Collector |
| Shell | See Note C |

TYPICAL OPERATING CONDITIONS

| | Symbol | | Unit | Note |
|---|---|---|---|---|
| Grid 1 Voltage | $V_{g1}$ | 0- -10 | V | A,B,D |
| Grid 2 Voltage | $V_{g2}$ | 150-350 | V | A,B,D |
| Helix Voltage | $V_{hel}$ | 575-650 | V | A,B,D |
| Collector Voltage | $V_{col}$ | 750 | V | A,B,D |
| Helix Current | $I_{hel}$ | 0-20 | uA | D,E |
| Collector Current | $I_{col}$ | 450 | uA | A,D |
| Frequency Range | | 4.1-7.0 | Gc/s | |
| Working Saturated Output Power | $P_{s1}$ | 7.0-13.0 | dBm | H |
| Max variation of Output Power for Input Power Change from Saturation Drive Level to +3 dBm | $\Delta P_{s1}$ | 13 | dB | J |
| Min Output Power for Input Power Change from Saturation Drive Level to +9 dBm | $P_{s2}$ | -18 | dBm | J |
| Noise Factor (nominal) | NF | 27 | dB | |
| Small Signal Gain | Gss | 28-38 | dB | F,G |

R.F. Input/Output CONNECTORS Coaxial N Type
NATO Stock No.
5935-99-943-7316
See Outline Drawing, Page 10

DIMENSIONS

See Outline Drawing, Page 10

MOUNTING POSITION

Any
See Note K

WEIGHT

8 lbs approx.

NOTES

A. Each valve shall be inscribed with individual markings determined by the manufacturer. (See Outline Drawing, Page 10). The valve should be operated at the marked conditions and within the following tolerances:-

$V_h \pm 1\%$ $V_{g1} \pm 1\%$ $V_{hel} \pm 0.5\%$ $V_{col} \pm 3\%$ $I_{col} \pm 1\%$

B. All voltages are quoted with respect to cathode.

C. The shell of the plug is connected to the body of the valve and should be connected to earth. All valve electrodes are insulated from the valve body.

D. The recommended switch-on and switch-off procedures are as follows:-

(a) 1. Ensure that $V_{g2}$ is zero.

2. Switch on heater and adjust to marked heater voltage.

3. Allow a minimum of 1 minute cathode heating time.

4. Switch on $V_{col}$, $V_{hel}$ and $V_{g1}$ simultaneously and adjust to marked values.

5. Increase $V_{g2}$ gradually until $I_{col}$ reaches the marked value.

6. Check and readjust electrode voltages.

(b) It is permissible to apply $V_{col}$, $V_{hel}$, $V_{g1}$ and $V_{g2}$ simultaneously but to ensure maximum tube life the applications of $V_{g2}$ should be delayed by 10 ms minimum after that of the other electrode voltages.

Switch-off

1. Reduce $V_{g2}$ to zero.

2. Then simultaneously switch-off all other voltages.

E. The helix current stated is that obtained when the valve is first placed into service. During the life of the valve, helix current may increase to 150 uA.

F. The minimum small signal gain stated is that which may be obtained when the valve is first placed into service. During the life of the valve, minimum small signal gain may decrease to 26 dB.

G. Measured over the range in which r.f. output does not exceed 0 dBm, the variation of small signal gain over the band will not exceed 7 dB when the valve is first placed into service. During the life of the valve, small signal gain variation may increase to 9 dB.

H. With the valve operating at the marked conditions, the working saturated output power, measured over the band, will lie within the limits quoted.

NOTES (Cont'd)

J. The variations of output power quoted are those which will be obtained when the valve is first placed into service. During the life of the valve, variations of output power for input power change from the drive level for saturation to +3 dBm may increase to 15 dB and minimum output power for the range of input powers from saturation drive level to +9 dBm may decrease to -21 dBm.

K. WARNING Magnets and ferromagnetic material in proximity to the valve will affect its performance and may cause permanent damage. Even small quantities of such materials must not be brought closer than two inches to any part of the valve. Non-magnetic bolts must be used for mounting the valve.

L. The valve must be kept in its storage container when not in use.

M. NATO Stock No. 5960-99-037-5438

## TESTS

To be performed in addition to those applicable in K1001.
Tests are to be performed, after a holding period of 14 days, in the order specified unless otherwise agreed with the Inspecting Authority.

**Test Conditions - Unless Otherwise Specified**

(i) Voltages shall be those marked on the valve, with the following tolerances applying:-

$V_h \pm 1\%$ $V_{g1} \pm 1\%$ $V_{hel} \pm 0.5\%$ $V_{col} \pm 3\%$ $I_{col} \pm 1\%$

(ii) Maximum mismatch presented to output connector 1.3:1

| Clause | Test | Test Conditions | AQL % | Insp. Level | Symbol | Limits | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Min. | Max. | |
| a | Heater Current | Apply $V_h$ only Note 1 | | 100% | $I_h$ | 0.4 | 0.6 | A |
| b | Grid 1 Voltage | As marked on valve Note 2 | | 100% | $V_{g1}$ | -10 | 0 | V |
| c | Helix Voltage | As marked on valve Note 2, 3 | | 100% | $V_{hel}$ | 575 | 650 | V |
| d | Grid 2 Voltage | Adjust $V_{g2}$ to obtain $I_{col}$ as marked on valve. No r.f. input applied. Note 2 | | 100% | $V_{g2}$ | 150 | 300 | V |
| e | Helix Current | Adjust $V_{g2}$ to value obtained in Clause (d). No r.f. input applied. Note 2 | | 100% | $I_{hel}$ | | 50 | µA |
| f | Cathode Current | Adjust $V_{g2}$ to value obtained in Clause (d). Note 2, 6. | | 100% | $I_K$ | 300 | 500 | µA |
| g | Small Signal Gain | Adjust $V_{g2}$ to value obtained in Clause (d). Note 2, 4 | | 100% | $G_{s,s}$ | 28 | 38 | dB |

TESTS CONTD.



| Clause | Test | Test Conditions | AQL % | Insp. Level | Symbol | Limits Min. | Limits Max. | Units |
|---|---|---|---|---|---|---|---|---|
| h | Small Signal Gain Variation | Adjust $V_{g2}$ to value obtained in Clause (d). Note 2, 4, 5 | | 100% | $\Delta G_{s,s}$ | | 7 | dB |
| j | Working Saturated Output Power | Adjust $V_{g2}$ to value obtained in Clause (d). Note 2, 7 | | 100% | $P_s$ | 7 | 13 | dBm |
| k | Output Power Variation | Adjust $V_{g2}$ to value obtained in Clause (d). | | | | | | |
| | (1) | Increase r.f. input signal level from saturation drive level to + 3 dBm. | | 100% | | | | |
| | | Output power variation. Note 2, 7, 8 | | | $\Delta P_{s1}$ | | 13 | dB |
| | (2) | Increase r.f. input signal level from saturation drive level to + 9 dBm | | 100% | | | | |
| | | Output power Note 2, 7 | | | $P_{s2}$ | -18 | | dBm |
| m | Spurious Output | Adjust $V_{g2}$ to obtain a value of $I_{col}$ equal to 120% of the value marked on the valve. Note 2, 9 | | 100% | | No spurious output shall be present | | |

| Clause | Test | Test Conditions | AQL % | Insp. Level | Symbol | Limits | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Min. | Max. | |
| n | Functional Vibration | Adjust $V_{g2}$ to value obtained in Clause (d). At a frequency of 5.5 Gc/s apply an input signal to give an output not exceeding 0 dBm. Gain variation Note 2, 10 | | Q.A. | | | ± 0.5 | dB |
| p | Shock | No voltages applied. Retest Clause (a), (d), (e), (g), (h), (k), and (m) Note 2, 11 | | Q.A. | | The valve shall meet the limits defined by Note 14 | | |
| q | Ambient Temperature | Adjust $V_{g2}$ to value obtained in Clause (d). No r.f. input applied. Retest Clause (e) Note 2, 12 | | Q.A. | $I_{hel}$ | | 50 | µA |
| r | Life | Adjust $V_{g2}$ initially to value obtained in Clause (d) Note 2, 6, | | Note 13 | | 1000 | | Hours |

NOTES

1. Read $I_h$ after a minimum operating time of 3 minutes at the marked heater voltage.

2. The setting up procedure for test is as follows:-

   (i) Ensure that $V_{g2}$ is zero.

   (ii) Switch on heater and increase voltage slowly to the marked value.

   (iii) Allow a minimum of 3 minutes cathode heating time.

   (iv) Switch on $V_{col}$, $V_{hel}$, and $V_{g1}$ simultaneously and adjust to marked values.

   (v) Increase $V_{g2}$ gradually until $I_{col}$ reaches the marked value.

   (vi) Check and readjust electrode voltages.

3. The marked value of $V_{hel}$ shows the relationship between the required value and that value giving maximum small signal gain for output levels not exceeding 0 dBm at a frequency of 7.0 Gc/s.

4. The r.f. input shall be such that the output power does not exceed 0 dBm. The frequency shall be swept over the band 4.1-7.0 Gc/s inclusive with the valve operating at constant electrode potentials.

5. The gain variation is defined as the difference between maximum small signal gain, at any frequency in the band 4.1-7.0 Gc/s inclusive and the minimum small signal gain at any frequency in that band, the electrode potentials remaining constant.

6. $I_K$ is defined as the sum of $I_{col}$ and $I_{hel}$.

7. Measured at the frequencies 4.1, 4.5, 5.0, 5.5, 6.0, 6.5 and 7.0 Gc/s inclusive.

8. At each of the stated frequencies, the output power variation is defined as the difference between the output power for the stated range of input powers and the working saturated output power.

9. The helix voltage shall be swept sinusoidally through an amplitude of 85 volts peak-to-peak centred on the marked value, at a frequency of 50 c/s. An r.f. signal of frequency 5.5 Gc/s and of power level not exceeding -30 dBm shall be applied to the input of the valve. The r.f. output power versus helix voltage characteristic shall be displayed on a suitable oscilloscope. The sensitivity of the system shall be such that the valve noise output is visible. In the absence of any spurious output, the characteristic will be a continuous smooth curve with a maximum at the synchronous helix potential, the r.f. power output at any helix potential in the swept range will decrease as the r.f. input is decreased. If spurious output is present, then either the characteristic will exhibit discontinuities and will not be smooth or the r.f. output, at any helix potential in the swept range, will not decrease as the r.f. input is decreased.

NOTES (CONT'D)

10. Gain variation is defined as the difference between the gain measured under static conditions and that measured under vibrational conditions.

The vibration shall be sinusoidal and shall cover the frequency range of 5-30 cycles per second, the rate of change not exceeding 5 cycles per second per minute. In the frequency range 5-7 cycles per second, the vibration amplitude shall be ± 0.25 inch. In the frequency range 7-30 cycles per second, the vibration peak acceleration shall be 1 g. The r.f. input shall be modulated by a pulse of rectangular waveform the valve r.f. output being detected and displayed on a suitable oscilloscope. The change of gain shall be measured with the direction of vibration (a) perpendicular and (b) parallel to the major axis of the valve.

11. The valve shall be subjected to six shocks in each of three directions:

(a) Perpendicular to the major axis of the valve.

(b) Parallel to and directed along the major axis of the valve from input end to output end.

(c) Parallel to and directed along the major axis of the valve from output end to input end.

The acceleration shall be 30g for a period of 5 ms, the waveform being rectangular in shape, with a rise time not exceeding 0.5 ms.

12. All operating voltages shall be applied to the valve and no adjustment to the voltages obtained at the initial temperature shall be made. The ambient temperature shall be adjusted to the values 10, 30, 50 and 70°C. At each of the stated temperatures, sufficient time shall be allowed for the valve temperature to stabilise.

13. The sample size shall be as follows:-

| Lot Size | Sample Size |
|---|---|
| 1-25 | 1 |
| 26-50 | 2 |
| 51-150 | 3 |
| 151 or greater | 2% |

The manufacturer may, at his discretion and at his expense, test additional samples. For the first lot of any production order, deliveries shall not be made until the satisfactory completion of a minimum of 500 hours life. Where life test data is available on samples from previous production orders, deliveries from the first lot may be released at the discretion of the Inspection Authority. If the results from samples of previous lots in a production order have proved satisfactory, then for the second and subsequent lots, delivery of valves may, at the discretion of the Inspection Authority, be permitted without awaiting results of samples from those lots.

NOTES CONTD.



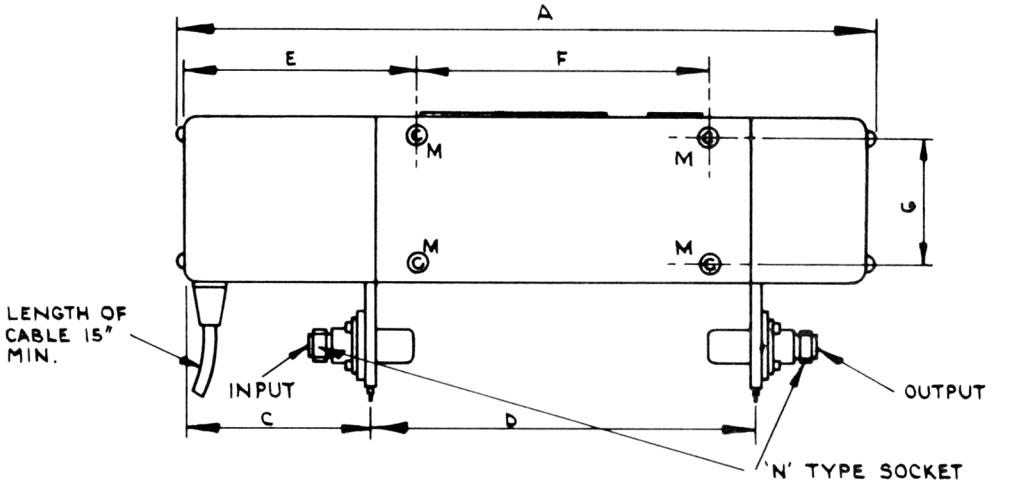
During the test, $V_{g2}$ shall be adjusted to maintain $I_K$ constant at the value obtained at the start of the test.

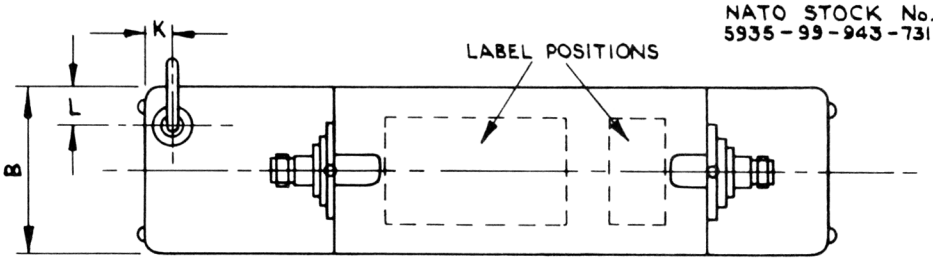
The life of the valve shall be considered terminated when, with the electrode voltages, excluding that of G2, adjusted to the marked values, any one or more of the parameters of the valve fall outside the limits defined by Note 14.

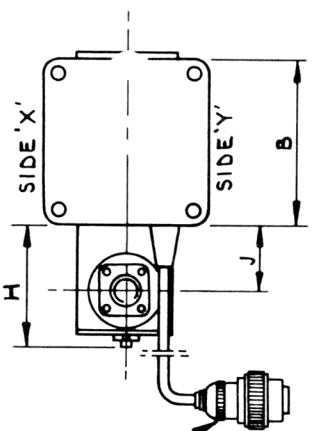
The minimum life of each valve in a sample is 1,000 hours. In the event of a sample failure, the Qualification Approval Authority must be informed.

14. The post test limits for Test Clauses (p) and (r) are as follows:-

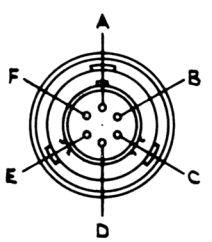
| Clause | Re-test | Symbol | Limits | | Units |
|---|---|---|---|---|---|
| | | | Min. | Max. | |
| a | Heater Current | $I_h$ | 0.37 | 0.63 | A |
| d | Grid 2 Voltage | $V_{g2}$ | | 350 | V |
| e | Helix Current | $I_{hel}$ | | 150 | μA |
| g | Small Signal Gain<br>Change of small signal gain at 4.1, 5.0, 6.0 and 7.0 GHz from initial values obtained in Test Clause (g) | $\Delta G_{s,s1}$ | 26 | 40<br>± 2 | dB<br>dB |
| h | Small signal gain variation | | | 9 | dB |
| k<br>(1)<br>(2) | Output power variation<br>Input power to +3 dBm<br>Input power to +9 dBm | <br>$\Delta P_{s1}$<br>$P_{s2}$ | <br><br>-21 | <br>15<br> | <br>dB<br>dBm |
| m | Spurious Output | | No spurious output shall be present | | |




| CONNECTOR | |
|---|---|
| PIN | ELECTRODE |
| A | h |
| B | h-k |
| C | g1 |
| D | g2 |
| E | HELIX |
| F | COLLECTOR |




BASIC DIMENSIONS ARE INCHES

| DIM | INCHES | MILLIMETRES |
|---|---|---|
| A | 12·900 MAX. | 327·66 MAX |
| B | 3 1/16 MAX. | 77·8 MAX |
| C | 3 19/32 ± 1/16 | 91·3 ± 1·6 |
| D | 7·168 ± 0·030 | 182·07 ± 0·76 |
| E | 4 1/2 ± 1/16 | 114·3 ± 1·6 |
| F | 5·375 T.P. | 136·53 T.P. |
| G | 2·250 T.P. | 57·15 T.P. |
| H | 2 5/16 MAX. | 58·7 MAX |
| J | 1 1/4 ± 1/32 | 31·8 ± 0·8 |
| K | 9/16 ± 1/16 | 14·3 ± 1·6 |
| L | 13/16 ± 1/16 | 20·6 ± 1·6 |
| M | 4 – 1/4 x 28 UNF TAPPED HOLES x 1/2 DEEP IN SIDES 'X' AND 'Y' POS. TOL. ·020" DIA. TO B.S. 308 1964. | |

OUTLINE DRAWING