TPD

M/100

COMPONENTS GROUP

The Registered Number of this Handbook is :

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Standard Telephones and Cables Limited

COMPONENTS GROUP

EDINBURGH WAY, HARLOW, ESSEX

For technical enquiries please see Page A—2

Components Handbook

Volume 3

Microwave Devices

Travelling-Wave Tubes

Klystrons

Varactor Diodes

Coaxial and H-Wave Oscillators

Microwave Power Indicator Tubes

Thermocouples

Preface

This volume is one of a set that provides comprehensive technical information on the full range of components manufactured and marketed by STC Components and S.T.C. Semiconductors Ltd.

A regular amendment service ensures that the data in these volumes is kept up to date with changes and additions. Data marked with an 'M' or 'Maintenance' refer to components that are only supplied as replacements for use in existing equipment and should not be used when designing new equipments.

Enquiries regarding this Handbook service should be addressed to Standard Telephones and Cables Ltd., Department 14531. Components Marketing Division, Edinburgh Way, Harlow, Essex or Telephone Harlow (STD code 0279 6) 26811, Ext. 249.

Technical and commercial enquiries concerning specific products should be addressed to the Sales Office of the appropriate Division.

Ref.	Sales Office Address	Telephone No.	Extensions for enquiries Technical	Commercial
1	**Capacitor Division** Brixham Road, Paignton, Devon	Paignton 50762†	Capacitors 477 Film Circuits 523	 418 418
2	**Electro-Mechanical Division** West Road, Harlow, Essex	Harlow 26811*	643 663	636 542
3	**Magnetic Materials Division** Edinburgh Way, Harlow, Essex	Harlow 26811*	735	735
4	**Modular Electronics Division** Cefndy Road, Rhyl, Flint	Rhyl 4507	13	13
5	**Potentiometer Division** Broad Lane, Leeds 13, Yorkshire	Pudsey 77261	7	15
6	**Quartz Crystal Division** Edinburgh Way, Harlow, Essex	Harlow 26811*	585	560
7	**Rectifier Division** Edinburgh Way, Harlow, Essex	Harlow 26811*	449 253	446 251
8	**Thermistor Division** Edinburgh Way, Harlow, Essex	Harlow 26811*	502	503
9	**Valve Division** Brixham Road, Paignton, Devon	Paignton 50762†	536	532
10	**S.T.C. Semiconductors Ltd.** Footscray, Sidcup, Kent	Footscray 3333‡	524	571

* STD code 0279 6 26811. † STD code 0803 50762. ‡ STD code 01 300 3333.

List of Products

The following list gives the products on which data is included in the Components Handbook, the volume in which the data appears and the Sales Office Code (see previous page) to which technical and commercial enquiries should be addressed.

Product	Handbook Volume	Sales Office
Brimistors (see Thermistors)	7	8
Capacitors	4	1
Crystal Filters	8	6
Diodes and Photo Devices	6A	10
Film Circuits	5	1
Hermetic Seals	1	9
Infra-Red Filters	1	7
Klystrons	3	9
Knobs and Dials	7	5
Lamps	1	9
Logic Modules	5	4
Magnetic Materials	9	3
Microwave Oscillators	3	9
Microwave Tubes	3	9
Ministac	5	4
Photo Devices (see Diodes and Photo Devices)	6A	10
Potentiometers	7	5
Quartz Crystal Units	8	6
Rectifiers, Selenium	5	7
Rectifiers, Silicon	6A	10
Rectifiers, Silicon Assemblies	5	7
Rectifiers, Valve	2C	9
Relays	10	2
Resistors, Carbon Film	7	7
Resistors, Temperature Sensitive (see Thermistors)	7	8
SafeTstaC Selenium Surge Suppressors	5	7
Silistors (see Thermistors)	7	8
Solenoids	10	2
Switches	10	2
Thermal Delay Switches	1	9
Thermistors	7	8
Thermocouples	3	9
Thyristors	6A	10
Transformers	9	3 or 7
Transistors	6B	10
Travelling Wave Tubes	3	9
Vacuum Gauges	1	9
Valves	2A, B and C	9
Varactor Diodes	3	9
Wound Components	9	3 or 7
Zener Diodes (see Diodes and Photo Devices)	6A	10

STC

SPECIAL VALVES

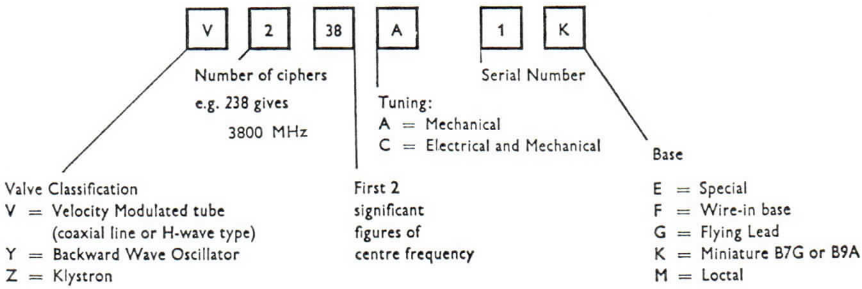
Microwave Tubes

MICROWAVE TUBE CODES

STC Reference Code System

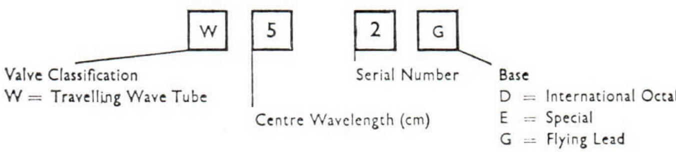
OSCILLATORS

Example V238A/1K



AMPLIFIERS

Example W5/2G



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COAXIAL LINE AND
H-WAVE OSCILLATORS

SPECIAL VALVES

Velocity-Modulated Oscillators

General Information

Coaxial Line Oscillators

Reference	Code	Frequency Range GHz	Minimum Power Output W	Minimum Electronic Tuning Range MHz
V233A/1K	V233A/1K	2·7 to 4·2	0·3	±1
V235A/1K	V235A/1K	2·7 to 4	0·5	±1
V238A/1K	V238A/1K	3·5 to 4·3	0·55	±1
V238A/1KY	V238A/1KY	3·52 to 4·255	0·55	±1
V243A/2FS	V243A/2FS	4·1 to 4·6	0·75	—
V243A/3FS	V243A/3FS	4·1 to 4·6	0·75	—

H-Wave Oscillators

Reference	Code	Frequency Range GHz	Minimum Power Output W	Minimum Electronic Tuning Range MHz
V265A/1M	V265A/1M	5·85 to 7·5	0·15	—
V271C/3M	V271C/3M	6·85 to 7·35	0·8	±8·5
V275C/3M	V275C/3M	{7·25 to 7·77	0·8	±8·5
		{7·25 to 8·3	0·3	±5

STC

General Information

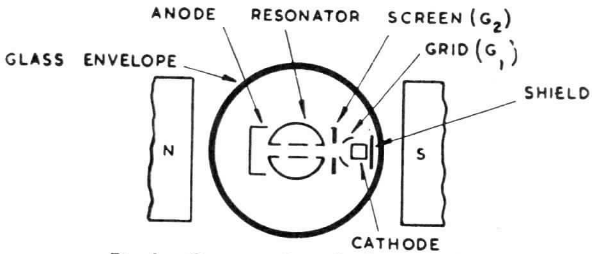

Fig. 1.—Cross section of valve assembly

INTRODUCTION

Coaxial line and H-wave oscillators are forms of single transit klystrons which combine the higher efficiency and frequency stability associated with the single transit type with the convenience of virtually only one resonant cavity to tune as normally associated with the reflex type of klystron.

PRINCIPLES OF OPERATION

An electron beam, accelerated from the cathode by a positively biased screen grid, is focused by grid and magnetic field into a beam, which traverses two interaction gaps in a resonator before reaching the anode, or collector.

In the frequency range 500 to 5 000 Mc/s the resonator takes the form of a section of coaxial line with a hollow centre conductor or drift tube—interaction gaps are between inner and outer conductor as shown in fig. 1.

The frequency of oscillation is determined by the cavity to which the structure is coupled, and by the potential difference between resonator and cathode or between inner conductor and cathode in those tubes where the coaxial line is terminated by an open rather than short circuit. Essentially the beam of electrons is bunched by the r.f. field between outer and inner conductors in the first gap and sustain the r.f. oscillation if the bunches arrive at the second gap when the r.f. field is maximum retarding.

Variation of resonator or drift tube voltages affords a means of frequency modulation.

H-wave oscillators designed for frequencies exceeding 5 000 Mc/s have a resonator which takes the form of a slotted waveguide, with drift tube between the slots, instead of a slotted coaxial line.

Introduction

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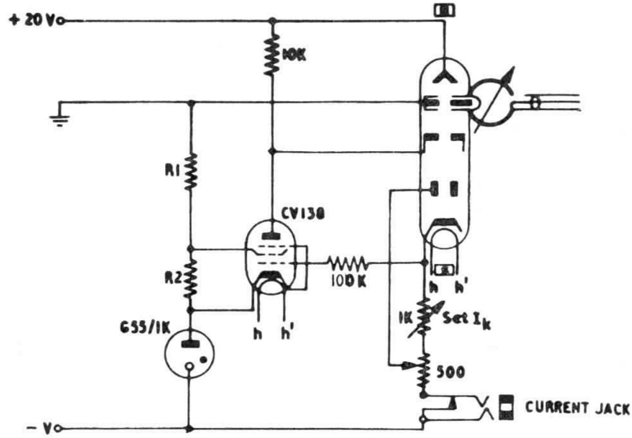

Fig. 2.—Circuit for stabilisation of V.M. oscillator tube current

CONNECTIONS

Resonator. For convenience this is usually operated at earth potential and the cathode at a controlled negative potential. When frequency modulation is to be achieved by variation of resonator voltage the resonator disc may be insulated from the cavity by a mica washer which thus forms the dielectric of a capacitor which offers a low impedance path to the r.f. signal.

Drift Tube. In many types this is internally connected to the resonator, but where there is a separate connection it is preferable to use the variation of drift tube voltage alone to obtain maximum output, also to apply frequency modulation signals to it, the d.c. bias being such that the peak drift tube voltage does not exceed the fixed resonator voltage.

Collector (Anode). Applied voltage is usually above that applied to resonator to avoid secondary emission effects.

Screen Grid. The positive bias is set to determine the cathode current. For unattended operation, it is convenient for constant beam current to be obtained by deriving screen voltage from a shunt regulator circuit (fig. 2), with feedback related to the oscillator tube cathode current. Resistor R1 may be zero for applied voltages—below 250V. For higher values R2 may be replaced by a 150V stabiliser (e.g. OA2) and R1 chosen to limit the stabiliser current to a suitable valve.

Precaution. The screen grid voltage should never exceed the resonator potential except marginally when permitted by an individual valve specification. Due to the heavy cathode loading in these tubes, high screen grid potentials must be avoided during periods of cathode heating: it is particularly important to delay the rise of screen voltage after a temporary shut down period or h.t. trip.

Introduction

CONTINUED

Grid 1. This grid has a negative bias applied to assist in the forming of a narrow ribbon electron beam.

Cathode. The cathodes of V.M. Oscillator tubes are necessarily required to give a high density of emission, and a cathode perheating period of at least 30 seconds (or longer if specified) should be allowed before electrode voltages (in particular the screen grid voltage) are applied.

FOCUSING

Focusing is achieved by grid voltages and maintained across the path of the beam by a magnetic field. This is provided by a permanent horseshoe magnet with a field exceeding 1 200 oersteds across the gap. The magnet is mounted on the cavity for coaxial line oscillators but supplied pre-set in position on the valve itself for H-wave types.

For B7G based coaxial line oscillators the use of magnet type Magloy P231677 (Preformations, Ltd.) is recommended. The magnet must be aligned to obtain the highest collector current for a given cathode current. Three holes or notches in the valve resonator disc locate on pins fixed to the valve clamping plate.

For quantity production of cavities, special valves can be supplied for magnet alignment: otherwise at least three but preferably six valves should be used to establish the initial alignment.

Once the magnet has been aligned, and has been securely clamped relative to the locating pins no further adjustment will be necessary for a given valve type.

MODES OF OPERATION

Tube Mode. In order that the bunches of electrons shall arrive in the optimum phase at the second gap, the time taken for them to traverse the drift space is 5, 9, 13, 17, etc. quarter periods for coaxial line tubes and 3, 7, 11, 15, 19 quarter periods for H-wave tubes and these numbers are referred to the mode number. They differ by a half period between the two types because in the coaxial line tube the r.f. field is radial and therefore in opposite directions across the the two gaps at any instant whereas in the H-wave tubes, which operate in the H_{01} mode of propagation, the r.f. field is across the waveguide in the same direction as (or opposing) the electron beam; therefore, at any instant, its direction is the same in the two gaps between inner and outer conductors.

Introduction

CONTINUED

CIRCUIT MODE—COAXIAL LINE TUBES

(a) Coaxial Line Cavities. The circuit mode is defined in terms of the fractions of wavelength between the cavity tuning piston and the open or short circuit termination of the coaxial line within the valve.

For a valve with open circuit termination of coaxial line within it (e.g. V190C/1M, fig. 3a) the circuit mode is an odd number of quarter wavelengths. For valves with short circuit termination of coaxial line within them (e.g. V231C/1K *et seq*, fig. 3b) the circuit mode is an even number of quarter wave lengths i.e. an integral number of half wave lengths.

(b) Waveguide Cavities (fig. 3c). The coupling between the valve resonator and a waveguide cavity is complex but for a given frequency of scillation the difference in positions of the tuning piston which tune to this frequency will be an integral number of $\lambda g/2$ where λg is the waveguide wavelength corresponding to this frequency.

N.B.—For convenience, circuit lengths in the data sheets are quoted using the plane of the resonator disc or a plane through the longitudinal axis of the valve as a reference for giving cavity piston position since a point in the internal structure of a valve does not afford a simple reference.

GENERAL CHARACTERISTICS (Coaxial Line Tubes)

The following general characteristics are typical of most types at their normal operating conditions and are given for guidance.

Variation of beam current with grid voltage.

Grid 1: 0.25 mA/V
Grid 2: 0.5 mA/V*

Pulling figure $\simeq$ 30 kc/s mA charge in beam current
*except in case of type V190C/1M tube.

Bulb Temperature

Unless otherwise stated in the individual data sheet, the maximum temperature of the bulb at any point should not exceed 250°C. The area of highest temperature of the bulb is normally in the immediate vicinity of the collector (anode).

Introduction

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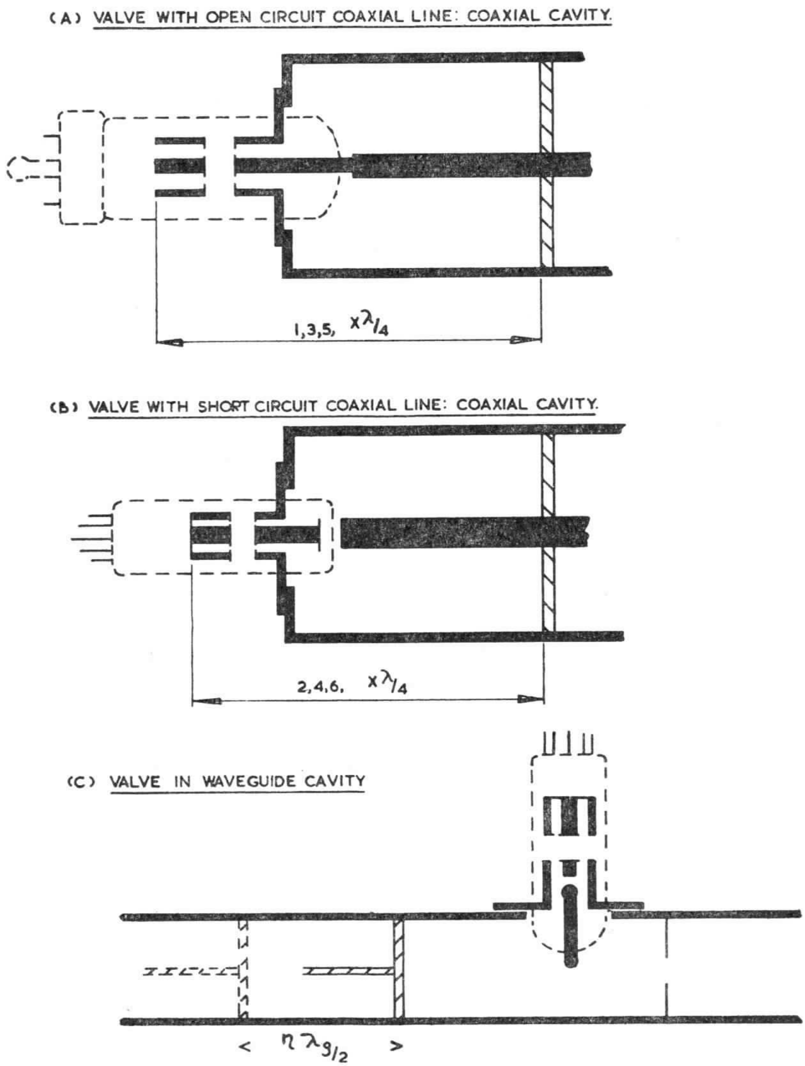

Fig. 3.—Basic Resonator and Cavity Structure

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V233A/1K (CV2190)

The V233A/1K is a velocity modulated oscillator of the coaxial line type for operation in the frequency band 2·7 to 4·2 GHz.

The valve may be operated in the tuning cavity type 495–LVA–201 in which it will give the performance quoted in these data sheets.

RADIO FREQUENCY PERFORMANCE (Note 1)

Operating frequency range	2·7 to 4·2	GHz
Power output throughout the band, minimum	300	mW

NOTE 1.—A graph of typical power output versus frequency is shown in Figure 3.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	3·6	4·2	GHz
Direct grid 1 voltage (Note 3)	−40	−40	V
Direct anode voltage (Note 4)	V_{res} +10	V_{res} +10	V
Direct resonator voltage (Note 5)	285	380	V
Direct screen voltage (Note 4)	150	150	V
Direct cathode current (Note 4)	41	45	mA
Direct anode current (Note 4)	33	26	mA
Direct screen current	0·2	0·2	mA
Power output	850	500	mW

NOTE 2.—All voltages are with respect to the cathode.

NOTE 3.—The use of bias improves the proportion of cathode current which passes through the resonator and reaches the collector (anode).

NOTE 4.—The tube operates at a typical anode dissipation of 10 watts, providing also that the cathode current does not exceed 65mA. If reduced power outputs can be tolerated operation with lower values of cathode current will increase the life of the valves.

NOTE 5.—A graph of resonator voltage versus frequency is shown in Figure 1.

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STC

Code: V233A/1K (CV2190)

CONTINUED

CATHODE

Indirectly heated, oxide coated.

HEATER

Heater voltage (Note 6)			6 ± 5%	V
Heater current	Min. 0·27	Nom. 0·30	Max. 0·33	A
Preheating time			60	s

NOTE 6.—The heater is usually supplied by a d.c. voltage or a r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 1·5 kHz must not be used.

LIMIT RATINGS (Note 7)

Valve damage may result if any one of these ratings is exceeded.

Maximum mean input power to all electrodes other than heater	18	W
Direct cathode current	65	mA
Peak cathode current	0·5	A
Direct screen voltage	400	V
Screen dissipation	1·5	W

D.C. SUPPLY (Note 7)

Electrode connections are made by a shrouded B7G socket plugging on to the base of the valve.

Direct grid 1 voltage	−40	V
Direct anode voltage	V_{res} +10	V
Direct resonator voltage	150 to 420	V
Direct screen voltage range	0 to V_{res} +50	V
Direct screen current maximum	5	mA

NOTE 7.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage +50, resonator voltage should not exceed anode voltage.

The valve can be operated with anode voltage equal to resonator voltage but there will be some loss in power output. It can also be operated with anode voltages up to V_{res} +40 with slight increase in power output.

Code: V233A/1K (CV2190)

CONTINUED

CAVITY TYPE 495–LVA–201—GENERAL DESCRIPTION

This approved cavity for the V233A/1K is of circular waveguide construction with a coaxial output leading to a Type "N" jack connector.

The waveguide is tuned to the required frequency by a piston with a rack and graduated scale calibrated in centimetres for precise adjustment.

The antenna of the valve enters the waveguide through the end face. Three holes punched in the valve resonator disc locate on pins fixed to the cavity clamping plate to locate the valve.

The coupling loop enters the cavity through the piston face.

The valve electron beam is focused by a permanent magnet of the horseshoe type which is clamped to the cavity.

The outline drawing of the cavity is shown in Fig. 8.

OPERATIONAL DATA FOR TUBE AND CAVITY 495–LVA–201

The coupling loop is preset at midband and gives satisfactory loading of the valve into 70Ω coaxial cable over a limited range, e.g. 3·6 to 4·2 GHz. The position of the loop can be altered by slackening the clamping screw, turning to the required position for maximum power output and reclamping.

The magnet of the 495–LVA–201 is aligned so that the best ratio of anode to cathode current is obtained. Thus no magnet readjustment is necessary when replacing valves.

Curves of circuit length L i.e. piston position as a function of frequency are plotted in Fig. 2.

Output Modulation

(*a*) Amplitude modulation

The voltage required is dependent upon both the particular operating conditions and the loading of the valve. For 100 per cent modulation it is only necessary to reduce the anode current to a value below the starting current of oscillation. (See below.)

Modulation of either the grid (g_1) or the screen (g_2) is permissible. Modulation voltages of between -50 and -200 applied to the grid will be found to be adequate. For the screen, however, positive modulating voltages of the same order are necessary, and, since the screen takes current, adequate modulation power should be provided.

(*b*) Frequency modulation

Although the valve is not specifically designed for frequency modulation, about ± 1 MHz is available by variation of the resonator voltage.

Code: V233A/1K (CV2190)

CONTINUED

USE OF V233A/1K CAVITIES OTHER THAN 495–LVA–201

These should take the form of the tuning cavity shown in Fig. 7. Operation is similar to that described for the 495–LVA–201. Output power is obtained over the whole range 2·7 to 4·2 GHz by means of a coupling loop placed either in the piston face (position A of Fig. 7) or at the valve end of the circuit (position B). In position A coupling is as the 495–LVA–201. In position B, however, it is usually necessary to make an adjustment of the loop orientation when tuning the oscillator over the frequency range. For applications where such adjustments of the loops are inadmissible the impedance of the loop must be transformed to that of the load by means of an appropriate impedance matching technique.

The valve will operate satisfactorily in other types of cavity with certain differences in performance.

The permanent magnet used to focus the electron beam may be of any suitable type which gives a uniform field of 1 200 oersteds minimum over a 22mm gap. The magnet must be aligned so that the best ratio of anode to cathode current is obtained. The three holes punched in the valve resonator disc locate on pins fixed to the valve clamping plate. Once the magnet has been aligned and has been securely clamped with respect to the locating pins, no further adjustment will be necessary when replacing valves. It is recommended that at least three, and preferably six, valves are used to establish the initial alignment of the magnet.

The anode current at which oscillations just start, when the valve is loaded only by the cavity, is referred to as the unloaded starting current, and serves as a useful measure of the efficiency of the tuning cavity. In Fig. 4 the unloaded starting current for a typical valve is plotted as a function of frequency using the recommended circuit.

To illustrate the importance of good tuning circuit construction a curve of power output versus the unloaded starting current of the valve cavity combination is given in Fig. 5.

Code: V233A/1K (CV2190)

CONTINUED

Fig. 1.—Resonator Voltage and Anode Current versus Frequency

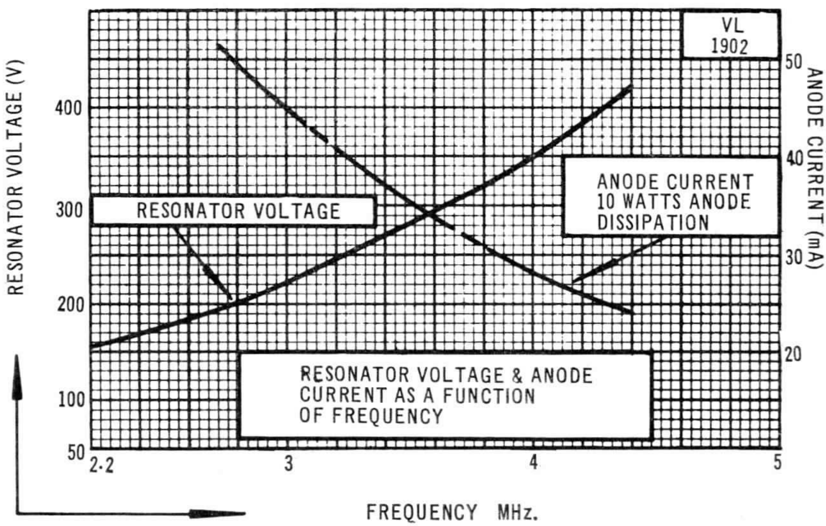
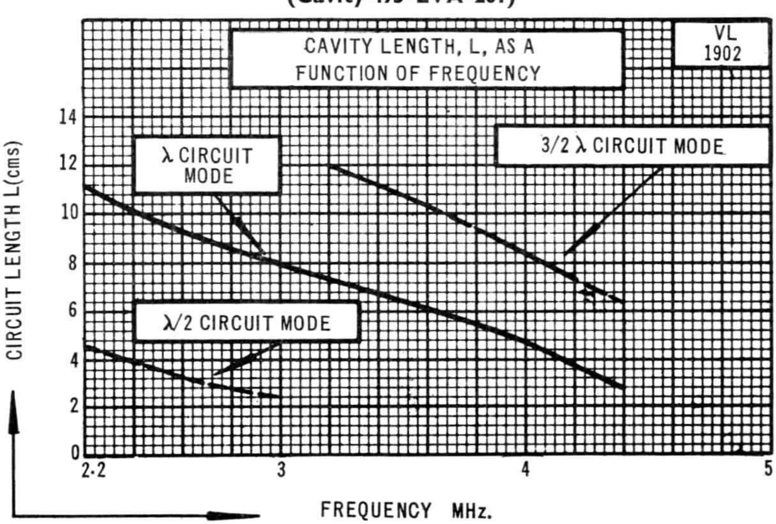


Fig. 2.—Cavity Length versus Frequency (Cavity 495–LVA–201)



Code: V233A/1K (CV2190)

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Fig. 3.—Power Output versus Frequency

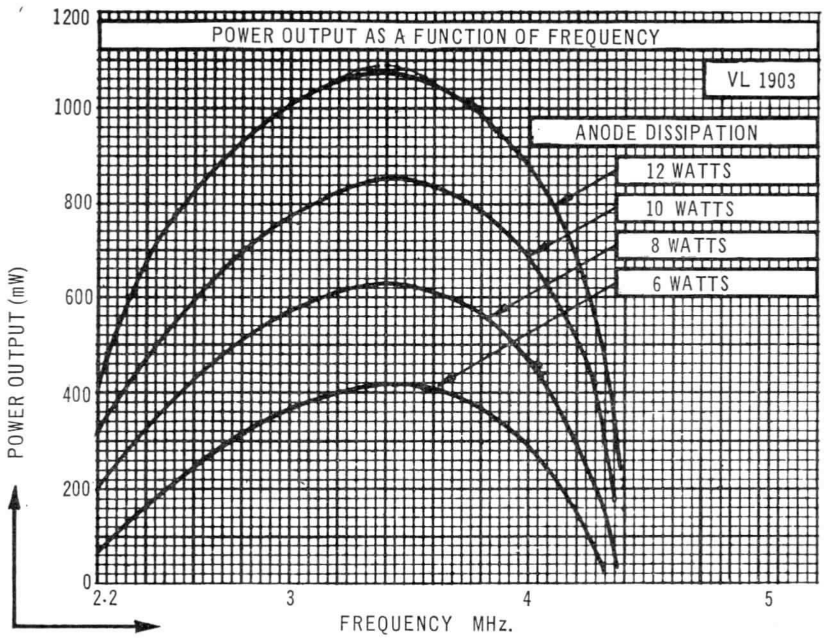
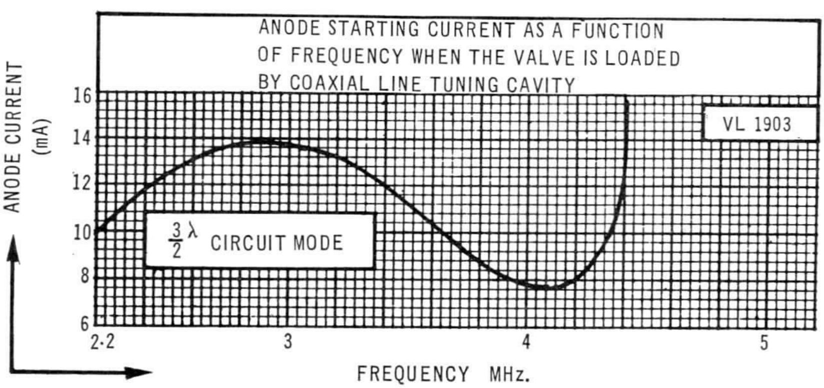


Fig. 4.—Unloaded Starting Current versus Frequency



Code: V233A/1K (CV2190)

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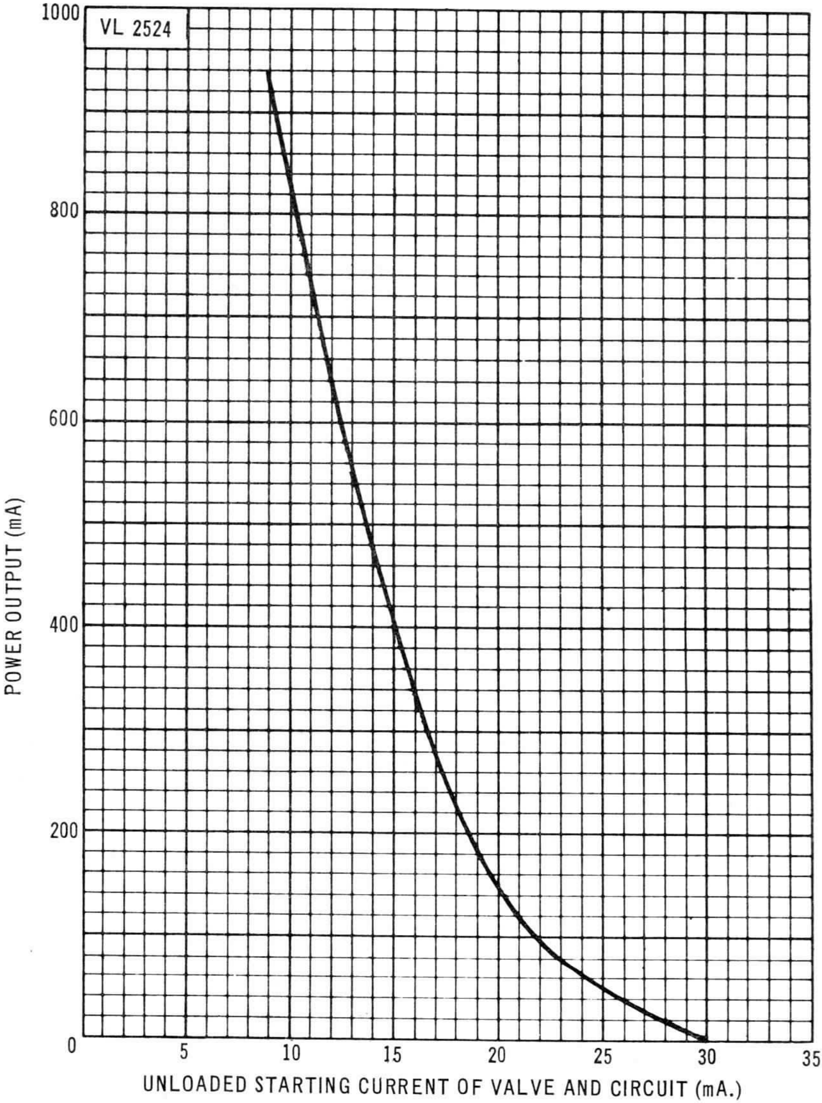
Fig. 5.—Power Output versus Unloaded Starting Current



Code: V233A/1K (CV2190)

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Fig. 6.—Cross Section of Valve Assembly

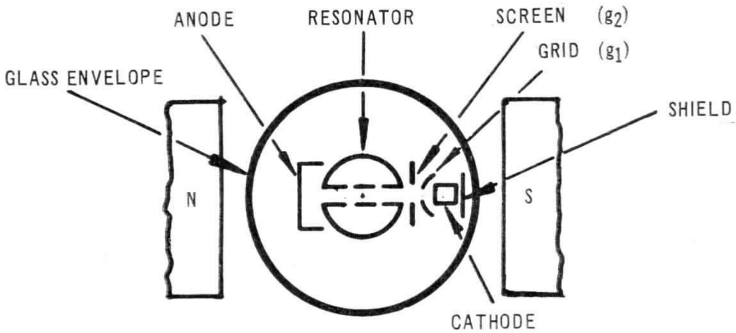
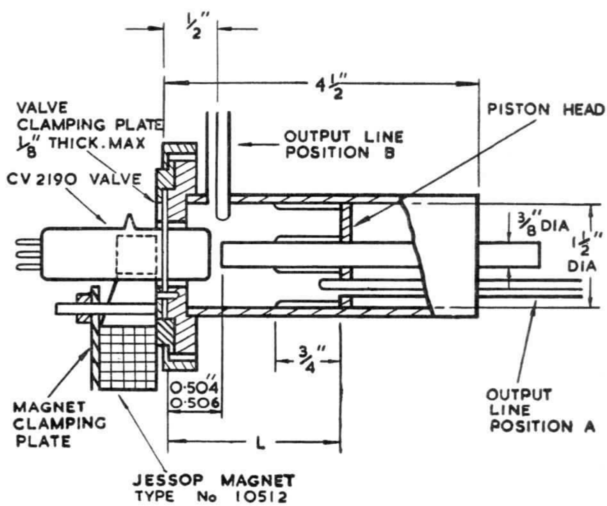


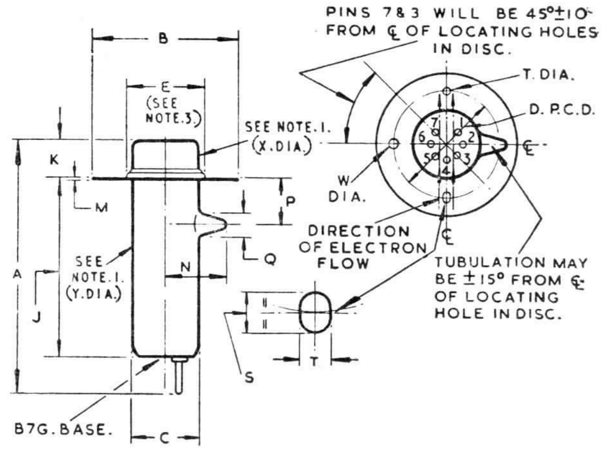
Fig. 7.—Typical Tuning Cavity



Code: V233A/1K (CV2190)

CONTINUED

Fig. 8.—V233A/1K Dimensioned Outline



NOTE I. THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN THE DISC.

BASING

1. CONTROL GRID
2. CATHODE
3. HEATER
4. HEATER
5. ANODE
6. RESONATOR
7. SCREEN GRID

DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	73 MAX.	2⅞ MAX.	P	13·5±4·0	0·53±0·16
B	42 MAX.	1·65 MAX.	Q	8·5 MAX.	0·33 MAX.
C	20·1 MAX.	0·79 MAX.	S	3·2 +0·13 −0·00	0·125 +0·005 −0·000
D	30·96±0·06	1·218±0·002			
E	24 MAX.	0·94 MAX.	T	2·36 +0·06 −0·00	0·093 +0·002 −0·000
J	46·0±6·4	$1\frac{13}{16}\pm\frac{1}{4}$			
K	11·1 MIN. 12·5 MAX.	0·437 MIN. 0·504 MAX.	W	2·79 +0·13 −0·00	0·110 +0·005 −0·000
M	0·3 MAX.	0·012 MAX.	X	21·59 MIN.	0·850 MIN.
N	18 MAX.	0·710 MAX.	Y	20·32 MIN.	0·800 MIN.

NOTE 2. BASIC FIGURES ARE INCHES. NOTE 3. ALSO MIN. CLAMPING DIA.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V235A/1K (CV2221)

The V235A/1K is a velocity modulated oscillator of the coaxial line type for operation in the frequency band 2·7 to 4 GHz.

The valve may be operated in the tuning cavity type 495–LVA–226 in which it will give the performance quoted in these data sheets.

RADIO FREQUENCY PERFORMANCE (Note 1)

Operating frequency range	2·7 to 4	GHz
Power output throughout the band, minimum	350	mW
Power output over frequency range 2·7 to 3·8 GHz, minimum	500	mW

NOTE 1.—A graph of typical power output versus frequency is shown in Figure 3.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	2·7	3·8	GHz
Direct grid 1 voltage (Note 3)	−40	−40	V
Direct anode voltage	V_{res} +10	V_{res} +10	V
Direct resonator voltage (Note 5)	185	318	V
Direct screen voltage	150	150	V
Direct cathode current (Note 4)	65	47	mA
Direct anode current	44	34	mA
Direct screen current	0·2	0·2	mA
Power output	715	900	mW

NOTE 2.—All voltages are with respect to the cathode.

NOTE 3.—The use of bias improves the proportion of cathode current which passes through the resonator and reaches the collector (anode).

NOTE 4.—If reduced power outputs can be tolerated operation with lower values of cathode current will increase the life of the valve.

NOTE 5.—A graph of resonator voltage versus frequency is shown in Figure 1.

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C O M P O N E N T S G R O U P

Code: V235A/1K (CV2221)

CONTINUED

CATHODE

Indirectly heated, oxide coated.

HEATER

Heater voltage (Note 6)			6 ± 5%	V
Heater current	Min. 0·27	Nom. 0·3	Max. 0·33	A
Preheating time			60	s

NOTE 6.—The heater is usually supplied by a d.c. voltage or a r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 1·5 kHz must not be used.

LIMIT RATINGS (Note 7)

Valve damage may result if any one of these ratings is exceeded.

Maximum mean input power to all electrodes other than heater	18	W
Direct cathode current	65	mA
Peak cathode current	0·5	A
Direct screen voltage	400	V
Screen dissipation	1·5	W

D.C. SUPPLY (Note 7)

Electrode connections are made by a shrouded B7G socket plugging on to the base of the valve.

Direct grid 1 voltage	−40	V
Direct anode voltage	V_{res} +10	V
Direct resonator voltage	170 to 385	V
Direct screen voltage range	0 to V_{res} +50	V
Direct screen current, maximum	5	mA

NOTE 7.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage +50, resonator voltage should not exceed anode voltage.

The valve can be operated with anode voltage equal to resonator voltage but there will be some loss in power output. It can also be operated with anode voltages up to V_{res} +40 with slight increase in power output.

Code: V235A/1K (CV2221)

CONTINUED

CAVITY TYPE 495–LVA–226—GENERAL DESCRIPTION

This approved cavity for the V235A/1K is of cylindrical resonator construction with twin coaxial outputs leading to type "N" jack connectors.

One output is of coupling loop construction for the extraction of power. The other has a coupling probe and may be used for frequency measurement. Both probe and coupling loop are adjustable for optimum depth or orientation.

The cavity is tuned to the required frequency by screw-thimble adjustment of the tuner rod. A micrometer type scale is provided for precise adjustment.

The antenna of the valve enters the cavity through the end face. The holes punched in the valve resonator disc locate on pins fixed to the cavity clamping plate to locate the valve.

The valve electron beam is focused by a permanent magnet of the horseshoe type which is clamped to the cavity.

The outline drawing is shown in Figure 7.

OPERATIONAL DATA FOR TUBE AND CAVITY 495–LVA–226

When supplied the magnet of the 495–LVA–226 is aligned so that the best ratio of valve anode to cathode current is obtained. Thus no magnet readjustment is necessary when replacing valves.

A graph of distance of tuner face from valve disc seal versus frequency is shown in Figure 2.

The cavity has a coupling loop designed to operate into 50Ω coaxial cable. Usually it is necessary to make an adjustment of the loop orientation when tuning the oscillator over the frequency range. For applications where such adjustment of the loop is inadmissible, the impedance of the load must be transformed by means of an appropriate impedance matching technique.

Output Modulation

(*a*) Amplitude modulation

The voltage required is dependent upon both the particular operating conditions and the loading of the valve. For 100 per cent modulation it is only necessary to reduce the anode current to a value below the starting current of oscillation. (See below.)
Modulation of either the grid (g_1) or the screen (g_2) is permissible. Modulation voltages of between -50 and -200 applied to the grid will be found to be adequate. For the screen, however, positive modulating voltages of the same order are necessary, and, since the screen takes current, adequate modulation power should be provided.

(*b*) Frequency modulation

Although the valve is not specifically designed for frequency modulation, about ± 1 MHz is available by variation of the resonator voltage.

Code: V235A/1K (CV2221)

CONTINUED

USE OF V235A/1K IN CAVITIES OTHER THAN 495–LVA–226

The valve will operate satisfactorily in other types of circuit, with certain differences in performance.

These should take the form of the tuning cavity shown in Figure 8. Operation is similar to that described for the 495–LVA–226. Output power is obtained over the whole range 2·7 to 4 GHz by means of a coupling loop placed either in the piston face (position A of Figure 8) or at the valve end of the cavity (position B). In position A, coupling is as for the 495–LVA–226. However, in position B it is necessary usually to make an adjustment of the loop orientation when tuning the oscillator over the frequency range. For applications where such adjustments of the loops are inadmissible the impedance of the loop must be transformed to that of the load by means of an appropriate impedance matching technique.

The permanent magnet used to focus the electron beam may be of any suitable type which gives a uniform field of 1 200 oersteds minimum over a 22mm gap. The magnet must be aligned so that the best ratio of anode to cathode current is obtained. The three holes punched in the valve resonator disc locate on pins fixed to the valve clamping plate. Once the magnet has been aligned and has been securely clamped with respect to the locating pins, no further adjustment will be necessary when replacing valves. It is recommended that at least three, and preferably six, valves are used to establish the initial alignment of the magnet.

The anode current at which oscillations just start, when the valve is loaded only by the cavity, is referred to as the unloaded starting current, and serves as a useful measure of the efficiency of the tuning cavity. In Figure 4 the unloaded starting current for a typical valve is plotted as a function of frequency using the recommended circuit.

To illustrate the importance of good tuning circuit construction a graph of power output versus the unloaded starting current of the valve cavity combination is given in Figure 5.

Code: V235A/1K (CV2221)

CONTINUED

Fig. 1.—Resonator Voltage and Cathode Current versus Frequency

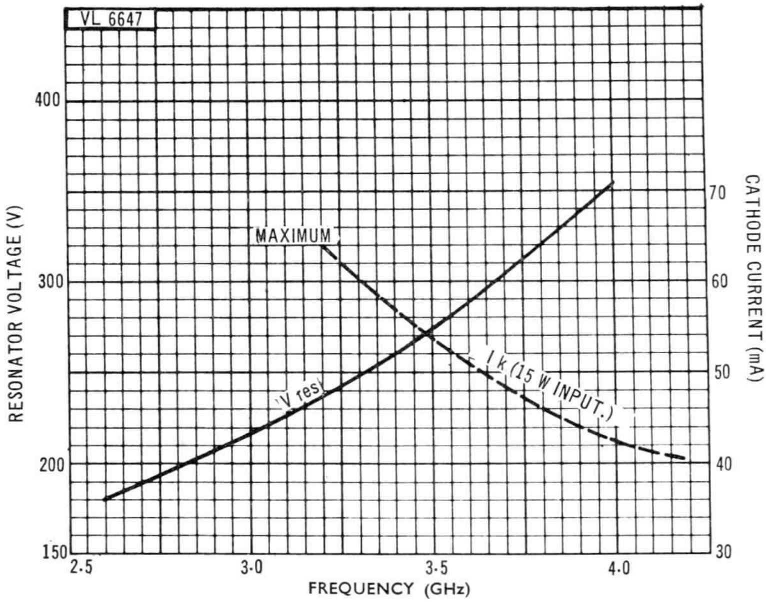
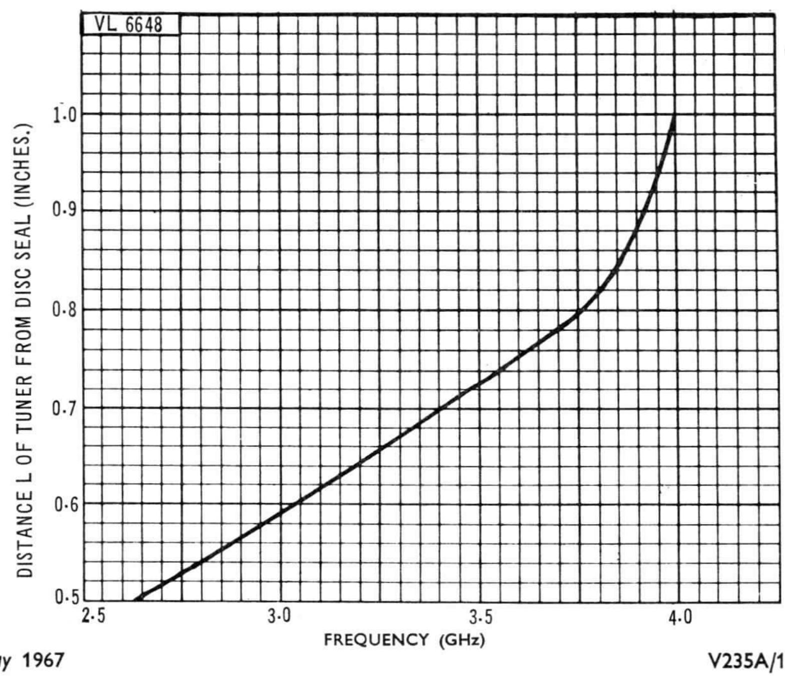


Fig. 2.—Distance of Tuner from Disc Seal versus Frequency



Code: V235A/1K (CV2221)

CONTINUED

Fig. 3.—Power Output versus Frequency

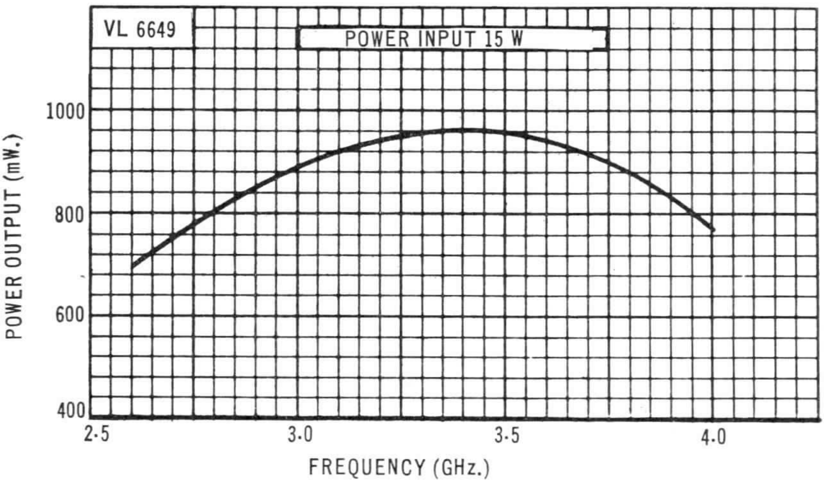
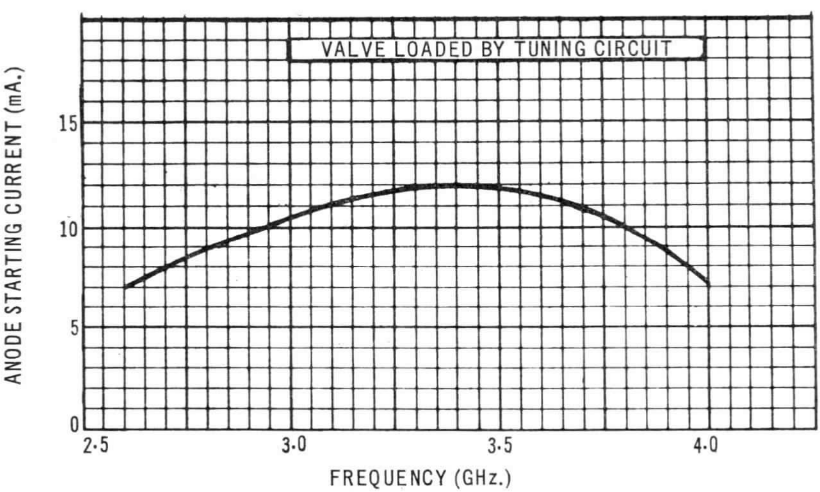


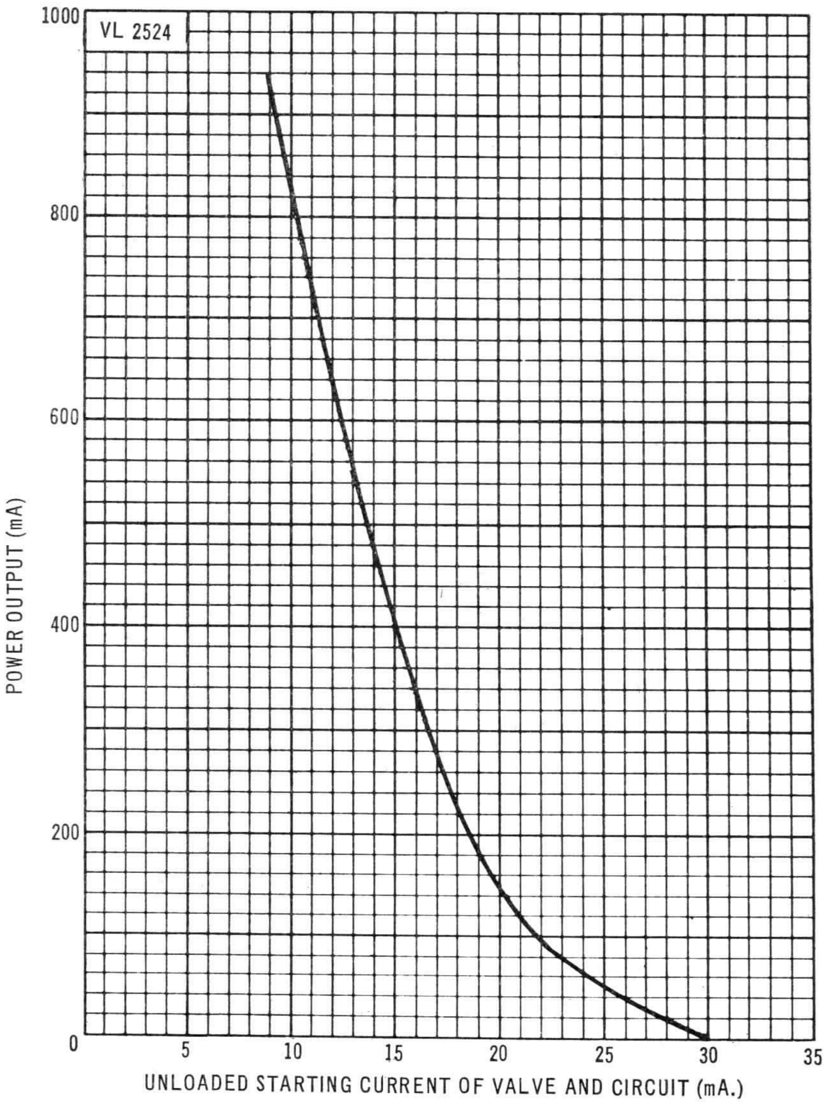
Fig. 4.—Anode Starting Current versus Frequency



Code: V235A/1K (CV2221)

CONTINUED

Fig. 5.—Power Output versus Unloaded Starting Current

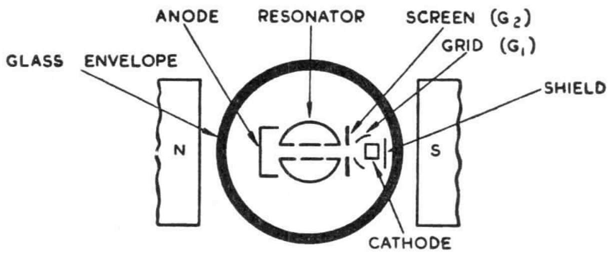


STC

Code: V235A/1K (CV2221)

CONTINUED

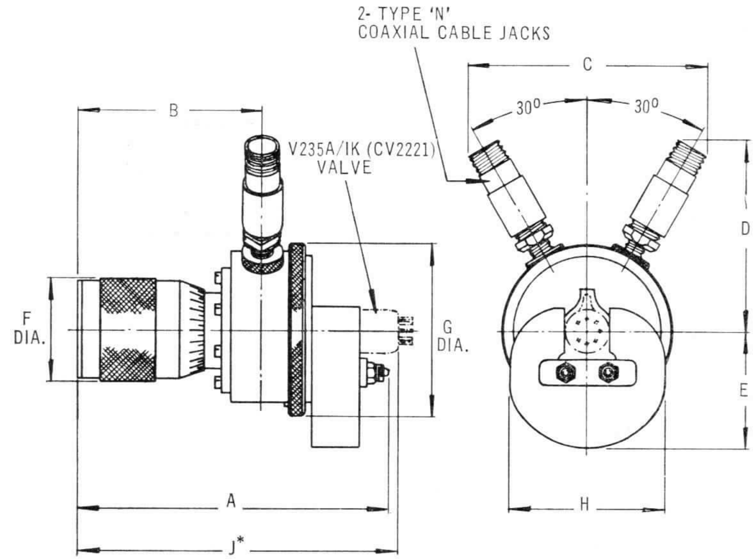
Fig. 6.—Cross Section of Valve Assembly



Code: V235A/1K (CV2221)

CONTINUED

Fig. 7.—Cavity 495–LVA–226



DIM.	INCHES		MILLIMETRES	
A	5½	MIN.	139,7	MIN.
	6.5/16	MAX.*	160,3	MAX.
B	4.1/16	MAX.*	103,2	MAX.
C	4.3/4	MAX. †	120,7	MAX.
D	3.5/8	MAX. †	92,1	MAX.
E	1.3/4	MIN.	44,4	MIN.
	2.3/16	MAX.	55,6	MAX.
F	1.7/8	MAX.	47,6	MAX.
G	3.1/8	MAX.	79,4	MAX.
H	2.7/8	MAX.	73,0	MAX.
J	6.5/8	MAX.*	168,3	MAX.

BASIC DIMENSIONS ARE INCHES

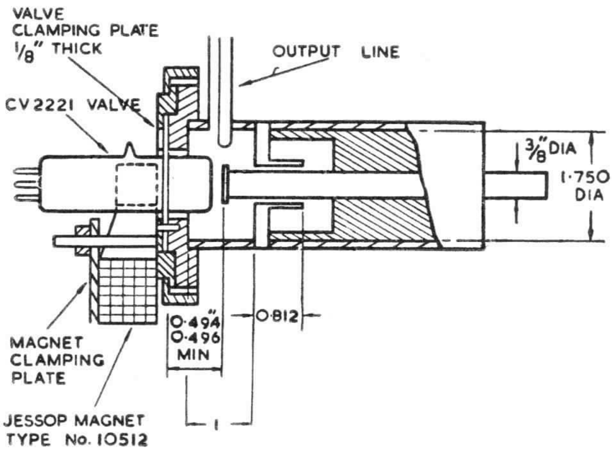
† DENOTES:
WITH ADJUSTMENT FULLY EXTENDED

* DENOTES:
WITH TUNING MICROMETER
ADJUSTMENT FULLY EXTENDED

Code: V235A/1K (CV2221)

CONTINUED

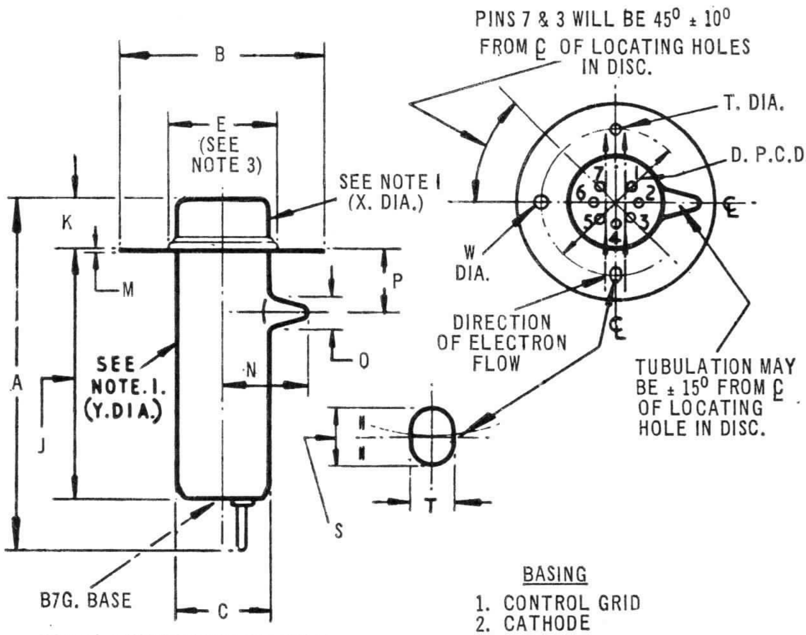
Fig. 8.—Typical Alternative Cavity



Code: V235A/1K (CV2221)

CONTINUED

Fig. 9.—V235A/1K Outline



NOTE I. THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN THE DISC.

BASING

1. CONTROL GRID
2. CATHODE
3. HEATER
4. HEATER
5. ANODE
6. RESONATOR
7. SCREEN GRID

DIM	MILLIMETRES	INCHES	DIM	MILLIMETRES	INCHES
A	73 MAX.	2.7/8 MAX.	P	13.5 ± 4.0	0.53 ± 0.16
B	42 MAX.	1·65 MAX.	Q	8·5 MAX.	0·33 MAX.
C	20·1 MAX.	0·79 MAX.	S	3·2 + 0.13 − 0.00	0·125 + 0·005 − 0·000
D	30·96 ± 0·06	1·218 ± 0·002			
E	24 MAX.	0·94 MAX.	T	2·36 + 0·06 − 0.00	0·093 + 0·002 − 0·000
J	46·0 ± 6.4	1.13/16 ± 1/4			
K	11·1 MIN. 12·5 MAX.	0·437 MIN. 0·494 MAX.	W	2·79 + 0·13 − 0·00	0·110 + 0·005 − 0·000
M	0·3 MAX.	0·012 MAX.	N	18 MAX.	0·710 MAX.
NOTE 2:- BASIC FIGURES ARE INCHES.			X	21·59 MIN.	0·850 MIN.
NOTE 3:- ALSO MIN. CLAMPING DIA.			Y	20·32 MIN.	0·800 MIN.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V238A/1K (CV5292)

The V238A/1K is a velocity modulated oscillator of the coaxial line type for operation in the frequency band 3·555 to 4·255 GHz.

The valve may be operated in the tuning cavity type 495–LVA–251 in which it will give the performance quoted in these data sheets, or in the slug tuned cavities illustrated in Figures 6 and 7.

RADIO FREQUENCY PERFORMANCE (Note 1)

Operating frequency range	3·555 to 4·255	GHz
Power output throughout the band, minimum	550	mW

NOTE 1.—A graph of typical power output versus frequency is shown in Figure 2.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	3·90	GHz
Direct grid 1 voltage (Note 3)	−40	V
Direct anode voltage	V_{res} +20	V
Direct resonator voltage (Note 4)	325	V
Direct screen voltage	150	V
Direct cathode current (Note 5)	50	mA
Direct anode current	42	mA
Direct screen current	negligible	
Power output	1 300	mW

NOTE 2.—All voltages are with respect to the cathode.

NOTE 3.—The use of bias improves the proportion of cathode current which passes through the resonator and reaches the collector (anode).

NOTE 4.—A graph of resonator voltage versus frequency is shown in Figure 1.

NOTE 5.—If reduced power outputs can be tolerated, operation with lower values of cathode current will increase the life of the valve.

Frequency Stability

When operated in a temperature-controlled oven, using the slug-tuned waveguide cavities shown in Figures 6 and 7 and with a suitably regulated power supply, the frequency stability is better than ±250kHz over long periods. Frequency variation with ambient temperature is approximately 50 kHz per °C. Frequency variation with resonator voltage is approximately 50 kHz per volt.

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C O M P O N E N T S   G R O U P

Code: V238A/1K (CV5292)

CONTINUED

CATHODE

Indirectly heated, oxide coated.

HEATER

Heater voltage (Note 6)			6·3 ± 5%	V
Heater current	Min. 0·235	Nom. 0·250	Max. 0·265	A
Preheating time			60	s

NOTE 6.—The heater is usually supplied by a d.c. voltage or a r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 60 Hz must not be used without consulting the manufacturer.

LIMIT RATINGS (Note 7)

(Valve damage may result if any one of these ratings is exceeded.)

Maximum mean input power to all electrodes other than heater	20	W
Direct cathode current	65	mA
Peak cathode current	0·5	A
Direct screen voltage	400	V
Screen dissipation	1·5	W

D.C. SUPPLY VOLTAGES (Note 7)

Electrode connections are made by a shrouded B7G socket plugging on to the base of the valve.

Direct grid 1 voltage	−40	V
Direct anode voltage	V_{res} +20	V
Direct resonator voltage	255 to 410	V
Direct screen voltage range	0 to V_{res}	V

NOTE 7.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage, resonator voltage should not exceed anode voltage.

The valve can be operated with anode voltage equal to resonator voltage but there will be some loss in power output. It can also be operated with anode voltages up to V_{res} +40 with slight increase in power output.

Code: V238A/1K (CV5292)

CONTINUED

CAVITY TYPE 495–LVA–251—GENERAL DESCRIPTION

This approved cavity for the V238A/1K is of waveguide construction with a coaxial output consisting of an adjustable coupling loop leading to a Type "N" jack connector.

The waveguide is tuned to the required frequency by a piston with a rack and graduated scale calibrated in millimetres for precise adjustment.

The antenna end of the valve enters the waveguide through a hole in its broad face. Three holes punched in the valve resonator disc locate on pins fixed to the cavity clamping plate to locate the valve.

The valve electron beam is focused by a permanent magnet of the horseshoe type which is clamped to the cavity.

An outline drawing of the cavity is shown in Figure 5.

OPERATIONAL DATA FOR TUBE AND CAVITY 495–LVA–251

The coupling loop rotation of 180° will suffice to obtain optimum loading of the valve when feeding a matched 50Ω load.

When the valve is loaded by the cavity only, the anode current at which oscillations just start is referred to as the "unloaded starting current"; it serves as a useful measure of the efficiency of the tuning cavity. In Figure 3 the unloaded starting current for a typical valve in the recommended cavity is plotted as a function of frequency.

The magnet of the 495–LVA–251 is aligned so that the best ratio of anode-to-cathode current is obtained. Thus no magnet readjustment is necessary when replacing valves.

USE OF V238A/1K IN CAVITIES OTHER THAN 495–LVA–251

The frequency range 3·55 to 4·27 GHz can be covered in three slug-tuned waveguide cavities. (See Figures 6 and 7.) The relevant dimensions of these mounts are shown in Fig. 7.

Output is by means of a coupling loop inserted through the narrow face of the waveguide. (See Fig. 6.) A fixed depth of penetration of this loop into the cavity will give satisfactory coupling when feeding into a 70 ohm load of V.S.W.R. $<1{\cdot}2$. A total rotation of the loop of 180° will provide optimum loading of the valve over the entire frequency range.

The coupling loop dimensions should be as shown in Fig. 8. The permanent magnet used to focus the electron beam may be of any suitable type which gives a uniform field of 1 400 oersteds minimum over a 22mm gap. The magnet must be aligned so that the best ratio of anode to cathode current is obtained. The three holes punched in the valve resonator disc locate on pins fixed to the valve clamping plate. Once the magnet has been aligned and has been securely clamped with respect to the locating pins, no further adjustment will be necessary when replacing valves. It is recommended that at least three, and preferably six, valves are used to establish the initial alignment of the magnet.

Code: V238A/1K (CV5292)

CONTINUED

Fig. 1.—Resonator Voltage as a Function of Frequency

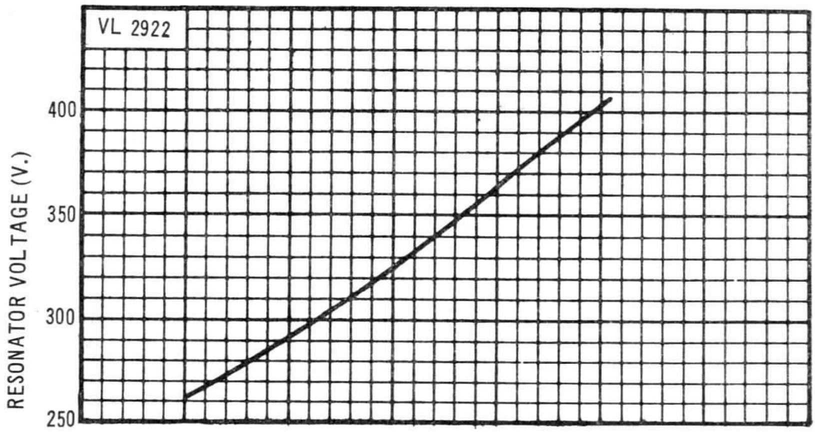


Fig. 2.—Power Output as a Function of Frequency

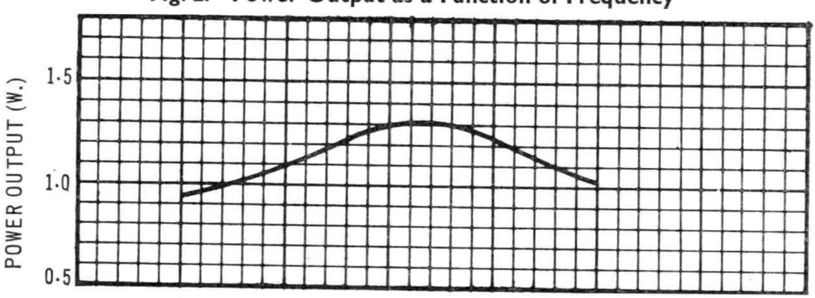
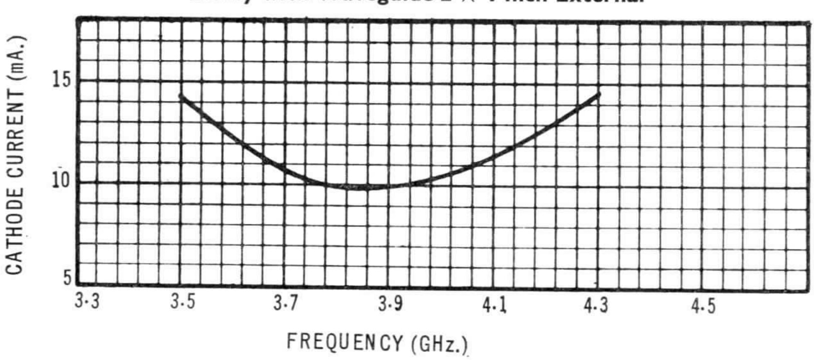


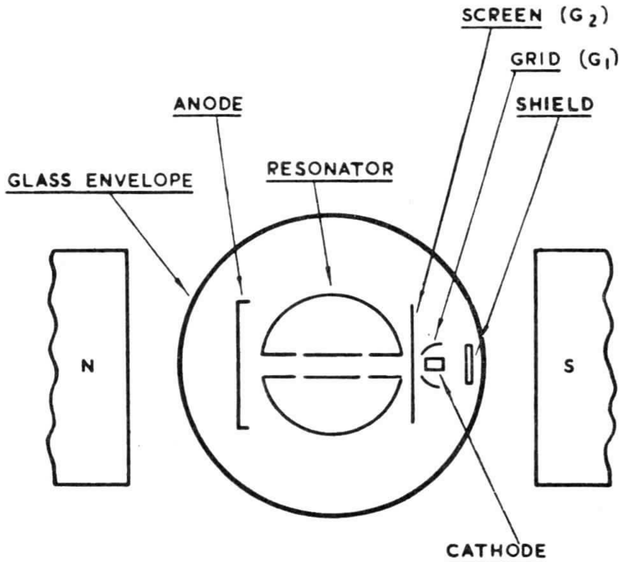
Fig. 3.—Anode Starting Current as a Function of Frequency in a Cavity with Waveguide 2 × 1 inch External



Code: V238A/1K (CV5292)

CONTINUED

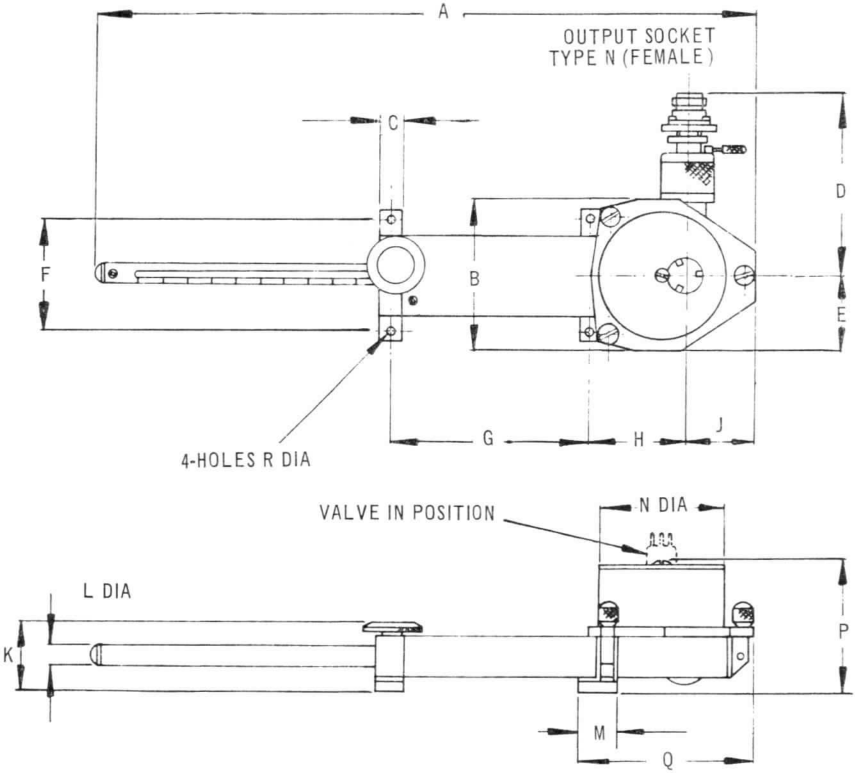
Fig. 4.—Cross Section of Valve Assembly



CAVITY

Code: 495-LVA-251

Fig. 5.—495-LVA-251 Dimensioned Outline

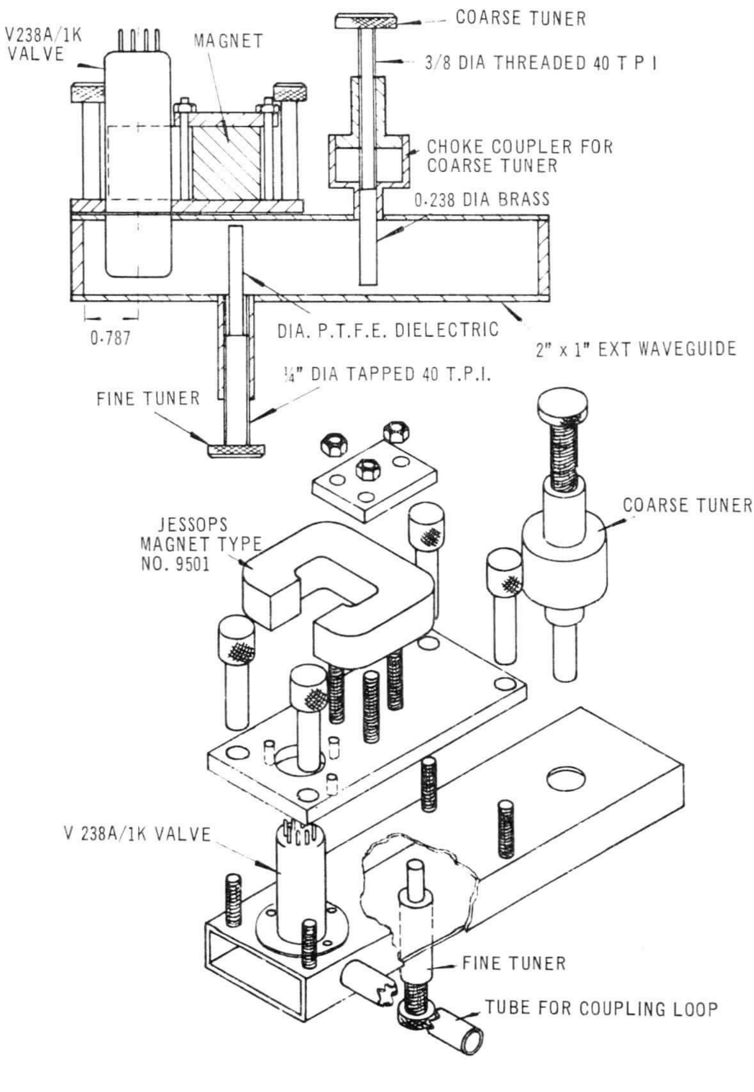


DIM.	INCHES	MILLIMETRES	DIM.	INCHES	MILLIMETRES
A	16.3/4 MAX.	425,5 MAX.	J	1.5/8 APP.	41,3 APP.
B	3.7/8 MAX.	98,4 MAX.	K	1.13/16 APP.	46,0 APP.
C	3/4 MAX.	19,1 MAX.	L	1/2 APP.	12,7 APP.
D	5 ± 1/16	127,0 ± 1,6	M	1 APP.	25,4 APP.
E	1.15/16 MAX.	49,2 MAX.	N	3.1/2 APP.	88,9 APP.
F	2,750 ± 0,020	69,85 ± 0,51	P	3.1/2 MAX.	88,9 MAX.
G	4.11/16 ± 1/16	119,1 ± 1,6	Q	4.3/4 MAX.	120,7 MAX.
H	2.3/4 ± 1/32	69,9 ± 0,8	R	1/4 APP.	6,4 APP.

CAVITY

CONTINUED

Fig. 6.—Slug Cavity



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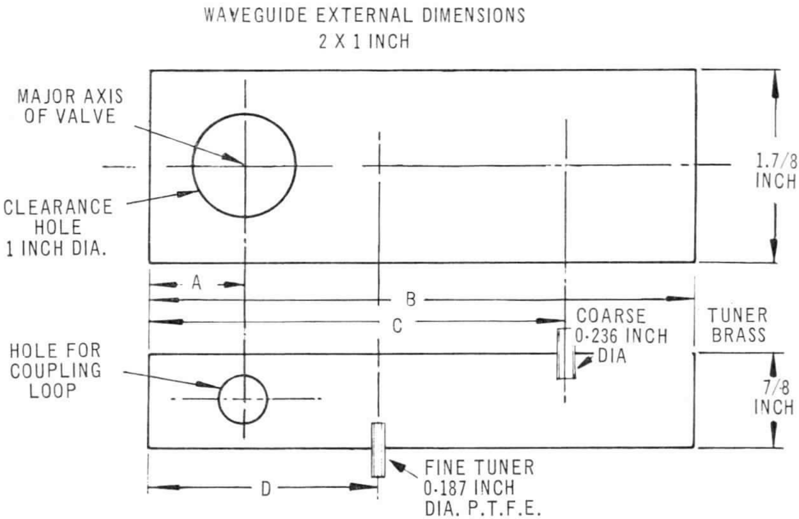
CAVITY

CONTINUED

Fig. 7.—Slug Cavity (Waveguide 2 × 1 inch External)



TRAVEL OF SLUGS JUST LESS THAN 7/8 INCH TO PREVENT CONTACT WITH OPPOSITE WAVEGUIDE WALL.
NOTE: ALL DIMENSIONS SHOWN ARE INTERNAL DIMENSIONS.

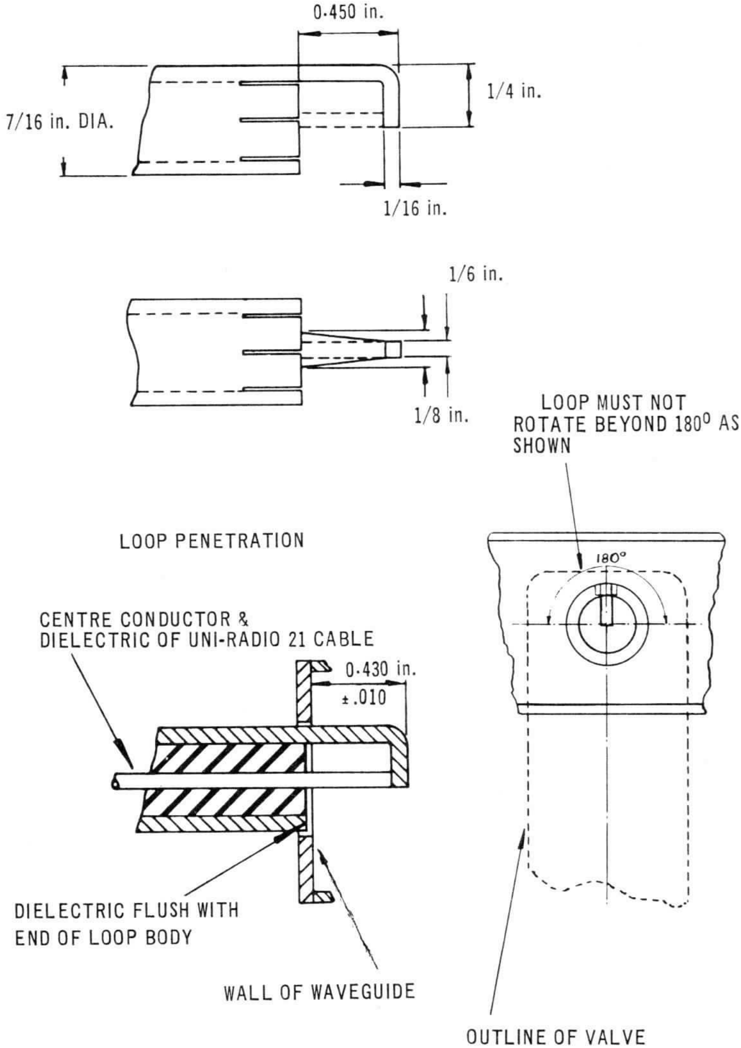
FREQUENCY BAND TO BE COVERED 3·52 to 4·27 GHz.

CIRCUIT NUMBER	DIMENSION A (CM)	B (CM)	C (CM)	D (CM)	COARSE FREQ. COVERAGE (GHz)	COARSE TUNER SENSTY. MINIMUM	FINE TUNER SENSTY.	FINE TUNER RANGE
1	2,0	11,15	9,2	4,8	3·95 to 4·275	0·0013 in./MHz. at 4·15 GHz.	0·052 in./MHz. at 4·15 GHz.	17 MHz at 4·15 GHz.
2	2,0	13,8	11,0	6,0	3·75 to 4·05	0·0015 in./MHz. at 3·925 GHz.	0·058 in./MHz. at 3·925 GHz.	15 MHz at 3·925 GHz.
3	2,0	16,4	14,8	8,05	3·52 to 3·85	0·001 in./MHz. at 3·7 GHz.	0·067 in./MHz. at 3·7 GHz.	13 MHz. at 3·7 GHz.

CAVITY

CONTINUED

Fig. 8.—Coupling Loop



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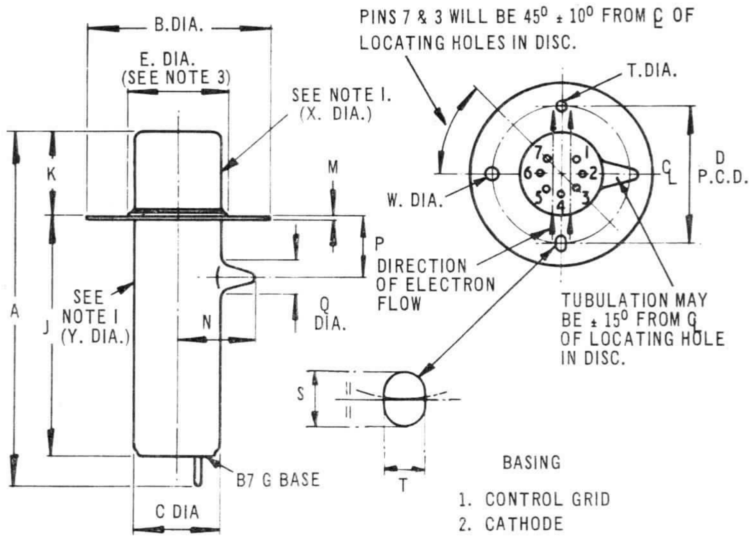
Code: V238A/1K (CV5292)

CONTINUED

Fig. 9.—V238A/1K Outline



BASING

1. CONTROL GRID
2. CATHODE
3. HEATER
4. HEATER
5. ANODE
6. RESONATOR
7. SCREEN GRID

NOTE I
THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN THE DISC.

DIM.	MILLIMETRES		INCHES	
A	88	MAX.	3·46	MAX.
B	42	MAX.	1·65	MAX.
C	20·1	MAX.	0·79	MAX.
D	30·96 ± 0·06		1·218 ± 0·002	
E	24	MAX.	0·94	MAX.
J	60	MAX.	2·36	MAX.
K	15·88	MIN.	0·625	MIN.
	20·63	MAX.	0·812	MAX.
M	0·3	MAX.	0·012	MAX.
N	18	MAX.	0·710	MAX.
P	13·5 ± 4·0		0·53 ± 0·16	

DIM.	MILLIMETRES		INCHES	
Q	8·5	MAX.	0·33	MAX.
S	3·2	+ 0·13 − 0·00	0·125	+ 0·005 − 0·000
T	2·36	+ 0·06 − 0·00	0·093	+ 0·002 − 0·000
W	2·79	+ 0·13 − 0·00	0·110	+ 0·005 − 0·000
X	21·59	MIN.	0·850	MIN.
Y	20·32	MIN.	0·800	MIN.

NOTE 2:- BASIC FIGURES ARE INCHES

NOTE 3:- ALSO MIN. CLAMPING DIA.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V238A/1KY

The V238A/1KY is a velocity modulated oscillator of the coaxial line type. It is a selected V238A/1K for operation in the extended frequency range of 3·52 to 4·255 GHz.

The valve may be operated in the tuning cavity type 495–LVA–251 in which it will give the performance quoted in these data sheets, or in the slug tuned cavities illustrated in Figures 6 and 7.

RADIO FREQUENCY PERFORMANCE (Note 1)

Operating frequency range	3·52 to 4·255	GHz
Power output throughout the band, minimum	500	mW

Note 1.—A graph of typical power output versus frequency is shown in Figure 2.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	3·52	3·90	GHz
Direct grid 1 voltage (Note 3)	−40	−40	V
Direct anode voltage	$V_{res}+20$	$V_{res}+20$	V
Direct resonator voltage (Note 4)	267	325	V
Direct screen voltage	150	150	V
Direct cathode current (Note 5)	50	50	mA
Direct anode current	43	42	mA
Direct screen current	negligible	negligible	
Power output	960	1 300	mW

Note 2.—All voltages are with respect to the cathode.

Note 3.—The use of bias improves the proportion of cathode current which passes through the resonator and reaches the collector (anode).

Note 4.—A graph of resonator voltage versus frequency is shown in Figure 1.

Note 5.—If reduced power outputs can be tolerated, operation with lower values of cathode current will increase the life of the valve.

Frequency Stability

When operated in a temperature-controlled oven, using the slug-tuned waveguide cavities shown in Figures 6 and 7 and with a suitable regulated power supply, the frequency stability is better than ±250 kHz over long periods. Frequency variation with ambient temperature is approximately 50 kHz per °C. Frequency variation with resonator voltage is approximately 50 kHz per volt.

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STC

Code: V238A/1KY

CONTINUED

CATHODE

Indirectly heated, oxide-coated.

HEATER

Heater voltage (Note 6)			6·3 ± 5%	V
Heater current	Min. 0·235	Nom. 0·250	Max. 0·265	A
Preheating time			60	s

Note 6.—The heater is usually supplied by a d.c. voltage or a r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 60 Hz must not be used without consulting the manufacturer.

LIMIT RATINGS (Note 7)

Valve damage may result if any one of these ratings is exceeded.

Maximum mean input power to all electrodes other than heater	20	W
Direct cathode current	65	mA
Peak cathode current	0·5	A
Direct screen voltage	400	V
Screen dissipation	1·5	W

D.C. Supply Voltages (Note 7)

Electrode connections are made by a shrouded B7G socket plugging on to the base of the valve

Direct grid 1 voltage	−40	V
Direct anode voltage	V_{res} +20	V
Direct resonator voltage	250 to 410	V
Direct screen voltage range	0 to V_{res}	V

Note 7.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage, resonator voltage should not exceed anode voltage.

The valve can be operated with anode voltage equal to resonator voltage but there will be some loss in power output. It can also be operated with anode voltages up to V_{res} +40 with slight increase in power output.

Code: V238A/1KY

CONTINUED

CAVITY TYPE 495–LVA–251—GENERAL DESCRIPTION

This approved cavity for the V238A/1KY is of waveguide construction with a coaxial output consisting of an adjustable coupling loop leading to a Type 'N' jack connector.

The waveguide is tuned to the required frequency by a piston with a rack and graduated scale calibrated in millimetres for precise adjustment.

The antenna end of the valve enters the waveguide through a hole in its broad face. Three holes punched in the valve resonator disc locate on pins fixed to the cavity clamping plate to locate the valve.

The valve electron beam is focused by a permanent magnet of the horseshoe type which is clamped to the cavity.

An outline drawing of the cavity is shown in Figure 5.

OPERATIONAL DATA FOR TUBE AND CAVITY 495–LVA–251

The coupling loop rotation of 180° will suffice to obtain optimum loading of the valve when feeding a matched 50Ω load.

When the valve is loaded by the cavity only, the anode current at which oscillations just start is referred to as the "unloaded starting current"; it serves as a useful measure of the efficiency of the tuning cavity. In Figure 3 the unloaded starting current for a typical valve in the recommended cavity is plotted as a function of frequency.

The magnet of the 495–LVA–251 is aligned so that the best ratio of anode-to-cathode current is obtained. Thus no magnet readjustment is necessary when replacing valves.

USE OF V238A/1KY IN CAVITIES OTHER THAN 495–LVA–251

The frequency range 3·52 to 4·27 GHz can be covered in three slug-tuned waveguide cavities. (See Figures 6 and 7.) The relevant dimensions of these mounts are shown in Figure 7.

Output is by means of a coupling loop inserted through the narrow face of the waveguide. (See Figure 6.) A fixed depth of penetration of this loop into the cavity will give satisfactory coupling, when feeding into a 70 ohm load of V.S.W.R. $<$1·2. A total rotation of the loop of 180° will provide optimum loading of the valve over the entire frequency range.

The coupling loop dimensions should be as shown in Figure 8. The permanent magnet used to focus the electron beam may be of any suitable type which gives a uniform field of 1 400 oersteds minimum over a 22 mm gap. The magnet must be aligned so that the best ratio of anode to cathode current is obtained. The three holes punched in the valve resonator disc locate on pins fixed to the valve clamping plate. Once the magnet has been aligned and has been securely clamped with respect to the locating pins, no further adjustment will be necessary when replacing valves. It is recommended that at least three, and preferably six, valves are used to establish the initial alignment of the magnet.

Code: V238A/1KY

CONTINUED

Fig. 1.—Resonator Voltage versus Frequency

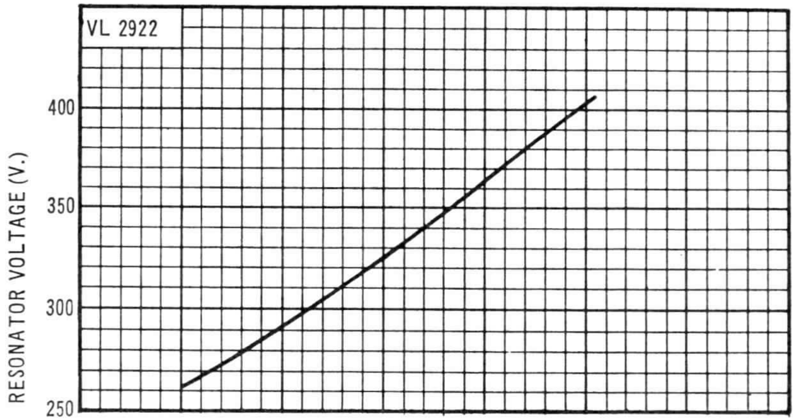


Fig. 2.—Power Output versus Frequency

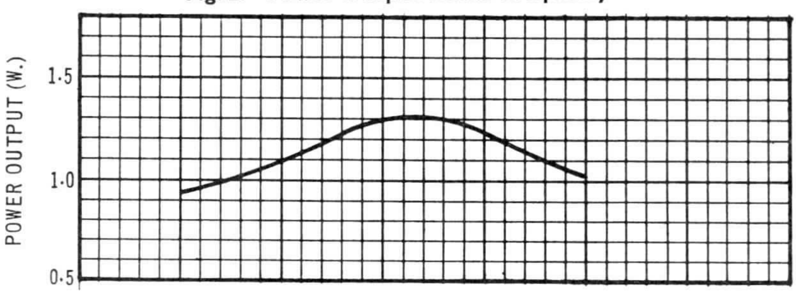
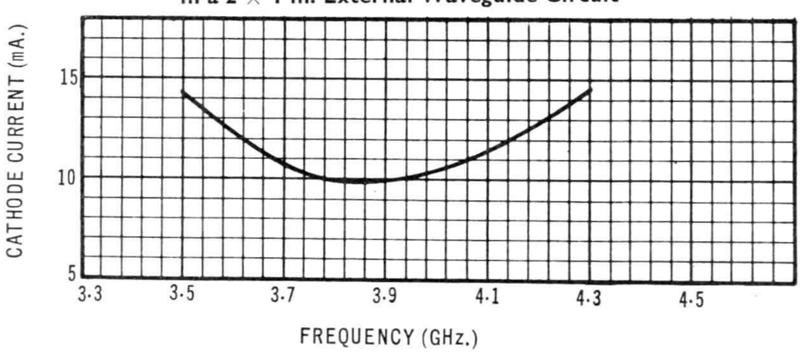


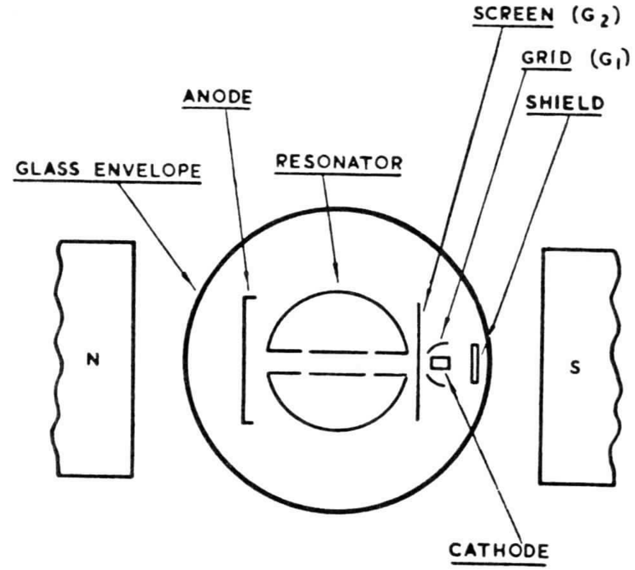
Fig. 3.—Anode Starting Current versus Frequency in a 2 × 1 in. External Waveguide Circuit



Code: V238A/1KY

CONTINUED

Fig. 4.—Cross Section of Valve Assembly

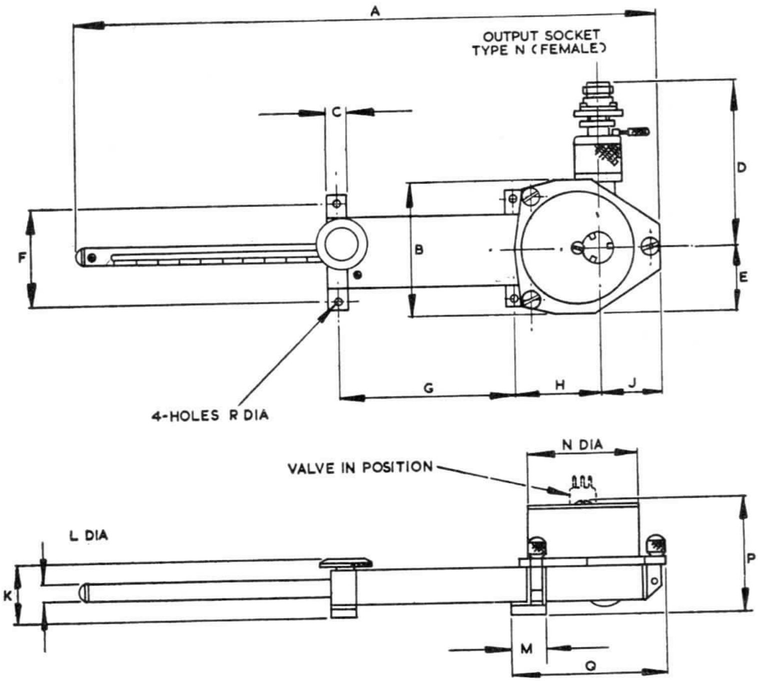


 STC

T.W.T. MOUNT

Code: 495–LVA–251

Fig. 5.—495–LVA–251 Dimensioned Outline

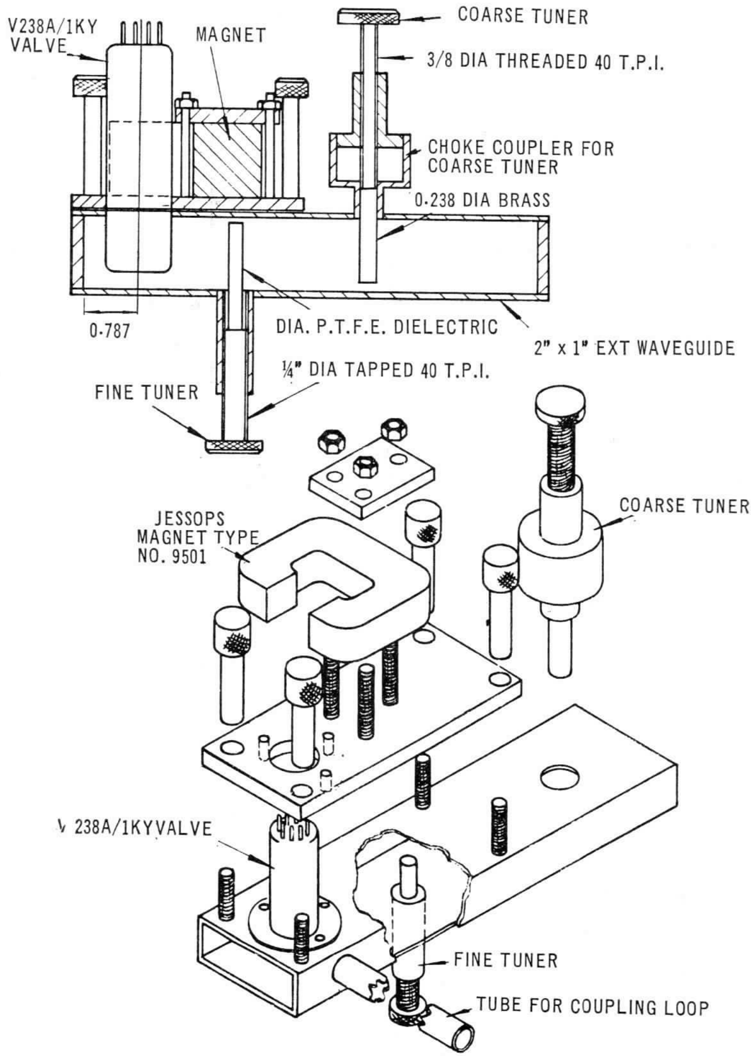


DIM.	INCHES	MILLIMETRES	DIM.	INCHES	MILLIMETRES
A	$16\frac{3}{4}$ MAX.	425,5 MAX.	J	$1\frac{5}{8}$ APPROX.	41,3 APPROX.
B	$3\frac{7}{8}$ MAX.	98,4 MAX.	K	$1\frac{13}{16}$ APPROX.	46,0 APPROX.
C	$\frac{3}{4}$ MAX.	19,1 MAX.	L	$\frac{1}{2}$ APPROX.	12,7 APPROX.
D	$5 \pm \frac{1}{16}$	127,0 ± 1,6	M	1 APPROX.	25,4 APPROX.
E	$1\frac{15}{16}$ MAX.	49,2 MAX.	N	$3\frac{1}{2}$ APPROX.	88,9 APPROX.
F	2.750 ± 0.020	69,85 ± 0,51	P	$3\frac{1}{2}$ MAX.	88,9 MAX.
G	$4\frac{11}{16} \pm \frac{1}{16}$	119,1 ± 1,6	Q	$4\frac{3}{4}$ MAX.	120,7 MAX.
H	$2\frac{3}{4} \pm \frac{1}{32}$	69,9 ± 0,8	R	$\frac{1}{4}$ APPROX.	6,4 APPROX.

T.W.T. MOUNT

CONTINUED

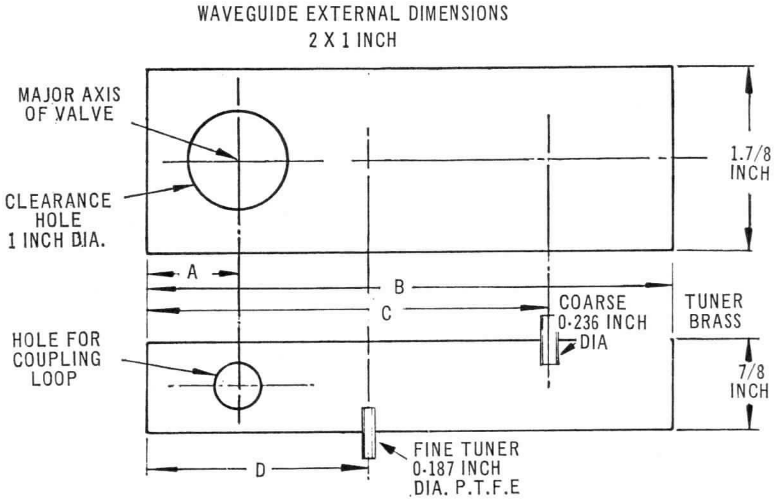
Fig. 6.—Slug Cavity



T.W.T. MOUNT

CONTINUED

Fig. 7.—Slug Cavity



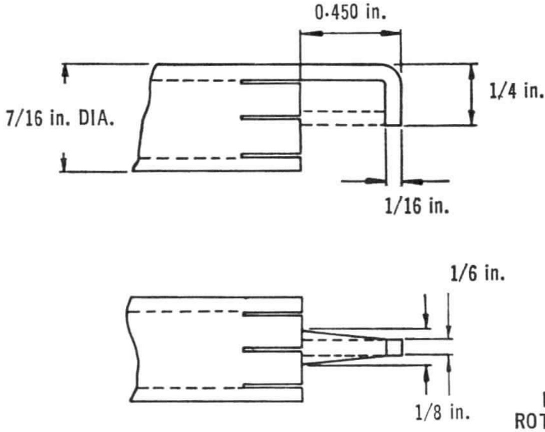
TRAVEL OF SLUGS JUST LESS THAN 7/8 INCH TO PREVENT CONTACT WITH OPPOSITE WAVEGUIDE WALL.
NOTE: ALL DIMENSIONS SHOWN ARE INTERNAL DIMENSIONS.

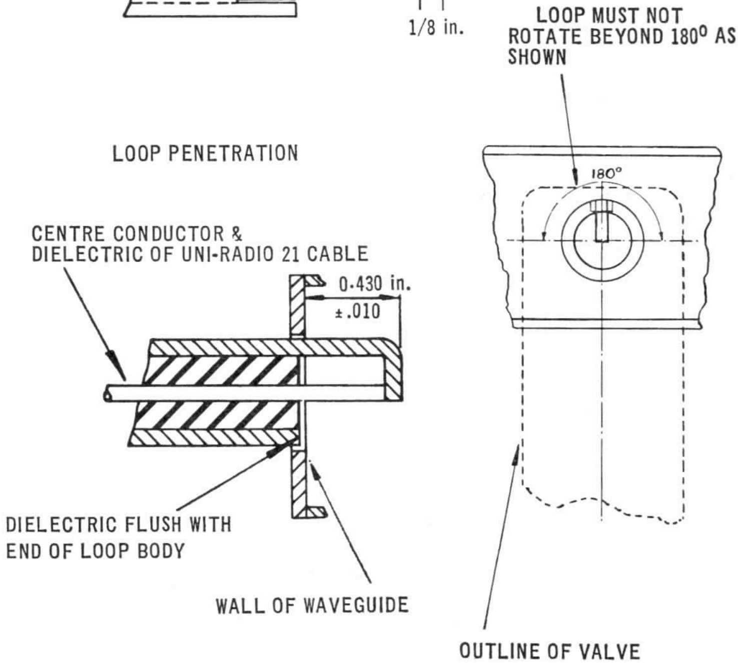
FREQUENCY BAND TO BE COVERED 3·52 to 4·27 GHz.								
CIRCUIT NUMBER	DIMENSION				COARSE FREQ. COVER-AGE (GHz)	COARSE TUNER SENSTY. MINIMUM	FINE TUNER SENSTY.	FINE TUNER RANGE
	A (CM)	B (CM)	C (CM)	D (CM)				
1	2,0	11,15	9,2	4,8	3·95 to 4·275	0·0013 in./MHz. at 4·15 GHz.	0·052 in./MHz. at 4·15 GHz.	17 MHz at 4.15 GHz.
2	2,0	13,8	11,0	6,0	3·75 to 4·05	0·0015 in./MHz. at 3·925 GHz.	0·058 in./MHz. at 3·925 GHz.	15 MHz at 3·925 GHz.
3	2,0	16,4	14,8	8,05	3·52 to 3·85	0·001 in./MHz. at 3·7 GHz.	0·067 in./MHz. at 3·7 GHz.	13 MHz. at 3·7 GHz.

T.W.T. MOUNT

CONTINUED

Fig. 8.—Coupling Loop



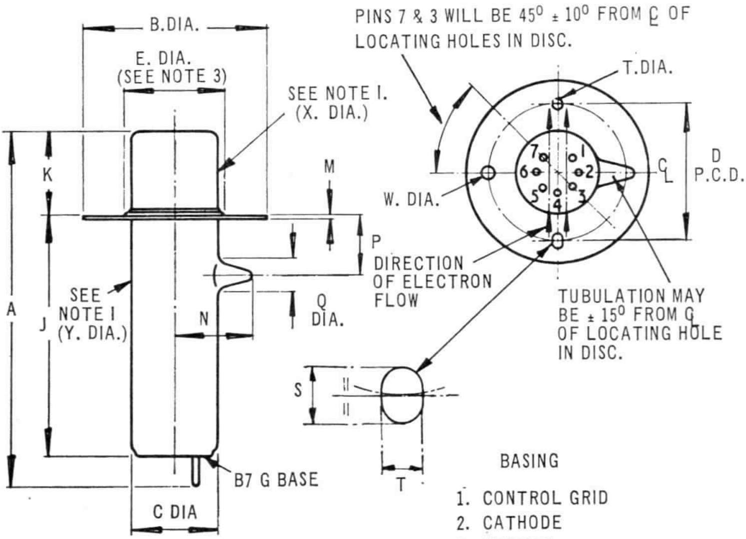


STC

Code: V238A/1KY

CONTINUED

Fig. 9.—V238A/1KY Outline



BASING

1. CONTROL GRID
2. CATHODE
3. HEATER
4. HEATER
5. ANODE
6. RESONATOR
7. SCREEN GRID

NOTE I
THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN THE DISC.

DIM.	MILLIMETRES			INCHES		
A	88		MAX.	3·46		MAX.
B	42		MAX.	1·65		MAX.
C	20·1		MAX.	0·79		MAX.
D	30·96	±	0·06	1·218	±	0·002
E	24		MAX.	0·94		MAX.
J	60		MAX.	2·36		MAX.
K	15·88		MIN.	0·625		MIN.
	20·63		MAX.	0·812		MAX.
M	0·3		MAX.	0·012		MAX.
N	18		MAX.	0·710		MAX.
P	13·5	±	4·0	0·53	±	0·16

DIM.	MILLIMETRES		INCHES	
Q	8·5	MAX.	0·33	MAX.
S	3·2	+ 0·13 − 0·00	0·125	+ 0·005 − 0·000
T	2·36	+ 0·06 − 0·00	0·093	+ 0·002 − 0·000
W	2·79	+ 0·13 − 0·00	0·110	+ 0·005 − 0·000
X	21·59	MIN.	0·850	MIN.
Y	20·32	MIN.	0·800	MIN.

NOTE 2:- BASIC FIGURES ARE INCHES
NOTE 3:- ALSO MIN. CLAMPING DIA.

SPECIAL VALVES

Velocity Modulated Oscillators

Codes: V243A/2FS (CV5463) V243A/3FS

These valves are coaxial line type velocity-modulated oscillators intended for use in a system with ±50 MHz mechanical frequency modulation and a mid-frequency in the band 4·2 GHz to 4·4 GHz; they can also be operated in a coaxial output waveguide cavity 495–LVA–251 over the frequency range 4·1 to 4·7 GHz.

The valves, which have similar electrical characteristics, are closely designed to withstand mechanical shock and vibration and have heat dissipating shields closely fitted to their envelopes to enable them to operate at ambient temperatures up to 100°C.

The valves have different basing arrangements (See Figures 1 and 2).

RADIO FREQUENCY PERFORMANCE (Note 1)

	4·3 GHz Cavity	495–LVA–251	
Operating frequency range	4·2 to 4·4	4·1 to 4·7	GHz
Power output			
minimum at 4·3 GHz	750		mW
minimum throughout the band		500	mW

Note 1.—A graph of typical power output versus frequency in the 495–LVA–251 cavity is shown in Figure 5.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	4·3	4·4	GHz
Direct grid 1 voltage (Note 3)	−40	−40	V
Direct anode voltage	V_{res} +20	V_{res} +20	V
Direct resonator voltage	254	267	V
Direct screen voltage	170	172	V
Direct cathode current (Note 4)	65	65	mA
Direct anode current	42·5	44	mA
Direct screen current	55	80	μA
Power output	1 010	990	mW

Note 2.—All voltages are with respect to the cathode.

Note 3.—The use of bias improves the proportion of cathode current which passes through the resonator and reaches the collector (anode).

Note 4.—If reduced power outputs can be tolerated, operation with lower values of cathode current will increase the life of the valve.

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STC

Codes: V243A/2FS (CV5463) V243A/3FS

CONTINUED

CATHODE

Indirectly-heated, oxide-coated.

HEATER

Heater voltage (Note 5)			6·3 ± 5%	V
Heater current	Min. 0·235	Nom. 0·250	Max. 0·265	A
Preheating time			30	sec

Note 5.—The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 1 000 Hz should not be used without consulting the manufacturer.

LIMIT RATINGS

Valve damage may result if any one of these ratings is exceeded.

Mean input power to all electrodes other than heater	18	W
Direct cathode current	65	mA
Resonator dissipation	10	W
Screen dissipation	1·5	W
Bulb temperature	300	°C
Peak cathode current	0·5	A

Screen voltage should not exceed resonator voltage

D.C. SUPPLY VOLTAGES (Note 6)

V243A/2FS electrode connections are made by leads soldered to the wiring-in adaptor on the B7G/F base.

V243A/3FS electrode connections are made by a Winchester Electronics Inc. Miniature Round Socket Series 'M' Ref. No. M7S–LRN which fits with its mating plug on the valve.

Direct grid 1 voltage	−40	V
Direct anode voltage	V_{res} +20	V
Direct resonator voltage, 4·3 GHz cavity	230 to 275	V
495–LVA–251 cavity	220 to 340	V
Direct screen voltage range	0 to V_{res}	V

Note 6.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage, resonator voltage should not exceed anode voltage. The output power is controlled by varying the cathode current by the screen grid voltage.
The valve can be operated with anode voltage equal to resonator voltage but there will be some loss in power output. It can also be operated with anode voltages up to V_{res} +40 with slight increase in power output.

Codes: V243A/2FS (CV5463)
V243A/3FS

CONTINUED

WAVEGUIDE CAVITY FOR OPERATION AT 4·2 to 4·4 GHz

This is shown in Figure 3. It is of waveguide construction with a coaxial output consisting of an adjustable coupling loop in the narrow face of the waveguide leading to a Type 'N' jack connector.

The waveguide is matched for maximum power by a stub tuning screw.

The antenna end of the valve enters the waveguide through a hole in its broad face. Three holes punched in the valve resonator disc locate on pins fixed to the cavity clamping plate to locate the valve.

The valve electron beam is focused by a permanent magnet of the horseshoe type which is clamped to the cavity.

The coupling loop rotation of 180° will suffice to obtain optimum loading of the valve when feeding a matched 50Ω load. A fixed depth of penetration of this loop into the cavity will give satisfactory coupling. The coupling loop dimensions are also shown in Figure 3. The permanent magnet used to focus the electron beam may be of any suitable type which gives a uniform field of 1 400 gauss minimum over a 22mm gap. The magnet must be aligned so that the best ratio of anode to cathode current is obtained. Once the magnet has been aligned and has been securely clamped, no further adjustment will be necessary when replacing valves. It is recommended that at least three, and preferably six, valves are used to establish the initial alignment of the magnet.

CAVITY TYPE 495–LVA–251

This is generally similar to the cavity described above excepting that the waveguide is tuned to the required frequency by a piston with a rack and graduated scale calibrated in millimetres for precise adjustment.

The cavity is supplied with a pre-aligned magnet.

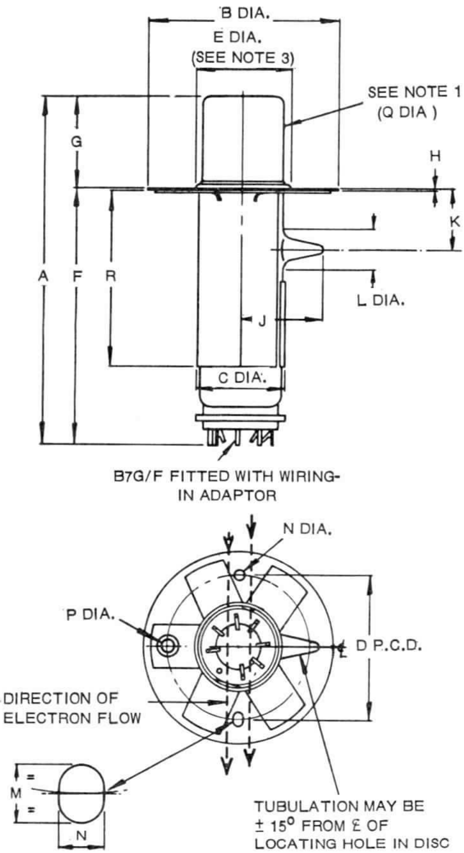
The outline drawing of the cavity is shown in Figure 4.

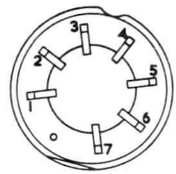
STC

Codes: V243A/2FS (CV5463)
V243A/3FS

CONTINUED

Fig. 1.—V243A/2FS Outline





BASING

PIN No.	ELECTRODE
1	RESONATOR
2	CONTROL GRID
3	HEATER
4	HEATER
5	CATHODE
6	SCREEN GRID
7	ANODE

NOTE:-

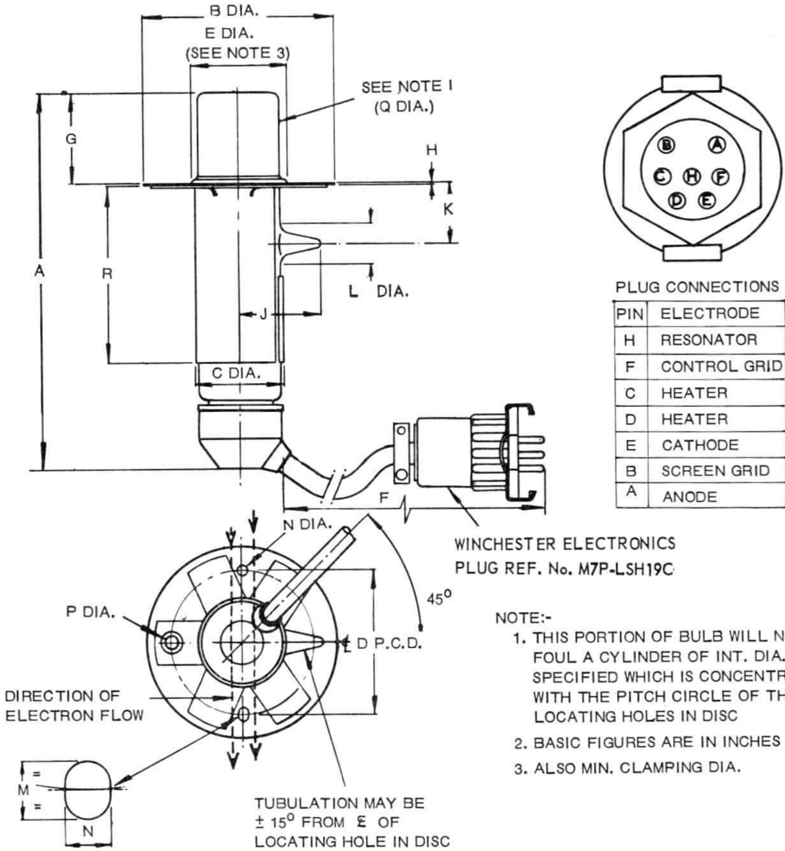
1. THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN DISC
2. BASIC FIGURES ARE IN INCHES
3. ALSO MIN. CLAMPING DIA.

DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	81,0 MAX.	3.3/16 MAX.	K	13,46 ± 4,06	0·530 ± 0·160
B	41,91 MAX.	1·650 MAX.	L	8,38 MAX.	0·330 MAX.
C	21,08 MAX.	0·830 MAX.	M	3,18 + 0,13 − 0,00	0·125 + 0·005 − 0·000
D	30,96 ± 0,05	1·218 ± 0·002			
E	23,88 MAX.	0.940 MAX.	N	2,36 + 0,05 − 0,00	0·093 + 0·002 − 0.000
F	55,6 ± 4,8	2.3/16 ± 3/16			
G	15,88 MIN. 20,64 MAX.	0·625 MIN. 0·812 MAX.	P	2,79 + 0,13 − 0,00	0·110 + 0·005 − 0·000
H	0,31 MAX.	0·012 MAX.	Q	21,59 MIN.	0·850 MIN.
J	18,03 MAX.	0·710 MAX.	R	38,1 ± 1,6	1.1/2 ± 1/16

Codes: V243A/2FS (CV5463)
V243A/3FS

CONTINUED

Fig. 2.—V243A/3FS Outline



PLUG CONNECTIONS

PIN	ELECTRODE
H	RESONATOR
F	CONTROL GRID
C	HEATER
D	HEATER
E	CATHODE
B	SCREEN GRID
A	ANODE

NOTE:-

1. THIS PORTION OF BULB WILL NOT FOUL A CYLINDER OF INT. DIA. SPECIFIED WHICH IS CONCENTRIC WITH THE PITCH CIRCLE OF THE LOCATING HOLES IN DISC
2. BASIC FIGURES ARE IN INCHES
3. ALSO MIN. CLAMPING DIA.

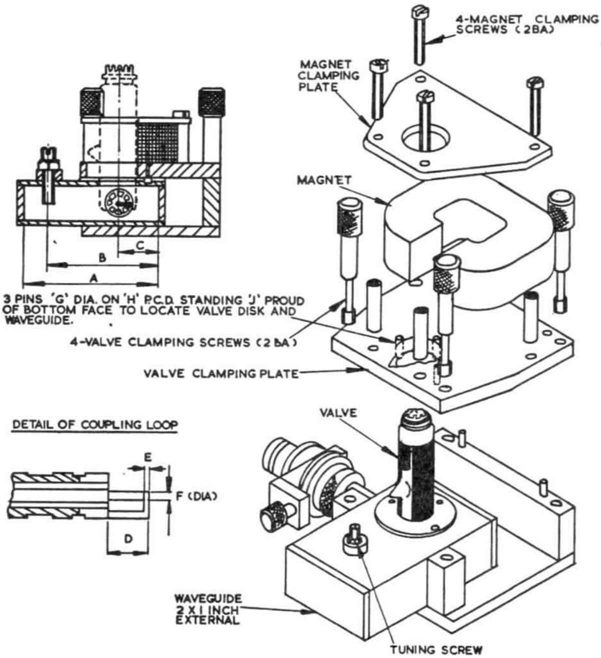
DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	87,31 MAX.	3.7/16 MAX.	K	13,46 ± 4,06	0·530 ± 0·160
B	41,91 MAX.	1·650 MAX.	L	8,38 MAX.	0·330 MAX.
C	21,08 MAX.	0·830 MAX.	M	3,18 + 0,13 − 0,00	0·125 + 0·005 − 0·000
D	30,96 ± 0,05	1·218 ± 0·002			
E	23,88 MAX.	0·940 MAX.	N	2,36 + 0,05 − 0,00	0·093 + 0·002 − 0.000
F	152,40 MIN-165,10 MAX	6 MIN – 6.1/2 MAX.			
G	15,88 MIN.	0·625 MIN.	P	2,79 + 0,13 − 0,00	0.110 + 0·005 − 0·000
	20,64 MAX.	0·812 MAX.			
H	0,31 MAX.	0.012 MAX.	Q	21,59 MIN.	0·850 MIN.
J	18,03 MAX.	0·710 MAX.	R	38,1 ± 1,6	1.1/2 ± 1/16

STC

Codes: V243A/2FS (CV5463)
V243A/3FS

CONTINUED

Fig. 3.—Waveguide Cavity for Operation at 4·3 GHz



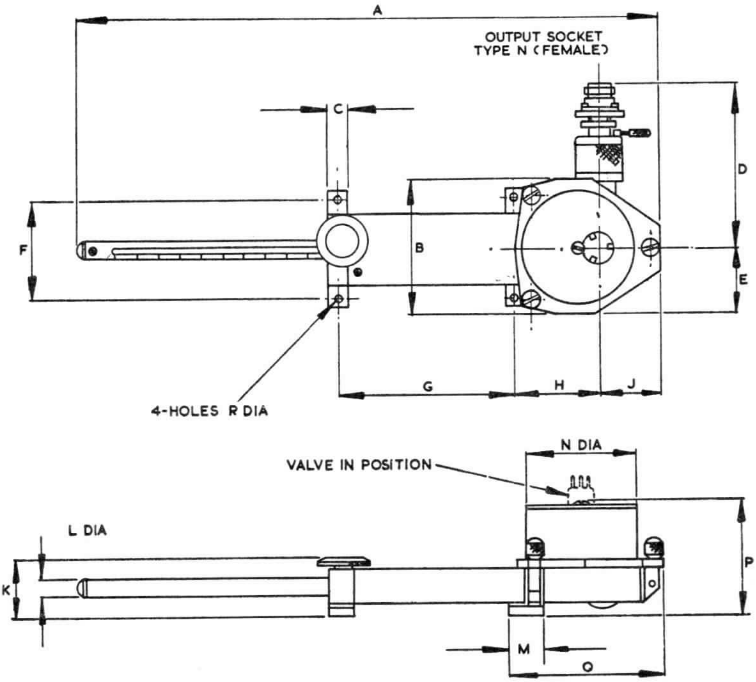
BASIC UNITS ARE METRIC

DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	84	3.307	G	2,4	0.093
B	62,5	2.46	H	31	1.218
C	23	0.906	J	1,6	$\frac{1}{16}$
D	11,4	0.45			
E	1,5	0.059			
F	1,5	0.059			

Codes: V243A/2FS (CV5463)
V243A/3FS

CONTINUED

Fig. 4.—495–LVA–251 Outline



DIM.	INCHES	MILLIMETRES	DIM.	INCHES	MILLIMETRES
A	$16\frac{3}{4}$ MAX.	425,5 MAX.	J	$1\frac{5}{8}$ APPROX.	41,3 APPROX.
B	$3\frac{7}{8}$ MAX.	98,4 MAX.	K	$1\frac{13}{16}$ APPROX.	46,0 APPROX.
C	$\frac{3}{4}$ MAX.	19,1 MAX.	L	$\frac{1}{2}$ APPROX.	12,7 APPROX.
D	$5 \pm \frac{1}{16}$	$127,0 \pm 1,6$	M	1 APPROX.	25,4 APPROX.
E	$1\frac{15}{16}$ MAX.	49,2 MAX.	N	$3\frac{1}{2}$ APPROX.	88,9 APPROX.
F	2.750 ± 0.020	$69,85 \pm 0,51$	P	$3\frac{1}{2}$ MAX.	88,9 MAX.
G	$4\frac{11}{16} \pm \frac{1}{16}$	$119,1 \pm 1,6$	Q	$4\frac{3}{4}$ MAX.	120,7 MAX.
H	$2\frac{3}{4} \pm \frac{1}{32}$	$69,9 \pm 0,8$	R	$\frac{1}{4}$ APPROX.	6,4 APPROX.

Codes: V243A/2FS (CV5463) V243A/3FS

CONTINUED

Fig. 5.—Typical Power Output versus Frequency in Cavity 495–LVA–251

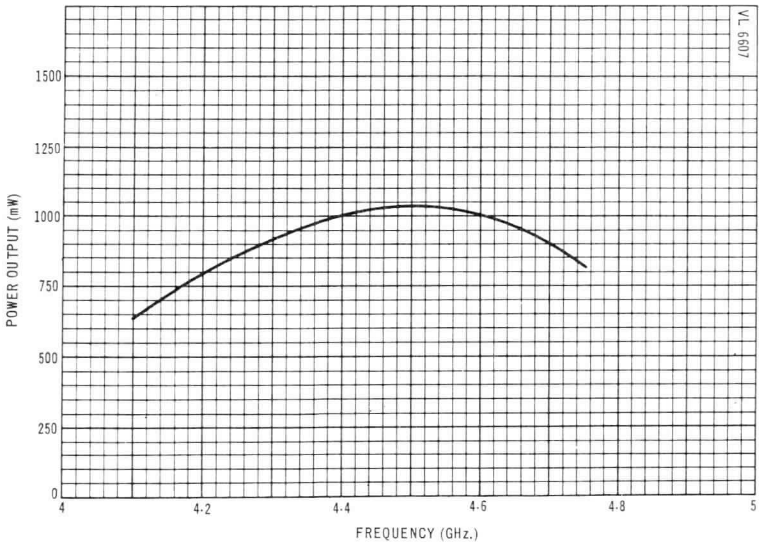
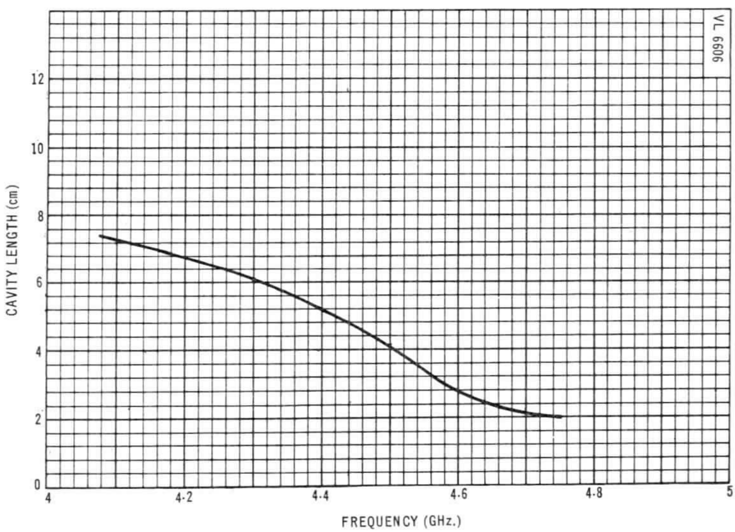


Fig. 6.—Typical Cavity Length versus Frequency in Cavity 495–LVA–251



SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V265A/1M

The V265A/1M is a single-transit velocity-modulated valve (H-wave Oscillator) designed as a local oscillator for operation in the frequency range 5·8 to 7·5 GHz.

The valve may be operated with the input and output tuning cavities 495–LVA–353 and 495–LVA–354 with which it will give the performance quoted in these data sheets.

RADIO FREQUENCY PERFORMANCE (Note 1)

Operating frequency range	5·85 to 7·5	GHz
Power output at frequencies 5·85 and 7·1 GHz, minimum	200	mW
Power output at frequency 7·5 GHz, minimum	150	mW

NOTE 1.—A graph of typical power output versus frequency is shown in Figure 1.

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	5·85	6·5	7·5	GHz
Direct grid 1 voltage	−50	−50	−50	V
Direct anode voltage	$V_{res}+20$	$V_{res}+20$	$V_{res}+20$	V
Direct resonator voltage (Note 3)	253	300	395	V
Direct screen voltage (Note 4)	180	167	155	V
Direct anode current	30	30	30	mA
Direct cathode current	48	46·5	45	mA
Direct screen current	100	100	100	μA
Direct grid 1 current	0·5	0·5	0·5	μA
Power output (Note 5)	530	630	360	mW
Circuit length	5	2·5	1·4	cm

NOTE 2.—All voltages are with respect to the cathode.

NOTE 3.—This is adjusted to give maximum power output at the operating frequency set by the tuning piston. Graphs of frequency as a function of resonator voltage and piston position are shown in Figures 2 and 3.

NOTE 4.—This is adjusted to give an anode current of 30mA. For unattended operation this should be effected automatically.

NOTE 5.—To obtain this the output cavity tuning slug is adjusted to give maximum power and the waveguide load should have a V.S.W.R. of less than 1·2 : 1.

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Code: V265A/1M

CONTINUED

CATHODE

Indirectly heated, oxide coated.

HEATER

Heater voltage (Note 6)			6·3 ± 5%	V
Heater current	Min. 0·18	Nom. 0·225	Max. 0·27	A
Preheating time			60	s

NOTE 6.—The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 Hz. Frequencies greater than 1·5 kHz must not be used.

LIMIT RATINGS

Valve damage may result if any one of these ratings is exceeded.

Total dissipation for all electrodes except heater	25	W
Direct anode voltage (Note 7)	500	V
Direct resonator voltage	500	V
Direct screen voltage	300	V
Direct anode dissipation	25	W
Direct resonator dissipation	15	W
Direct screen dissipation	2	W
Direct cathode current	60	mA
Maximum temperature of mica window seal	130	°C
Maximum temperature of any other part of valve envelope	300	°C

D.C. SUPPLIES (Note 7)

Electrode connexions are made by a shrouded B8G socket plugging on to the valve.

Direct grid 1 voltage	−50	V
Direct anode voltage	V_{res} +20	V
Direct resonator voltage	230 to 400	V
Direct screen voltage range	0 to 300	V
Direct screen current maximum	5	mA
Direct grid 1 current	250	μA

NOTE 7.—All voltages are relative to the cathode. The resonator is normally at earth potential and the cathode negative. Screen voltage should not exceed resonator voltage +50 with the limit at 300 volts, resonator voltage should not exceed anode voltage.

Code: V265A/1M

CONTINUED

V265A/1M PHYSICAL FEATURES

The valve is designed to work into W.G.14 waveguide. Each valve is fitted with its own beam focusing magnet. The magnet is adjusted and locked in position during the testing of the valve and should not be readjusted during its life. A flange plate is fitted on each side of the valve. The output and tuning waveguide circuits are each secured by a split ring locking under the three studs on each plate. An outline drawing of the valve is shown in Figure 6.

TUNING AND OUTPUT CAVITIES 495–LVA–353 AND 495–LVA–354

A diagram of the cavities with a valve assembled is shown in Figure 4. A separate diagram of the tuning cavity showing the reference plane for measurement of piston position is shown in Figure 5. The two cavities are both constructed of waveguide 14. The output cavity is fitted with an adjustable coupling slug to enable correct output loading to be obtained. Some adjustment of this slug is necessary when tuning over the available frequency range.

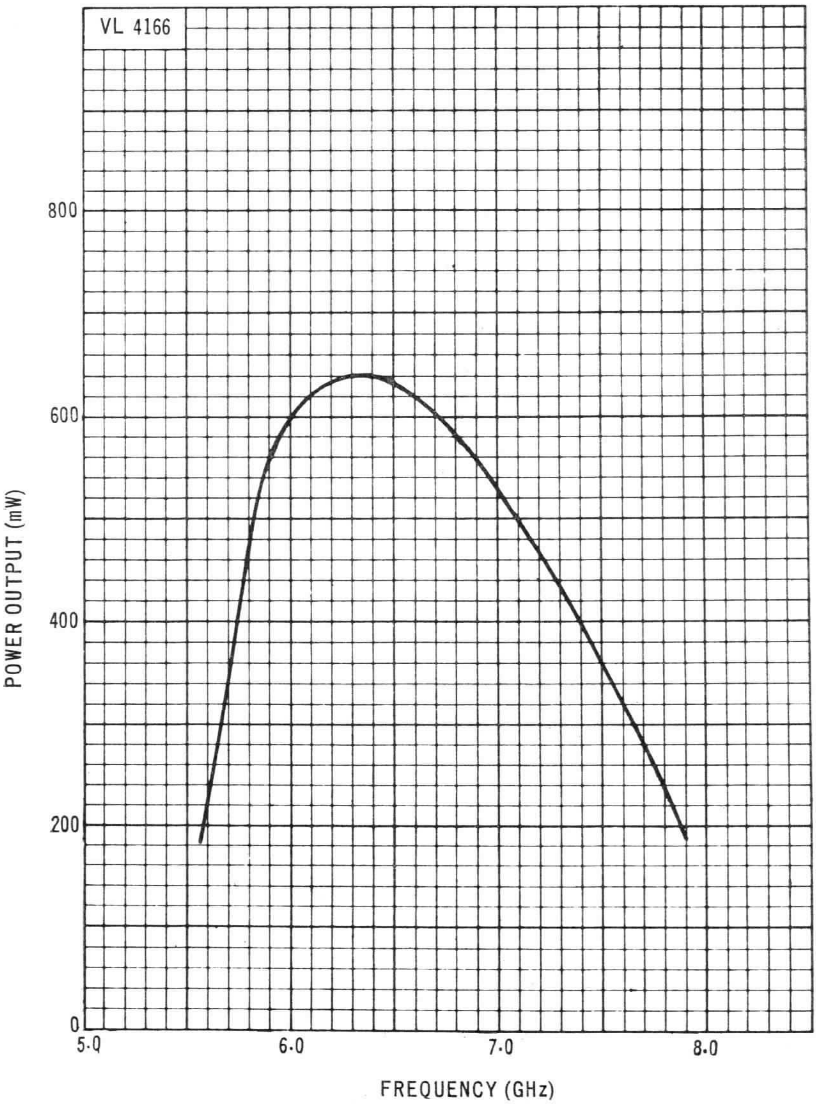
The frequency tuning circuit is also in waveguide 14 and incorporates a non-contact tuning piston which is calibrated in centimetres for precise adjustment.

STC

Code: V265A/1M

CONTINUED

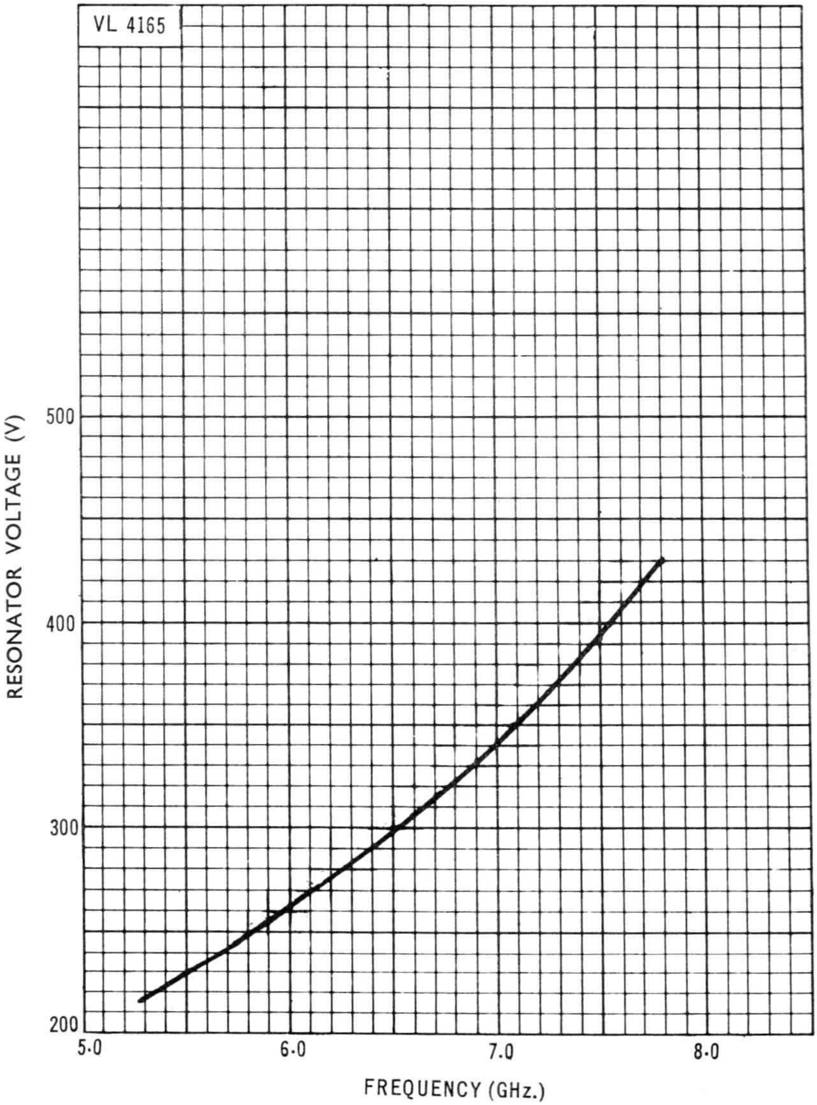
Fig. 1.—Power Output versus Frequency



Code: V265A/1M

CONTINUED

Fig. 2.—Resonator Voltage versus Frequency

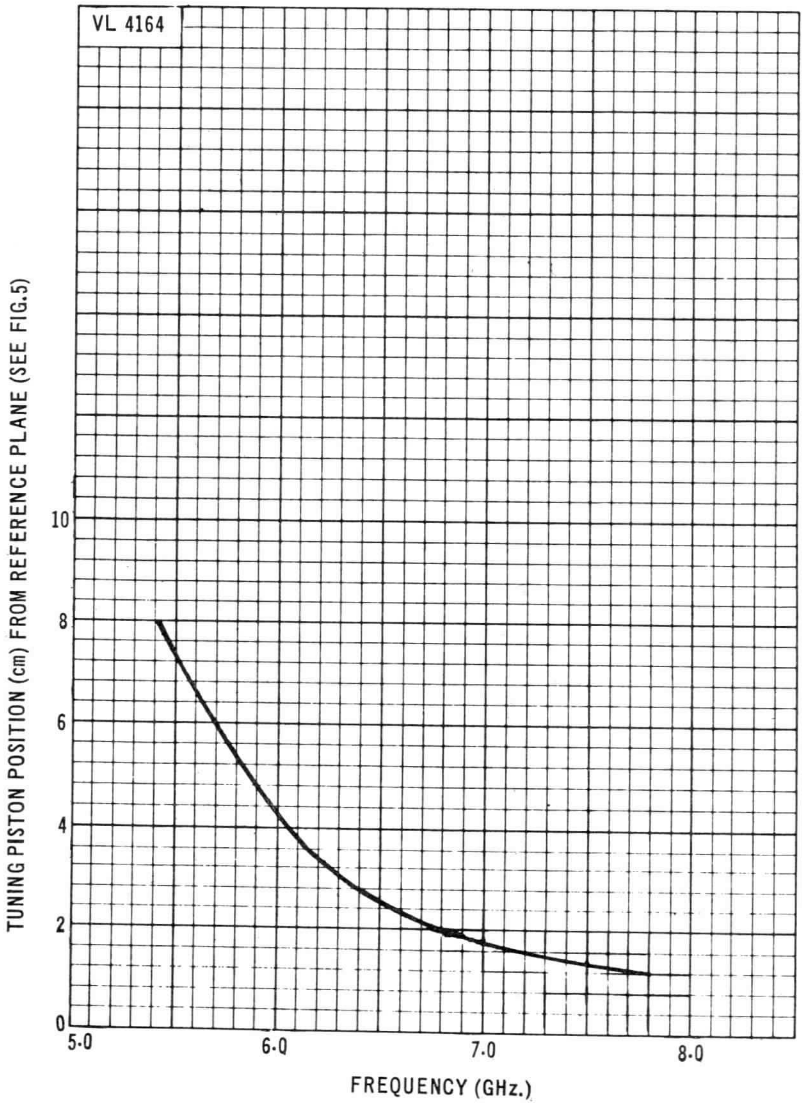


STC

Code: V265A/1M

CONTINUED

Fig. 3.—Piston Position versus Frequency



Code: V265A/1M

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Fig. 4.—Cavity—Valve Assembly

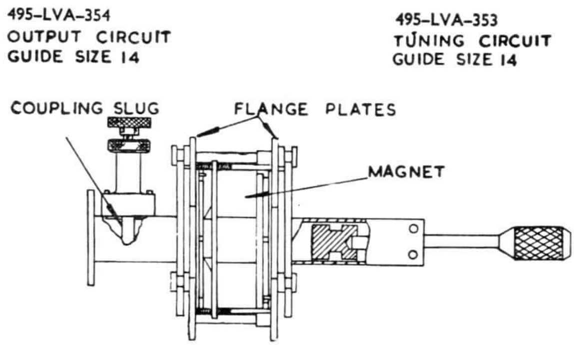
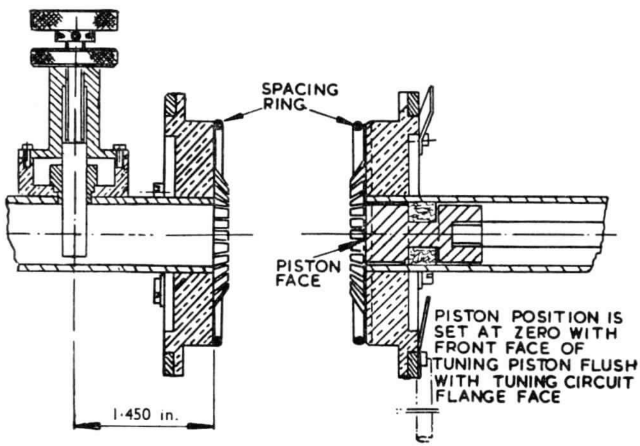


Fig. 5.—Cross-section of Cavities



Code: V265A/1M

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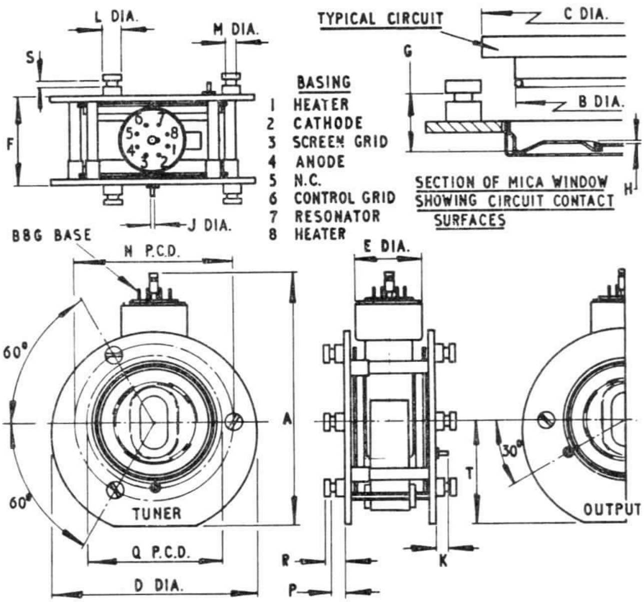
Fig. 6.—V265A/1M Outline



DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	138,1 MAX.	$5\frac{7}{16}$ MAX.	K	6,4±0,4	$\frac{1}{4}\pm\frac{1}{64}$
B	57,63 MAX.	2.269 MAX.	L	$9,53\,^{+0,00}_{-0,25}$	$0.375\,^{+0.000}_{-0.010}$
C	74,40 MAX.	2.929 MAX.	M	4,75±0,13	0.187±0.005
D	108,0±1,6	$4\frac{1}{4}\pm\frac{1}{16}$	N	84,33 NOM.	3.320 NOM.
E	38,1 MAX.	$1\frac{1}{2}$ MAX.	P	7,54±0,18	0.297±0.007
F	51,6 MAX.	$2\frac{1}{32}$ MAX.	Q	71,42 NOM.	2.812 NOM.
G	16,69±0,51	0.657±0.020	R	10,72±0,79	0.422±0.031
H	1,78 MIN.	0.070 MIN.	S	2,36±0,18	0.093±0.007
J	3,18±0,25	0.125±0.010	T	55,6±0,8	$2\frac{3}{16}\pm\frac{1}{32}$

NOTE.—Basic figures are inches.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M

The V271C/3M is a single-transit velocity-modulated oscillator of a new type for operation in the frequency range 6 850–7 350 Mc/s.

It is intended for use as a frequency modulated transmitting valve in radio links. No forced air cooling is required for operation up to the conditions specified as maximum ratings.

CATHODE

Indirectly-heated, oxide-coated		
Heater voltage	6.3	V
Nominal current	0.25	A

DIMENSIONS

Nominal overall length	$5\frac{1}{4}$ in.,	134	mm
Nominal overall width	$4\frac{1}{4}$ in.,	108	mm
Nominal overall depth	1.9 in.,	69	mm
Base		B8G	
Weight of packaged assembly, including magnet but excluding tuning and output circuits		900	g
		31.8	oz

MOUNTING

The valve has fitted on each side a flange plate with three OBA tapped holes into which are screwed special studs shown on the outline drawing.

The circuits have special flanges with quick release attachments which engage under the heads of the studs, as shown in Fig. 1.

Alternatively the tuning and output circuits may have plain flanges which are attached to the plates by OBA knurled screws. In this case the special studs are removed by unscrewing them.

COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, W.C.2

VALVE DIVISION, FOOTSCRAY, KENT Telephone: Footscray 3333

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M

MAXIMUM RATINGS

Voltages are given with respect to cathode unless otherwise stated.

Maximum direct anode voltage	600	V
Maximum direct resonator voltage	600	V
Maximum direct drift tube voltage, *with respect to resonator*	200	V
Maximum direct screen voltage	400	V
Maximum direct anode dissipation	27	W
Maximum direct resonator dissipation	18	W
Maximum direct drift tube dissipation	3	W
Maximum direct screen dissipation	2	W
Maximum total dissipation for all electrodes except heater	40	W
Maximum direct cathode current	65	mA
Maximum temperature of mica window seal	130	°C
Maximum temperature of any other part of valve envelope	300	°C

TYPICAL OPERATING CONDITIONS

Conditions are given for operation in Mode 15 ($3\frac{3}{4}$ cycles) and Mode 19 ($4\frac{3}{4}$ cycles). The Mode numbers are the number of quarter periods of oscillation occupied by electrons in transit through the drift space.

Mode 15

Frequency-modulated oscillator in the frequency range 6 850–7 350 Mc/s.

Direct anode voltage	550	V
Direct resonator voltage	530	V
Direct grid voltage	−50	V
*Direct drift tube voltage	395 to 505	V
†Direct screen voltage, approximately	180	V

*This is adjusted to give maximum power output at the operating frequency set by the tuning piston. Graphs of frequency as a function of piston position and drift tube voltage are shown in Figs. 3 and 4. The frequency-modulating voltage is applied to the drift tube only.

†This is adjusted to give a cathode current of 60 mA with a corresponding anode current of 30 to 40 mA.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M

Mode 19

Oscillator in the frequency range 6 850–7 350 Mc/s.		
Direct anode voltage	370	V
Direct resonator voltage	350	V
Direct grid voltage	−50	V
*Direct drift tube voltage	240 to 310	V
†Direct screen voltage, approximately	120	V

*This is adjusted to give maximum power output at the operating frequency. The graph of piston position versus operating frequency is the same as for Mode 15.

†This is adjusted to give a cathode current of 45 mA with a corresponding anode current of 22 to 30 mA.

PERFORMANCE

The valve should be used with the tuning and output circuits shown in Fig. 1. With the operating conditions as previously specified and the coupling slug adjusted to give maximum power output into a waveguide load whose V.S.W.R. is less than 1.2 the following performance should be obtained.

Mode 15

Power output, minimum	800	mW
Electronic tuning between half-power points, minimum	±8.5	Mc/s
Modulation sensitivity when loaded for maximum power	250 to 450	kc/s per V
Minimum mechanical tuning range obtained by variation of piston position	6 850 to 7 350	Mc/s

Typical Characteristic Curves

Tuning piston position versus frequency	Figure 3
Power output versus frequency	Figure 5
Electronic tuning versus frequency	Figure 6

Mode 19

Power output, minimum	200	mW
Electronic tuning between half-power points, minimum	±6	Mc/s
Modulation sensitivity when loaded for maximum power	450 to 650	kc/s per V

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M

CIRCUITS

A diagram of the tuning and output circuits with a valve assembled is shown in Fig. 1. A separate diagram of the tuning circuit showing the reference plane for measurement of piston position is shown in Fig. 2.

The valve is designed to operate into Waveguide No. 14, correct loading being obtained by adjustment of the coupling slug. Some adjustment may be necessary to obtain maximum power when tuning over the available frequency range.

The tuning circuit is of 1 in. $\times$ $\frac{1}{2}$ in. internal section waveguide incorporating a non-contact tuning piston moved directly by a micrometer.

MODULATION

Frequency modulation is obtained by variation of the drift tube voltage with respect to resonator.

The direct drift tube current does not exceed 5 mA; the input capacitance is 20 to 30 pF and the slope resistance is of the order of 25 kilohm.

THERMAL DRIFT AND STABILITY

The initial thermal drift from cold to the final operating frequency is between 9 Mc/s and 13 Mc/s and is completed in less than 5 minutes.

The variation of frequency with ambient temperature is between 50 and 100 kc/s per °C over the range covered by movement of the tuning piston.

MAGNET

The magnet is adjusted and locked in position during the testing of the valve and *should not be re-adjusted* during the life of the valve.

Code: V271C/3M

CONTINUED

Type 495–LVA–352

Type 495–LVA–351

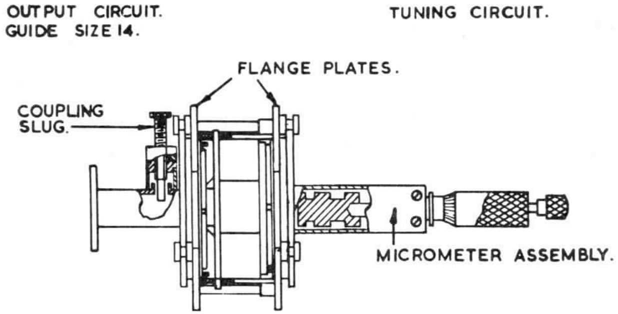


FIG. 1

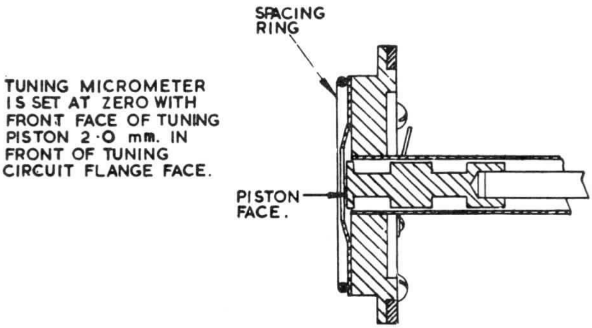


FIG. 2

Code: V271C/3M

CONTINUED

Fig. 3.—Typical Mechanical Tuning Characteristic.

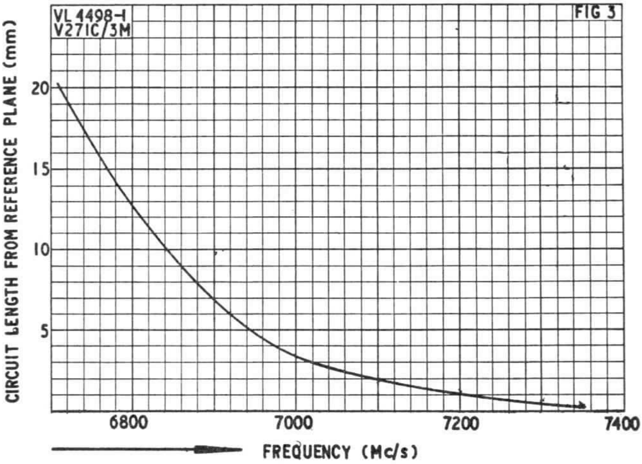
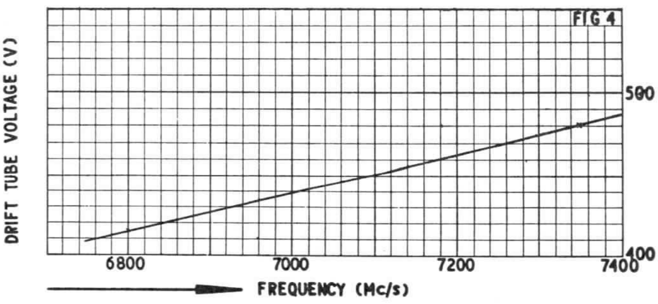


Fig. 4.—Typical Optimum Drift Tube Voltage Characteristic.



SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M

Fig. 5.—Typical Power Output Characteristic.

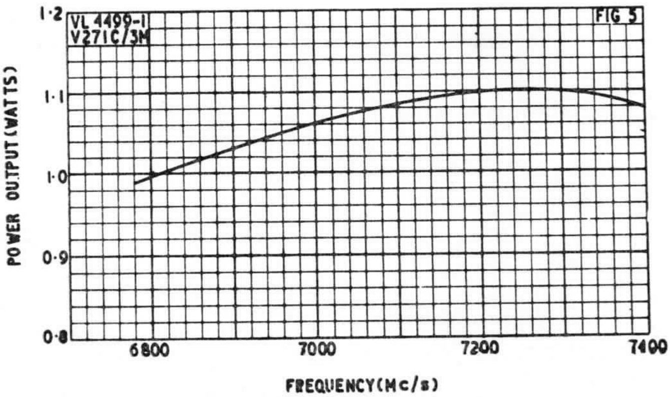
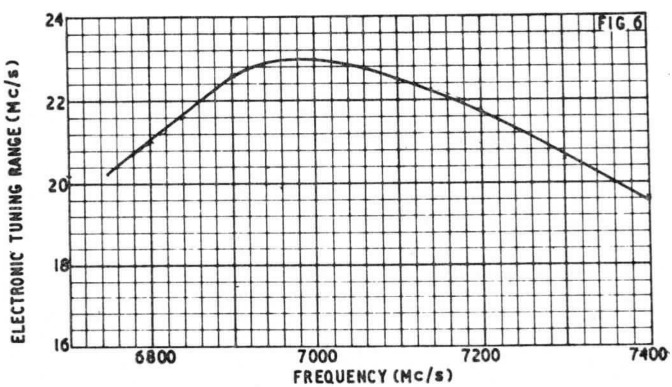


Fig. 6.—Typical Variation of Electronic Tuning Range with Operating Frequency.

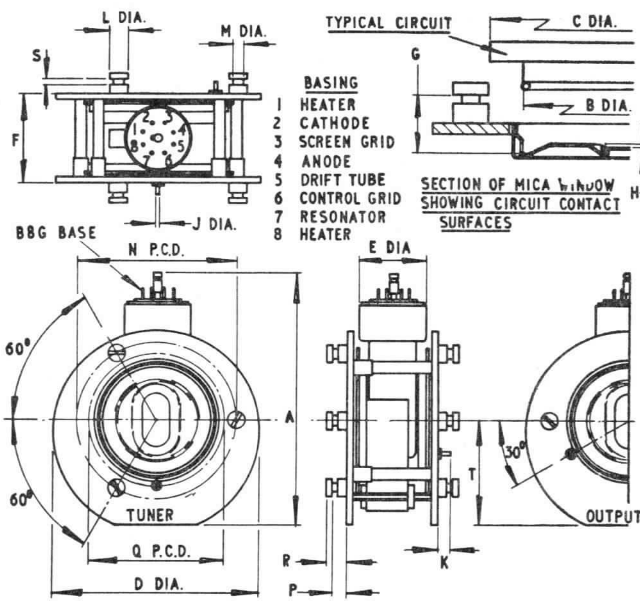


Ref.: V271C/3M

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V271C/3M



DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	138,1 MAX.	$5\frac{7}{16}$ MAX.	K	6,4 ± 0,4	$\frac{1}{4} \pm \frac{1}{64}$
B	57,63 MAX.	2.269 MAX.	L	$9{,}53^{+0{,}00}_{-0{,}25}$	$0.375^{+0.000}_{-0.010}$
C	74,40 MAX.	2.929 MAX.	M	4,75 ± 0,13	0.187 ± 0.005
D	108,0 ± 1,6	$4\frac{1}{4} \pm \frac{1}{16}$	N	84,33 NOM.	3.320 NOM.
E	38,1 MAX.	$1\frac{1}{2}$ MAX.	P	7,54 ± 0,18	0.297 ± 0.007
F	51,6 MAX.	$2\frac{1}{32}$ MAX.	Q	71,42 NOM.	2.812 NOM.
G	16,69 ± 0,51	0.657 ± 0.020	R	10,72 ± 0,79	0.422 ± 0.031
H	1,78 MIN.	0.070 MIN.	S	2,36 ± 0,18	0.093 ± 0.007
J	3,18 ± 0,25	0.125 ± 0.010	T	55,6 ± 0,8	$2\frac{3}{16} \pm \frac{1}{32}$

NOTE.—Basic figures are inches.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

The V275C/3M is a single-transit velocity-modulated oscillator of a new type for operation in the frequency range 7 250–7 770 Mc/s.

It is intended for use as a frequency-modulated transmitting valve in radio links. No forced air cooling is required for operation up to the conditions specified as maximum ratings.

CATHODE

Indirectly-heated, oxide-coated		
Heater voltage	6.3	V
Nominal current	0.25	A

DIMENSIONS

Nominal overall length	5¼ in.,	134	mm
Nominal overall width	4¼ in.,	108	mm
Nominal overall depth	1.9 in.,	69	mm
Base		B8G	
Weight of packaged assembly, including magnet but excluding tuning and output circuits		900	g
		31.8	oz

MOUNTING

The valve has fitted on each side a flange plate with three OBA tapped holes into which are screwed special studs shown on the outline drawing.

The circuits have special flanges with quick release attachments which engage under the heads of the studs as shown in Fig. 1.

Alternatively the tuning and output circuits may have plain flanges which are attached to the plates by OBA knurled screws. In this case the special studs are removed by unscrewing them.

COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, W.C.2

VALVE DIVISION, FOOTSCRAY, KENT Telephone: Footscray 3333

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

MAXIMUM RATINGS

Voltages are given with respect to cathode unless otherwise stated.

Maximum direct anode voltage	600	V
Maximum direct resonator voltage	600	V
Maximum direct drift tube voltage, *with respect to resonator*	200	V
Maximum direct screen voltage	400	V
Maximum direct anode dissipation	27	W
Maximum direct resonator dissipation	18	W
Maximum direct drift tube dissipation	3	W
Maximum direct screen dissipation	2	W
Maximum total dissipation for all electrodes except heater	40	W
Maximum direct cathode current	65	mA
Maximum temperature of mica window seal	130	°C
Maximum temperature of any other part of valve envelope	300	°C

TYPICAL OPERATING CONDITIONS

Conditions are given for operation in Mode 15 ($3\frac{3}{4}$ cycles) and Mode 19 ($4\frac{3}{4}$ cycles). The Mode number is the number of quarter periods of oscillation occupied by electrons in transit through the drift space.

Mode 15

Frequency modulated oscillator in the frequency range 7 250–7 770 Mc/s.

Direct anode voltage	550	V
Direct resonator voltage	530	V
Direct grid voltage	−50	V
*Direct drift tube voltage	395 to 505	V
†Direct screen voltage, approximately	180	V

*This is adjusted to give maximum power output at the operating frequency set by the tuning piston. Graphs of frequency as a function of piston position and drift tube voltage are shown in Figs. 3 and 4. The frequency-modulating voltage is applied to the drift tube.

†This is adjusted to give a cathode current of 60 mA with a corresponding anode current of 30 to 40 mA.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

Mode 19

Oscillator in the frequency range 7 250–7 770 Mc/s.

Direct anode voltage	370	V
Direct resonator voltage	350	V
Direct grid voltage	−50	V
*Direct drift tube voltage	240 to 310	V
†Direct screen voltage, approximately	120	V

*This is adjusted to give maximum power output at the operating frequency. The graph of piston position versus operating frequency is the same as for Mode 15.

†This is adjusted to give a cathode current of 45 mA with a corresponding anode current of 22 to 30 mA.

PERFORMANCE

The valve should be used with the tuning and output circuits shown in Fig. 1. With the operating conditions as previously specified and the coupling slug adjusted to give maximum power output into a waveguide load whose V.S.W.R. is less than 1.2 the following performance should be obtained.

Mode 15

Power output, minimum	750	mW
Electronic tuning between half-power points, minimum	±8.5	Mc/s
Modulation sensitivity when loaded for maximum power	250 to 450	kc/s per volt
Minimum mechanical tuning range obtained by variation of piston position	7 250 to 7 770	Mc/s

Typical Characteristic Curves

Tuning piston position versus frequency	Figure 3
Power output versus frequency	Figure 5
Electronic tuning versus frequency	Figure 6

Mode 19

Power output	200	mW
Electronic tuning between half-power points	±6	Mc/s
Modulation sensitivity when loaded for maximum power	450 to 650	kc/s per volt

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

CIRCUITS

A diagram of the tuning and output circuits with a valve assembled is shown in Fig. 1. A separate diagram of the tuning circuit showing the reference plane for measurement of piston position is shown in Fig. 2.

The valve is designed to operate into Waveguide No. 14, correct loading being obtained by adjustment of the coupling slug. Some adjustment may be necessary to obtain maximum power when tuning over the available frequency range.

The tuning circuit is of 1 in. $\times$ $\frac{1}{2}$ in. internal section waveguide incorporating a non-contact tuning piston moved directly by a micrometer.

MODULATION

Frequency modulation is obtained by variation of the drift tube voltage with respect to resonator.

The direct drift tube current does not exceed 5 mA; the input capacitance is 20 to 30 pF and the slope resistance is of the order of 25 kilohm.

THERMAL DRIFT AND STABILITY

The initial thermal drift from cold to the final operating frequency is between 9 Mc/s and 13 Mc/s and is completed in less than 5 minutes.

The variation of frequency with ambient temperature is between 50 and 100 kc/s per °C over the range covered by movement of the tuning piston.

MAGNET

The magnet is adjusted and locked in position during the testing of the valve and *should not be readjusted* during the life of the valve.

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

Type 495–LVA–352

Type 495–LVA–351

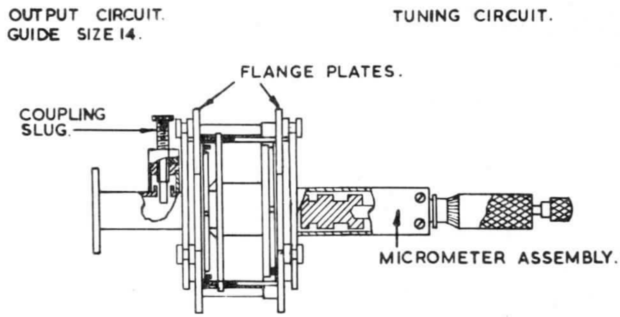


FIG. 1

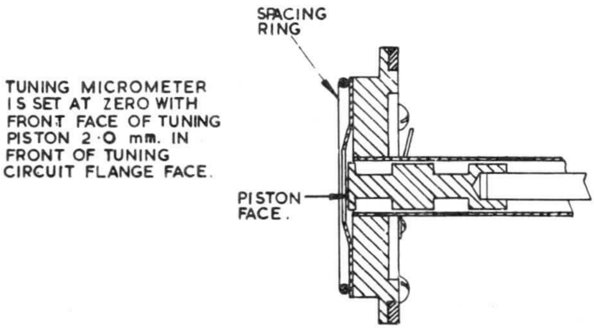


FIG. 2

SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

Fig. 3.—Typical Mechanical Tuning Characteristic.

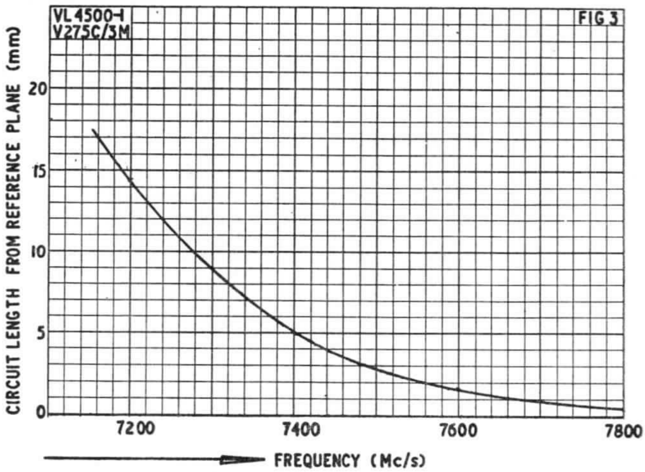
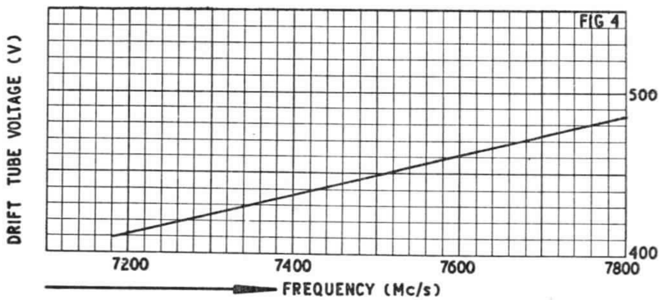


Fig. 4.—Typical Electronic Tuning Characteristic.



SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M

Fig. 5.—Typical Power Output Characteristic.

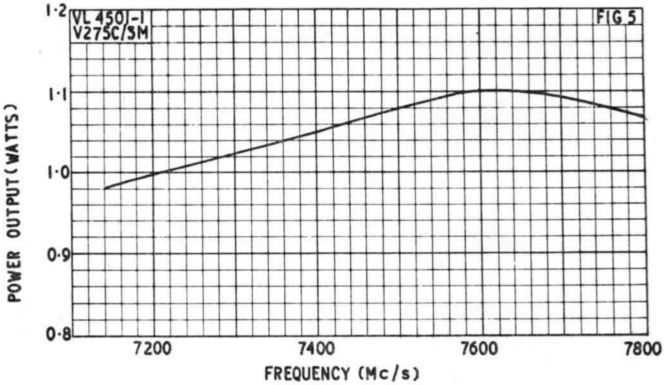
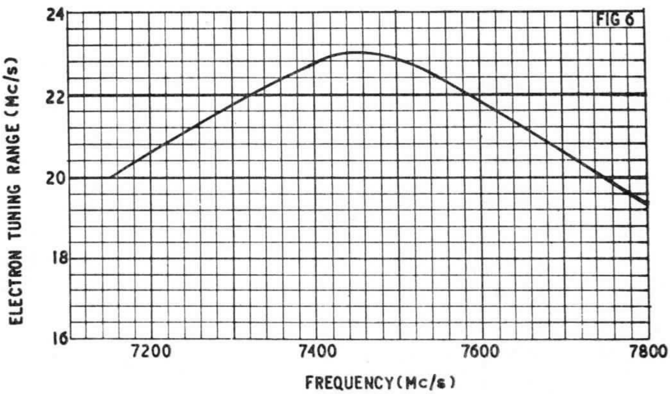


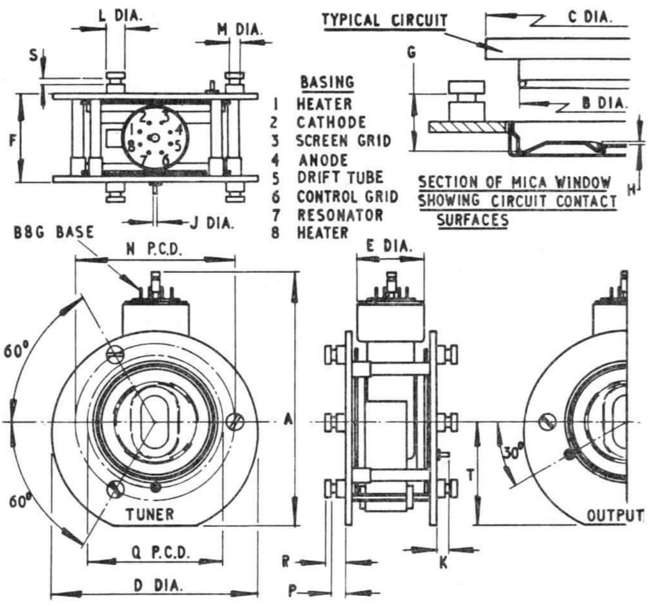
Fig. 6.—Typical Variation of Electronic Tuning Range with Mean Frequency.



SPECIAL VALVES

Velocity-Modulated Oscillator

Code: V275C/3M



DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	138,1 MAX.	$5\frac{7}{16}$ MAX.	K	$6{,}4 \pm 0{,}4$	$\frac{1}{4} \pm \frac{1}{64}$
B	57,63 MAX.	2.269 MAX.	L	$9{,}53 \begin{smallmatrix}+0{,}00 \\ -0{,}25\end{smallmatrix}$	$0.375 \begin{smallmatrix}+0.000 \\ -0.010\end{smallmatrix}$
C	74,40 MAX.	2.929 MAX.	M	$4{,}75 \pm 0{,}13$	0.187 ± 0.005
D	$108{,}0 \pm 1{,}6$	$4\frac{1}{4} \pm \frac{1}{16}$	N	84,33 NOM.	3.320 NOM.
E	38,1 MAX.	$1\frac{1}{2}$ MAX.	P	$7{,}54 \pm 0{,}18$	0.297 ± 0.007
F	51,6 MAX.	$2\frac{1}{32}$ MAX.	Q	71,42 NOM.	2.812 NOM.
G	$16{,}69 \pm 0{,}51$	0.657 ± 0.020	R	$10{,}72 \pm 0{,}79$	0.422 ± 0.031
H	1,78 MIN.	0.070 MIN.	S	$2{,}36 \pm 0{,}18$	0.093 ± 0.007
J	$3{,}18 \pm 0{,}25$	0.125 ± 0.010	T	$55{,}6 \pm 0{,}8$	$2\frac{3}{16} \pm \frac{1}{32}$

NOTE.—Basic figures are inches.

TRAVELLING WAVE
TUBES

SPECIAL VALVES

Travelling-Wave Tubes

General Information

Travelling-Wave Amplifier Tubes

Reference	Code	Frequency Range Gc/s	Max. Power Output (mW)	Low Level Gain dB	Typical Noise Factor dB
W3/2G	W3/2G	10·7 to 12·5	12 000	40 to 46	26
W3MQ/1D W3MQ/1F	W3MQ/1D W3MQ/1F	7 to 11·5	15	35	7·5 to 9
W4/2G	W4/2G	7 to 8·5	15 000	40 to 44	26
W5/2G	W5/2G	5·85 to 8·2	25 000	45	28
W5/3G	W5/3G	5·85 to 6·5	23 000	40	27
W7/3G	W7/3G	3·64 to 4·2	10 000	26	27
W7/4G	W7/4G	3·6 to 5·0	15 000	42	27
W7/5G	W7/5G	3·6 to 5·0	30 000	43	—
W9/2E	W9/2E	2·5 to 4·1	10	40	8
W10/3E	W10/3E	2·7 to 3·3 2·8 to 3·7	3	23	6·5
W10/4G	W10/4G	2·6 to 3·6	12 000	38	27

Travelling-Wave Limiter Tubes

W9/3E	W9/3E	2·5 to 4·1	0·1	15	16

STC

SPECIAL VALVES

Medium Power Travelling-Wave Amplifier Tube

Code: W3/2G

The W3/2G is a travelling-wave amplifier tube intended for use in microwave radio links in the frequency range 10·7GHz to 13·2GHz. This range may be extended to 15GHz.

The tube is operated in periodic permanent magnet mounts types WM109C and WM109CR in which it will give the performance quoted in these data sheets.

The design of the mounts permits easy replacement under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	10·7 to 13·2	GHz
Maximum power output	12	W
Gain at 5W output		
Minimum	40	db
Maximum	45	db
Noise factor at small signal levels	26 to 30	db
Reverse attenuation	>65	db
Phase sensitivity		
$d\Phi/dV_{hel}$	1	°/V
$d\Phi/dV_{g2}$	0·15	°/V
AM/PM conversion at 5W	2	°/db

Modulation noise peaks

Measured in any 20kHz band 0·5 to 10MHz from carrier are less than 3db above tube noise after 10 hours and will continue to improve to less than 1db above tube noise.

Matching

Adjustment of two flags and two plungers in the input and output waveguides of mount WM109C will give a VSWR less than 1·02 at a spot frequency, and less than 1·1 over a 20MHz band when operating at 5W output. Mount WM109CR, with two plungers, will give a VSWR less than 1·5 over a 20MHz band. By similar adjustments, the WM109C will give a broadband match with a VSWR less than 1·5 over 500MHz in the frequency range 10·7 to 13·2 GHz: under similar conditions the WM109CR VSWR is 2·0.

Graphs showing typical power output, gain and helix voltage as functions of frequency are shown in Figure 1. Typical maximum power output versus helix voltage is given in Figure 2, and Figure 3 shows typical power output versus power input with the helix voltage adjusted for maximum small signal gain (synchronous helix voltage).

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COMPONENTS GROUP

Code: W3/2G

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	12	GHz
Direct helix to cathode voltage (Note 2)	3·4	kV
Direct grid 2 to cathode voltage (Note 3)	2	kV
Direct grid 1 to cathode voltage (Note 4)	−15	V
Direct collector (earth) to cathode voltage	2·2	kV
Direct grid 2 current	0	mA
Direct helix current at 5W output	0·35	mA
Direct collector current	30	mA
Direct cathode current	30·35	mA
Gain at 5W output, approx.	44	db
Saturated output at synchronous helix voltage, approx.	8·5	W
Band of output impedance match to 5% voltage reflection (Note 5)	20	MHz

Note 1. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. Adjusted to the value stated on the individual tube and its data sheet.

Note 5. The matching plungers must be adjusted for each tube at the required operating frequency.

CATHODE

Indirectly heated, oxide-coated type.

HEATER

	Min	Nom	Max	
Heater voltage (Note 6)		6·3		V
Heater voltage tolerance				
Long-term average			±3	%
Short-term fluctuations up to 2 minutes duration			±5	%
Heater current	0·7	0·82	1	A
Heater pre-heating time	60			s
Interruption time for zero pre-heat			10	s

Note 6. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50Hz. Other frequencies of supply up to 10kHz may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W3/2G

CONTINUED

LIMIT RATINGS

	Min	Max	
Voltages			
Direct helix to cathode (Note 7)	2·9	4	kV
Direct grid 2 to cathode		3	kV
Direct grid 1 to cathode		−0·5	kV
Direct collector (earth) to cathode (Note 7)	1·85		kV
Direct grid 2 to helix		4	kV
Direct grid 2 to collector		4	kV

Note 7. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

	Max	
Currents		
Cathode	35	mA
Helix		
Absolute maximum to trip supplies with delay of less than 5 seconds	2·5	mA
Switching transient	20	mA
Direct grid 2	0·5	mA
Power Dissipations		
Grid 2	2	W
Helix	7	W
Collector (Note 8)	70	W

Note 8. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling.

Code: W3/2G

CONTINUED

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage		
Adjustable for required working conditions, range	3·2 to 3·7	kV
The synchronous helix voltage for individual tubes lies within the range	3·3 to 3·6	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically:—		
2% change in helix voltage causes a fall in gain of	0·25	db
1% change in helix voltage causes a phase change of approx.	33	°
Supply impedance, including resistance in mount, max. (Note 9)	20	k Ω

Note 9. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage		
Set between absolute limits of	2 to 3·5	kV
For operation with depressed collector it is usual to choose a nominal voltage of	2·2	kV
A minimum collector voltage of 2 kV may be used up to 5W output power		
Grid 1 Voltage		
Adjustable for optimum focus, never positive, range	0 to −50	V
The value for minimum helix current is specified on each tube and in its individual data sheet.		
A change of 5V is permissible if it improves focusing when operating conditions have been set up: this in turn may necessitate re-adjustment of grid 2 voltage.		
Grid 2 Voltage		
Adjustable for required working conditions, range	1·8 to 2·6	kV
When adjusted to give 30mA collector current		
Initial range is	1·8 to 2·4	kV
End of life limit is	2·6	kV

Code: W3/2G

CONTINUED

MECHANICAL DATA (W3/2G)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 5

LIFE

Shelf life Operational life	Subject to guarantee

Life-end points

(a) Grid 2 voltage greater than 2·6kV for 30mA collector current, or

(b) Helix current greater than 2·5mA for 30mA collector current, or

(c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min	Max	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

STC

T.W.T. MOUNTS

Codes: WM109C
WM109CR

GENERAL DESCRIPTION

These approved mounts, in which the W3/2G tube operates, incorporate a periodic permanent magnet system, r.f. coupling and matching elements; mechanical alignment and deflection adjustments; and a convection cooler. They differ from one another in respect of various physical and electrical characteristics; the differences are described in later sections of these data sheets.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and in the WM109C mount resistors are incorporated in the grid 2 and helix leads to limit surges.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws: two pairs align the tube and the other pair move a magnetic deflector plate.

On the WM109C, fine adjustments to the matching are made with movable flags and variable short-circuit plungers in the waveguides. The flags, which may be rotated and moved longitudinally, are controlled by rods protruding opposite to the input and output ports and offset from the centre line of the waveguide. The short-circuit plungers of non-contact design are moved by rotating the screw stems protruding adjacent to the flag rods.

The WM109CR matching adjustments are simplified in that each waveguide has only one movable flag, the short-circuit plunger being pre-set.

The tube is held firmly in the mount at the collector end by the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining catch: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining catch is shown in Figures 7 and 9.)

Each mount has a tube ejection mechanism, incorporated in the cooler assembly and operated by an internal control at the lid end of the mount. (See Figures 7 and 9.)

The design of the mount is such that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

The mounts should be secured by the threaded holes in the mount body using $\frac{1}{4}$ inch UNC non-magnetic screws.

T.W.T. MOUNTS

Codes: WM109C
WM109CR

CONTINUED

MECHANICAL DATA (MOUNTS)

Dimensions	As shown in Figures 6 and 9.		
Weight, approx.	12 lb	5,5	kg
Mounting position	For maximum efficiency of the convection cooler, the plane of the cooler fins should be vertical. Magnetic materials should be kept at least 1 inch (2,5 cm) away from the exterior of the mounts, particularly in the vicinity of the waveguides. Permanent magnets should be kept at least 9 inches (23 cm) away from the axis of the mount.		
Fixing of mounts	Attach mounts to equipment with $\frac{1}{4}$ inch UNC non-magnetic screws fitting into tapped holes provided in mount body.		

Connecting leads

Electrode leads — Five-core P.T.F.E. insulated cable, leads colour-coded as shown in Figures 6 and 9 (Note 10).

Interlock leads — Twin cable, sleeve coloured blue.

Mechanical adjustment controls (Note 11)

Alignment — Two pairs of external knobs

Deflection — Two pairs of external knobs

R.F. matching adjustments

WM109C — One sliding flag and one screwed plunger in each waveguide.

WM109CR — One sliding flag and one pre-set plunger in each waveguide.

Waveguide connections, input and output

Flanges for connection to waveguide WG17 (WR75). (Note 12.)

Note 10. In the near future, a 6-core cable will be fitted: this will include a black earth lead to provide an additional earth path to that existing between the mount body and equipment chassis.

Note 11. The positions of adjustment controls are shown in Figures 7 and 9.

Note 12. An outline drawing of a WG17 flange, as fitted to WM109C, is shown in Figure 10. The WM109CR flanges are similar except for the fixing holes which are as given in Figure 8.

COOLING

Cooling is effected by the integral convection cooler. It is important that the mount is installed with the cooler fins in the vertical plane. For efficient air circulation, free spaces above and below the cooler of at least 2 inches (5cm) depth, with access to a free supply of air at ambient temperature, must be provided.

If values of collector dissipation in excess of the specified limit rating are employed, the normal convection cooling must be supplemented by forced-air-cooling (see Note 8 in Limit Ratings Section).

T.W.T. MOUNTS

Codes: WM109C
WM109CR

CONTINUED

ELECTRICAL DATA

Ratings

Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 2 — to body of mount, maximum voltage		4·5	kV
Supervisory cable and interlock	240V a.c.	2	A

Lead resistance

	WM109C (Note 13)	WM109CR	
Grid 2	47kΩ	0·05	Ω
Helix	7·5kΩ	0·05	Ω
Heater (Note 14)	0·05Ω	0·05	Ω

Note 13. These values include those of the limiting resistors in grid 2 and helix leads.

Note 14. At 0·8A. Heater line voltage drop of 0·04V.

R.F. PERFORMANCE

Frequency range	10·7 to 13·2	GHz

Each mount will permit the specified performance of the W3/2G tube to be achieved

R.F. leakage (Note 15)

Input waveguide level to free space	>65	db
Output waveguide level to free space	>65	db

Matching

Adjustment of two flags and two plungers in the input and output waveguides of mount WM109C will give a VSWR less than 1·02 at a spot frequency, and less than 1·1 over a 30 MHz band when operating at 5W output. Mount WM109CR, with the adjustment of two plungers, will give a VSWR less than 1·5 over a 30MHz band.

By similar adjustments the WM109C will give a broadband match with a VSWR less than 1·5 over 500MHz in the frequency range 10·7 to 13·2GHz. Under similar conditions, the WM109CR VSWR is 2·0.

Note 15. Measured by using a $1\frac{1}{4}$ in. × $\frac{5}{8}$ in. (3,175 cm × 1,59 cm) waveguide horn in a way such as to obtain a maximum reading.

ENVIRONMENTAL CONDITIONS

Ambient temperature range	Min	Max	
Operating	−10	+60	°C
Storage	−60	+60	°C

Code: W3/2G

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on, continuous working and switch-off. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:

30mA for not longer than 10 milliseconds
10mA for not longer than 150 milliseconds
5mA for not longer than 1 second
2·5mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 4. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage.

To avoid excessive helix current surges at switch-on and switch-off, use of the circuit technique illustrated in Figure 4 is recommended. This provides for an unregulated bias of about —300V to be applied to grid 1 for the first half minute after the application of collector, helix and grid 2 voltages. This highly negative grid 1 bias reduces the beam current to approximately 2mA which is quite safe should the tube be out of alignment with the magnetic focusing field. Thus, there is time for an approximately correct alignment to be made before the full beam current of about 28mA is allowed to flow. When the transistor R–C timer circuit closes a reed relay, the effective grid 1 bias is reduced to the pre-set working level and is zener stabilised.

Simultaneous with the switch-off of helix, grid 2 and collector voltages, the reed relay supply voltage will be removed and the relay contacts will open. This results in the immediate re-application of the high negative grid bias so that the t.w.t. beam current is virtually cut-off, thus preventing any dangerous current transient from damaging the helix. This safeguard also applies if the helix trip operates. In this event the e.h.t. must be re-applied manually and the half minute beam current delay is again available for improved focusing to be attempted.

Towards the end of the life of the tube it is likely that the helix current will rise to about 2mA and the grid 2 voltage, which initially was between 1·8 and 2·4kV, will increase to about 2 600 volts.

Code: W3/2G

CONTINUED

SETTING-UP PROCEDURE (Note 16)

The following procedure is recommended for setting up the W3/2G tube in its mount for operation:

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining catch is in a position to allow tube to be inserted.
2. Insert tube in mount (Note 17). At the end of the travel of the tube, pressure needs to be applied to overcome the resistance of the cooler contacts and the spring located on the mount ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The blue spot on the base of the tube should be aligned with the black mark on the seating; this is necessary for best matching.
3. Secure tube in mount by rotating the two-position retaining catch to turn over the projection of the tube base ring (Note 18).
4. Connect colour-coded leads of the tube to appropriate terminals in the mount and ensure that mount is properly earthed.
5. Replace lid, making sure that the interlock two-pin plug is fitted correctly in its socket.
6. Apply heater voltage and allow one minute heating time.
7. It is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:
   (a) switch off any r.f. drive.
   (b) by using the calibrated potentiometer (R_1 in Figure 4), pre-set grid 1 voltage to the value specified on the tube and its data sheet (Note 19).
   (c) pre-set grid 2 (anode) voltage to a value such that the specified voltage will be achieved on load.
   (d) pre-set helix voltage to give 3·3kV on load.
8. After the one minute cathode pre-heat, switch on simultaneously the collector, helix and grid voltages. The 24 volt supply to the transistor delay circuit should be applied at the same time.
9. Adjust alignment and deflection control knobs to give a minimum helix current. After a 30 second time delay the pre-set grid 1 voltage will be switched on and the control knobs can be re-adjusted to give minimum helix current.
10. Slight adjustments to grid 2 (anode) and grid 1 voltages may be necessary to obtain a collector current of 30mA and optimum helix current.
11. Apply r.f. input at a level of approximately —15dbm and adjust helix voltage and matching controls for optimum performance.
    Then increase the r.f. input to obtain the required power output.
    It is recommended that the helix voltage be set at the synchronous value.
    A slight re-adjustment of the control knobs may be necessary to obtain minimum helix current and the value of grid 2 voltage to maintain a collector current of 30mA.
    A small change (approximately $\pm$5 volts) of grid 1 voltage, with a subsequent change in grid 2 voltage, is permissible provided improved focusing is obtained.
    Final adjustments to the matching controls may also be required.

Note 16. During setting-up, or in subsequent operation of the tube, the helix current trip circuit must be so arranged that if the helix current exceeds 2·5mA, the h.t. supplies and the supply to the transistor delay circuit are switched off automatically.

Note 17. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment. When the tube is inserted in the same plane as the longitudinal axis of the mount, a minimum free space of 12½ inches (31,8 cm) is needed. By presenting the tube at an angle of 45° to the main axis of the mount a minimum free space of 10 inches (25,4 cm) is required.

Note 18. Once the tube has been secured by the retaining catch, it is important to ensure that the tube ejection mechanism is not operated inadvertently. Failure to observe this precaution will result in the tube being damaged.

Note 19. Under running conditions, the voltage across the grid 1 potentiometer is 50V. If the potentiometer is pre-calibrated, the use of a voltmeter to set its position prior to switch-on is avoided

Code: W3/2G

CONTINUED

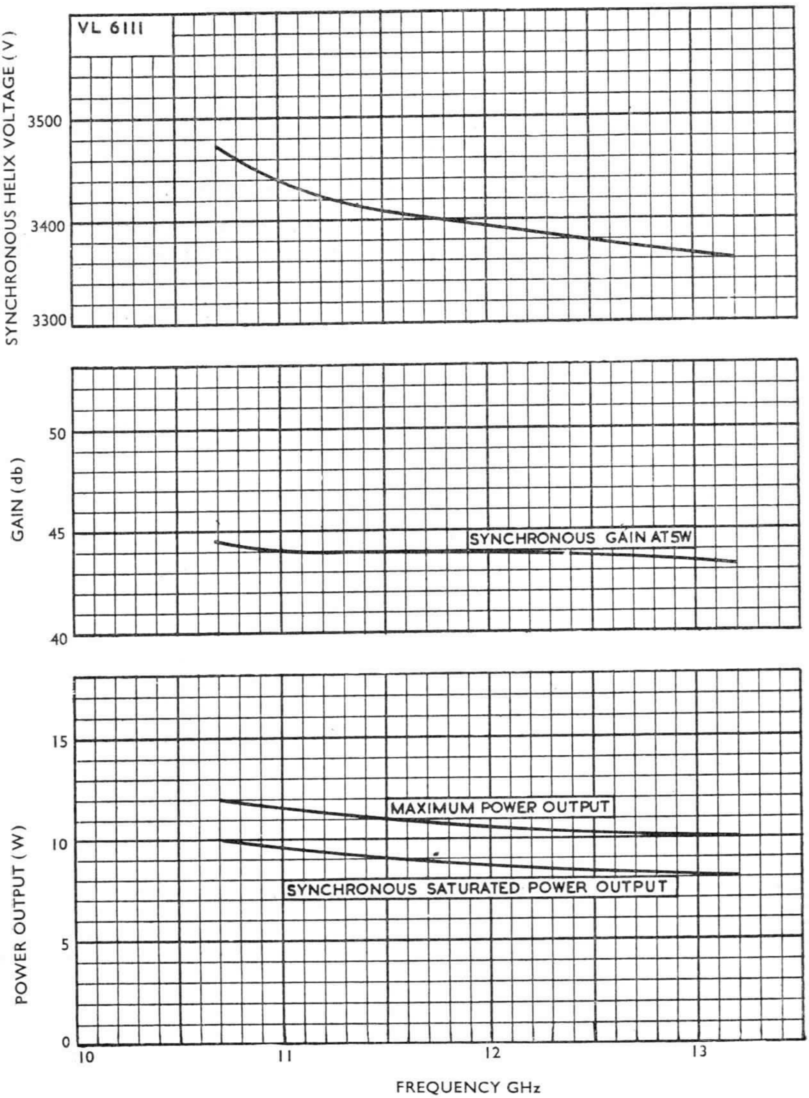
TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining catch to clear the tube base ring.
7. Support the base end of the tube and gradually operate the tube ejector mechanism to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal.

Code: W3/2G

CONTINUED

Fig. 1.—Typical Frequency Characteristics



Code: W3/2G

CONTINUED

Fig. 2.—Typical Maximum Power Output versus Helix Voltage

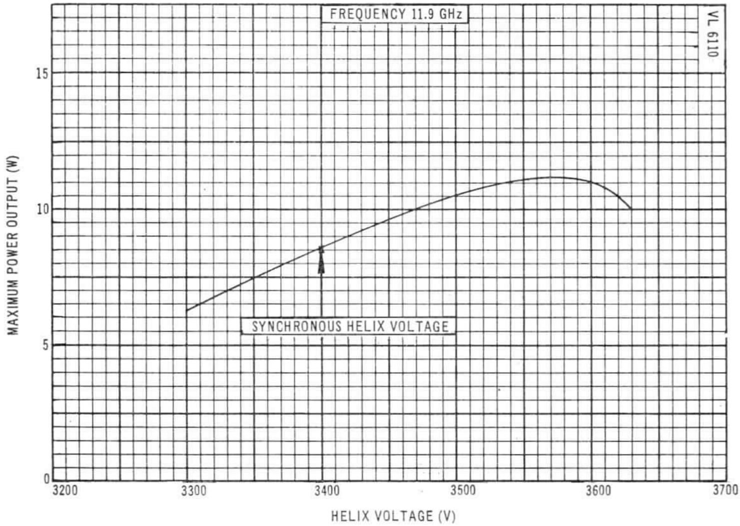
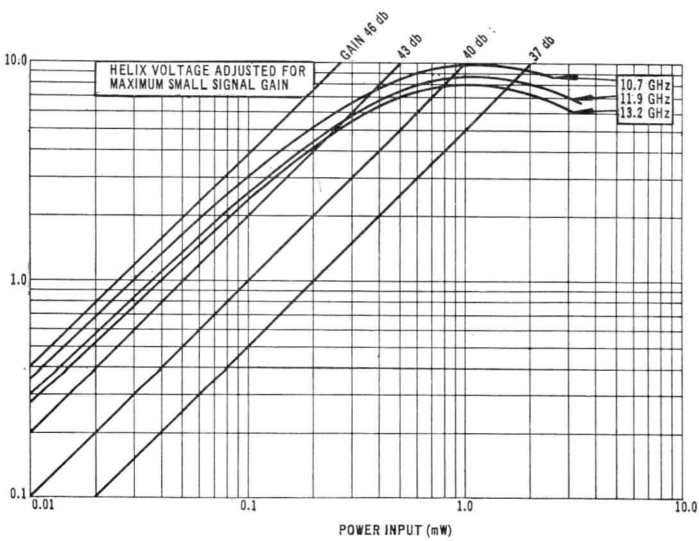


Fig. 3.—Typical Power Output versus Power Input



Code: W3/2G

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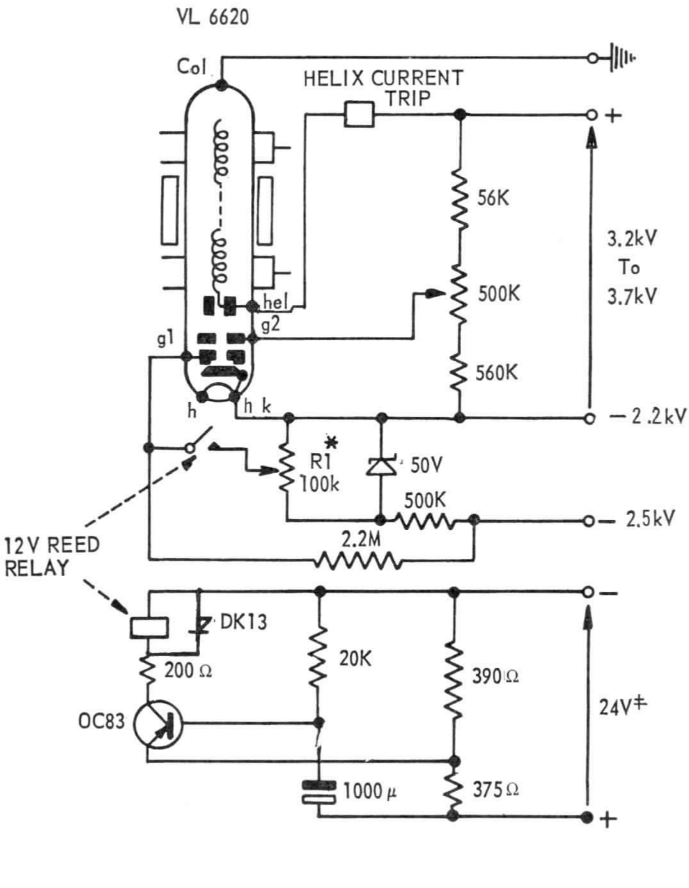
Fig. 4.—Typical Cathode Current Control Circuit



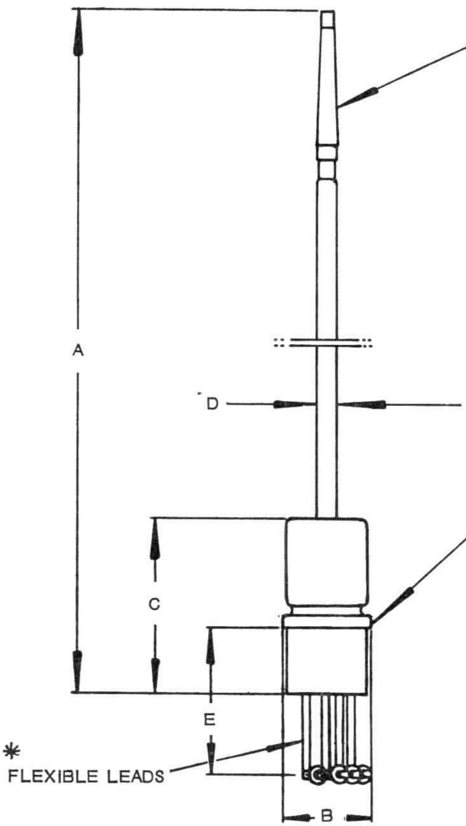
* R1 IS A POTENTIOMETER WITH A CALIBRATED SCALE.

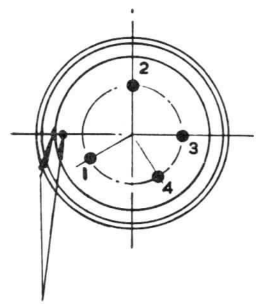
† THE 24V SUPPLY IS SWITCHED AND INTERLOCKED WITH THE PRIMARY OF THE HELIX AND COLLECTOR H.V. SUPPLY.

Code: W3/2G

CONTINUED

Fig. 5.—W3/2G Outline





INDEX MARKS WILL BE DIAMETRICALLY OPPOSITE YELLOW LEAD AND WILL NOT DEVIATE FROM A COMMON CENTRE LINE BY MORE THAN 15° IN EITHER DIRECTION.

LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	GREEN	GRID 1
3	YELLOW	HEATER CATHODE
4	BROWN	HEATER
CONTACT		
5		HELIX
6		COLLECTOR

DIM	MILLIMETRES	INCHES
A	304,8 MAX.	12 MAX.
B	36,20 ± 0,18	1·425 ± 0·007
C	74,6 MAX.	2 15/16 MAX.
D	7,37 MAX.	0·290 MAX.
E	63,5 ± 3,2	2.1/2 ± 1/8

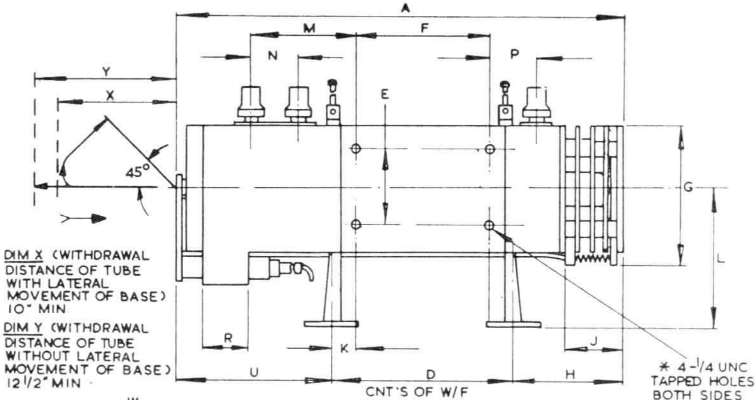
NOTE:- BASIC FIGURES ARE INCHES

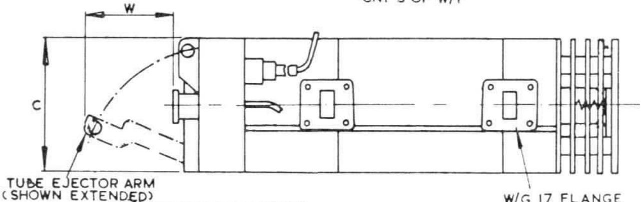
STC

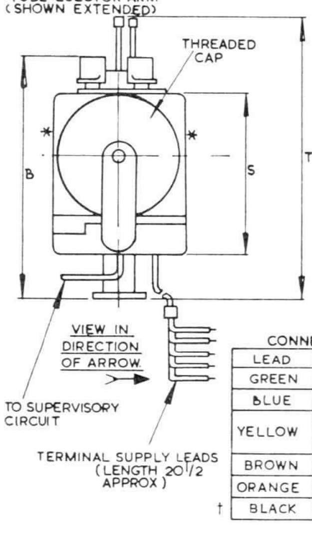
Code: W3/2G

CONTINUED

Fig. 6.—WM109C Dimensioned Outline







CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER CATHODE
BROWN	HEATER
ORANGE	HELIX
† BLACK	COLLECTOR

DIM	MILLIMETRES		INCHES	
A	331, 8	MAX.	13 1/16	MAX.
B	173, 0	MAX.	6 13/16	MAX.
C	92, 1	MAX.	3 5/8	MAX.
D	128.91 ± 5, 1		5·075 ± 0·020	
E	54, 0 ± 0, 8		2 1/8 ± 1/32	
F	92, 1 ± 0, 8		3 5/8 ± 1/32	
G	101, 6	MAX.	4	MAX.
H	95, 3 ± 3, 2		3 3/4 ± 1/8	
J	46, 0 ± 1, 6		1 13/16 ± 1/16	
K	18, 3 ± 1, 6		23/32 ± 1/16	
L	98, 4 ± 0, 8		3 7/8 ± 1/32	
M	71, 4 ± 3, 2		2 13/16 ± 1/8	
N	31, 8 ± 1, 6		1 1/4 ± 1/16	
P	47, 6 ± 1, 6		1 7/8 ± 1/16	
R	31, 8	MAX.	1 1/4	MAX.
S	111, 1	MAX.	4 3/8	MAX.
T	200, 0	MAX.	7 7/8	MAX.
U	103, 2 ± 3, 2		4 1/16 ± 1/8	
W	58, 7	APP.	2 5/16	APP.
NETT WEIGHT APPROX			lbs	
			kgs	

NOTE:- BASIC DIMS ARE IN INCHES

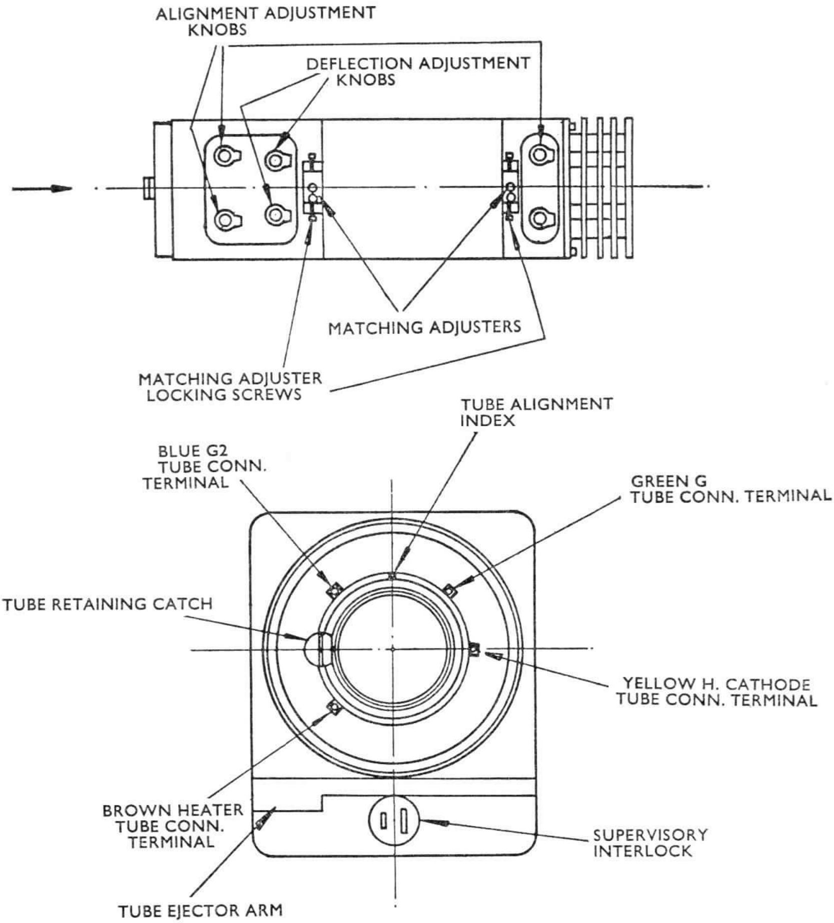
† The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

T.W.T. MOUNT

Codes: WM109C

CONTINUED

Fig. 7.—Diagram Showing Operational Controls of WM109C



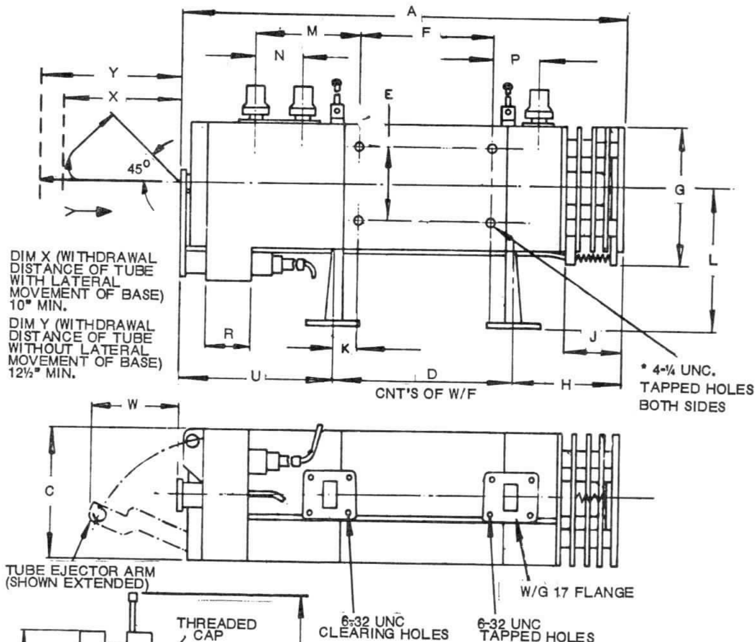
VIEW OF END 'A' WITH COVER REMOVED

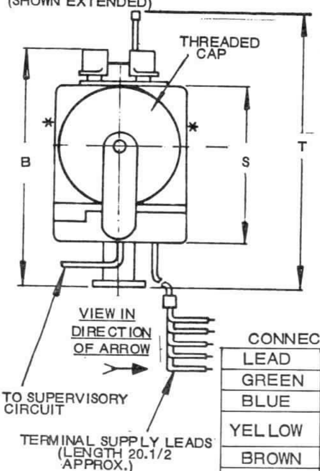
STC

T.W.T. MOUNT

Code: WM109CR

Fig. 8.—WM109CR Dimensioned Outline





CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER CATHODE
BROWN	HEATER
ORANGE	HELIX
† BLACK	COLLECTOR

DIM.	MILLIMETRES		INCHES	
A	331,8	MAX.	13.1/16	MAX.
B	173,0	MAX.	6.13/16	MAX.
C	92,1	MAX.	3.5/8	MAX.
D	128,91	± 5,1	5.075	± 0.020
E	54,0	± 0,8	2.1/8	± 1/32
F	92,1	± 0,8	3.5/8	± 1/32
G	101,6	MAX.	4	MAX.
H	95,3	± 3,2	3.3/4	± 1/8
J	46,0	± 1,6	1.13/16	± 1/16
K	18,3	± 1,6	23/32	± 1/16
L	98.4	± 0,8	3.7/8	± 1/32
M	71,4	± 3,2	2.13/16	± 1/8
N	31,8	± 1,6	1.1/4	± 1/16
P	47,6	± 1,6	1.7/8	± 1/16
R	31,8	MAX.	1.1/4	MAX.
S	111.1	MAX.	4.3/8	MAX.
T	185,42	MAX.	7.300	MAX.
U	103,2	± 3,2	4.1/16	± 1/8
W	58,7	APP.	2.5/16	APP.
NETT. WEIGHT APPROX.				lbs. kgs.

NOTE:- BASIC DIMS ARE IN INCHES.

†The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

T.W.T. MOUNT

Code: WM109CR

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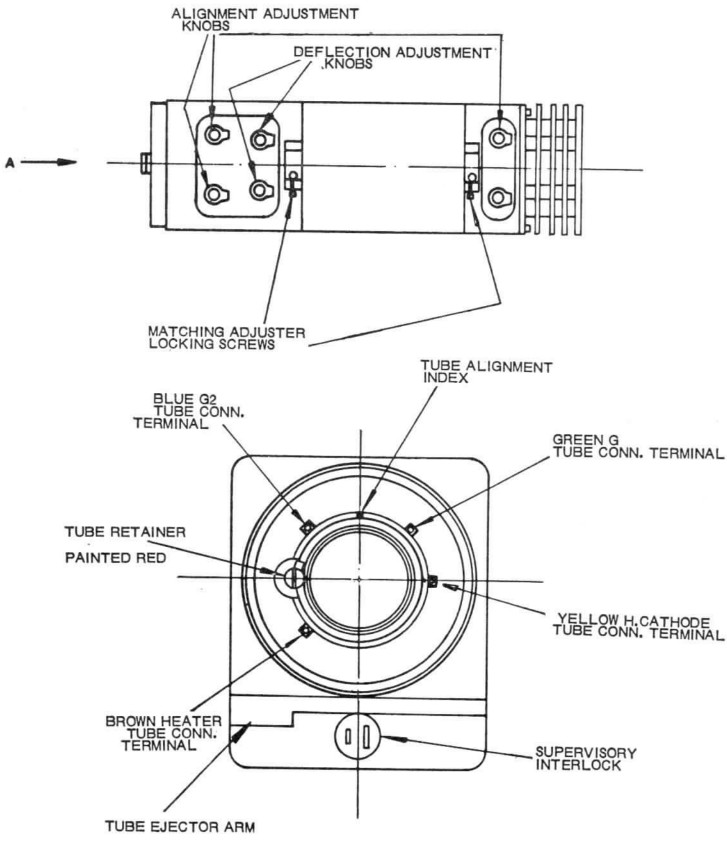
Fig. 9.—Diagram Showing Operational Controls of WM109CR

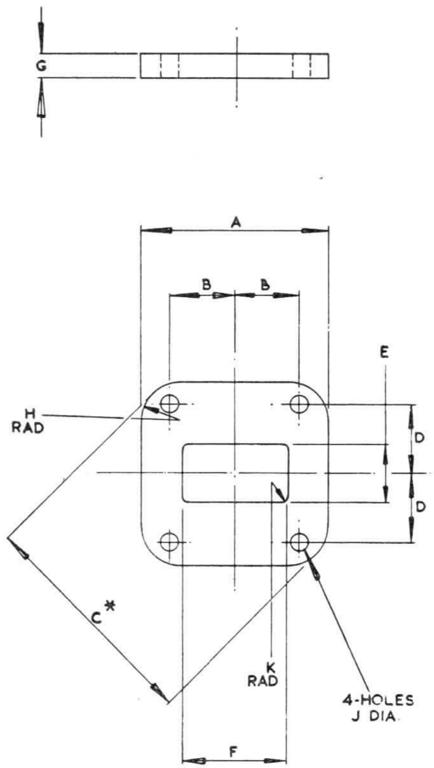


VIEW OF END 'A' WITH COVER REMOVED

Codes: WM109C

CONTINUED

Fig. 10.—Outline of Waveguide Flange WG17 for WM109C



DIM	INCHES	MILLIMETRES
A	1.500±0.005	38,10 ± 0,13
B	0.520 ±0.001	13,21 ± 0,03
C	1.875±0.005	47,63 ± 0,13
D	0.561 ±0.001	14,25 ± 0,03
E	0.479 +0.0002 −0.0000	12,17 + 0,005 − 0,00
F	0.854 +0.0002 −0.0000	21,69 + 0,005 − 0,00
G	0.187 ±0.010	4,75 ± 0,25
H	0.312 ± 0.005	7,92 ± 0,13
J	0.1405 ±0.002	3,567 ± 0,051
K	1/32 ± 1/64	0,8 ± 0,4

BASIC DIMS ARE INCHES.
* FOR REF. ONLY.

Low-Noise X-Band

Travelling-Wave Tubes

Codes: W3MQ/1D
W3MQ/1F

These travelling-wave tubes are supplied completely packaged in a single reversal permanent magnet mount incorporating magnetic screening: this screening allows undisturbed operation of two tubes with a spacing of only a few inches between mounts.

They are designed for operation as wide-band amplifiers over the frequency band 7 to 11·5 Gc/s or for use over narrower frequency ranges in the same band. When narrow-band operation is required by customers, the tube will be optimised for a particular band specified, with a consequent improvement in performance.

The r.f. coupling of the W3MQ/1D is via coaxial connectors Type N and of the W3MQ/1F via waveguide connectors WG16.

R.F. CHARACTERISTICS*

Gain, small signal		
Typical	39	dB
Minimum	35	dB
Noise figure		
Narrow-band, typical	7·5 to 9	dB
Wide-band, typical	8·5 to 10·5	dB
Maximum	11	dB
Saturated power output		
Typical	3 to 15	mW
Minimum	2	mW

* Typical broad-band curves are shown in Figure 1.

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Telephone: Paignton 50762 Telex: 4230
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Codes: W3MQ/1D W3MQ/1F

CONTINUED

CATHODE

Indirectly heated, oxide coated		
Heater voltage	6·3	V
Nominal current	0·5	A
Minimum pre-heat time	120	s
Maximum heater interruption time	5	s

ELECTRICAL CHARACTERISTICS

Electrode Voltages and Effect on Phase Change

	Min.	Nom.	Max.	Nominal Phase Change	
Grid 1 voltage	−30V	−15V	0V	6	°/V
Grid 2 voltage	30V	45V	70V	3·5	°/V
Grid 3 voltage	70V	130V	180V	<0·1	°/V
Grid 4 voltage	300V	400V	600V	<0·1	°/V
Helix voltage	880V	1 000V	1 100V	6	°/V
Collector voltage		1 200V		<0·1	°/V

Electrode Currents

Helix current, nominal	10	μA
Collector current, nominal	500	μA
Grid 1 current, nominal Grid 2 current, nominal Grid 3 current, nominal Grid 4 current, nominal	<1	μA
Input and output match	<2·5:1	
Reverse attenuation	>70	dB

MECHANICAL DATA

Dimensions	As shown in outline drawings			
Weight, approx.		27·5 lb	12,5	kg

Codes: W3MQ/1D
W3MQ/1F

CONTINUED

OPERATIONAL PROCEDURE

1. Connect colour coded leads to the power supply as follows:—

Cathode—Yellow	Grid 3—Grey
Heater—Brown	Grid 4—White
Grid 1—Green	Helix—Orange
Grid 2—Blue	Collector—Red

2. Switch on heater supply and allow two minutes cathode pre-heat time.

3. Apply the voltages specified on the mount label to the collector, helix, grid 4 and grid 3 either in this order or simultaneously. Either the collector or the cathode may be run at earth potential.

4. Set the grid 1 voltage and then the grid 2 voltage to the specified values. As the collector current increases, the helix current may rise to as much as 30μA but should drop to a few microamperes as the operating current is reached.

5. To obtain optimum focusing, slight adjustment of grid 3 and grid 4 voltages may be necessary.

6. With the voltages specified, optimum broad-band noise performance should be obtained, but to optimise over a narrow frequency band within the normal operating band the helix voltage should be adjusted. Normally, the optimum voltage will be found between 15V below and 10V above that specified for broad-band operation, with the lower voltages applying to the lower frequencies. When the helix voltage is changed, the grid 3 and grid 4 voltages should be adjusted again; normally the best noise figure is found close to the optimum focusing condition.

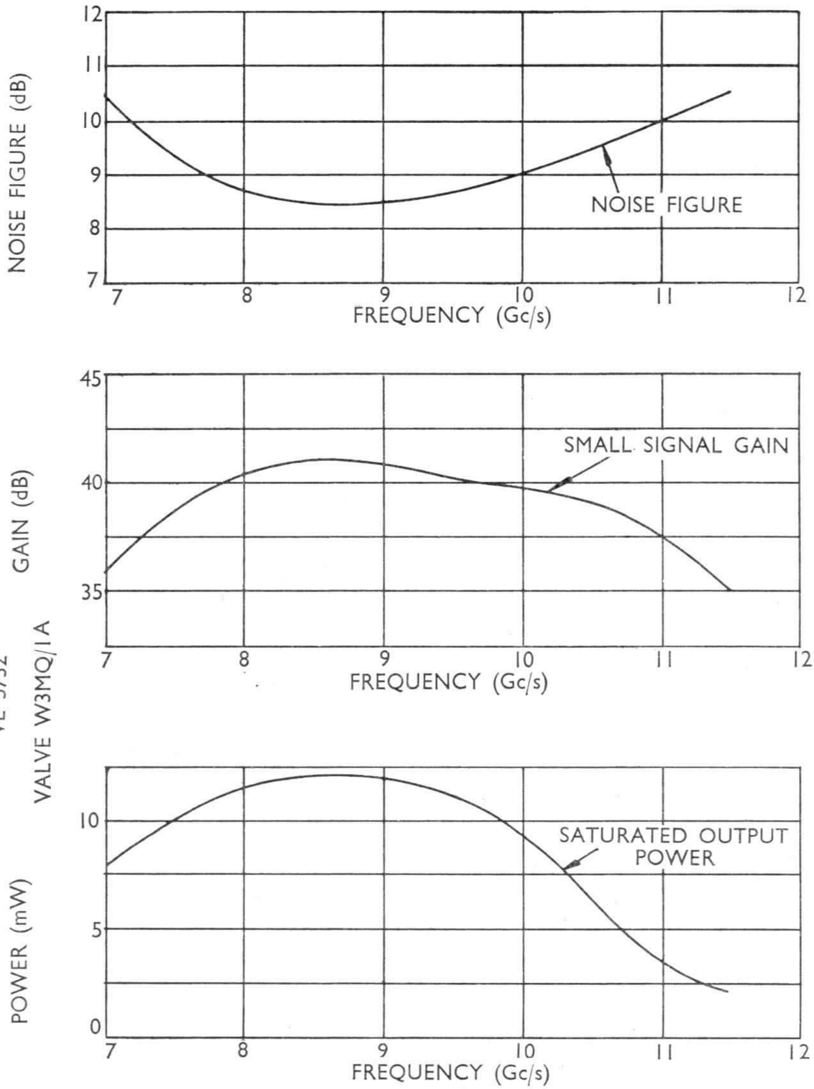
7. Should higher or lower gain be required the collector current may be increased or decreased by up to 20% by adjusting V_{g1} or V_{g2}. Some deterioration in noise figure and focusing is likely to occur but small adjustments to V_{g3} and V_{g4} will minimise this deterioration.

8. Pulsed operation of the tube may be achieved by applying negative pulses of about 100 to 150 volts to grid 1 or grid 2.

Codes: W3MQ/1D
W3MQ/1F

CONTINUED

Fig. 1. Typical r.f. Performance with Fixed Voltages

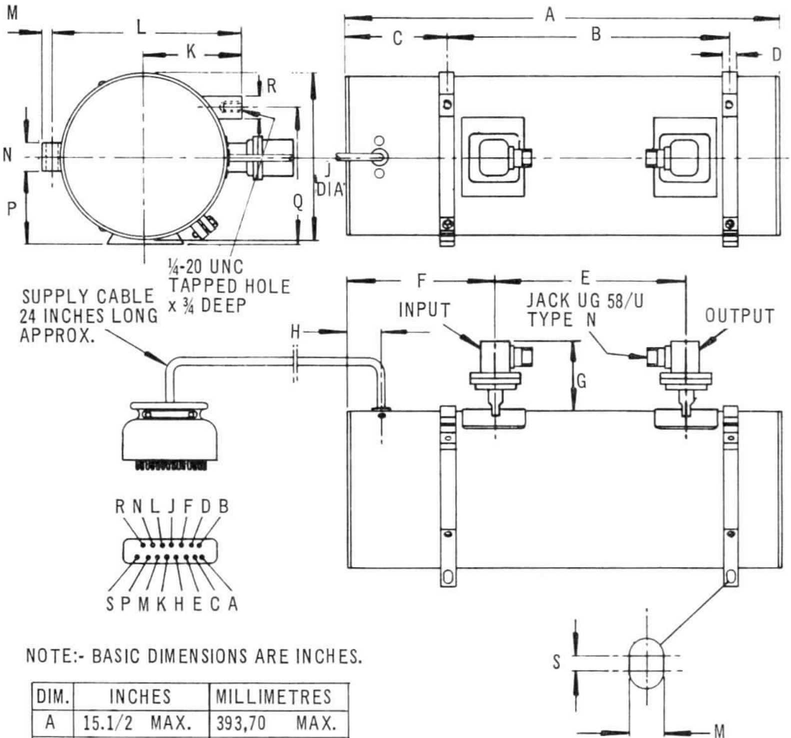


VL 5732 VALVE W3MQ/1A

Codes: W3MQ/1D W3MQ/1F

CONTINUED

Fig. 2. W3MQ/1D Outline



NOTE:- BASIC DIMENSIONS ARE INCHES.

DIM.	INCHES	MILLIMETRES
A	15.1/2 MAX.	393,70 MAX.
B	10·830 ± 0·060	275,08 ± 1,52
C	3.3/32 ± 1/8	78,58 ± 3,18
D	11/16 ± 1/32	17,46 ± 0,79
E	7·830 ± 0·060	198,88 ± 1,52
F	4.21/32 ± 1/8	118,27 ± 3,18
G	2.1/2 MAX.	63,5 MAX.
H	21/32 ± 1/16	16,67 ± 1,59
J	5.13/16 MAX.	147,64 MAX.
K	3.3/8 ± 1/32	85,73 ± 0,79
L	6.37/64 ± 1/32	167,08 ± 0,79
M	5/16 ± 1/64	7,94 ± 0,40
N	1 ± 1/64	25,4 ± 0,40
P	2.1/2 ± 1/32	63,5 ± 0,79
Q	4.13/16 ± 1/32	122,24 ± 0,79
R	3/4 ± 1/64	19,05 ± 0,40
S	1/8 ± 1/64	3,18 ± 0,40

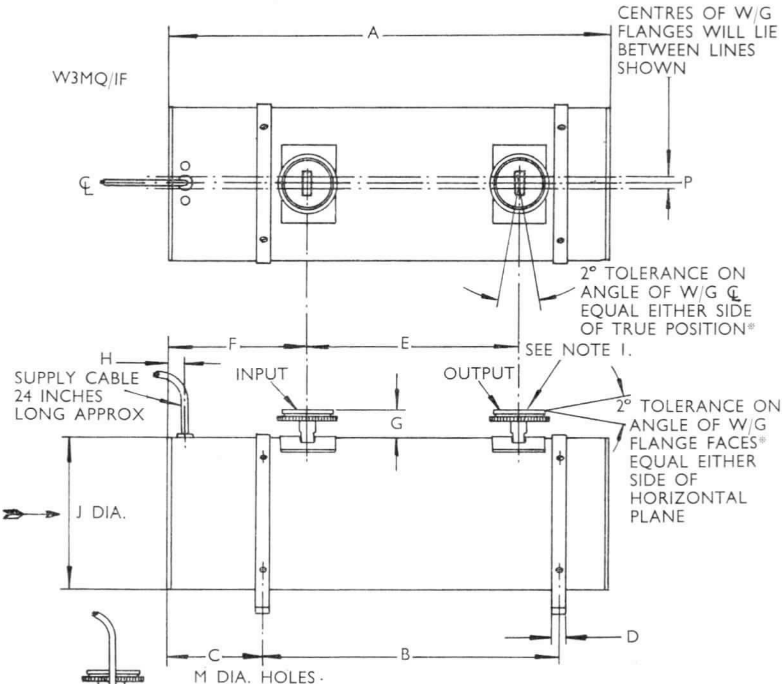
ELECTRO METHODS PLUG BA15P CONNECTIONS	
ELECTRODE	PIN LETTER
HEATER	P
hk	R
CATHODE	N
G1	L
G2	E
G3	H
G4	K
HELIX	A
COLL	C

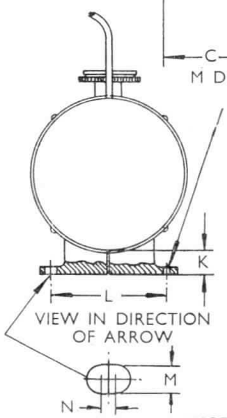
STC

Codes: W3MQ/1D
W3MQ/1F

CONTINUED

Fig. 3. W3MQ/1F Outline





CONNECTIONS

LEAD	ELECTRODE
Brown	heater
Yellow	h/k
Green	g_1
Blue	g_2
Grey	g_3
White	g_4
Orange	hel
Red	coll

DIM	INCHES	MILLIMETRES
A	$15\frac{1}{2}$ MAX	393,70 MAX
B	$10{\cdot}830 \pm 0{\cdot}060$	$275{,}08 \pm 1{,}52$
C	$3\frac{3}{32} \pm \frac{1}{8}$	$78{,}58 \pm 3{,}18$
D	$\frac{11}{16} \pm \frac{1}{32}$	$17{,}46 \pm 0{,}79$
E	$7{\cdot}830 \pm 0{\cdot}060$	$198{,}88 \pm 1{,}52$
F	$4\frac{21}{32} \pm \frac{1}{8}$	$118{,}27 \pm 3{,}18$
G	1 MAX	25,4 MAX
H	$\frac{21}{32} \pm \frac{1}{16}$	$16{,}67 \pm 1{,}59$
J	$5\frac{13}{16}$ MAX	147,64 MAX
K	$\frac{13}{16} \pm \frac{1}{32}$	$20{,}64 \pm 0{,}79$
L	$4\frac{1}{4} \pm \frac{1}{32}$	$107{,}95 \pm 0{,}79$
M	$\frac{9}{32} \pm \frac{1}{64}$	$7{,}14 \pm 0{,}40$
N	$\frac{1}{8} \pm \frac{1}{32}$	$3{,}18 \pm 0{,}79$
P	0·2 MAX	5,08 MAX

NOTE:—BASIC DIMENSIONS ARE INCHES

*NOTE:—W/G FLANGES MAY BE INDEPENDENTLY POSITIONED WITHIN THE LIMITS STATED

NOTE I.
W/G FLANGE JOINT SERVICE N°5985-99 —083 —0004.
RING LOCATING JOINT SERVICE N°5985 —99 —083 —0002

Gain-tracking Low-noise T.W.T Amplifier

Description

The W3MT/4A is a gain-tracking, low-noise travelling-wave tube amplifier intended for use in the frequency range 7,5GHz to 12GHz.

All W3MT/4A amplifiers have a close tolerance of gain from one to another over the operating frequency band (i.e. low gain-tracking error). All amplifiers follow a standard curve of gain versus frequency to a tolerance of less than ±1,5dB over a wide ambient temperature range.

The amplifier is supplied as a package, included in which is a travelling-wave tube, its straight-field focus mount and a potentiometer chain to supply the required voltages to the various tube electrodes from three d.c. inputs.

The package is screened magnetically; this screening allows undisturbed operation of two tubes spaced 12mm apart.

R.F. coupling is by coaxial connectors type OSM jack.

A service is offered to the user by the manufacturer whereby at the end of tube life the package is refurbished at the factory and the tube replaced.

Radio Frequency Performance

Operating frequency range	(GHz)	7,5 to 12
Gain tracking; deviation from standard curve across frequency band, maximum	(dB)	±1,5
Gain limits (input less than -35dBm) across frequency band	(dB)	min. 30
	(dB)	max. 36
Noise figure at small signal levels, maximum across band	(dB)	14
maximum at 9,75GHz	(dB)	11
Saturated output power limits	(dBm)	min. +9
	(dBm)	max. +17

The tube will withstand the application of an input pulse 1kW peak, 0,5W mean of 1μs duration with no subsequent change in performance.

Matching

This is preset and is better than 2,5:1 VSWR at the input and output across the recommended frequency band, measured hot.

Typical Operating Conditions

Frequency	(GHz)	7,5 to 12
V_1 voltage input	(V)	+1 200
V_2 voltage input	(V)	-25
V_1 current input	(mA)	3,3
V_2 current input	(mA)	2,1
Gain tracking; deviation from standard curve across frequency band	(dB)	±1,0
Standard small signal gain curve, variation across band	(dB)	31,7 to 34,2
Noise figure at small signal levels, variation across band	(dB)	8,0 to 9,25
Saturated power output, variation across band	(dBm)	+11,2 to 15,5

Heater

Heater voltage, d.c. (Note 1)	(V)	6,5 ± 0,5%
Heater current	(A)	min. 0,33
	(A)	nom. 0,47
	(A)	max. 0,6
Pre-heating time	(s)	60
Switch-on surge will be a maximum of	(A)	3,9

Note 1. The heater voltage must be d.c. with the polarity of the supply as shown in Figure 3.

Limit Ratings

Damage to the package will result if the following ratings are exceeded.

V_1 voltage input	(V)	+1 330
V_2 voltage input	(V)	-40
V_h voltage input	(V)	7,2

Supply Voltages

It is important that these be maintained within the following tolerances. The polarity of the voltages is with respect to the common return lead, pin E on the BA7P plug. (Note 2).

V_1	(V)	+1 200 ± 0,25%
V_2	(V)	-25 ± 0,25%

To obtain maximum benefit from the inclusion of the electrode potentiometer chains in the tube package all the amplifiers in a system should be run from common h.t. and heater supplies: thereby optimum gain tracking performance will be obtained. At voltages outside the stated tolerance, the specified radio frequency performance cannot be guaranteed.

The input currents will not exceed the following values:

I_1	(mA)	+3,8
I_2	(mA)	-3,5

Note 2. The tube must not be run with heater voltage only applied for periods other than that recommended for pre-heating. Such running results in degradation of gain tracking performance and a consequent short life.

At no time should V_1 be applied in the absence of V_2 (see operating instructions).

Environmental Performance

Ambient temperature operating range (Note 3)	(°C)	-10 to +55
storage range	(°C)	-40 to +70

The tube/mount package conforms to the requirements of approved military specification for vibration and shock.

Note 3. At the extreme temperatures of -10°C and +55°C the limit of gain deviation from the standard curve is relaxed (to a maximum value of ±2dB). The noise figure limit at 9,75GHz is relaxed to 14dB.

Life

Shelf life Operational life	Subject to guarantee

Life end points

(a) the gain deviation from the standard curve exceeds ±2,0dB at normal ambient temperatures.

(b) the noise figure is greater than 15dB.

(c) one or more of the other tube parameters falls outside the stated limits.

General Data

The tube is completely enclosed in its permanent magnet mount package. No adjustments for focussing or match are necessary.

A screened lead attached to the mount carries the h.t. and heater supplies.

The W3MT/4A is fitted with an elapsed time meter in the heater supply line. It records tube life up to 5 000 hours.

Mechanical Data

Dimensions	As shown in Figure 3.	
Weight	5,22kg	11,5 lb
Fixing	Attach amplifier to equipment with 10-32 UNF non-magnetic screws fitting into four tapped holes 9,55mm (0,375 inch) deep provided in package body. (See Figure 3).	

R.F. connections

Input and output.	Type OSM jack
Mounting position.	No restriction

Proximity of Magnetic Materials

Magnets and ferromagnetic materials in proximity to the tube will affect its performance and may cause permanent damage. Such materials must not be brought closer than 12mm to any part of the amplifier. Ambient magnetic fields must not exceed 0,001 Tesla.

Operating Procedure

The recommended switch-on procedure is:

(a) switch on heater.

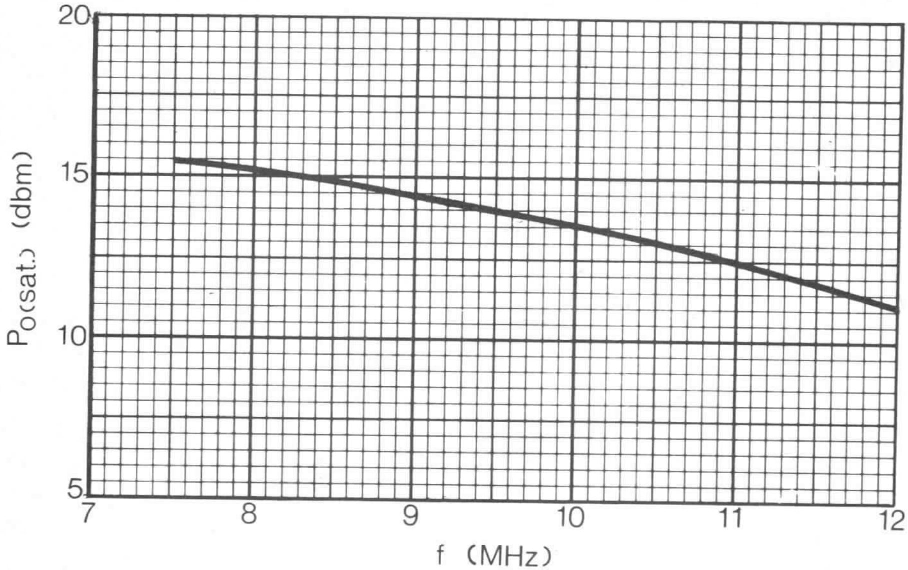
(b) allow one minute warm-up.

(c) switch on V_2 (negative) and then V_1 (positive), and only in that order. (Note 4).

When switching off, either remove both h.t. voltages simultaneously or V_1 before V_2.

Note 4. At no time should V_1 voltage be applied in the absence of V_2 voltage.

Fig. 1 Typical Noise figure and Saturated Output Power versus Frequency



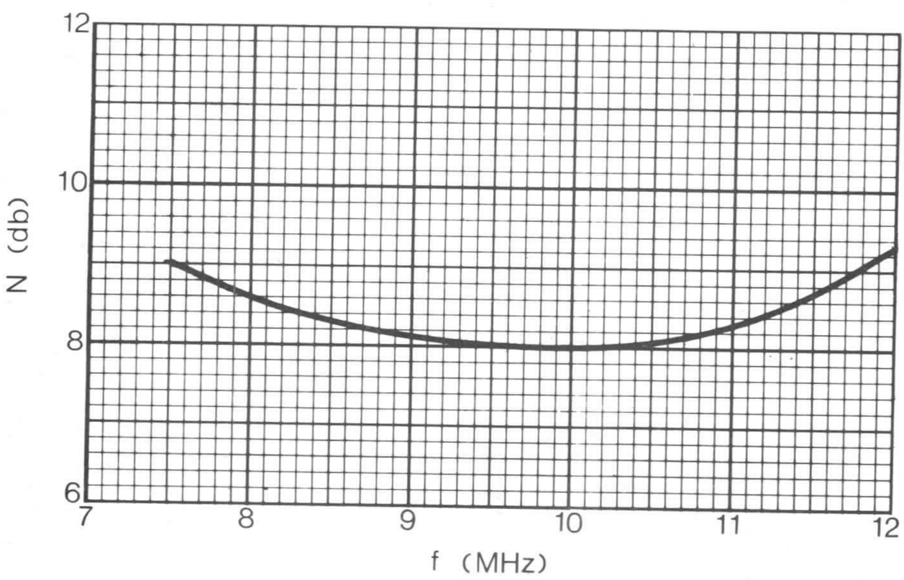


Fig.2 Typical plots of Small Signal Gain versus Frequency (6 tubes)

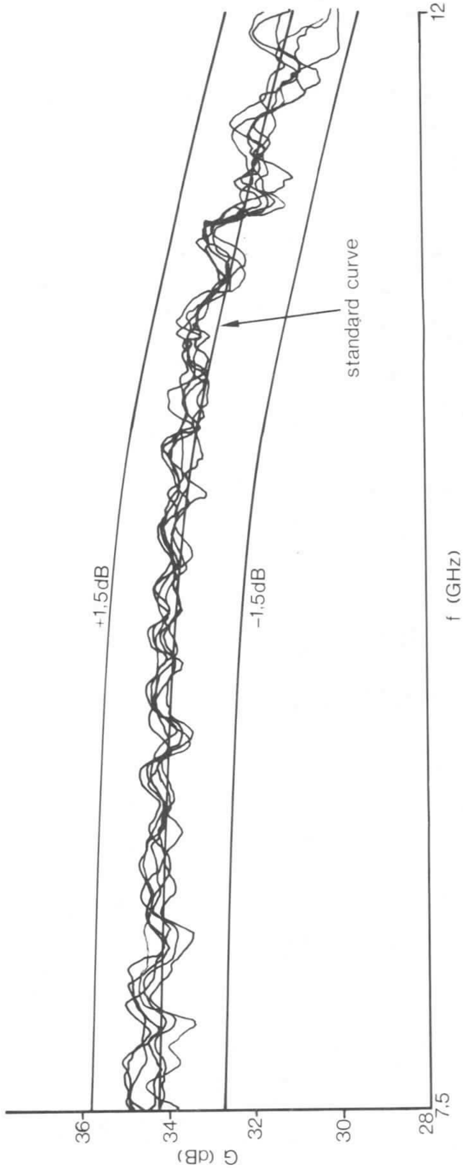


Fig.3 W3MT/4A Outline

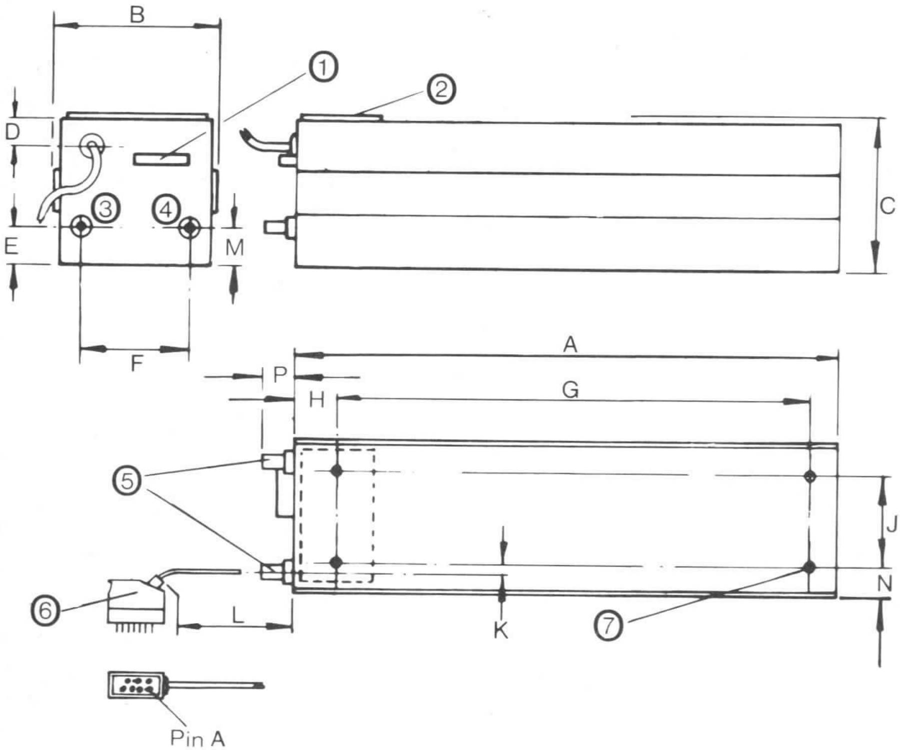


Fig. 3 W3MT/4A Outline - continued.

Notes

1. Elapsed time meter.
2. Label.
3. Input.
4. Output.
5. R.F. connectors type OSM210 jack.

   Position of connectors shown when tube is mounted on pads 19,05mm (0,75in.) diameter located under the four fixing holes.
6. Plug type BA7P (Pye Connectors Ltd.).

   Pin connections as follows:

Pin	Supply
A	HT1+
B	HT2-
C*	h+
D	h-
E	Earth and HT1- plus HT2+
F	Not connected
H	Not connected

   * Connected internally to pin E.
7. Four fixing holes 10-32 UNF x 9,5mm (0,375 inch) deep: position tolerance 0,030 inch diameter (to BS308).

Dimensions

	mm	in.
A	315,9 max.	12,437 max.
B	98,42 max.	3,875 max.
C	92,71 max.	3,650 max.
D	16,51 ± 3,18	0,650 ± 0,125
E	19,05 ± 0,51	0,750 ± 0,020
F	53,18 ± 0,51	2,093 ± 0,020
G	276,22 tp	10,875 tp
H	23,81 ± 0,79	0,930 ± 0,031
J	50,8 tp	2,000 tp
K	1,27 ± 0,76	0,050 ± 0,030
L	381,0 min.	15,000 min.
M	19,05 ± 0,76	0,750 ± 0,030
N	20,0 min.	0,787 min.
	25,0 max.	0,984 max.
P	8,76 nom.	0,345 nom.

These components are available from :

ITT Components Group Europe
Standard Telephones and Cables Limited,
Valve Product Division,
Brixham Road,
PAIGNTON, Devon. TQ4 7BE
Tel, 0803 - 50762 Telex : 42830

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SPECIAL VALVES

Medium ~~Wave~~ Power

Travelling-Wave Amplifier Tube

Code: W4/2G

The W4/2G is a travelling-wave amplifier tube intended for use in microwave radio links in the frequency range 7 to 8·5 Gc/s.

The tube is operated in periodic permanent magnet mounts types WM108C and WM108CA in which it will give the performance quoted in these data sheets. The mounts are fitted with a convection cooler but a conduction cooler is available and this can be modified, if necessary, to meet individual requirements. The WM108CA mount has a front-end tube ejector control.

The design of the mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	7 to 8·5	Gc/s
Maximum output power	15	W
Gain at 5W output		
Minimum	36	db
Maximum	47	db
Noise factor at small signal levels	26	db
Reverse attenuation	70	db
Phase sensitivity		
$d\Phi/dV_{hel}$	−0·75	°/V
$d\Phi/dV_{g2}$	+0·25	°/V
AM/PM conversion at 5W output	1·5	°/db

Modulation noise peaks

Measured in any 20 kc/s band 0·5 to 10 Mc/s from carrier are less than 3 db above tube noise after 10 hours and will continue to improve to less than 1 db above tube noise.

Matching

Adjustment of two plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 15 Mc/s band when operating at 5W output.

A graph showing typical helix voltage, synchronous saturated power output and gain as functions of frequency is shown in Figure 1, and a graph of typical power output versus power input is given in Figure 2.

As will be seen in Figure 2, an increase in output may be achieved by setting the helix voltage above the synchronous value with a resulting drop in gain. Synchronous helix voltage is that which gives maximum gain at low signal levels.

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C O M P O N E N T S G R O U P

Code: W4/2G

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	7·8	Gc/s
Direct helix to cathode voltage (Note 2)	3·3	kV
Direct grid 2 to cathode voltage (Note 3)	2	kV
Direct collector (earth) to cathode voltage	2	kV
Direct grid 2 current	0·01	mA
Direct helix current	0·65	mA
Direct collector current	40	mA
Direct cathode current	40·75	mA
Gain at 5W output, approx.	45	db
Saturated output at synchronous helix voltage, approx.	10	W
Band of output impedance match to 5% voltage reflection (Note 4)	>15	Mc/s

Note 1. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. The matching plungers must be adjusted for each tube at the required operating frequency.

CATHODE

Indirectly-heated, oxide-coated type.

HEATER

	Min	Nom	Max	
Heater voltage (Note 5)		6·3		V
Heater voltage tolerance				
Long-term average			±3	%
Short-term fluctuations up to 2 minutes duration			±5	%
Heater current	0·65	0·73	0·85	A
Heater pre-heating time	60			s
Interruption time for zero pre-heat			10	s

Note 5. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 cycles. Other frequencies of supply up to 10 kc/s may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W4/2G

CONTINUED

LIMIT RATINGS

Voltages	Min	Max	
Direct helix to cathode (Note 6)	2·7	3·7	kV
Direct grid 2 to cathode		2·8	kV
Direct collector (earth) to cathode (Note 6)	1·6	3·7	kV
Direct grid 2 to helix		3·7	kV
Direct grid 2 to collector		3·7	kV

Note 6. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

Currents	Nom	Max	
Cathode	40	50	mA
Helix			
Absolute maximum to trip supplies with delay of less than 5 seconds		4	mA
Switching transient	5	40	mA
Direct grid 2	0·01	0·1	mA

Power Dissipations		
Grid 2	2	W
Helix	12	W
Collector (Note 7)	120	W

Note 7. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling.

STC

Code: W4/2G

CONTINUED

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage		
Adjustable for required working conditions, range	3·1 to 3·7	kV
The synchronous helix voltage for individual tubes lies within the range	3·15 to 3·45	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically:		
2% change in helix voltage causes a fall in gain of	0·5	db
1% change in helix voltage causes a phase change of approximately	30	°
Supply impedance, including resistance in mount, maximum (Note 8)	20	k Ω

Note 8. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage		
Set between absolute limits of	1·6 and 3·7	kV
For operation with depressed collector, it is usual to choose a nominal voltage of	2	kV
A minimum collector voltage of 1·6kV may be used up to 5W output power		

Grid 2 Voltage		
Adjustable for required working conditions, range	1·8 to 2·7	kV
When adjusted to give 40mA collector current:		
Initial range is	1·8 to 2·2	kV
End of life limit is	2·7	kV

Code: W4/2G

CONTINUED

MECHANICAL DATA (W4/2G)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 6

LIFE

Shelf life Operational life	Subject to guarantee

Life-end points

(a) Grid 2 voltage greater than 2·7kV for 40mA collector current, or,

(b) Helix current greater than 2·5mA for 40mA collector current, or,

(c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min	Max	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

T.W.T. Mounts

Codes: WM108C
WM108CA

GENERAL DESCRIPTION

These approved mounts in which the W4/2G tube operates, incorporate a periodic permanent magnet system, r.f. coupling and matching elements, mechanical alignment and deflection adjustments and a convection cooler.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges in the unlikely event of a momentary breakdown in the tube.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws: two pairs align the tube and the other pair move a magnetic deflector plate.

Fine adjustments to the matching are made with movable flags in the waveguides. These flags, which may be rotated or moved longitudinally, are controlled by rods protruding opposite to the input and output ports.

The tube is held firmly in the mount at the collector end by spring contacts in the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining screw: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining screw is shown in Figures 8 and 10.)

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external control (see Figures 8 and 10).

The design of the mounts is such that circuit alignment is unaffected by normal handling and the tube can be easily replaced under field conditions.

The mounts should be secured by the threaded holes using $\frac{1}{4}$-inch UNC non-magnetic screws.

T.W.T. Mounts

Codes: WM108C
WM108CA

CONTINUED

MECHANICAL DATA (MOUNT)

Dimensions	As shown in Figures 7 and 9.			
Weight, approx.		18 lb	8,2	kg
Fixing	Four tapped holes, $\frac{1}{4}$-inch UNC			
Connections				
Electrode leads				
Type	4-core PTFE insulated cable			
Colour coding	As shown in Figures 7 and 9			
Length of leads		22 in.	55	cm
Interlock leads				
Type	Twin cable			
Sleeve colour	Blue			
Length of leads		18 in.	45,5	cm

Mechanical alignment and deflection adjustments

Alignment	Two pairs of external knobs (Note 9)
Deflection	One pair of external knobs (Note 9)

R.F. matching adjustment. Two plungers in input and output waveguides (Note 9)

Waveguides, input and output. Type UG51/U

Mounting position for maximum efficiency of cooler

Mount horizontal with waveguides in horizontal plane (WM108C).

Mount horizontal with waveguides in horizontal or vertical plane (WM108CA).

Proximity of Magnetic Materials

Magnetic material should be kept at least 1 inch (2,5 cm) away from the exterior of the mounts, particularly around the waveguides: permanent magnets should be kept at least 9 inches (22,5 cm) away from the axis of the mounts.

Note 9. Positions of adjustment controls are shown in Figures 8 and 10.

COOLING

The cooler is an integral part of each mount. Cooling takes place by convection and it is important that a mount is installed in the plane recommended.

The air flow through the cooler requires a free space of 2 inches (5 cm) above and below it with access to a free supply of air at ambient temperature; this is to ensure that the convection cooling is efficient. The cooler temperature under normal conditions of operation is about 65°C above ambient temperature.

If values of collector dissipation in excess of the specified limit rating are employed, the normal cooling must be supplemented by forced-air-cooling. (See Note 7 in Limit Rating Section.)

The convection cooler may be replaced by a conduction cooler modified to meet individual requirements in respect of which customers' enquiries are invited.

STC

T.W.T. Mounts

Codes: WM108C
WM108CA

CONTINUED

ELECTRICAL DATA

Ratings

Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 2 — to body of mount, maximum voltage		4·5	kV
Supervisory cable and interlock	240V a.c.	2	A
Lead resistance (including limiting resistors)			
Grid 2		47	k Ω
Helix		7·5	k Ω
Heater (Note 10)		0·07	Ω

Note 10. At 0·7A. Heater line voltage drop of 0·05V.

R.F. PERFORMANCE

Frequency range	7 to 8·5	Gc/s

Each mount will permit the specified performance of the W4/2G tube to be achieved.

R.F. leakage (Note 11)

Input waveguide level to free space	>65	db
Output waveguide level to free space	>65	db

Matching

Adjustment of two plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 30 Mc/s band (tube not operating).

Note 11. Measured by using a 2·5 inch × 1·5 inch (6,4 cm × 3,8 cm) waveguide horn in such a way as to obtain a maximum reading.

ENVIRONMENTAL CONDITIONS

Ambient temperature range	Min	Max	
Operating	−10	+60	°C
Storage	−60	+60	°C

Code: W4/2G

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:

40mA for not longer than 10 milliseconds

20mA for not longer than 150 milliseconds

10mA for not longer than 1 second

4 mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 3. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. With the recommended setting, corresponding to 1 800 volts on grid 2 with respect to cathode when the helix supply is at 3 300 volts, the maximum value of helix current during the rise of helix voltage may be of the order of 15mA.

Graphs of helix current versus helix voltage are shown in Figure 4. Here the grid 2 voltage has been pre-set by means of the grid 2 potentiometer, referred to above, to a fraction of the helix voltage at the values shown. The maximum surge current to the helix during the switch-on period will be the appropriate value obtained from the graph.

Figure 5, which is a graph of helix and cathode currents versus grid 2 voltage, shows how the helix current reaches a maximum at about 10mA cathode current. If the helix voltage is established prior to the application of grid 2 voltage, which is increased to the working value at any suitable rate, the helix current surge will be as indicated in the graph.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage by means of capacitor C_1 in Figure 3. The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 500 volts until the helix voltage has risen to over 2 000 volts. A suitable value for a helix supply with a rise time of 0·02 seconds from zero to 2 500 volts is $C_1 = 0{\cdot}04\mu F$, the surge helix current being reduced to approximately 2mA.

Towards the end of the life of the tube it is likely that the helix current will rise to about 2mA and the grid 2 voltage, which initially was between 1·8 and 2·2kV, will increase to about 2 700 volts.

Code: W4/2G

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W4/2G tube in its mount for operation:—

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining screw is in a position to allow tube to be inserted.
2. Insert tube in mount (Note 12). At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the cooler contacts and the spring locating on the base ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The blue spot on the base of the tube should be aligned with the black mark on the seating. This is necessary for best matching, but the adjustment is not critical, misalignment up to 20° being permissible.
3. Secure tube in mount by rotating the two-position screw to turn over the projection of the tube base ring (Note 13).
4. Connect colour-coded leads of the tube to appropriate terminals in the mount and ensure that mount is properly earthed.
5. Replace lid making sure that the interlock two-pin plug is fitted correctly in its socket.
6. Apply heater voltage and allow one minute heating time.
7. It is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:—
   (a) switch off any r.f. drive.
   (b) pre-set grid 2 voltage (cathode current control) to give about 1·8kV when switched on; this corresponds to a cathode current of about 35mA. At lower voltages the helix current may be excessive.
8. After the one minute cathode pre-heat, switch on collector voltage at 2kV.
9. Switch on simultaneously the helix voltage at 3·3kV and the grid 2 voltage to the pre-set value.
10. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until a collector current of 40mA is achieved.
11. Apply r.f. input and adjust helix voltage for optimum performance; a slight readjustment of the control knobs may be necessary to obtain minimum helix current, and of grid 2 voltage to maintain a collector current of 40mA.

Note 12. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment. When the tube is inserted in the same plane as the longitudinal axis of the mount, a minimum free space of 14½ inches (36,8 cm) is needed. By presenting the tube at an angle of 45° to the main axis of the mount a minimum free space of 10 inches (25,4 cm) is required.

Note 13. Once the tube has been secured by the retaining screw, it is important to ensure that the tube ejection mechanism is not operated inadvertently. Failure to observe this precaution may result in the tube being damaged.

Code: W4/2G

CONTINUED

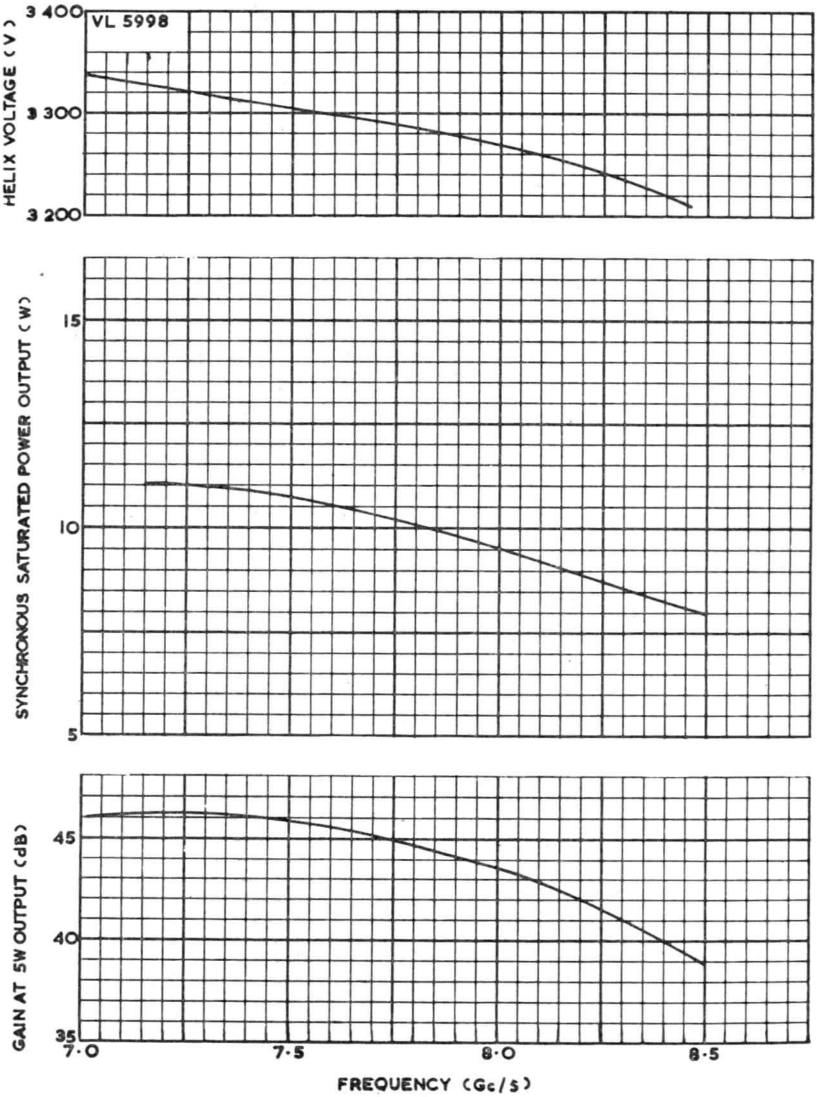
TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining screw to clear the tube base ring.
7. Support the base end of the tube and gradually operate the tube ejector knob to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal.

Code: W4/2G

CONTINUED

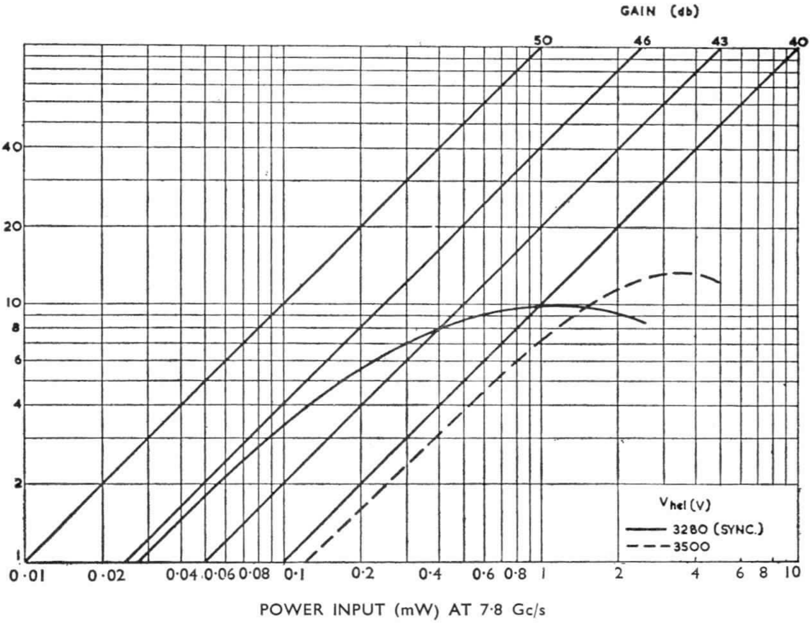
Fig. 1.—Typical Frequency Characteristics



Code: W4/2G

CONTINUED

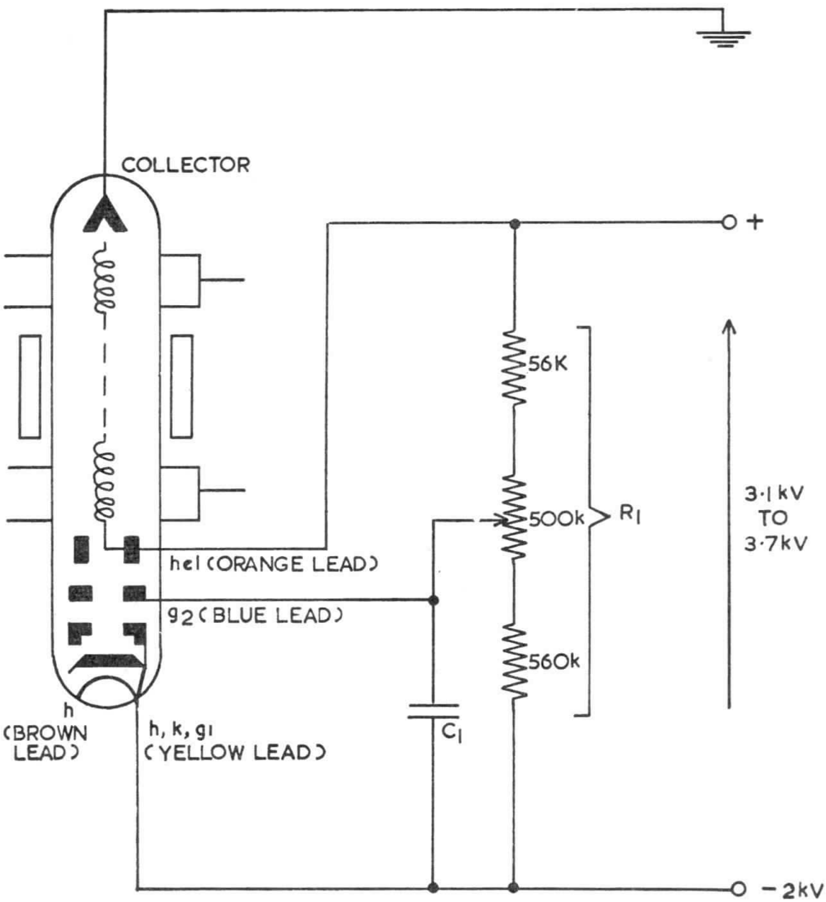
Fig. 2.—Typical Power Output versus Power Input at 7·8 Gc/s



Code: W4/2G

CONTINUED

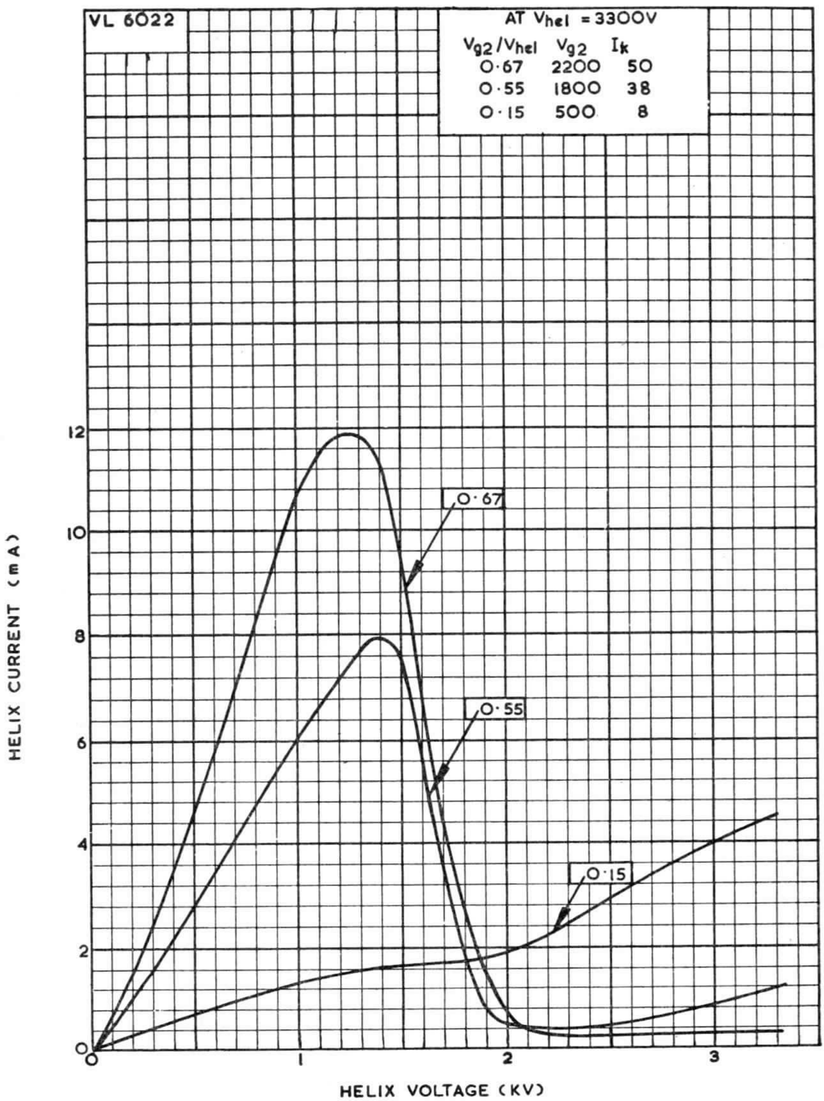
Fig. 3.—Typical Cathode Current Control Circuit



Code: W4/2G

CONTINUED

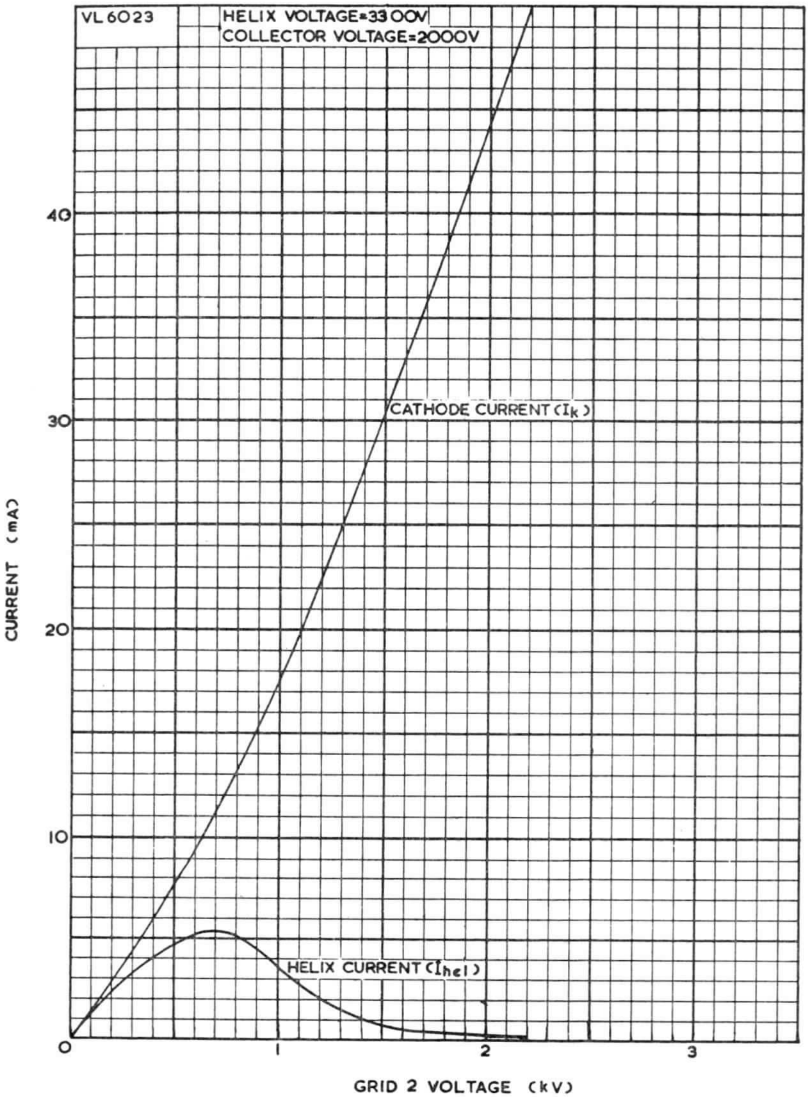
Fig. 4.—Typical Helix Current versus Helix Voltage



Code: W4/2G

CONTINUED

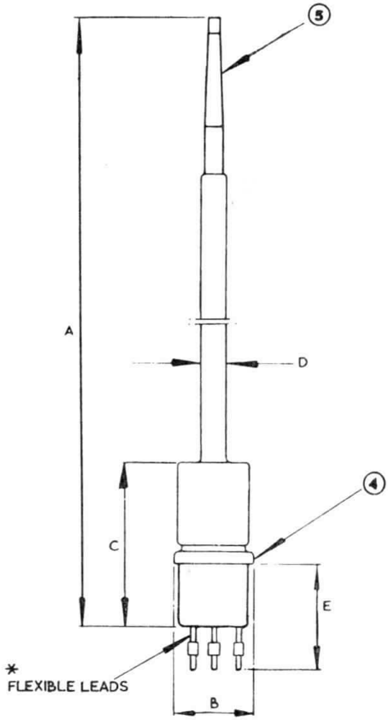
Fig. 5.—Typical Helix and Cathode Currents versus Grid 2 Voltage

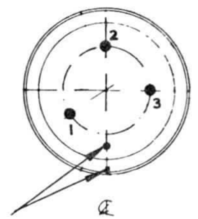


Code: W4/2G

CONTINUED

Fig. 6.—W4/2G Outline





LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	YELLOW	HEATER, CATHODE, GRID 1
3	BROWN	HEATER
CONTACT		
4		HELIX
5		COLLECTOR

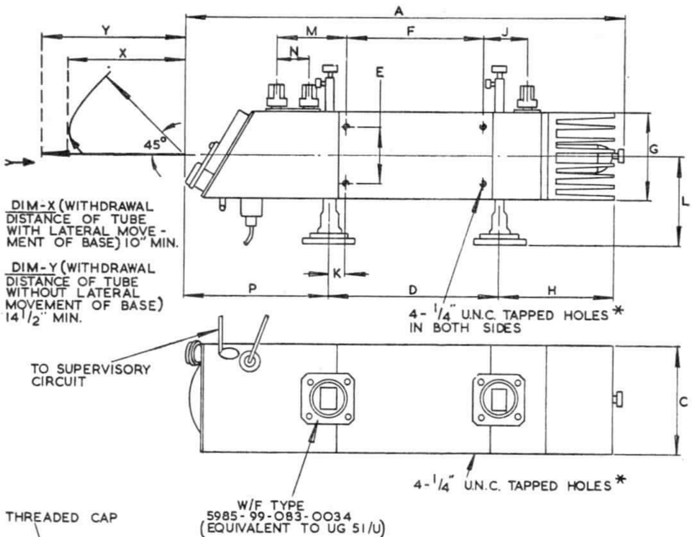
NOTE - BASIC FIGURES ARE INCHES

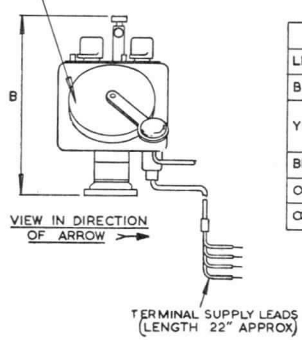
DIM	MILLIMETRES	INCHES
A	346,76 MAX	13·652 MAX
B	36,20±0·18	1·425±0·007
C	70,61 MAX.	2·780 MAX
D	9,27 MAX.	0·365 MAX.
E	73,0 ±3·2	2 7/8 ± 1/8

T.W.T. Mount

Code: WM108C

Fig. 7.—WM108C Dimensional Outline





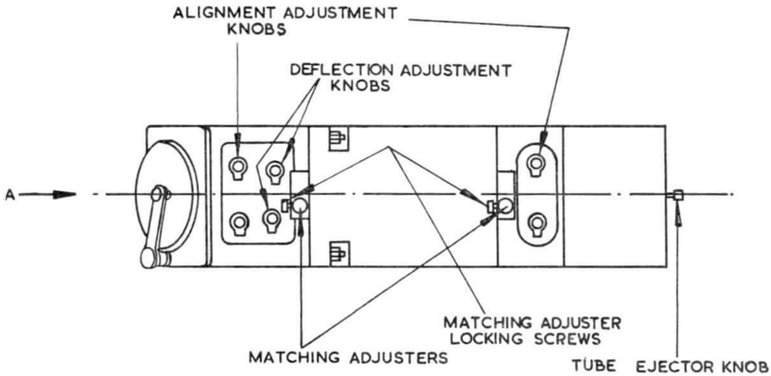
CONNECTIONS	
LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

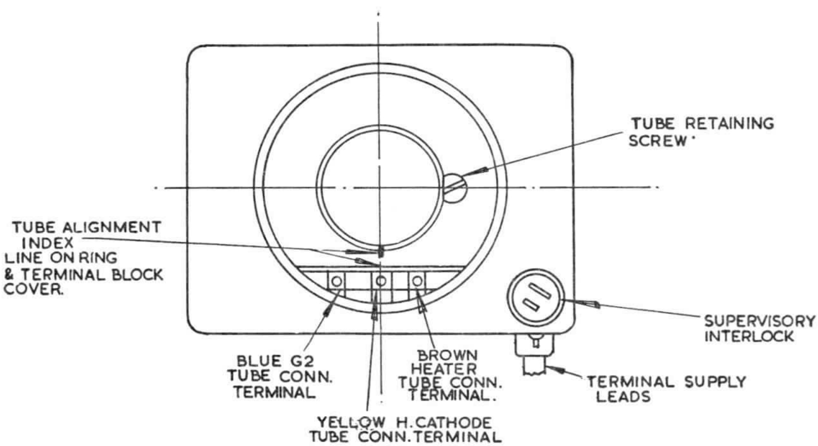
DIM.	INCHES		MILLIMETRES	
A	17 1/4	MAX.	438,2	MAX.
B	9	MAX.	228,6	MAX.
C	4 5/16	MAX.	109,5	MAX.
D	6·654 ± 0·020		169,01	± 0,51
E	2 1/4 ± 1/32		57,2	± 0,8
F	5 3/8 ± 1/32		136,5	± 0,8
G	3 1/2	MAX.	88,9	MAX.
H	4 9/16 ± 1/8		115,9	± 3,2
J	1 21/32 ± 1/16		42,1	± 1,6
K	11/16 ± 1/16		17,5	± 1,6
L	3 7/16 ± 1/32		87,3	± 0,8
M	2 3/4 ± 1/8		69,9	± 3,2
N	1 3/8 ± 1/16		34,9	± 1,6
P	5 5/8 ± 1/8		142,9	± 3,2
BASIC DIMS. ARE INCHES				
NET. WEIGHT APPROX.				lbs
				kgs

The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

T.W.T. Mount
Code: WM108C
CONTINUED

Fig. 8.—Diagram showing Operational Controls of WM108C





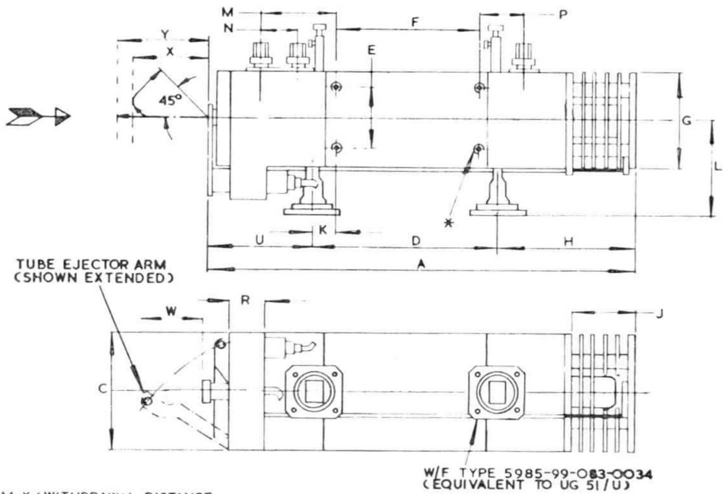
VIEW OF END 'A' WITH COVER REMOVED

STC

T.W.T. Mount

Code: WM108CA

Fig. 9. WM108CA Dimensioned Outline (Provisional)



DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 10" MIN.

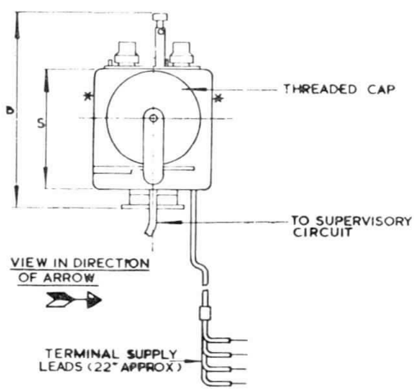
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE 14½" MIN.

* DENOTES:- 4-¼ UNC TAPPED HOLES BOTH SIDES.

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM	INCHES		MILLIMETRES	
A	15 1/8	NOM	384,2	NOM.
B	9	MAX	228,6	MAX.
C	4 5/16	MAX	109,5	MAX.
D	6·654	± 0·020	169,01	± 0,51
E	2 1/4	± 1/32	57,2	± 0,8
F	5 3/8	± 1/32	136,5	± 0,8
G	3 1/2	MAX	88,9	MAX.
H	4 13/32	± 1/8	111,9	± 3,2
J	2 13/32	± 1/16	61,1	± 1,6
K	11/16	± 1/16	17,5	± 1,6
L	3 7/16	± 1/32	87,3	± 0,8
M	2 3/4	± 1/8	69,9	± 3,2
N	1 3/8	± 1/16	34,9	± 1,6
P	1 21/32	± 1/16	42,1	± 1,6
R	1 1/4	MAX.	31,8	MAX.
S	4 3/8	MAX.	111,1	MAX.
U	4 1/16	± 1/8	103,2	± 3,2
W	2 5/8	APP.	66,7	APP.
NETT WEIGHT APPROX				lbs
				kgs

BASIC DIMS ARE IN INCHES

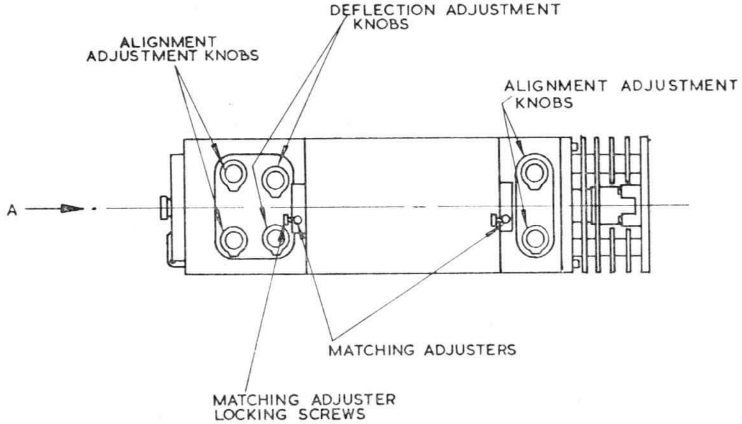


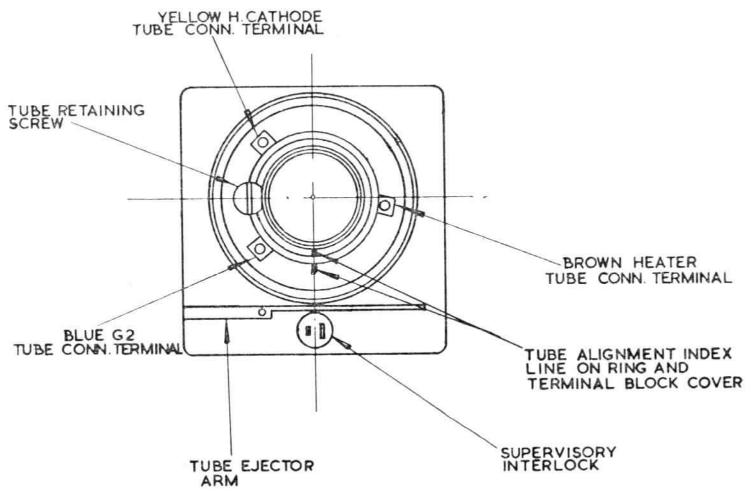
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

T.W.T. Mount

Code: WM108CA

Fig. 10. Diagram showing Operational Controls of WM108CA





VIEW OF END 'A' WITH COVER REMOVED

SPECIAL VALVES

Medium Power

Travelling-Wave Amplifier Tube

Code: W5/2G

The W5/2G is a travelling-wave amplifier tube intended for use in microwave radio links in the frequency range 5·85 to 8·5GHz.

The tube is operated in periodic permanent magnet mounts types WM107A, WM107CA, and WM107GA in which it will give the performance quoted in these data sheets.

The design of the mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	5·85 to 7·2	7·2 to 7·8	7·8 to 8·5	GHz
Maximum power output	25	18	16	W
Gain at 10W output				
Minimum	36			db
Maximum	43			db
Gain at 7W output				
Minimum		34	30	db
Maximum		42	38	db
Noise factor at small signal levels	28	28	28	db
Reverse attenuation	>65	>65	>65	db
Phase sensitivity				
$d\Phi/dV_{hel}$	−0·75	−0·75		°/V
$d\Phi/dV_{g2}$	+0·25	+0·25		°/V
AM/PM conversion at 10W output	1·7			°/db
AM/PM conversion at 7W output		1·5	1·5	°/db

Modulation noise peaks

Measured in any 20kHz band 0·5 to 10MHz from carrier are less than 3db above tube noise after 10 hours and will improve to less than 1db above tube noise with life.

Matching

Adjustment of flags in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 15MHz band when operating at 10W output.

Graphs showing typical power output, gain and helix voltage as functions of frequency are shown in Figures 1 and 2, and graphs of typical power output versus power input are given in Figures 3 and 4.

As will be seen in Figures 3 and 4, an increase in output may be achieved by setting the helix voltage above the synchronous value with a resulting drop in gain. Synchronous helix voltage is that which gives maximum gain at low signal levels.

A graph showing typical AM/PM conversion at 6·25GHz is given in Figure 5.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: 01-300 3333 Telex: 21836
COMPONENTS GROUP

STC

Code: W5/2G

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	6·4	7·8	GHz
Direct helix to cathode voltage (Note 2)	3·38	3·29	kV
Direct grid 2 to cathode voltage (Note 3)	2·3	2·3	kV
Direct collector (earth) to cathode voltage	2	2	kV
Direct grid 2 current	0·01	0·01	mA
Direct helix current	0·5	0·5	mA
Direct collector current	50	50	mA
Direct cathode current	50·5	50·5	mA
Gain at 10W output, approx.	40		db
Gain at 7W output, approx.	42	36·5	db
Saturated output at synchronous helix voltage, approx.	18·5	14	W
Band of output impedance match to 5% voltage reflection (Note 4)	>15	>15	MHz

Note 1. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. The matching plungers must be adjusted for each tube at the required operating frequency.

CATHODE

Indirectly-heated, oxide-coated type.

HEATER

	Min	Nom	Max	
Heater voltage (Note 5)		6·3		V
Heater voltage tolerance				
Long-term average			±3	%
Short-term fluctuations up to two minutes' duration			±5	%
Heater current	0·65	0·75	0·85	A
Heater pre-heating time	60			s
Interruption time for zero pre-heat			10	s

Note 5. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50Hz. Other frequencies of supply up to 10kHz may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W5/2G

CONTINUED

LIMIT RATINGS

Voltages	Min	Max	
Direct helix to cathode (Note 6)	2·7	3·7	kV
Direct grid 2 to cathode	—	2·8	kV
Direct collector (earth) to cathode (Note 6)	1·8	3·7	kV
Direct grid 2 to helix		3·7	kV
Direct grid 2 to collector		3·7	kV

Note 6. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

Currents	Max	
Cathode	55	mA
Helix		
Absolute maximum to trip supplies with delay of less than 5 seconds	4	mA
Switching transient	50	mA
Direct grid 2	0·5	mA

Power Dissipations		
Grid 2	2	W
Helix	12	W
Collector (Note 7)	120	W

Note 7. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling. As a general guide, an air flow of about 25 ft^3/min (708 l/min.) is required for a collector dissipation at 175W.

Code: W5/2G

CONTINUED

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage		
Adjustable for required working conditions, range	3·1 to 3·7	kV
The synchronous helix voltage for individual tubes lies within the range	3·15 to 3·6	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically:		
2% change in helix voltage causes a fall in gain of	0·5	db
1% change in helix voltage causes a phase change of approximately	30	°
Supply impedance, including resistance in mount, max. (Note 8)	20	k Ω

Note 8. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage		
Set between absolute limits of	1·6 and 3·7	kV
For operation with depressed collector at 50mA it is usual to choose a nominal voltage of	2	kV
A minimum collector voltage of 1·6 kV may be used up to 5W output power		

Grid 2 Voltage		
Adjustable for required working conditions, range	1·8 to 2·7	kV
When adjusted to give 50mA collector current		
Initial range is	2 to 2·4	kV
End of life limit is	2·7	kV

Code: W5/2G

CONTINUED

MECHANICAL DATA (W5/2G)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 9

LIFE

Shelf life Operational life	Subject to guarantee

Life-end points

(a) Grid 2 voltage greater than 2·7kV for 50mA collector current, or

(b) Helix current greater than 3·5mA for 50mA collector current, or

(c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min	Max	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

STC

T.W.T. MOUNTS

Codes: WM107A
WM107CA
WM107GA

GENERAL DESCRIPTION

These approved mounts, in which W5/2G tubes operate, incorporate a periodic permanent magnet system, r.f. coupling and matching elements, mechanical alignment and deflection adjustments and a convection cooler.

They differ from one another in respect of various physical characteristics and r.f. performance: these differences are detailed in the MECHANICAL DATA, ELECTRICAL DATA and R.F. PERFORMANCE Sections, and the relevant drawings given later in these data sheets.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed (Note 9). The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws: two pairs align the tube and the other pair move a magnetic deflector plate.

Fine adjustments to the matching are made with movable flags in the waveguides. These flags, which may be rotated or moved longitudinally, are controlled by rods protruding opposite to the input and output ports.

The tube is held firmly in the mount at the collector end by the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining catch: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining catch is shown in Figures 11, 13, and 15.)

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external control. (See Figures 11, 13, and 15.)

The design of the mounts is such that tube alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

Note 9. The link and twin lead are omitted on the WM107A.

T.W.T. MOUNTS
Codes: WM107A
WM107CA
WM107GA
CONTINUED

MECHANICAL DATA (MOUNTS)

Dimensions	As shown in Figures 10, 12, and 14.
Mounting position	For maximum efficiency of the convection cooler, the plane of the cooler fins should be vertical. Magnetic materials should be kept at least 1 inch (2,5 cm) away from the exterior of the mounts, particularly in the vicinity of the waveguides. Permanent magnets should be kept at least 9 inches (22,9 cm) away from the axis of the mount.
Fixing of mounts	Attach mounts to equipment with $\frac{1}{4}$ inch UNC non-magnetic screws fitting into tapped holes provided in mount body.
Connecting leads	
Electrode leads	4-cored or 5-cored P.T.F.E. insulated cable, leads colour coded as shown in Figures 10, 12, 14, 16, and 18. (Note 10.)
Interlock leads	Twin cable, sleeve coloured blue. (Not applicable to WM107A.)
Mechanical adjustment controls (Note 11)	
Alignment	Two pairs of external knobs.
Deflection	One pair of external knobs.
R.F. matching	On WM107A and WM107GA two pairs of external plungers controlling two flags in each waveguide. On WM107CA mount two external plungers controlling a single flag in each waveguide.
Waveguide connections, input and output	
WM107A	Flanges 1·375 inch × 0·197 inch for connection to waveguide WGL70.
WM107CA	Flanges CMR137 for connection to waveguide RG50.
WM107GA	Flanges UG344/U for connection to waveguide WR137.

Note 10. All mounts manufactured in future will be fitted with a 5-core lead incorporating a black coloured earthing lead connected to the mount body.

Note 11. The positions of adjustment controls are shown in Figures 11, 13, and 15.

COOLING

The cooler is an integral part of each mount. Cooling takes place by convection and it is important that the plane of the cooler fins is vertical.

The air flow through the cooler requires a free space of 2 inches (5 cm) above and below the cooler, with access to a free supply of air at ambient temperature. Normally, the cooler temperature is about 70°C above ambient.

If values of collector dissipation in excess of the maximum specified in the LIMIT-RATINGS section are employed, the normal cooling must be supplemented by forced-air-cooling: as a general rule, an air flow of about 25ft^3/min (708 l/min) is required for 175W collector dissipation.

STC

Codes: WM107A
WM107CA
WM107GA

CONTINUED

ELECTRICAL DATA

Ratings

Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 2 } to body of mount, maximum voltage		4·5	kV
Supervisory cable and interlock (Note 12)	240V a.c.	2	A

Lead Resistance (including limiting resistors)

	WM107A	WM107CA WM107GA	
Grid 2	4·7	47	k Ω
Helix	1	7·5	k Ω
Heater (Note 13)	0·07	0·07	Ω

Note 12. Not applicable to mount WM107A.

Note 13. At 0·7A. Heater line voltage drop of 0·05V.

R.F. PERFORMANCE

	WM107A	WM107CA WM107GA	
Frequency Range	5·85 to 7·2	5·85 to 8·5	GHz

Each mount will permit the specified performance of the W5/2G tube to be achieved.

R.F. Leakage (Note 14)

	WM107A	WM107CA WM107GA	
Input waveguide level to free space	>65	>65	db
Output waveguide level to free space	>65	>65	db

Matching

Adjustment of flags in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 30MHz band (tube not operating).

Note 14. Measured by using a 2·5 inch × 1·5 inch (6,4 cm × 3,8 cm) waveguide horn in a way such as to obtain a maximum reading.

ENVIRONMENTAL CONDITIONS (All mounts)

Ambient temperature range

	Min	Max	
Operating	−10	+60	°C
Storage	−60	+60	°C

Code: W5/2G

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:—

50mA for not longer than 10 milliseconds
20mA for not longer than 150 milliseconds
10mA for not longer than 1 second
4mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 6. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. With the recommended setting for switch-on, corresponding to 1 800 volts on grid 2 with respect to cathode when the helix supply is at 3 300 volts, the maximum value of helix current during the rise of helix voltage may be of the order of 15mA.

Graphs of helix current versus helix voltage are shown in Figure 7. Here the grid 2 voltage has been pre-set by means of the grid 2 potentiometer, referred to above, to a fraction of the helix voltage at the values shown. The maximum surge current to the helix during the switch-on period will be the appropriate value obtained from the graph.

Figure 8, which is a graph of helix and cathode currents versus grid 2 voltage, shows how the helix current reaches a maximum at about 10mA cathode current. If the helix voltage is established prior to the application of grid 2 voltage, which is increased to the working value at any suitable rate, the helix current surge will be as indicated in the graph.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage by means of capacitor C_1 in Figure 6. The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 500 volts until the helix voltage has risen to over 2 000 volts. A suitable value for a helix supply with a rise time of 0·02 seconds from zero to 2 500 volts is $C_1 = 0{\cdot}04\ \mu F$, the surge helix current being reduced to approximately 2mA.

Towards the end of the life of the tube it is likely that the helix current will rise to about 3·5mA and the grid 2 voltage, which initially was between 2·1 and 2·4kV, will increase to about 2 700 volts.

Code: W5/2G

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W5/2G tube in its mount for operation:—

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining catch is in a position to allow tube to be inserted.
2. Insert tube in mount (Note 15). At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the cooler contacts and the spring located on the mount ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The blue spot on the base of the tube should be aligned with the black mark on the seating. This is necessary for best matching, but the adjustment is not critical, misalignment up to 20° being permissible.
3. Secure tube in mount by rotating the two-position retaining catch to turn over the projection of the tube base ring (Note 16).
4. Connect colour-coded leads of the tube to appropriate terminals in the mount and ensure that mount is properly earthed (Note 17).
5. Replace lid making sure that the interlock two-pin plug is fitted correctly in its socket (not applicable to mount WM107A).
6. Apply heater voltage and allow one minute heating time.
7. It is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:—
   (a) switch off any r.f. drive
   (b) pre-set grid 2 voltage (cathode current control) to give about 1·8kV when switched on; this corresponds to a cathode current of about 35mA. At lower voltages the helix current may be excessive.
8. After the one minute cathode pre-heat, switch on collector voltage at 2kV.
9. Switch on simultaneously the helix voltage at 3·3kV and the grid 2 voltage to the pre-set value.
10. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until a collector current of 50mA is achieved.
11. Apply r.f. input and adjust helix voltage for optimum performance; a slight readjustment of the control knobs may be necessary to obtain minimum helix current, and of grid 2 voltage to maintain a collector current of 50mA.

Note 15. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment. When the tube is inserted in the same plane as the longitudinal axis of the mount, a minimum free space of 14½ inches (36,8 cm) is needed. By presenting the tube at an angle of 45° to the main axis of the mount a minimum free space of 10 inches (25,4 cm) is required.

Note 16. Once the tube has been secured by the retaining catch, it is important to ensure that the tube ejection mechanism is not operated inadvertently. Failure to observe this precaution will result in the tube being damaged.

Note 17. The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

Code: W5/2G

CONTINUED

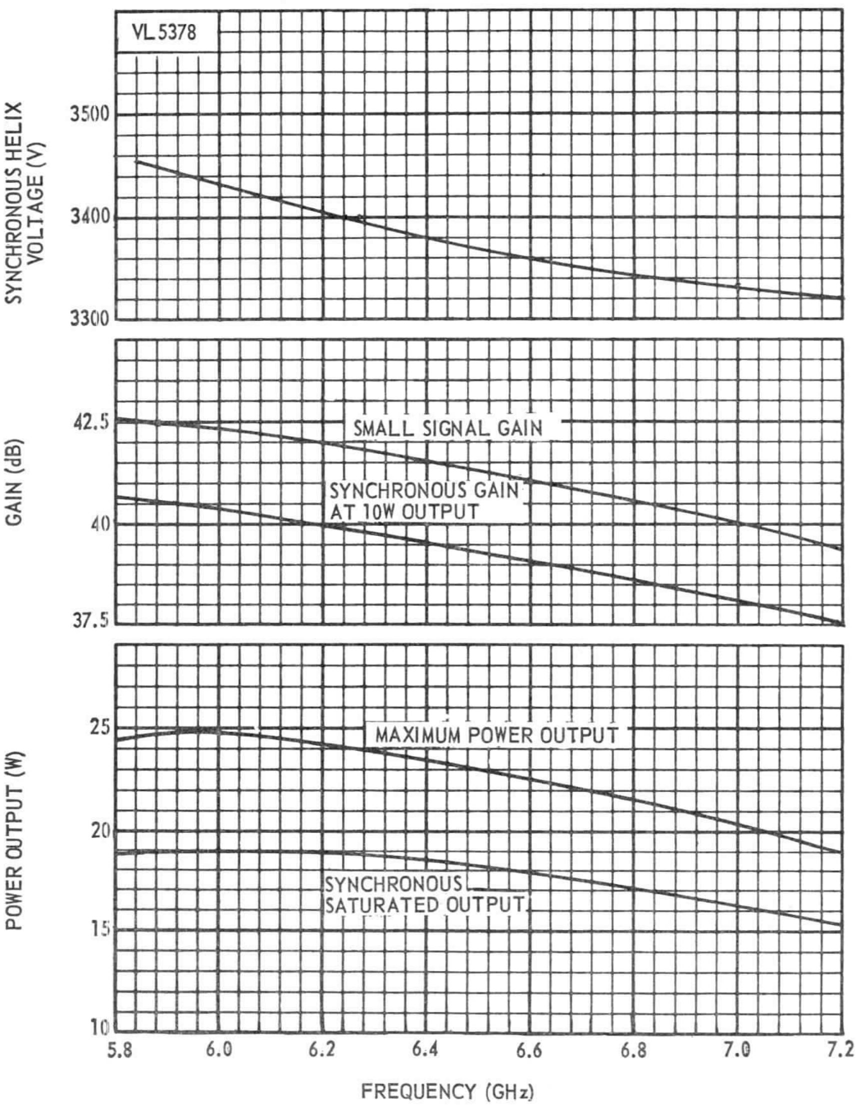
TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining catch to clear the tube base ring.
7. Support the base end of the tube and gradually operate the tube ejector control to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal.

Code: W5/2G

CONTINUED

Fig. 1.—Typical Frequency Characteristics 5·8 to 7·2 GHz



Code: W5/2G

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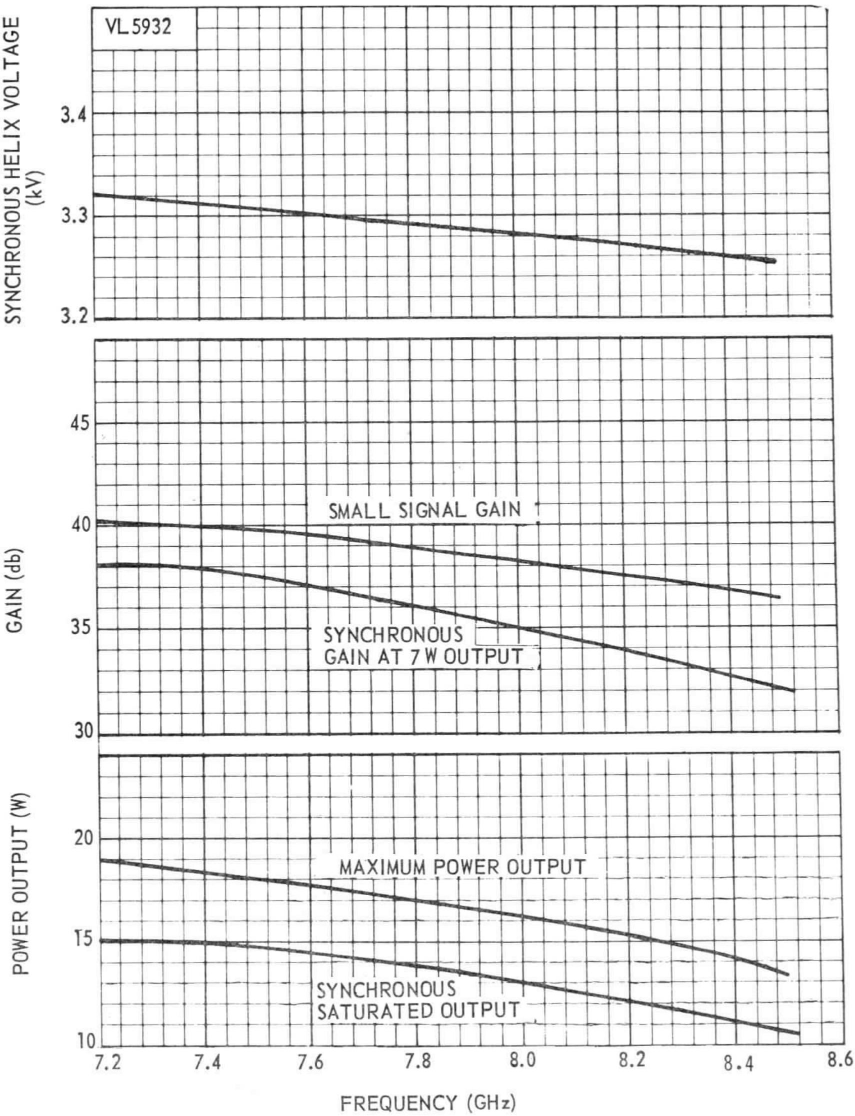
Fig. 2.—Typical Frequency Characteristics 7·2 to 8·5 GHz



Code: W5/2G

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Fig. 3.—Typical Power Output versus Power Input at 6·4 GHz

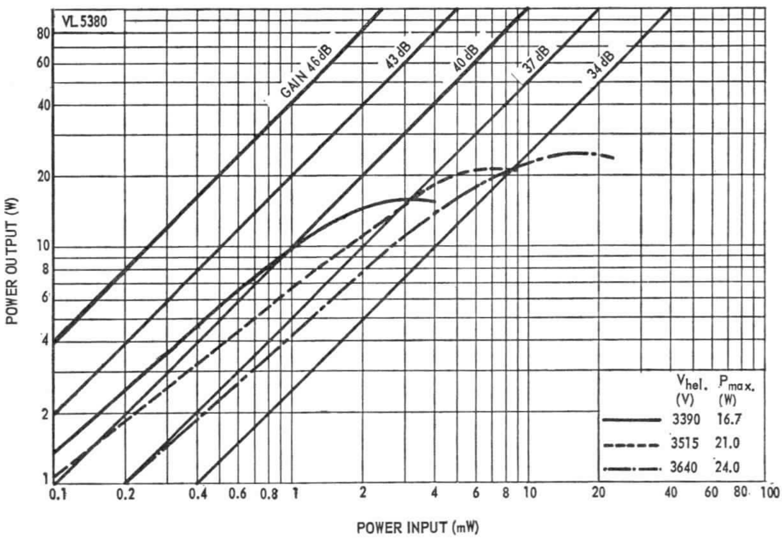
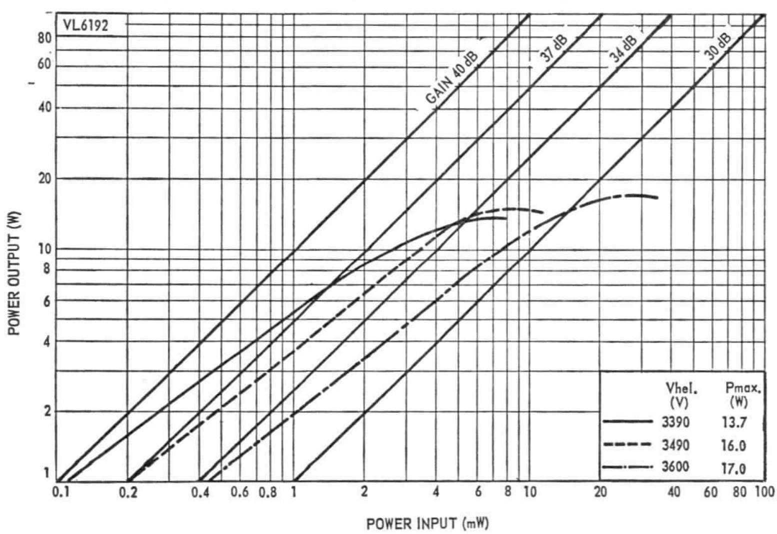


Fig. 4.—Typical Power Output versus Power Input at 7·8 GHz



Code: W5/2G

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Fig. 5.—Typical AM/PM Conversion at 6·25 GHz

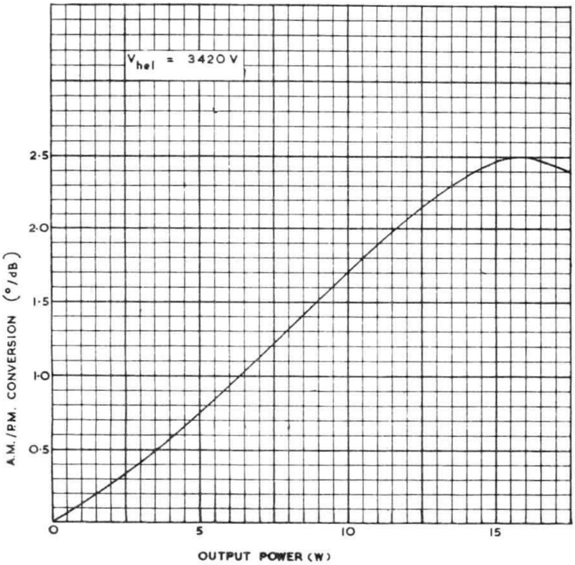
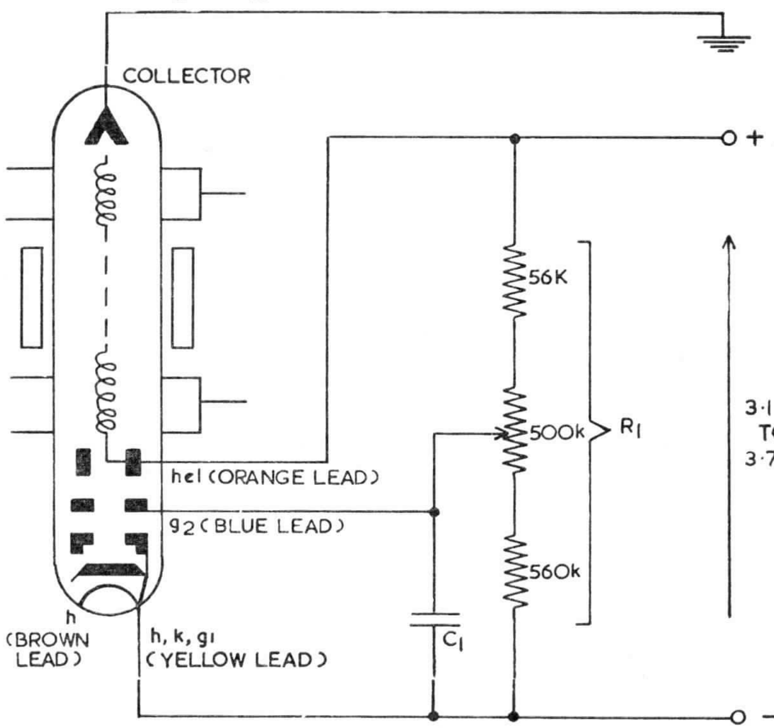


Fig. 6.—Typical Cathode Current Control Circuit



Code: W5/2G

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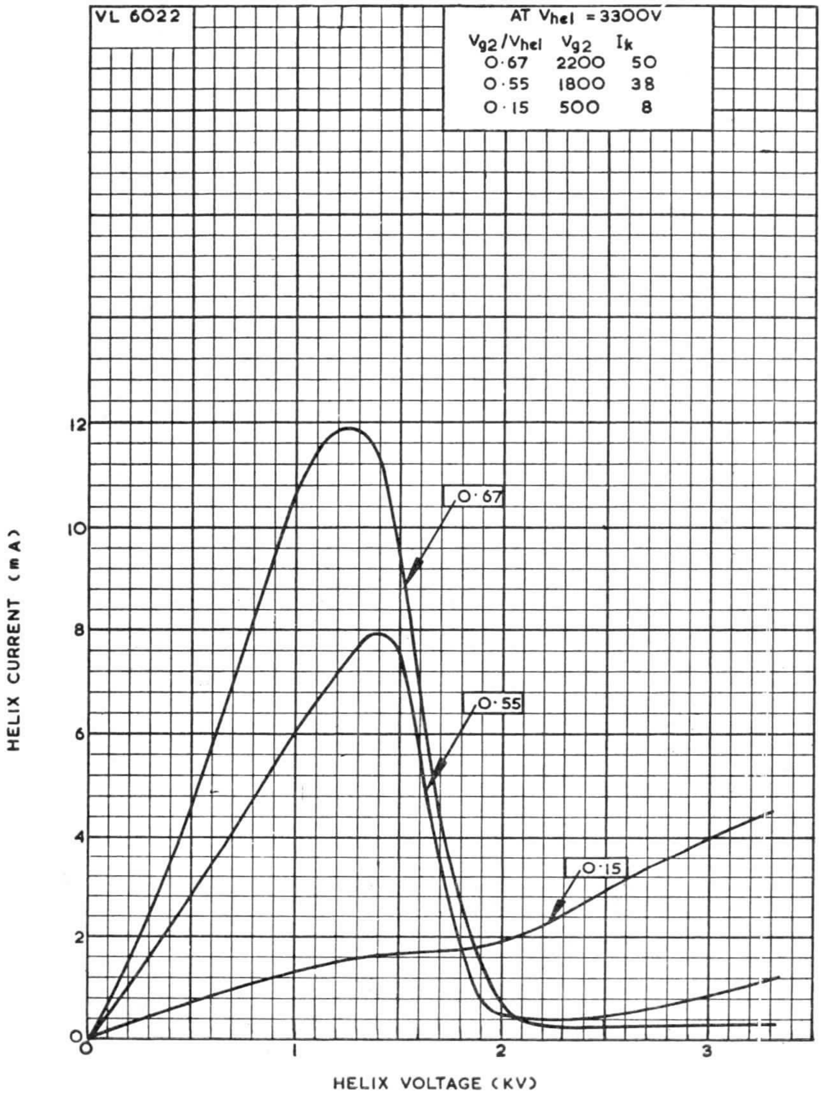
Fig. 7.—Typical Helix Current versus Helix Voltage



Code: W5/2G

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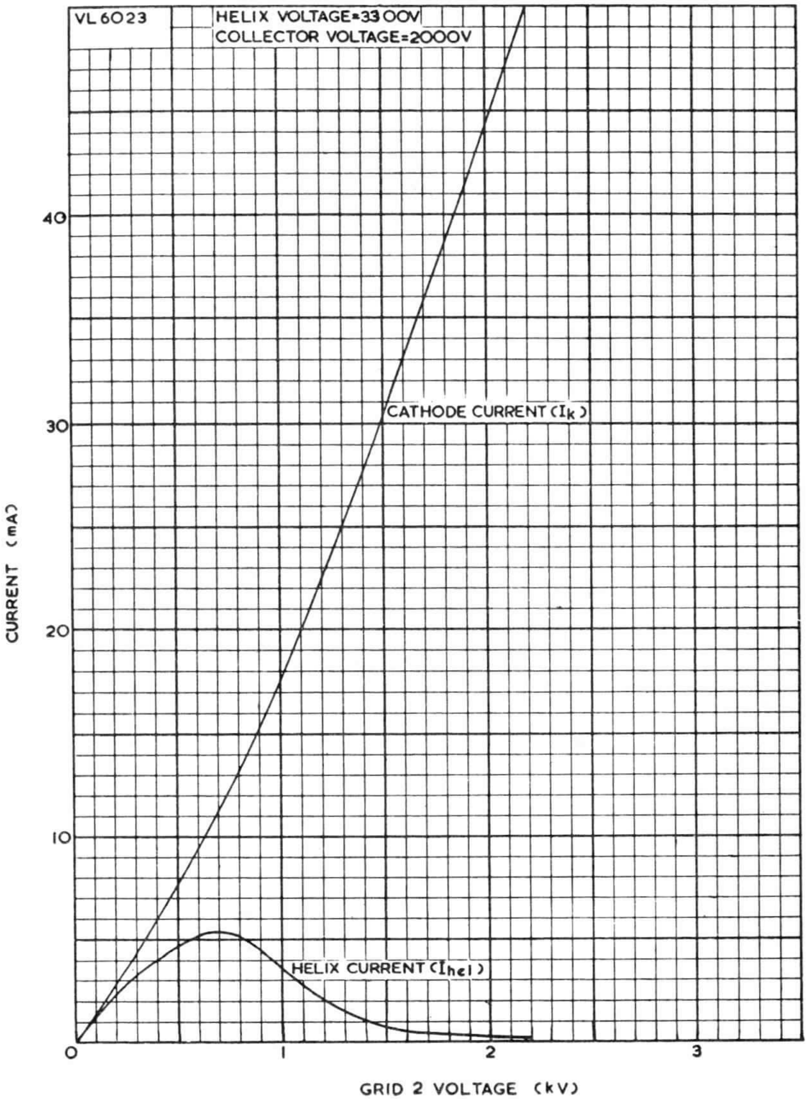
Fig. 8.—Typical Helix and Cathode Currents versus Grid 2 Voltage



Code: W5/2G

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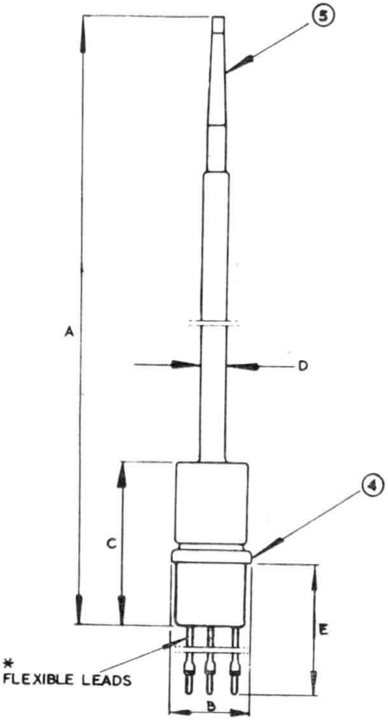
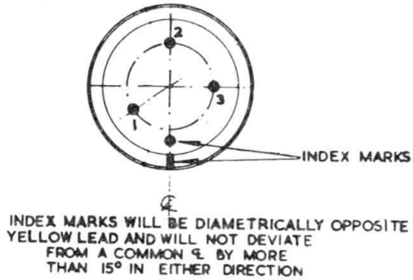
Fig. 9.—W5/2G Dimensioned Outline





LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	YELLOW	HEATER, CATHODE, GRID 1
3	BROWN	HEATER
CONTACT		
4		HELIX
5		COLLECTOR

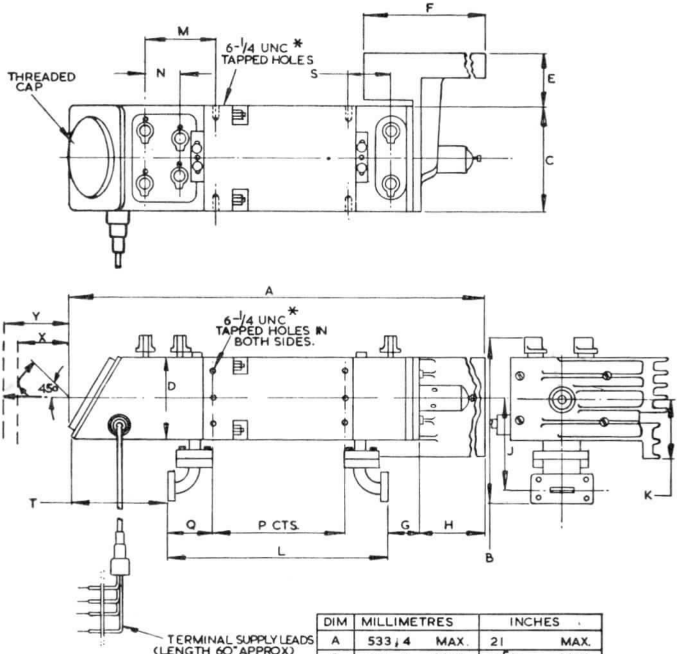
NOTE:- BASIC FIGURES ARE INCHES

DIM	MILLIMETRES	INCHES
A	346,76 MAX.	13·652 MAX.
B	36,20±0·18	1·425±0·007
C	70,61 MAX.	2·780 MAX.
D	9,27 MAX.	0·365 MAX.
E	73,0 ±3·2	2 7/8 ± 1/8

T.W.T. MOUNT

Code: WM107A

Fig. 10.—WM107A Dimensioned Outline



DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 10" MIN.

DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 14 1/2" MIN.

CONNECTIONS

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
* BLACK	COLLECTOR

DIM	MILLIMETRES		INCHES	
A	533,4	MAX.	21	MAX.
B	193,7	MAX.	7 5/8	MAX.
C	109,5	MAX.	4 5/16	MAX.
D	88,9	MAX.	3 1/2	MAX.
E	58,7	MAX.	2 5/16	MAX.
F	225,4	MAX.	8 7/8	MAX.
G	30,2	APP.	1 3/16	APP.
H	168,3	MAX.	6 5/8	MAX.
J	103,56	± 0,25	4·077	± 0·010
K	66,7	MAX.	2 5/8	MAX.
L	219,86	± 0.38	8·656	± 0·015
M	69,9	± 3,2	2 3/4	± 1/8
N	34,9	± 1,6	1 3/8	± 1/16
P	136,5	± 0,8	5 3/8	± 1/32
Q	42,9	± 1,6	1 11/16	± 1/16
R	28,6	± 0,4	1 1/8	± 1/64
S	42,1	± 1,6	1 21/32	± 1/16
T	111,1	± 3,2	4 3/8	± 1/8
NOTE:- BASIC DIMS ARE IN INCHES.				
NETT WEIGHT APPROX				lbs kgs

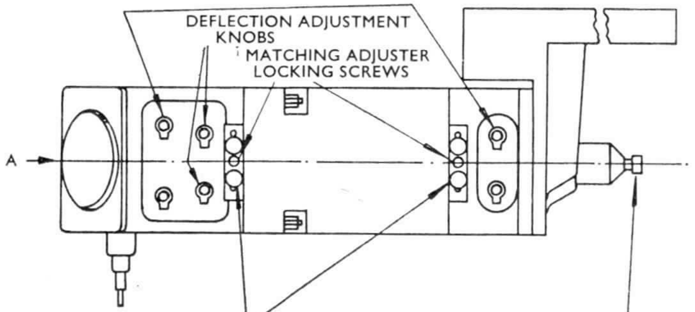
*The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

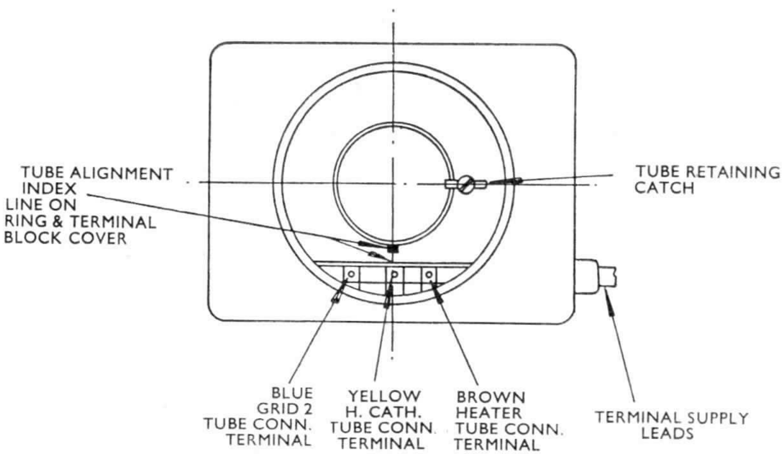
T.W.T. MOUNT

Code: WM107A

CONTINUED

Fig. 11.—Diagram Showing Operational Controls of WM107A



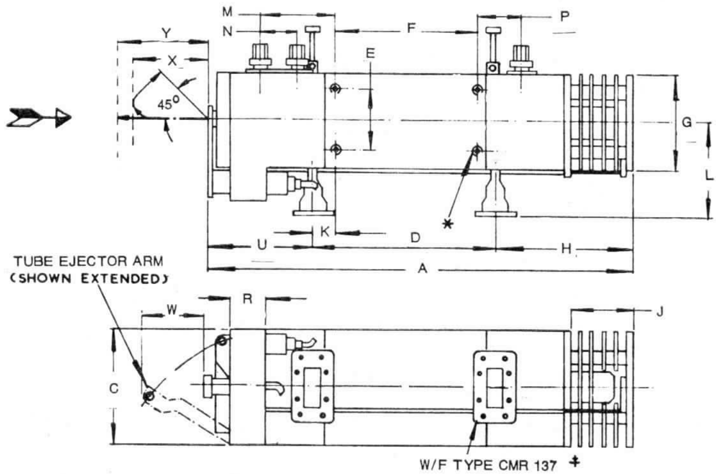


VIEW OF END 'A' WITH COVER REMOVED

T.W.T. MOUNT

Code: WM107CA

Fig. 12.—WM107CA Dimensioned Outline



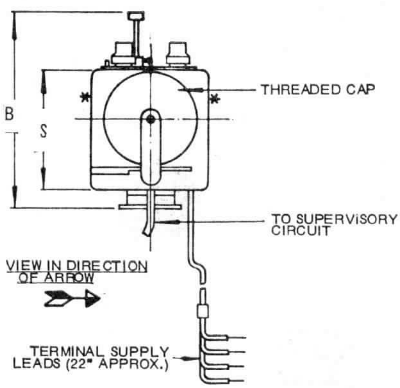
DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 10" MIN.
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE 14.1/2" MIN.)

* • DENOTES:- 4-¼ UNC TAPPED HOLES BOTH SIDES ½ INCH DEEP
‡ DENOTES:- SHIMS & TIN PLATED SCREWS MUST BE USED IN CONJUNCTION WITH ALUMINIUM ALLOY W/G FLANGES

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR

DIM.	INCHES	MILLIMETRES	
A	15.1/8 NOM.	384,2 NOM.	
B	7.3/4 MAX.	196,9 MAX.	
C	4.5/16 MAX.	109,5 MAX.	*
D	6.654 ± 0.020	169,01 ± 0,51	
E	2.1/4 ± 1/32	57,2 ± 0,8	*
F	5.3/8 ± 1/32	136,5 ± 0,8	*
G	3.1/2 MAX.	88,9 MAX.	
H	4.13/32 ± 1/8	111,9 ± 3,2	
J	2.13/32 ± 1/16	61,1 ± 1,6	
K	11/16 ± 1/16	17,5 ± 1,6	*
L	3.7/16 ± 1/32	87,3 ± 0,8	*
M	2.3/4 ± 1/8	69,9 ± 3,2	
N	1.3/8 ± 1/16	34,9 ± 1,6	
P	1.21/32 ± 1/16	42,1 ± 1,6	
R	1.1/4 MAX.	31,8 MAX.	
S	4.3/8 MAX.	111,1 MAX.	
U	4.1/16 ± 1/8	103,2 ± 3,2	
W	2.5/8 APP.	66,7 APP.	
NETT. WEIGHT APPROX.		lbs. kgs.	

BASIC DIMS. ARE IN INCHES



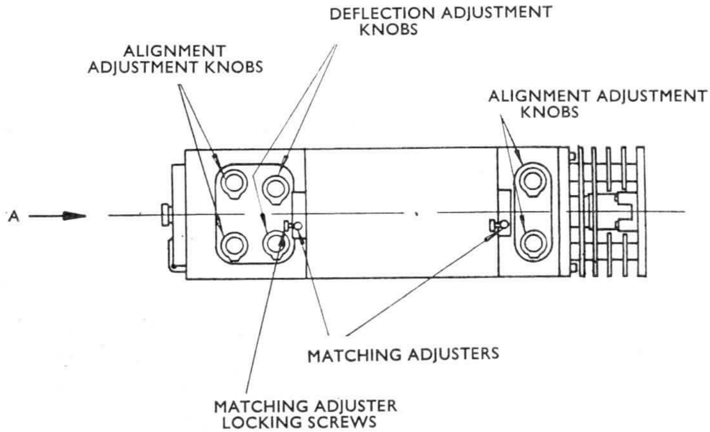
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

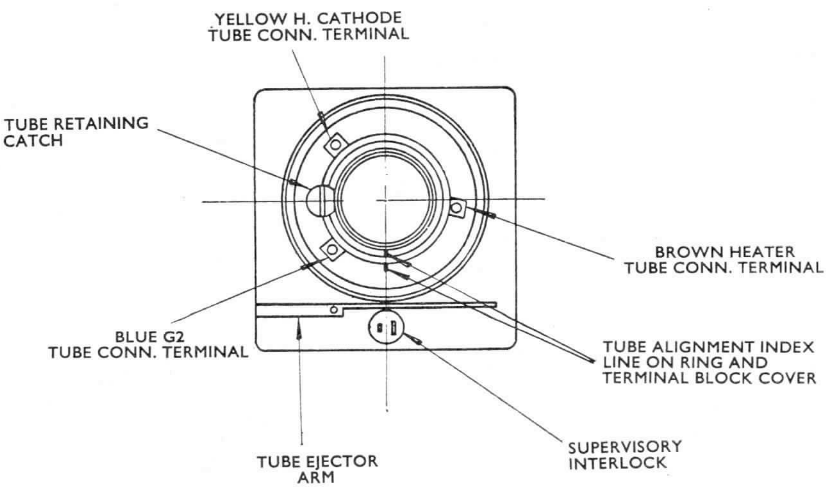
* Applic. to WM112F as supplied Pye MBR.

T.W.T. MOUNT

Code: WM107CA

Fig. 13.—Diagram Showing Operational Controls of WM107CA



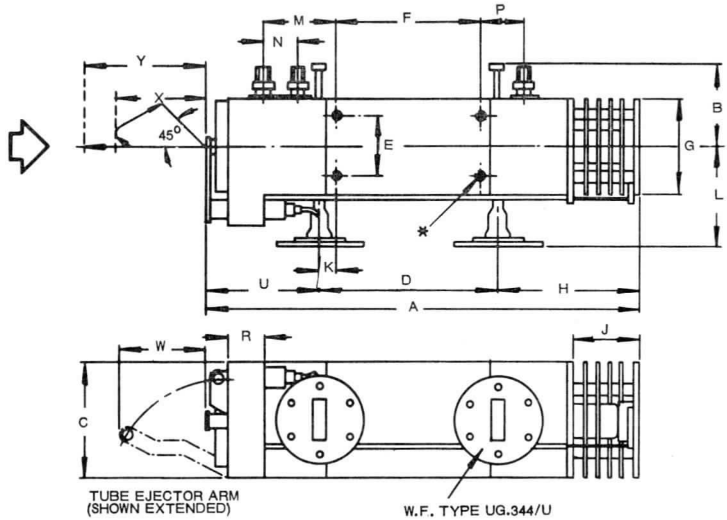


VIEW OF END 'A' WITH COVER REMOVED

T.W.T. MOUNT

Code: WM107GA

Fig. 14.—WM107GA Dimensioned Outline



DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 10" MIN.

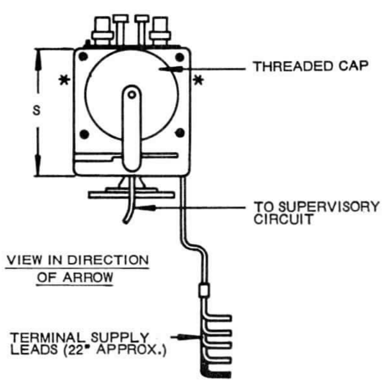
DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 14.1/2" MIN.

* DENOTES:
4-1/4" UNC TAPPED HOLES BOTH SIDES

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR ‡

DIM.	INCHES		MILLIMETRES	
A	15.1/8	NOM.	384,2	NOM.
B	3.1/8	MAX.	79,4	MAX.
C	4.5/16	MAX.	109,5	MAX.
D	6.654	± .020	169,01	± 0,51
E	2.1/4	± 1/32	57,2	± 0,8
F	5.3/8	± 1/32	136,5	± 0,8
G	3.1/2	MAX.	88,9	MAX.
H	4.13/32	± 1/8	111,9	± 3,2
J	2.13/32	± 1/16	61,1	± 1,6
K	11/16	± 1/16	17,5	± 1,6
L	3.7/16	± 1/32	87,3	± 0,8
M	2.3/4	± 1/8	69,9	± 3,2
N	1.3/8	± 1/16	34,9	± 1,6
P	1.21/32	± 1/16	42,1	± 1,6
R	1.1/4	MAX.	31,8	MAX.
S	4.3/8	MAX.	111,1	MAX.
U	4.1/16	± 1/8	103,2	± 3,2
W	2.5/8	APPROX.	66,7	APPROX.

BASIC DIMENSIONS ARE INCHES



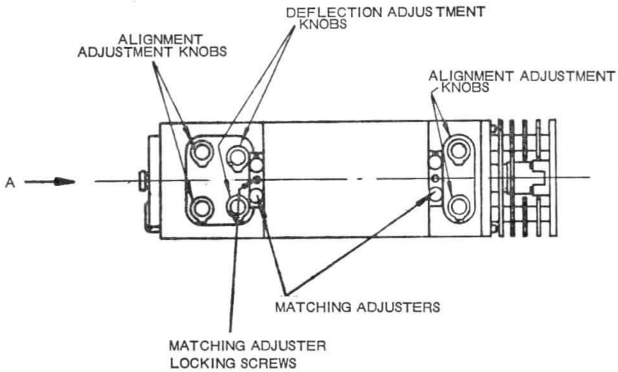
‡The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

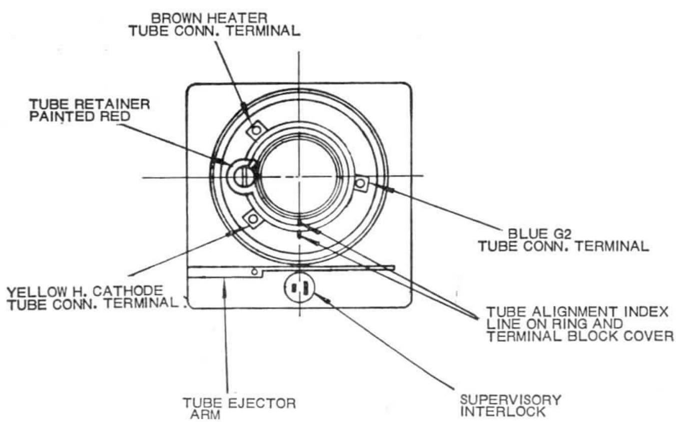
STC

T.W.T. MOUNT

Code: WM107GA

Fig. 15.—Diagram Showing Operation Controls of WM107GA





VIEW OF END 'A' WITH COVER REMOVED

MEDIUM POWER TRAVELLING-WAVE AMPLIFIER TUBE

Code : W5/3G

The W5/3G is a periodically focused travelling-wave amplifier tube of medium power output. It is intended for use in microwave radio links in which there is a requirement for a low AM/PM conversion figure. The typical frequency range of the tube is from 5·85 to 6·5 Gc/s but customers' enquiries are invited regarding extension of frequency range to 8·2 Gc/s.

The W5/3G is designed to operate in the same type of periodic permanent magnet mount as the W5/2G tube and may be easily replaced under field conditions.

MECHANICAL DATA – TUBE

Envelope – Glass and metal

Dimensions and connexion detail are shown in the outline drawing included in this data sheet.

RADIO FREQUENCY PERFORMANCE

Operating frequency range		5·85 to 6·5	Gc/s
Maximum output power		23	W
Gain at 10W output			
Minimum		37	db
Maximum		43	db
Noise factor at small signal levels		< 30	db
Reverse attenuation		> 65	db
Phase sensitivity	$d\Phi/dV_{hel}$	−0·75	°/V
	$d\Phi/dV_{g2}$	+0·25	°/V
A.M./P.M. conversion at 6·250 Gc/s, 10W output		< 1·0	°/db

Modulation peaks (measured in any 20 kc/s band 0·5 to 10 Mc/s from carrier) are less than 3 db above tube noise after 10 hours operation and will continue to improve to less than 1 db above tube noise.

Matching *

Adjustment of two plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 15 Mc/s band when operating at 10W output

RADIO FREQUENCY PERFORMANCE (Cont'd.)

Synchronous helix voltage is the helix voltage which gives maximum gain at low signal levels. An increase in output may be achieved by operating the helix up to 200 volts above the low level value with a resulting drop in gain. A graph showing power output as gain and helix voltage functions of frequency is given in Fig. 2.

* Adjustable in mounts WM107A, 495-LVA-107C and WM107G to less than 1% reflection coefficient at input and output.

TYPICAL OPERATING CONDITIONS

Frequency	6·4	Gc/s
Direct helix to cathode voltage *	3·4	kV
Direct grid 2 to cathode voltage	2·3	kV
Direct collector (earth) to cathode voltage	2	kV
Direct grid 2 current	0·01	mA
Direct helix current	0·5	mA
Direct collector current (adjusted by V_{g2}) ⊀	50	mA
Direct cathode current	50·5	mA
Amplification at 10W output, approx.	40	db
Maximum power output, approx.	22	W
Band of output impedance match to 5% voltage reflection Ø	>15	Mc/s
A.M./P.M. conversion at 10W ≠	0·75	°/db

* Adjusted to give optimum small signal gain. The appropriate helix voltage for individual tubes lies between 3·15 and 3·55 kV.

⊀ The required grid 2 voltage will be between 2·1 and 2·5 kV initially and will rise to about 2·7 kV towards the end of tube life.

Ø The trimming devices must be used for matching each tube at the required operating frequency.

≠ A typical A.M./P.M. conversion graph is shown in Fig. 3.

LIMIT RATINGS

Voltages

Maximum direct helix to cathode	3·7	kV
Maximum direct grid 2 to cathode	2·8	kV
Maximum direct collector (earth) to cathode	3·7	kV
Minimum direct collector to cathode (with tube operating)*	1·8	kV
Maximum direct grid 2 to helix	3·7	kV
Maximum grid 2 to collector	3·7	kV

* The minimum rating is specified to avoid excessive helix current. A minimum of 1·6kV may be used up to 5·0W power output.

Currents

Cathode	55	mA
Helix		
Absolute maximum to trip supplies with delay of less than 5 seconds	4	mA
Switching transient	45	mA
Direct grid 2	0·5	mA

Power Dissipations

Grid 2	2	W
Helix	12	W
Collector (with natural cooling in mounts type WM107A, 495-LVA-107C and WM107G) **	120	W

** Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling.

CATHODE

	MIN.	NOM.	MAX.	
Indirectly heated, oxide coated				
Heater voltage		6·3		V
Heater voltage tolerance				
long term average			±3	%
short term fluctuations up to 2 minutes duration			±5	%
Heater current	0·6	0·7	0·8	A
Heater pre-heating time ⊀	60			s
Interruption time for zero pre-heat			10	s

⊀ Pre-heating time applicable for ambient temperatures above 0°C.

CODE: W5/3G

(Continued)

D.C. SUPPLY VOLTAGES

By the design of the mount it is intended that the tube shall be operated with the collector grounded. However, following the usual convention, electrode voltages given below are referred to cathode potential.

Note :- Voltages must be applied in the correct sequence, as given in "Setting-up Procedure".

Helix Voltage

Adjustable for maximum gain, range	3·1 to 3·7	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically :-		
2% change in V_{hel} causes a 0·5 db fall in gain		
1% change in V_{hel} causes less than 1·0 radian phase change		
Supply impedance, including resistance in mount, maximum (this is required to avoid excessive voltage drop on switch-on).	20	kΩ

Collector Voltage

Set between absolute limits of 1·6 and 3·7 kV
Normally for operation with depressed collector, a nominal voltage of 2·0 kV is chosen.

Grid 2 Voltage (adjusted to give 50mA collector current)

Initial range	2 to 2·4	kV
End of life limit	2·7	kV
Regulation and ripple – a 1% change in grid 2 voltage ives a change of approximately 3% in output power.		

LIFE

Shelf life)
Operational life) Subject to guarantee

Life-end points

(a) V_{g2} greater than 2·7 kV for 50mA collector current,
or (b) I_{hel} greater than 2·5 mA for 50 mA collector current,
or (c) gain or power deteriorated by more than 2 db from initial figures
or (d) failure to meet any other clauses of the specification.

ENVIRONMENTAL CONDITIONS

	MIN.	MAX.	
Storage temperature	−60	+80	°C
Operating ambient temperature *	−10	+60	°C

* In mounts types WM107A, 495-LVA-107C and WM107G.

T.W.T. MOUNTS
CODES: WM107A
495-LVA-107C
WM107G

GENERAL DESCRIPTION

These approved mounts in which W5/3G tubes operate, incorporate a periodic permanent magnet system, r.f. coupling and matching elements, all mechanical deflection and alignment adjustments and a convector cooler.

The variants of the mount differ in respect of pattern or arrangement of wave-guide flanges, matching adjustments and convector cooler. Within limits these features can be arranged to meet the needs of individual users.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges in the unlikely event of a momentary breakdown in the tube.

A detachable lid provides additional microwave screening of the tube and has attached to it a link* which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws: two pairs align the tube and the other pair move a magnetic trimming plate.

Fine adjustments to the matching are made by two plungers in the input and output waveguides.

The tube is held firmly in the mount at the collector by spring contacts in the cooler assembly and at the base ring by a two-position screw located on an end plate.

The mounts are designed so that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

The mounts should be secured by the threaded holes using ¼ inch UNC non-magnetic screws.

* The link and twin lead are omitted on the WM107A.

T.W.T. MOUNTS

(Continued)

MECHANICAL DATA –

Dimensions – See outline drawings

Weight (max.)			18	lbs
			8,16	kg

Fixing – four tapped holes, ¼ inch UNC

Connexions

Electrode leads	4-core P.T.F.E. insulated			
Colour code	As shown in outline drawings			
Length	Mount WM107A	5 ft	1,5	m
	Mount WM107G } Mount 495-LVA-107C }	1·5 ft	0,46	m
Interlock leads	Twin cable. Blue sleeve			
Length	All mounts	1·5 ft	0,46	m

Mechanical deflection and alignment adjustment –

Six knobs on mount

Waveguides, input and output

Mount WM107A	WGL70 with rectangular flange 1·375 in x 0·197 in
Mount WM107G	Built in transition pieces to UG344U flanges
Mount 495-LVA-107C	Built in transition pieces to CMR137 flanges

Mounting position for maximum efficiency of cooler

Mount WM107A	Mount vertical with waveguides in horizontal plane
Mount 495-LVA-107C	Mount horizontal with waveguides in horizontal plane
Mount WM107G	Mount horizontal with waveguides in vertical plane

Free space of not less than 2 inches (5,8 cm) should be provided around the cooler for effective passage of air.

Proximity of magnetic materials

Magnetic material should be kept at least 1 inch (2,5 cm) away from the exterior of the mount, particularly around the waveguides; permanent magnets should be kept at least 9 inches (22,5 cm) away from the axis of the mount.

ELECTRICAL DATA

Ratings

Cathode plus heater, Heater, Second grid, Helix, Collector	As for W5/3G tube		
Supervisory cable and interlock	240 V a.c.	2·0	A

ELECTRICAL DATA (Cont'd.)

Lead Resistance (including limiting resistors)

	WM107A	WM107G 495-LVA-107C	
Second grid	7·5	47	kΩ
Helix	1·0	7·5	kΩ
Heater (at 0·7A and heater line volts drop of 0·05 V)	0·07	0·07	Ω

R.F. Performance

Frequency range	5·85 to 6·6	5·85 to 8·2	Gc/s

Each mount will permit specified performance of W5/3G to be obtained

R.F. Leakage *

Input waveguide level to free space) Output waveguide level to free space)	>65	db

* Measured by using a 2·5 inch x 1·5 inch (6,4 cm x 3,8 cm) waveguide horn to obtain maximum reading.

Matching

Adjustments of two plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 15 Mc/s band

ENVIRONMENTAL CONDITIONS (All Mounts)

Ambient temperature

	MIN.	MAX.	
Operating **	−10	+60	°C
Storage	−60	+60	°C

** In mounts types WM107A, 495-LVA-107C and WM107G.

OPERATIONAL DATA

Cathode Current Control

Satisfactory periodic focusing cannot be obtained with either low helix voltages or low cathode current. The maximum helix current is likely to occur with a helix voltage between 1 200 volts and 2 000 volts, the actual value of current depending upon the setting of the grid 2 voltage relative to the helix voltage. It is essential when switching on to ensure that the helix dissipation does not exceed a safe value. A typical manual control circuit is shown in Fig. 1. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, that of the helix. With the recommended setting, corresponding to 1·8kV on grid 2 with respect to cathode when the helix supply is at 3·3kV, the maximum value of the helix current during the rise of helix voltage may be of the order of 15mA.

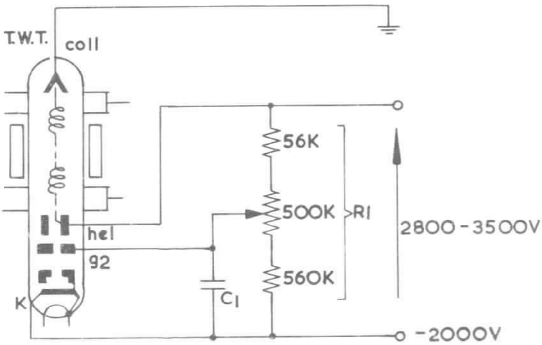
The peak current drawn from the helix supply may be reduced by delaying the rise of grid 2 voltage by means of capacitor C1 in Fig. 1.

The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 500V until the helix voltage has risen to over 2 000V. A suitable value for a helix supply with a rise time T of 0·02 seconds from zero to 2 500V is C1 – 0·04 μF, the surge helix current being reduced to approximately 2 mA.

Values for other conditions may be determined from:

$$C_1 R_1 - 2T$$

Fig. 1. Typical Cathode Current Manual Control Circuit



SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W5/3G tube in its mount for operation:-

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position screw referred to at (3) below is in a position to allow tube to be inserted.

2. Insert tube in mount. At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the cooler contacts and the spring locating on the base ring before the tube meets the stop at the base end. A slight twist will help with this insertion. The black mark on the base of the tube should be aligned with the black mark on the seating. This is necessary for best matching, but the adjustment is not critical, misalignment up to 20° being permissible.

3. Secure tube in mount by rotating the two-position screw to turn over the projection of the tube base ring.*

4. Connect colour-coded leads of the tube to appropriate terminals in the mount.

5. Replace lid making sure that the interlock two-pin plug is fitted correctly in its socket. (Not applicable to mount WM107A).

6. Apply heater voltage and allow one minute heating time.

7. As mentioned in the Cathode Current Control section, satisfactory periodic focusing cannot be obtained with either low helix voltages or low cathode current. Accordingly it is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:-

   (a) switch off any r.f. drive
   (b) pre-set grid 2 voltage (cathode current control) to give about 1·8kV when switched on; this corresponds to a cathode current of about 35mA. At lower voltages the helix current may be excessive.

8. After the one minute cathode pre-heat, switch on collector voltage at 2·0kV.

9. Switch on simultaneously the helix voltage at 3·3kV and the grid 2 voltage to the pre-set value.

10. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until a collector current of 50 mA is achieved.

SETTING-UP PROCEDURE (Cont'd.)

11. Apply r.f. input and adjust helix voltage for optimum performance; a slight re-adjustment of the control knobs may be necessary to obtain minimum helix current, and of grid 2 voltage to maintain a collector current of 50mA.

It is necessary to operate the tube with the collector earthed and the cathode at a negative potential with respect to earth. To obtain optimum performance, the tube should be operated at the rated collector current of 50mA. Towards the end of the life of the tube it is likely that the helix current may rise to about 2·0mA and the grid 2 voltage, which was initially between 2·1 and 2·4kV, will rise to about 2·6kV.

* Special Note

Once the tube is in its operating position in the mount, any undue pressure on the collector ejector knob (located at the end of the cooler) may cause damage to the tube. Accordingly, care must be taken to ensure that the ejector knob is not knocked, or, that when the tube is to be removed no pressure is exerted on the knob until the two-position clamping screw has been turned to clear the tube base ring.

TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position clamping screw to clear the tube base ring.
7. Support the base end of the tube and gradually apply pressure to the collector ejector knob to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal.

Fig. 2. Typical Frequency Characteristics

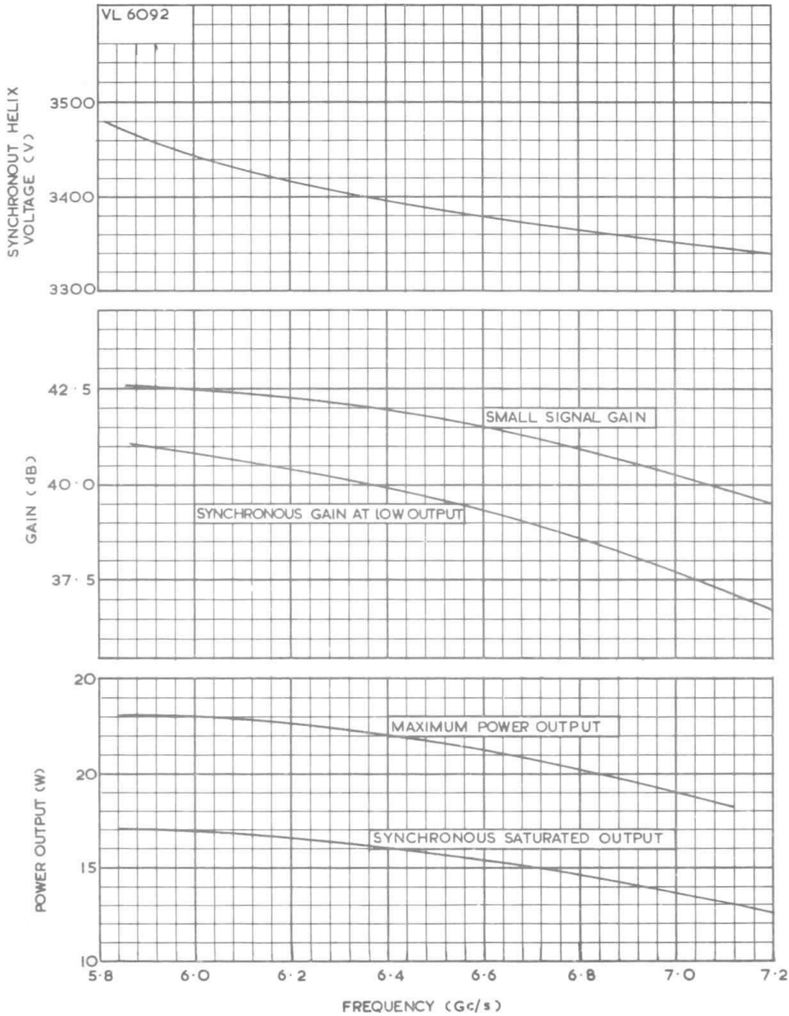
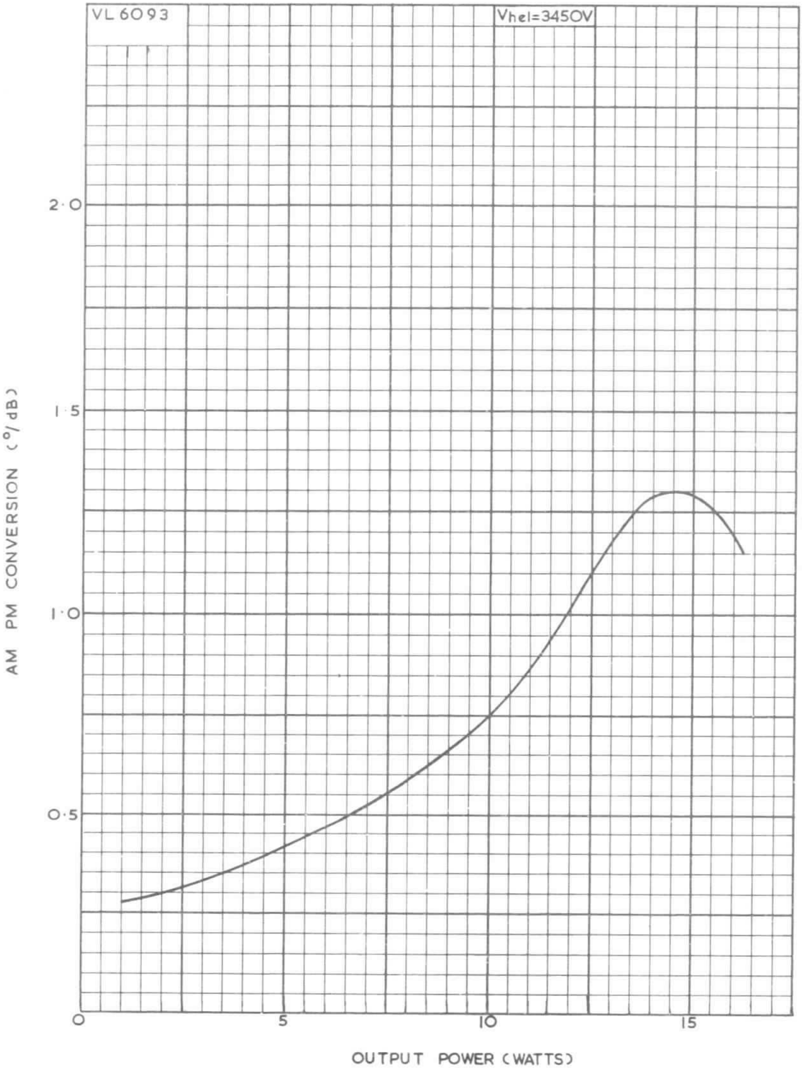
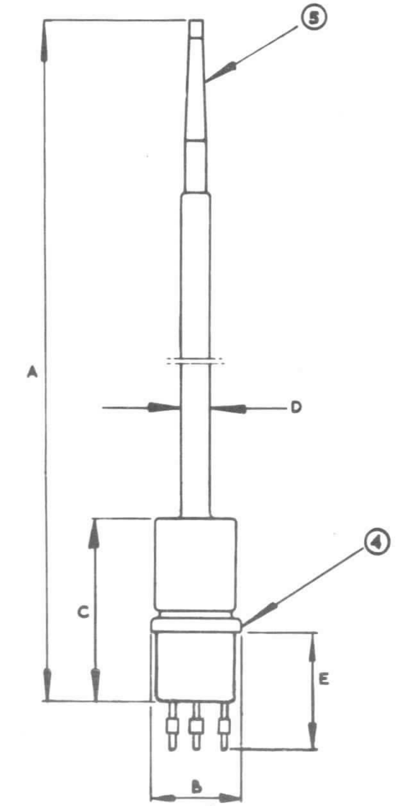
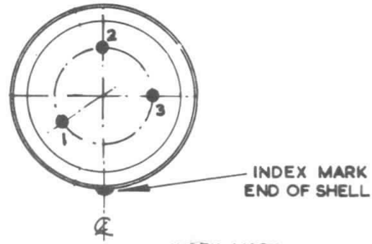


Fig. 3. AM/PM Conversion versus Power Output



W5/3G Outline





INDEX MARK AND PIN No.2 WILL NOT DEVIATE FROM A COMMON ℄ BY MORE THAN 15° IN EITHER DIRECTION

LEAD	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	YELLOW	HEATER, CATHODE, GRID 1
3	BROWN	HEATER
CONTACT		
4		HELIX
5		COLLECTOR

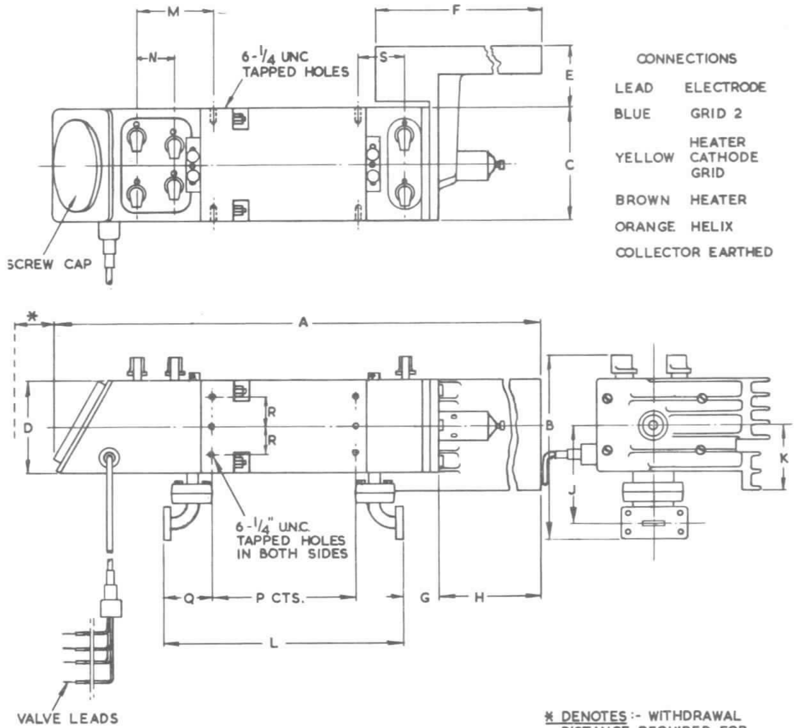
NOTE:- BASIC FIGURES ARE INCHES

DIM	MILLIMETRES	INCHES
A	346,76 MAX.	13·652 MAX.
B	36,20±0·18	1·425±0·007
C	70,61 MAX.	2·780 MAX.
D	9,27 MAX.	0·365 MAX.
E	73,0 ± 3·2	2 7/8 ± 1/8

CODE: W5/3G

(Continued)

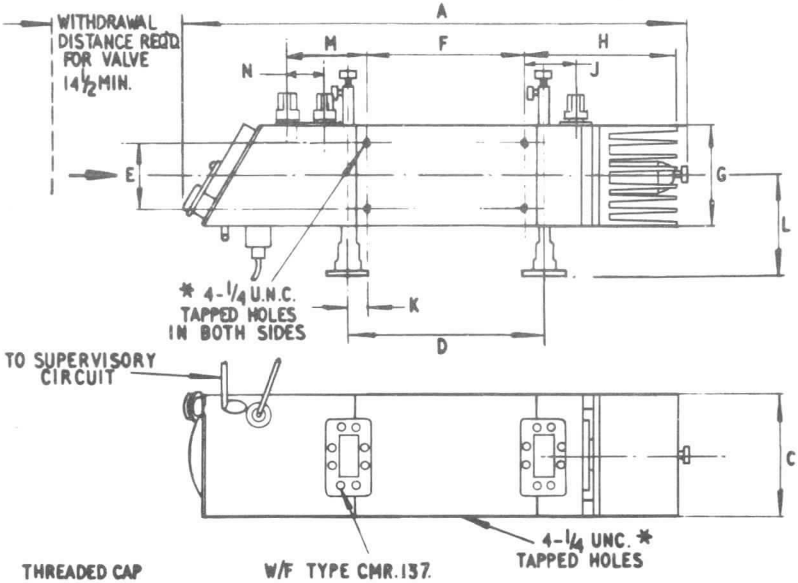
WM107A Outline

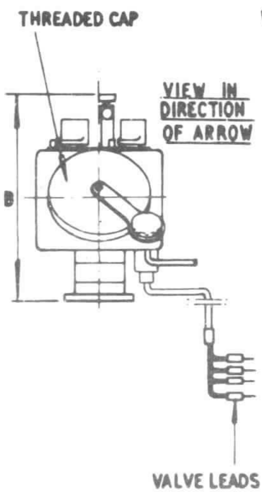


* DENOTES :- WITHDRAWAL DISTANCE REQUIRED FOR VALVE 14 1/2 MIN.

DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	533,4 MAX.	21 MAX.	H	168,3 MAX.	$6\frac{5}{8}$ MAX.	Q	42,9 ± 1,6	$1\frac{11}{16} \pm \frac{1}{16}$
B	193,7 MAX.	$7\frac{5}{8}$ MAX.	J	103,56 ± 0,25	4·077 ± C·010	R	28,6 ± 0,4	$1\frac{1}{8} \pm \frac{1}{64}$
C	109,5 MAX.	$4\frac{5}{16}$ MAX.	K	66,7 MAX.	$2\frac{5}{8}$ MAX.	S	42,1 ± 1,6	$1\frac{21}{32} \pm \frac{1}{16}$
D	88,9 MAX.	$3\frac{1}{2}$ MAX.	L	219,86 ± 0,25	8·656 ± 0·010			
E	58,7 MAX.	$2\frac{5}{16}$ MAX.	M	69,9 ± 3·2	$2\frac{3}{4} \pm \frac{1}{8}$			
F	225,4 MAX.	$8\frac{7}{8}$ MAX.	N	34,9 ± 1,6	$1\frac{3}{8} \pm \frac{1}{16}$	NOTE:- BASIC DIMENSIONS ARE IN INCHES		
G	30,2 APPROX	$1\frac{3}{16}$ APPROX.	P	136,5 ± 0,8	$5\frac{3}{8} \pm \frac{1}{32}$	NETT. WT. APPROX.		LBS. KGS.

495-LVA-107C Outline





CONNECTIONS

LEAD	ELECTRODE
BLUE	GRID. 2.
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

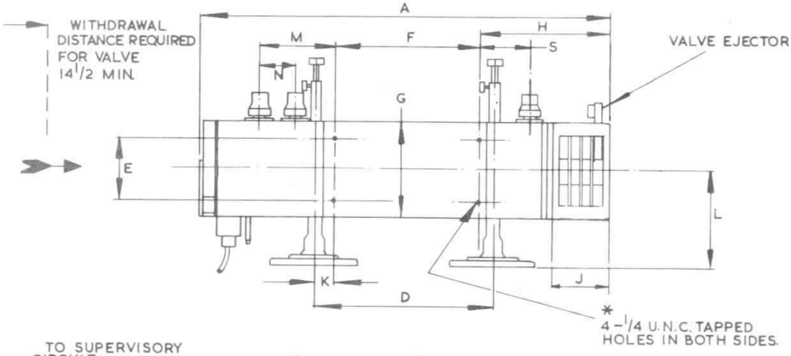
DIM.	MILLIMETRES	INCHES
A	438,2 MAX.	17¼ MAX.
B	228,6 MAX.	9 MAX.
C	109,5 MAX.	4 5/16 MAX.
D	169,01 ± 0,51	6·654 ± 0·020
E	57,2 ± 0,8	2¼ ± 1/32
F	136,5 ± 0,8	5 3/8 ± 1/32
G	88,9 MAX.	3½ MAX.
H	139,7 MAX.	5½ MAX.
J	42,1 ± 1,6	1 21/32 ± 1/16
K	17,5 ± 1,6	11/16 ± 1/16
L	87,3 ± 0,8	3 7/16 ± 1/32
M	69,9 ± 3,2	2¾ ± 1/8
N	34,9 ± 1,6	1 3/8 ± 1/16

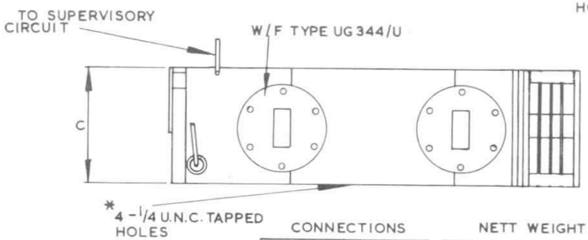
NOTE:-
BASIC DIMENSIONS ARE IN INCHES.

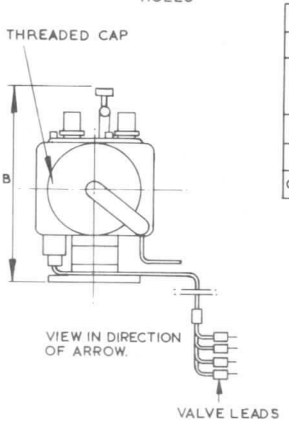
CODE: W5/3G

(Continued)

WM107G Outline







CONNECTIONS

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID.1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

NOTE :- BASIC DIMENSIONS ARE IN INCHES

NETT WEIGHT LBS APPROX.

DIM	MILLIMETRES	INCHES
A	381,0 MAX.	15 MAX.
B	228,6 MAX.	9 MAX.
C	109,5 MAX	4 5/16 MAX.
D	169,01 ± 0,51	6·654 ± 0·020
E	57,2 ± 0,8	2 1/4 ± 1/32
F	136,5 ± 0,8	5 3/8 ± 1/32
G	88,9 MAX.	3 1/2 MAX.
H	119,1 MAX.	4 11/16 MAX.
J	54,0 MAX.	2 1/8 MAX.
K	17,5 ± 1,6	11/16 ± 1/16
L	87,3 ± 0,8	3 7/16 ± 1/32
M	71,4 ± 3,2	2 13/16 ± 1/8
N	36,5 ± 1,6	1 7/16 ± 1/16
S	42,1 ± 1,6	1 21/32 ± 1/16

Standard Telephones and Cables Limited

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SPECIAL VALVES

Travelling-Wave Amplifier Tube

Code: W7/4G (CV6162)

The W7/4G is a travelling-wave amplifier tube intended for use in microwave radio links in the frequency range 3·6 to 5 Gc/s. The tube is operated in periodic permanent magnet type mounts 495-LVA-101A, B or C, in which it will give the performance quoted in these data sheets. The design of the mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	3·6 to 5	Gc/s
Maximum power output	15	W
Gain at 6W output		
Minimum	35	db
Maximum	42	db
Noise factor at small signal levels	27	db
Reverse attenuation	>65	db
Phase sensitivity		
$d\Phi/dV_{hel}$	0·75	°/V
$d\Phi/dV_{g2}$	0·25	°/V
AM/PM conversion at 6W output	2	°/db

Modulation noise peaks

Measured in any 4 kc/s band 0·5 to 10 Mc/s from carrier are less than 3 db above tube noise after 10 hours and will continue to improve to less than 1 db above tube noise.

Matching

Adjustment of plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 15 Mc/s band when operating at 6W output.

Graphs showing typical power output, helix voltage and gain as functions of frequency are shown in Figure 1 and a graph of typical output power versus input power is given in Figure 2. Figure 3 shows typical maximum power output and gain at 6W versus helix voltage.

Synchronous helix voltage is that which gives maximum gain at low signal levels.

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C O M P O N E N T S G R O U P

STC

Code: W7/4G (CV6162)

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	3·9	4·7	Gc/s
Direct helix to cathode voltage (Note 2)	3	2·95	kV
Direct grid 2 to cathode voltage (Note 3)	2	2	kV
Direct collector (earth) to cathode voltage	2	2	kV
Direct grid 2 current	0·01	0·01	mA
Direct helix current	0·5	0·5	mA
Direct collector current	40	40	mA
Direct cathode current	40·5	40·5	mA
Gain at 6W output, approx.	40	37	db
Saturated output at synchronous helix voltage, approx.	12	9	W
Band of output impedance match to 5% voltage reflection (Note 4)	>15	>15	Mc/s

Note 1. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. The matching plungers must be adjusted for each tube at the required operating frequency.

CATHODE

Indirectly-heated, oxide-coated type.

HEATER

	Min	Nom	Max	
Heater voltage (Note 5)		6·3		V
Heater voltage tolerance				
Long-term average			±3	%
Short-term fluctuations up to 2 minutes duration			±5	%
Heater current	0·65	0·73	0·85	A
Heater pre-heating time	60			s
Interruption time for zero pre-heat			10	s

Note 5. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 cycles. Other frequencies of supply up to 10 kc/s may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W7/4G

CONTINUED

LIMIT RATINGS

Voltages	Min	Max	
Direct helix to cathode (Note 6)	2·8	3·5	kV
Direct grid 2 to cathode	—	2·8	kV
Direct collector (earth) to cathode (Note 6)	1·6	3·5	kV
Direct grid 2 to helix		3·5	kV
Direct grid 2 to collector		3·5	kV

Note 6. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

Currents	Nom	Max	
Cathode	40	50	mA
Helix			
Absolute maximum to trip supplies with delay of less than 5 seconds		4	mA
Switching transient	5	45	mA
Direct grid 2	0·01	0·5	mA

Power Dissipations		
Grid 2	2	W
Helix	12	W
Collector (Note 7)	100	W

Note 7. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling.

STC

Code: W7/4G

CONTINUED

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage		
Adjustable for required working conditions, range	2·8 to 3·3	kV
The synchronous helix voltage for individual tubes lies within the range	2·8 to 3·1	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically:		
2% change in helix voltage causes a fall of gain of	0·5	db
1% change in helix voltage causes a phase change of approximately	25	°
Supply impedance, including resistance in mount, maximum (Note 8)	20	k Ω

Note 8. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage		
Set between absolute limits of	1·6 and 3·5	kV
For operation with depressed collector it is usual to choose a nominal voltage of	2	kV

A minimum collector voltage of 1·6kV may be used up to 5W output power.

Grid 2 Voltage		
Adjustable for required working conditions, range	1·7 to 2·6	kV
When adjusted to give 40mA collector current		
Initial range is	1·8 to 2	kV
End of life limit is	2·6	kV

Code: W7/4G

CONTINUED

MECHANICAL DATA (W7/4G)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 5

LIFE

Shelf life Operational life	Subject to guarantee

Life-end points

(a) Grid 2 voltage greater than 2·6kV for 40mA collector current, or
(b) Helix current greater than 3mA for 40mA collector current, or
(c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min	Max	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

STC

T.W.T. Mounts
Codes: 495-LVA-101A
495-LVA-101B
495-LVA-101C

GENERAL DESCRIPTION

These approved mounts in which W7/4G tubes operate, incorporate a periodic permanent magnet system, r.f. coupling and matching elements, mechanical deflection and alignment adjustments and a convector cooler.

The variants of the mount differ in respect of pattern or arrangement of waveguide flanges, matching adjustments, deflection and alignment devices and convector cooler. Within limits these features can be arranged to meet the needs of individual users.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges in the unlikely event of a momentary breakdown in the tube.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of two pairs of mechanical positioning screws: one pair align the tube and the other pair move a magnetic trimming plate.

Fine adjustments to the matching are made with movable plungers in the waveguides. These plungers are controlled by knobs and locking screws on the input and output waveguides.

The tube is held firmly in the mount at the collector end by spring contacts in the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining screw: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining screw is shown in Figures 7, 9 and 11.)

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external knob. On the 495-LVA-101A mount this knob is fitted to the cooler; on the 495-LVA-101B and 495-LVA-101C mounts the knob is located at the lid end. (See Figures 7, 9 and 11).

The design of the mounts is such that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

The mounts should be secured by the threaded holes using $\frac{1}{4}$-inch UNC non-magnetic screws.

Codes: 495-LVA-101A 495-LVA-101B 495-LVA-101C

CONTINUED

MECHANICAL DATA—MOUNTS

Dimensions	As shown in Figures 6, 8 and 10.			
Weight, maximum		24 lb	10,9	kg
Fixing	Four tapped holes, $\frac{1}{4}$ inch UNC			
Connections				
Electrode leads				
Type	4-core PTFE insulated cable			
Colour coding	As shown in Figures 6, 8 and 10.			
Length of leads	Mount 495-LVA-101A and C	18 in.	45,5	cm
	Mount 495-LVA-101B	60 in.	152,4	cm
Interlock leads				
Type	Twin cable			
Length of leads	Mount 495-LVA-101A and C	18 in.	45,5	cm
	Mount 495-LVA-101B	36 in.	91,4	cm
Sleeve colour	Blue			

Mechanical alignment and deflection adjustments

Alignment	Two external knobs (Note 9)
Deflection	Two external knobs (Note 9)

R.F. matching adjustment. Plungers in the input and output waveguides (Note 9)

Waveguides, input and output

Mounts 495-LVA-101A and B	WG12A (2 in. × 0·666 in. internal). See Figure 12 for details
Mount 495-LVA-101C	Built-in transition pieces to WR229

Mounting position for maximum efficiency of cooler

Mount 495-LVA-101A	Mount horizontal with waveguides in horizontal plane
Mounts 495-LVA-101B and C	Mount horizontal with waveguides in vertical plane

Proximity of magnetic materials

Magnetic materials should be kept at least 1 inch (2,5 cm) away from the exterior of the mount, particularly around the waveguides; permanent magnets should be kept at least 9 inches (22,5 cm) away from the axis of the mount.

Note 9. Positions of adjustment controls on mounts are shown in Figures 7, 9 and 11.

COOLING

The cooler is an integral part of each mount. Cooling takes place by convection and it is important that a mount is installed in the plane recommended.

The air flow through the cooler requires a free space of 2 inches (5 cm) above and below it with access to a free supply of air at ambient temperature; this is to ensure that the convection cooling is efficient. The cooler temperature under normal conditions of operation is about 70°C above ambient temperature.

If values of collector dissipation in excess of the specified limit rating are employed, the normal convection cooling must be supplemented by forced-air-cooling. (See Note 7 in Limit Ratings Section.)

STC

Codes: 495-LVA-101A
495-LVA-101B
495-LVA-101C

CONTINUED

ELECTRICAL DATA

Ratings

Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 2 } to body of mount, maximum voltage		4	kV
Supervisory cable and interlock	240V a.c.	2	A

Lead Resistance (including limiting resistors)

	495-LVA-101A & C	495-LVA-101B	
Grid 2	47	47	k Ω
Helix	7·5	1	k Ω
Heater (Note 10)	0·07	0·07	Ω

Note 10. At 0·7A and heater line voltage drop of 0·05V.

R.F. PERFORMANCE

	495-LVA-101A & C	495-LVA-101B	
Frequency range	3·6 to 5	3·8 to 5	Gc/s

Each mount will permit the specified performance of the W7/4G tube to be achieved.

R.F. leakage (Note 11)

Input waveguide level to free space	>65	>65	db
Output waveguide level to free space	>65	>65	db

Matching

Adjustment of plungers in the input and output waveguides will give a VSWR less than 1·02 at a spot frequency and less than 1·1 over a 30 Mc/s band (tube not operating).

Note 11. Measured by using a 2 inch × 2 inch (5,08 cm × 5,08 cm) waveguide horn in such a way as to obtain a maximum reading.

ENVIRONMENTAL CONDITIONS (All mounts)

Ambient temperature range

	Min	Max	
Operating	−10	+60	°C
Storage	−60	+60	°C

Code: W7/4G

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:

50mA for not longer than 10 milliseconds
20mA for not longer than 150 milliseconds
10mA for not longer than 1 second
4mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 4. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. With the recommended setting, corresponding to 1 700 volts on grid 2 with respect to cathode when the helix supply is at 3 000 volts, the maximum value of helix current during the rise of helix voltage may be of the order of 10mA.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage by means of capacitor C_1 in Figure 4. The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 500 volts until the helix voltage has risen to over 2 000 volts. A suitable value for a helix supply with a rise time of 0·02 seconds from zero to 2 500 volts is $C_1 = 0{\cdot}04\mu F$, the surge helix current being reduced to approximately 2mA.

Towards the end of the life of the tube it is likely that the helix current will rise to about 2·5mA and the grid 2 voltage, which initially was between 1 800 and 2 000 volts, will increase to about 2 500 volts.

Code: W7/4G

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W7/4G tube in its mount for operation:—

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining screw is in a position to allow tube to be inserted.
2. Insert tube in mount (Note 12). At the end of the travel of the tube, pressure needs to be applied to overcome the resistance of the cooler contacts and the spring locating on the base ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The blue spot on the base of the tube should be aligned with the black mark on the seating. This is necessary for best matching, but the adjustment is not critical, misalignment up to 20° being permissible.
3. Secure tube in mount by rotating the two-position retaining screw to turn over the projection of the tube base ring (Note 13).
4. Connect colour-coded leads of the tube to appropriate terminals in the mount and ensure that mount is properly earthed.
5. Replace lid making sure that the interlock two-pin plug is fitted correctly in its socket.
6. Apply heater voltage and allow one minute heating time.
7. It is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:—
   (a) switch off any r.f. drive
   (b) pre-set grid 2 voltage (cathode current control) to give about 1·7kV when switched on; this corresponds to a cathode current of about 35mA. At lower voltages the helix current may be excessive.
8. After the one minute cathode pre-heat, switch on collector voltage at 2kV.
9. Switch on simultaneously the helix voltage at 3kV and the grid 2 voltage to the pre-set value.
10. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until a collector current of 40mA is achieved.
11. Apply r.f. input and adjust helix voltage for optimum performance; a slight readjustment of the control knobs may be necessary to obtain minimum helix current, and of grid 2 voltage to maintain a collector current of 40mA.

Note 12. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment. When the tube is inserted in the same plane as the longitudinal axis of the mount, a minimum free space of 18 inches (45,7cm) is needed. By presenting the tube at an angle of 45° to the main axis of the mount a minimum free space of 14 inches (35,6cm) is required.

Note 13. Once the tube has been secured by the retaining screw, it is important to ensure that the tube ejection mechanism is not operated inadvertently. Failure to observe this precaution may result in the tube being damaged.

Code: W7/4G

CONTINUED

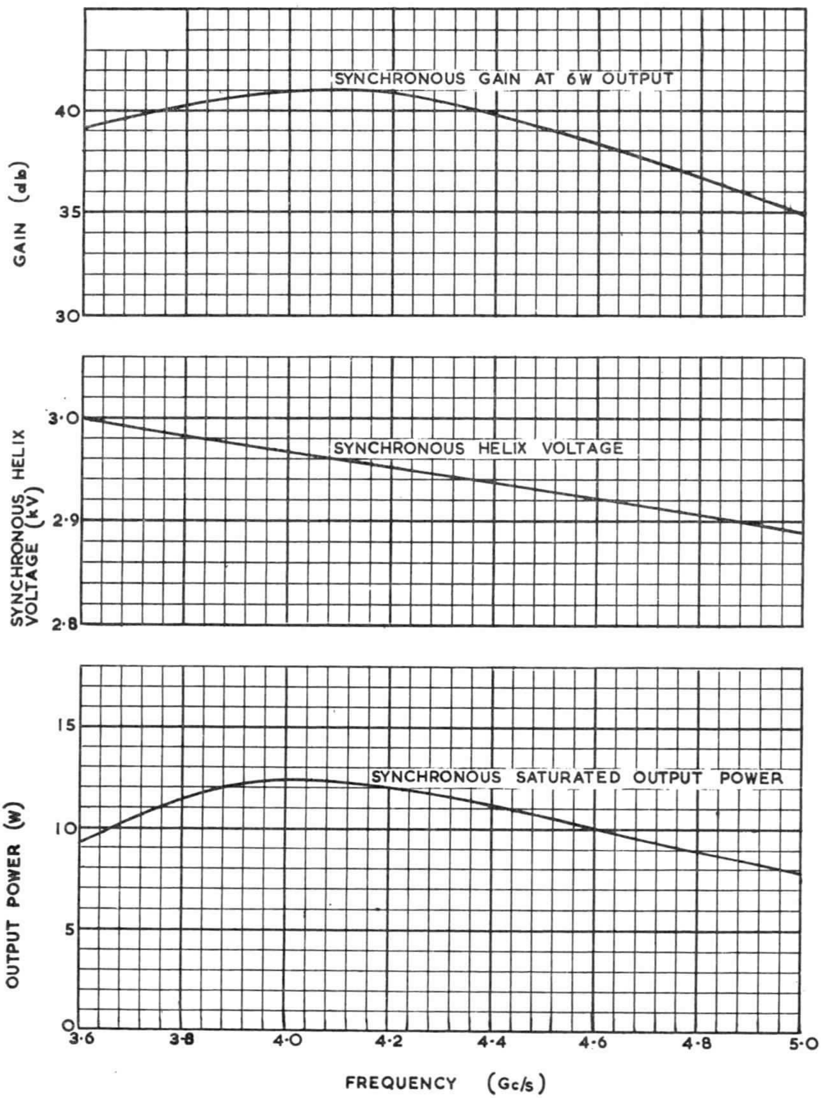
TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining screw to clear the tube base ring.
7. Support the base end of the tube and gradually operate the tube ejector knob to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal

Code: W7/4G

CONTINUED

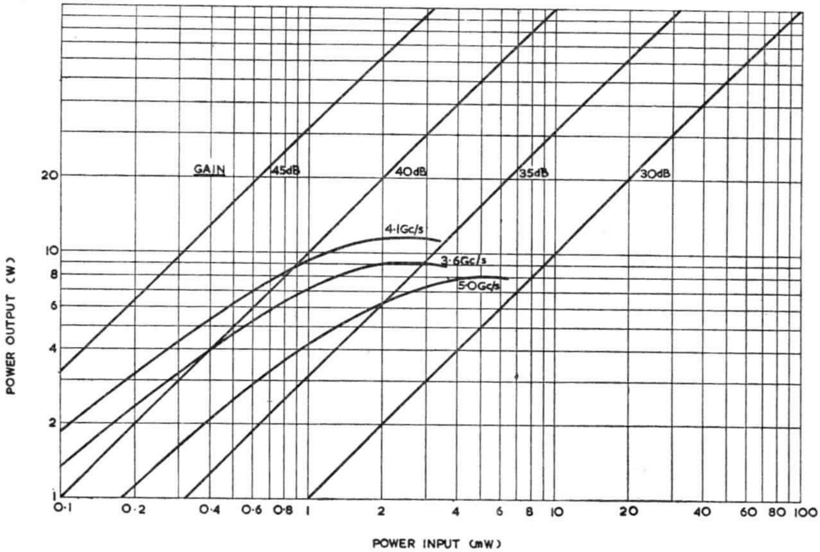
Fig. 1.—Typical Frequency Characteristics



Code: W7/4G

CONTINUED

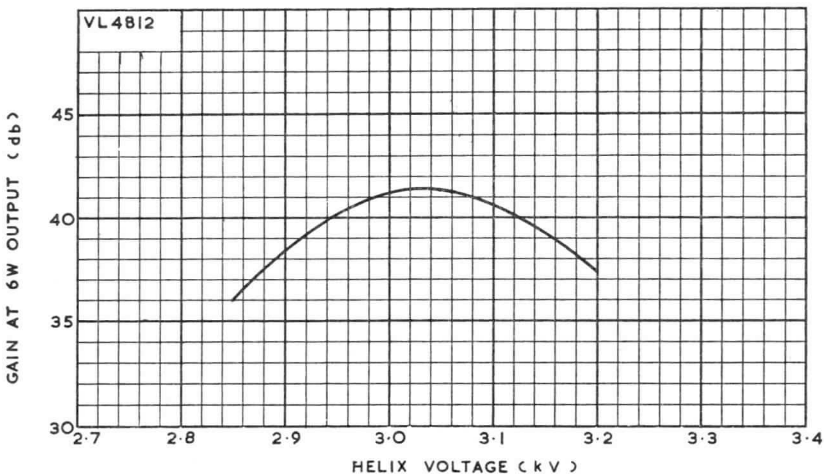
Fig. 2.—Typical Power Output versus Power Input (At Synchronous Helix Voltage)

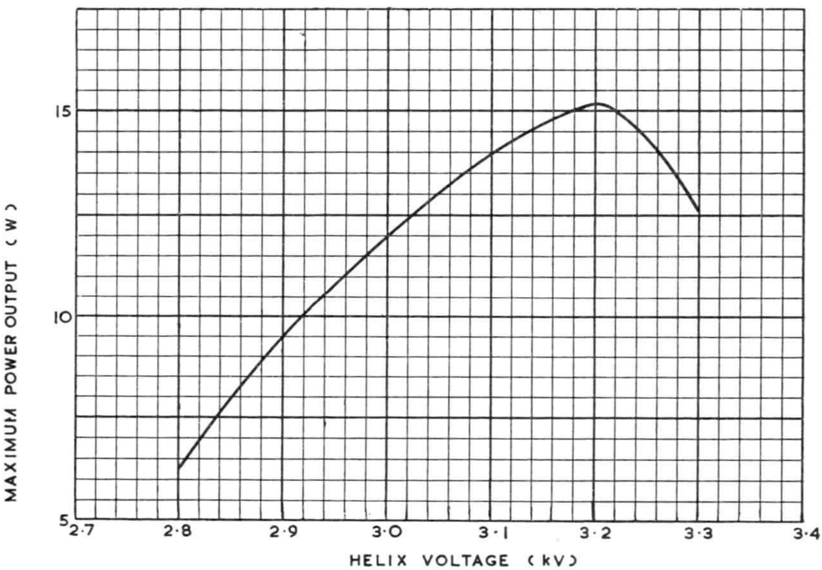


Code: W7/4G

CONTINUED

Fig. 3.—Typical Helix Voltage Characteristics
(Measured at 3·9 Gc/s)

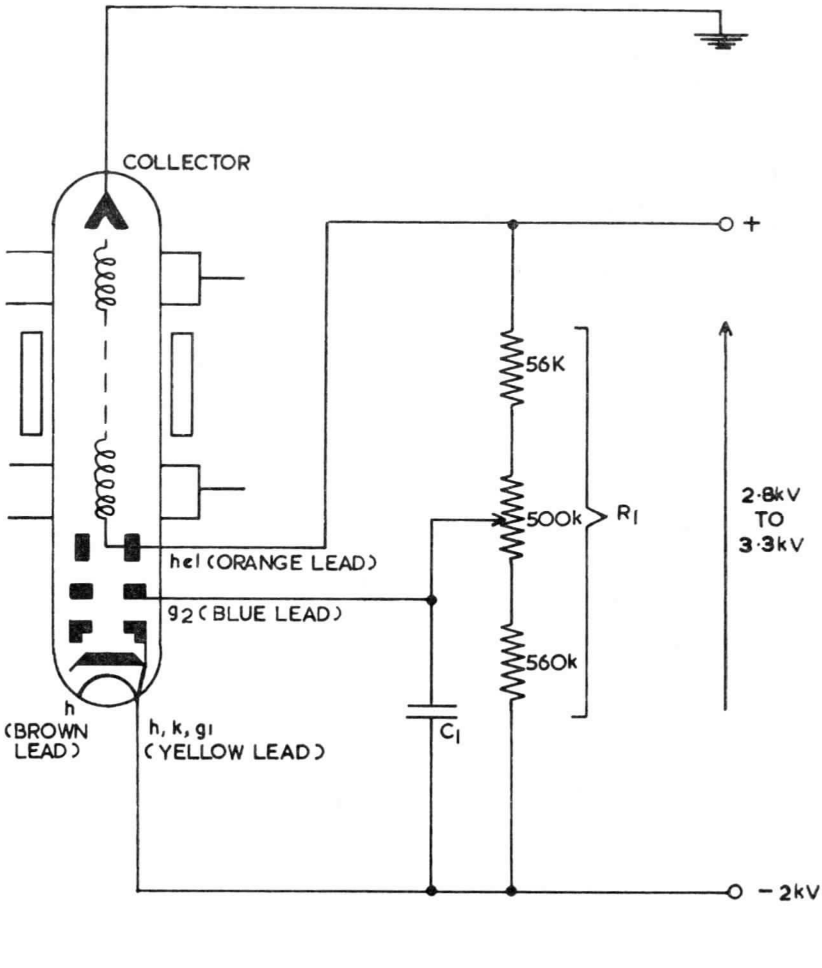




Code: W7/4G

CONTINUED

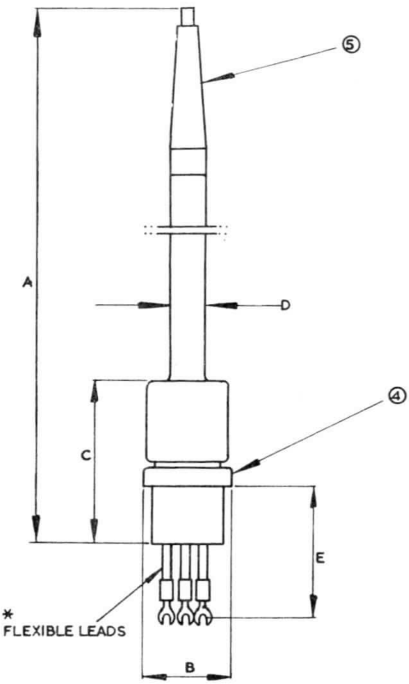
Fig. 4.—Typical Cathode Current Control Circuit

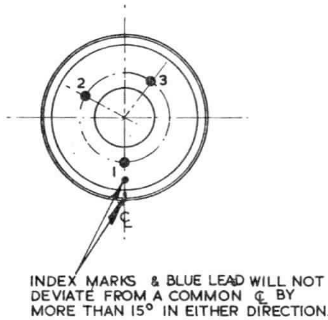


Code: W7/4G

CONTINUED

Fig. 5.—W7/4G Dimensioned Outline





LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	YELLOW	HEATER, CATHODE, GRID 1
3	BROWN	HEATER
CONTACT		
4		HELIX
5		COLLECTOR

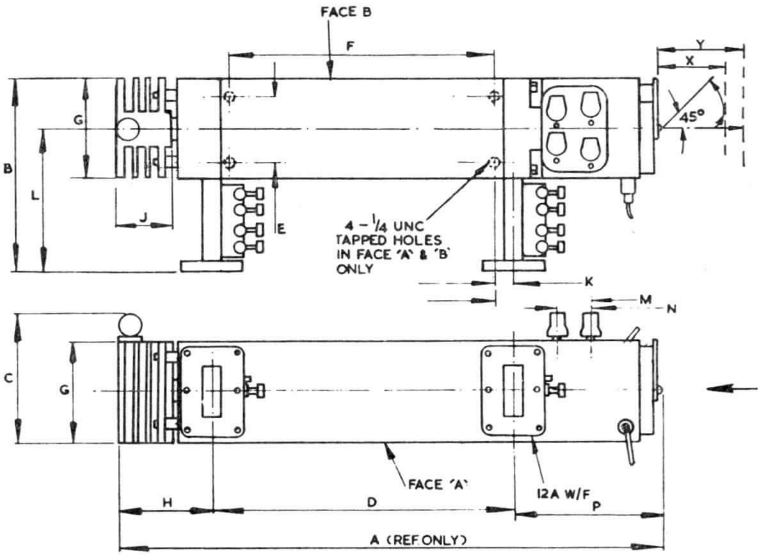
NOTE:- BASIC FIGURES ARE INCHES.

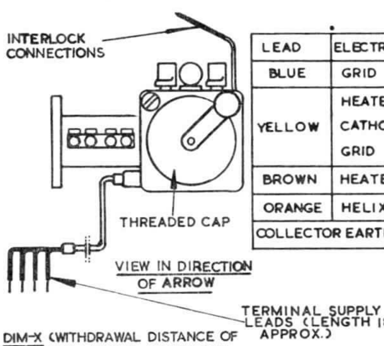
DIM	MILLIMETRES	INCHES
A	465,43 MAX.	18·324 MAX.
B	36,20 ± 0,18	1·425 ± 0·007
C	70,62 MAX.	2·780 MAX.
D	13,46 MAX.	0·530 MAX.
E	57,2 ± 3,2	2 1/4 ± 1/8 •

T.W.T. Mount

Code: 495-LVA-101A

Fig. 6.—495-LVA-101A Dimensioned Outline





LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

NETT WEIGHT 23 LBS APPROX.

DIM	MILLIMETRES	INCHES
A	514, 4 MAX.	20 1/4 MAX.
B	193, 7 MAX.	7 5/8 MAX.
C	127, 0 MAX.	5 MAX.
D	286, 26 ± 0, 51	11·270 ± 0·020
E	57, 2 ± 0, 8	2 1/4 ± 1/32
F	238, 1 ± 0, 8	9 3/8 ± 1/32
G	98, 4 MAX.	3 7/8 MAX.
H	84, 1 ± 2, 4	3 5/16 ± 3/32
J	54, 0 MAX.	2 1/8 MAX.
K	23, 8 ± 1, 6	15/16 ± 1/16
L	139, 7 ± 1, 6	5 1/2 ± 1/16
M	97, 6 ± 3, 2	3 27/32 ± 1/8
N	34, 9 ± 1, 6	1 3/8 ± 1/16
P	136, 5 ± 4, 8	5 3/8 ± 3/16

DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 14" MIN.
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 18" MIN.

NOTE:- BASIC DIMENSIONS ARE INCHES.

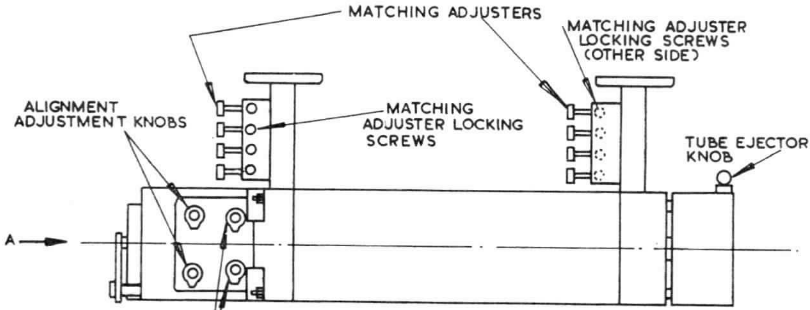
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

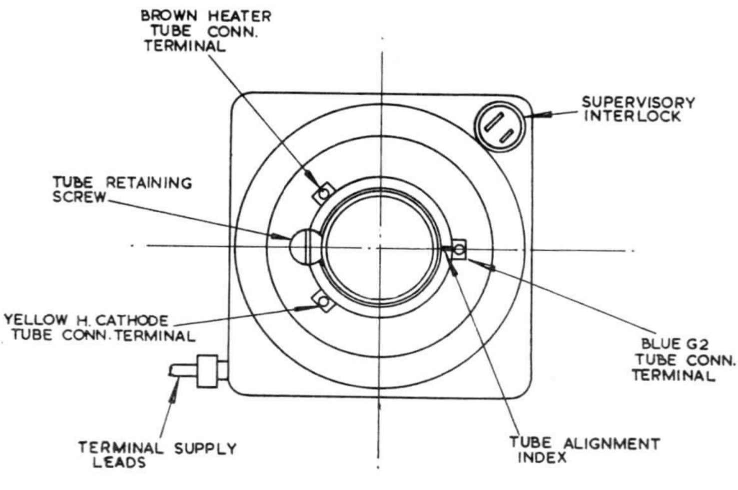
T.W.T. Mount

Code: 495-LVA-101A

CONTINUED

Fig. 7.—Diagram Showing Operational Controls of 495-LVA-101A



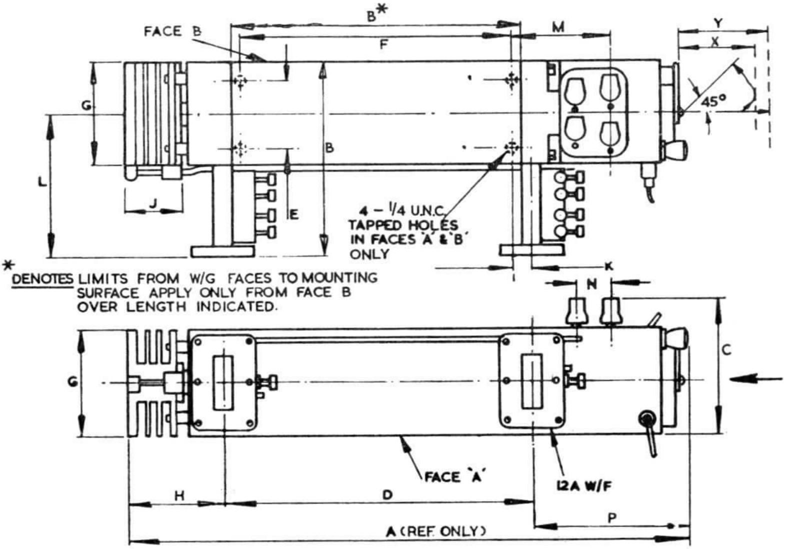


VIEW OF END 'A' WITH COVER REMOVED

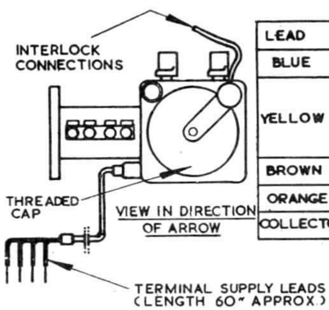
T.W.T. Mount

Code: 495-LVA-101B

Fig. 8.—495-LVA-101B Dimensioned Outline



NETT WEIGHT 23 LBS APPROX.



LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID 1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM	MILLIMETRES	INCHES
A	514,4 MAX.	20 1/4 MAX.
B	187,33 ± 0,51	7·375 ± 0·020
C	127,0 MAX.	5 MAX.
D	286,26 ± 0,51	11·270 ± 0·020
E	57,2 ± 0,8	2 1/4 ± 1/32
F	238,1 ± 0,8	9 3/8 ± 1/32
G	98,4 MAX.	3 7/8 MAX.
H	84,1 ± 2,4	3 5/16 ± 3/32
J	54,0 MAX.	2 1/8 MAX.
K	23,81 ± 0,51	0·937 ± 0·020
L	139,70 ± 0,51	5·500 ± 0·020
M	97,6 ± 3,2	3 27/32 ± 1/8
N	34,9 ± 1,6	1 3/8 ± 1/16
P	136,5 ± 4,8	5 3/8 ± 3/16

DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 14" MIN.
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 18" MIN.

NOTE:-
BASIC DIMENSIONS ARE INCHES.

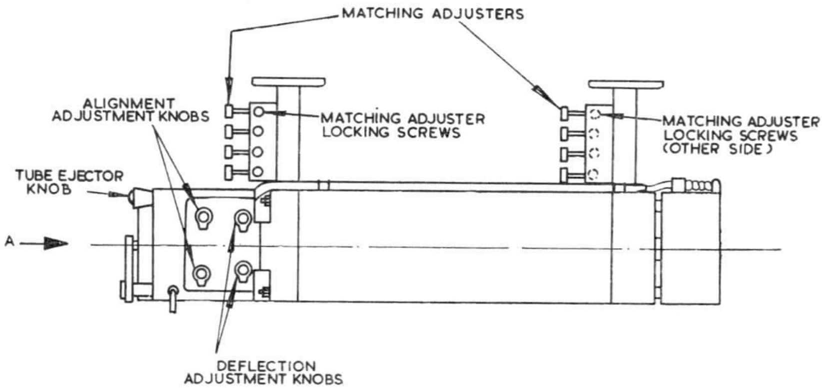
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

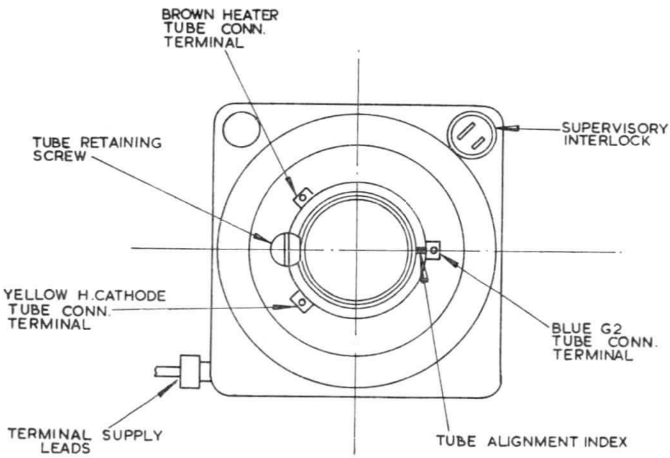
T.W.T. Mount

Code: 495-LVA-101B

CONTINUED

Fig. 9.—Diagram Showing Operational Controls of 495-LVA-101B



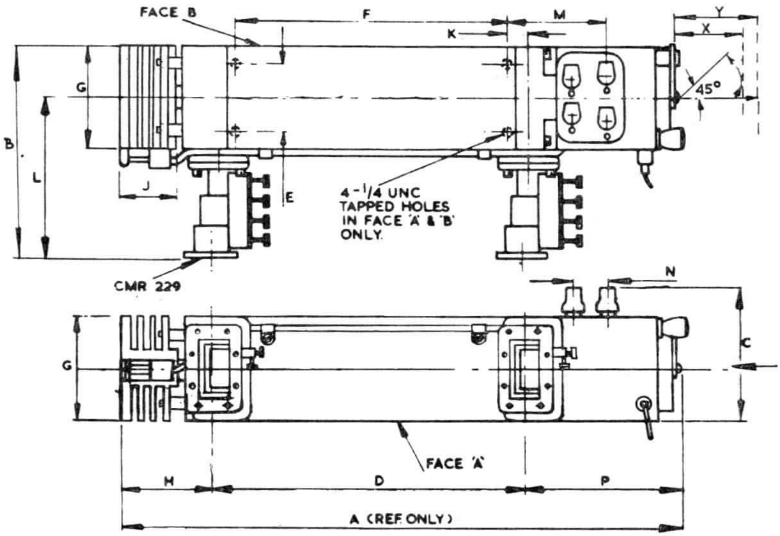


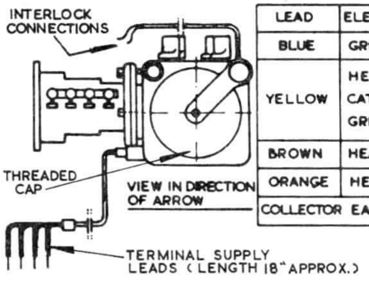
VIEW OF END 'A' WITH COVER REMOVED

T.W.T. Mount

Code: 495-LVA-101C

Fig. 10.—495-LVA-101C Dimensioned Outline





LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

NETT. WEIGHT 23LBS APPROX.

DIM	MILLIMETRES	INCHES
A	514,4 MAX	20 1/4 MAX
B	198,4 MAX	7 13/16 MAX
C	127,0 MAX	5 MAX
D	286,26 ± 0,51	11·270 ± 0·020
E	57,2 ± 0,8	2 1/4 ± 1/32
F	238,1 ± 0,8	9 3/8 ± 1/32
G	98,4 MAX	3 7/8 MAX
H	77,8 ± 2,4	3 1/16 ± 3/32
J	54,0 MAX	2 1/8 MAX
K	17,5 3,2	11/16 ± 1/8
L	147,6 ± 1,6	5 13/16 ± 1/16
M	97,6 ± 3,2	3 27/32 ± 1/8
N	34,9 ± 1,6	1 3/8 ± 1/16
P	142,8 ± 4,8	5 5/8 ± 3/16

DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 14" MIN.
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 18" MIN.

NOTE:-
BASIC DIMENSIONS ARE INCHES

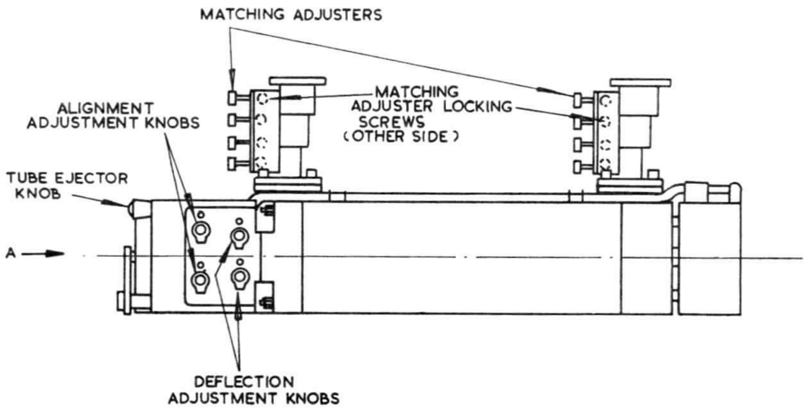
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

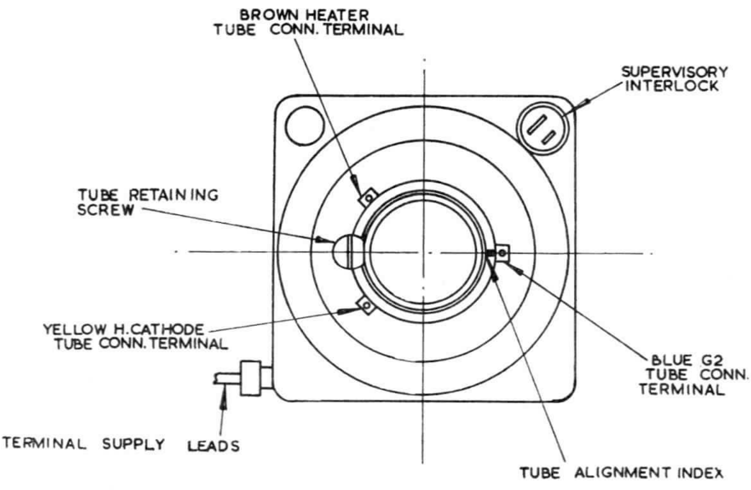
T.W.T. Mount

Code: 495-LVA-101C

CONTINUED

Fig. 11.—Diagram Showing Operational Controls of 495-LVA-101C





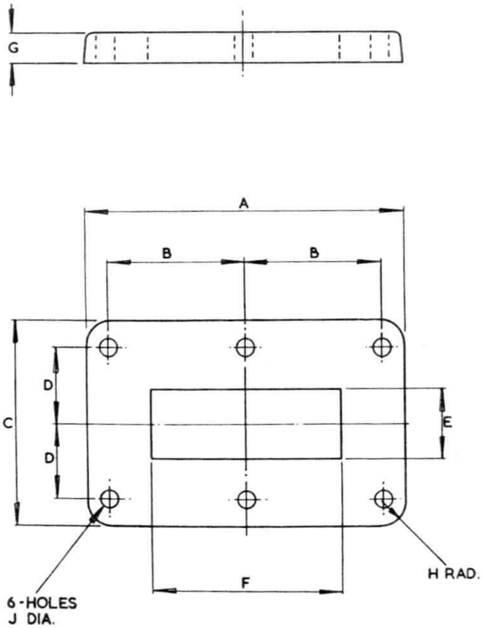
VIEW OF END 'A' WITH COVER REMOVED

T.W.T. Mounts

Codes: 495-LVA-101A
495-LVA-101B

CONTINUED

Fig. 12.—Outline of Waveguide Flange WG12A



DIM.	INCHES	MILLIMETRES
A	3·625 ± 0·005	92,08 ± 0,13
B	1·531 ± 0·001	38,89 ± 0,03
C	2·312 ± 0·005	58,72 ± 0,13
D	0·859 ± 0·001	21,82 ± 0,03
E	0·795 ± 0·001	20,19 ± 0,03
F	2·128 ± 0·001	54,05 ± 0,03
G	0·328 ± 0·005	8,33 ± 0,13
H	0·281 ± 0·005	7,14 ± 0,13
J	0·196 ± 0·001	4,98 ± 0,03

BASIC DIMS. ARE INCHES

Travelling-wave Amplifier Tubes

Description

These tubes are intended for use in microwave radio links in frequency bands within the range 5,85GHz to 7,9GHz. Useful performance is also obtained in the range 5,1GHz to 5,85GHz.

The W5/4GC and W5/4GF tubes operate in the periodic permanent magnet type focus mounts WM112C and WM112F respectively in which they give the performance quoted in this data. The mounts are designed to permit easy replacement of tubes under field conditions.

The W5/4GC - WM112C and W5/4GF - WM112F tube/mount combinations are direct replacements for the W5/2GD - WM107DA and W5/2GF - WM107DF combinations respectively in existing equipment.

Radio Frequency Performance (Note 1)

		W5/4GC	W5/4GF
f range	(GHz)	5,85/7,2	5,85/7,9
P_o(sat.) typical across f range	(W)	27/24	27/21
P_o(wkg.)	(W)	10	10
P_o(sat.) at optimum V_{hel}, min. (Note 2)			
5,85 to 6,5GHz	(W)	16	16
6,51 to 7,2GHz	(W)	13	-
6,51 to 7,9	(W)	-	12
G at 10W output across range			
5,85 to 6,5GHz, max./min.	(dB)	41/37	-
6,51 to 7,2GHz, max./min.	(dB)	41/35	-
5,85 to 7,2GHz, max./min.	(dB)	-	44,5/36
7,2 to 7,9GHz, max./min.	(dB)	-	44,5/34
G flatness at 10W output over any 25MHz band, max. (Note 3)	(dB)	0,1	0,2
N at 10W output, max.	(dB)	26	26
Modulation noise peaks	N in any 20kHz band from 0,5 to 10MHz from the carrier does not exceed that value equivalent to N = 26dB after 10 hours operation		
Reverse attenuation at 10W output, min.	(dB)	65	65
AM/PM conversion at 10W output, typical			
5,85 to 7,2GHz	(^{o}/dB)	1,8	1,8
7,2 to 7,9GHz	(^{o}/dB)	-	2,5

Note 1. Performance graphs are shown in Figures 1 to 4.

Radio Frequency Performance – continued

Matching, input and output (hot) — A VSWR < 1,2:1 is obtainable over any 25MHz band when operating at 10W output (achieved by adjustment of flags in input and output waveguides).

		W5/4GC	W5/4GF
Phase sensitivity at optimum voltage and working output			
$d\varphi/dV_{hel}$, max.	(°/V)	−1,5	−1,5
$d\varphi/dV_{g2}$, max.	(°/V)	+0,5	+0,5
With optimum voltages at working output			
ΔG for ±1% change in V_{hel}, max.	(dB)	−0,8	−0,8
ΔG for ±2% change in V_{hel}, max.	(dB)	−2,0	−2,0
dG/dV_{g2} for V_{g2} change up to ±2%, max.	(dB/V)	+0,03	+0,03

Note 2. Optimum voltage is defined as value of V_{hel} for $G_{max.}$ at 10W output.

Note 3. Obtained by tuning input and output match adjusters for max. gain flatness.

Typical Operating Conditions (Note 4)

f	(GHz)	5,85	6,5	7,2	7,9
Direct V_{hel-k}, optimum (note 2)	(kV)	3,43	3,36	3,31	3,27
Direct V_{g2-k} (Note 5)	(kV)	2,3	2,3	2,3	2,3
Direct $V_{col(earth)-k}$	(kV)	2,1	2,1	2,1	2,1
Direct I_{g2}	(µA)	−2,0	−2,0	−2,0	−2,0
Direct I_{hel} at working output	(mA)	0,5	0,5	0,5	0,5
Direct I_{col}	(mA)	50	50	50	50
Direct I_k	(mA)	50,5	50,5	50,5	50,5
G max. at working output (Note 6)					
W5/4GF	(dB)	42,8	42,2	40,5	35,8
W5/4GC	(dB)	39,4	38,6	36,8	–
$P_{o(sat.)}$ at optimum V_{hel} (Notes 6, 7)	(W)	18,5	18	17,5	15,8
N at working output	(dB)	24,5	24,5	24,5	24,5
Phase sensitivity at working output					
$d\varphi/dV_{hel}$	(°/V)	−0,75	−0,75	−0,75	−0,75
$d\varphi/dV_{g2}$	(°/V)	+0,25	+0,25	+0,25	+0,25
Change of G, with voltages at working output					
ΔG for ±1% change in V_{hel}	(dB)	−0,5	−0,5	−0,5	−0,5
ΔG for ±2% change in V_{hel}	(dB)	−1,0	−1,0	−1,0	−1,0
dG/dV_{g2} for V_{g2} change up to ±2%	(dB/V)	+0,02	+0,02	+0,02	+0,02

Note 4. Electrode voltages are referred to cathode potential. The collector is earthed.
Note 5. Adjusted to give stated I_{col}.
Note 6. The mount matching adjusters must be adjusted for each tube at the required operating frequency and power level.
Note 7. An increase in output may be achieved by setting V_{hel} above the synchronous value, with a resulting drop in gain: in these conditions an increase in V_{col} to 2,3kV is recommended to limit I_{hel}.

Cathode/Heater

Cathode: Indirectly heated, oxide coated type

		min.	nom.	max.
Heater				
V_h (Note 8)	(V)	-	6,3	-
V_h tolerance				
long-term average	(%)	-	-	±3,0
short-term fluctuations up to 2 minutes duration	(%)	-	-	±5,0
I_h	(A)	0,65	0,75	0,85
Heater pre-heating time	(s)	60	-	-
Interruption time for zero pre-heat	(s)	-	-	10

Note 8. The heater is usually supplied by a direct voltage or an r.m.s. equivalent at a frequency of 45Hz to 65Hz. If other supply frequencies are to be used, the manufacturer should be consulted beforehand. If the heater is operated with d.c., it is preferable to make the free heater lead negative with respect to the cathode.

Limit Ratings

		min.	max.
Voltages			
Direct V_{hel-k} (Note 9)	(kV)	3,2	4,0
Direct V_{g2-k}	(kV)	-	2,8
Direct $V_{col(earth)-k}$ (Note 9)	(kV)	1,8	3,3
Direct V_{g2-hel}	(kV)	-	4,0
Direct V_{g2-col}	(kV)	-	3,3
Currents			
I_k	(mA)	-	55
I_{hel}			
Absolute max. to trip supplies with delay of ⩽ 5 sec.	(mA)	-	4,0
Switching transient	(mA)	50 for not longer than 10ms	
	(mA)	20 for not longer than 150ms	
	(mA)	10 for not longer than 1,0s	
	(mA)	4 for not longer than 5,0s	
I_{g2} (see D.C. Supply Requirements section)	(mA)		0,7

Limit Ratings – continued

Power dissipations

P_{g2}, max.	(W)	2,0
P_{hel}, max.	(W)	14
P_{col}, max. (Note 10)	(W)	125

Note 9. Minimum ratings are specified for continuous operation to avoid excessive I_{hel}.

Note 10. Higher values of P_{col} are permissible if the normal convection cooling is supplemented by forced-air-cooling. As a general guide, an air flow of about 25 ft^3/min. (708 l/min.) is required for a P_{col} of 175W up to an altitude of 10 000 ft (3 050 m). (See section on Collector Cooler later).

D.C. Supply Requirements

General

The tube collector is connected to the body of the mount via the cooler. The mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the Setting-up Procedure section.

Helix Voltage

V_{hel} is adjustable for required working conditions, range 3,2 to 3,8kV. The optimum V_{hel} (Note 2) for individual tubes lies within the range 3,2 to 3,7kV. Ripple and regulation tolerances depend upon acceptable phase and output amplitude variations (see Typical Operating Conditions and Radio Frequency Performance sections).

A protective resistor, value 7,5kΩ, may be used in the power supply line: this resistor is already fitted in the WM112C mount.

The supply impedance, including that of the protective resistor, should not exceed 20kΩ: this is required to avoid excessive voltage-drop at switch-on.

A trip circuit must be incorporated in the helix supply to prevent burn-out of the tube by the passage of excessive I_{hel}. (See Limit Ratings section for required settings).

Collector Voltage

For operation with depressed collector at I_{col} = 50mA, V_{col} should be set within limits of 1,9 and 2,4kV.

For operation at 10W output, the nominal voltage is 2,1kV.

Prolonged operation below 1,9kV should be avoided.

Off-load V_{col} should not exceed 3,3kV.

Grid 2 Voltage

V_{g2} is adjustable for required conditions, range 2,0 to 2,7kV. When adjusted to give I_{col} = 50mA, initial range is 2,0 to 2,4kV: end of life limit is 2,7kV.

Grid 2 Current

This will be in the range -50µA to +100µA for the majority of tubes. A protective resistor, value 47kΩ is fitted in the grid 2 lines of the mounts.

Certain prime requirements should be met during conditions of switch-on and continuous working. Satisfactory periodic focussing cannot be achieved with low V_{hel} or low I_k. If the tube is operated with V_{hel} below the minimum limit of 3,2kV, the I_{hel} may be excessive, the actual value of I_{hel} being dependent upon the setting of V_{g2} relative to V_{hel}.

When switching-on it is imperative that I_{hel} does not exceed the transient values given in the tube Limit Ratings section.

Cathode Current Control Circuit

A suitable cathode current control circuit is shown in Figure 5. V_{g2} is supplied from a potentiometer connected across the helix supply, V_{g2} always being proportional to, but less than, V_{hel}.

The recommended setting for switch-on is 2,0kV on grid 2 with respect to cathode, and a helix supply of 3,3kV. The switch-on of V_{g2} should be delayed until V_{hel} has reached 3,3kV.

The rise times of V_{hel} and V_{col} are not important: V_{g2} may be applied as soon as these voltages have reached their set values. The rise time of V_{g2} must be short to limit the I_{hel} transient value. A typical rise time is 10ms.

The delaying device, for example a reed relay, should also operate to cut-off the grid 2 supply in the event of the helix trip being operated; this prevents excessive I_{g2} being passed.

The 10MΩ bleed resistor prevents build-up of static charge on grid 2 during the period when V_{hel} and V_{col} only are applied.

On final switch-off V_{g2} should precede V_{hel} on a time scale such that V_{g2} drops below 250V before V_{hel} falls below 3,2kV.

An alternative switch-on method of delaying V_{g2} rise by a shunt capacitor (C_1 in Figure 5) may be used. V_{hel}, V_{col} and V_{g2} may be applied simultaneously, but V_{hel} should exceed 3,2kV before V_{g2} exceeds 250V and essentially the sequence of voltage rises must be (i)V_{col} (ii)V_{hel} (iii)V_{g2} with the rise times of (i) and (ii) sufficiently fast to limit the rise time of V_{g2}.

With this method the surge of I_{hel} at switch-on may operate the helix trip and appropriate re-setting arrangements should be provided.

Mechanical Data (Tubes)

Envelope	Glass and metal
Dimensions and connection detail	As shown in Figure 6

Tube Life

Shelf and operational life	Subject to guarantee
Life-end points	(a) $V_{g2} > 2{,}7kV$ for $I_{col} = 50mA$, or
	(b) $I_{hel} > 3{,}5mA$ for $I_{col} = 50mA$, or
	(c) G or P_o deteriorated by more than 2dB from initial figures.

Focus Mounts - Description

These approved mounts in which the W5/4G series tubes operate incorporate a periodic permanent magnet system, r.f. coupling waveguides with matching elements, mechanical tube focussing adjustments and a convection collector cooler.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made through the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies.

A hinged lid provides access to the tube connections. It has attached to it a link which, when the lid is in place, is connected to a twin-lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides microwave screening.

Optimum adjustment of focussing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws. (See Figure 8).

Fine adjustments to the matching are made with a movable flag in each waveguide. These flags, which may be rotated or moved longitudinally, are controlled by plungers protruding opposite to the input and output ports. (See Figure 8).

The operation of closing the hinged lid automatically locates the tube in the mount longitudinally. Mating rings at the base end of the tube and mount provide lateral location.

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated through a cable by a control at the base end This control is concealed by the hinged lid to prevent inadvertent operation when the lid is closed. (See Figures 8 and 9)

Focus Mounts - Data

R.F. leakage	Input and output waveguide levels to free space > 65dB.
Dimensions	As shown in Figures 7 and 10.
Fixing of mounts	Attach mounts to equipment with 1/4 inch UNC non-magnetic screws fitting into 0,5 inch (12,7 mm) deep tapped holes in mount body (see Figure 8).

Waveguide connections	Input and output flanges as shown in figure 11 and 12 for connection to WG14 (WR137). Tin-plated shims and screws, which are available if required, should be used for connection to brass waveguide flanges.
Electrode supply cables	
WM112C	The five cores for h, h/k, hel g2 and col/earth are contained in a braided and sheathed cableform: the braid and col/earth are connected to the mount body.
WM112F	The cableform is similar to that for the WM112F except that the hel lead is a screened and sheathed core. A short lead is attached to the hel screening at the free end. The hel screen is insulated from earth and other cores for connection to cathode potential.
Maximum ratings	
Heater and heater/cathode Helix Grid 2 Helix screen (WM112F only)	to body of mount, 3,3kV max.
Supervisory cable and interlock	to body of mount voltage 500V max.: current 10A max.

Lead resistance, (including lead resistors)

	WM112C	WM112F
Grid 2	47kΩ	4,7kΩ
Helix	7,5Ω	0,09Ω
Heater	0,04Ω	0,09Ω

Collector Cooler

Cooling takes place by convection and it is important that the mount is operated in the position intended. The mount is intended for horizontal operation and the cooling fins must be vertical.

The air flow through the cooler requires a free space of 2 inches (5cm) around the cooler slots with access to a free supply of air at ambient temperature. The cooler temperature under normal conditions of operation is about 120°C above ambient temperature.

At altitudes up to 15 000 ft (4 772 m) and within the maximum ambient temperatures specified below, free convection is adequate for dissipations up to the specified limit rating. Where it is required to exceed either the ambient temperature or the collector dissipation limits, forced-air-cooling is necessary and the manufacturer should be consulted to obtain the flow applicable to individual requirements. (See also Note 10).

Environmental Conditions – Tube and mount

Ambient temperature and altitude		
operating ranges	-30°C min. to $+65^{\circ}$C max.	up to 5 000 ft (1 524m)
	$+60^{\circ}$C max.	up to 10 000 ft (3 048m)
	$+50^{\circ}$C max.	up to 15 000 ft (4 772m)
storage		
mount	-35°C min. to $+75^{\circ}$C max.	up to 45 000 ft (13 720m)
tube	-60°C min. to $+80^{\circ}$C max.	up to 45 000 ft (13 720m)
Relative humidity	95% max. at $+35^{\circ}$C	

Proximity of Magnetic Materials

Soft magnetic materials should be kept at least 1 inch (2,5cm) away from the exterior of mount.

Magnetized materials in the vicinity of the mount must be positioned so that I_{hel} at $P_{o(sat.)}$ does not increase by more than 0,1mA.

Assistance with focussing tests in the presence of permanent magnets and guidance concerning their position is always available from the manufacturer.

Setting-up Procedure

The following procedure is recommended for setting-up the tube in its mount for operation:

1. Ensure that the mechanical tube focussing control knobs on the mount are set to the middle of their travel.

2. Ensure that the mount is properly earthed.

3. (a) Disengage the catch and open the lid. Insert tube (see Note 11) far enough for the colour-coded leads to be easily connected. No damage is caused by pushing the tube fully home; it simply tends to be partially ejected by the cooler on releasing the base.

   The yellow line on the tube base cap should be aligned with the white index mark on the seating ring; this is necessary for best matching but the adjustment is not critical, in that misalignment up to 20° is permissible.

   (b) Close lid, engage the catch. This operation automatically moves the tube to its correct longitudinal position relative to the mount, completes the interlock circuit and prevents operation of the tube ejector mechanism.

4. Make the following adjustments before switching on to ensure that the helix current will not exceed that value which causes the trip to operate.

   (a) Switch off any r.f. drive.

   (b) Set the V_{hel} control to give operation at 3,3kV; set the V_{g2} (cathode current control) to give about 2,0kV at switch-on; this corresponds to a I_k of around 35mA. Set V_{col} to give 2,1kV under operating conditions.

5. Apply V_h and allow one minute heating time.
6. Apply V_{hel} and V_{col}.
7. Apply V_{g2} at the preset value.
8. Adjust focussing control knobs to give minimum I_{hel} and repeat these adjustments as V_{g2} is increased until a I_{col} of 50mA is achieved.
9. Apply an r.f. input of approximately -15dBm, adjust the input and output r.f. matching and V_{hel} for maximum output. Increase the r.f. input to obtain the required output level, readjust focussing control knobs to minimise I_{hel}. Optimise V_{hel}, readjust matching adjusters, r.f. input level and focus controls, and also V_{g2} to maintain appropriate I_{col}.

Note 11. The insertion of the tube requires a free space between the lid of the mount and extraneous equipment: the space required is specified in Figures 7 and 10.

Tube Removal Procedure

1. Switch off all voltages preferably V_{g2} first but otherwise simultaneously.
2. Switch off V_h.
3. Move focus control knobs to mid-travel position.
4. Disengage catch in hinged lid and thus allow the spring loaded cooling fins to push the tube outwards.
5. Disconnect the tube leads from their terminals.
6. Pull the tube ejector control to free the collector from the cooling fins and withdraw the tube.

Fig. 1. Typical Output Power; Helix Voltage and Gain versus Frequency

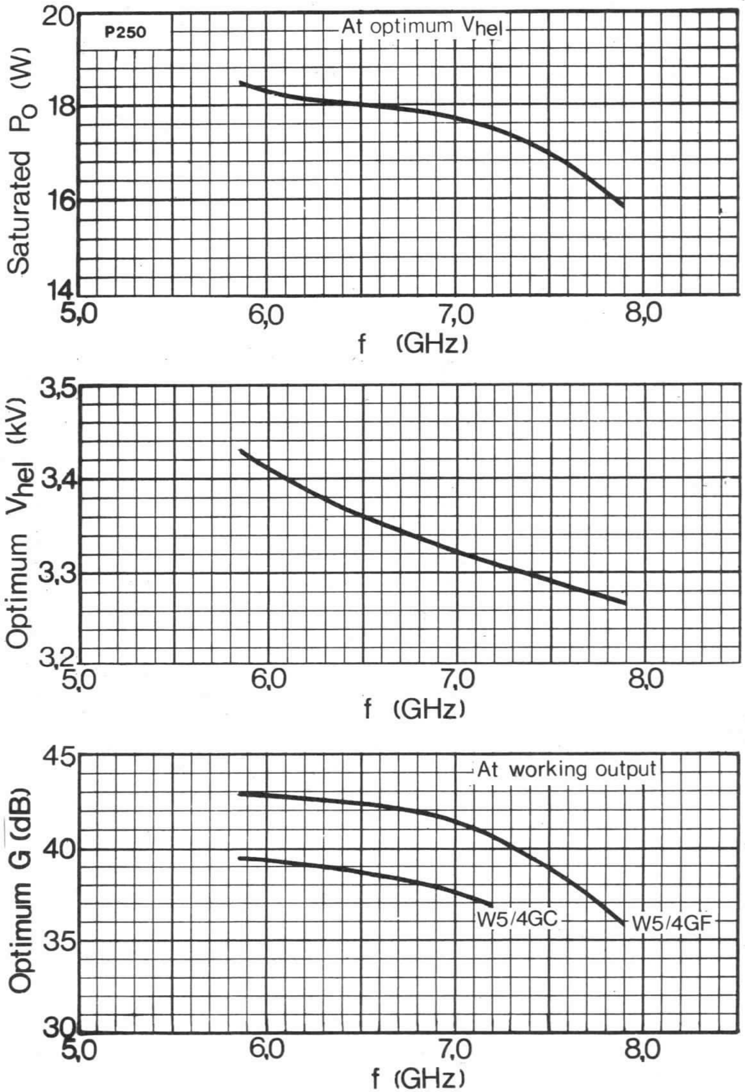


Fig. 2. Typical Output Power versus Input Power - W5/4GF

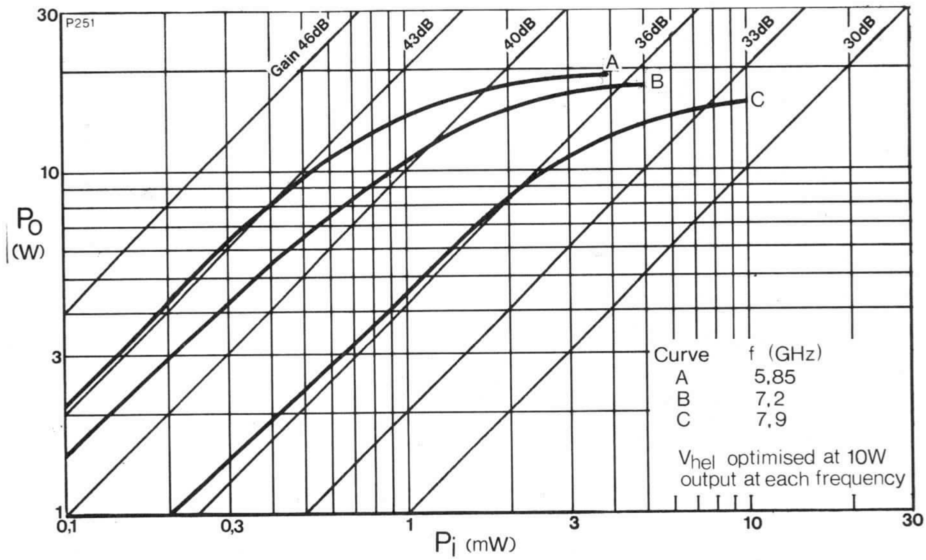


Fig. 3. Typical Output Power versus Input Power - W5/4GC

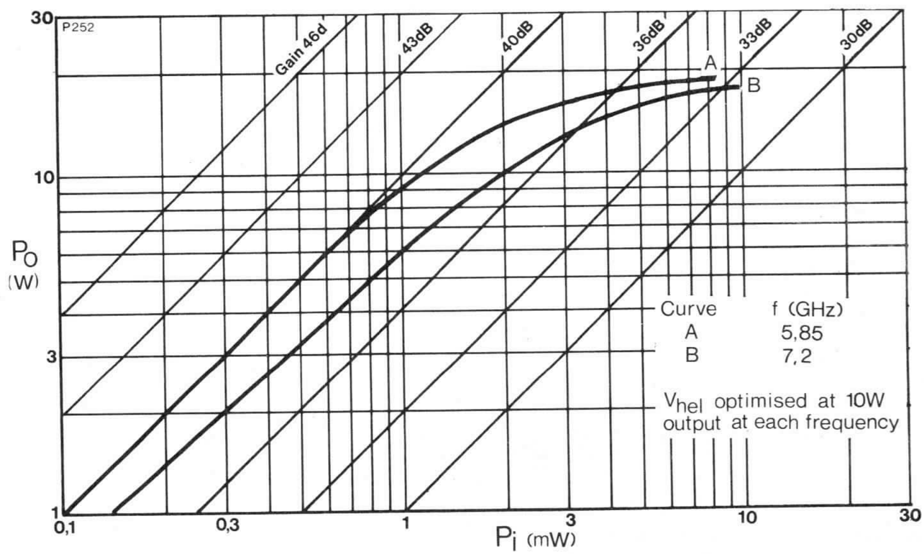


Fig. 4. Typical Gain Variation, Noise Factor and AM/PM Conversion

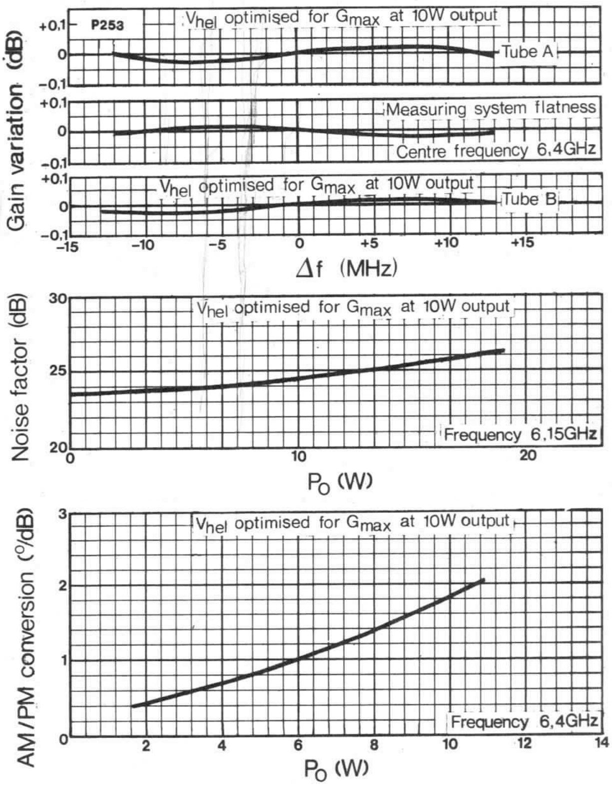


Fig. 5. Typical Cathode Current Control Circuit

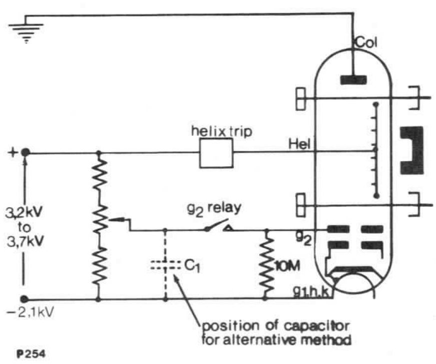
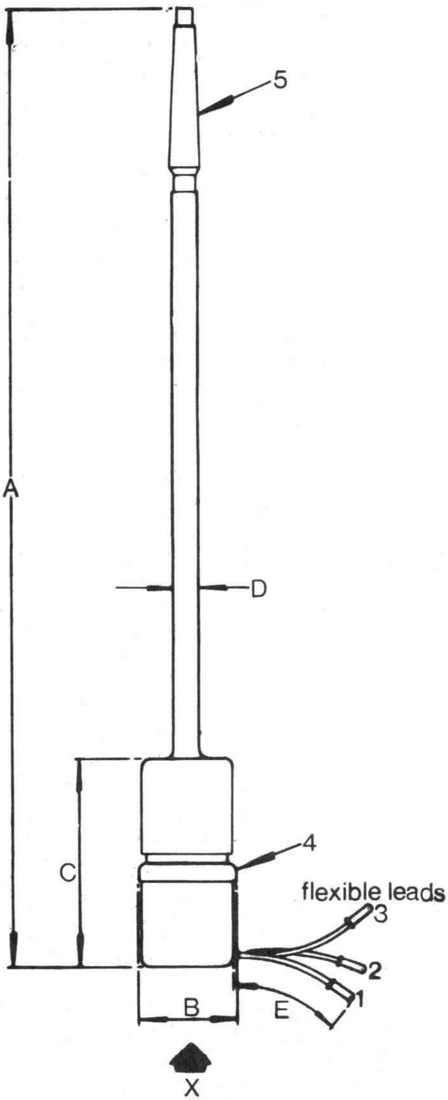


Fig. 6. Outline of W5/4GC and W5/4GF Tubes

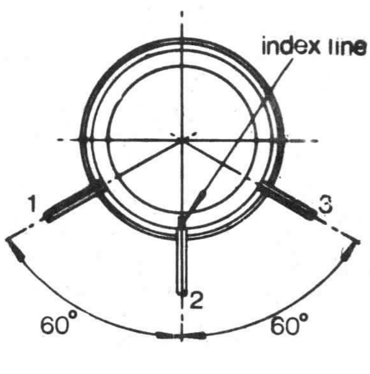


Dimensions

	mm	in
A	351,8 max	13,85 max
B	36,20±0 18	1,425±0 007
C	77,5 max	3,05 max
D	9,27max	0,365max
E	46 nom	1,8 nom

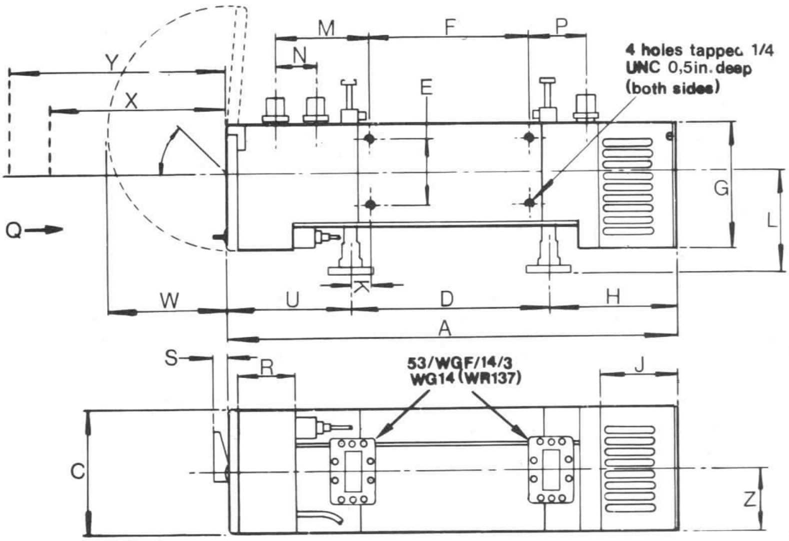
Electrode leads and contacts

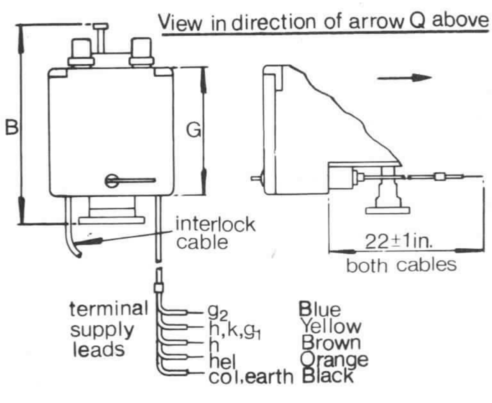
lead	colour	electrode
1	yellow	h,k,g_1
2	blue	g_2
3	brown	h
contact		
4		hel
5		col



View at X

Fig. 7. Outline WM112C Mount



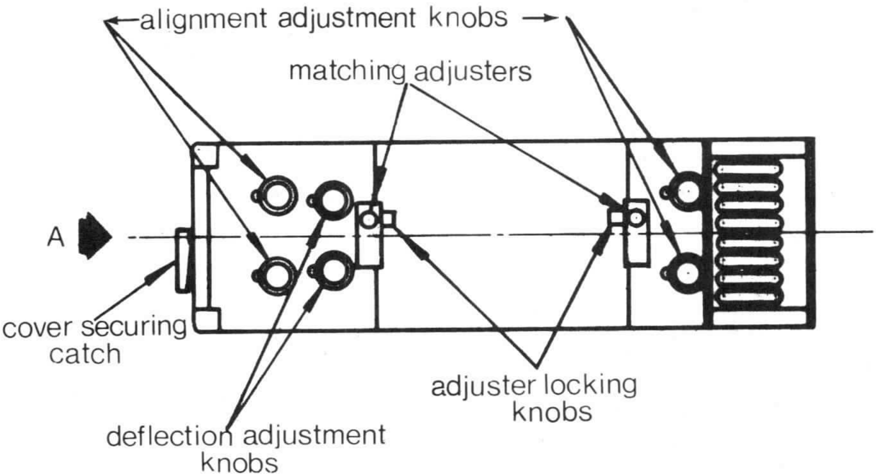


Dimensions

	mm	in.
A	387,4 max.	15,25 max.
B	196,9 max.	7,75 max.
C	104,8 ± 1,0	4,125 ± 0,04
D	169,01 ± 0,51	6,654 ± 0,02
E	57,2 ± 0,40	2,25 ± 0,016
F	136,5 ± 0.40	5,375 ± 0,016
G	111,1 max.	4,375 max.
H	109,5 ± 3,2	4,313 ± 0,125
J	66,7 ± 1,6	2,625 ± 0,063
K	17,48 ± 0,79	0,688 ± 0,031
L	87,3 ± 0,8	3,438 ± 0,031
M	69,9 ± 3,2	2,75 ± 0,125
N	34,9 ± 1,6	1,375 ± 0,063
P	48,4 ± 1,6	1,906 ± 0,063
R	41,3 max.	1,625 max.
S	12,7 app.	0,5 app.
U	106,4 ± 3,2	4,188 ± 0,125
W	104,8 max.	4,125 max.
Z	52,4 ± 0,40	2,063 ± 0,016

Withdrawal distances of tube:
X (with lateral movement of tube base up to 45°) = 254mm min.
Y (without lateral movement of tube base) = 350mm min.

Fig. 8. Diagram showing Operational Controls of WM112C Mount



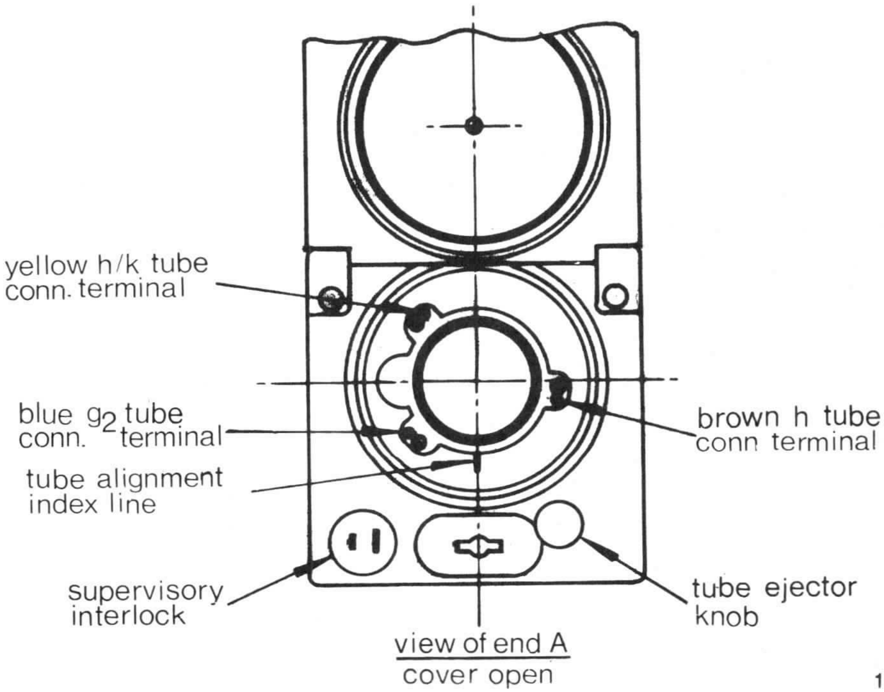
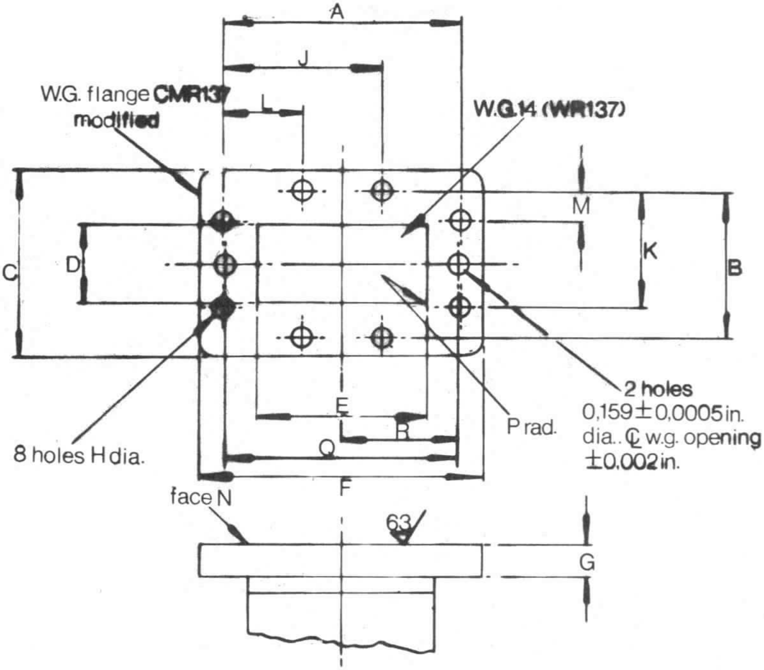


Fig. 9. Outline of Flange 53/WGF/14/3 for WM112C Mount



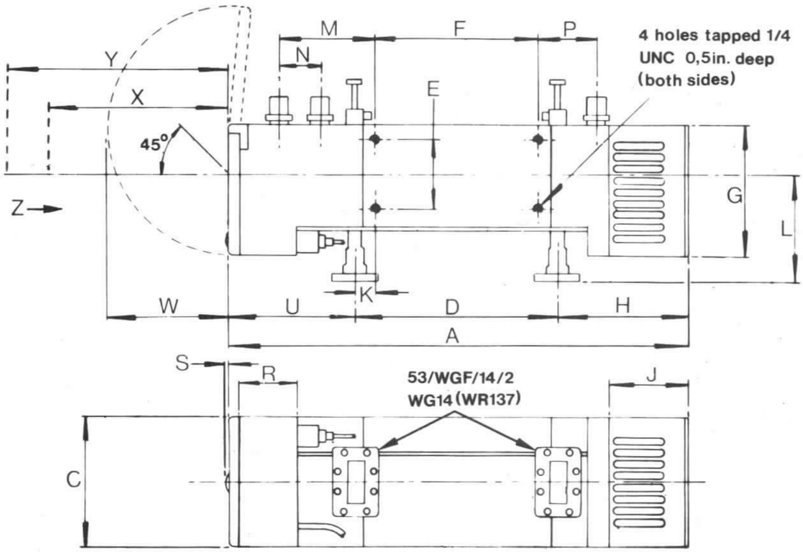
	mm	in
A	49,02 tp	1,93 tp
B	29,97 tp	1,18 tp
C	38,10 ± 0,4	1,5 ± 0,016
D	15,88 ± 0,13	0,625 ± 0,005
E	34,93 ± 0,2	1,375 ± 0,008
F	57,94 ± 0,4	2,281 ± 0,016
G	6,35 ± 0,4	0,25 ± 0,016
H	4,09 $^{+0,05}_{-0,03}$	0,161 $^{+0,002}_{-0,001}$
J	32,69 tp	1,287 tp
K	23,70 tp	0,933 tp
L	16,33 tp	0,643 tp
M	6,27 tp	0,247 tp
P	0,80 max	0,031 max
Q	49,02 ± 0,05	1,93 ± 0,002
R	24,51 ± 0,05	0,965 ± 0,002

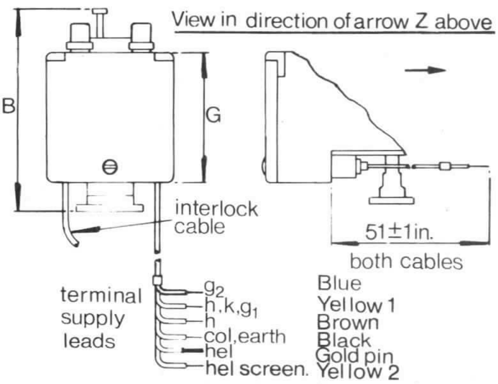
Feature	Characteristic	Tolerance	Datum
Width A	Symmetry	0,005 wide	Width E MMC
Width B	Symmetry	0,005 wide	Width D MMC
Width C	Symmetry	0,010 wide	Width D MMC
Width F	Symmetry	0,010 wide	Width E MMC
Holes H	Positional	0,002 MMC	
Face N	Flatness	0 002 wide	

Note

Angle of face N to ℄ of w.g. aperture is 90° ± 0,25°.

Fig. 10. Outline WM112F Mount



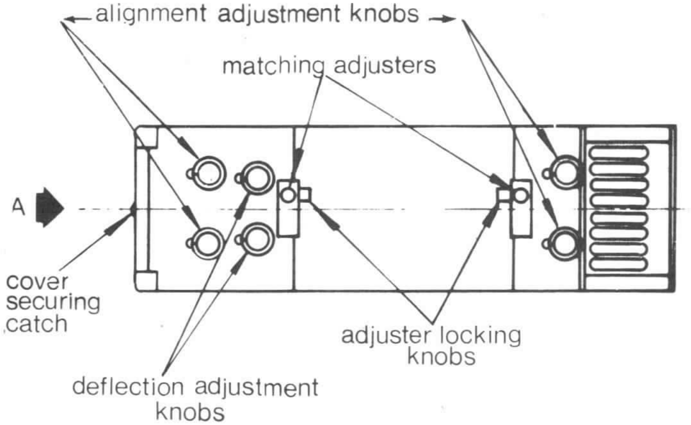


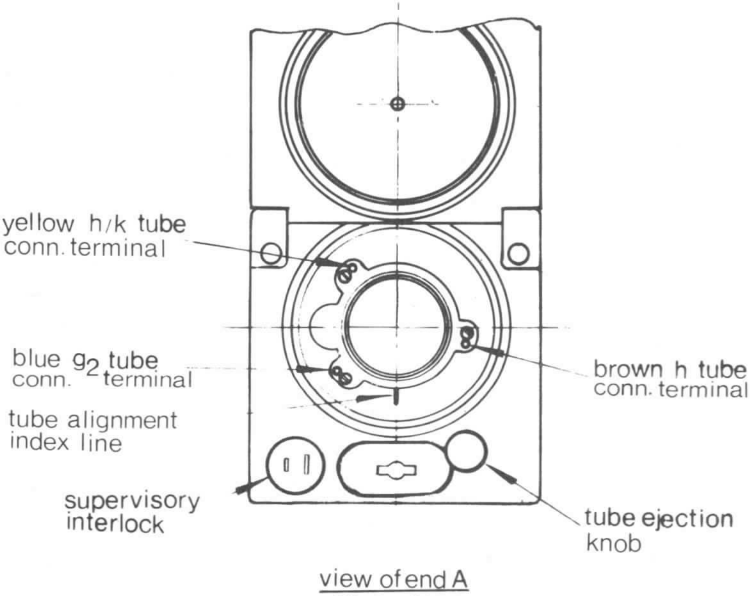
Dimensions

	mm	in.
A	387,4 max.	15,25 max.
B	196,9 max.	7,75 max.
C	109,5 max.	4,313 max.
D	169,01 ± 0,5	6,654 ± 0,02
E	57,2 ± 0,8	2,25 ± 0,031
F	136,5 ± 0,8	3,375 ± 0,031
G	111,1 max.	4,375 max.
H	109,5 ± 3,2	4,313 ± 0,125
J	66,7 ± 1,6	2,625 ± 0,063
K	17,5 ± 1,6	0,688 ± 0,625
L	87,3 ± 0,8	3,438 ± 0,031
M	69,9 ± 3,2	2,75 ± 0,125
N	34,9 ± 1,6	1,375 ± 0,063
P	48,4 ± 1,6	1,906 ± 0,063
R	41,3 max.	1,625 max.
S	4,8 max.	0,188 max.
U	106,4 ± 3,2	4,188 ± 0,125
W	104,8 max.	4,125 max.

Withdrawal distances of tube:
X (with lateral movement of tube base up to 45°) = 254mm min.
Y (without lateral movement of tube base) = 350mm min.

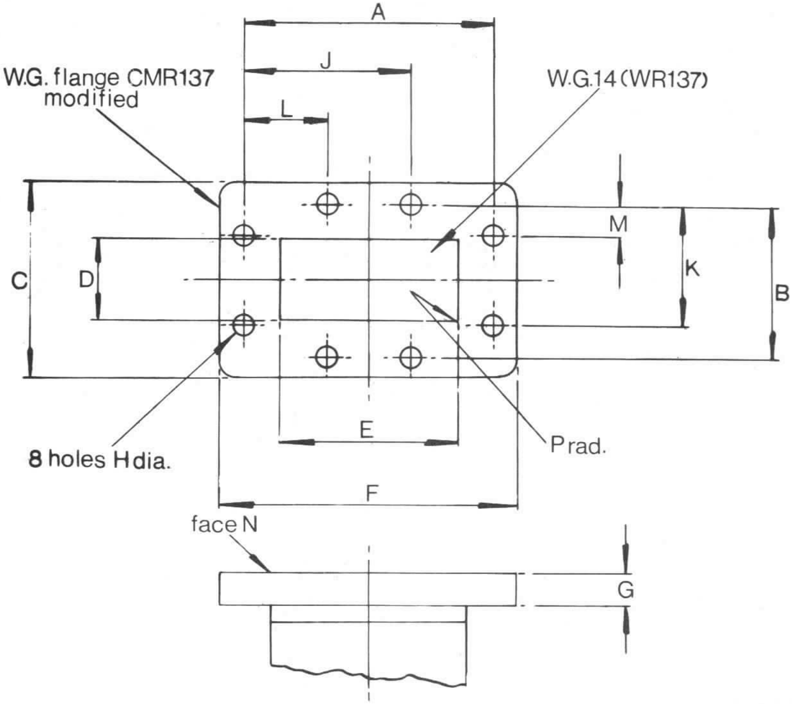
Fig. 11. Diagram showing Operational Controls of WM112F Mount





view of end A
-cover open

Fig. 12. Outline of Flange 53/WGF/14/2 for WM112F Mount



	mm	in
A	49,02 tp	1,93 tp
B	29,97 tp	1,18 tp
C	38,10 ± 0,4	1,5 ± 0,016
D	15,88 ± 0,13	0,625 ± 0,005
E	34,93 ± 0,2	1,375 ± 0,008
F	57,94 ± 0,4	2,281 ± 0,016
G	6,35 ± 0,4	0,25 ± 0,016
H	4,09 $^{+0,05}_{-0,03}$	0,161 $^{+0,002}_{-0,001}$
J	32,69 tp	1,287 tp
K	23,70 tp	0,933 tp
L	16,33 tp	0,643 tp
M	6,27 tp	0,247 tp
P	0,80 max	0,031 max

Feature	Characteristic	Tolerance	Datum
Width A	Symmetry	0,005 wide	Width E MMC
Width B	Symmetry	0,005 wide	Width D MMC
Width C	Symmetry	0,010 wide	Width D MMC
Width F	Symmetry	0,010 wide	Width E MMC
Holes H	Positional	0,002 MMC	
Face N	Flatness	Note 2	

Notes

1. Angle of face N to ℄ of w.g. aperture is 90° ± 0,25°.
2. To ensure that final inspection tolerance of 0,0008 in. is met, a max. flatness tolerance of 0,0005 in. is applied at piecepart manufacture.

ITT Components are available from:

or directly from:

ITT COMPONENTS GROUP EUROPE
Standard Telephones and Cables Limited
Valve Product Division
Brixham Road
PAIGNTON, Devon, TQ4 7BE.
Tel: 0803-50762 Telex: 42830

STC

SPECIAL VALVES

Medium Power Travelling-Wave Amplifier Tubes

Codes: W7/5GA
W7/5GB
W7/5GC

These travelling-wave tubes, when operated in the appropriate periodic permanent magnet type mounts, cover between them the frequency range 3·6 to 5 GHz.

The mounts, of which there are five types, give a choice of r.f. connections and other features; they are listed below under their commercial codes together with the tubes which operate in them.

WM110A, WM110C	W7/5GA
WM110B	W7/5GB
WM110CA, WM110CB	W7/5GC

RADIO FREQUENCY PERFORMANCE (Tubes)

(See page 7 for frequency performance of mounts)

	W7/5GA	W7/5GB	W7/5GC	
Operating frequency range	3·6 to 4·2	4·4 to 5	3·7 to 5	GHz
Power output, maximum	30	30	25	W
Gain				
at 10W			37 to 45	dB
at 20W	41 to 46			dB
at 25W		35 to 44		dB
AM/PM conversion				
at 10W			<1·5	°/dB
at 20W	<1·5	<1·5		
Reverse attenuation	>70	>70	>70	dB

Graphs showing typical performance are shown in Figures 1 to 5.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: 01-300 3333 Telex: 21836
COMPONENTS GROUP

STC

Codes: W7/5GA W7/5GB W7/5GC

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

	W7/5GA	W7/5GB	W7/5GC	
Frequency	3·9	4·7	4·2	GHz
Direct helix to cathode voltage (Note 2)	2·6	2·6	2·55	Vk
Direct grid 1 to cathode voltage (never positive)	−10	−10	−10	V
Direct grid 2 to cathode voltage (Note 3)	1·5	1·6	1·3	kV
Direct collector (earth) to cathode voltage	1·8	2·2	1·7	kV
Direct grid 2 current	0	0	0	mA
Direct helix current	0·6	0·6	0·6	mA
Direct collector current	80	85	65	mA
Input power				
for 10W output			1	mW
for 20W output	1			mW
for 25W output		2		mW
Saturated output at synchronous helix voltage, approximately	26	27	20	W
Gain-flatness characteristic (Note 4)				
over 30 MHz	0·3			dB
over 20 MHz			0·2	dB
over 15 MHz		0·5		dB

Note 1.—Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2.—Adjusted to synchronous voltage (that which gives maximum gain at low signal levels).

Curves of typical synchronous helix voltage versus frequency are shown in Figure 5.

Note 3.—Adjusted to give required collector current.

Note 4.—The matching plungers must be adjusted for each tube at the required operating frequency.

CATHODE (All Tubes)

Indirectly heated, oxide coated type

HEATER (All Tubes)

	Min.	Nom.	Max.	
Heater voltage (Note 5)	—	6·3	—	V
Heater voltage tolerance				
Long-term average	—	—	±3	%
Short-term fluctuations up to 2 minutes' duration	—	—	±5	%
Heater current	—	1	—	A
Heater pre-heating time	60	—	—	s

Note 5.—The heater is usually supplied by a d.c. voltage or a r.m.s. equivalent at a frequency of 50 Hz. Other frequencies of supply up to 10 kHz may be used but it is recommended that the manufacturer be consulted beforehand.

W7/5GA
W7/5GB
W7/5GC

LIMIT RATINGS (All Tubes)

	Min.	Max.	
Voltages			
Direct helix to cathode	—	3	kV
Direct grid 1 to cathode	—	0·5	kV
Direct grid 2 to cathode	—	2·5	kV
Direct collector (earth) to cathode (Note 6)	1·6	3	kV

Note 6.—The minimum rating is specified for continuous operation to avoid excessive helix current.

	Max.	
Currents		
Cathode	100	mA
Helix		
Absolute maximum to trip supplies with delay of less than 5 seconds	4·5	mA
Switching transient	50	mA
Direct grid 2	0·5	mA
Power Dissipations		
Grid 2, maximum	2	W
Helix, maximum	12	W
Collector, maximum (Note 7)	150	W

Note 7.—Higher values of collector dissipation are permissible if the normal cooling is supplemented by forced-air-cooling.

D.C. SUPPLY VOLTAGES (All Tubes)

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix voltage		
Adjustable for required working conditions, range	2·4 to 2·9	kV
The synchronous helix voltage for individual tubes lies within the range	2·45 to 2·75	kV
Supply impedance, including resistance in mount, maximum (Note 8)	20	kΩ

Note 8.—This is required to avoid excessive voltage drop at switch-on.

Collector voltage		
Set between absolute limits of	1·7 and 2·5	kV

For depressed collector operation at 80mA, it is usual to choose a nominal voltage of 1·8kV.

For depressed collector operation at 85mA, the minimum voltage should be 2·2kV.

For collector dissipations above 150W, forced-air-cooling must be used.

A minimum collector voltage of 1·7kV may be used up to 65mA collector current.

Grid 2 voltage		
Adjustable for required working conditions, range	1·15 to 1·8	kV
When adjusted to give 80mA collector current		
Initial range is	1·4 to 1·6	kV
End of life limit is	2	kV
Grid 1 voltage (specified for each valve), range	−0·5 to −25	V

Codes: W7/5GA W7/5GB W7/5GC

STC

CONTINUED

MECHANICAL DATA (Tubes)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 7

LIFE

Shelf life Operational life	Guarantee subject to negotiation

Life-end points
- (a) Grid 2 voltage greater than 2kV for 80mA collector current, or
- (b) Helix current greater than 4·5mA for 80mA collector current, or
- (c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min.	Max.	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

T.W.T. MOUNTS

Codes: WM110A, WM110B, WM110C WM110CA, WM110CB

GENERAL DESCRIPTION OF MOUNTS

These approved mounts, in which the W7/5G series of tubes operate, incorporate a periodic permanent magnet system; r.f. coupling and matching elements; mechanical deflection adjustments and a convection cooler.

They differ from one another in respect of various physical features and r.f. performance: these differences are described later and are shown in the relevant drawings.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected via a twin-lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws; two pairs align the tube and the other pair move a magnetic deflector plate.

Fine adjustments to the matching are made with movable plungers in the waveguides.

The tube is held firmly in the mount at the collector end by the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining catch: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining catch is shown in Figues 9, 12, 14, 16 and 18.)

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external control lever. (See Figures 9, 12, 14, 16 and 18.)

The design of the mounts is such that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions. The mount should be secured by the threaded holes using $\frac{1}{4}$-inch UNC non-magnetic screws.

T.W.T. MOUNTS

Codes: WM110A, WM110B, WM110C WM110CA, WM110CB

CONTINUED

MECHANICAL DATA (Mounts)

Unless otherwise indicated, the following data is common to all mounts.

Dimensions	As shown in Figures 8, 11, 13, 15 and 17.
Mounting position	For maximum efficiency of the convection cooler, the plane of the cooler fins should be vertical. Magnetic materials should be kept at least 1 inch (2,5 cm) away from the exterior of mounts, particularly in the vicinity of the waveguides. Permanent magnets should be kept at least 9 inches (22,9 cm) away from the axis of the mounts.
Fixing of mounts	Attach mount to equipment with $\frac{1}{4}$ inch UNC non-magnetic screws fitting into tapped holes provided in mount body.
Connecting leads	
Electrode leads	5-core PTFE insulated cable, leads colour-coded as shown in Figures 8, 11, 13, 15 and 17 (Note 9).
Interlock leads	Twin cable, sleeve coloured blue.
Mechanical adjustment controls (Note 10)	
Alignment	Two pairs of external knobs.
Deflection	One pair of external knobs.
R.F. matching	Eight external screws or plungers.
Waveguide connections, input and output	
WM110A mount	Flanges 12A W/F for connection to waveguide WG12A. (See Figure 10.)
WM110B mount	Flanges UG149A/U for connection to waveguide WR187 (WG12).
WM110C mount	Special flanges for connection to waveguide WR187 (WG12). See Figure 10.
WM110CA mount	Flanges CMR187 for straight entry waveguide WR187 (WG12).
WM110CB mount	Flanges CMR229 for straight entry waveguide WR229 (WG11A).

Note 9.—In the near future a 6-core cable will be fitted: this will include a black earth lead to provide an additional earth path to that existing between the mount body and equipment chassis.

Note 10.—The positions of adjustment controls are shown in Figures 9, 12, 14, 16 and 18.

COOLING

The cooler is an integral part of each mount. Cooling takes place by convection and it is important that the planes of the cooler fins are vertical.

The air flow through the cooler requires a free space of 2 inches (5 cm) above and below the cooler with access to a free supply of air at ambient temperature. Normally, the cooler temperature is about 70°C above ambient.

If values of collector dissipation in excess of the maximum specified in the LIMIT RATINGS section are employed, the normal cooling must be supplemented by forced-air-cooling: as a general guide, an air flow of about 25ft³/min (707,5 l/min) is required at 250W collector dissipation.

Codes: WM110A, WM110B, WM110C WM110CA, WM110CB

CONTINUED

ELECTRICAL DATA (Mounts)

Ratings			
Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 1, Grid 2	to body of mount, maximum voltage	4	kV
Supervisory cable and interlock 240V a.c.		2	A
Lead resistance (including limiting resistors)			
Grid 2		4·7	kΩ
Helix		1	kΩ
Heater (Note 11)		0·07	Ω

Note 11.—At 0·7A and heater line voltage drop of 0·05V.

R.F. PERFORMANCE

Each mount will permit the specified performance of its associated tube to be achieved.

Frequency range		
WM110A	3·6 to 4·2	GHz
WM110B	4·4 to 5·0	GHz
WM110C	3·7 to 4·2	GHz
WM110CA	4·4 to 5·0	GHz
WM110CB	3·7 to 4·2	GHz
R.F. leakage (Note 12)		
Input or output waveguide level to free space	>65	dB

Note 12.—Measured by using a 2 inch × 2 inch (5,08 × 5,08 cm) waveguide horn in a way such as to obtain a maximum reading.

ENVIRONMENTAL CONDITIONS

Ambient temperature range	Min.	Max.	
Operating	−10	+60	°C
Storage	−30	+60	°C

W7/5GA
Codes: W7/5GB
W7/5GC

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 800 and 1 600 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:

50 mA for not longer than 10 milliseconds
20 mA for not longer than 150 milliseconds
10 mA for not longer than 1 second
5 mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 6. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. With the recommended setting at switch-on, corresponding to 1 300 volts on grid 2 with respect to cathode when the helix supply is at 2 500 volts, the maximum value of helix current during the rise of helix voltage may be of the order of 20 mA.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage by means of capacitor C_1 in Figure 6. The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 300 volts until the helix voltage has risen to over 1 600 volts. A suitable value for a helix supply with a rise time of 0·02 seconds from zero to 2 500 volts is $C_1 = 0{\cdot}04\mu F$, the surge helix current being reduced to approximately 3mA.

Towards the end of the life of the tube it is likely that the helix running current will rise to about 3mA and the grid 2 voltage, which initially was between 1 100 and 1 800 volts, will increase to about 2 000 volts.

SETTING-UP PROCEDURE

The following procedure is recommended for setting-up the W7/5 series of tubes in their mounts for operation.

1. Remove screwed lid of mount.
2. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining catch is in a position to allow the tube to be inserted.
3. Insert tube in mount. At the end of the travel of the tube, pressure needs to be exerted to overcome the resistance of the cooler contacts and the spring locating on the base ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The black spot on the base of the tube should be aligned with the black mark on the seating; this is necessary for best matching but the adjustment is not critical, misalignment up to 20° is permissible.
4. Secure tube in the mount by rotating the two-position retaining catch to turn over the projection of the tube base ring (Note 13).
5. Connect colour-coded leads of the tube to appropriate terminals in the mount ensuring that the green and blue leads are not transposed.
6. Ensure that the mount is properly earthed. The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads; one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.
7. Replace lid, making sure that the interlock two-pin plug is correctly fitted in its socket.
8. Apply heater voltage and allow one minute heating time.
9. Pre-set grid 1 voltage to the value specified on the data sheet supplied with each tube.
10. Satisfactory periodic focusing cannot be obtained with either low helix voltage or low cathode current. Accordingly it is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:
    (a) Switch off any r.f. drive.
    (b) Pre-set grid 2 voltage (cathode current control) to give about 1·3kV when switched on; this corresponds to a cathode current of about 65mA. At lower voltages the helix current may be excessive.
11. After the one minute cathode pre-heat, switch on collector at 1·8kV. (See operation 12.) The collector is connected to the mount internally so that an earth must be provided.
12. Switch on simultaneously the helix voltage at 2·6kV and the grid 2 voltage to the pre-set value. Operations 11 and 12 may be combined providing the collector supply rise time is not shorter than that of the helix supply.
13. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until the appropriate collector current is achieved.
14. Ensure that all of the eight r.f. matching adjusters are retracted.

Codes: W7/5GA W7/5GB W7/5GC

STC

CONTINUED

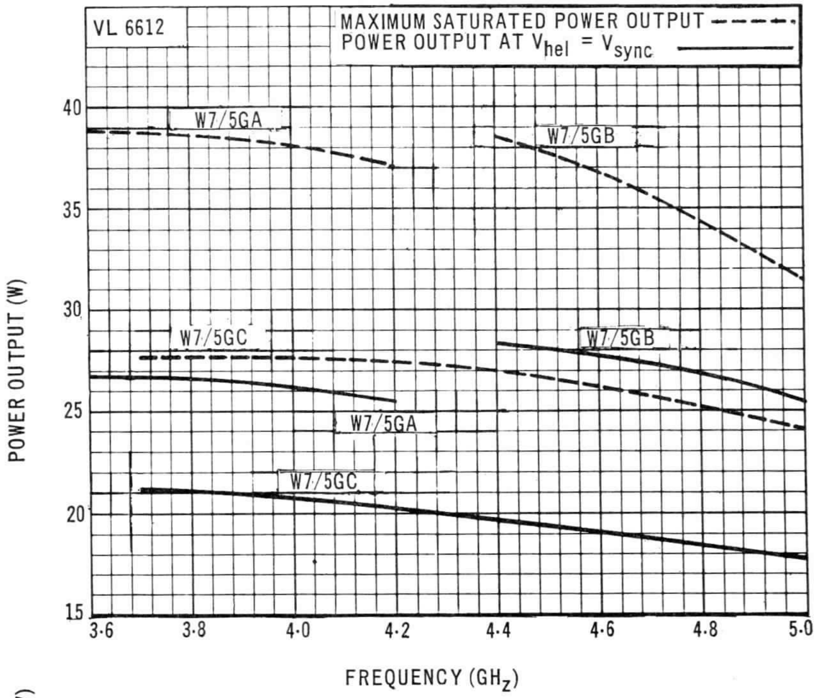
15. Apply an r.f. input of approximately —15 dbm and adjust the input and output r.f. matching for maximum output. The helix voltage also should be adjusted for maximum output if operation is required under synchronous conditions. Increase the r.f. input to obtain the required output level; it may be necessary to make slight readjustments to the control knobs to obtain minimum helix current and to the grid 2 voltage to maintain the appropriate collector current.

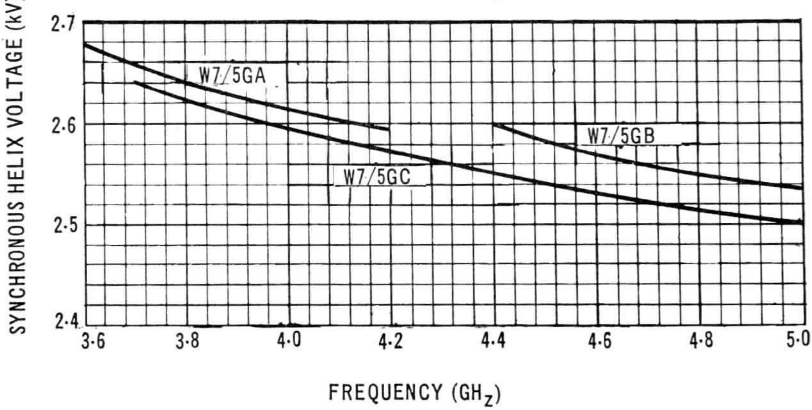
Note 13.—Once the tube is in its operating position in the mount and is secured by the two-position retaining catch, any undue pressure on the tube ejector lever will cause damage to the tube. Accordingly, care must be taken to ensure that the ejector lever is not knocked inadvertently, or, that when the tube is to be removed, no pressure is exerted on the lever until the two-position retaining catch has been turned to clear the tube base ring.

TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals in mount.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining catch to clear the tube base ring.
7. Support the base end of the tube and gradually apply pressure to the tube ejector lever to ease the tube from the mount.

Fig. 1.—Typical Power Output and Synchronous Helix Voltage versus Frequency (3·6 to 5·0 GHz)





W7/5GA
Codes: W7/5GB
W7/5GC

STC

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Fig. 2.—Typical Power Output versus Power Input at 3·7 GHz (W7/5GA, W7/5GC)

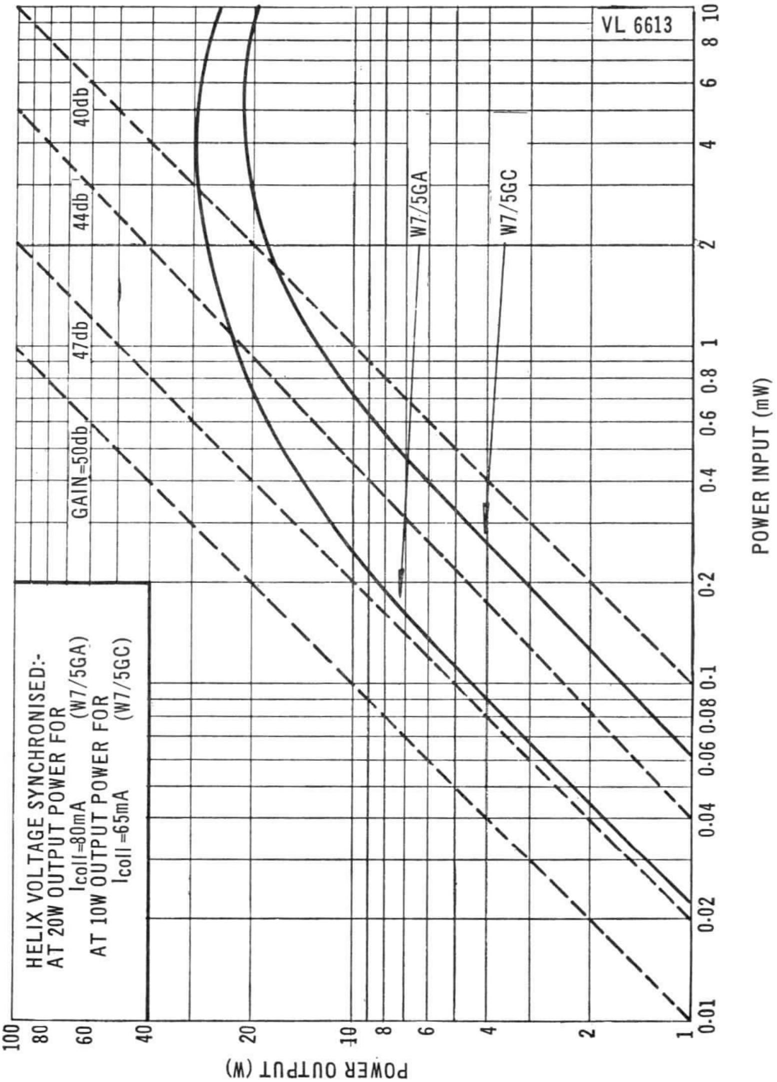

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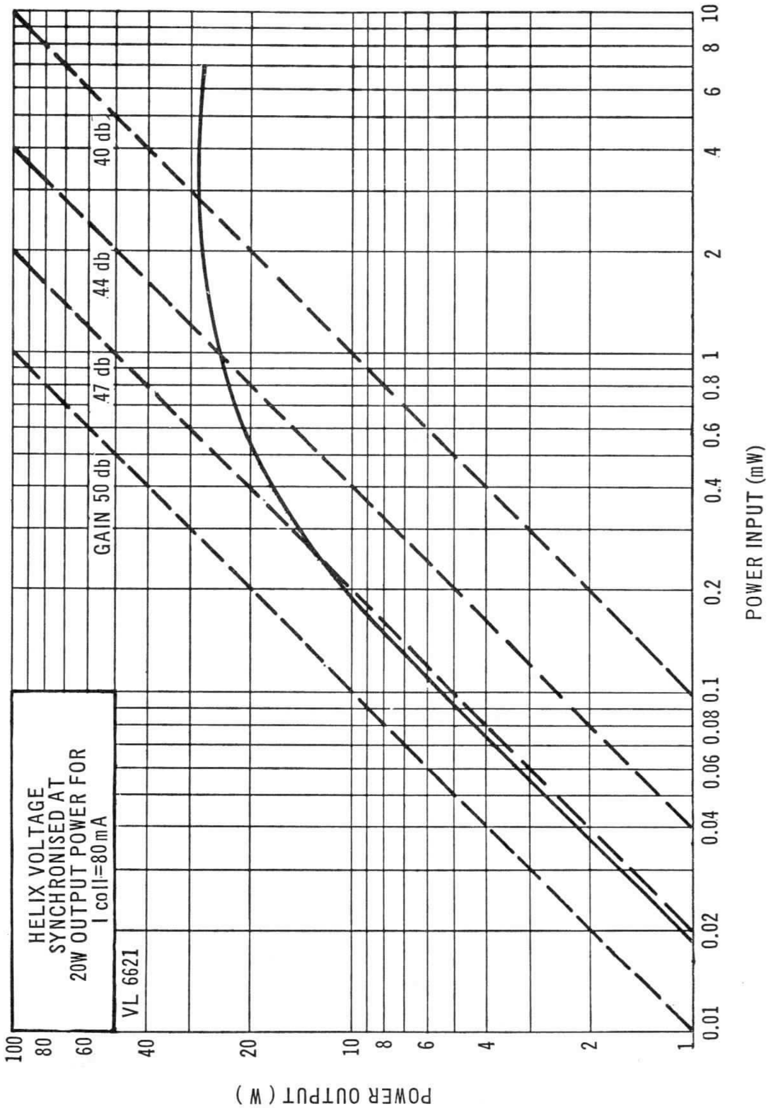
Fig. 3.—Typical Power Output versus Power Input at 4·2GHz (W7/5GA)



Codes: W7/5GA W7/5GB W7/5GC

STC

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Fig. 4.—Typical Power Output versus Power Input at 4·4 GHz (W7/5GB, W7/5GC)

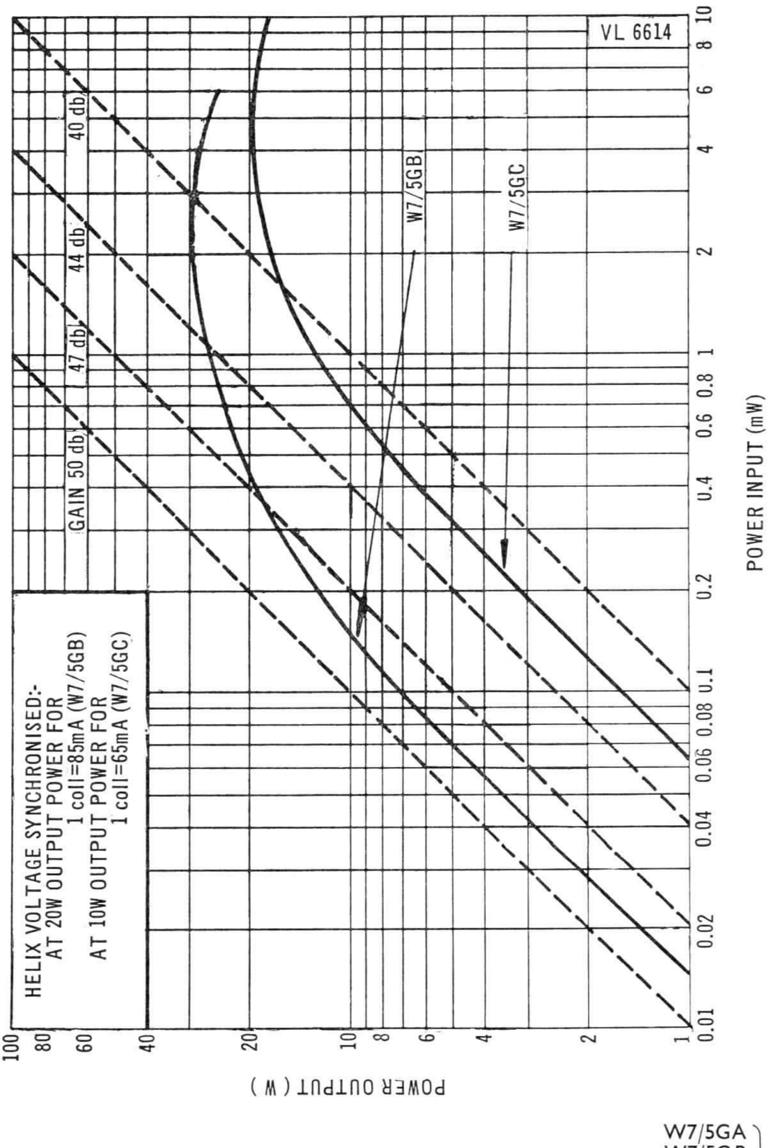

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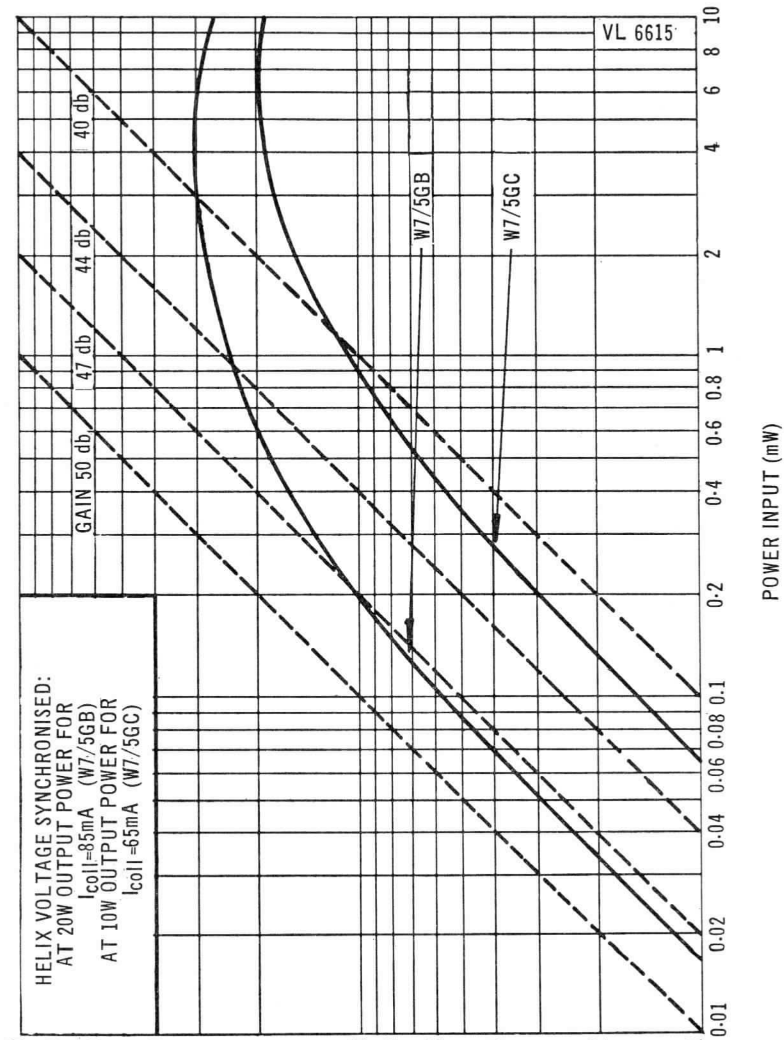
Fig. 5.—Typical Power Output versus Power Input at 5 GHz (W7/5GB, W7/5GC)



Codes: W7/5GA W7/5GB W7/5GC

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Fig. 6.—Typical Gain at Synchronous (Low-level) Helix Voltage versus Frequency (3·6 to 5 GHz)

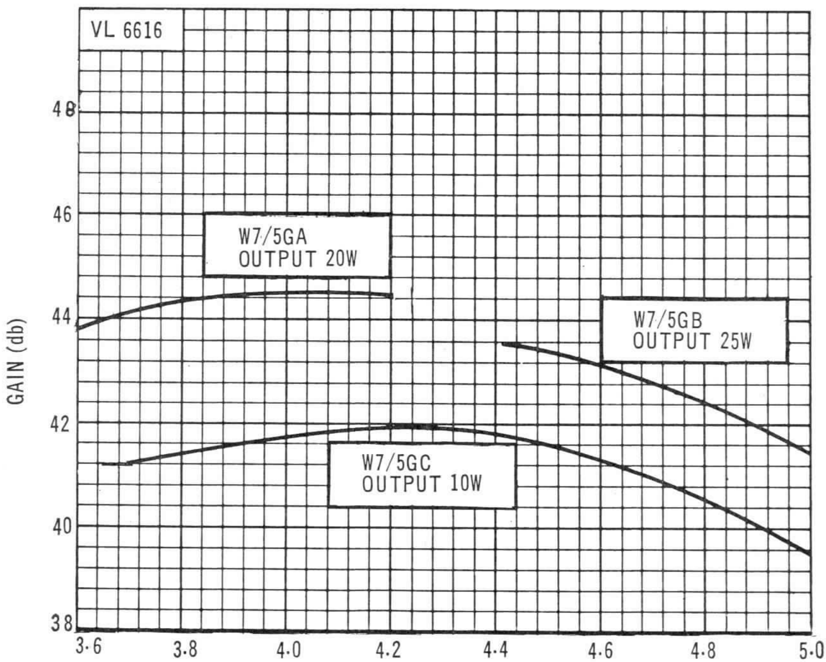
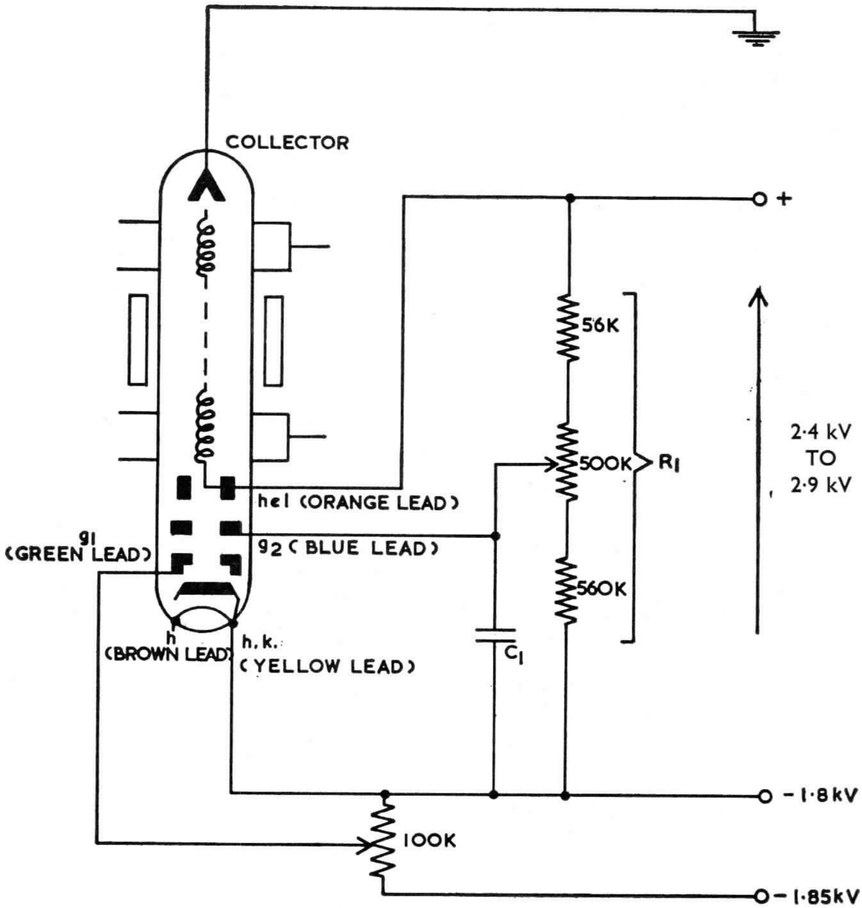


Fig. 7.—Typical Cathode Current Control Circuit for W7/5GA



Codes: W7/5GA W7/5GB W7/5GC

STC

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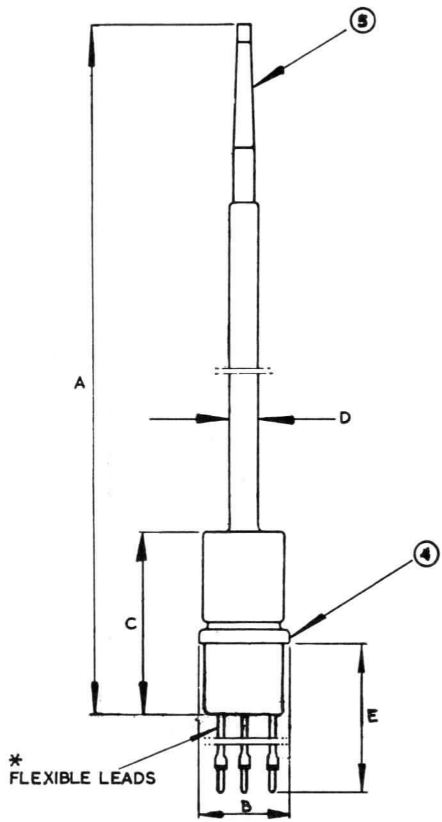
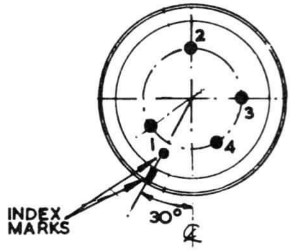
Fig. 8.—W7/5GA, W7/5GB and W7/5GC Outline





LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	GREEN	GRID 1
3	YELLOW	HEATER CATHODE
4	BROWN	HEATER
CONTACT		
5		HELIX
6		COLLECTOR

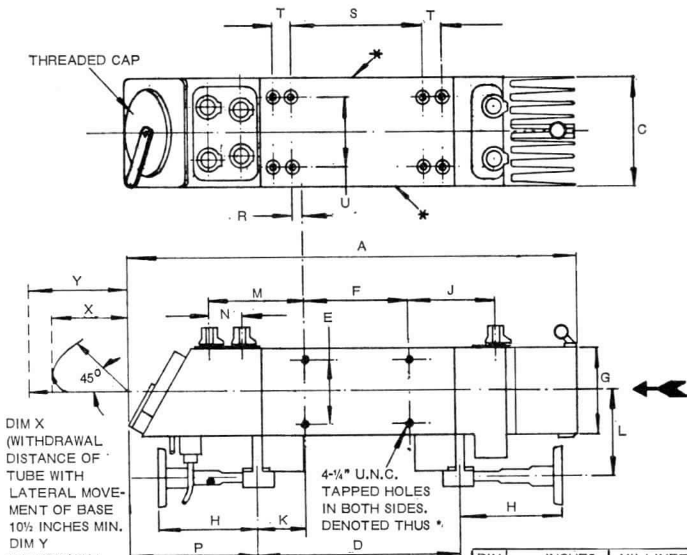
NOTE:- BASIC FIGURES ARE INCHES

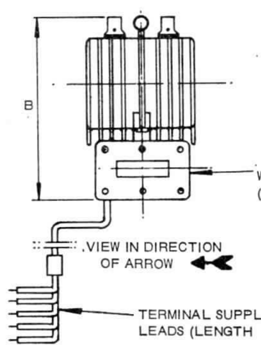
DIM	MILLIMETRES	INCHES
A	376,2 MAX.	14 13/16 MAX.
B	36,20 ± 0,18	1·425 ± 0·007
C	73,0 MAX.	2 7/8 MAX.
D	9,27 MAX.	0·365 MAX.
E	73,0 ± 3·2	2 7/8 ± 1/8

T.W.T. MOUNT

Code: WM110A

Fig. 9.—WM110A Dimensioned Outline





CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER CATHODE
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM	INCHES		MILLIMETRES	
A	17.1/2	MAX	444,5	MAX
B	7.1/2	MAX	190,5	MAX
C	4.5/16	MAX	109,5	MAX
D	7·750	NOM	196,85	NOM
E	2.1/4	± 1/32	57 , 2	± 0,8
F	4	± 1/32	101 , 6	± 0,8
G	3.1/2	MAX	88 , 9	MAX
H	4·100	± 1/32	103,2	± 0,8
J	3.9/32	± 1/16	83,3	± 1,6
K	1.7/8	± 1/16	47,6	± 1,6
L	3.5/16	± 1/32	84,1	± 0,8
M	3.3/4	± 1/8	95,3	± 3,2
N	1.1/4	± 1/16	31,8	± 1,6
P	5.3/8	± 1/8	136,5	± 3,2
R	1/2	± 1/16	12,7	± 1,6
S	5.1/16	± 1/8	128,6	± 3,2
T	23/32	± 1/16	18,3	± 1,6
U	2.11/16	± 1/16	68,3	± 1,6

BASIC DIMENSIONS ARE INCHES

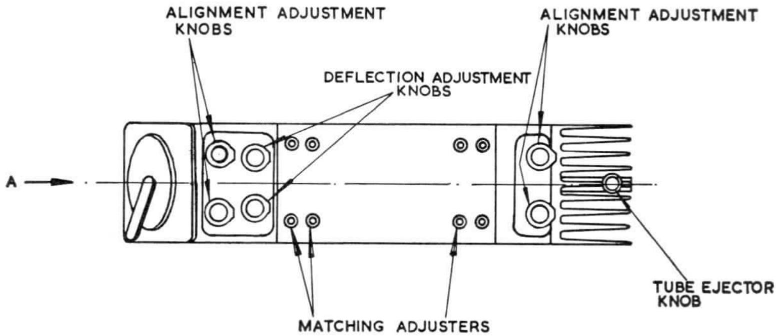
NETT. WEIGHT APP. 18.1/2 lbs
8,38 kgs

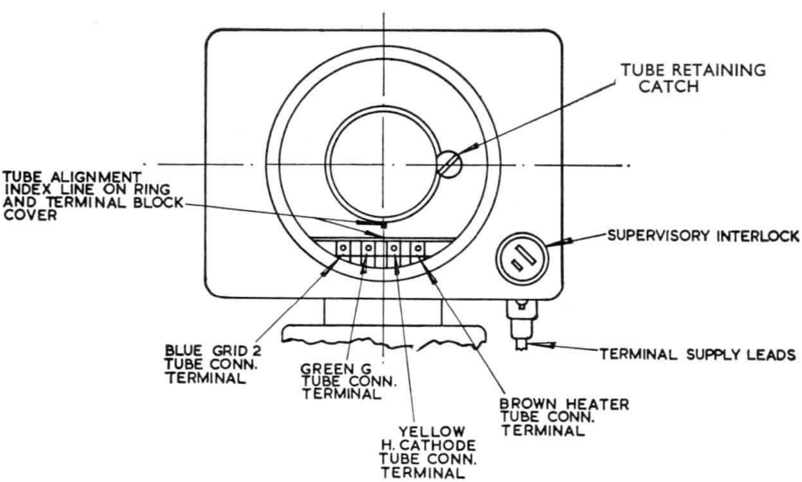
T.W.T. MOUNT

Code: WM110A

CONTINUED

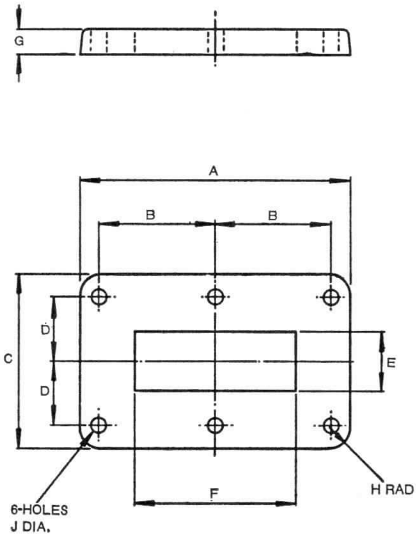
Fig. 10.—Diagram showing Operational Controls of WM110A





VIEW OF END 'A' WITH COVER REMOVED

Fig. 11.—Outline of Waveguide Flange 12A.



DIM.	INCHES	MILLIMETRES
A	3.625 ± 0.005	92,08 ± 0,13
B	1·531 ± 0·001	38,89 ± 0,03
C	2·312 ± 0·005	58,72 ± 0,13
D	0·859 ± 0·001	21,82 ± 0,03
E	0·795 ± 0·001	20,19 ± 0,03
F	2·128 ± 0·001	54,05 ± 0,03
G	0·328 ± 0·005	8,33 ± 0,13
H	0·281 ± 0·005	7,14 ± 0,13
J	0·196 ± 0·001	4,98 ± 0,03

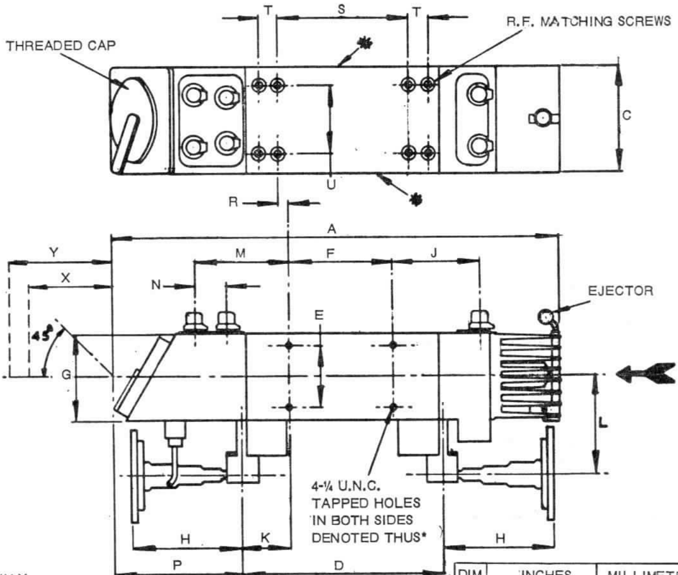
BASIC DIMS. ARE INCHES

STC

T.W.T. MOUNT

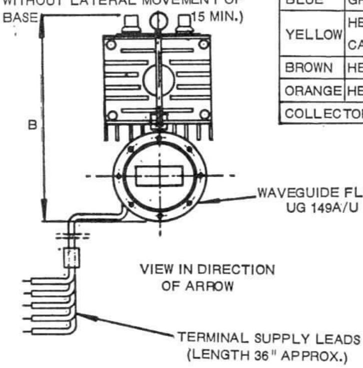
Code: WM110B

Fig. 12.—WM110B Dimensioned Outline



DIM.X
(WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE 10½ MIN.)

DIM.Y
(WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE 15 MIN.)



CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1.
BLUE	GRID 2.
YELLOW	HEATER CATHODE
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

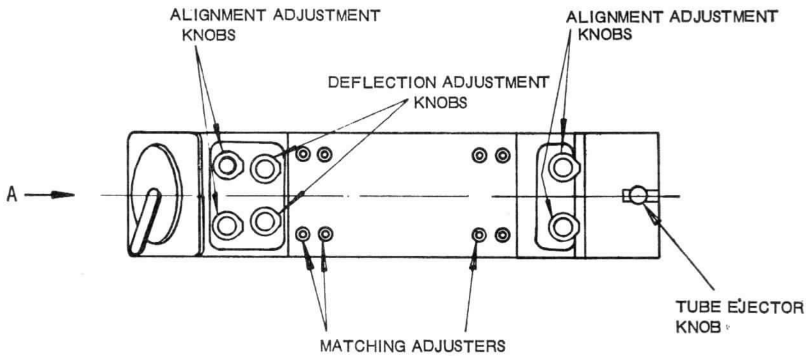
DIM.	INCHES		MILLIMETRES	
A	17.1/2	MAX.	444,5	MAX.
B	8.3/8	MAX.	212,7	MAX.
C	4.5/16	MAX.	109,5	MAX.
D	7·750	NOM.	196,85	NOM.
E	2.1/4	± 1/32	57,2	± 0,8
F	4	± 1/32	101,6	± 0,8
G	3.1/2	MAX.	88,9	MAX.
H	4·100	± 0·031	104,14	± 0,79
J	3.9/32	± 1/16	83,3	± 1,6
K	1.7/8	± 1/16	47,6	± 1,6
L	3.3/4	± 1/32	95,3	± 0,8
M	3.3/4	± 1/8	95,3	± 3,2
N	1.1/4	± 1/16	31,8	± 1,6
P	5.3/8	± 1/8	136,5	± 3,2
R	1/2	± 1/16	12,7	± 1,6
S	5.1/16	± 1/8	128,6	± 3,2
T	23/32	± 1/16	18,3	± 1,6
U	2.11/16	± 1/16	68,3	± 1,6

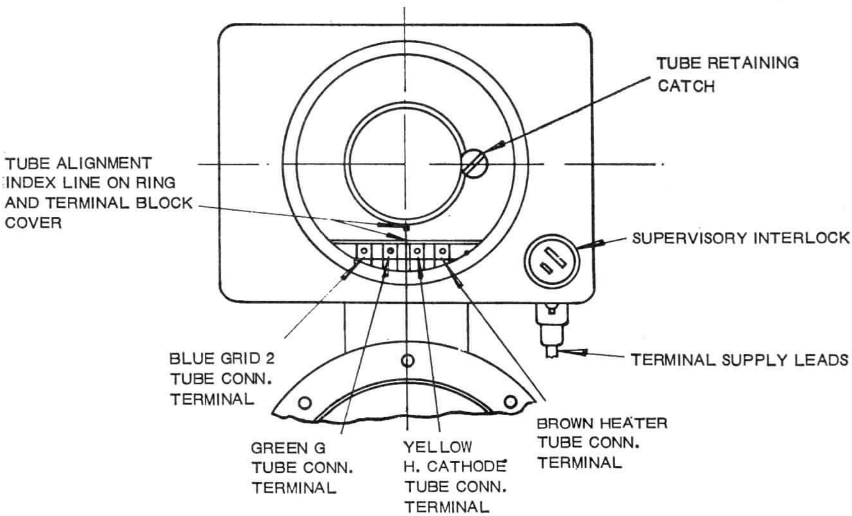
BASIC DIMENSIONS ARE INCHES

NETT. WEIGHT APP. 25 lbs
11·34 kgs

July 1967

Fig. 13.—Diagram showing Operational Controls of WM110B



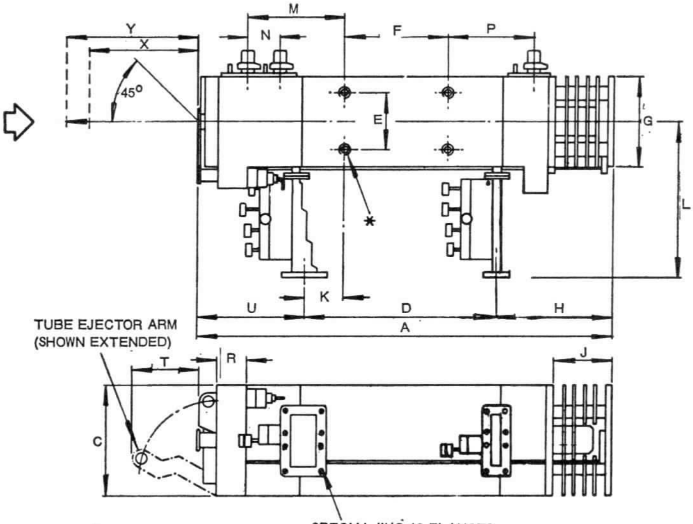


VIEW OF END 'A' WITH COVER REMOVED

T.W.T. MOUNT

Code: WM110C

Fig. 14.—WM110C Dimensioned Outline



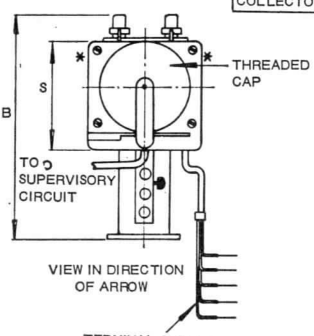
DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 12½" MIN.

DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 15 MIN.

* DENOTES: 4-¼" UNC TAPPED HOLES BOTH SIDES

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM.	INCHES	MILLIMETRES
A	16.1/4 MAX.	412,8 MAX.
B	8.15/16 MAX.	227,0 MAX.
C	4.5/16 MAX.	109,5 MAX.
D	7·413 NOM.	188,29 NOM.
E	2.1/4 ± 1/32	57,2 ± 0,8
F	4 ± 1/32	101,6 ± 0,8
G	3.1/2 MAX.	88,9 MAX.
H	4.1/2 ± 1/16	114,3 ± 1,6
J	2 13/32 ± 1/16	61,1 ± 1,6
K	1.17/32 ± 1/16	38,9 ± 1,6
L	6 ± 1/32	152,4 ± 0,8
M	3.3/4 ± 1/8	95,3 ± 3,2
N	1.1/4 ± 1/16	31,8 ± 1,6
P	3.9/32 ± 1/16	83,3 ± 1,6
R	1.1/4 MAX.	31,8 MAX.
S	4.3/8 MAX.	111,1 MAX.
T	2.5/8 APPROX.	66,7 APPROX.
U	4.5/32 ± 1/16	105,6 ± 1,6

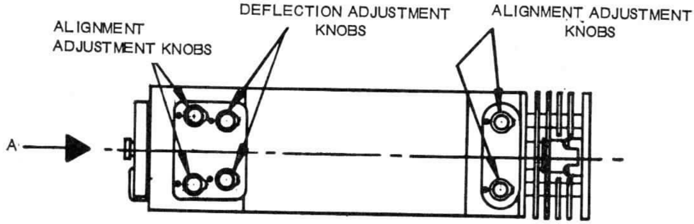


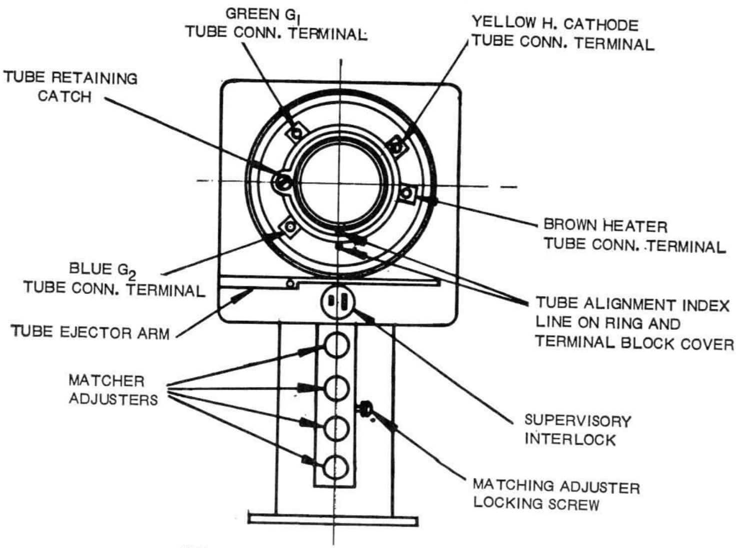
VIEW IN DIRECTION OF ARROW

TERMINAL SUPPLY LEADS (22" APPROX.)

BASIC DIMENSIONS ARE INCHES

Fig. 15.—Diagram Showing Operational Controls of WM110C



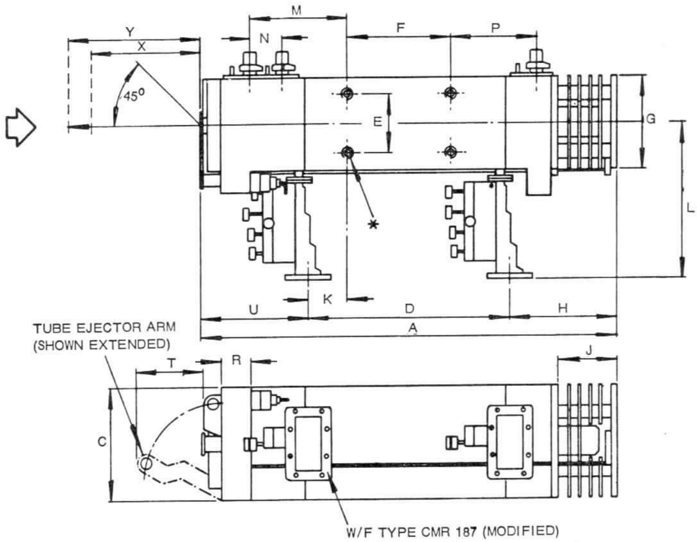


VIEW OF END 'A' WITH COVER REMOVED

T.W.T. MOUNT

Code: WM110CA

Fig. 16.—WM110CA Dimensioned Outline



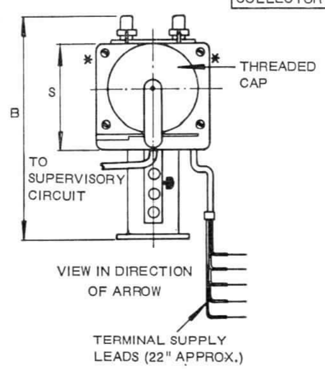
DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 12½" MIN.

DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 15" MIN.

* DENOTES: 4-¼" UNC TAPPED HOLES BOTH SIDES

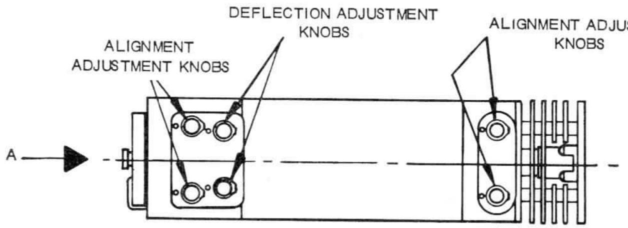
LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

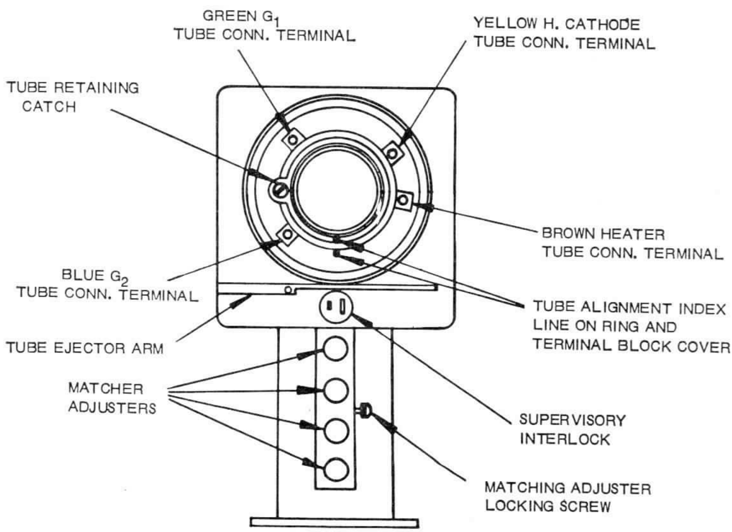
DIM.	INCHES		MILLIMETRES	
A	16.1/4	MAX.	412,8	MAX.
B	8.15/16	MAX.	227,0	MAX.
C	4.5/16	MAX.	109,5	MAX.
D	7·750	NOM.	196,85	NOM.
E	2¼	± 1/32	57,2	± 0,8
F	4	± 1/32	101,6	± 0,8
G	3½	MAX.	88,9	MAX.
H	4.5/32	± 1/16	105,6	± 1,6
J	2.13/32	± 1/16	61,1	± 1,6
K	1.17/32	± 1/16	38,9	± 1,6
L	6	± 1/32	152,4	± 0,8
M	3.3/4	± 1/8	95,3	± 3,2
N	1.1/4	± 1/16	31,8	± 1,6
P	3.9/32	± 1/16	83,3	± 1,6
R	1.1/4	MAX.	31,8	MAX.
S	4.3/8	MAX.	111,1	MAX.
T	2.5/8	APPROX.	66,7	APPROX.
U	4.5/32	± 1/16	105,6	± 1,6



BASIC DIMENSIONS ARE INCHES

Fig. 17.—Diagram showing Operational Controls of WM110CA





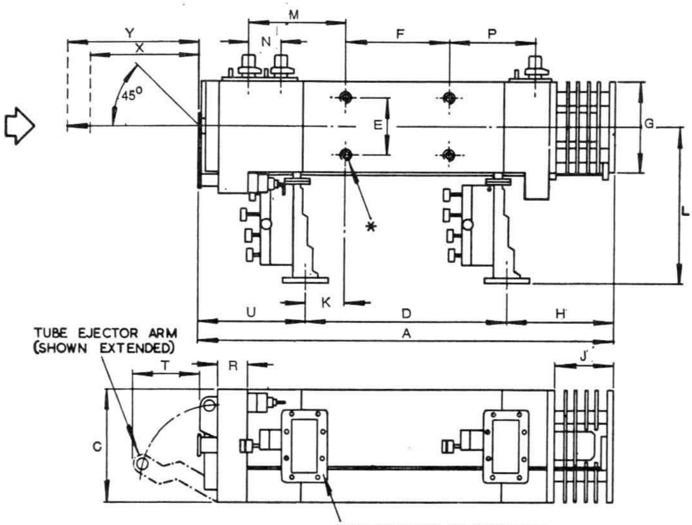
VIEW OF END 'A' WITH COVER REMOVED

STC

T.W.T. MOUNT

Code: WM110CB

Fig. 18.—WM110CB Dimensioned Outline



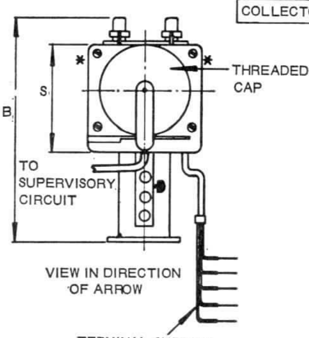
DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LITERAL. MOVEMENT OF BASE) 12½" MIN.

DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 15" MIN.

* DENOTES: 4-¼" UNC TAPPED HOLES BOTH SIDES

LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM.	INCHES		MILLIMETRES	
A	16.1/4	MAX.	412,8	MAX.
B	8.15/16	MAX.	227,0	MAX.
C	4.5/16	MAX.	109,5	MAX.
D	7·750	NOM.	196,85	NOM.
E	2.1/4	± 1/32	57,2	± 0,8
F	4	± 1/32	101,6	± 0,8
G	3.1/2	MAX.	88,9	MAX.
H	4	± 1/16	101,6	± 1,6
J	2.13/32	± 1/16	61,1	± 1,6
K	1.17/32	± 1/16	38,9	± 1,6
L	6	± 1/32	152,4	± 0,8
M	3.3/4	± 1/8	95,3	± 3,2
N	1.1/4	± 1/16	31,8	± 1,6
P	3.9/32	± 1/16	83,3	± 1,6
R	1.1/4	MAX.	31,8	MAX.
S	4.3/8	MAX.	111,1	MAX.
T	2.5/8	APPROX.	66,7	APPROX.
U	4.5/16	± 1/16	109,5	± 1,6

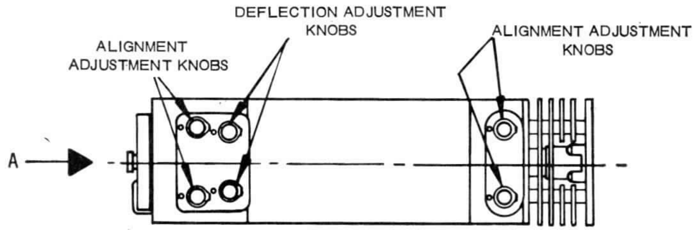


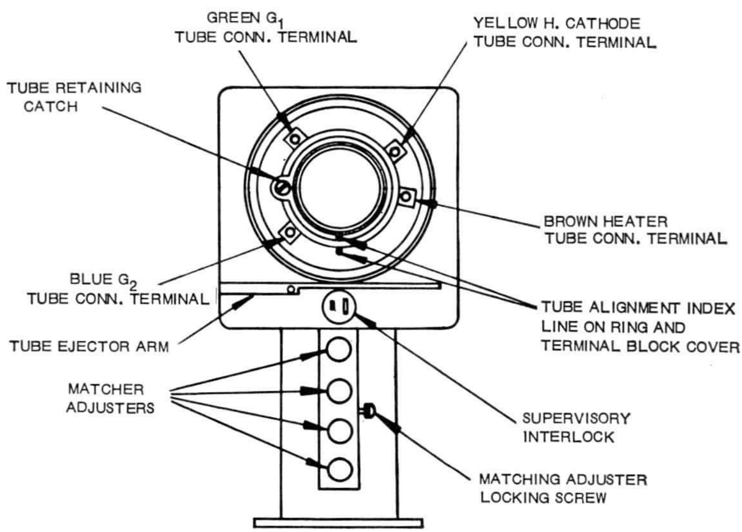
VIEW IN DIRECTION OF ARROW

TERMINAL SUPPLY LEADS (22" APPROX.)

BASIC DIMENSIONS ARE INCHES

Fig. 19.—Diagram showing Operational Controls of WM110CB





VIEW OF END 'A' WITH COVER REMOVED

MEDIUM POWER TRAVELLING–WAVE AMPLIFIER TUBES
CODES: W7/6GA; W7/6GC; W7/6GZ

These tubes are intended for use in microwave radio links in the frequency range 3·6 to 5·0GHz.

The tubes operate in four types of periodic permanent magnet focus mounts, in which they will give the performances quoted in these data sheets. The codes of the mounts and their associated tubes are as follows:-

WM111A (W7/6GA): WM111CA (W7/6GC): WM111CB (W7/6GC): WM111Z (W7/6GZ)

Each type of mount differs from the others in respect of certain electrical and mechanical features, described later, which afford a choice of frequency range, mounting position and waveguide size. All mounts are designed to permit easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE (Note 1)

	W7/6GZ in WM111Z	W7/6GA in WM111A	W7/6GC in WM111CB	W7/6GC in WM111CA	
Operating frequency range	3·6 to 4·2	3·7 to 4·2	3·7 to 4·2	4·4 to 5·0	GHz
Saturated power output, typical across band	37 to 41	37 to 41	30 to 31	26 to 30	W
Gain at 20W output, across band					
minimum	40	39			db
maximum	45	44			db
Gain at 10W output, across band					
minimum			38	38	db
maximum			43	43	db
Low-level-synch. saturated power output, minimum					
at 3·6GHz	24				W
at 3·7GHz	24	24	16		W
at 4·2GHz	24	24	16		W
at 4·4GHz				16	W
at 5·0GHz				16	W
Noise factor at working output, maximum	28	28	28	28	db
Reverse attenuation at working output, minimum	65	65	65	65	db
AM/PM conversion at working output, maximum	2·5	2·5	2·5	2·5	^{o}/db

Modulation noise peaks

Noise in any 4kHz band from 0·5MHz to 10MHz from the carrier does not exceed that value equivalent to 30db noise figure after 10 hours operation.

Matching

A VSWR of less than 1·2:1 maximum over any 20MHz band is obtainable at both input and output by means of stub tuners in each waveguide, tube voltages being applied. For W7/6GA in WM111A mount only, an r.f. input match of 1·5:1 maximum and an r.f. output match of 2:1 maximum is obtained over a 30MHz band with the tube and mount optimised for a working power output of 20W.

Note 1. For typical power output, gain, and helix voltage versus frequency graphs see Figures 1, 2 and 3: for typical power output versus power input graphs see Figures 4 and 5: for typical AM/PM conversion versus output power graph see Figure 6.

ITT Components Group Europe

Standard Telephones and Cables Limited
Electron Device Product Group
Electron Tube Division, Brixham Road
Paignton, Devon. TQ4 7BE
Tel. 0803 550762 Telex No. 42951 (ITT CPN G)

ITT COMPONENTS

TYPICAL OPERATING CONDITIONS (Note 2)

Frequency	3·7	4·2	4·7	GHz
Direct helix to cathode voltage (Note 3)	2 720	2 680	2 640	V
Direct grid 2 to cathode voltage (Note 4)				
W7/6GA, W7/6GZ	1 520	1 520		V
W7/6GC	1 340	1 340	1 340	V
Direct collector (earth) to cathode voltage	1 900	1 900	1 900	V
Direct grid 1 voltage (Note 5)	−15	−15	−15	V
Direct helix current at working output	0·5	0·5	0·5	mA
Direct grid 2 current	+2	+2	+2	μA
Direct cathode current				
W7/6GA, W7/6GZ	80·5	80·5		mA
W7/6GC	65·5	65·5	65·5	mA
Director collector current				
W7/6GA, W7/6GZ	80	80		mA
W7/6GC	65	65	65	mA
Low level synch. gain at 20W output, approx. (Note 6)				
W7/6GA	42	43		db
W7/6GZ	42·5	43·5		db
Low level synch. gain at 10W output, approx. (Note 6)				
W7/6GC	40	41·5	41	db
Saturated output at low level synch. helix voltage, approx. (Note 6)				
W7/6GA, W7/6GZ	26	25		W
W7/6GC	20	19·5	19	W
Noise factor (Note 7)	27	27	27	db
Phase sensitivity (Note 7)				
$d\Phi/dV_{he1}$	−1·3	−1·3	−1·3	°/V
$d\Phi/dV_{g2}$	+0·3	+0·3	+0·3	°/V
Change in gain (Note 7)				
for ±1% change in helix voltage	1·0	1·0	1·0	db
for ±2% change in helix voltage	2·5	2·5	2·5	db
for ±2% change in grid 2 voltage	0·02	0·02	0·02	db

Note 2. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 3. Adjusted to low level synchronous voltage.

Note 4. Adjusted to give required collector current.

Note 5. Preset value for switch-on. Adjusted for minimum helix current at required power level.

Note 6. As will be seen in Figures 4 and 5, an increase in output may be achieved by setting the helix voltage above the low level synchronous value with a resulting drop in low level gain.

For operation at outputs above the low level synchronous saturated values specified, an increase in collector volts to reduce helix current is recommended.

The matching adjusters must be optimised for each tube at the required operating frequency and power level.

Note 7. Measured at working power output and low level synchronous voltage.

CATHODE

Indirectly heated oxide-coated type

HEATER

	Min.	Nom.	Max.	
Heater voltage (Note 8)		6·3		V
Heater voltage tolerance				
long term average			±3	%
short term fluctuations up to two minutes duration			±5	%
Heater current	0·85	1·0	1·15	A
Heater preheat time	60			sec
Interruption time for zero preheat			10	sec

Note 8. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 45Hz to 65Hz. Other frequencies of supply may be used but it is recommended that the manufacturer be consulted beforehand. If the heater is operated with d.c. it is preferable to make the free heater lead negative with respect to the cathode.

LIMIT RATINGS

Voltages	Min.	Max.	
Direct helix to cathode (Note 9)	2·4	3·5	kV
Direct grid 2 to cathode		3·0	kV
Direct collector (earth) to cathode (Note 9)	1·7	4·0	kV
Direct grid 2 to helix		4·0	kV
Direct grid 2 to collector		4·0	kV
Direct grid 1 to cathode		0·5	kV

Note 9. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

Currents		Max.	
Cathode		100	mA
Helix	Absolute maximum to trip supplies with delay of less than 5 seconds	4·5	mA
	Switching Transient 50mA for not longer than 10ms 20mA for not longer than 150ms 10mA for not longer than 1 sec. 4·5mA for not longer than 5 sec.		
Direct grid 2		0·5	mA

Power Dissipations	Max.	
Grid 2	7·5	W
Helix	12	W
Collector (Note 10)	150	W

Note 10. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling. As a general guide, an air flow of about 25 ft^3/min. (708 l/min.) is required for a collector dissipation of 175W up to an altitude of 10 000 ft (3 048 m). (See page 6 COOLING).

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage

Adjustable for required working conditions, range	2·4 to 3·2 kV
The synchronous helix voltage for individual tubes lies within the range	2·45 to 2·75 kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation. See Typical Operating Conditions.	
Supply impedance, including resistance in mount, maximum (Note 11)	20 kΩ

Note 11. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage

Set between working limits of	1·7 and 2·75 kV

For operation with depressed collector at 65mA or 80mA it is recommended that a nominal voltage of 1·9kV be used. (See Note 6).

Grid 2 Voltage

Adjustable for required working conditions, range		1·1 to 2·0 kV
When adjusted to give stated collector current	65mA	80mA
initial range is	1·1 to 1·5	1·3 to 1·7 kV
end of life limit is	1·8	2·0 kV

Grid 1 Voltage

ADJUSTABLE for minimum helix current, range	−0·5 to −50 V

TUBE MECHANICAL DATA

Envelope	Glass and metal
Dimensions)	As shown in Figure 9
Connection detail)	

TUBE LIFE

Shelf life)	Subject to guarantee
Operational life)	

Life-end points

(a) Grid 2 voltage greater than 1·8kV for 65mA collector current, or 2·0kV for 80mA, or

(b) Helix current greater than 4·5mA for 65 or 80mA collector current, or

(c) Gain or power deteriorated by more than 2db from initial figures.

Tube storage temperature range (Note 12)	Min. −60	Max. +80 °C

Note 12. See page 8 for operating conditions.

GENERAL DESCRIPTION

These approved mounts, in which W7/6G series tubes operate, incorporate a periodic permanent magnet focusing system, r.f. coupling and matching elements, mechanical tube focusing adjustments and a convection cooler.

They differ from one another in respect of various physical characteristics and r.f. performance: these differences are detailed in the MECHANICAL DATA, ELECTRICAL DATA and R.F. PERFORMANCE Sections, and in the relevant drawings given later in these data sheets.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies. Resistors are incorporated in the grid 2 and helix leads to limit surges on the WM111CA, WM111CB and WM111Z mounts.

A lid (detachable or hinged depending on mount type) provides access to the tube connections. It has attached to it a link which, when the lid is in place, is connected to a twin-lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of three pairs of mechanical positioning screws: two pairs align the tube and the other pair move a magnetic deflector plate. (See Figures 10, 12 14 and 16).

Fine adjustments to the matching are made by moveable stub tuners in the waveguides. (See Figures 10, 12, 14 and 16).

WM111A, WM111CA, WM111CB. The operation of closing the hinged lid automatically locates the tube in the mount longitudinally. Mating rings at the base end of the tube and mount and the collector cooler provide lateral location.

WM111Z. The tube is held firmly in the mount at the collector end by the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining catch: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining catch is shown in Figures 10 and 12).

Each mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external control at the collector end in the WM111Z (See Figures 10 and 12), and at the base end in the WM111A, WM111CA and WM111CB (See Figures 14 and 16). A two-position control on the WM111Z prevents inadvertent operation and possible damage to the tube.

The design of the mounts is such that tube alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

R.F. LEAKAGE

Input waveguide level to free space	>65	db
Output waveguide level to free space at 20W output power	>65	db

MECHANICAL DATA (Mounts)

Dimensions	As shown in Figures 9, 11, 13 and 15.
Mounting position	That which allows correct operation of the collector cooler, see COOLING section below.
Fixing of mounts	Attach mounts to equipment with ¼ inch UNC non-magnetic screws fitting into ½ inch deep tapped holes provided in mount bodies. (See Figures 9, 11, 13 and 15).
R.F. matching	Four moveable stub tuners in each waveguide. (See Figures 10, 12, 14 and 16).
Waveguide connections	input and output
WM111CB	Flanges as shown in Figure 19 for connection to waveguide WG11A (WR229).
WM111A WM111CA	Flanges as shown in Figures 17 and 18 for connection to waveguide WG12 (WR187). Tin plated shims and screws, which are available if required, should be used for connection to brass waveguide flanges.
WM111Z	Flanges as shown in Figure 20 for connection to waveguide WG12A.

COOLING

The collector cooler is an integral part of the mount. Cooling takes place by convection and it is important that the mount is operated in the position intended. The WM111Z is designed for vertical mounting and the cooler is provided with a vertical duct. WM111A, WM111CA and WM111CB are for horizontal operation and the cooling fins must be vertical.

The air flow through the cooler requires a free space of 2 inches (5cm) around the cooler slots with access to a free supply of air at ambient temperature; this is to ensure that the convection cooling is efficient. The cooler temperature under normal conditions of operation is about 135°C above ambient.

At altitudes up to 15 000 ft, and within the maximum ambient temperatures specified in the next paragraph, free convection is adequate for dissipations up to the specified limit rating. Where it is required to exceed either the ambient temperature or the collector dissipation limits, forced-air-cooling is necessary and the manufacturer should be consulted to obtain the flow applicable to individual requirements. See also Note 10.

ENVIRONMENTAL CONDITIONS

Operating ambient temperature range and altitude for full specification performance.

−10°C min. to +65°C max. up to 5 000 ft (1 524m)
+60°C max. up to 10 000 ft (3 048m)
+55°C max. up to 15 000 ft (4 552m)

Between −10°C and −30°C there will be satisfactory switch-on but some degradation of performance may occur.

Storage ambient temperature range and altitude

−30°C min. to +75°C max. up to 45 000 ft (13 176m)

PROXIMITY OF MAGNETIC MATERIALS

Soft magnetic materials should be kept at least 1 inch (2,5cm) away from the exterior of the mounts.

Permanent magnets in the vicinity of the mount must be positioned so that the helix current at fully saturated output does not increase by more than 0·1mA. Assistance with focusing tests in the presence of permanent magnets and guidance concerning their position is always available from the manufacturer.

ELECTRICAL DATA

Ratings		
Heater and heater-cathode) Helix) Grid 2) to body of mount, maximum voltage	4·5	kV
Maximum voltage, supervisory cable and interlock to body of mount	500	V
Maximum current, supervisory cable and interlock to body of mount		
WM111CA, WM111CB, WM111Z	10	A
WM111A	2	A
Lead Resistance (including limiting resistors)		
Grid 2		
WM111CA, WM111CB, WM111Z	4·7	kΩ
WM111A	0·055	Ω
Helix		
WM111CA, WM111CB, WM111Z	1	kΩ
WM111A	0·055	Ω
Heater (Note 14)	0·055	Ω

Note 14. Measured at 2A.

OPERATIONAL DATA FOR TUBE IN MOUNT

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the transient values given in the tube limit ratings.

A suitable cathode current control circuit is shown in Figure 7. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. The recommended setting for switch-on, is 1 300 volts on grid 2 with respect to cathode and the helix supply at 2 600 volts, when the maximum transient value of helix current during the rise of helix voltage may be of the order of 30mA.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage, for example by means of capacitor C_1 in Figure 7. The value of capacitance is dependent upon the rise time of the helix voltage but should be arranged to keep the grid 2 voltage below 250 volts until the helix voltage has risen to over 2 000 volts.

SETTING-UP PROCEDURE

The following procedure is recommended for setting-up the tube in its mount for operation:

1. Ensure that the mechanical tube focusing control knobs on the mount are set to the middle of their travel. Ensure that the two-position retaining catch is in a position to allow the tube to be inserted (WM111Z only).
2. Ensure that the mount is properly earthed (Note 16).
3. WM111Z only.
   (a) Insert tube in mount (Note 17). At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the spring-loaded cooler fins and the spring located on the mount ring before the tube meets the stop at the base end. The yellow index line on the base of the tube should be aligned with the black mark on the seating: this is necessary for best matching, but the adjustment is not critical, misalignment up to 20^{o} being permissible.
   (b) Holding the tube in the fully home position against the pressure of the spring cooler fins, secure the tube in the mount by rotating the two-position retaining catch to turn over the projection of the tube base ring (Note 18).
   (c) Connect colour-coded electrode leads of the tube to appropriate terminals in the mount.
   (d) Replace lid. Ensure that the interlock two-pin plug is fitted correctly in its socket.
3. WM111A, WM111CA, WM111CB
   (a) Unscrew the two captive locking screws in the hinged lid, disengage the spring catch and open the lid. Insert tube (See Note 17) far enough for the colour-coded electrode leads to be easily connected. No damage is caused by pushing the tube fully home; it simply tends to be partially ejected by the cooler on releasing the base.

   The yellow line on the tube base cap should be aligned with the black index mark on the seating ring; this is necessary for best matching but the adjustment is not critical, misalignment up to 20^{o} is permissible.
   (b) Close lid, engage the spring catch and fully tighten both locking screws in the lid. This operation automatically moves the tube to its correct longitudinal position relative to the mount, completes the interlock circuit and prevents operation of the tube ejector mechanism.
4. Apply heater voltage and allow one minute heating time.
5. Preset grid 1 voltage to −15 volts.
6. Make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:
   (a) Switch off any r.f. drive.
   (b) Pre-set grid 2 voltage (cathode current control) to give about 1·3kV when switched on; this corresponds to a cathode current of about 65mA. At lower voltages the helix current may be excessive.
7. After the one minute cathode pre-heat, switch on collector voltage at 1·9kV.

8. Switch on simultaneously the helix voltage at 2·6kV and the grid 2 voltage to the preset value. See Note 15.
9. Adjust focusing control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until the required collector current is achieved.
10. Apply an r.f. input of approximately −15dbm and adjust the input and output r.f. matching for maximum output. The helix voltage also should be adjusted for maximum output if operation is required under low level synchronous conditions. Increase the r.f. input to obtain the required output level; readjust focusing control knobs to minimise helix current, grid 2 voltage to maintain appropriate collector current and matching adjusters.

Note 15. Provided that the rise time of the collector voltage is not greater than that of the helix and grid 2 voltages, all three supplies may be switched on together.

Note 16. The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. A black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

Note 17. The insertion of the tube requires a free space between the lid of the mount and extraneous equipment. The space required is specified for individual mounts in Figures 9, 11, 13 and 15.

Note 18. Once the tube has been secured by the retaining catch, it is important to ensure that the tube ejection mechanism is not operated inadvertently: failure to observe this precaution will result in the tube being damaged. To minimise this risk the mechanism is designed so that the tube ejector knob (See Figures 15 and 16) must be pulled outward before the lever can be moved.

TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Move adjusting knobs to mid travel position.
4. WM111Z only
   (a) Remove mount lid.
   (b) Disconnect tube leads from terminals.
   (c) Rotate the two-position retaining catch to clear the tube base ring and thus allow the spring loaded cooling fins to push the tube outwards.
   (d) Lift and pull the tube ejector lever to free the collector from the cooling fins and withdraw the tube.
4. WM111A, WM111CA, WM111CB
   (a) Unscrew the two captive locking screws in the hinged lid, disengage the spring catch and lift lid and thus allow the spring-loaded cooling fins to push the tube outwards.
   (b) Disconnect the tube leads from their terminals.
   (c) Pull the tube ejector lever to free the collector from the cooling fins and withdraw the tube.

Fig. 1. Typical Power Output versus Frequency

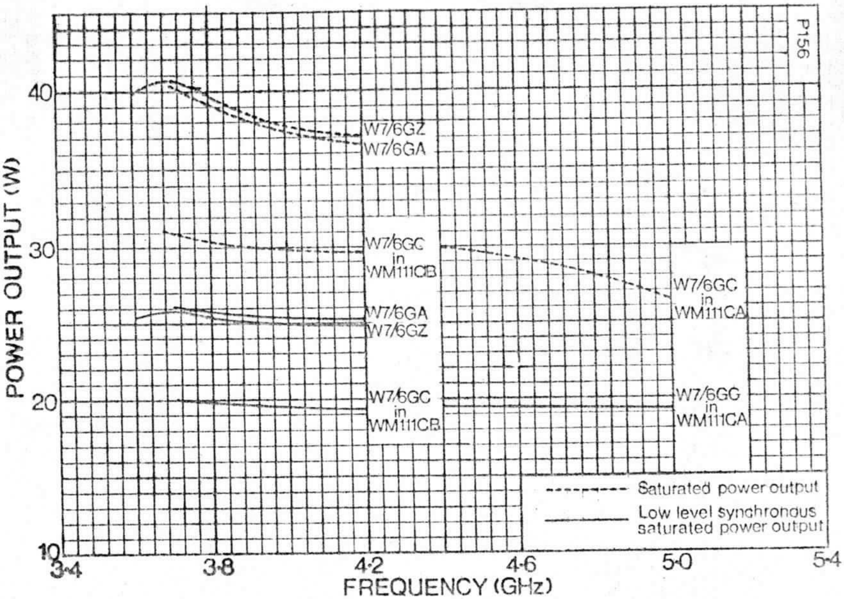


Fig. 2. Typical Low-level-synchronous Gain versus Frequency

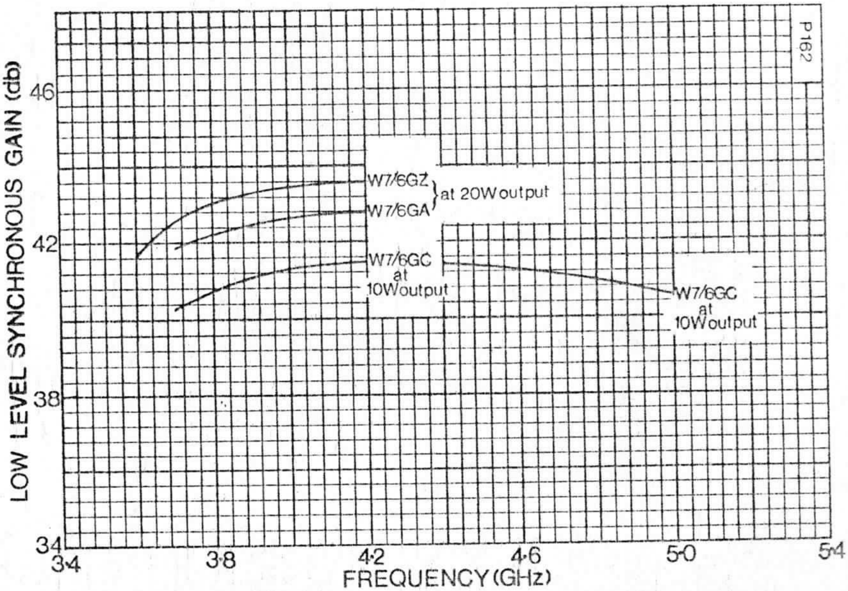


Fig. 3. Typical Low-level-synchronous Helix Voltage versus Frequency

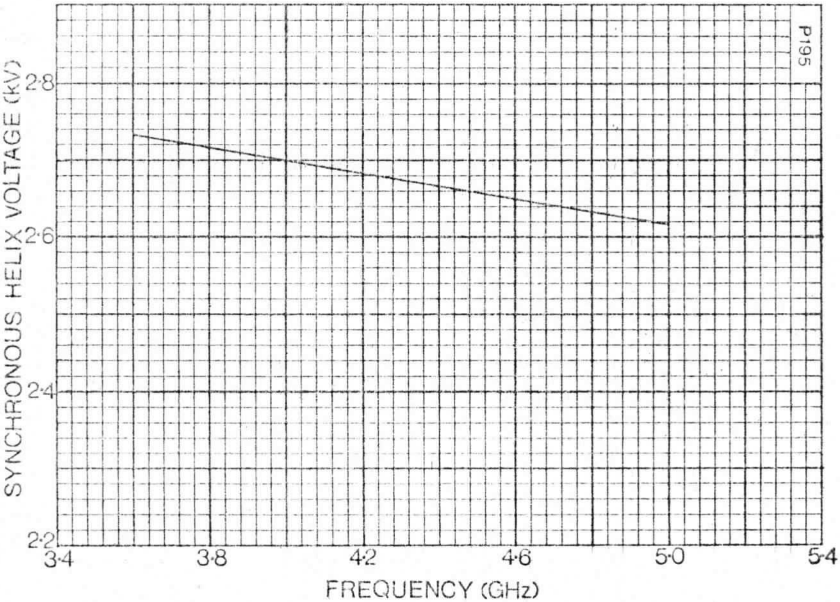


Fig. 4. W7/6GA Typical Power Output versus Power Input at 3·7GHz

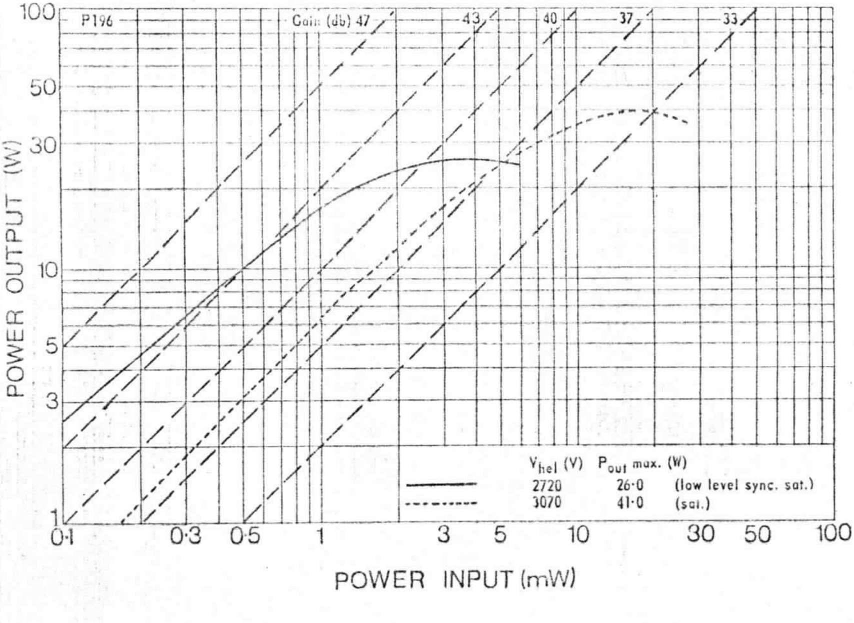


Fig. 5. W7/6GA Typical Power Output versus Power Input at 4·2GHz

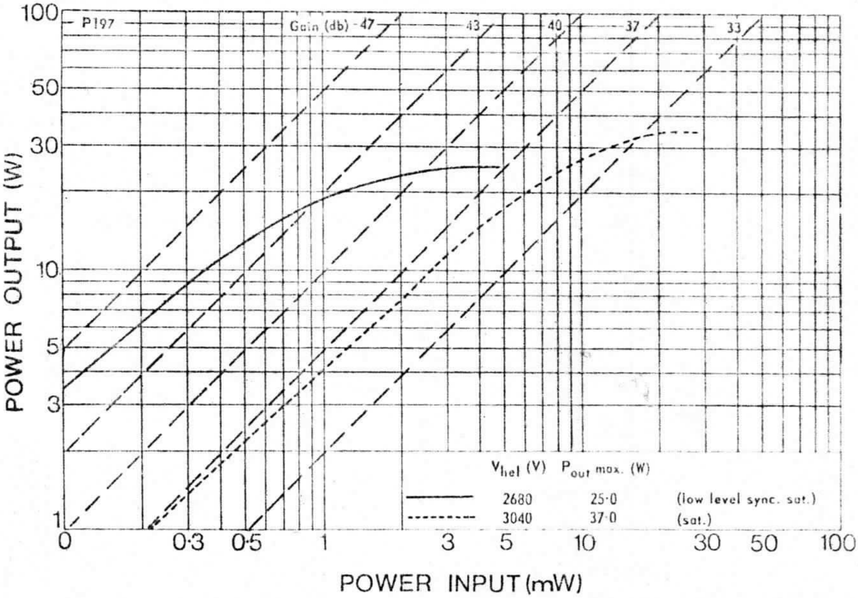


Fig. 6. Typical AM/PM Conversion versus Output Power at 3·9GHz

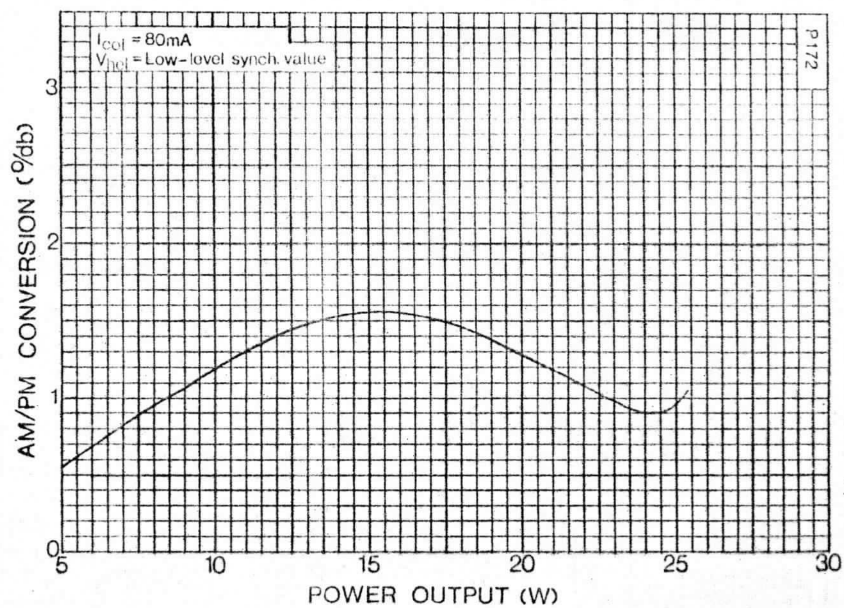


Fig. 7. Typical Cathode Current Control Circuit for W7/6F Series Tubes

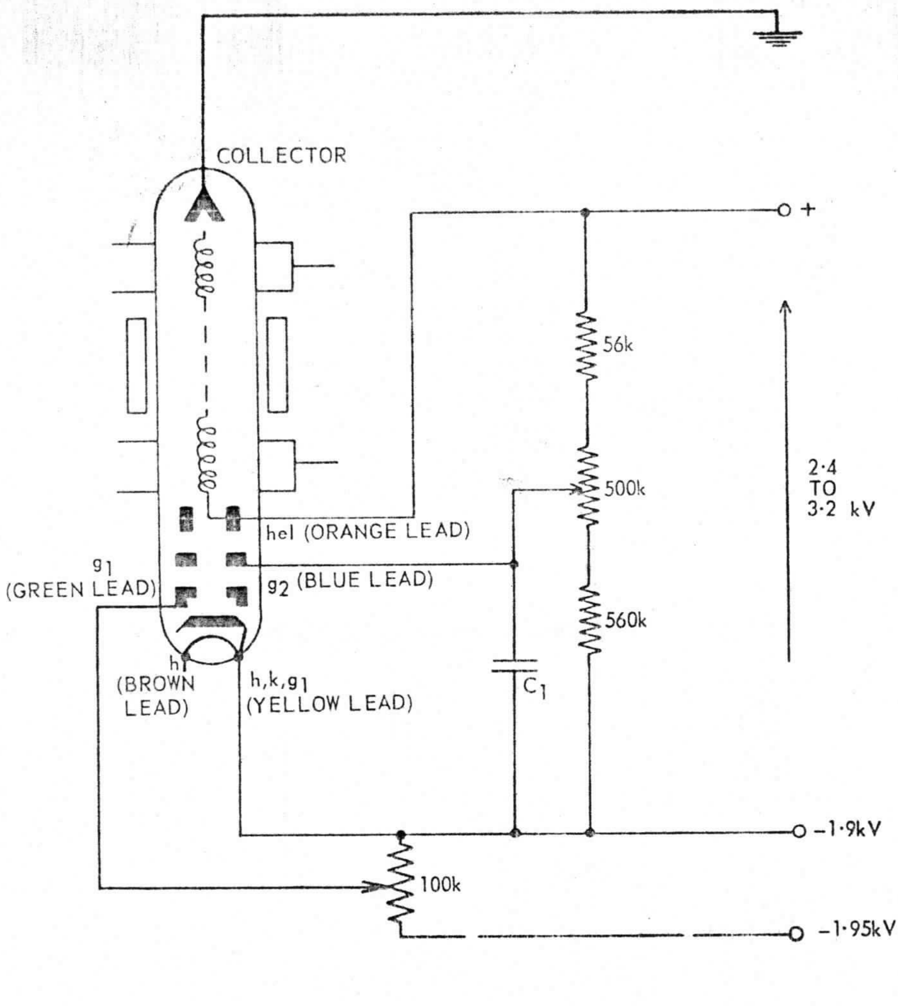
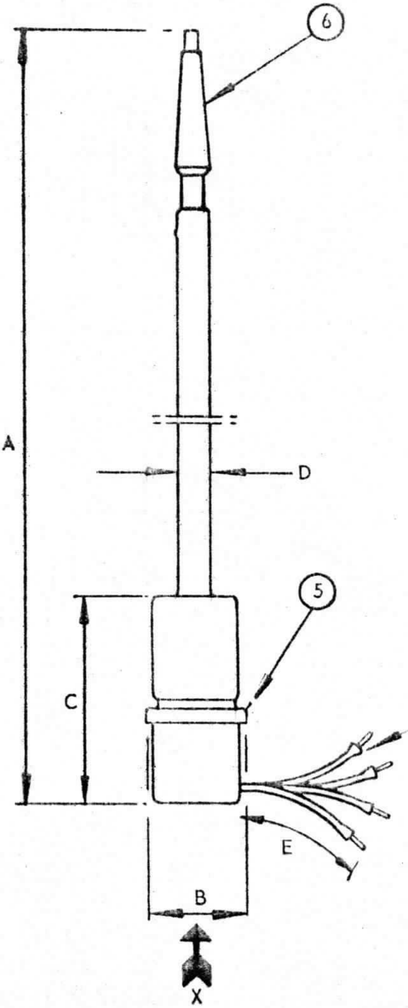
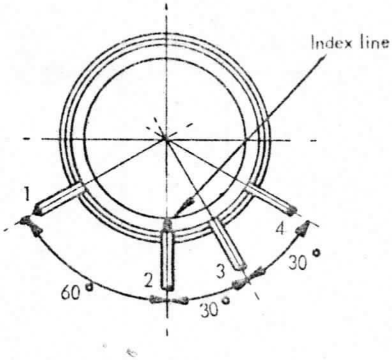


Fig. 8. W7/6GA, W7/6GC, W7/6GZ Outline





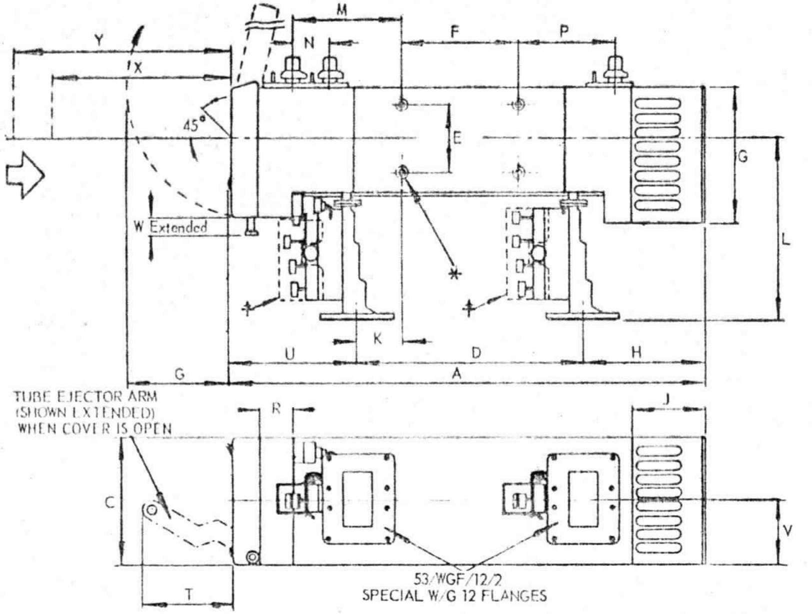
View on arrow 'X'

Lead	Colour	Electrode
1	GREEN	GRID 1
2	BLUE	GRID 2
3	BROWN	HEATER
4	YELLOW	HEATER CATHODE
Contact		
5	—	HELIX
6	—	COLLECTOR

Dim.	Millimetres		Inches	
A	376,2	max.	$14\frac{13}{16}$	max.
B	36,20 ±	0,18	1·425 ±	0·007
C	73,0	max.	$2\frac{7}{8}$	max.
D	9,27	max.	0·365	max.
E	46,0	nom.	$1\frac{13}{16}$	nom.

Millimetre dimensions are derived from the original inch dimensions.

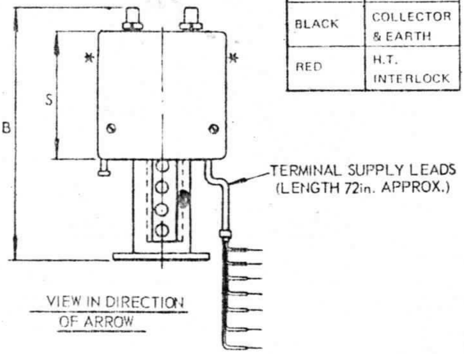
Fig. 9. WM111A Mount Outline



DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 12½in. MIN.
DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 15in. MIN.

* DENOTES:
4 -¼in. UNC TAPPED HOLES BOTH SIDES

† DENOTES:
PROTECTIVE COVERS FITTED OVER MATCHING ADJUSTERS



VIEW IN DIRECTION OF ARROW

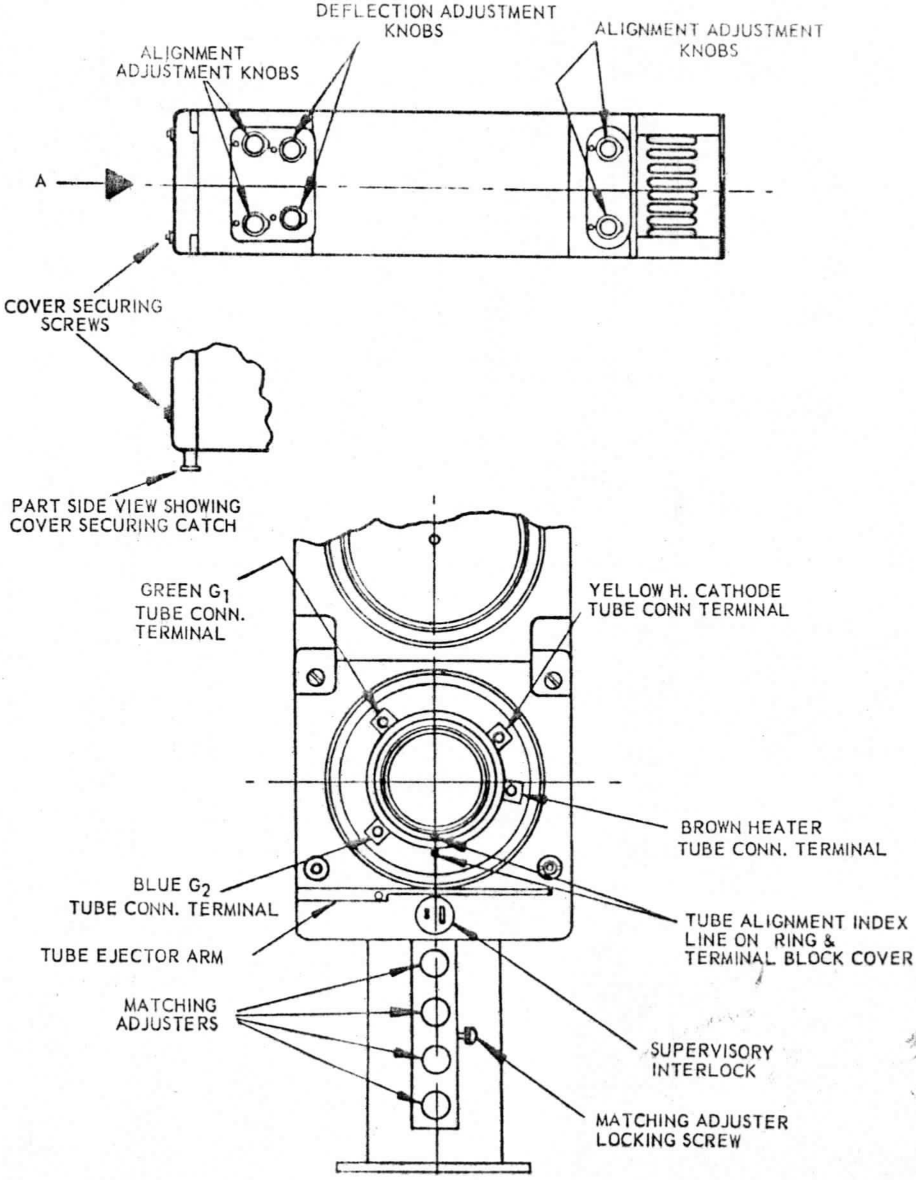
Lead	Electrode
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & EARTH
RED	H.T. INTERLOCK

Dim.	Inches			Millimetres		
A	$16\frac{7}{16}$		max.	417,5		max.
B	$8\frac{15}{16}$		max.	227,0		max.
C	$4\frac{1}{8}$	±	$\frac{1}{16}$	104,8	±	1,6
D	7·750		nom.	196,85		nom.
E	2¼	±	$\frac{1}{64}$	57,2	±	0,4
F	4	±	$\frac{1}{64}$	101,6	±	0,4
G	$4\frac{3}{8}$		max.	111,1		max.
H	$4\frac{1}{16}$	±	$\frac{1}{8}$	103,2	±	3,2
J	$2\frac{5}{8}$	±	$\frac{1}{16}$	66,7	±	1,6
K	$1\frac{17}{32}$	±	$\frac{1}{32}$	38,9	±	0,8
L	6	±	$\frac{1}{32}$	152,4	±	0,8
M	3¾	±	$\frac{1}{8}$	95,3	±	3,2
N	1¼	±	$\frac{1}{16}$	31,8	±	1,6
P	$3\frac{9}{32}$	±	$\frac{1}{16}$	83,3	±	1,6
R	1¼		max.	31,8		max.
S	4½		nom.	114,3		nom.
T	$2\frac{5}{8}$		approx	66,7		approx
U	$4\frac{3}{8}$	±	$\frac{1}{16}$	111,1	±	1,6
V	$2\frac{1}{16}$	±	$\frac{1}{32}$	52,4	±	0,8
W	1		max.	25,4		max.

Nett Weight app.	23·5 lbs
	10,7 kgs

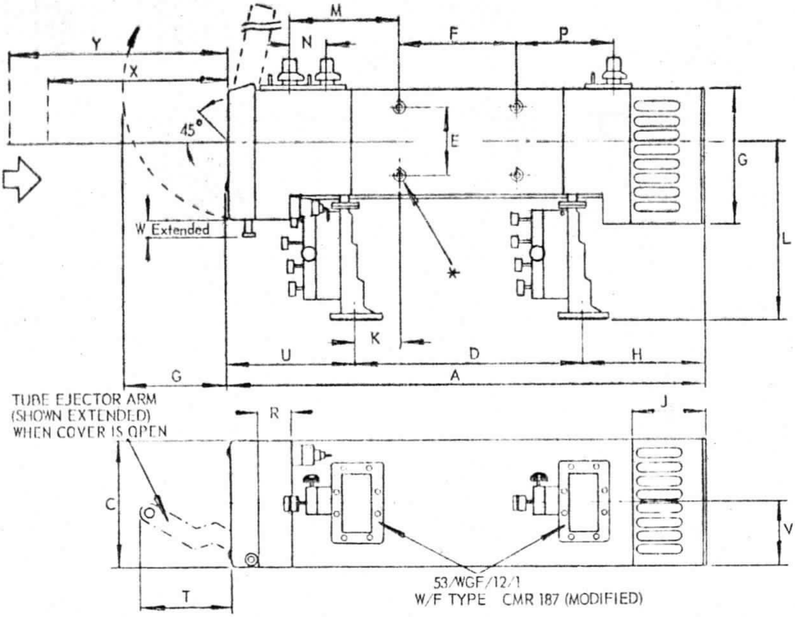
Metric dims. are derived from original inch dims.

Fig. 10. Diagram Showing Operational Controls of WM111A



VIEW OF END 'A' WITH COVER OPEN

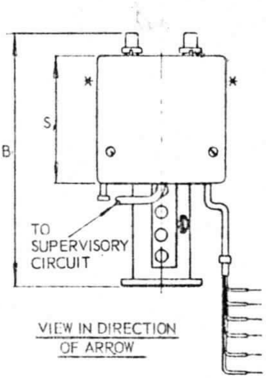
Fig. 11. WM111CA Mount Outline



DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 12½in. MIN.

DIM. Y (WITHDRAWAL DISTANCE WITHOUT LATERAL MOVEMENT OF BASE) 15in. MIN.

* DENOTES:
4-¼in. UNC TAPPED HOLES BOTH SIDES*



VIEW IN DIRECTION OF ARROW

Lead	Electrode
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & GROUND

Dim.	Inches		Millimetres	
A	$16\frac{7}{16}$	max.	417,5	max.
B	$8\frac{15}{16}$	max.	227,0	max.
C	$4\frac{1}{8}$	$\pm\frac{1}{16}$	104,8	± 1,6
D	7·750	nom.	196,85	nom.
E	2¼	$\pm\frac{1}{64}$	57,2	± 0,4
F	4	$\pm\frac{1}{64}$	101,6	± 0,4
G	$4\frac{3}{8}$	max.	111,1	max.
H	$4\frac{1}{16}$	$\pm\frac{1}{8}$	103,2	± 3,2
J	$2\frac{5}{8}$	$\pm\frac{1}{16}$	66,7	± 1,6
K	$1\frac{17}{32}$	$\pm\frac{1}{32}$	38,9	± 0,8
L	6	$\pm\frac{1}{32}$	152,4	± 0,8
M	3¾	$\pm\frac{1}{8}$	95,3	± 3,2
N	1¼	$\pm\frac{1}{16}$	31,8	± 1,6
P	$3\frac{9}{32}$	$\pm\frac{1}{16}$	83,3	± 1,6
R	1¼	max.	31,8	max.
S	4½	nom.	114,3	nom.
T	$2\frac{5}{8}$	approx.	66,7	approx.
U	$4\frac{7}{16}$	$\pm\frac{1}{16}$	112,7	± 1,6
V	$2\frac{1}{16}$	$\pm\frac{1}{32}$	52,4	± 0,8
W	1	max.	25,4	max.

Nett Weight app.	23·5 lbs
	10,7 kgs

Metric dims. are derived from original inch dims.

Fig. 12. Diagram Showing Operational Controls of WM111CA

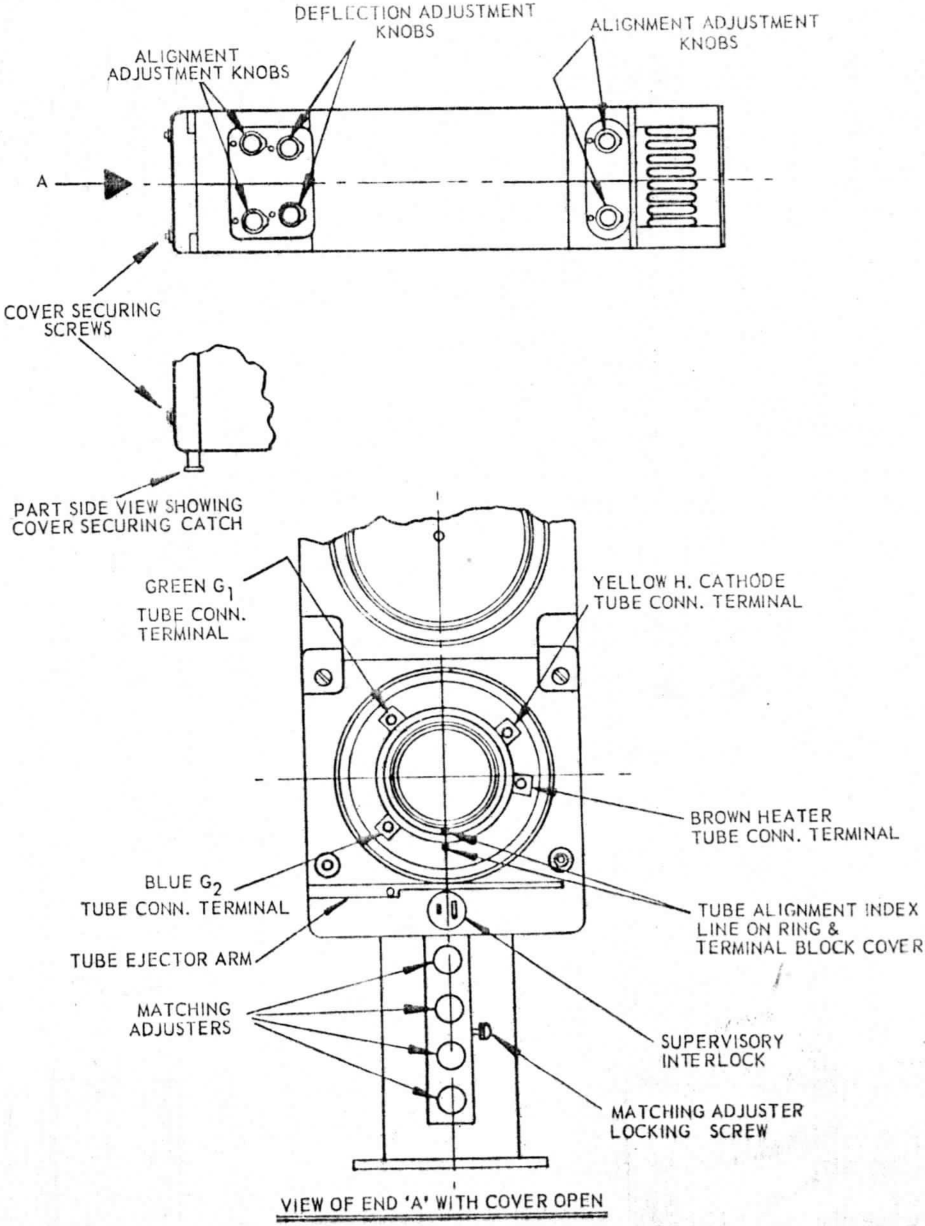
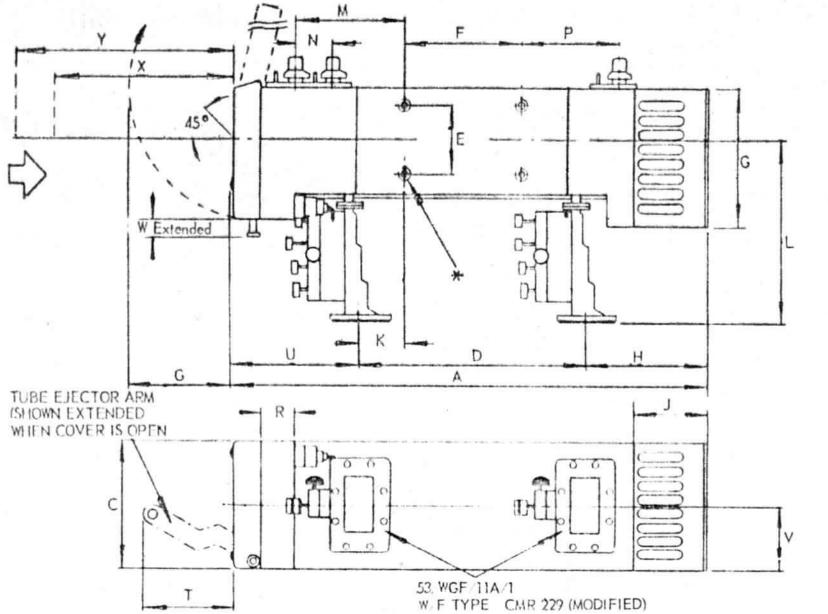


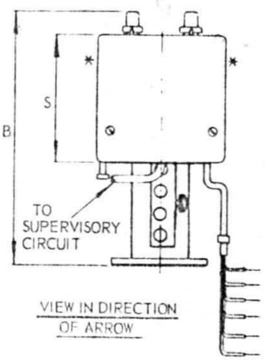
Fig. 13. WM111CB Mount Outline



DIM. X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 12½ in. MIN.

DIM. Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 15in. MIN.

* DENOTES
4 -¼in. UNC TAPPED HOLES BOTH SIDES



VIEW IN DIRECTION OF ARROW

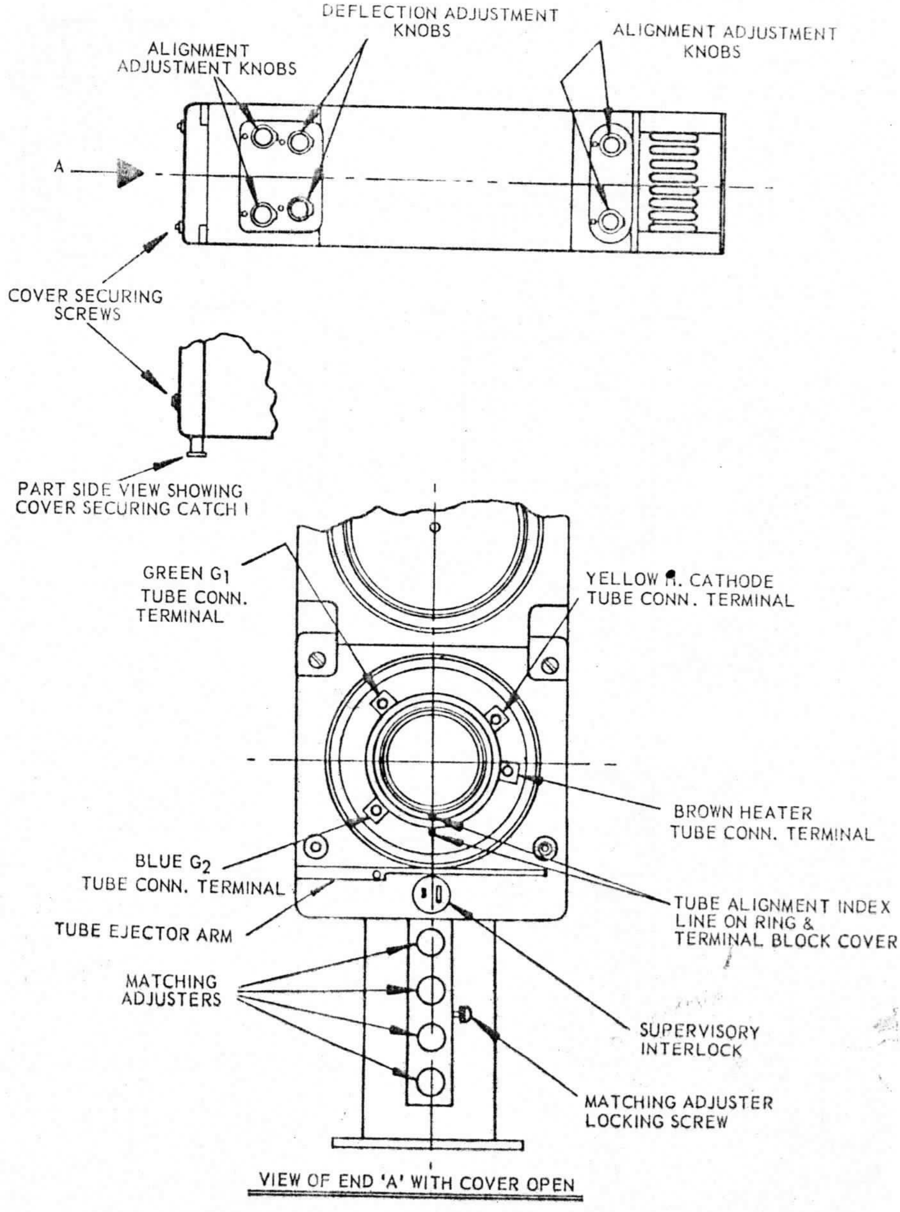
Lead	Electrode
BLUE	GRID 2
YELLOW	HEATER CATHODE
GREEN	GRID 1
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & GROUND

Dim.	Inches			Millimetres		
A	$16\frac{7}{16}$		max.	417,5		max.
B	$8\frac{15}{16}$		max.	227,0		max.
C	$4\frac{1}{8}$	±	$\frac{1}{16}$	104,8	±	1,6
D	7·750		nom.	196,85		nom.
E	2¼	±	$\frac{1}{64}$	57,2	±	0,4
F	4	±	$\frac{1}{64}$	101,6	±	0,4
G	$4\frac{3}{8}$		max.	111,1		max.
H	$3\frac{15}{16}$	±	$\frac{1}{8}$	100,0	±	3,2
J	$2\frac{5}{8}$	±	$\frac{1}{16}$	66,7	±	1,6
K	$1\frac{13}{32}$	±	$\frac{1}{32}$	35,7	±	0,8
L	6	±	$\frac{1}{32}$	152,4	±	0,8
M	3¾	±	$\frac{1}{8}$	95,3	±	3,2
N	1¼	±	$\frac{1}{16}$	31,8	±	1,6
P	$3\frac{9}{32}$	±	$\frac{1}{16}$	83,3	±	1,6
R	1¼		max.	31,8		max.
S	4½		nom.	114,3		nom.
T	$2\frac{5}{8}$		approx.	66,7		approx
U	$4\frac{9}{16}$	±	$\frac{1}{16}$	115,9	±	1,6
V	$2\frac{1}{16}$	±	$\frac{1}{32}$	52,4	±	0,8
W	1		max.	25,4		max.

Nett Weight app.	23·5 lbs
	10,7 kgs

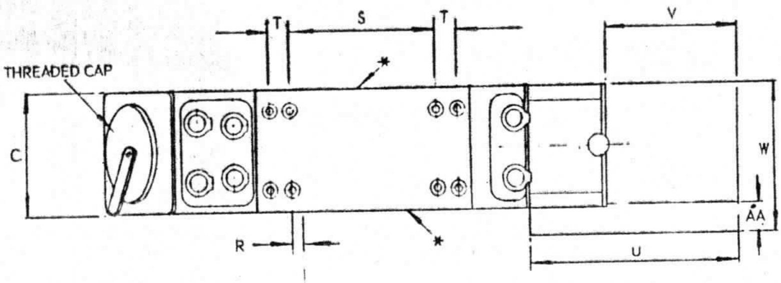
Metric dims. are derived from original inch dims.

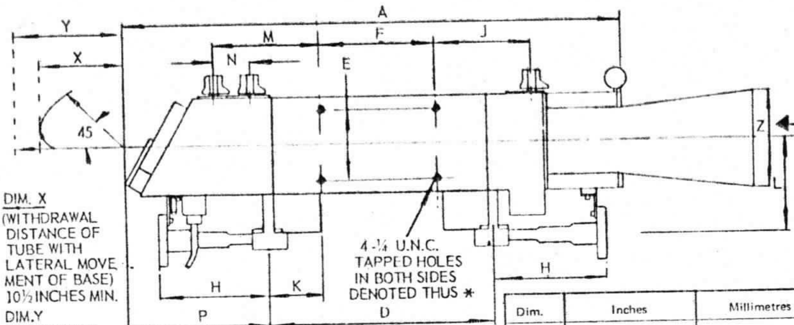
Fig. 14. Diagram Showing Operational Controls of WM111CB



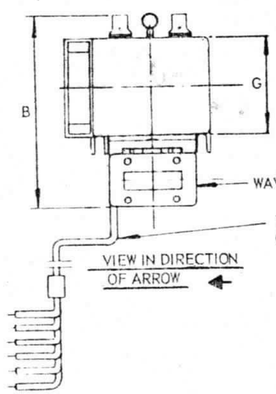
VIEW OF END 'A' WITH COVER OPEN

Fig. 15. WM111Z Mount Outline





Lead	Electrode
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER CATHODE
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & GROUND

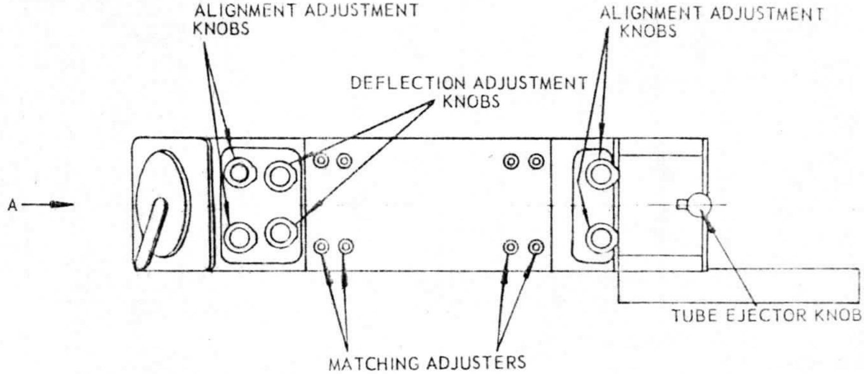


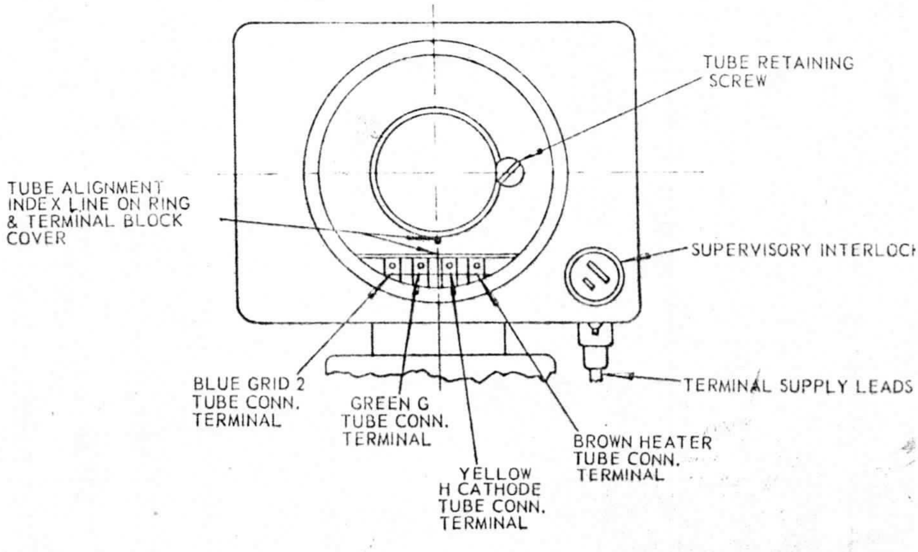
Dim.	Inches	Millimetres
A	17½ max.	444,5 max.
B	7 9/32 max.	184,9 max.
C	4·125 ± 0·040	104,78 ± 1,02
D	7·750 nom.	196,85 nom.
E	2¼ ± 1/32	57,2 ± 0,8
F	4 ± 1/32	101,6 ± 0,8
G	3½ max.	88,9 max.
H	4·100 ± 1/32	103,2 ± 0,8
J	3 9/32 ± 1/16	83,3 ± 1,6
K	1 7/8 ± 1/16	47,6 ± 1,6
L	3 5/16 ± 1/32	84,1 ± 0,8
M	3¾ ± 1/8	95,3 ± 3,2
N	1¼ ± 1/16	31,8 ± 1,6
P	5 3/8 ± 1/8	136,5 ± 3,2
R	½ ± 1/16	12,7 ± 1,6
S	5 1/16 ± 1/8	128,6 ± 3,2
T	23/32 ± 1/16	18,3 ± 1,6
U	7½ ± 1/16	190,5 ± 1,6
V	5 ± 1/16	127,0 ± 1,6
W	4·937 ± 0·040	125,40 ± 1,02
Z	3½ ± 1/16	88,9 ± 1,6
AA	1 ± 1/32	25,4 ± 0,8

Nett Weight app.	24 lbs
	10,9 kgs

Metric dims. are derived from original inch dims.

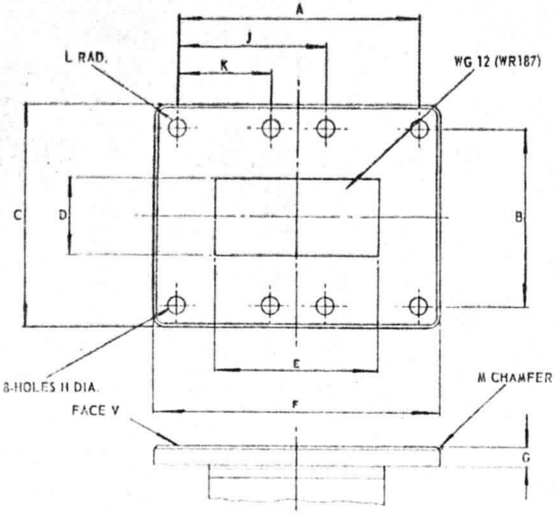
Fig. 16. Diagram Showing Operational Controls of WM111Z





VIEW OF END 'A' WITH COVER REMOVED

FIG. 17 OUTLINE OF FLANGE WG12 FOR WM111A



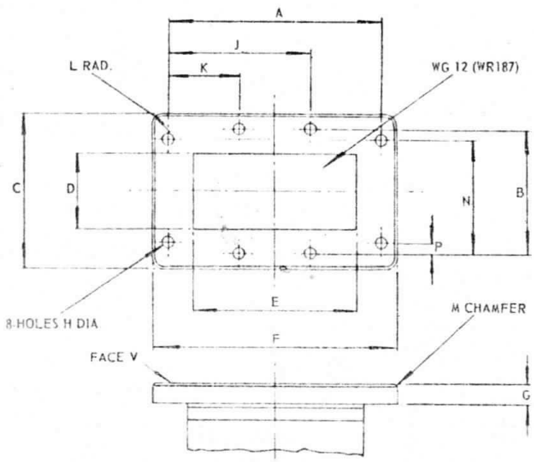
ANGLE OF FACE V TO ℄ OF WAVEGUIDE APERTURE 90°±½°

Dim.	Millimetres	Inches
A	69,85 TP	2·750 TP
B	50,80 TP	2·000 TP
C	63,50 ± 0,40	2½ ± $\frac{1}{64}$
D	22,15 ± 0,10	0·872 ± 0·004
E	47,55 ± 0,18	1·872 ± 0·007
F	82,55 ± 0,40	3¼ ± $\frac{1}{64}$
G	5,84 ± 0,76	0·230 ± 0·030
H	4,90 $^{+0,08}_{-0,03}$	0·193 $^{+0·003}_{-0·001}$
J	42,85 TP	1·687 TP
K	26,98 TP	1·062 TP
L	3,18 ± 0,40	$\frac{1}{8}$ ± $\frac{1}{64}$
M	0,38 Min. 0,81 Max. X 45°	0·015 Min. 0·032 Max. X 45°

The millimetre dimensions are derived from the original inch dimensions.

Geometric Tolerances			
Feature	Characteristic	Tolerance	Datum
Width A	Symmetry	0·005 Wide	Width E MMC
Width B	Symmetry	0·005 Wide	Width D MMC
Holes H	Positional	0·004 Dia. MMC	—
Face V	Flatness	0·002 Wide	—

FIG. 18 OUTLINE OF FLANGE WG12 FOR WM111CA



ANGLE OF FACE V TO ℄ OF WAVEGUIDE APERTURE 90°±½°

Dim.	Millimetres	Inches
A	61,72 TP	2·430 TP
B	36,32 TP	1·430 TP
C	45,24 ± 0,40	1$\frac{25}{32}$ ± $\frac{1}{64}$
D	22,15 ± 0,10	0·872 ± 0·004
E	47,55 ± 0,18	1·872 ± 0·007
F	70,64 ± 0,40	2$\frac{25}{32}$ ± $\frac{1}{64}$
G	5,84 ± 0,76	0·230 ± 0·030
H	3,73 $^{+0,08}_{-0,03}$	0·147 $^{+0·003}_{-0·001}$
J	41,15 TP	1·620 TP
K	20,57 TP	0·810 TP
L	3,18 ± 0,40	$\frac{1}{8}$ ± $\frac{1}{64}$
M	0,38 min. 0,81 max X 45°	0·015 min. 0·032 max X 45°
N	30,05 TP	1·183 TP
P	6,27 TP	0·247 TP

The millimetre dimensions are derived from the original inch dimensions.

Geometric Tolerances			
Feature	Characteristic	Tolerance	Datum
Width A	Symmetry	0·005 Wide	Width E MMC
Width B	Symmetry	0·005 Wide	Width D MMC
Holes H	Positional	0·004 Dia. MMC	—
Face V	Flatness	0·002 Wide	—

Travelling-wave Amplifier Tube

W7/6GLF

Description

This tube is intended for use in microwave systems in the frequency range 4,7GHz to 5,45GHz.
It operates in a periodic permanent magnet mount type WM111LF in which it will give the performance quoted in these data sheets.

The mount is designed to permit easy replacement of tubes under field conditions and is fitted with a convection cooler.

The r.f. input is through a type N coaxial connector; the output is in WG12(WR187).

Radio Frequency Performance

f, range	(GHz)	4,7 to 5,45
$P_o(sat)$ at optimum V_{hel}, min. (Note 1)	(W)	25
$P_o(wkg)$	(W)	10
G_{max} at $P_o(wkg)$	(dB)	40 to 48
G_{max} variation at $P_o(wkg)$ across band, max.	(dB)	3,0
N at $P_o(wkg)$	(dB)	28

Modulation noise peaks
noise in any 20kHz band from 0,5MHz to 10MHz from the carrier does not exceed that value equivalent to N = 30dB after 10 hours operation

Reverse attenuatiion at $P_o(wkg)$, min.	(dB)	65
AM/PM conversion at $P_o(wkg)$, max.	(°/dB)	2,5
Fixed broadband match input VSWR (cold), max.		1,7:1
output VSWR (hot), max.		2,3:1

Typical Operating Conditions

f	(GHz)	5,25
$V_{hel/k}$ (Notes 1,2)	(kV)	2,85
$V_{g2/k}$ (Note 3)	(kV)	1,65
$V_{g1/k}$ (Note 4)	(V)	-10
$V_{col/k}$	(kV)	2,1
I_{g2}	(μA)	10
I_{hel} at $P_o(wkg)$	(mA)	0,25
I_{col}	(mA)	90
I_k	(mA)	90,25
G_{max} at $P_o(wkg)$	(dB)	45
N at $P_o(wkg)$	(dB)	27
$P_o(sat)$ at optimum V_{hel}	(W)	30
V_h	(V)	6,3
I_h, nom.	(mA)	1,0

Environmental Conditions

Operating temperature ranges
up to 1500m(5000ft) (°C) -10 to +55
up to 3000m(10000ft)(°C) -10 to +50
up to 4500m(15000ft)(°C) -10 to +40

Storage temperature range
up to 14000m(45000ft)(°C)-30 to +75

Satisfactory switch-on and performance to a relaxed specification is achieved at -30°C

Humidity 95% at 35°C

Note 1. V_{hel} optimised for minimum G_{max} at $P_o(wkg)$ across band.

Note 2. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 3. Adjusted for required I_{col}.

Note 4. Adjusted for optimum focussing at $P_o(wkg)$.

Components ITT

Fig. 1 Typical Power Output versus Power Input.

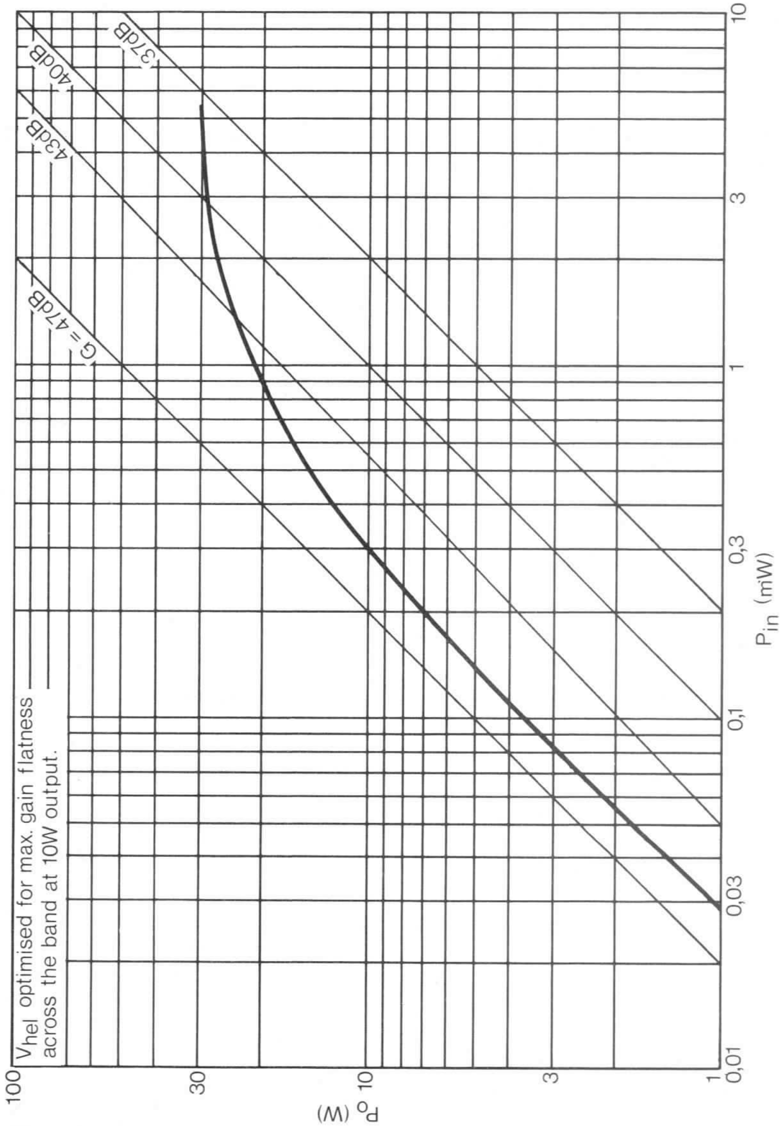


Fig. 2 Plot of Typical Gain at 10W Output versus Frequency.
(V_{hel} optimised for max. gain flatness across band, as specified on data sheet supplied with each tube)

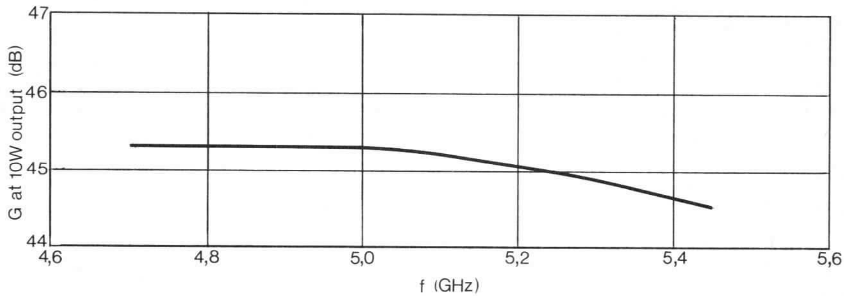
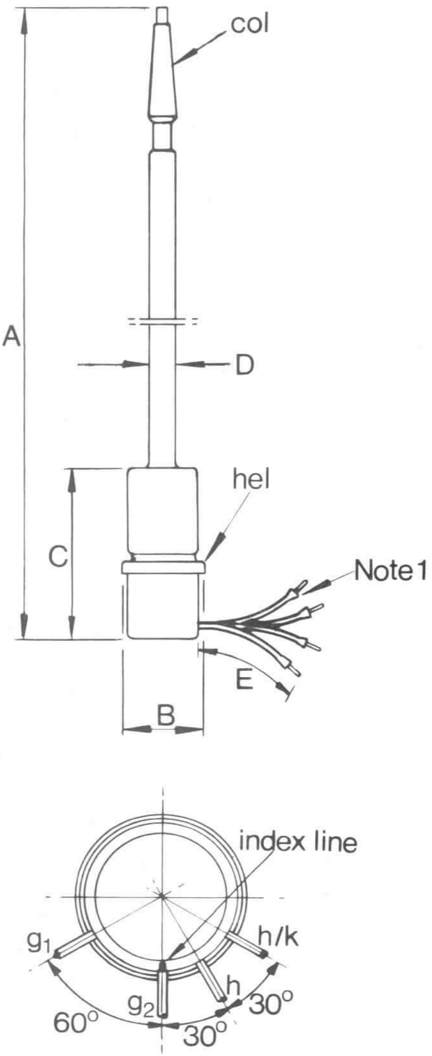


Fig. 1. W7/6GLF Tube Outline



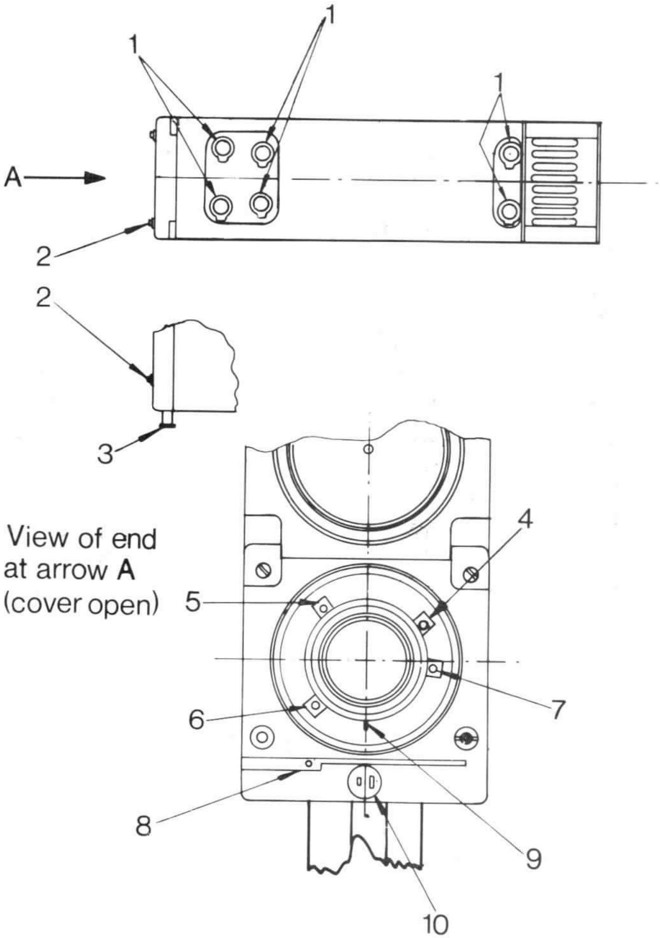
Dimensions

	mm	in.
A	376,2 max.	14,813 max.
B	36,20 ± 0,18	1,425 ± 0,007
C	73,0 max.	2,875 max.
D	9,27 max.	0,365 max.
E	46,0 nom.	1,813 nom.

Note 1. Flexible leads as follows:

Green	g_1
Blue	g_2
Brown	h
Yellow	h/k

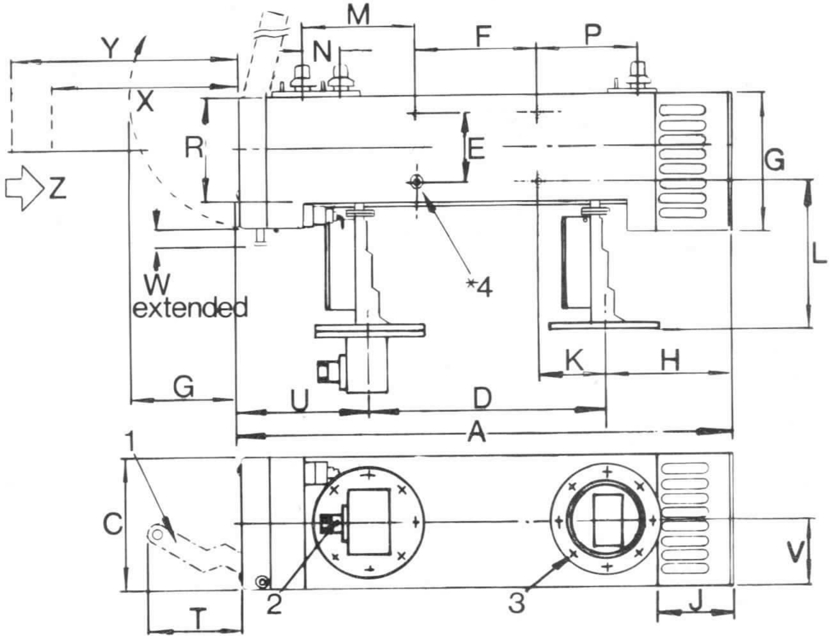
Fig. 2. WM111LF Mount Operational Controls



Legend

1. Focus adjustment knobs.
2. Cover securing screws.
3. Cover securing catch.
4. Yellow h/k tube connection terminal.
5. Green g_1 tube connection terminal.
6. Blue g_2 tube connection terminal.
7. Brown h tube connection terminal.
8. Tube ejector arm.
9. Tube alignment index line on terminal block.
10. Supervisory interlock.

Fig. 3. WM111LF Mount Outline



End view at arrow Z

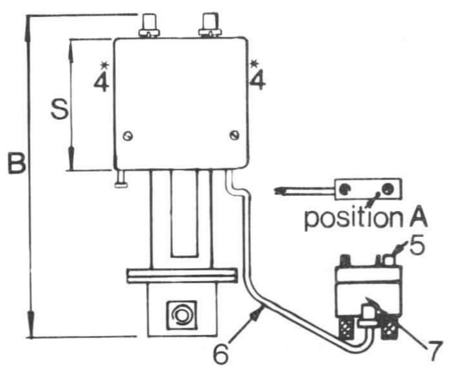


Fig. 3. WM111LF Mount Outline - continued

Dimensions

	mm		in.	
A	417,5	max.	16,438	max.
B	280,1	max.	11,063	max.
C	104,8	± 1,6	4,125	± 0,063
D	196,85	nom.	7,750	nom.
E	57,2	± 0,4	2,25	± 0,031
F	101,6	± 0,4	4,0	± 0,031
G	111,1	max.	4,375	max.
H	103,2	± 3,2	4,063	± 0,125
J	66,7	± 1,6	2,625	± 0,063
K	56,4	± 0,8	2,438	± 0,031
L	123,8	± 1,6	4,875	± 0,063
M	95,3	± 3,2	3,750	± 0,125
N	31,8	± 1,6	1,250	± 0,063
P	83,3	± 1,6	3,281	± 0,063
R	85,7	± 1,6	3,375	± 0,063
S	114,3	nom.	4,50	nom.
T	66,7	approx.	2,625	approx.
U	111,1	nom.	4,375	nom.
V	52,4	± 0,8	2,063	± 0,031
W	25,4	max.	1,00	max.
X (Note 8)	317,5	min.	12,50	min.
Y (Note 9)	381,0	min.	15,00	min.

Notes

1. Tube ejector arm (shown extended) when cover open.
2. Type N female connector.
3. Flange WG12 (5985-99-083-0042).
4. Asterisks denote four ¼ in. UNC tapped holes both sides of mount.
5. Female jackscrew.
6. Cable length 30,5cm (10ft) approx.
7. 26P-JTC2-H1D (Pye Connectors) with pins MRAC 62P.

Pin	Connector	Pin	Connector
L	-h	W	hel
F	+h/k	b	col/earth
C	g_1	c	interlock
T	g_2	d	interlock

8. Dimension X is the withdrawal distance of the tube with lateral movement of the base.
9. Dimension Y is the withdrawal distance of the tube without lateral movement of the base.

These components are available from :

ITT Components Group Europe
Standard Telephones and Cables Limited,
Valve Product Division,
Brixham Road,
PAIGNTON, Devon. TQ4 7BE
Tel, 0803 - 50762 Telex : 42830

Printed by Lay-Press Ltd. England

SPECIAL VALVES

S-Band Low Noise Travelling-Wave Amplifier Tube

Code: W9/2E (CV6090)

The W9/2E is a low noise wide-band travelling-wave amplifier tube for use in the frequency band 2·5 to 4·1 Gc/s.

The tube is operated in solenoid mounts type 495-LVA-005, 495-LVA-005B or 495-LVA-005C in which it will give the performance quoted in these data sheets.

The design of these mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	2·5 to 4·1	Gc/s
Saturated power output, minimum	3	mW
	4·8	dbm
maximum	12	mW
	10·8	dbm
Gain with input less than —40 dbm		
minimum	38	db
maximum	50	db
The gain over the frequency range does not vary by more than	6	db
Noise factor at small signal levels	<10	db
Reverse attenuation	>75	db

Matching

No adjustments are necessary over the recommended frequency band. The match at all frequencies will be less than 2·5:1 and less than 2:1 at 3·3 Gc/s.

Graphs showing gain, noise factor and V.S.W.R. as functions of frequency are shown in figures 1A, 1B and 2.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
COMPONENTS GROUP

STC

Code: W9/2E (CV6090)

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	3·3	Gc/s
Direct grid 1 voltage	−2·5	V
Direct helix voltage (Note 2)	400	V
Direct collector voltage	600	V
	or V_{hel} +200	V
Direct grid 2 voltage (Note 3)	30	V
Direct grid 3 voltage (Note 4)	100	V
Direct grid 4 voltage (Note 4)	200	V
Direct helix current	0·7	μA
Direct collector current (Note 5)	400	μA
Grid currents are negligible		
Saturated output at synchronous helix voltage	8	mW
	9	dbm
Gain with input at less than −40 dbm	46	db
Noise figure	7·4	db

Note 1. Electrode voltages are referred to cathode potential.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. Adjusted to give minimum noise factor.

Note 5. The collector should be at earth potential but to facilitate monitoring of collector current it is isolated from the circuit.

CATHODE

Indirectly heated, oxide coated.

HEATER

Heater voltage (Note 6)			5 ± 3%	V
Heater current	min. 0·45	nom. 0·55	max. 0·65	A
Pre-heating time			120	sec

Note 6. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 cycles/sec. Other frequencies may be used but it is recommended that the manufacturer be consulted beforehand.

LIMIT RATINGS (Note 7)

Tube damage may result if any one of these ratings is exceeded.

Direct collector voltage	1	kV
Direct helix voltage	750	V
Direct grid 1 voltage	100	V
Direct grid 2 voltage	100	V
Direct grid 3 voltage	250	V
Direct grid 4 voltage	500	V
Direct helix current	150	μA
Direct cathode current	1	mA

Note 7. All voltages are relative to cathode.

Code: W9/2E (CV6090)

CONTINUED

D.C. SUPPLY VOLTAGES

Collector connection is made by 'Unitor' socket. Other electrode connections are made by a shrouded B9A socket plugging on to the base of the valve.

Collector voltage range (Note 8)	550 to 650	V
Synchronous helix voltage for individual valves lies within the range	350 to 450	V
Grid 2 voltage is adjustable to the required working conditions within the range (Note 9)	12 to 55	V
Grid 1 voltage range (Note 10)	0 to −75	V
Grid 3 voltage range	50 to 150	V
Grid 4 voltage range	150 to 300	V

Note 8. The collector voltage must be equal to $V_{hel} + 200V$.

Note 9. When adjusted to 400μA collector current the initial range is 12 to 40V. The end of life limit is 55V.

Note 10. The range of grid 1 voltage for minimum noise is 0 to −10V. For cut-off of the electron beam a bias of about −50 volts is suitable.

MECHANICAL DATA (W9/2E)

Envelope	Glass and metal
Dimensions, Connection details	As shown in figure 4.

T.W.T. Mounts

STC

Codes: 495-LVA-005
495-LVA-005B
495-LVA-005C

GENERAL DESCRIPTION

These approved mounts in which W9/2E tubes operate, incorporate an aluminium foil solenoid system which contains r.f. matching cavities fed from rigidly mounted 50 Ω coaxial connectors. Both matching and mechanical alignment are pre-set and no adjustment is necessary.

Two pairs of deflector coils in the mounts enable the tube helix current to be optimised. A circuit diagram of the necessary potentiometer connections for these coils is shown in figure 3. The voltage to energise the coils may be taken from the solenoid voltage supply.

The 495-LVA-005C circuit is screened to minimise the interference of external magnetic fields with t.w.t. operation.

The 495-LVA-005 and 495-LVA-005B differ only in the type of coaxial connectors fitted.

A sheathed cable attached to the mount carries the electrode supplies. The leads of this cable are effectively choked for microwave frequencies. A Belling-Lee 'Unitor' 8-pin plug and socket on the mount carries the collector lead, solenoid supply, deflector coil supply and tappings for deflector coil potentiometer.

A hinged lid provides access to the tube connections (excluding collector) which are made by a shrouded B9A socket plugging on to the base of the valve. The lid also provides additional microwave screening.

The tube is held firmly at both ends in the mount by toroidal springs with an additional wide-headed locking screw at the base. Alignment marks are provided on both mount and tube to ensure correct positioning on fitting.

The mounts are designed so that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

A mounting bracket is provided at both ends of the solenoid. These brackets contain elongated holes to accept fixing screws. When fixing, allowance should be made for slight longitudinal expansion during running.

MECHANICAL DATA—MOUNTS

Dimensions	As shown in Figures 5, 6 and 7.		
Weight	23 lb	10,4	kg
Fixing	Six elongated clearing holes $\frac{1}{4}$ in. diameter		
Connections			
Solenoid d.c. supply, Collector, Deflector coils	Bellin Lee 8-pin 'Unitor' L654 plug and socket		
Other electrodes	Screened 7-core P.T.F.E. covered cable of length 3 ft. approx. (91,44 cm)		
Focusing adjustments	Non-mechanical		
Matching adjustments	Pre-set		
R.F. connections			
Mount 495-LVA-005	Input and output Type C Jack (UG704/U)		
Mount 495-LVA-005B	Input and output Type N Jack		
Mount 495-LVA-005C	Input and output Type N Jack		
Mounting position	Any which allows free circulation of air		

Proximity of ferrous materials

(a) 495-LVA-005 and 495-LVA-005B
Ferrous materials should be kept at least 7 in. (17,78 cm) away from the mount during operation, magnetic materials at least 14 in. (35,6 cm) away.

(b) 495-LVA-005C
Ferrous materials should be kept at least 3 in. (7,62 cm) away from the mount during operation, magnetic materials at least 8 in. away.

Codes: 495-LVA-005
495-LVA-005B
495-LVA-005C

CONTINUED

COOLING

Sufficient space should be allowed around the circuit to permit free circulation of air to cool the solenoid. The temperature of the mounts when stabilised is approximately 70°C above ambient.

ELECTRICAL DATA

Solenoid current	9	A

The solenoid voltage supply should be adjustable between 15 and 26 volts to give a current of 9A throughout the recommended ambient temperature range.
The solenoid voltage between pins 1 and 9 of the Unitor socket provided for operation of the deflector coils will be between 12 and 20 volts at normal temperature and will provide sufficient current through the deflector coils, 80mA per pair minimum, to focus all good tubes.

ENVIRONMENTAL CONDITIONS

Ambient temperature

Operating, maximum	+50	°C

Vibration

When mounted horizontally the mount will satisfy the requirements of DEF5011 Severity VI.

Damp heat, long-term

The mount will satisfy the requirements of DEF5011 Severity H3.

OPERATIONAL DATA FOR TUBE AND MOUNT

A data sheet giving optimum electrode voltages, etc., is provided with each tube.

The gain is very sensitive to helix voltage which, for narrow band applications, should be set for maximum gain at the required frequency. For wide band applications the helix voltage should be set for maximum gain at the arithmetic mean frequency. To maintain the gain within ±1 db, the helix voltage must be held within ±2 volts of the optimum value.

Minimum noise factor is obtained by adjustment of grids 3 and 4 for minimum noise output, and adjustment of deflector coils for minimum helix current.

The voltages specified for grids 3 and 4 in the test data sheet are related to optimum noise factor at mid-band (3·3 Gc/s). Improvement in noise factor at other frequencies may be obtained by adjusting the voltages for minimum noise output at those frequencies.

Towards the end of life of the tube it is likely that the grid 2 voltage will increase.

Codes: 495-LVA-005 495-LVA-005B 495-LVA-005C

STC

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W9/2E tube in its mount for operation:—

1. Hold the tube at the base end and insert it in the mount sufficiently to permit the tube supply socket to be fitted (Note 11).
2. Holding the socket gently but firmly push the tube home. At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the gun and collector toroids. A slight clockwise twist will help with this insertion. The black line on the base of the tube should be aligned with the black mark on the solenoid end plate. This is necessary for best matching.
3. Secure tube in mount by rotating the retaining screw over the tube base ring (Note 12).
4. Close screening box lid and secure.
5. Apply solenoid voltage to give 9A solenoid current (Note 13).
6. Apply heater voltage and allow three minutes heating time.
7. Set deflector coil currents to zero, i.e. adjust controls to mid-position.
8. Apply grid 1 voltage as on test data sheet.
9. Apply helix, collector, grid 4 and grid 3 voltages as on test data sheet.
10. Raise grid 2 voltage to give required collector current, adjusting deflector coils during operation to minimise helix current.

Note 11. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment of 15½ in. minimum.

Note 12. Once the tube is in its operating position in the mount, any undue pressure on the tube ejector ring at the rear of the solenoid may cause damage to the tube. Accordingly care must be taken to ensure that the ejector is not knocked or that when the tube is to be removed, no pressure is exerted on the ejector until the screening box lid is opened and the retaining screw has been turned to clear the tube base ring.

Note 13. Application of tube electrode voltages before the solenoid voltage will cause severe damage to the tube.
The resistance of the solenoid mount will take four hours to stabilise and adjustment of the solenoid supply will be necessary during this time. Some excess voltage may be applied to the solenoid on switching on to avoid adjustment but best focusing of the tube is only obtained with 9A solenoid current.
Should it be necessary to insert the tube with the solenoid energised care should be taken to resist attraction of ferrous portions of the tube to the mount which may cause damage to the tube.

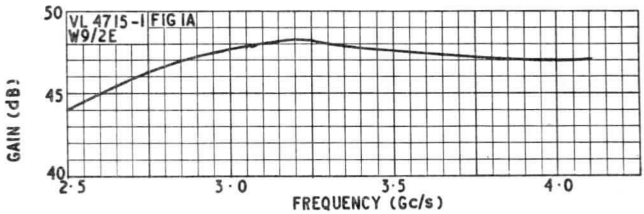
TUBE REMOVAL PROCEDURE

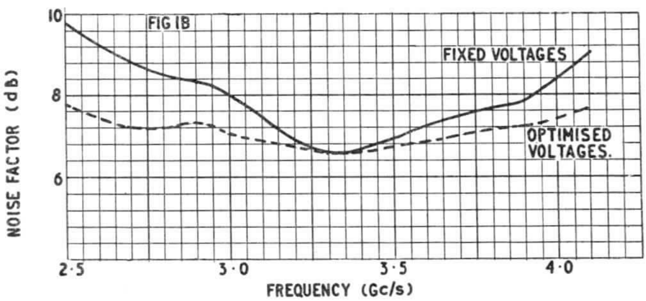
1. Reduce grid 2 control to zero.
2. Switch off all voltages.
3. Open screening box lid and unscrew retaining screw.
4. Lightly holding valve socket press ejector ring.
5. Withdraw ejected tube until tube base can be reached.
6. Remove socket.
7. Withdraw tube. Note that the base ring may be hot.

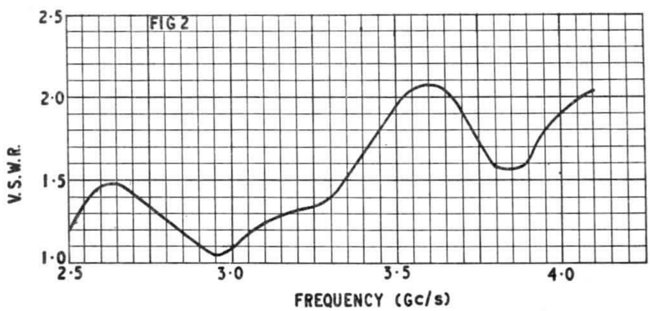
Code: W9/2E (CV6090)

CONTINUED

Figs. 1A, 1B and 2. Typical Characteristics



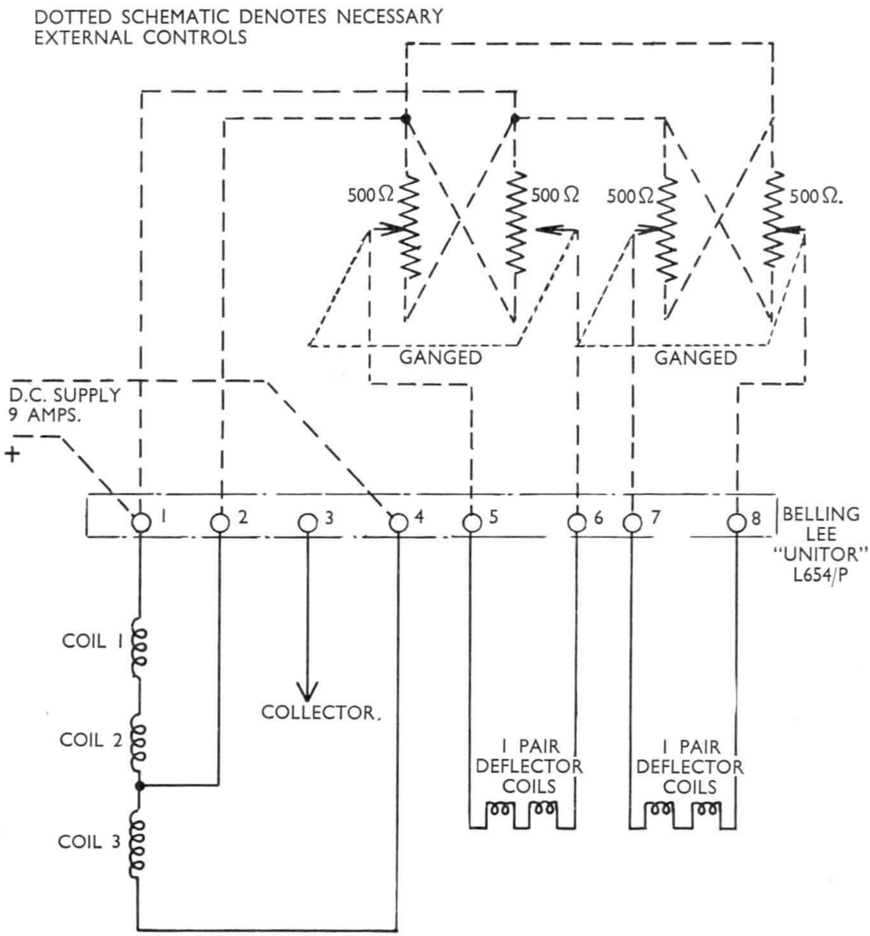




Code: W9/2E (CV6090)

CONTINUED

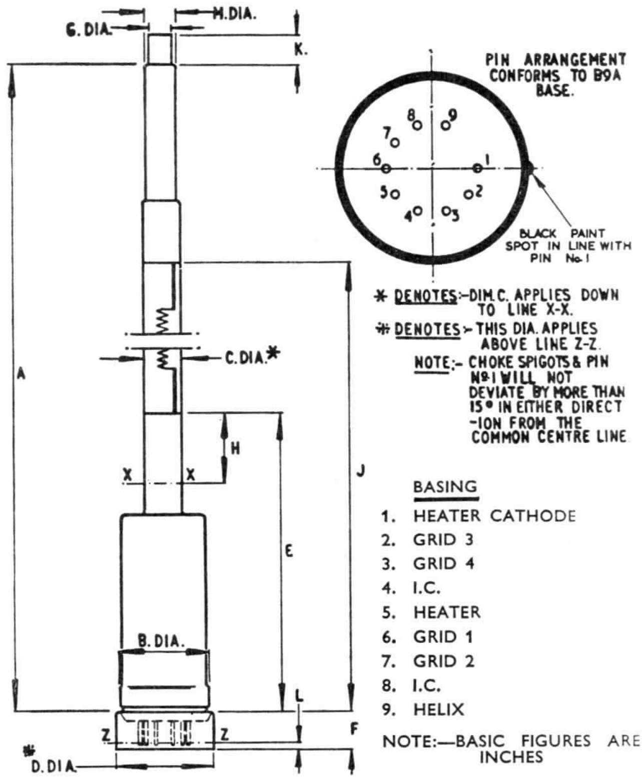
Fig. 3. Circuit showing the connexion of potentiometers to solenoid type 495-LVA-005 terminals for the control of deflector coil current.



POTENTIOMETERS RELIANCE TYPE TW/1 DUAL GANGED TROPICAL.

Code: W9/2E (CV6090)

CONTINUED



BASING

1. HEATER CATHODE
2. GRID 3
3. GRID 4
4. I.C.
5. HEATER
6. GRID 1
7. GRID 2
8. I.C.
9. HELIX

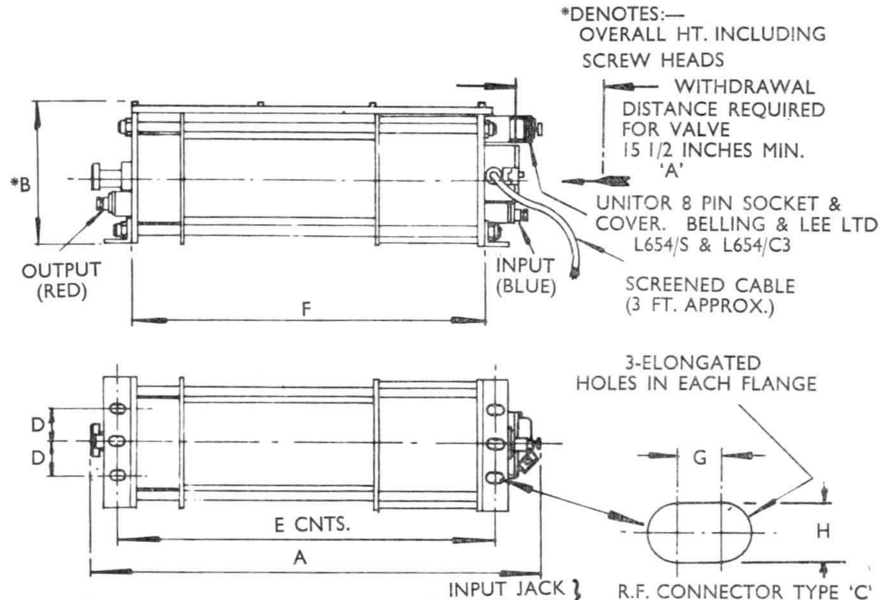
NOTE:—BASIC FIGURES ARE INCHES

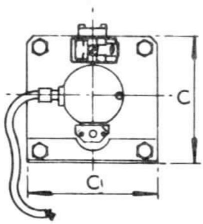
DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	366,90±0,89	14.445±0.035	G	5,99±0,18	0.236±0.007
B	23,24 MAX.	0.915 MAX.	H	19,1 MIN.	¾ MIN.
C	9,27 MAX.	0.365 MAX.	J	315,60±0,63	12.425±0.025
D	25,30±0,18	0.996±0.007	K	7,62±0,76	0.300±0.030
E	76,83±0,38	3.025±0.015	L	1,59 MAX.	0.063 MAX.
F	10,16±0,63	0.400±0.025	M	$7{,}62^{+0{,}10}_{-0{,}00}$	$0.300^{+0.004}_{-0.000}$

STC

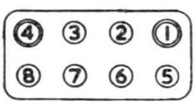
Code: 495-LVA-005

Fig. 5. 495-LVA-005 Outline





VIEW IN DIRECTION OF ARROW 'A'



UNITOR CONNECTIONS

CONNECTIONS	
	UNITOR
1	FIELD CURRENT
2	FIELD CENTRE TAP
3	COLLECTOR
4	FIELD CURRENT
5 }	ONE PAIR OF
6 }	DEFLECTOR COILS
7 }	ONE PAIR OF
8 }	DEFLECTOR COILS
	SCREENED CABLE
hk	YELLOW
g3	GREY
g4	WHITE
h	BROWN
g1	GREEN
g2	BLUE
hel	ORANGE

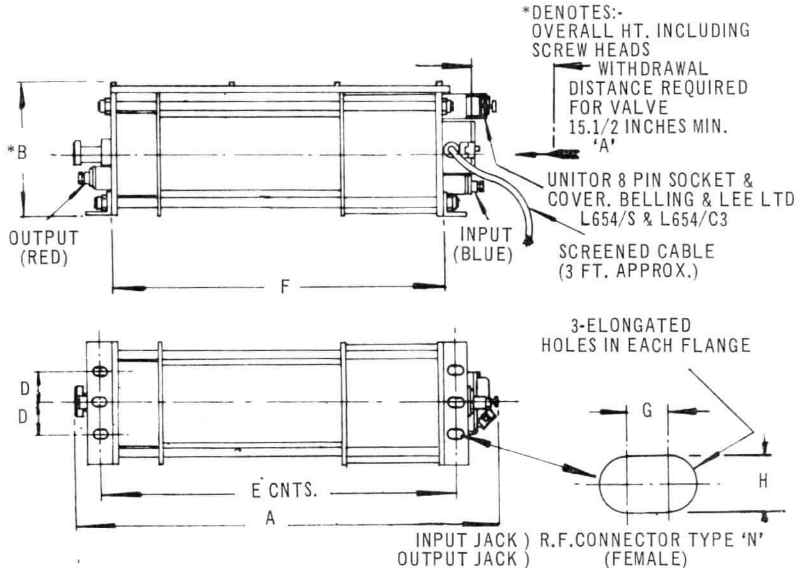
DIMENSIONS		
DIM	INCHES	MILLIMETRES
A	19 MAX.	482,6 MAX.
B	5 7/8 MAX.	149,2 MAX.
C	5 1/4±1/16	133,4±1,6
D	1 1/2±1/32	38,1±0,8
E	15 3/8±1/8	390,5±3,2
F	14 1/4±1/8	362,0±3,2
G	5/32±1/64	4,0±0,4
H	21/64 DIA	8,3 DIA

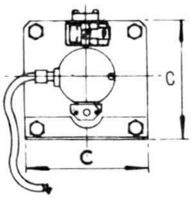
NET WT. APPROX.		
	Lbs	23
	Kgs	10,4

NOTE:—BASIC DIMENSIONS ARE INCHES

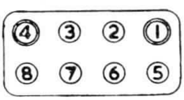
Code: 495-LVA-005B

Fig. 6. 495–LVA–005B Outline





VIEW IN DIRECTION OF ARROW 'A'



UNITOR CONNECTIONS

CONNECTIONS	
UNITOR	
1	FIELD CURRENT
2	FIELD CENTRE TAP.
3	COLLECTOR
4	FIELD CURRENT
5	ONE PAIR OF
6	DEFLECTOR COILS
7	ONE PAIR OF
8	DEFLECTOR COILS
SCREENED CABLE	
hk	YELLOW
g_3	GREY
g_4	WHITE
h	BROWN
g_1	GREEN
g_2	BLUE
hel	ORANGE

DIMENSIONS		
DIM	INCHES	MILLIMETRES
A	19 MAX.	482,6 MAX.
B	5.7/8 MAX.	149,2 MAX.
C	5.1/4 ± 1/16	133,4 ± 1,6
D	1.1/2 ± 1/32	38,1 ± 0,8
E	15.3/8 ± 1/8	390,5 ± 3,2
F	14.1/4 ± 1/8	362,0 ± 3,2
G	5/32 ± 1/64	4,0 ± 0,4
H	21/64 DIA.	8,3 DIA.

NET.WT.APPROX.		
	LBS	23
	Kgs	10,4

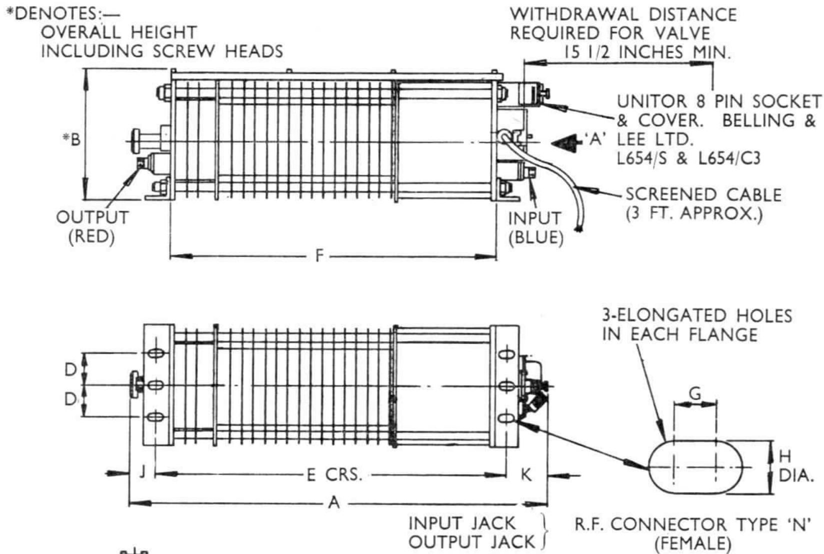
NOTE:- BASIC DIMENSIONS ARE INCHES

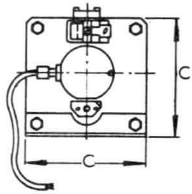
STC

T.W.T. Mount

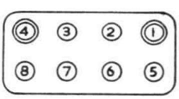
Code: 495-LVA-005C

Fig. 7. 495-LVA-005C Outline





VIEW IN DIRECTION OF ARROW 'A'



UNITOR CONNECTIONS

CONNECTIONS	
UNITOR	
1	FIELD CURRENT
2	FIELD CENTRE TAP
3	COLLECTOR
4	FIELD CURRENT
5 }	ONE PAIR OF
6 }	DEFLECTOR COILS
7 }	ONE PAIR OF
8 }	DEFLECTOR COILS
SCREENED CABLE	
hk	YELLOW
g_3	GREY
g_4	WHITE
h	BROWN
g_1	GREEN
g_2	BLUE
hel	ORANGE

DIMENSIONS		
DIM	INCHES	MILLIMETRES
A	18 13/16 MAX.	477,8 MAX.
B	6 MAX.	152,4 MAX.
C	5 1/4 ± 1/16	133,4 ± 1,6
D	1 1/2 ± 1/32	38,1 ± 0,8
E	15 3/8 ± 1/8	390,5 ± 3,2
F	14 1/4 ± 1/8	362,0 ± 3,2
G	5/32 ± 1/64	4,0 ± 0,4
H	21/64 ± 1/64	8,3 ± 0,4
J	1 1/4 MAX.	31,8 MAX.
K	2 1/16 MAX.	52,4 MAX.
NET WT. APPROX.		Lbs. 23 Kgs. 10,4
BASIC DIMS. ARE INCHES		

SPECIAL VALVES

S-Band Travelling-Wave Tube Limiter

Code: W9/3E (CV6127)

The W9/3E is a wide band travelling-wave tube limiter intended for use in the frequency band 2·5 to 4·1 Gc/s.

The tube is operated in solenoid mounts type 495-LVA-007A or 495-LVA-007E in which it will give the performance quoted in these data sheets.

The design of these mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	2·5 to 4·1	Gc/s
Saturated power output, minimum	−12	dbm
maximum	−4	dbm
Gain with input less than −40dbm		
minimum	11	db
maximum	20	db
The gain over the frequency range does not vary by more than	5	db
Noise factor at small signal levels	<18	db
Reverse attenuation	>45	db

Matching

No adjustments are necessary over the recommended frequency band.

Graphs showing typical amplification characteristic as a function of frequency with fixed electrode potentials and power output versus power input characteristic are shown in figures 1 and 2.

Improved limiting characteristics can be obtained by the use of two W9/3E stages in series.

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Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333
COMPONENTS GROUP

STC

Code: W9/3E (CV6127)

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	3·3	Gc/s
Direct helix voltage (Note 2)	200	V
Direct grid 2 voltage (Note 3)	50	V
Direct collector voltage	300	V
	i.e. V_{hel} +100	V
Direct collector current (Note 4)	125	μA
Direct helix current	10	μA
Direct grid 2 current	negligible	
Saturated output at synchronous helix voltage	−6	dbm
Gain with input at less than −40 dbm	15	db

The tube can be operated at a cathode current of up to 320μA to give a greater gain of not less than 23db. A higher grid 2 voltage will be required, but its value will not exceed the helix voltage.

Note 1. Electrode voltages are referred to cathode potential.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. The collector should be at earth potential but to facilitate monitoring of collector current it is isolated from the circuit.

CATHODE

Indirectly heated, oxide-coated

HEATER

Heater voltage (Note 5)			6·3 ± 3%	V
Heater current	min. 0·37	nom. 0·45	max. 0·63	A
Pre-heating time			120	s

Note 5. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 cycles/sec. Other frequencies may be used but it is recommended that the manufacturer be consulted beforehand.

LIMIT RATINGS (Note 6)

Tube damage may result if any one of these ratings is exceeded.

Direct collector voltage	1	kV
Direct helix voltage	1	kV
Direct grid 2 voltage	1	kV
Direct helix current	150	μA
Direct cathode current	500	μA

Note 6. All voltages are relative to cathode.

Code: W9/3E (CV6127)

CONTINUED

D.C. SUPPLY VOLTAGES

Collector connection is made by 'Unitor' socket. Other electrode connections are made by a shrouded B9A socket plugging on to the base of the valve.

Collector voltage range (Note 7)	260 to 330	V
Synchronous helix voltage for individual valves lies within the range (Note 8)	160 to 230	V
Grid 2 voltage is adjustable to the required working conditions within the range (Note 9)	18 to 230	V

Note 7. The collector voltage must be equal to $V_{hel} + 100V$

Note 8. Because of the low voltage used, the gain of the valve is dependent to a marked extent upon the correct value of helix voltage being set carefully and regulated to 0·1%

Note 9. When adjusted to 125μA collector current the initial range is 20 to 100V. The end of life limit is 230V. Grid 2 voltage must never exceed helix voltage

MECHANICAL DATA (W9/3E)

Envelope	Glass and metal
Dimensions, Connection details	As shown in Figure 5

ENVIRONMENTAL CONDITIONS

Vibration

Acceleration	1	g
Frequency range	6 to 30	c/s
Under the vibration conditions specified above the tube gain will not vary by more than	1	db

Shock

The tube will withstand impact pulses of 6 ms duration with peak acceleration 20g.

STC

T.W.T. Mounts

Code: 495-LVA-007A
495-LVA-007E

GENERAL DESCRIPTION

These approved mounts in which W9/3E tubes operate, incorporate an aluminium foil solenoid system which contains r.f. matching cavities fed from rigidly mounted 50 Ω coaxial connectors. Both matching and mechanical alignment is pre-set and no adjustment is necessary. The mounts are screened to minimise the interference of external magnetic fields with t.w.t. operation.

The 495-LVA-007A and 495-LVA-007E differ only in the type of coaxial connectors fitted.

A sheathed cable attached to the mount carries the electrode supplies. The leads of this cable are effectively choked for microwave frequencies. A Belling-Lee 'Unitor' 4-pin plug and socket on the mount carries the collector lead and the solenoid supply.

A hinged lid provides access to the tube connections (excluding collector) which are made by a shrouded B9A socket plugging on to the base of the valve. The lid also provides additional microwave screening.

The tube is held firmly at both ends in the mount by toroidal springs with an additional wide-headed locking screw at the base. Alignment marks are provided on both mount and tube to ensure correct positioning on fitting.

The mounts are designed so that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

A mounting bracket is provided at both ends of the solenoid. These brackets contain elongated holes to accept fixing screws. When fixing, allowance should be made for slight longitudinal expansion during running.

MECHANICAL DATA—MOUNTS

Dimensions	As shown in Figures 3 and 4		
Weight	12·25 lb	5,5	kg
Fixing	Four elongated clearing holes $\frac{3}{16}$ in. diameter		
Connections			
Solenoid d.c. supply / Collector	Belling-Lee 4-pin 'Unitor' L653 plug and socket		
Other electrodes	Screened 4-core P.T.F.E. covered cable, length 3 ft	91,44	cm
Focusing adjustments	Pre-set		
Matching adjustments	Pre-set		
R.F. connections			
Mount 495-LVA-007A	Input and output Type C Jack (UG704/U)		
Mount 495-LVA-007E	Input and output Type N Jack		
Mounting position	Any which allows free circulation of air		

Proximity of ferrous materials

Ferrous materials should be kept at least 4 in. (10,2 cm) away from the mount during operation, magnetic materials at least 18 in. (45,7 cm) away.

Proximity of other mounts

If a second mount and tube are used in series they should be positioned with at least a 6-inch (15,2 cm) gap between mounts and preferably facing in the same direction.

Codes: 495-LVA-007A 495-LVA-007E

CONTINUED

COOLING

Sufficient space should be allowed around the circuit to permit free circulation of air to cool the solenoid. The temperature of the mount when stabilised is approx. 60°C above ambient.

ELECTRICAL DATA

Solenoid current	10	A

The solenoid voltage supply should be adjustable between 6 and 13 volts to give a current of 10A throughout the recommended ambient temperature range.

ENVIRONMENTAL CONDITIONS

Ambient temperature

Operating, maximum	+60	°C

Vibration

When mounted horizontally the mount will satisfy the requirements of DEF5011 Severity VI.

Damp heat, long-term

The mount will satisfy the requirements of DEF5011 Severity H3.

OPERATIONAL DATA FOR TUBE AND MOUNT

A data sheet giving optimum electrode voltages, etc., is provided with each tube.

Because of the low voltage, the gain of the valve is dependent to a marked extent upon the correct value helix voltage being set carefully and regulated to 0·1%.

If two tubes are operated in series, independent adjustment of grid 2 and helix voltages will be required.

Towards the end of life of the tube it is likely that the grid 2 voltage will increase. It must not be allowed to exceed helix voltage.

STC

Codes: 495-LVA-007A
495-LVA-007E

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W9/3E tube in its mount for operation:—

1. Hold the tube at the base end and insert it in the mount sufficiently to permit the tube supply socket to be fitted (Note 10).
2. Holding socket gently but firmly push tube home. At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the gun and collector toroids. A slight clockwise twist will help with this insertion. The black line on the base of the tube should be aligned with the black mark on the solenoid end plate. This is necessary for best matching.
3. Secure tube in mount by rotating the retaining screw over the tube base ring (Note 11).
4. Close screening box lid and secure.
5. Apply solenoid voltage to give 10A solenoid current (Note 12).
6. Apply heater voltage and allow two minutes' heating time.
7. Apply collector and helix voltages as indicated on the tube data sheet and then the grid 2 voltage to give required collector current.

Note 10. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment of 8 in. minimum.

Note 11. Once the tube is in its operating position in the mount, any undue pressure on the tube ejector ring at the rear of the solenoid may cause damage to the tube. Accordingly care must be taken to ensure that the ejector is not knocked or that when the tube is to be removed, no pressure is exerted on the ejector until the screening box lid is opened and the retaining screw has been turned to clear the tube base ring.

Note 12. Application of tube electrode voltages before the solenoid voltage will cause severe damage to the tube.

The resistance of the solenoid mount will take four hours to stabilise and adjustment of the solenoid supply will be necessary during this time. Some excess voltage may be applied to the solenoid on switching on to avoid adjustment but best focusing of the tube is only obtained with 10A solenoid current.

Should it be necessary to insert the tube with the solenoid energised care should be taken to resist attraction of ferrous portions of the tube to the mount which may cause damage to the tube.

TUBE REMOVAL PROCEDURE

1. Reduce grid 2 control to zero.
2. Switch off all voltages.
3. Open screening box lid and unscrew tube retaining screw.
4. Lightly holding valve socket press ejector ring.
5. Withdraw ejected tube until valve base can be reached.
6. Remove socket.
7. Withdraw tube. Note that base ring may be hot.

Code: W9/3E (CV6127)

CONTINUED

Fig. 1.—Amplification Characteristic.

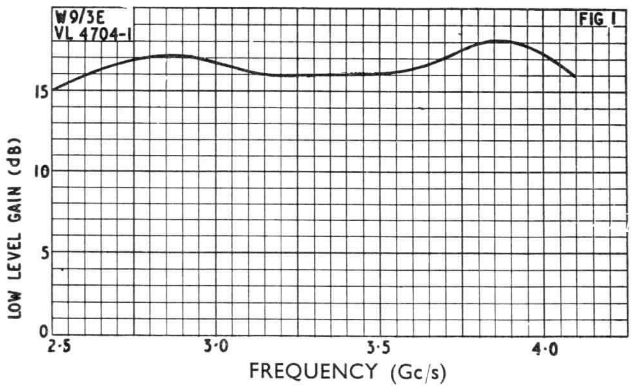
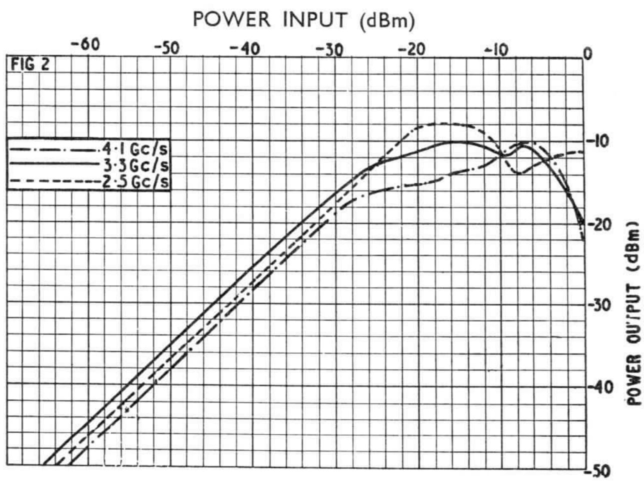


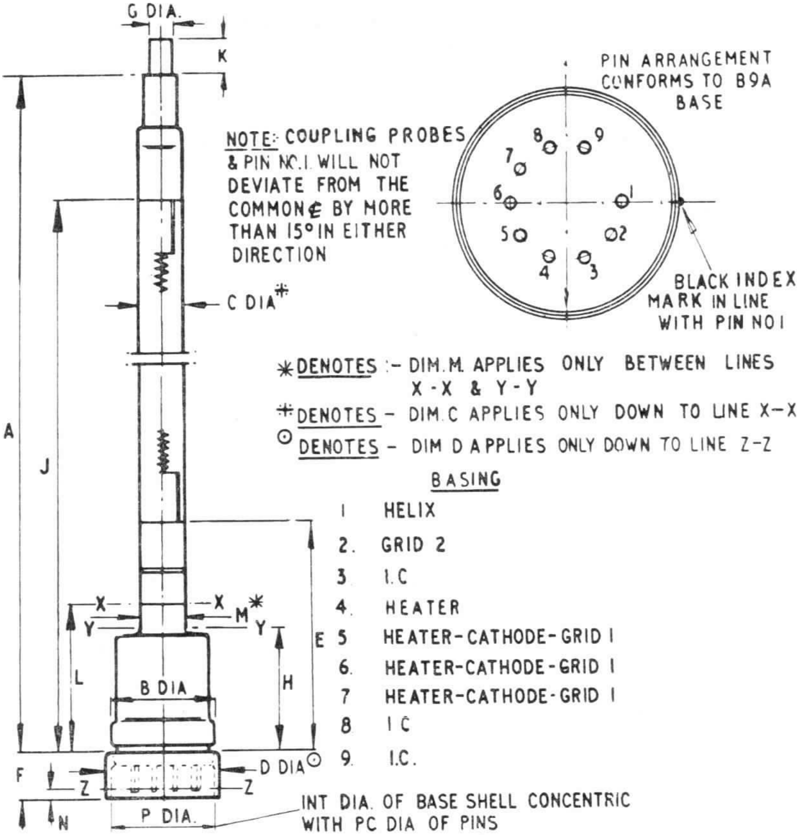
Fig. 2.—Saturation Characteristic.



Code: W9/3E (CV6127)

CONTINUED

Fig. 3.—W9/3E Outline



✳ DENOTES :- DIM. M. APPLIES ONLY BETWEEN LINES X-X & Y-Y

⧺ DENOTES - DIM. C APPLIES ONLY DOWN TO LINE X-X

⊙ DENOTES - DIM D APPLIES ONLY DOWN TO LINE Z-Z

BASING

1. HELIX
2. GRID 2
3. I.C
4. HEATER
5. HEATER-CATHODE-GRID I
6. HEATER-CATHODE-GRID I
7. HEATER-CATHODE-GRID I
8. I C
9. I.C.

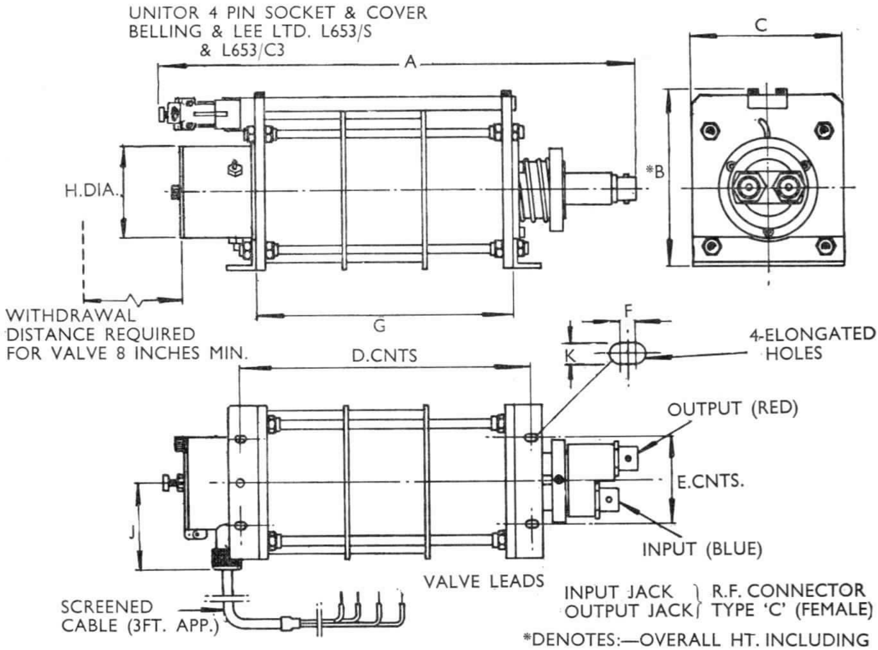
DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	177,34 ± 0,63	6.982 ± 0.025	G	5,99 ± 0,18	0.236 ± 0.007
B	23,24 MAX.	0.915 MAX.	H	24,13 MAX.	0.950 MAX.
C	9,27 MAX.	0.365 MAX.	J	149,86 ± 0,38	5.900 ± 0.015
D	25,30 ± 0,18	0.996 ± 0.007	K	7,62 ± 0,76	0.300 ± 0.030
E	48,26 ± 0,89	1.900 ± 0.035	L	27,56 MAX.	1.085 MAX.
F	10,16 ± 0,63	0.400 ± 0.025	M	9,60 MAX.	0.378 MAX.
P	22,22 MIN.	0.875 MIN.	N	1,59 MAX.	0.063 MAX.

NOTE: BASIC FIGURES ARE INCHES

Codes: 495-LVA-007A

CONTINUED

Fig. 4. 495-LVA-007A Outline

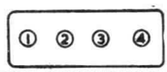


INPUT JACK } R.F. CONNECTOR
OUTPUT JACK } TYPE 'C' (FEMALE)

*DENOTES:—OVERALL HT. INCLUDING SCREW HEADS.

CONNECTIONS

VALVE LEADS		UNITOR	
COLOUR	ELECTRODE	PIN	CONNECTION
ORANGE	HELIX	1	FIELD CURRENT
BLUE	GRID 2	2	FIELD CURRENT
BROWN	HEATER	3	NO CONNECTION
YELLOW	HEATER-CATHODE	4	COLLECTOR



UNITOR CONNECTIONS

NETT WEIGHT APPROX. LBS. 12·25
KGS. 5.5

NOTE:—BASIC DIMENSIONS ARE IN INCHES

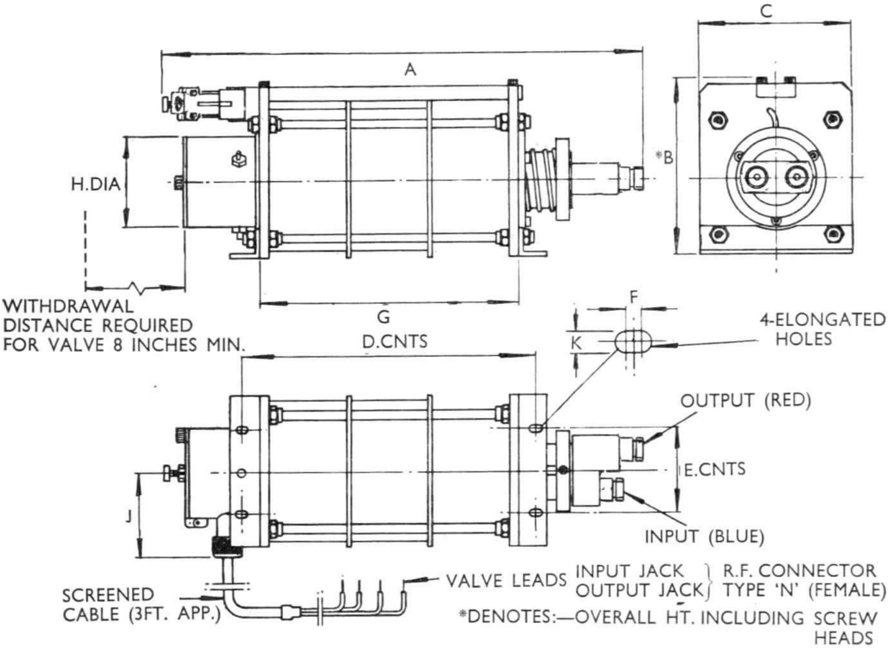
DIMENSIONS					
DIM	INCHES	MILLIMETRES	DIM	INCHES	MILLIMETRES
A	12 3/4 MAX.	323,9 MAX.	F	1/8 ±1/64	3,2±0,4
B	4 5/8 MAX.	117,5 MAX.	G	6 13/16±1/8	173,0±3,2
C	4 ±1/16	101,6±1,6	H	2 7/16 MAX.	61,9 MAX.
D	7 5/8±1/16	193,7±1,6	J	2 3/8 MAX.	60,3 MAX.
E	2 1/4±1/32	57,2±0,8	K	15/64 DIA.	6,0 DIA.

STC

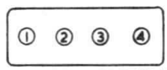
CODE: 495-LVA-007E

CONTINUED

Fig. 5. 495-LVA-007E Outline



CONNECTIONS			
VALVE LEADS		UNITOR	
COLOUR	ELECTRODE	PIN	CONNECTION
ORANGE	HELIX	1	FIELD CURRENT
BLUE	GRID 2	2	FIELD CURRENT
BROWN	HEATER	3	NO CONNECTION
YELLOW	HEATER-CATHODE	4	COLLECTOR



UNITOR CONNECTIONS

NETT WEIGHT APPROX. LBS. 12·25
KGS. 5,5

NOTE:—BASIC DIMENSIONS ARE IN INCHES

DIMENSIONS					
DIM	INCHES	MILLIMETRES	DIM	INCHES	MILLIMETRES
A	13 MAX.	333,2 MAX.	F	1/8±1/64	3,2±0,4
B	4 5/8 MAX.	117,5 MAX.	G	6 13/16±1/8	173,0±3,2
C	4 ±1/16	101,6±1,6	H	2 7/16 MAX.	61,9 MAX.
D	7 5/8±1/16	193,7±1,6	J	2 3/8 MAX.	60,3 MAX.
E	2 1/4±1/32	57,2±0,8	K	15/64 DIA.	6,0 DIA.

SPECIAL VALVES

S-Band Low-Noise Travelling-Wave Tube Amplifier

Code: W10/3E

The W10/3E is a wide-band low-noise travelling-wave tube amplifier intended for use in the frequency band 2·7 to 3·7 Gc/s.

The tube is operated in solenoid mounts type 495-LVA-003, 495-LVA-006 or 495-LVA-006S in which it will give the performance quoted in these data sheets. The design of these mounts permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

	495-LVA-003	495-LVA-006 or 495-LVA-006S	
Circuits	495-LVA-003	495-LVA-006 or 495-LVA-006S	
Operating frequency range	2·7 to 3·3	2·8 to 3·7	Gc/s
Saturated power output, nominal	3	3	mW
Gain with input less than −40 dbm,			
Minimum	20	20	db
Maximum	25	26	db
Noise factor at small signal levels, maximum	7·75	7·5	db
Reverse attenuation	>75	>75	db
Match at all frequencies,			
Input	<2:1	<2·5:1	
Output	<2·4:1	<2·5:1	
Match at 3·3 Gc/s,			
Input		<2:1	
Output		<2:1	

No matching adjustments are necessary over the recommended frequency band.

Typical gain and noise factor characteristics are shown in Figure 1 and optimum anode voltage characteristics are given in Figure 2.

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Telephone: Paignton 50762 Telex: 4230
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C O M P O N E N T S G R O U P

STC

Code: W10/3E

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

	495-LVA-003	495-LVA-006 or 495-LVA-006S	
Frequency	3	3·3	Gc/s
Direct grid 1 voltage	−0·5	−0·5	V
Direct helix voltage (Note 2)	450	450	V
Direct collector voltage	700	700	V
	or V_{hel} +250	or V_{hel} +250	V
Direct grid 2 voltage (Note 3)	26	26	V
Direct grid 3 voltage (Note 4)	50	50	V
Direct grid 4 voltage	250	250	V
Direct helix current	0·4	0·4	μA
Direct collector current (Note 5)	400	400	μA
Grid currents are negligible			
Saturated output at synchronous helix voltage	2	2	mW
Gain with input at less than 40 dbm	23	23	db
Noise factor	6·8	6·8	db

Note 1. Electrode voltages are referred to cathode potential.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

Note 4. Adjusted to give minimum noise factor.

Note 5. The collector should be at earth potential.

CATHODE

Indirectly heated, oxide coated

HEATER

	Min.	Nom.	Max.	
Heater voltage (Note 6)		5		V
Heater voltage tolerance				
Long term average			±2	%
Short term fluctuations up to 2 minutes' duration			±4	%
Heater current	0·45	0·58	0·7	A
Pre-heating time	120			sec
Interruption time for zero pre-heat			10	sec

Note 6. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 cycles/sec.

Other frequencies may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W10/3E

CONTINUED

LIMIT RATINGS (Note 7)

Tube damage may result if any one of these ratings is exceeded.

Direct collector voltage	1	kV
Direct helix voltage	750	V
Direct grid 1 voltage	100	V
Direct grid 2 voltage	100	V
Direct grid 3 voltage	250	V
Direct grid 4 voltage	500	V
Direct helix current	150	μA
Peak pulse power input	250	W
C.W. power input	1	W

Note 7. All voltages are relative to cathode.

D.C. SUPPLY VOLTAGES

Collector connection is made through the frame of the mount. Other electrode connections are made by a shrouded B9A socket plugging on to the base of the valve.

Collector voltage range (Note 8)	650 to 750	V
Synchronous helix voltage for individual valves lies within the range	400 to 500	V
Grid 2 voltage is adjustable to the required working conditions within the range (Note 9)	20 to 55	V
Grid 1 voltage	−0·5	V
Grid 3 voltage range	40 to 110	V
Grid 4 voltage	250	V

Note 8. The collector voltage must be equal to $V_{hel} + 200V$.

Note 9. When adjusted to 400μA collector current the initial range is 20 to 40 volts. The end of life limit is 55V.

MECHANICAL DATA (W10/3E)

Envelope	Glass and metal
Dimensions Connection details	As shown in Figure 4

STC

T.W.T. Mounts

Codes: 495-LVA-003
495-LVA-006
495-LVA-006S

GENERAL DESCRIPTION

These approved solenoid mounts in which W10/3E tubes operate have both matching and mechanical alignments preset and no adjustment is neccessary.

Two pairs of deflector coils in the mounts enable the tube helix current to be optimised. A circuit diagram of the necessary potentiometer connections for these coils is shown in Figure 3. The voltage to energise the coils may be taken from the solenoid voltage supply through a tap connection on the mounts.

The 495-LVA-003 mount incorporates a copper foil solenoid system and has standard rectangular waveguides, WG10 for r.f. input and output. The circuit is fitted with magnetic screening laminations to minimise the interference of external fields with t.w.t. operation.

The 495-LVA-006 and 495-LVA-006S mounts incorporate an aluminium foil solenoid system which contains r.f. matching cavities fed from rigidly mounted 50 Ω coaxial connectors. The 495-LVA-006S is fitted with mild steel tubular magnetic screening.

A sheathed cable attached to the mounts carries the electrode supplies. The leads of this cable are effectively choked for microwave frequencies. On the 495-LVA-006S mount this cable is taken to a 12 way 'CINCH' barrier terminal strip on the front face. On the 495-LVA-003 and 495-LVA-006S mounts a 'CINCH' barrier terminal strip carries the solenoid supply, deflector coil supply and tappings for deflector coil potentiometer. On the 495-LVA-006 mount a Belling-Lee 'Unitor' 8-pin plug and socket carries these supplies.

The method of collector connection for each circuit is as follows:—

495-LVA-003 The collector is connected to mount frame.

495-LVA-006 The collector is connected to the Belling-Lee 'Unitor' plug and socket.

495-LVA-006S The collector is connected to the electrode terminal strip.

On all three mounts a hinged lid provides access to the tube connections (excluding collector) which are made by a shrouded B9A socket plugging on to the base of the valve. The lid also provides additional microwave screening.

The tube is held firmly at both ends in the mount by toroidal springs with an additional wide-headed locking screw at the base. Alignment marks are provided on both mount and tube to ensure correct positioning on fitting.

The mounts are designed so that circuit alignment is unaffected by normal handling and tubes can be easily replaced under field conditions.

A mounting bracket is provided at both ends of the solenoids. These brackets contain elongated holes to accept fixing screws. When fixing, allowance should be made for slight longitudinal expansion during running.

T.W.T. Mounts

Codes: 495-LVA-003 495-LVA-006 495-LVA-006S

CONTINUED

MECHANICAL DATA—MOUNTS

495-LVA-003			
Dimensions	As shown in Figure 5		
Weight	50 lb	22·6	kg
Fixing	Two elongated ¼ UNC clearing holes in each top and bottom bracket at either end		
Connections			
Solenoid d.c. supply, Deflector coils	7-way "Cinch" T.F.S. Red Mikacin terminal strip		
Collector	Earthed through frame		
Other electrodes	Screened 7-core P.T.F.E. covered cable of length 3 ft approx. (91,44 cm)		
Focusing adjustments	Non-mechanical		
Matching adjustments	Pre-set		
R.F. connections	Input and output, WG10 rectangular waveguide		
Mounting position	Any which allows free circulation of air		
495-LVA-006S			
Dimensions as shown in Figure 6			
Weight	approx. 25 lb	11,3	kg
Fixing	Two elongated ¼ UNC clearing holes in feet at either end of the mount		
Connections			
Solenoid supply, Deflector coils, Frame earth, All electrodes including collector	2 to 12-way "Cinch" T.F.S. Red Mikacin terminal strips		
Focusing adjustments	Non-mechanical		
Matching adjustments	Pre-set		
R.F. connections—			
Input	Coaxial connector Type 'C' Jack (UG704/U)		
Output	Coaxial connector Type 'C' Plug		
Mounting position	Any which allows free circulation of air		
495-LVA-006			
Dimensions as shown in Figure 7			
Weight	19 lb	8,6	kg
Fixing holes	Three elongated ¼ UNC clearing holes in brackets at either end of the mount		
Connections			
Solenoid d.c. supply, Collector, Deflector coils	Belling-Lee 8-pin "Unitor" L654 plug and socket		
Other electrodes	Screened 7-core P.T.F.E. covered cable of length 3 ft approx. (91,44 cm)		
Focusing adjustments	Non-mechanical		
Matching adjustments	Pre-set		
R.F. connections—			
Input	Coaxial connector Type 'C' Jack (UG704/U)		
Output	Coaxial connector Type 'C' Plug		
Mounting position	Any which allows free circulation of air		

STC

T.W.T. Mounts

Codes: 495-LVA-003
495-LVA-006
495-LVA-006S

CONTINUED

MECHANICAL DATA—MOUNTS (Cont.)

Proximity of ferrous materials

(a) 495-LVA-003 and 495-LVA-006S
Ferrous materials should be kept at least 2 in. (5,08 cm) away from the mount during operation, magnetic materials at least 6 in. (15,2 cm) away.

(b) 495-LVA-006
Ferrous materials should be kept at least 7 in. (17,78 cm) away from the mount during operation, magnetic materials at least 14 in. (35,56 cm) away.

COOLING

Sufficient space should be allowed around the circuit to permit free circulation of air to cool the solenoids. The temperature of the mounts above ambient when stabilized is approximately 80°C (495-LVA-003 and 495-LVA-006S) and 70°C (495-LVA-006).

ELECTRICAL DATA

Solenoid current	495-LVA-003	6·5	A
	495-LVA-006	7	A
	495-LVA-006S	7	A

The solenoid voltage supplies should be adjustable between the following limits to maintain these currents throughout the recommended ambient temperature range.

495-LVA-003	34 to 63	V
495-LVA-006S } 495-LVA-006 }	17 to 33	V

The solenoid tap voltage provided for operation of the deflector coils will provide sufficient current through the deflector coils, 80mA per pair minimum, to focus all good tubes.

ENVIRONMENTAL CONDITIONS

Ambient temperature		
Operating, maximum	+50	°C

OPERATIONAL DATA FOR TUBE AND MOUNT

A data sheet giving optimum electrode voltages, etc., is provided with each tube.

The gain is very sensitive to helix voltage which, for narrow band applications, should be set for maximum gain at the required frequency. For wide band applications the helix voltage should be set for maximum gain at the arithmetic mean frequency. To maintain the gain within ±1 db the helix voltage must be held within ±5V of the optimum value.

Minimum noise factor is obtained by adjustment of grid 3 for minimum noise output and adjustment of deflector coils for minimum helix current.

The voltage specified for grid 3 in the test data sheet is related to optimum noise factor at mid-band (3 Gc/s). Improvement in noise factor at other frequencies may be obtained by adjusting the voltage for minimum noise output at those frequencies.

Towards the end of life of the tube it is likely that the grid 2 voltage will increase.

T.W.T. Mounts

Codes: 495-LVA-003
495-LVA-006
495-LVA-006S

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting-up the W10/3E tube in its mount for operation:—

1. Hold the tube at the base end and insert it in the mount sufficiently to permit the tube supply socket to be fitted (Note 10).
2. Holding the socket gently but firmly, push the tube home. At the end of the travel of the tube pressure needs to be applied to overcome the resistance of the gun and collector toroids. A slight clockwise twist will help with this insertion. The black line on the base of the tube should be aligned with the black mark on the solenoid end plate. This is necessary for best matching.
3. Secure tube in mount by rotating the retaining screw over the tube base ring (Note 11).
4. Close screening box lid and secure.
5. Apply solenoid voltage to give requisite solenoid current.
6. Apply heater voltage and allow three minutes heating time.
7. Set deflector coil currents to zero, i.e. adjust controls to mid-position.
8. Apply grid 1 voltage as on test data sheet.
9. Apply helix, collector, grid 4 and grid 3 voltages as on test data sheet.
10. Raise grid 2 voltage to give required collector current, adjusting deflector coils during operation to minimise helix current.

Note 10. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment of $12\frac{3}{4}$ in. minimum.

Note 11. Once the tube is in its operating position in the mount, any undue pressure on the tube ejector at the rear of the solenoid may cause damage to the tube. Accordingly care must be taken to ensure that the ejector is not knocked or that when the tube is to be removed, no pressure is exerted on the ejector until the screening box lid is opened and the retaining screw has been turned to clear the tube base ring.

Note 12. Application of tube electrode voltages before the solenoid voltage will cause severe damage to the tube.
The resistance of the solenoid mount will take four hours to stabilize and adjustment of the solenoid supply will be necessary during this time. Some excess voltage may be applied to the solenoid on switching on to avoid adjustment but best focusing of the tube is only obtained with stated solenoid current.
Should it be necessary to insert the tube with the solenoid energised care should be taken to resist attraction of ferrous portions of the tube to the mount which may cause damage to the tube.

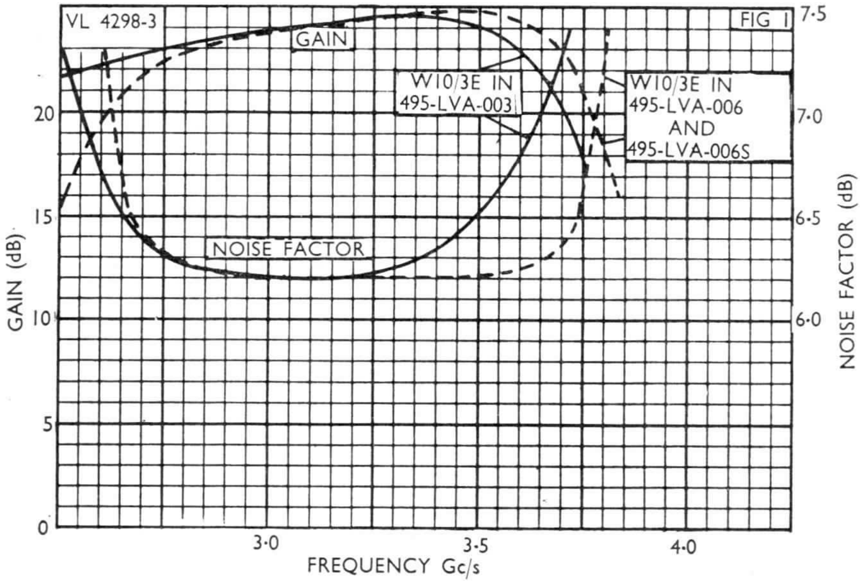
TUBE REMOVAL PROCEDURE

1. Reduce grid 2 control to zero.
2. Switch off all voltages.
3. Open screening box lid and unscrew retaining screw.
4. Lightly holding valve socket press ejector ring.
5. Withdraw ejected tube until tube base can be reached.
6. Remove socket.
7. Withdraw tube. Note that the base ring may be hot.

Code: W10/3E

CONTINUED

Fig. 1. Typical Gain and Noise Factor Characteristics



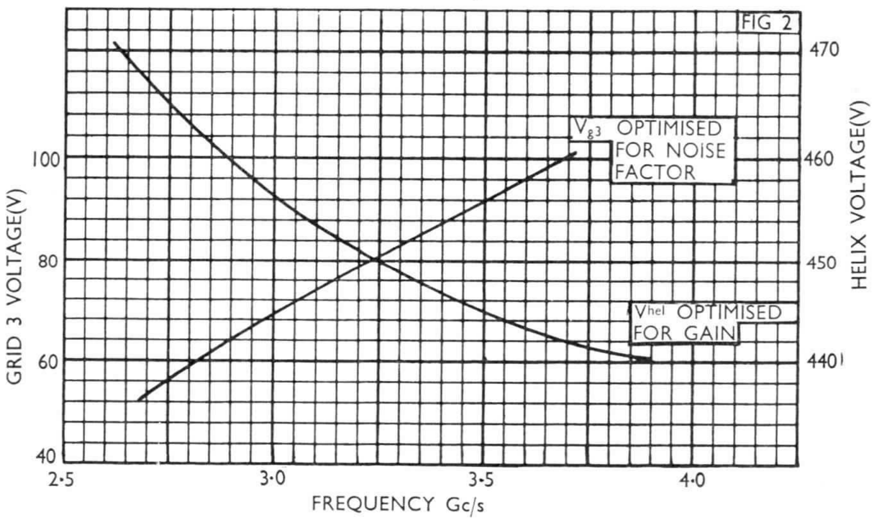
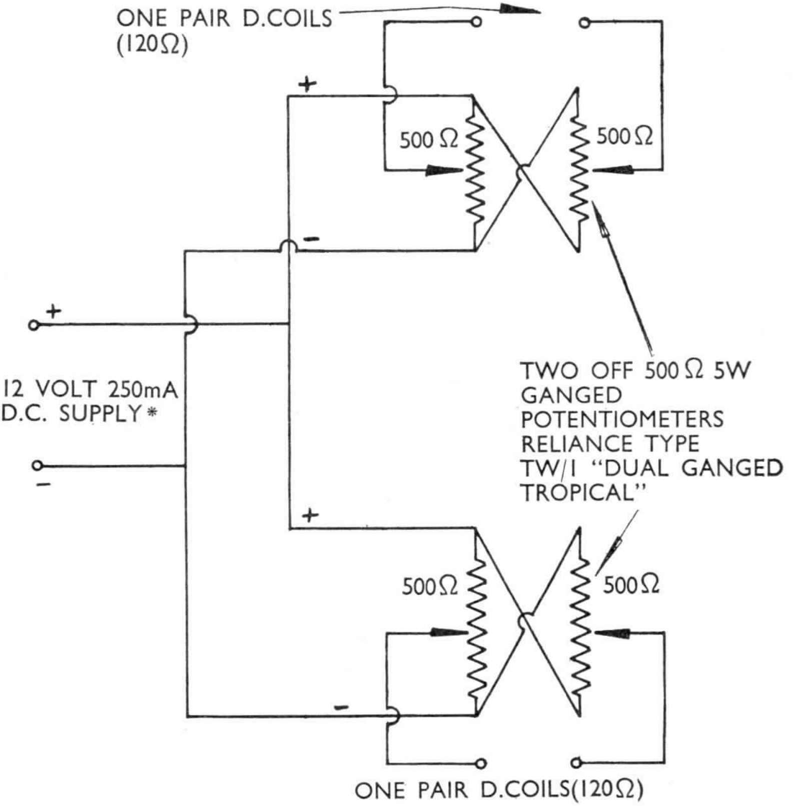


Fig. 2. Optimum Anode Voltage Characteristics

Code: W10/3E

CONTINUED

Fig. 3. Circuit showing the connexion of ganged potentiometers to solenoid type 495-LVA-003 terminals for the control of deflector coil current.



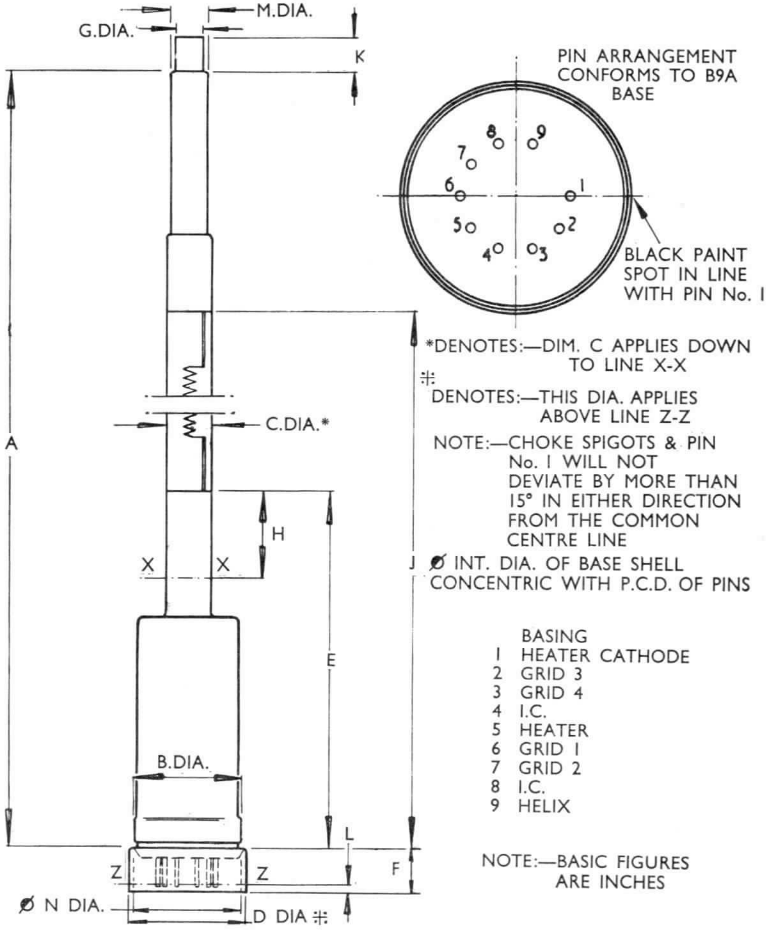
*DENOTES:—THIS MAY BE OBTAINED FROM THE SOLENOID SUPPLY THROUGH A SUITABLE DROPPING RESISTOR

STC

Code: W10/3E

CONTINUED

Fig. 4. W10/3E Outline



*DENOTES:—DIM. C APPLIES DOWN TO LINE X-X

⁜ DENOTES:—THIS DIA. APPLIES ABOVE LINE Z-Z

NOTE:—CHOKE SPIGOTS & PIN No. 1 WILL NOT DEVIATE BY MORE THAN 15° IN EITHER DIRECTION FROM THE COMMON CENTRE LINE

Ø INT. DIA. OF BASE SHELL CONCENTRIC WITH P.C.D. OF PINS

BASING
1 HEATER CATHODE
2 GRID 3
3 GRID 4
4 I.C.
5 HEATER
6 GRID 1
7 GRID 2
8 I.C.
9 HELIX

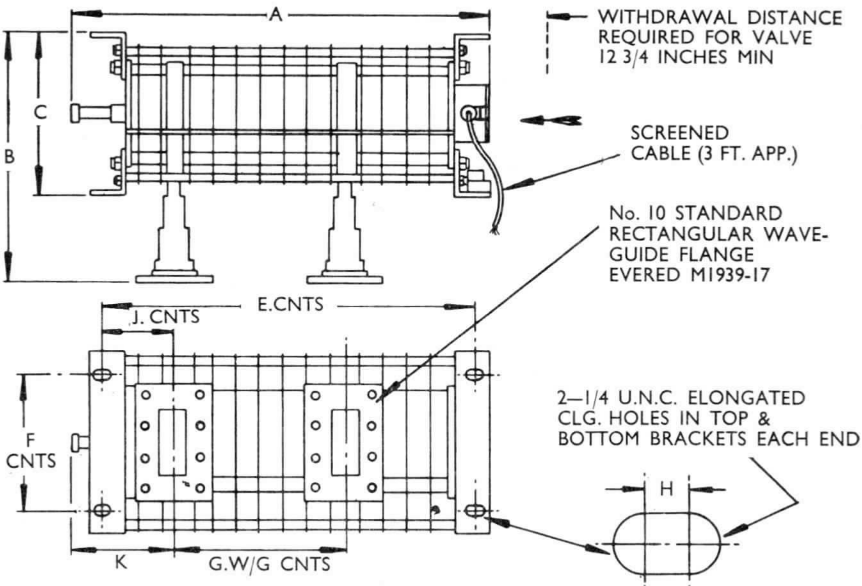
NOTE:—BASIC FIGURES ARE INCHES

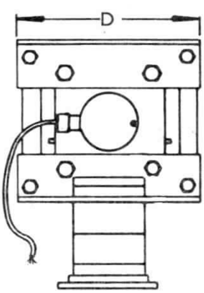
DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	316,10±0,89	12·445±0·035	G	5,99±0,18	0·236±0·007
B	23,24 MAX.	0·915 MAX.	H	19,1 MIN.	3/4 MIN.
C	9,27 MAX.	0·365 MAX.	J	265,53±0,63	10·413±0·025
D	25,30±0,18	0·996±0·007	K	7,62±0,76	0·300±0·030
E	76,52±0,38	3·013±0·015	L	1,59 MAX.	0·063 MAX.
F	10,16±0,63	0·400±0·025	M	7,62+0,10 −0,00	0·300+0·004 −0·000
			N	22,22 MIN.	0·875 MIN.

T.W.T. Mount

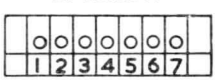
Code: 495-LVA-003

Fig. 5. 495-LVA-003 Outline





VIEW IN DIRECTION OF ARROW



TERMINALS

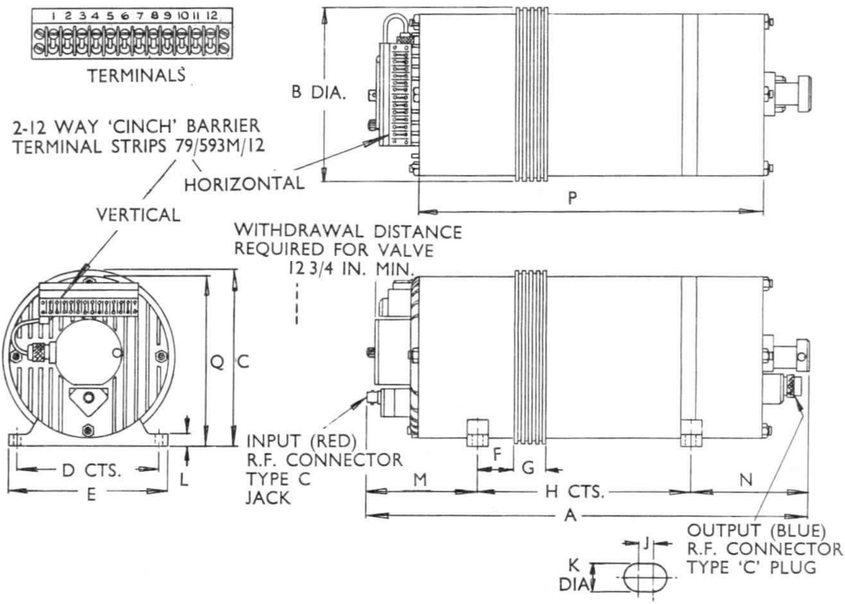
CONNECTIONS		DIMENSIONS		
	TERMINALS	DIM	INCHES	MILLIMETRES
1	FIELD CURRENT	A	17 MAX.	431,8 MAX.
2	ONE PAIR OF	B	10 1/4±3/16	260,4±4,8
3	DEFLECTOR COILS	C	6 3/4±1/8	171,5±3,2
4	ONE PAIR OF	D	7 1/2±1/8	190,5±3,2
5	DEFLECTOR COILS	E	14 7/16±3/16	366,7±4,8
6	DEFLECTOR COILS	F	5 1/2±1/16	139,7±1,6
	SUPPLY	G	6·920±0·020	175,77±0,51
7	FIELD CURRENT	H	3/16	4,8
	SCREENED CABLE	J	3±1/8	76,2±3,2
hk	YELLOW	K	4 1/2±1/8	114,3±3,2
h	BROWN			
g_2	BLUE			
g_3	GREY			
g_4	WHITE	NET WT. 50 LB APPROX.		
g_1	GREEN	NOTE:—BASIC DIMENSIONS ARE INCHES		
hel	ORANGE			

STC

T.W.T. Mount

Code: 495-LVA-006S

Fig. 6. 495-LVA-006S Outline



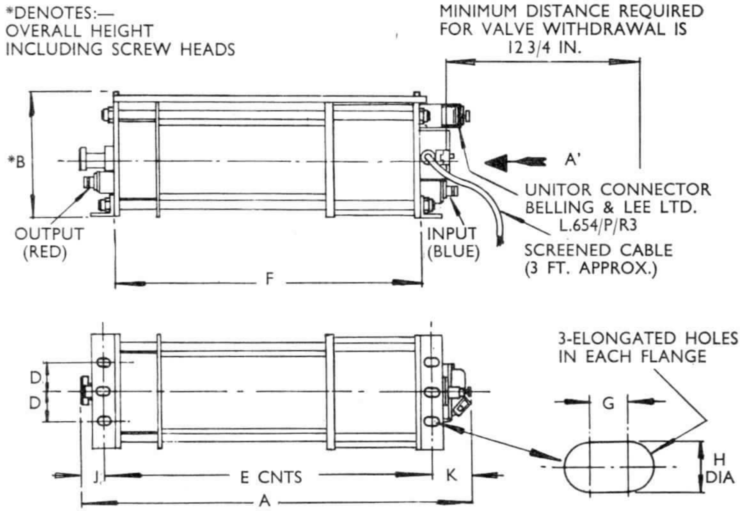
HORIZONTAL CONNECTIONS (CIRCUIT) TERMINALS		VERTICAL CONNECTIONS (VALVE) TERMINALS	
1	FIELD CURRENT	1	hk
2		2	g_3
3	FIELD CENTRE TAP	3	g_4
4		4	h
5	FIELD CURRENT	5	g_1
6		6	g_2
7	ONE PAIR OF	7	helix
8	DEFLECTOR COILS	8	collector
9	ONE PAIR OF	9	
10	DEFLECTOR COILS	10	
11		11	
12	FRAME EARTH	12	

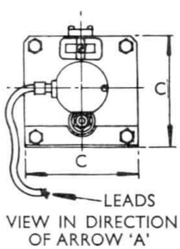
DIM	INCHES	MILLIMETRES
A	15 3/4 MAX.	400,1 MAX.
B	6 1/16 MAX.	154,0 MAX.
C	6 3/16 MAX.	157,2 MAX.
D	5 ±1/32	127,0±0,8
E	5 5/8 ±1/32	142,9±0,8
F	1 9/32±1/16	32,5±1,6
G	1 1/8±1/32	28,6±0,8
H	7 1/2±1/16	190,5±1,6
J	1/8±1/64	3,2±0,4
K	17/64±1/64	6,7±0,4
L	7/16±1/32	11,1±0,8
M	4 MAX.	101,6 MAX.
N	4 5/16 MAX.	109,5 MAX.
P	12 1/8 APPROX.	308,0 APPROX.
Q	5 15/16 APPROX.	150,8 APPROX.

T.W.T. Mount

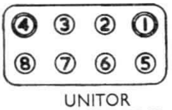
Code: 495-LVA-006

Fig. 7. 495-LVA-006 Outline





VIEW IN DIRECTION OF ARROW 'A'



UNITOR CONNECTIONS

INPUT R.F. CONNECTOR TYPE 'C' JACK
OUTPUT R.F. CONNECTOR TYPE 'C' PLUG

CONNECTIONS		DIMENSIONS		
UNITOR		DIM	INCHES	MILLIMETRES
1	FIELD CURRENT	A	16 11/16 MAX.	423,9 MAX.
2	FIELD CENTRE TAP.	B	5 7/8 MAX.	149,2 MAX.
3	COLLECTOR	C	5 1/4±1/16	133,4±1,6
4	FIELD CURRENT	D	1 1/2±1/32	38,1±0,8
5 }	ONE PAIR OF	E	13 1/4±1/8	336,6±3,2
6 }	DEFLECTOR COILS	F	12 1/8±1/8	308,0±3,2
7 }	ONE PAIR OF	G	5/32±1/64	4,0±0,4
8 }	DEFLECTOR COILS	H	21/64±1/64	8,3±0,4
	LEADS	J	1 1/4 MAX.	31,8 MAX.
hk	YELLOW	K	2 1/16 MAX.	52,4 MAX.
g3	GREY			
g4	WHITE			
h	BROWN	NET WT. APPROX.	LBS 19	
g1	GREEN		Kgs 8-6	
g2	BLUE	NOTE:—BASIC DIMENSIONS ARE INCHES		
hel	ORANGE			

SPECIAL VALVES

Travelling-Wave Amplifier Tube

Code: W10/4G

The W10/4G is a travelling-wave amplifier tube intended for use in radar applications in the frequency range 2·6 to 3·6 GHz. The tube is operated in a periodic permanent magnet type mount 495-LVA-106A, in which it will give the performance quoted in these data sheets. The design of the mount permits easy replacement of tubes under field conditions.

RADIO FREQUENCY PERFORMANCE

Operating frequency range	2·6 to 3·6	GHz
Maximum power output	15	W
Gain at 6W output		
Minimum	35	db
Maximum	42	db
Noise factor at small signal levels	<30	db
Reverse attenuation	>65	db
Phase sensitivity		
$d\Phi/dV_{hel}$	0·75	°/V
$d\Phi/dV_{g2}$	0·25	°/V
AM/PM conversion at 6W output	2	°/db

Modulation noise peaks

Measured in any 4 kHz band 0·5 to 10 MHz from carrier are less than 3 db above tube noise after 10 hours and will continue to improve to less than 1 db above tube noise.

Matching: Pre-set, no adjustment provided.

Graphs showing typical power output, helix voltage and gain as functions of frequency are shown in Figure 1 and a graph of typical output power versus input power is given in Figure 2. Figure 3 shows typical maximum power output and gain at 6W versus helix voltage.

Synchronous helix voltage is that which gives maximum gain at low signal levels.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
C O M P O N E N T S G R O U P

STC

Code: W10/4G

CONTINUED

TYPICAL OPERATING CONDITIONS (Note 1)

Frequency	3·1	GHz
Direct helix to cathode voltage (Note 2)	3·1	kV
Direct grid 2 to cathode voltage (Note 3)	2	kV
Direct collector (earth) to cathode voltage	2	kV
Direct grid 2 current	0·01	mA
Direct helix current	0·5	mA
Direct collector current	40	mA
Direct cathode current	41	mA
Gain at 6W output, approx.	38	db
Saturated output at synchronous helix voltage, approx.	12	W
Band of output impedance match to 5% voltage reflection	>15	GHz

Note 1. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 2. Adjusted to synchronous voltage.

Note 3. Adjusted to give required collector current.

CATHODE

Indirectly heated, oxide-coated type.

HEATER

	Min	Nom	Max	
Heater voltage (Note 4)		6·3		
Heater voltage tolerance				
Long-term average			±3	%
Short-term fluctuations up to 2 minutes' duration			±5	%
Heater current	0·65	0·73	0·85	A
Heater pre-heating time	60			s
Interruption time for zero pre-heat			10	s

Note 4. The heater is usually supplied by a d.c. voltage or an r.m.s. equivalent at a frequency of 50 Hz. Other frequencies of supply up to 10 kHz may be used but it is recommended that the manufacturer be consulted beforehand.

Code: W10/4G

CONTINUED

LIMIT RATINGS

Voltages	Min	Max	
Direct helix to cathode (Note 5)	2·8	3·5	kV
Direct grid 2 to cathode		2·8	kV
Direct collector (earth) to cathode (Note 5)	1·6	3·5	kV
Direct grid 2 to helix		3·5	kV
Direct grid 2 to collector		3·5	kV

Note 5. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to Operational Data Section.

Currents	Nom	Max	
Cathode	40	50	mA
Helix			
Absolute maximum to trip supplies with delay of less than 5 seconds		4	mA
Switching transient	5	45	mA
Direct grid 2	0·01	0·5	mA

Power Dissipations		
Grid 2	2	W
Helix	12	W
Collector (Note 6)	100	W

Note 6. Higher values of collector dissipation are permissible if the normal convection cooling is supplemented by forced-air-cooling.

STC

Code: W10/4G

CONTINUED

D.C. SUPPLY VOLTAGES

The collector is connected to the body of the mount via the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence, as given in the "Setting-up Procedure" section of these data sheets.

Helix Voltage		
Adjustable for required working conditions, range	2·8 to 3·3	kV
The synchronous helix voltage for individual tubes lies within the range	2·8 to 3·1	kV
Ripple and regulation tolerance depend upon acceptable phase and output amplitude variation, typically:		
2% change in helix voltage causes a fall of gain of	0·5	db
1% change in helix voltage causes a phase change of approximately	25	°
Supply impedance, including resistance in mount, maximum (Note 7)	20	k Ω

Note 7. This is required to avoid excessive voltage drop at switch-on.

Collector Voltage		
Set between absolute limits of	1·6 and 3·5	kV
For operation with depressed collector it is usual to choose a nominal voltage of	2	kV
A minimum collector voltage of 1·6kV may be used up to 5W output power.		

Grid 2 Voltage		
Adjustable for required working conditions, range	1·7 to 2·6	kV
When adjusted to give 40mA collector current		
Initial range is	1·8 to 2	kV
End of life limit is	2·6	kV

Code: W10/4G

CONTINUED

MECHANICAL DATA (W10/4G)

Envelope	Glass and metal
Dimensions Connection detail	As shown in Figure 6.

LIFE

Shelf life Operational life	Subject to guarantee

Life-end points

(a) Grid 2 voltage greater than 2·6kV for 40mA collector current, or

(b) Helix current greater than 3mA for 40mA collector current, or

(c) Gain or power deteriorated by more than 2db from initial figures.

ENVIRONMENTAL CONDITIONS

	Min	Max	
Storage temperature	−60	+80	°C
Operating ambient temperature	−10	+60	°C

STC

T.W.T. Mount
Code: 495-LVA-106A

GENERAL DESCRIPTION

This approved mount in which the W10/4G tube operates, incorporates a periodic permanent magnet system, r.f. coupling and matching elements, mechanical deflection and alignment adjustments and a convector cooler.

A sheathed cable attached to the mount carries the electrode supplies, the collector connection being made to the body of the mount which must be at earth potential. The leads of this cable are effectively choked for microwave frequencies and resistors are incorporated in the grid 2 and helix leads to limit surges in the unlikely event of a momentary breakdown in the tube.

A detachable lid provides access to the tube connections and has attached to it a link which, when the lid is in place, is connected to a twin lead interlock cable attached to the mount. This cable may be wired into supervisory circuits to ensure that no voltage can be applied when the lid is off and the terminals inside the mount are exposed. The lid also provides additional microwave screening.

Optimum adjustment of focusing to allow for variations from tube to tube and in mount manufacture is achieved by the use of two pairs of mechanical positioning screws: one pair align the tube and the other pair move a magnetic trimming plate.

The r.f. matching is pre-set and no adjustment is provided.

The tube is held firmly in the mount at the collector end by spring contacts in the cooler assembly and at the base end by a ring in the mount to which is attached a two-position retaining screw: the latter is turned over a projection of the tube base ring to lock the tube in position. (The position of the retaining screw is shown in Figure 8.)

The mount has a tube ejector mechanism, incorporated in the cooler assembly, which is operated by an external knob fitted to the cooler (see Figure 8). If required, a mount can be supplied with tube ejection control at the lid end.

The design of the mount is such that circuit alignment is unaffected by normal handling, and tubes can be easily replaced under field conditions.

The mount should be secured by the threaded holes using $\frac{1}{4}$ inch UNC non-magnetic screws.

Code: 495-LVA-106A

CONTINUED

MECHANICAL DATA—MOUNT

Dimensions	As shown in Figure 7.			
Weight, maximum		24 lb	10,9	kg
Fixing	Four tapped holes, $\frac{1}{4}$ inch UNC			
Connections				
Electrode leads				
Type	4-core PTFE insulated cable			
Colour coding	As shown in Figure 7.			
Length of leads		18 in.	45,5	cm
Interlock leads				
Type	Twin cable			
Length of leads		18 in.	45,5	cm
Sleeve colour	Blue			
Mechanical alignment and deflection adjustments				
Alignment	Two external knobs (Note 8)			
Deflection	Two external knobs (Note 8)			
R.F. Matching	Pre-set			
Waveguides, input and output	Plug UG536A/U			
Mounting position	For maximum efficiency of cooler mount horizontal with waveguides in vertical plane.			

Proximity of magnetic materials

Magnetic materials should be kept at least 1 inch (2,5cm) away from the exterior of the mount, particularly around the waveguides: permanent magnets should be kept at least 9 inches (22,5cm) away from the axis of the mount.

Note 8. Positions of adjustment controls on mount are shown in Figure 8.

COOLING

The cooler is an integral part of each mount. Cooling takes place by convection and it is important that a mount is installed in the plane recommended.

The air flow through the cooler requires a free space of 2 inches (5cm) above and below it with access to a free supply of air at ambient temperature; this is to ensure that the convection cooling is efficient. The cooler temperature under normal conditions of operation is about 70°C above ambient temperature.

If values of collector dissipation in excess of the specified limit rating are employed, the normal convection cooling must be supplemented by forced-air-cooling. (See Note 6 in Limit Ratings Section.)

Code: 495-LVA-106A

CONTINUED

ELECTRICAL DATA

Ratings			
Heater to heater-cathode maximum voltage		1	kV
Heater and heater-cathode, Helix, Grid 2 — to body of mount, maximum voltage		4	kV
Supervisory cable and interlock	240V a.c.	2	A
Lead Resistance (including limiting resistors)			
Grid 2		47	k Ω
Helix		7·5	k Ω
Heater (Note 9)		0·07	Ω

Note 9. At 0·7A and heater line voltage drop of 0·05V.

R.F. PERFORMANCE

Frequency range	2·6 to 3·6	Gc/s

Each mount will permit the specified performance of the W10/4G tube to be achieved.

R.F. leakage		
Input level to free space	>65	db
Output level to free space	>65	db

Matching

The pre-set matching will give a VSWR less than 2 over the specified frequency band.

ENVIRONMENTAL CONDITIONS

Ambient temperature range	Min	Max	
Operating	−10	+60	°C
Storage	−60	+60	°C

Code: W10/4G

CONTINUED

OPERATIONAL DATA

Efficient operation of a travelling-wave tube in a periodic permanent magnet mount depends upon certain prime requirements being met during conditions of switch-on and continuous working. These requirements are such that satisfactory periodic focusing cannot be achieved with either low helix voltage or low cathode current.

The maximum helix current is likely to occur when the helix voltage is between 1 200 and 2 000 volts, the actual value of current being dependent upon the setting of the grid 2 voltage relative to the helix voltage.

When switching on, it is essential that the helix current does not exceed the following safe values:

50mA for not longer than 10 milliseconds
20mA for not longer than 150 milliseconds
10mA for not longer than 1 second
4mA for not longer than 5 seconds

A suitable cathode current control circuit is shown in Figure 4. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. With the recommended setting, corresponding to 1 700 volts on grid 2 with respect to cathode when the helix supply is at 3 000 volts, the maximum value of helix current during the rise of helix voltage may be of the order of 10mA.

The peak current drawn from the helix supply may be minimised by delaying the rise of grid 2 voltage by means of capacitor C_1 in Figure 4. The value of capacitance is dependent upon the rise time of the helix voltage and should be arranged to keep the grid 2 voltage below 500 volts until the helix voltage has risen to over 2 000 volts. A suitable value for a helix supply with a rise time of 0·02 seconds from zero to 2 500 volts is $C_1 = 0{\cdot}04\mu F$, the surge helix current being reduced to approximately 2mA.

Towards the end of the life of the tube it is likely that the helix current will rise to about 2·5mA and the grid 2 voltage, which initially was between 1 800 and 2 000 volts, will increase to about 2 500 volts.

Code: W10/4G

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting up the W10/4G tube in its mount for operation:—

1. Ensure that the mechanical alignment and deflection control knobs on the mount are set to the middle of their travel and that the two-position retaining screw is in a position to allow tube to be inserted.
2. Insert tube in mount (Note 11). At the end of the travel of the tube, pressure needs to be applied to overcome the resistance of the cooler contacts and the spring locating on the base ring before the tube meets the stop at the base end. A slight clockwise twist will help with this insertion. The blue spot on the base of the tube should be aligned with the black mark on the seating. This is necessary for best matching, but the adjustment is not critical, misalignment up to 20° being permissible.
3. Secure tube in mount by rotating the two-position retaining screw to turn over the projection of the tube base ring (Note 12).
4. Connect colour-coded leads of the tube to appropriate terminals in the mount and ensure that mount is properly earthed.
5. Replace lid making sure that the interlock two-pin plug is fitted correctly in its socket.
6. Apply heater voltage and allow one minute heating time.
7. It is necessary to make the following adjustments before switching on to ensure that the helix current will not exceed a safe value:—
   (a) switch off any r.f. drive
   (b) pre-set grid 2 voltage (cathode current control) to give about 1·7kV when switched on; this corresponds to a cathode current of about 35mA. At lower voltages the helix current may be excessive.
8. After the one minute cathode pre-heat, switch on collector voltage at 2kV.
9. Switch on simultaneously the helix voltage at 3kV and the grid 2 voltage to the pre-set value.
10. Adjust alignment and deflection control knobs to give minimum helix current and repeat these adjustments as grid 2 voltage is increased until a collector current of 40mA is achieved.
11. Apply r.f. input and adjust helix voltage for optimum performance; a slight readjustment of the control knobs may be necessary to obtain minimum helix current, and of grid 2 voltage to maintain a collector current of 40mA.

Note 11. The insertion of the tube requires a free space between the lid end of the mount and extraneous equipment. When the tube is inserted in the same plane as the longitudinal axis of the mount, a minimum free space of 18 inches (45,7cm) is needed. By presenting the tube at an angle of 45° to the main axis of the mount a minimum free space of 14 inches (35,6cm) is required.

Note 12. Once the tube has been secured by the retaining screw, it is important to ensure that the tube ejection mechanism is not operated inadvertently. Failure to observe this precaution may result in the tube being damaged.

Code: W10/4G

CONTINUED

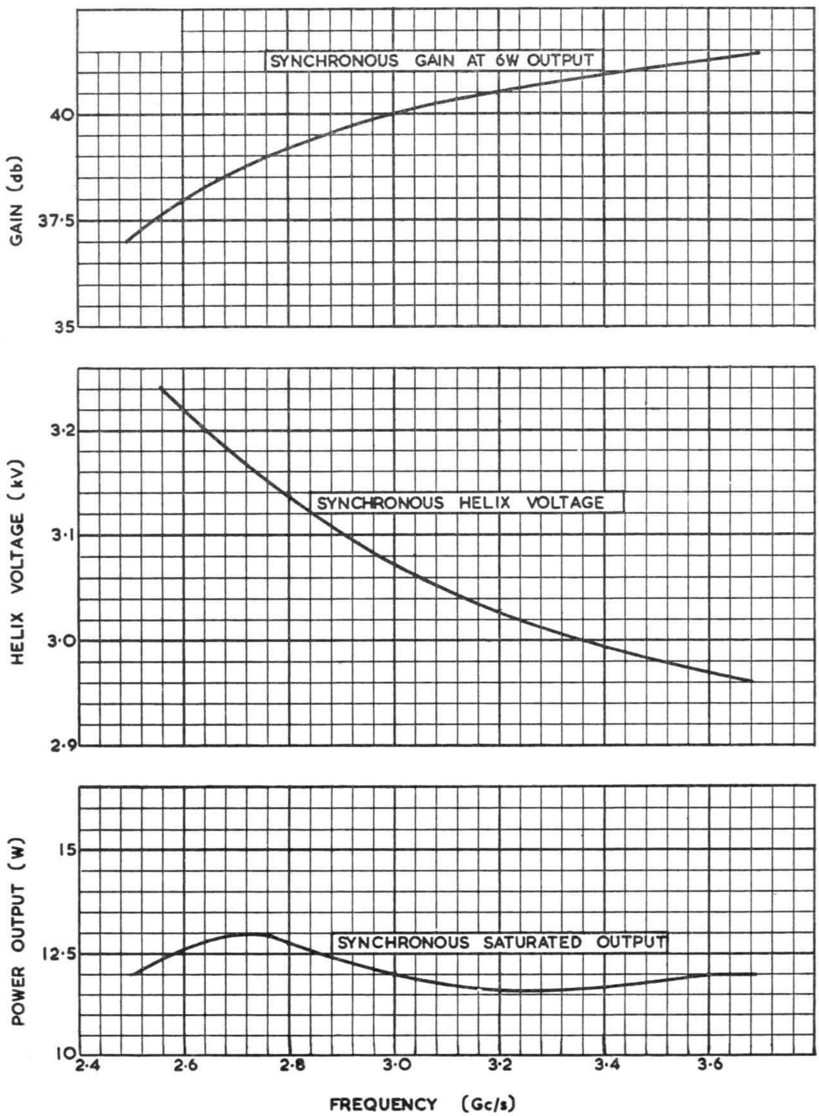
TUBE REMOVAL PROCEDURE

1. Switch off all h.t. voltages simultaneously.
2. Switch off heater voltage.
3. Remove mount lid.
4. Disconnect tube leads from terminals.
5. Move adjusting knobs to mid-travel positions.
6. Rotate the two-position retaining screw to clear the tube base ring.
7. Support the base end of the tube and gradually apply pressure to the tube ejector knob to ease the tube from the mount. A slight clockwise twist applied to the tube will assist removal.

Code: W10/4G

CONTINUED

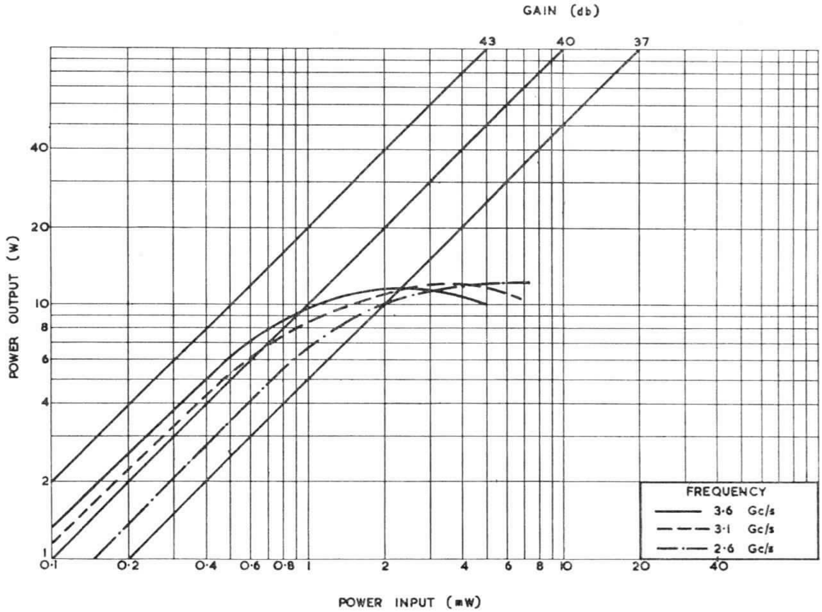
Fig. 1.—Typical Frequency Characteristics



Code: W10/4G

CONTINUED

Fig. 2.—Typical Power Output versus Power Input



Code: W10/4G

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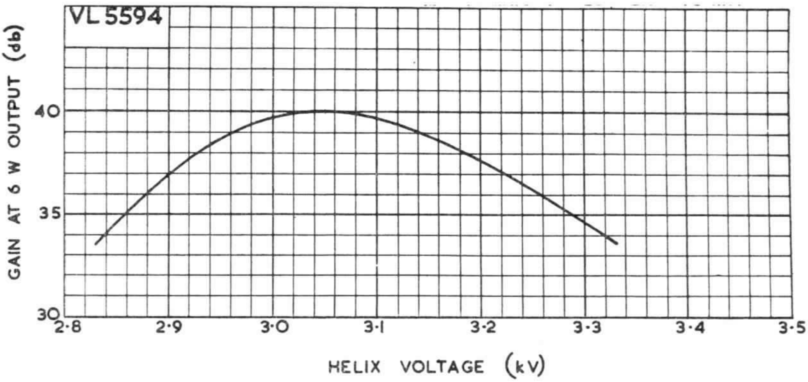
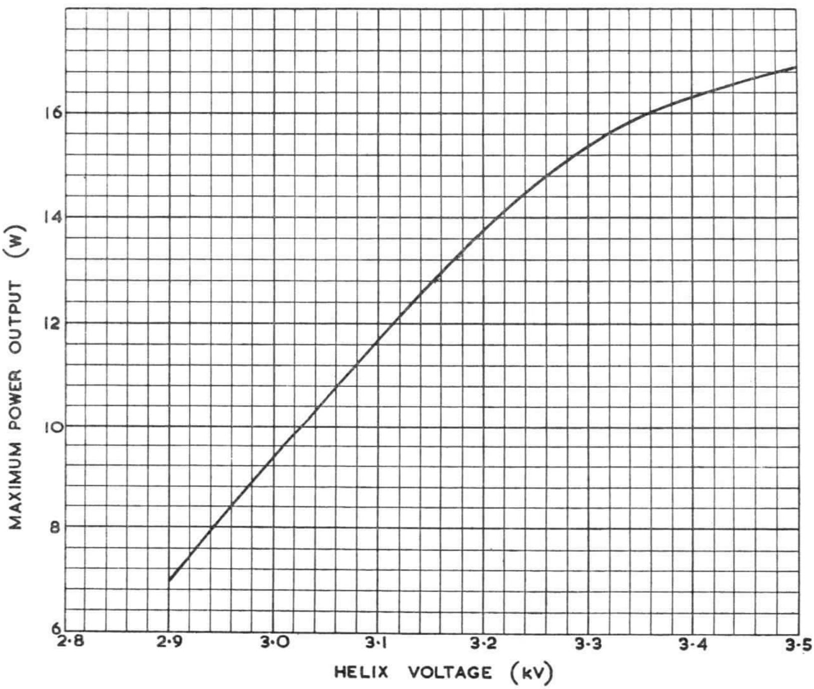
Fig. 3.—Typical Helix Voltage Characteristics (Measured at 3·1 Gc/s)

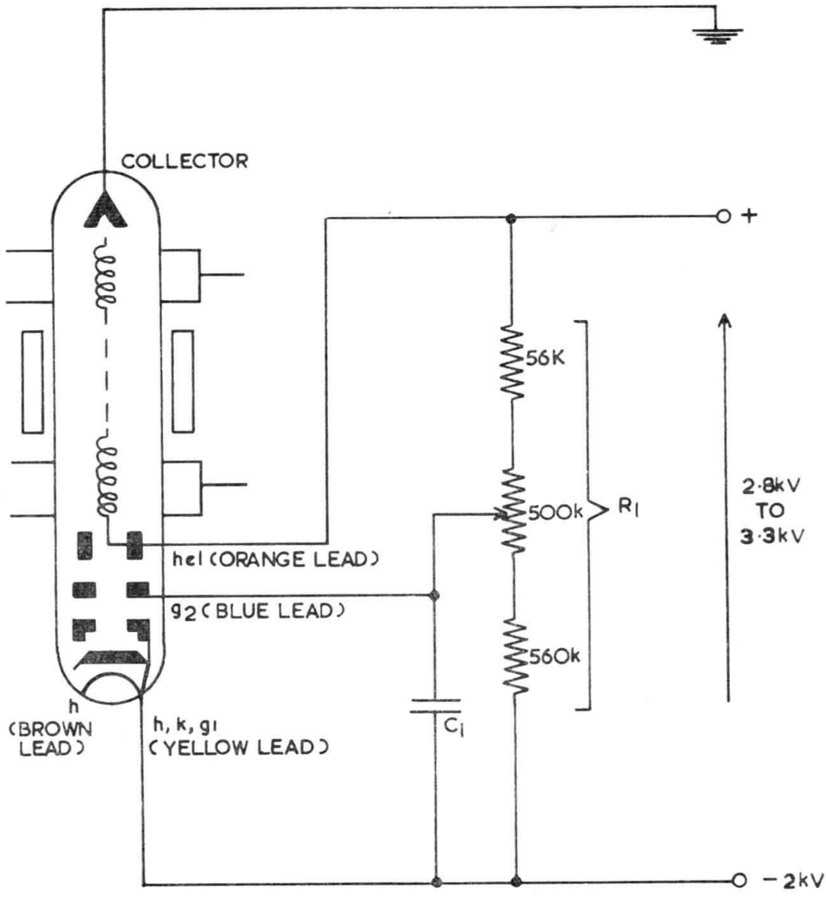




Code: W10/4G

CONTINUED

Fig. 4.—Typical Cathode Current Control Circuit



Code: W10/4G

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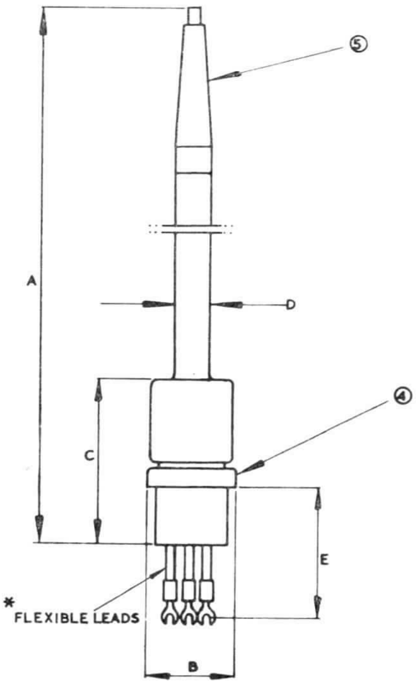
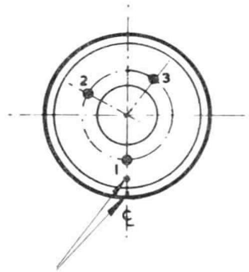
Fig. 6.—W10/4G Dimensional Outline





LEAD*	COLOUR	ELECTRODE
1	BLUE	GRID 2
2	YELLOW	HEATER, CATHODE, GRID 1
3	BROWN	HEATER
CONTACT		
4		HELIX
5		COLLECTOR

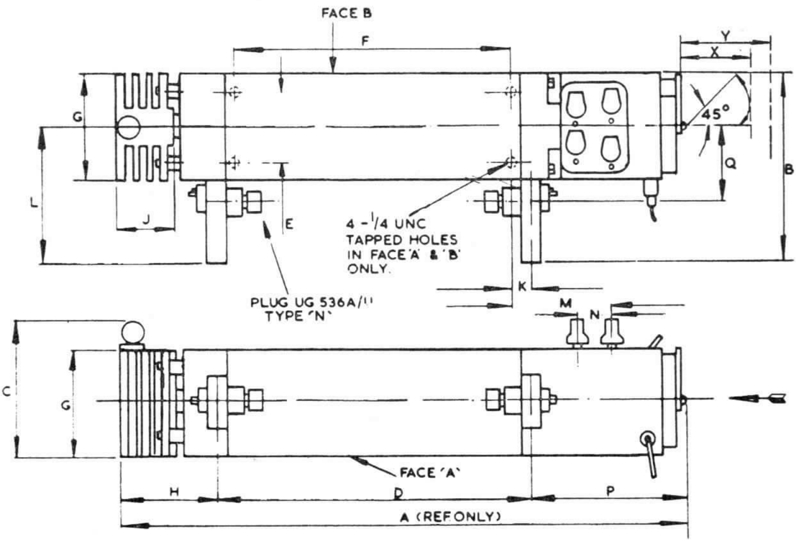
NOTE:- BASIC FIGURES ARE INCHES.

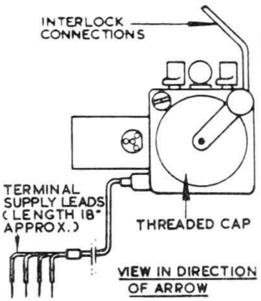
DIM	MILLIMETRES	INCHES
A	465,43 MAX	18·324 MAX
B	36,20 ± 0,18	1·425 ± 0·007
C	70,62 MAX.	2·780 MAX.
D	13,46 MAX.	0·530 MAX.
E	57,2 ± 3,2	2 1/4 ± 1/8

T.W.T. Mount

Code: 495-LVA-106A

Fig. 7.—495-LVA-106A Dimensional Outline





LEAD	ELECTRODE
BLUE	GRID 2
YELLOW	HEATER CATHODE GRID. 1
BROWN	HEATER
ORANGE	HELIX
COLLECTOR EARTHED	

DIM-X (WITHDRAWAL DISTANCE OF TUBE WITH LATERAL MOVEMENT OF BASE) 14 MIN.
DIM-Y (WITHDRAWAL DISTANCE OF TUBE WITHOUT LATERAL MOVEMENT OF BASE) 18 MIN.

NOTE - BASIC DIMENSIONS ARE INCHES.

NETT. WEIGHT 23LBS APPROX.

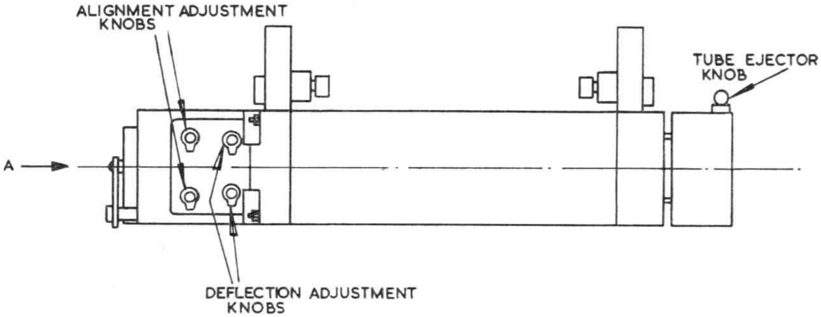
DIM	MILLIMETRES	INCHES
A	514,4 MAX	20 1/4 MAX
B	171,4 MAX	6 3/4 MAX
C	127,0 MAX	5 MAX
D	286,26 ± 0,51	11·270 ± 0·020
E	57,2 ± 0,8	2 1/4 ± 1/32
F	238,1 ± 0,8	9 3/8 ± 1/32
G	98,4 MAX	3 7/8 MAX
H	84,1 ± 2,4	3 5/16 ± 3/32
J	54,0 MAX	2 1/8 MAX
K	23,8 ± 1,6	15/16 ± 1/16
L	117,5 ± 3,2	4 5/8 ± 1/8
M	97,6 ± 3,2	3 27/32 ± 1/8
N	34,9 ± 1,6	1 3/8 ± 1/16
P	136,5 ± 4,8	5 3/8 ± 3/16
Q	68,3 ± 3,2	2 11/16 ± 1/8

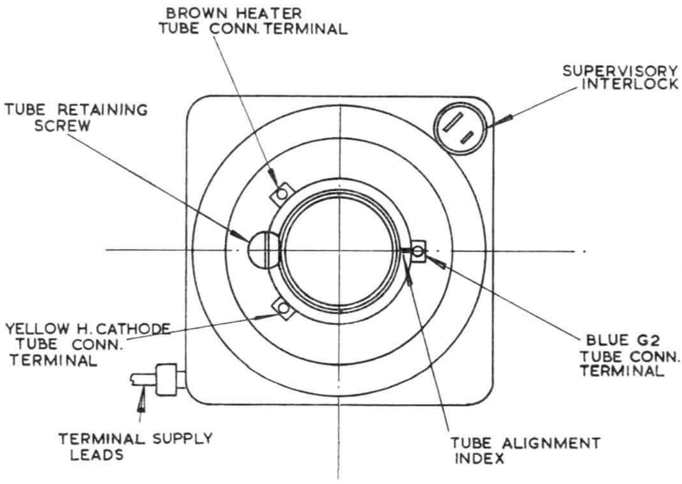
The collector is connected to the body of the mount and its earth path is via the mount body and the chassis to which the mount is attached. In some mounts a black lead is included in the cableform carrying the terminal supply leads: one end of this lead is connected to the body of the mount and the other may be earthed to provide an additional earth path.

T.W.T. Mount

Code: 495-LVA-106A

Fig. 8.—Diagram Showing Operational Controls of 495-LVA-106A





VIEW OF END 'A' WITH COVER REMOVED

SPECIAL VALVES

High Power
Travelling-Wave Amplifier Tube
Code: W45B/5E

The W45B/5E is a forced-air-cooled high power travelling-wave tube intended for use in Bands IV and V u.h.f. television transmitters and transposers, f.m. sound transmitters and link amplifiers. The tube operates in the 470 to 960 MHz frequency band and provides 200 watts for transmitter service, or 50 watts for common sound and vision transposer service. The saturation output of 500W can be obtained in pulsed service with duty ratios up to 10 per cent.

The tube is operated in permanent magnet mounts types WM455A and WM455B in which it will give the performance quoted in these data sheets. The mounts are designed to have a low external magnetic field and to permit easy replacement of tubes under field conditions.

A feature of this tube is that all power supplies, including that for the heater, may be switched on simultaneously: this is very desirable when remote switching is employed.

RADIO FREQUENCY PERFORMANCE

Frequency range	470 to 960	MHz
Pulse saturated power output at 700 MHz, nominal	550	W
Gain at 200W c.w. and 700 MHz, nominal	33	dB
Cold VSWR (Note 1)		
Nominal	1·35	
Maximum	1·85	
Cold attenuation, nominal		

Note 1. Measured at tube input and output in the frequency range 470 to 960 MHz.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: 01-300 3333 Telex: 21836
C O M P O N E N T S G R O U P

Code: W45B/5E

CONTINUED

VIDEO TRANSMITTER SERVICE. BANDS IV AND V

Maximum Ratings (Absolute Values)

Direct collector voltage	3·1	kV
Direct helix voltage	3·3	kV
Direct positive grid 1 voltage	0	V
Direct negative grid 1 voltage	−200	V
Direct grid 2 voltage	1	kV
Direct helix current	30	mA
Direct helix current, peak (Note 2)	40	mA
Direct cathode current	750	mA
Mean power output	275	W
Collector dissipation	2·5	kW
Reflected c.w. power	20	W

Note 2. During switch-on or as a result of a mains surge.

Typical Operation (Note 3)

Television band	IV	V	
Video carrier frequency	550	700	MHz
Peak synch. power output	170	210	W
Gain	30	33	dB
Direct collector voltage (Note 4)	3	2·9	kV
Direct helix voltage	3·2	3·1	kV
Direct grid 2 voltage, approx.	550	600	V
Direct grid 1 voltage	−100	−100	V
Direct helix current	15	15	mA
Direct grid 2 current	0·5	0·5	mA
Direct cathode current	700	700	mA
Linearity from 10 to 65 per cent peak amplitude	⩾0·95	⩾0·95	
Differential phase of colour sub-carrier	⩽3	⩽3	°
Gain variation within channel	⩽1	⩽0·5	dB

Note 3. Graphs showing typical values of gain, peak power output and helix voltage as functions of frequency are shown in Figure 2.

Note 4. The collector voltage must always be 200V less than that of the helix.

Code: W45B/5E

CONTINUED

TELEVISION TRANSPOSER SERVICE WITH COMMON VISION AND SOUND TRANSMISSION

Maximum Ratings (Absolute Values)

Direct collector voltage (Note 4)	3·1	kV
Direct helix voltage	3·3	kV
Direct positive grid 1 voltage	0	V
Direct negative grid 1 voltage	−200	V
Direct grid 2 voltage	1	kV
Direct helix current	20	mA
Direct helix current, peak (Note 2)	30	mA
Direct cathode current	800	mA
Collector dissipation	2·5	kW
Reflected c.w. power	20	W

Typical Operation (Note 5)

Video carrier frequency	700	MHz
Peak synchronous power output (Note 6)	53	W
Intermodulation ratio relative to peak sync. (Note 7)		
By 3-tone test	−51	dB
By 2-tone test	−43	dB
Gain	35	dB
Direct collector voltage	2·9	kV
Direct helix voltage	3·1	kV
Direct grid 2 voltage	700	V
Direct grid 1 voltage	−100	V
Direct helix current, approx.	8	mA
Direct grid 2 current	0·5	mA
Direct cathode current	750	mA

Note 5. Graphs showing typical gain, peak power output and helix voltage as functions of frequency are shown in Figure 3. Figure 4 shows graphs of typical peak power outputs versus helix voltage.

Note 6. A peak sync. power output of more than 100W may be obtained without significant reduction of picture quality.

Note 7. For definitions of the 3-tone and 2-tone tests applied, see Figure 11.

Code: W45B/5E

CONTINUED

CATHODE AND HEATER

Cathode

Indirectly heated, metal capillary dispenser type

Heater (Note 8)

Heater voltage, 50 Hz, r.m.s. (Note 9)	6·3	V
Heater voltage tolerance, absolute value (Note 10)	±2	%
Heater current, r.m.s.	2·8	A

Note 8. The heater and cathode are at a potential of approximately −3kV d.c. with respect to earth. The insulation of the heater transformer must be designed accordingly.

Note 9. When setting the heater voltage, account should be taken of the voltage drop in the supply cable and connecting plug. When using the standard 3·6 ft (1,1 m) supply cable and connector socket the voltage drop is 0·25V.

Note 10. If this tolerance is exceeded the operational performance and life of the tube may be impaired.

SUPPLY VOLTAGES

The cathode is connected inside the tube to one side of the heater (Note 11).

The helix is connected internally to the metal body of the tube which, together with the mount body, is earthed.

The collector, which is isolated electrically from the rest of the tube, is supplied via a flying lead, attached to the focus mount.

Supply voltages to all electrodes other than the collector and helix are applied by means of a connector socket and 6-core cable. The cable leads are colour-coded as follows:

Brown	Heater
Brown/Yellow	Heater/cathode
Yellow	Cathode
Green	Grid 1
Blue	Grid 2
Red	Not to be connected
Black	Earth (screening)

The following values of d.c. voltage, all of which are with reference to cathode, are recommended for use:

Helix Voltage		
Adjustable for required working conditions, range	2·7 to 3·3	kV
Collector Voltage (see Note 4)		
Set between absolute limits of	2·5 to 3·1	kV
Grid 1 Voltage		
Derived from cathode resistor and set to	−100	V
Grid 2 Voltage		
Adjustable for working conditions, range	350 to 1 000	V

Note 11. To avoid hum, it is advisable to connect to the cathode via the yellow lead of the 6-core connector cable. The heater voltage is then applied via the brown and brown/yellow leads. If it is necessary for the heater and cathode to be connected again outside the tube, this must be done only by connecting the brown/yellow and the yellow leads together.

Code: W45B/5E

CONTINUED

MECHANICAL DATA—TUBE

Dimensions	As shown in Figure 6.		
Base	Special 8-pin. Pin connections are shown in Figure 6.		
R.F. input and output terminals	Coaxial connector mating with adaptors to type N supplied with focus mount.		
Mounting position	Unrestricted		
Weight	6·6 lb	3	kg

OPERATING TEMPERATURES

Absolute maximum temperature of collector (Note 12)	200	°C
Minimum operating ambient temperature	−20	°C

Note 12. Measured at the outer edge of the last collector cooling fin.

COOLING REQUIREMENTS

The collector temperature must not exceed 200°C.

An air flow of approximately 106 ft^3/min (3 000 l/min) should be sufficient for the purpose; pressure drop 30 mm of water.

The cooling system should be included in the protection circuit so that the power supplies, including that for the heater, are switched off if the air flow fails.

LIFE

Shelf life
Operational life } Subject to guarantee

T.W.T. MOUNTS
Codes: WM455A
WM455B

CONTINUED

STC

GENERAL DESCRIPTION OF MOUNTS

The approved mounts, WM455A and WM455B, in which the W45B/5E tube operates, are of the permanent magnet type. They have the same electrical characteristics but differ in respect of certain mechanical features, described later, intended to facilitate equipment design.

The mounts are of hinged construction. When an external securing clip is released, the body of the mount opens to give access to the field straightener and the travelling-wave tube. A view of an opened WM455A mount is shown in Figure 5 from which it will be seen that the complete magnet system divides into two main sections.

The field straightener is an important part of the magnet system, its function being to reduce the transverse magnetic field. It consists of a slotted tube, made up of soft iron laminations and aluminium spacers, to one end of which is attached a focus adjustment ring unit.

Around the outside of the field straightener are two slotted soft iron rings. The one at the collector end is locked in a pre-set position to give optimum field adjustment for different tubes. The ring at the gun end is linked mechanically to the focus adjustment ring so that it may be moved from outside the closed magnet system; movement of the gun end ring adjusts the axial field in the vicinity of the gun to reduce the helix current to a minimum in operating conditions.

The field straightener assembly is held in position by a metal clamp, adjacent to the focus ring assembly, which is attached to the r.f. input connector by a securing screw.

The travelling-wave tube is mounted inside the field straightener; its base or gun end lies within the focus ring assembly and the base pins protrude outside the mount. The tube collector end-cap bears on a brass contact spring to which is connected the collector supply cable. The two apertures in the cowling surrounding the collector cooling fins are aligned with two cooling system ports in the mount casing.

T.W.T. MOUNTS
Codes: WM455A
WM455B
CONTINUED

At the time of insertion of the tube in the mount, the r.f. input and output type N adaptors are attached by screws to the tube r.f. terminals. The tube is fixed in position by two studs and knurled nuts which clamp the r.f. terminals to a metal bar attached to the mount. The point at which the r.f. output terminal is clamped is connected by a lead to an earth terminal on the mount casing; this ensures that when an external earth is connected to the terminal, the tube envelope, and thus the helix, is at earth potential.

The external supplies to all the tube electrodes, excepting the helix and collector, are made via an external 6-core cable and connector socket which are supplied with the mount as a complete assembly. The connector plug is mated with the tube base pins and is fixed in position by a threaded locking ring. In order that equipment designers may arrange for the connector cable to be brought to the mount from alternative directions, five types of plug are available, details being given in the Mechanical Data—Mounts section.

On an outer face of the mount there are six tapped fixing holes by which the mount is attached to main equipment. The fixing holes of the WM455A and WM455B are on diametrically opposite sides of the respective mounts. It will be seen from Figures 7 and 9 that, when the two mounts are viewed in a vertical position with the supply connector plug downwards and the r.f. connectors pointing towards one, the fixing holes of the WM455A are on the left-hand side, so that the mount opens to the right, whereas the WM455B has its fixing holes on the right-hand side and opens to the left.

Both types of mount are so constructed that, when they are opened, the field straightener assembly, the tube with its associated fittings, the external earth terminal and the collector cable entry hole are incorporated in the fixed portion of the mount.

STC

Codes: WM455A
WM455B

CONTINUED

MECHANICAL DATA—MOUNTS (Note 13)

Dimensions	As shown in figures 7 and 9		
Weight	88 lb	40	kg
Fixing	Six tapped holes each with 8 mm standard metric thread and 11 mm deep		
External connections			
Collector supply	Flying lead attached to mount		
Helix supply, Earth	Connected to earth terminal on outside of mount		
Supplies to other electrodes.	By connector socket and attached 6-core screened cable, supplied with the mount.		

In order that the supply connector cable may be brought to the mount from alternative directions, five mechanically different variants of the connector socket are available: these allow the cable to be brought in axially or from one of four other directions at right angles to the axial plane, as shown in Figures 7 and 9.

The five types of socket are available under the following codes:

CN45A
CN45B
CN45C
CN45D
CN45E

The standard length of connector cable supplied is 3·6 ft (1,1 m), but if specified by the customer, other lengths can be provided.

R.F. connections	Type N (female jack)	50	Ω
Mounting position	Unrestricted		

Note 13. Diagrams showing salient external mechanical features of the mounts are given in Figures 8 and 10.

PROXIMITY OF MAGNETIC MATERIALS

When installed, the mounts should be kept at least 2·5 inches (60 mm) away from large ferro-magnetic objects such as mounting supports and at a minimum distance of 1·2 inches (30 mm) from small items.

Adjacent mounts should be separated by at least 3·6 inches (90 mm).

OPERATING TEMPERATURES

Absolute maximum operating temperatures of mounts (Note 14)	55	°C
Absolute minimum ambient temperature	−20	°C

Note 14. Measured at the magnet system near the r.f. input and output terminals, as shown in Figures 7 and 9.

COOLING REQUIREMENTS

The forced-air supply system for cooling the tube collector is connected to the inlet and outlet ports in the mount casing and must be capable of providing an air flow of approximately 106 ft^3/min (3 000 l/min). A pressure drop of 30 mm water occurs between the ports.

The cooling air system should be included in the protection circuit so that the power supplies, including that for the heater, are switched off if the air flow fails.

Code: W45B/5E

CONTINUED

OPERATIONAL DATA

A typical power supply circuit is shown at Figure 1.

When setting the heater voltage to the specified value, the voltage drop in the supply leads should be taken into consideration; in the 3·6 ft (1,1 m) connector cable normally supplied the voltage drop is 0·25V.

It is recommended that the supply voltages for grid 2, helix and collector be taken from a common source: where the tube application requires high helix voltage stability a regulated helix voltage supply of low current capacity can be used in conjunction with an unregulated collector supply.

Permissible ripple levels depend upon the application: further information may be obtained from the manufacturer.

Grid 1 voltage may be derived from the cathode resistor R_k.

Grid 2 voltage is taken from the potential divider R_1, the total resistance of which should not exceed 100 kΩ.

The collector voltage is lower than the helix voltage by 200V, corresponding to the voltage drop across R_2.

It is necessary that a protection relay be incorporated in the helix supply line so that if the value of helix current exceeds the permitted maximum all voltage supplies are switched off.

Grid 1 and grid 2 should be protected by resistances of 10kΩ inserted in the supply leads.

As the heater and cathode are at a potential of approximately 3kV with respect to earth, the insulation of the heater transformer must be designed accordingly.

Code: W45B/5E

CONTINUED

SETTING-UP PROCEDURE

The following procedure is recommended for setting-up the W45B/5E in its mount for operation.

1. Release the mount body securing clip and carefully allow the mount to open. It should be noted that the mutual repulsion of the two portions of the split magnet system is such that the mount will fly open if the movement is not controlled by the operator.
2. Slide the tube into the field straightener.
3. Screw the field straightener clamping arm to the input r.f. terminal assembly.
4. Place the field straightener and tube in the mount. The tube collector end-cap should be pressed firmly against its contact spring as the r.f. terminal fittings are positioned over the two clamping studs and are secured with nuts.
5. Fit the r.f. input and output adaptors to the tube r.f. terminals by the screws provided, and connect r.f. input and output cables.
6. Move the focus ring so that the adjustable soft iron ring at the gun end of the field straightener is positioned midway between the two red setting marks.
7. Close the mount and fasten the securing clip.
8. Mate the power supply connector socket with the tube base pins and lock in position with the securing cap on the socket.

Code: W45B/5E

CONTINUED

9. Make the following connections:
   (*a*) The collector supply cable to the collector voltage supply;
   (*b*) The helix voltage supply and the external earth to the earthing terminal on the mount;
   (*c*) The individual colour-coded leads of the 6-core screened connector cable to the points indicated in the SUPPLY VOLTAGES section.
10. Activate the air-cooling system.
11. Switch on simultaneously all operating voltages, including that for the heater, ensuring that they are of the values specified previously in these data sheets. (Note 15).
12. Adjust cathode current to the specified value by varying grid 2 voltage.
13. Adjust the helix current to a minimum by adjusting the focus ring setting.
14. Apply an r.f. input signal and readjust the focus ring to obtain minimum helix current.

Note 15. When initially put into service or after very long non-operational periods, the tube should be operated with a zero grid 2 voltage for at least 20 minutes. After non-operational periods of about a month the tube should be run under that condition for 10 minutes.

Code: W45B/5E

CONTINUED

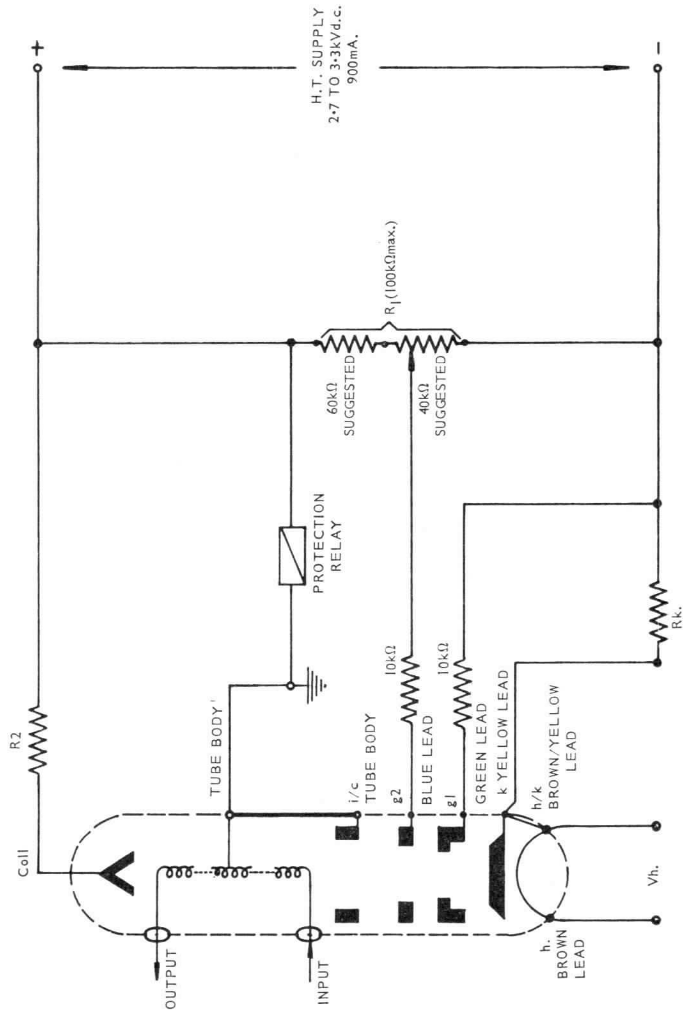
PROCEDURE FOR TUBE REMOVAL

1. Switch off all power supplies to the tube.
2. Unscrew the securing cap of the supply connector socket and withdraw the socket from the tube base and mount.
3. Disconnect the r.f. input and output cables and unscrew the adaptors.
4. Open mount by releasing the outside clip.
5. Remove the circular nuts from the two studs which position the tube in the mount and carefully lift the tube and field straightener off the studs and remove from the mount.
6. Unscrew the bolt fastening the field straightener to the r.f. input terminal assembly.
7. Slide the tube out of the field straightener.

Code: W45B/5E

CONTINUED

Fig. 1.—Typical Power Supply Circuit



Code: W45B/5E

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Fig. 2.—Typical Gain, Peak Power Output and Helix Voltage versus Frequency. Video Transmitter Service

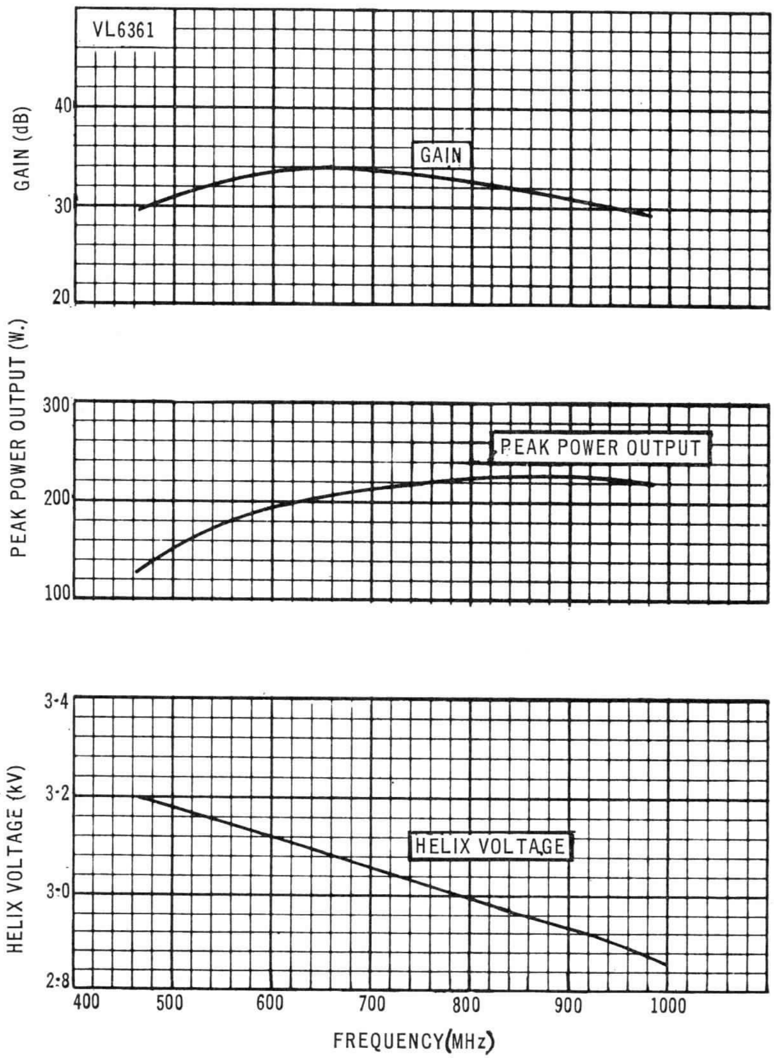

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Fig. 3.—Typical Gain, Peak Power Output and Helix Voltage versus Frequency. Common Sound and Vision Transmission

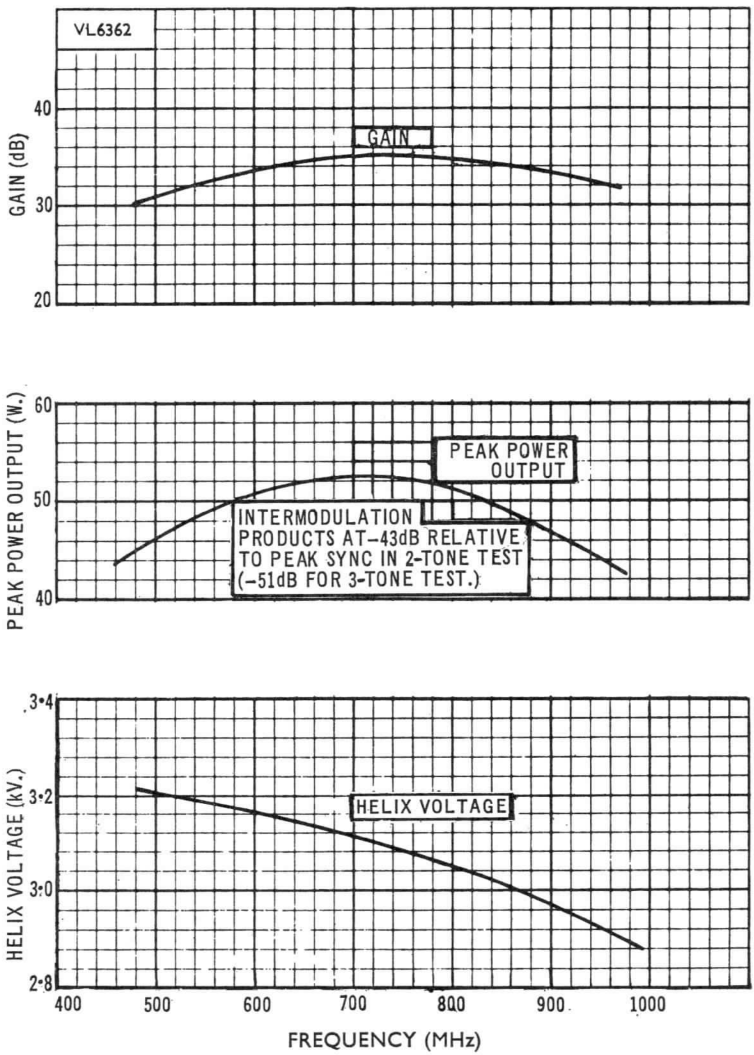

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Fig. 4.—Typical Peak Power Output versus Helix Voltage. Common Sound and Vision Transmission

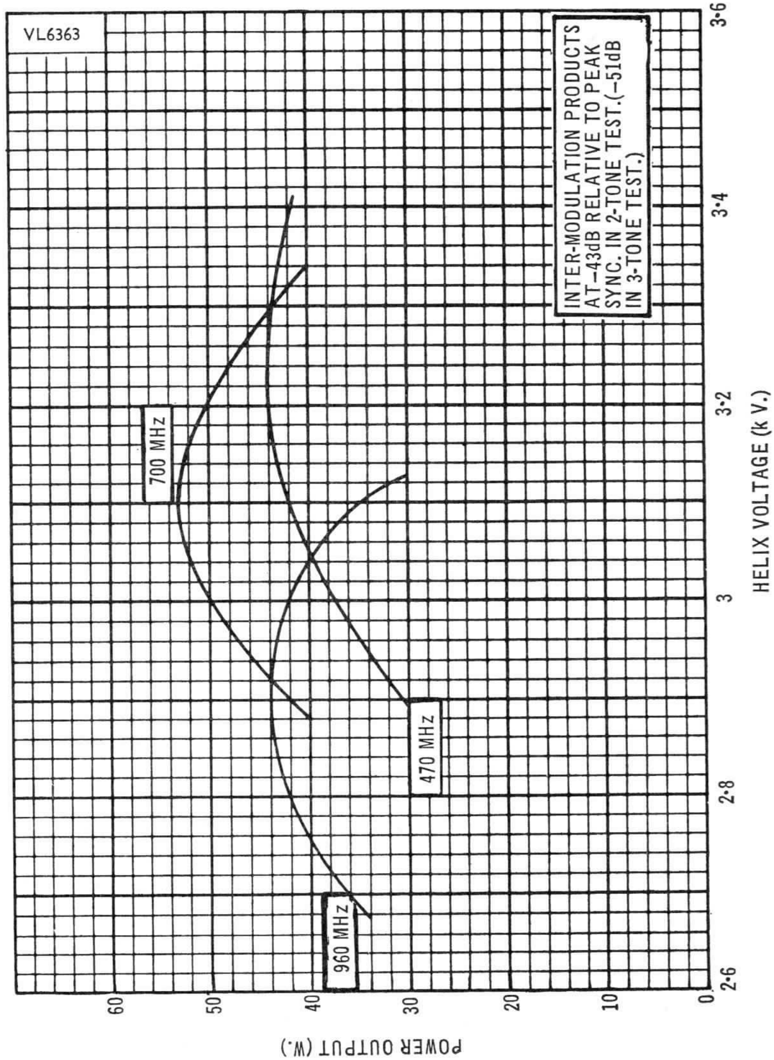

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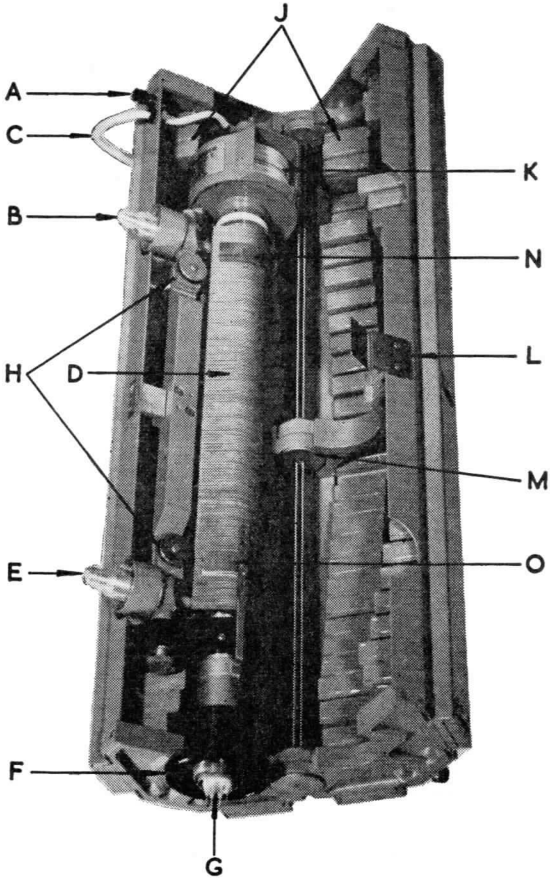
Fig. 5.—View of WM455A Mount in Opened Position.

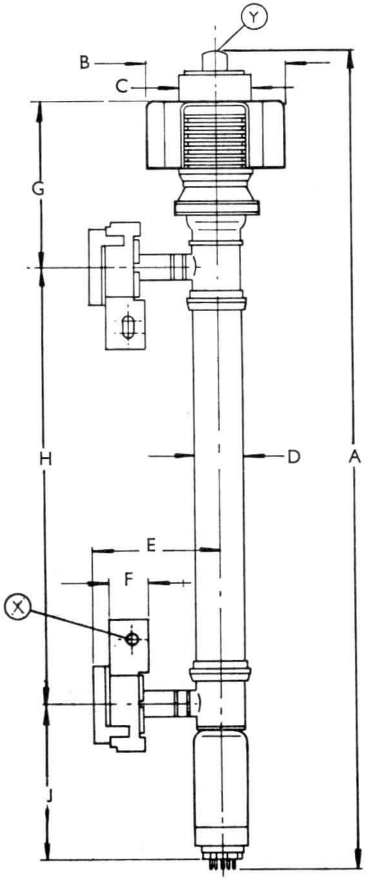


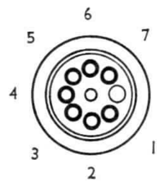
A. Earth terminal
B. R.F. output connector
C. Collector supply lead
D. Field straightener
E. R.F. input connector
F. Focus ring assembly
G. Tube base pins
H. Clamping studs and nuts
J. Magnet system
K. Collector cooling fins
L. Case fastening clip
M. Hinge
N. Fixed soft iron ring
O. Adjustable iron ring

Code: W45B/5E

CONTINUED

Fig. 6.—W45B/5E Dimensioned Outline





PIN	ELECTRODE
1	HEATER
2	HEATER (I.C. PIN 5)
3	I.C. PIN 2
4	GRID. 1
5	CATHODE (I.C. PIN 2)
6	I.C. PIN 5
7	GRID 2

BODY X	HELIX
CAP Y	COLLECTOR

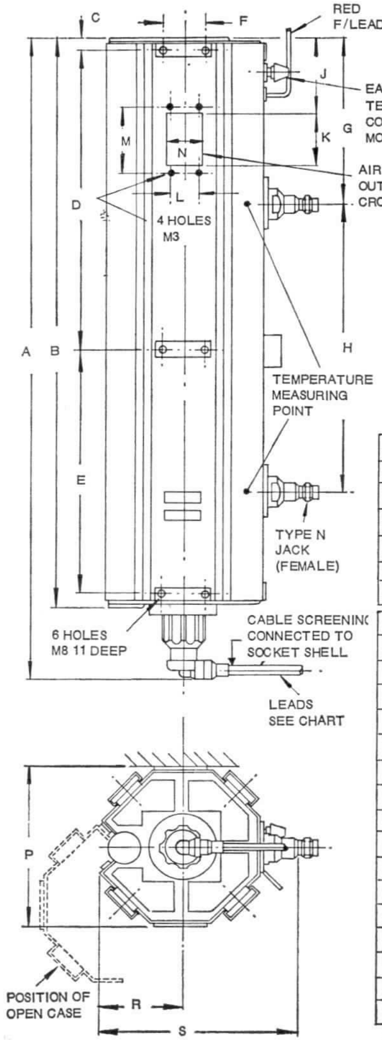
DIM	MILLIMETRES	INCHES
A	733, 0	28·86
B	109, 0	4·29
C	52, 5	2·07
D	31, 2	1·23
E	81, 5	3·21
F	28, 0	1·10
G	116, 5	4·59
H	384, 0	15·12
J	168, 0	6·61

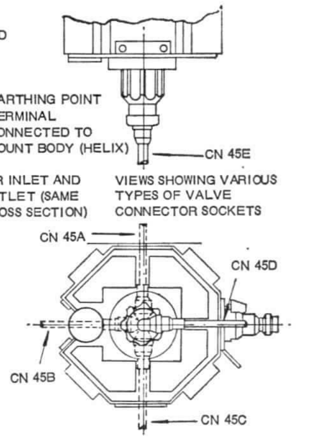
BASIC DIMS ARE MILLIMETRES

Code: WM455A

CONTINUED

Fig. 7.—WM455A Mount Dimensioned Outline





LEAD	ELECTRODE	LEAD OR TERMINAL	ELECTRODE
BROWN	HEATER	TERMINAL	HELIX
BROWN/ YELLOW	HEATER/ CATHODE	RED F/LEAD	COLLECTOR
YELLOW	CATHODE		
GREEN	GRID. 1	THE RED LEAD CONTAINED IN THE 6 CORE CABLE MUST NOT BE CONNECTED	
BLUE	GRID. 2		
BLACK	CABLE SCREENING		

DIM.	MILLIMETRES	INCHES
A	815	32.09
B	734	28.90
C	12	.47
D	385	15.16
E	325	12.80
F	44	1.73
G	205	8.07
H	384	15.12
J	85	3.35
K	62	2.44
L	40	1.57
M	74	2.91
N	50	1.97
P	194	7.64
R	96	3.78
S	225	8.86

BASIC DIMENSIONS ARE MILLIMETRES

Code: WM455A

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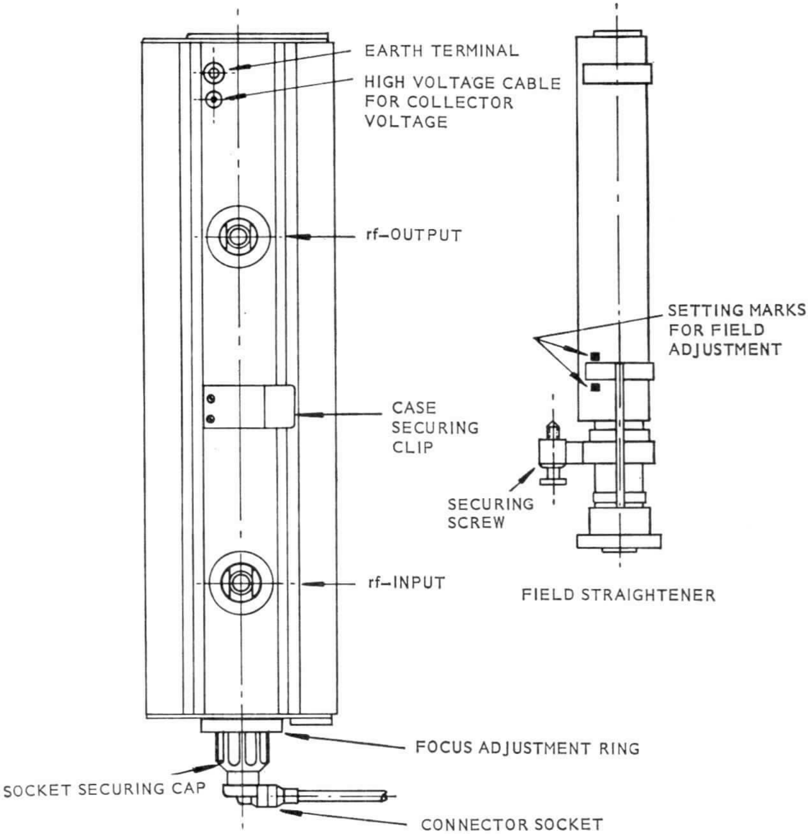
Fig. 8.—Diagram showing Operational Features of WM455A Mount



Code: WM455B

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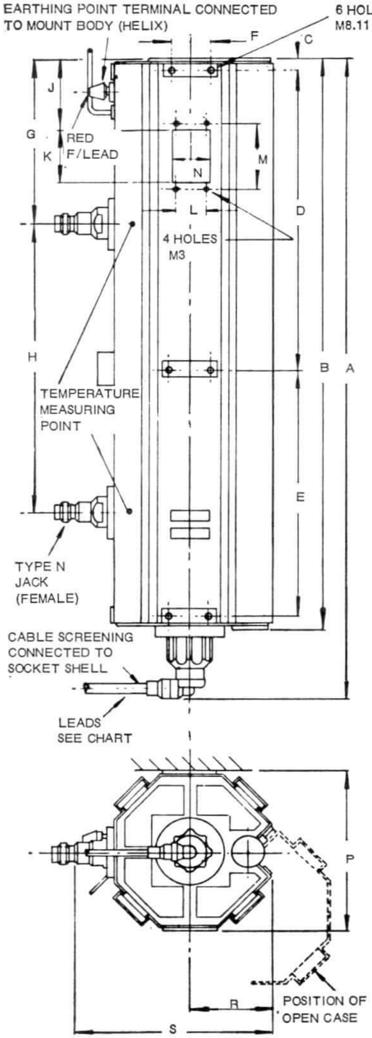
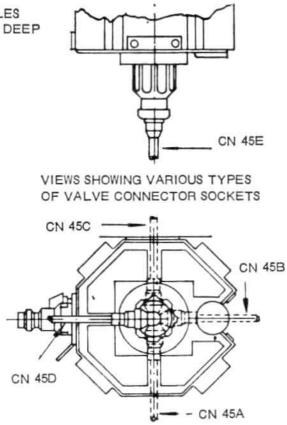
Fig. 9.—WM455B Mount Dimensioned Outline





LEAD	ELECTRODE	LEAD OR TERMINAL	ELECTRODE
BROWN	HEATER	TERMINAL	HELIX
BROWN/YELLOW	HEATER/CATHODE	RED F/LEAD	COLLECTOR
YELLOW	CATHODE		
GREEN	GRID. 1	THE RED LEAD CONTAINED IN THE 6 CORE CABLE MUST NOT BE CONNECTED	
BLUE	GRID. 2		
BLACK	CABLE SCREENING		

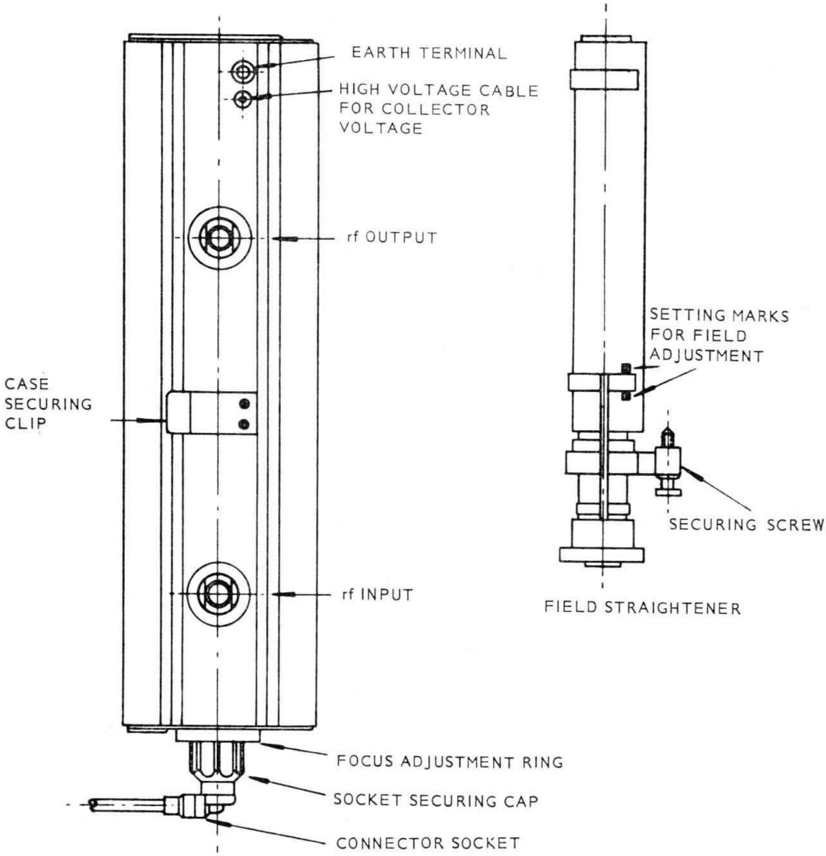
DIM.	MILLIMETRES	INCHES
A	815	32.09
B	734	28.90
C	12	.47
D	385	15.16
E	325	12.80
F	44	1.73
G	205	8.07
H	384	15.12
J	85	3.35
K	62	2.44
L	40	1.57
M	74	2.91
N	50	1.97
P	194	7.64
R	96	3.78
S	225	8.86

BASIC DIMENSIONS ARE MILLIMETRES

Code: WM455B

CONTINUED

Fig. 10.—Diagram showing Operational Features of WM455B Mount



STC

Code: W45B/5E

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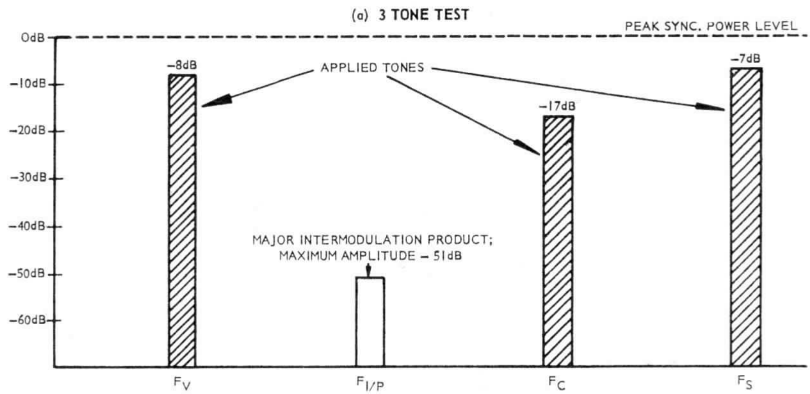
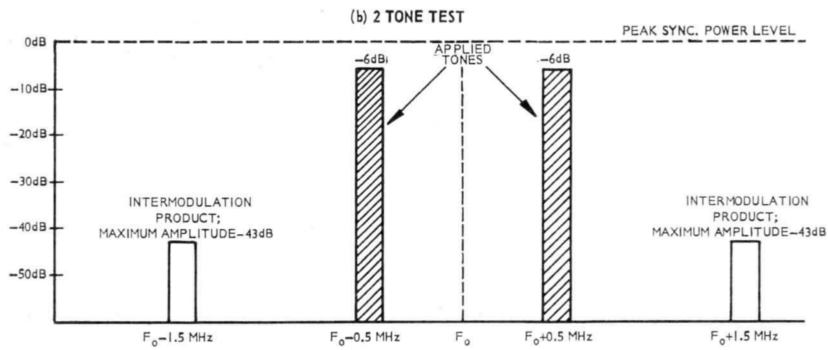
Fig. 11.—Definitions of 3-tone and 2-tone Tests





MEDIUM POWER TRAVELLING-WAVE AMPLIFIER TUBES
Codes: W3MC/3A: W3MC/3B: W3MC/3C: W3MC/5A: W3MC/6A.

These tubes are intended for use in microwave radio links operating in the 10·7 to 13·25GHz frequency band.

Each type comprises a travelling-wave tube packaged in its periodic permanent magnet focusing mount; all types are basically similar in outline.

The W3MC/3A, W3MC/3B and W3MC/3C differ from one another in respect of certain minor electrical and mechanical features specified later.

Other variants of the W3MC series with the frequency range extended downwards to 9·0GHz can be supplied if required.

Facilities are available for re-tubing packages by the manufacturer at the end of tube life.

RADIO FREQUENCY PERFORMANCE (Note 1)

	W3MC/3A-3B-3C	W3MC/5A	W3MC/6A	
Operating frequency range	10·7 to 11·7	11·7 to 12·7	12·7 to 13·25	GHz
Saturated output power, minimum	15	10	10	W
Working power output	10	7·5	7·5	W
Gain at working output (Note 2)				
minimum	40	38	38	dB
maximum	45	45	45	dB
Noise factor at working output, maximum	28	28	28	dB
Reverse attenuation at working output, minimum	65	65	65	dB
AM/PM conversion at working output, maximum	2·5	2·5	2·5	°/dB
Phase sensitivity at working output, maximum				
$d\Phi/dV_{hel}$	-2	-2	-2	°/V
$d\Phi/dV_{g2}$	+0·5	+0·5	+0·5	°/V
Change in gain with V_{hel} at working output, maximum				
ΔG for ±1% change	0·4	0·4	0·4	dB
ΔG for ±2% change	-1·0	-1·0	-1·0	dB
Change in gain with V_{g2} at working output for up to ±2% change in voltage, maximum	+0·02	+0·02	+0·02	dB
VSWR, maximum (Note 3)				
input	1·5:1	1·5:1	1·5:1	
output	2·0:1	2·0:1	2·0:1	

ITT Components Group Europe
Standard Telephones and Cables Limited
Valve Product Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 (STD Code 0803) Telex: 42830

ITT COMPONENTS

RADIO FREQUENCY PERFORMANCE (continued)

Modulation noise at working output

The noise in any 4kHz band from 0·5MHz to 10MHz from the carrier does not exceed that value equivalent to 30dB noise figure after 10 hours operation.

Note 1. Typical power output, gain and helix voltage versus frequency graphs are shown in Figures 1, 2 and 3; AM/PM conversion versus output power is shown in Figure 4 and output power versus input power in Figure 5.

Note 2. With helix voltage optimised for maximum gain at working output.

Note 3. The input and output match is pre-set; the figures quoted apply across the frequency band for any specified tube.

TYPICAL OPERATING CONDITIONS (Note 4)

Frequency	10·7	11·7	13·25	GHz
Direct helix to cathode voltage (Note 2)				
at 10W working output power	4 320	4 270		V
at 7·5W working output power		4 250	4 180	V
Direct grid 2 to cathode voltage	1 910	1 910	1 910	V
Direct collector (earth) to cathode voltage	2 400	2 400	2 400	V
Direct grid 1 voltage (Note 5)	−15	−15	−15	V
Direct helix current at working output	0·4	0·4	0·4	mA
Direct grid 2 current	+2	+2	+2	µA
Direct cathode current	36·4	36·4	36·4	mA
Synchronous gain (Note 2)				
at 10W working output, approx.	43·5	42·8		dB
at 7·5W working output, approx.		44	39·7	dB
Saturated output, approx.	17·5	16·0	11·5	W

Note 4. Electrode voltages are referred to cathode potential. The collector is earthed.

Note 5. Adjusted to optimum value for focusing at the required power level. Switch-on and test figures are quoted in the data sheets supplied with each tube. A change in grid 1 voltage may necessitate readjustment of grid 2 voltage.

CATHODE

Indirectly-heated, oxide coated type.

HEATER

	Min.	Nom.	Max.	
Heater voltage (Note 6)		6·3		V
Heater voltage tolerance				
long term average			±3	%
short term fluctuations of up to 2 min. duration			±5	%
Heater current	0·7	0·82	1	A
Heater pre-heat time	60			s
Interruption time for zero pre-heat			10	s

Note 6. With exception of W3MC/3C, the heaters of all tubes are usually supplied from a d.c. voltage or an r.m.s. equivalent at a frequency between 45 and 65Hz; other frequencies may be used but the manufacturer should be consulted beforehand. If a heater is operated with d.c., it is preferable to make the free heater lead negative with respect to cathode.

The W3MC/3C heater must be operated from a d.c. supply with the free heater lead negative with respect to cathode; this is to enable the time elapsed meter to operate correctly.

LIMIT RATINGS

Voltages

	Min.	Max.	
Direct helix to cathode voltage (Note 7)	3·9	4·6	kV
Direct grid 2 to cathode voltage		3·0	kV
Direct grid 1 to cathode voltage		-0·5	kV
Direct collector (earth) to cathode voltage (Note 7)	2·0	4·6	kV
Direct grid 2 to helix voltage		4·6	kV
Direct grid 2 to collector voltage		4·6	kV

Note 7. Minimum ratings are specified for continuous operation to avoid excessive helix current. Refer to OPERATIONAL DATA section.

Currents

Cathode	45	mA
Helix		
absolute maximum to trip supplies with delay less than 5 sec.	2	mA
switching transient		
20mA for not longer than 10ms		
10mA for not longer than 150ms		
5mA for not longer than 1 sec.		
2mA for not longer than 5 sec.		
Grid 2 current	0·5	mA

Power Dissipations

Grid 2 dissipation, maximum	1·5	W
Helix dissipation, maximum	9	W
Collector dissipation, maximum	115	W

ENVIRONMENTAL CONDITIONS

Operating ambient temperature ranges and altitudes for full specification performance are:

-10°C min. to +65°C max. up to 5 000 ft. (1 524m)
-10°C min. to +60°C max. up to 10 000 ft. (3 048m)
-10°C min. to +50°C max. up to 15 000 ft. (4 552m)

Operation down to -30°C is possible with a slight degradation of performance.
Storage ambient temperature range and altitude are:

-35°C min. to +75°C max. up to 4 5000 ft. (13 656m)

Humidity 95% max. at +65°C

TUBE LIFE

Shelf life }
Operational life } Subject to guarantee

Life-end points

(a) grid 2 voltage greater than 2·8kV for 36mA collector current
(b) helix current greater than 2mA for 36mA collector current, or
(c) change in power output or gain by more than 2dB from initial values

GENERAL DESCRIPTION OF TUBE PACKAGES

The W3MC series are assemblies in which the travelling-wave tube is encapsulated in its mount. The mount incorporates a periodic permanent magnet focusing system, r.f. coupling waveguides with the matching elements pre-set and non-adjustable, pre-set and non-adjustable tube focusing, and a convection collector cooler.

Types W3MC/3A, W3MC/5A and W3MC/6A cover consecutive portions of the overall operating frequency band of the tube series. The code suffices A, B and C of the three W3MC/3 tubes denote small differences in electrical and mechanical specifications, referred to in this section and shown in the drawings at Figures 7 and 8.

A screened cable attached to the mount carries the electrode supplies; it also earths the mount body. The leads of this cable are effectively choked for microwave frequencies. Certain mounts, detailed later, incorporate resistors in the grid 2 and helix leads to limit surges.

Tapped holes are provided in the sides of the mounts for use in installation in equipment.

The mounts are intended for horizontal positioning which allows correct operation of the convection cooler. The cooler will operate efficiently in any horizontal orientation of the mount.

The W3MC/3C contains an elapsed time meter which operates off the d.c. heater supply: it is provided to record tube life up to 10 000 hours.

MECHANICAL DATA

Dimensions	As shown in Figures 7 and 8.
Fixing of mounts	Attach mounts to main equipment with 1/4 UNC non-magnetic screws locating in tapped holes 5/8 inch deep provided in sides of mounts.
Waveguide connexions	(input and output) All mounts are fitted with flanges as shown in Figure 9 for connection to WG17 (WR75). Tin-plated shims and screws, which are available if required, should be used for connection to brass waveguide flanges.

ELECTRICAL DATA

Ratings (all mounts)

Heater and heater-cathode, Helix, Grid 2 } to body of mount, maximum voltage 9 kV

Lead resistance (including limiting resistors)

	W3MC/3A-5A-6A	W3MC/3B	W3MC/3C
Grid 2	0·03Ω	47kΩ	47kΩ
Helix	0·03Ω	0·03Ω	4·7kΩ
Heater (Note 8)	0·05Ω	0.05Ω	0·05Ω

Note 8. At current of 2A. Heater line voltage drop 0·04V.

D.C. SUPPLY REQUIREMENTS

The collector is connected to the body of the mount through the cooler. It is intended that the mount shall be operated at earth potential. Voltages must be applied in the correct sequence as shown in the SETTING-UP PROCEDURE section of this data.

Helix Voltage

The helix voltage should be adjustable to obtain the required working conditions. Voltage ranges are:

for 7·5W and 10W working	3·9 to 4·4kV
for saturation	4·0 to 4·6kV

Ripple and regulation tolerances depend on acceptable phase and output amplitude variation (refer to RADIO FREQUENCY PERFORMANCE section).

The use of a protective series resistor, value 4·7kΩ, in the power supply line, is recommended: this resistor is already fitted in some mount types before delivery (refer to ELECTRICAL DATA section).

The power supply impedance, including that of the protective resistor, should not exceed 20kΩ. This is required to avoid excessive voltage drop at switch-on.

A trip circuit set to operate at 2mA must be incorporated in the helix supply to prevent burn-out of the tube by the passage of excessive helix current.

Collector Voltage

For operation with depressed collector at 36mA the recommended collector voltage is 2·4kV at which value optimum life will be obtained. Under power supply fault conditions the tube will not be damaged by operation at 2·0kV.

Grid 2 Voltage

This should be adjustable for required working conditions. For 36mA collector current voltage ranges are:

throughout tube life	1·8 to 2·8kV
for new tube	1·8 to 2·5kV

Grid 2 current — Negative values of up to 50μA may occur

The use of a protective series resistor, value 47kΩ, in the power supply line is recommended (see ELECTRICAL DATA section).

Grid 1 Voltage

Adjustable for minimum helix current, range 0 to -35V.

Efficient operation of the W3MC series of tubes depends upon certain prime requirements being met during conditions of switch-on and continuous working.

These requirements are such that satisfactory periodic focusing cannot be achieved with low helix voltages.

If the tube is operated with helix voltages below the minimum limit of 3 900 volts, the helix current will be excessive, the actual value of current being dependent upon the setting of the grid 2 voltage relative to helix voltage.

When switching on, it is imperative that the helix current does not exceed the transient values given in the tube limit ratings.

A suitable cathode control circuit is shown in Figure 6. The grid 2 voltage is supplied from a potentiometer connected across the helix supply, the grid 2 voltage always being proportional to, but less than, the helix voltage. The recommended setting for switch-on is 1 800 volts on grid 2 with respect to cathode, and a helix supply of 4 350 volts. The switch-on of grid 2 voltage should be delayed until helix voltage has reached 3 900 volts.

The delaying device, for example a reed relay, should also operate to cut off the grid 2 voltage in the event of the helix trip being operated; this is to prevent excessive grid 2 current being passed.

The 10MΩ bleed resistor prevents build-up of the static charge on grid 2 during the period when the helix and collector voltages only are applied.

On final switch-off, the grid 2 voltage should precede the helix voltage on a time scale such that the grid 2 voltage drops below 500 volts before the helix voltage falls to 3 900 volts.

COOLING

The air flow through the cooler requires a free space of 2 inches (5cm) around the cooler slots with access to a free supply of air at ambient temperature. The cooler temperature under normal conditions of operation is about 180°C above ambient.

At altitudes up to 15 000 feet (4 552m), and within the maximum ambient temperature specified, free convection is adequate for dissipations up to the specified limit rating. When it is required to exceed either the ambient temperature or the collector dissipation limits, or to mount the package in a plane other than that specified, forced-air-cooling is necessary and the manufacturer should be consulted regarding the air flow applicable to particular requirements.

PROXIMITY OF MAGNETIC MATERIALS

Soft magnetic materials should be kept at least 2 inches (5cm) away from the exterior of mounts.

Magnetised materials in the vicinity of the mounts must be positioned so that the helix current at fully saturated output does not increase by more than 0·05mA.

Assistance with focusing tests in the presence of permanent magnets, and guidance concerning their position is readily available from the manufacturer.

SETTING-UP PROCEDURE

1. Apply heater voltage and allow 1 minute heating time.
2. Apply grid 1 voltage as specified in data sheet supplied with tube.
3. Make the following adjustments before switching on to ensure that the helix current will not exceed that value which causes the trip to operate:
   (a) switch-off any r.f. drive.
   (b) pre-set grid 2 voltage (cathode current control) to give about 1 800 volts at switch on; this corresponds to a cathode current of about 30mA.
4. After the 1 minute cathode pre-heat, switch on collector voltage at 2·4kV.
5. Switch on the helix voltage at 4 350 volts and, using the automatic delay, apply the grid 2 voltage at the pre-set value. (See Note 8).
6. Increase the grid 2 voltage to give a collector current of 36mA.
7. Adjust grid 1 voltage to minimise helix current. Re-adjust grid 2 voltage if necessary, to maintain collector current.
8. Apply r.f. input and adjust helix voltage to give maximum power output.
9. Re-adjust grid 1 voltage and then grid 2 voltage if necessary.

Note 8. Provided that the rise time of the collector voltage is not greater than that of the helix voltage, these supplies may be switched on together.

Fig. 1. Typical Saturated Output versus Frequency

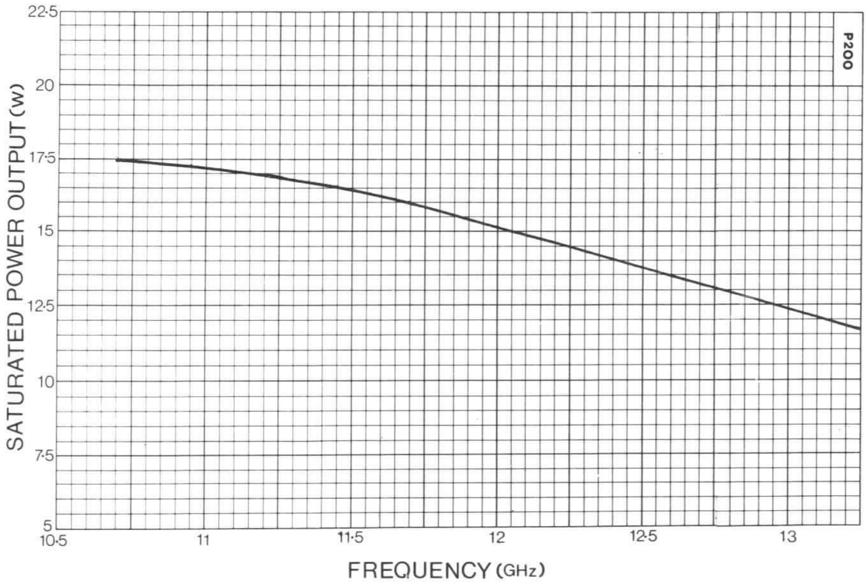


Fig. 2. Typical Synch. Gain at Working Output versus Frequency

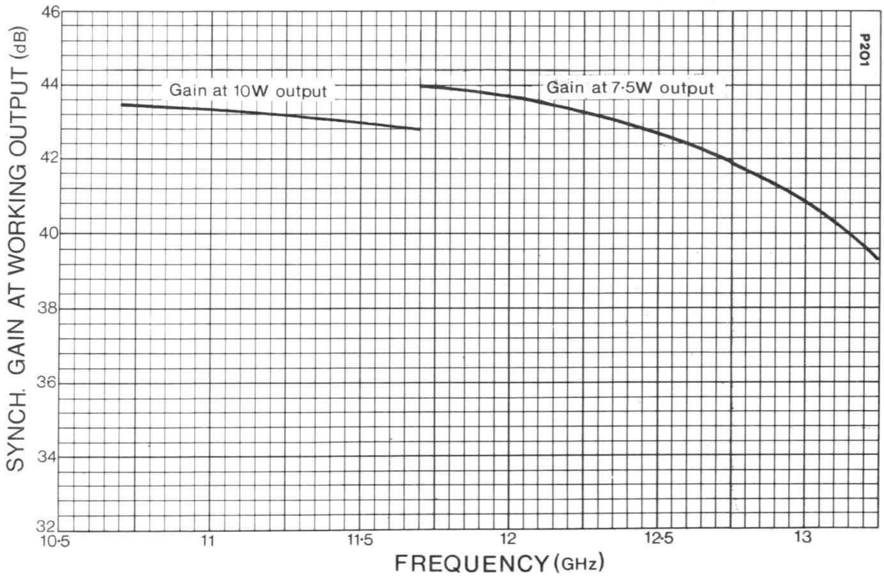


Fig. 3. Typical Synch. Helix Voltage at Working Power Output versus Frequency

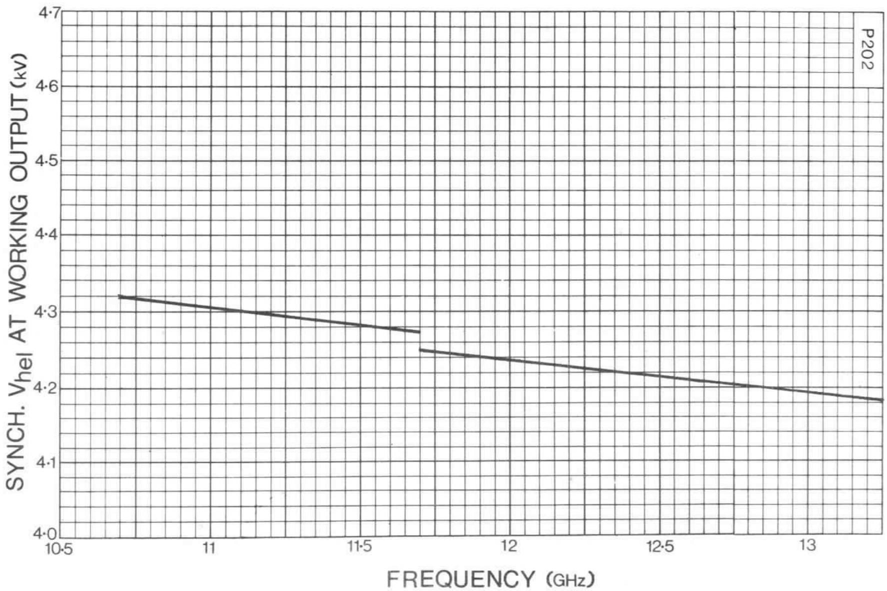


Fig. 4. Typical AM/PM Conversion versus Power Output

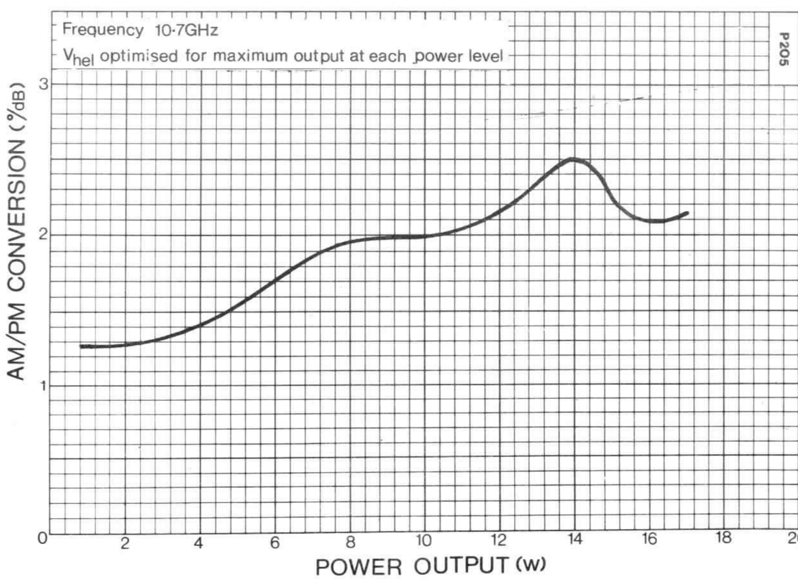


Fig. 5. Typical Power Output versus Power Input

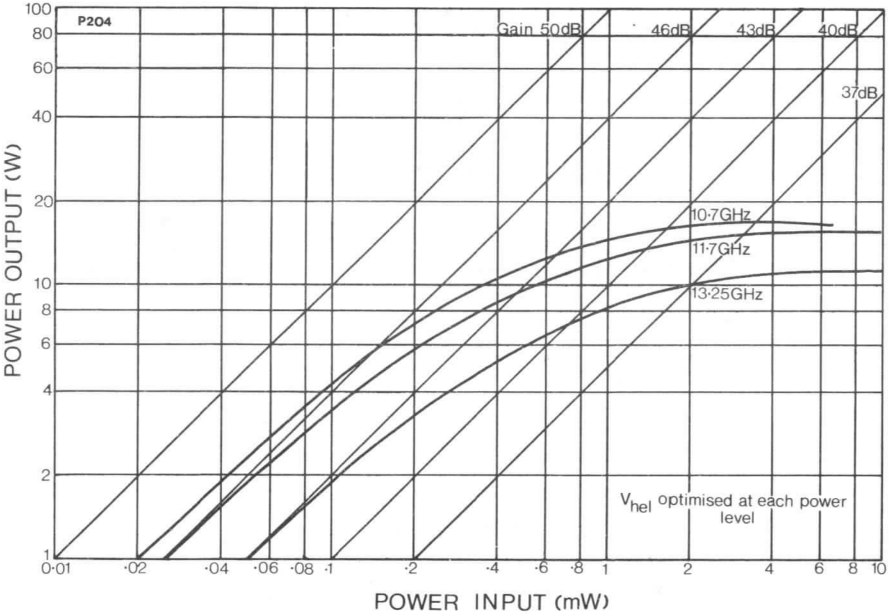


Fig. 6. Typical Cathode Current Control Circuit

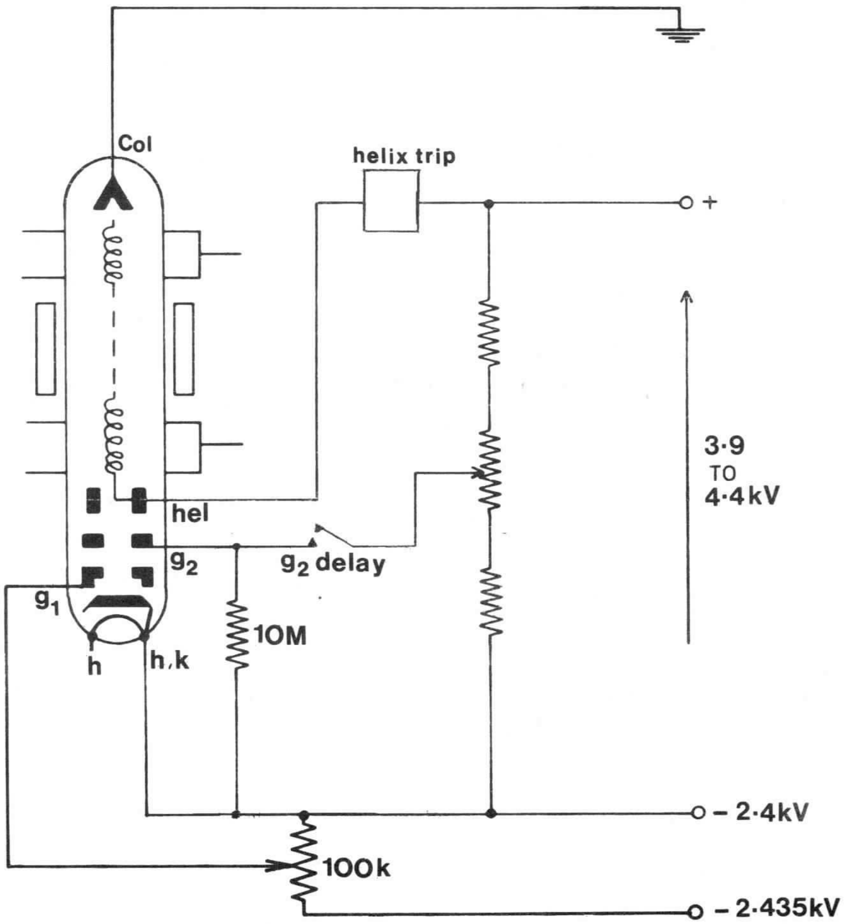
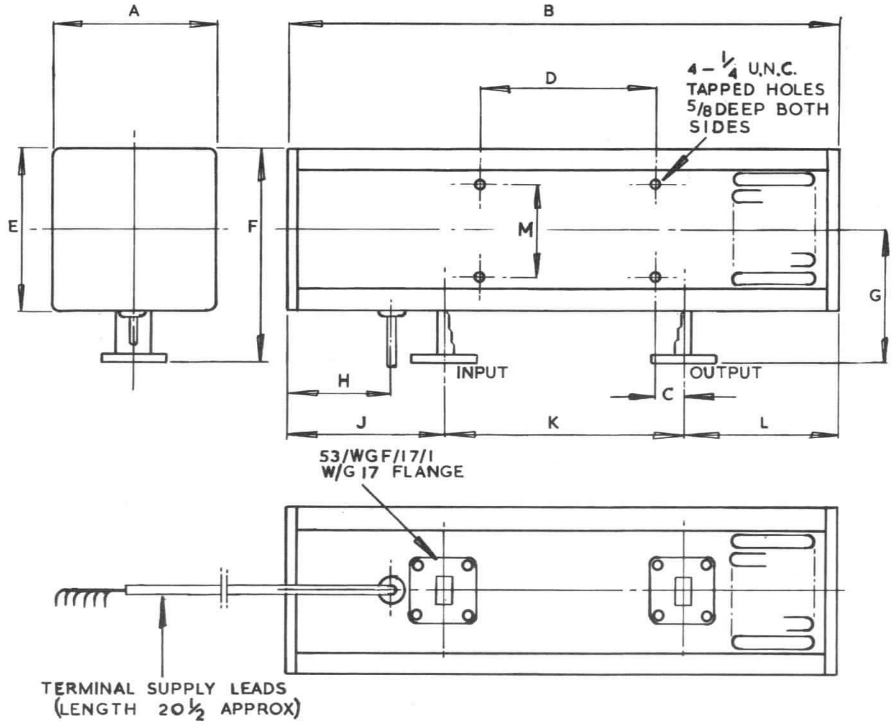


Fig. 7. Outline of W3MC/3A, W3MC/3B, W3MC/5A, W3MC/6A

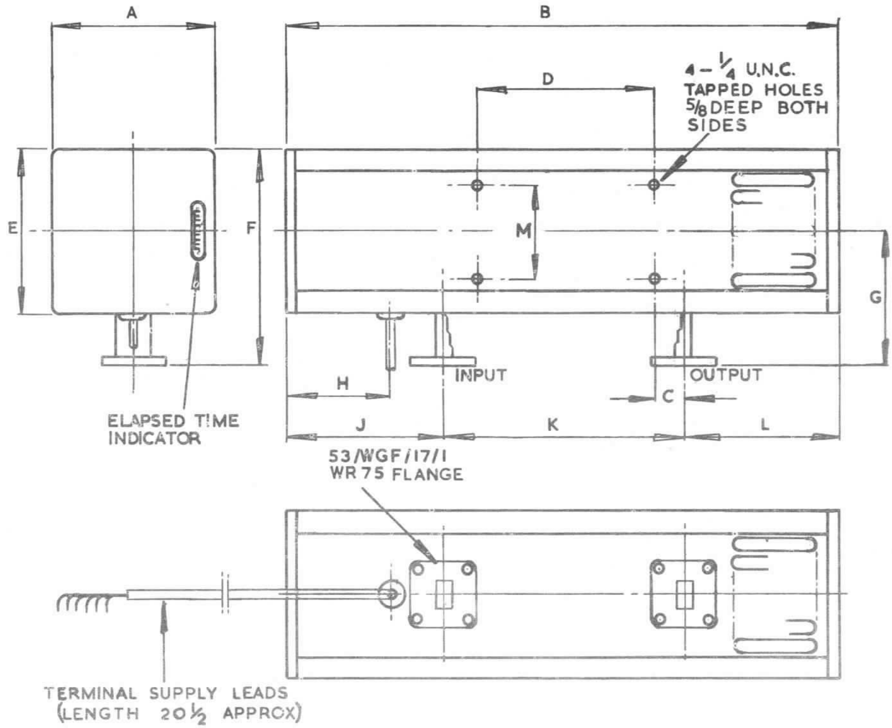


TERMINAL SUPPLY CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER-CATHODE
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & GROUND

DIM	INCHES
A	$3\frac{3}{4} \pm \frac{1}{16}$
B	$13\frac{1}{4} \pm \frac{1}{4}$
C	$\frac{47}{64} \pm \frac{1}{16}$
D	$3\frac{5}{8} \pm \frac{1}{32}$
E	$3\frac{3}{4} \pm \frac{1}{16}$
F	5 MAX
G	$3 \pm \frac{1}{8}$
H	$2\frac{7}{8} \pm \frac{1}{8}$
J	3·900 AUX
K	$5{\cdot}590 \pm {\cdot}020$
L	$3\frac{3}{4} \pm \frac{1}{8}$
M	$2\frac{1}{8} \pm \frac{1}{32}$

Fig. 8. Outline of W3MC/3C

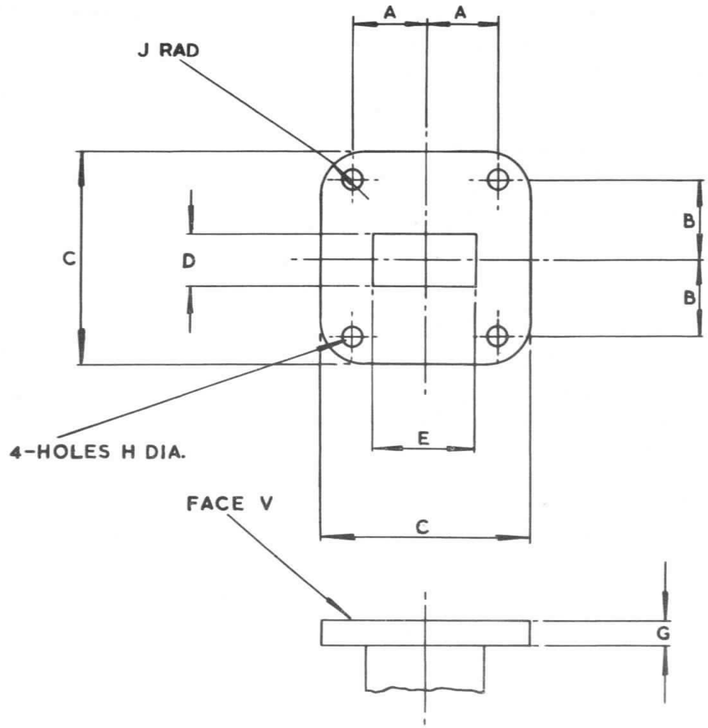


TERMINAL SUPPLY CONNECTIONS

LEAD	ELECTRODE
GREEN	GRID 1
BLUE	GRID 2
YELLOW	HEATER-CATHODE
BROWN	HEATER
ORANGE	HELIX
BLACK	COLLECTOR & GROUND

DIM	INCHES
A	$3\frac{3}{4} \pm \frac{1}{16}$
B	$13\frac{1}{4} \pm \frac{1}{4}$
C	$\frac{47}{64} \pm \frac{1}{16}$
D	$3\frac{5}{8} \pm \frac{1}{32}$
E	$3\frac{3}{4} \pm \frac{1}{16}$
F	5 MAX
G	$3 \pm \frac{1}{8}$
H	$2\frac{7}{8} \pm \frac{1}{8}$
J	3·900 AUX
K	$5{\cdot}590 \pm {\cdot}020$
L	$3\frac{3}{4} \pm \frac{1}{8}$
M	$2\frac{1}{8} \pm \frac{1}{32}$

Fig. 9. Flange Outline



The millimetre dimensions are derived from the original inch dimensions

Dim	Millimetres	Inches
A	13.21±0.03	0·520±0·001
B	14.25+0.03	0·561+0·001
C	38.10±0.13	1·500±0·005
D	9.53±0.05	0·375±0·002
E	19.05±0.05	0·750±0·002
G	4.75±0.25	0·187±0·010
H	3.56±0.05	0·1405±0·002
J	7.93±0.13	0·312±0·005

Geometric Tolerances			
Feature	Characteristic	Tolerance	Datum
Face V	Flatness	0·002 Wide	

ANGLE OF FACE V TO ℄ OF WAVEGUIDE APERTURE 90° ± 1/4°

LOW-NOISE X-BAND TRAVELLING WAVE TUBES

CODES: W3MQ/1A
W3MQ/1B

These travelling-wave tubes are supplied completely packaged in a single reversal permanent magnet mount. The W3MQ/1A has waveguide connectors to WG16 and the W3MQ/1B has coaxial transducers added. The devices are designed for operation as wide-band amplifiers over the frequency range 7 to 11·5 Gc/s or for use over narrower frequency ranges in the same band. Where narrow band operation is required by the customer, the tube will be optimised for the particular band specified.

CATHODE

Indirectly heated, oxide coated		
Heater voltage	6·3	V
Nominal current	0·5	A
Minimum pre-heat time	120	s
Maximum heater interruption time	5	s

R.F. CHARACTERISTICS *

Gain, small signal, minimum	35	db
Noise factor, maximum, wide-band operation (7 to 11·5 Gc/s)	11	db
Power output	2 to 15	mW

* Typical broad-band performance curves are shown in Figure 1.

Standard Telephones and Cables Limited

CODES: W3MQ/1A
W3MQ/1B
Continued

ELECTRICAL CHARACTERISTICS

Electrode Voltages and Effect on Phase Change

	MIN.	NOM.	MAX.	NOMINAL PHASE CHANGE	
Grid 1 voltage	−10V	−5V	+5V	6	°V
Grid 2 voltage	30V	35V	55V	3·5	°V
Grid 3 voltage	70V	130V	180V	<0·1	°V
Grid 4 voltage	300V	400V	600V	<0·1	°V
Helix voltage	880V	1 000V	1 100V	6	°V
Collector voltage		1 200V		<0·1	°V

Electrode Currents

Helix current, nominal	10	μA
Collector current, nominal	500	μA
Grid 1 current, nominal; Grid 2 current, nominal; Grid 3 current, nominal; Grid 4 current, nominal	<1	μA
Input and output match	<2:1	
Reverse attenuation	>70	db

MECHANICAL DATA

Dimensions	As shown in outline drawings		
Weight, approx.	21 lb	9,5	kg

OPERATIONAL PROCEDURE

1. Connect waveguide transitions to the mount; this should be done with a non-magnetic screwdriver.

2. Connect colour coded leads to the power supply as follows :-

Cathode	– Yellow	Grid 3	– Grey
Heater	– Brown	Grid 4	– White
Grid 1	– Green	Helix	– Orange
Grid 2	– Blue	Collector	– Red

3. Switch on heater supply and allow two minutes cathode pre-heat time.

4. Apply the voltages specified on the mount label to the collector, helix, grid 4 and grid 3 either in this order or simultaneously. Either the collector or the cathode may be run at earth potential.

5. Set the grid 2 voltage and then the grid 1 voltage to the specified values. As the collector current increases, the helix current may rise to as much as 30μA but should drop to a few microamps as the operating current is reached.

6. To obtain optimum focusing, slight adjustment of grid 3 and grid 4 voltages may be necessary.

7. With the voltages specified, optimum broadband noise performance should be obtained, but to optimise over a narrow frequency band within the normal operating band the helix voltage should be adjusted. Normally, the optimum voltage will be found between 15V below and 10V above that specified for broadband operation, with the lower voltages applying to the lower frequencies. When the helix voltage is changed, the grid 3 and grid 4 voltages should be adjusted again; normally the best noise figure is found close to the optimum focusing condition.

8. The broadband gain is flattest when using the specified voltages and rises at lower frequencies when the helix voltage is reduced. Should lower overall gain be required, the collector current may be reduced by decreasing the grid 2 voltage but the noise figure may then deteriorate.

9. Care must be taken to avoid bringing magnetic materials close to the mount as this may permanently affect the focusing. It is essential that non-magnetic screws be used in the mount body fixing holes.

10. A plot of the magnetic field for the mount in the absence of magnetic screening is shown in Figure 2.

CODES: W3MQ/1A
W3MQ/1B
Continued

Fig. 1. Typical R.F. Performance

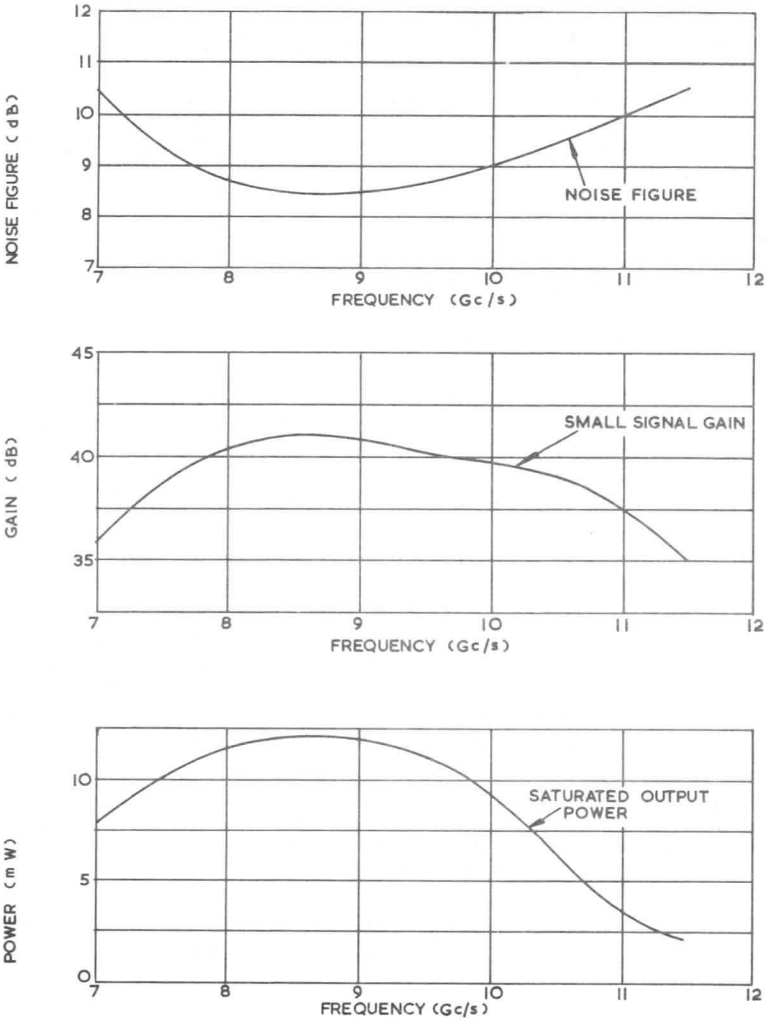
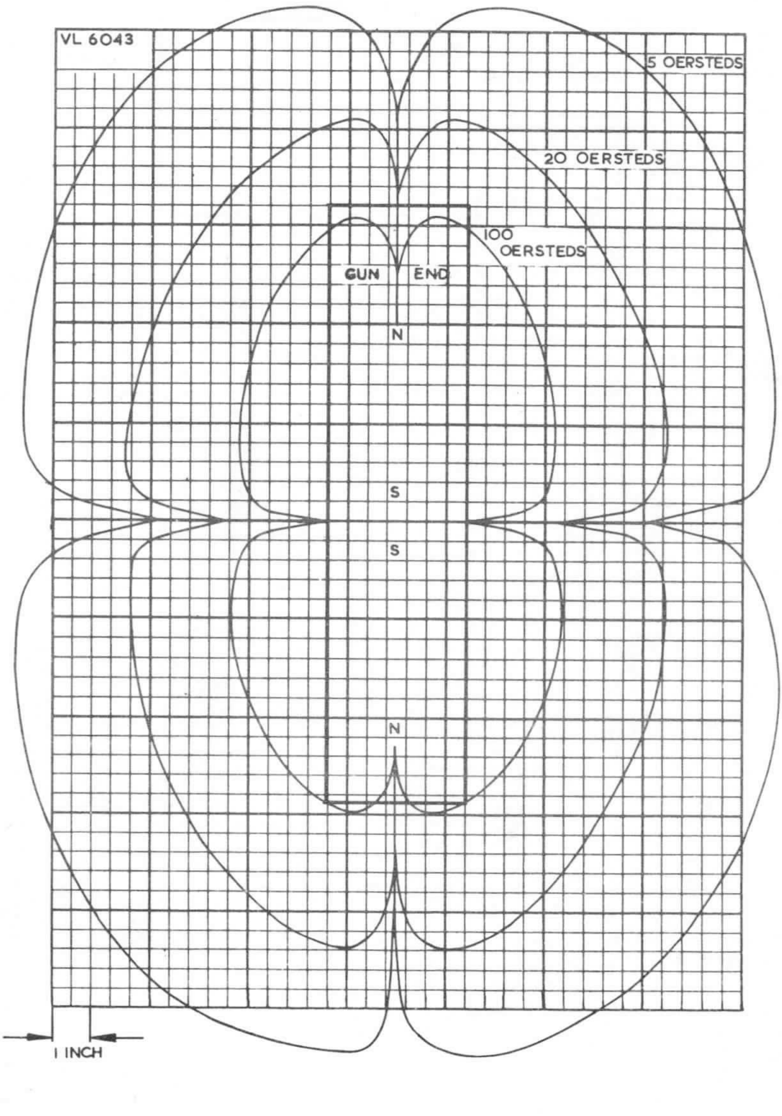
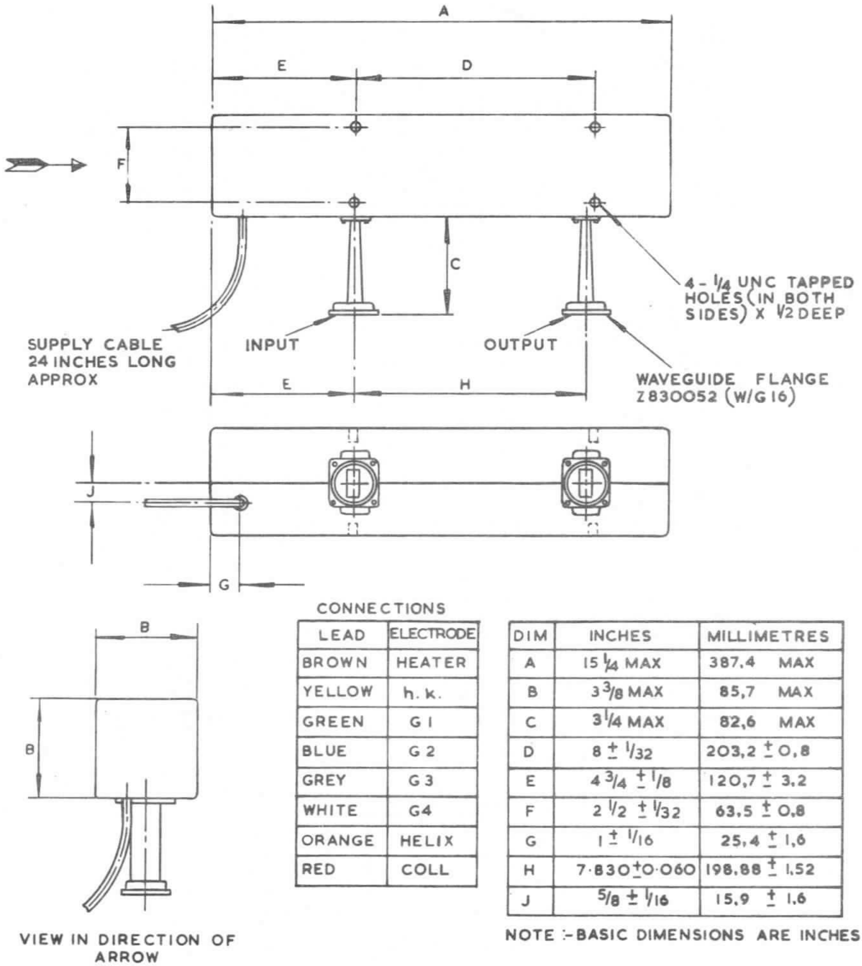


Fig. 2. Plot of External Magnetic Field



CODES: W3MQ/1A

W3MQ/1A OUTLINE



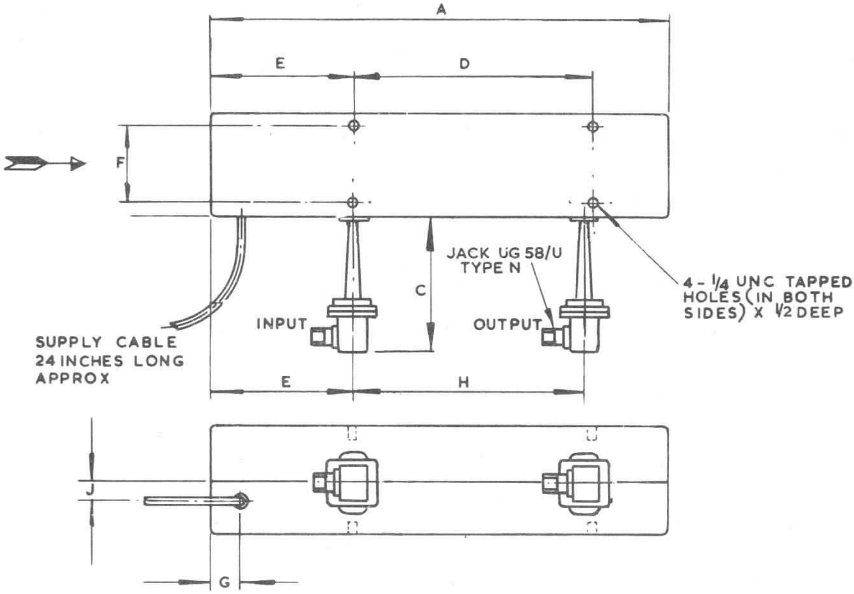
CONNECTIONS

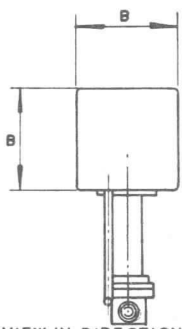
LEAD	ELECTRODE
BROWN	HEATER
YELLOW	h. k.
GREEN	G 1
BLUE	G 2
GREY	G 3
WHITE	G4
ORANGE	HELIX
RED	COLL

DIM	INCHES	MILLIMETRES
A	15 1/4 MAX	387.4 MAX
B	3 3/8 MAX	85,7 MAX
C	3 1/4 MAX	82,6 MAX
D	8 ± 1/32	203,2 ± 0,8
E	4 3/4 ± 1/8	120,7 ± 3,2
F	2 1/2 ± 1/32	63,5 ± 0,8
G	1 ± 1/16	25,4 ± 1,6
H	7·830 ± 0·060	198,88 ± 1,52
J	5/8 ± 1/16	15,9 ± 1,6

NOTE :- BASIC DIMENSIONS ARE INCHES

W3MQ/1B OUTLINE





VIEW IN DIRECTION OF ARROW

CONNECTIONS

LEAD	ELECTRODE
BROWN	HEATER
YELLOW	h. k.
GREEN	G 1
BLUE	G 2
GREY	G 3
WHITE	G4
ORANGE	HELIX
RED	COLL

DIM	INCHES	MILLIMETRES
A	15 1/4 MAX	387,4 MAX
B	3 3/8 MAX	85,7 MAX
C	4 5/8 MAX	117,5 MAX
D	8 ± 1/32	203,2 ± 0,8
E	4 3/4 ± 1/8	120,7 ± 3,2
F	2 1/2 ± 1/32	63,5 ± 0,8
G	1 ± 1/16	25,4 ± 1,6
H	7·830 ± 0·060	198,88 ± 1,52
J	5/8 ± 1/16	15,9 ± 1,6

NOTE :- BASIC DIMENSIONS ARE INCHES

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KLYSTRONS

SPECIAL VALVES

Klystrons

General Information

REFLEX KLYSTRONS

Reference	Code	Frequency Range (MHz)	Min. Power Output (W)	Resonator Voltage (V)	Collector or Reflector Voltage (V)	Beam Current (mA)
Z237/1KW	Z237/1KW	3 505 to 3 535	0·125	300	−90 to −140	55

POWER KLYSTRONS

Reference	Code	Frequency Range (MHz)	Min. Power Output (kW)	Min. Power Gain (db)	Beam Voltage (kV)	Beam Current (A)	Heater Voltage (V)
Z154/100Q	4KM100LA	470 to 610	25	40	18	4·8	26
Z165/100Q	4KM100LF	590 to 720	25	40	17·5	4·5	26
Z180/100Q	4KM100LH	720 to 890	25	40	19	4·9	26
Z211/1G (CV5314)	Z211/1G	950 to 1 213	7	34	15	2 (peak)	12·6

U.H.F Power Klystrons

Z153/50Z
Z163/50Z
Z173/50Z

Provisional Data

These klystrons are intended for use as final amplifiers in the vision and sound sections of u.h.f. t.v. transmitters: they are also suitable for t.v. transposer service.

The tubes are of the four-integral cavity type and are magnetically focussed. Incorporated is a modulating anode for beam current control which enables the tubes to be operated at lower power levels in sound transmitters whilst using the same beam voltage supply as the vision amplifier klystrons: in addition, the electrode may be used as a protective device for vision operation.

Each tube operates in an approved focus mount assembly, incorporating the focus electromagnet system in which the klystron will give the performance specified in these data sheets.

Whilst the three tubes have similar electrical characteristics and performances, each covers a different frequency range, as follows:

Klystron	Mount	Frequency range (MHz)
Z153/50Z	ZM153	470 to 598
Z163/50Z	ZM163	598 to 710
Z173/50Z	ZM173	710 to 854

In transmitters using a third klystron for combined vision and sound signals as an emergency reserve, the tubes are suitable for operation at 2,5kW peak sync. power output, where the vision/sound powers ratio is 5:1.

If required, the tubes can be supplied already broadband tuned for vision operation in specified channels.

A special feature of these tubes is that they are designed to fit into the existing sockets of the following ITT external-cavity klystrons, or the sockets of similar tubes of other manufacturers which use the same types of mount assemblies:

Z151/50Z used in ZM151 mount
Z161/50Z used in ZM161 mount
Z171/50Z used in ZM171 mount

The conversion of existing mounts to accept the Z153/50Z series of tubes can be effected very simply by the use of available small kits of accessories. (See page 10).

Abridged Data

Power output, saturated	(kW)	15
Power gain, typical	(dB)	43
Bandwidth	(MHz)	8,0
Beam voltage	(kV)	13
Output connection		
special quick-fit for EIA 1,625 inch rigid coaxial line (50Ω)		
Cooling		
collector		vapour
gun and tube body		forced air

Cathode/Heater

Cathode		indirectly heated
Heater voltage, min. (Note1)	(V)	5,0
Heater current range	(A)	38 to 44
Heater starting current, peak, max.	(A)	84
Cathode heating time	(min)	5,0

Note 1. New tubes should be operated at 5,0V. Heater voltage may have to be increased to 5,5V max. as life progresses.

MAXIMUM (ABSOLUTE) RATINGS (No individual rating should be exceeded)

Beam voltage, continuous	(kV)	14
Beam current, mean	(A)	3,5
Body current		
with zero input power	(mA)	50
at saturated power output	(mA)	150
Power output, saturated	(kW)	45
Collector dissipation	(kW)	45
Load VSWR (Note 2)		1,5:1

Note 2. Tubes will operate at this figure without damage but satisfactory t.v. operation can be assured only if load VSWR does not exceed 1,1:1 .

TYPICAL OPERATING CONDITIONS — Television Vision Amplifier Service (For T.V. transmitter giving sync. power output of 12,5kW)

Z153/50Z in ZM153 Mount

Frequency range	(MHz)	470-478	526-534	590-598
Channel		21	28	36
Beam voltage	(kV)	13	13	13
Beam current	(A)	3,0	3,0	3,0
Modulating anode voltage	(kV)	13	13	13
Modulating anode current	(mA)	1,0	1,0	1,0
Electromagnet current (Note 3)	(A)	12,2	11,8	11,5
Bandwidth (Notes 4,5)	(MHz)	8,0	8,0	8,0
Body current (Note 6)				
with zero input power	(mA)	15	14	13
black level, +sync. (11kW)	(mA)	24	23	21
at 12,5kW c.w. output, vision frequency	(mA)	30	34	36
Drive power (Notes 7,8)				
at 12,5kW output	(W)	0,45	0,35	0,35
at 10kW output	(W)	0,32	0,27	0,27
Power gain (Note 8)	(dB)	44,4	45,5	45,5
Differential gain (Notes 4,9)	(%)	74	72	70
Differential phase (Notes 4,10)	(°)	6,5	4,5	5,0
AM noise (Note 11)	(dB)	60	60	60
Linearity (Notes 4,12)	(%)	74	73	72
Power output, saturated (Note 8)	(kW)	16	15,5	15
Efficiency (Notes 8,13)	(%)	32	32	32

(Notes are given on pages 8 and 9)

Z163/50Z in ZM163 Mount

Frequency range	(MHz)	598-606	654-662	702-710
Channel		37	44	50
Beam voltage	(kV)	13	13	13
Beam current	(A)	3,0	3,0	3,0
Modulating anode voltage	(kV)	13	13	13
Modulating anode current	(mA)	1,0	1,0	1,0
Electromagnet current (Note 3)	(A)	11	11,2	11,4
Bandwidth (Notes 4,5)	(MHz)	8,0	8,0	8,0

Z163/50Z in ZM163 Mount – continued

Body current (Note 6)				
with zero power input	(mA)	14	15	15
black level, +sync. (11kW)	(mA)	23	24	25
at 12,5kW c.w. output, vision frequency	(mA)	30	32	36
Drive power (Notes 7,8)				
at 12,5kW output	(W)	0,45	0,35	0,34
at 10kW output	(W)	0,33	0,28	0,27
Power gain (Note 8)	(dB)	44,4	45,5	45,6
Differential gain (Notes 4,9)	(%)	73	76	74
Differential phase (Notes 4,10)	(°)	7,0	4,5	5,6
AM noise (Note 11)	(dB)	60	60	60
Linearity (Notes 4,12)	(%)	75	77	76
Power output, saturated (Note 8)	(kW)	16	16,5	16
Efficiency (Notes 8,13)	(%)	32	32	32

Z173/50Z in ZM173 Mount

Frequency range	(MHz)	710-718	782-790	846-854
Channel		51	60	68
Beam voltage	(kV)	13	13	13
Beam current	(A)	3,0	3,0	3,0
Modulating anode voltage	(kV)	13	13	13
Modulating anode current	(mA)	1,0	1,1	0,8
Electromagnet current (Note 3)	(A)	11	11,2	11,2
Bandwidth	(MHz)	8,0	8,0	8,0
Body current (Note 6)				
with zero input power	(mA)	12	14	15
black level, +sync. (11kW)	(mA)	17	21	24
at 12,5kW c.w. output, vision frequency	(mA)	30	33	34
Drive power (Notes 7,8)				
at 12,5kW output	(W)	0,4	0,35	0,3
at 10kW output	(W)	0,32	0,27	0,23
Power gain (Note 8)	(dB)	44,9	45,5	46,1
Differential gain (Notes 4,9)	(%)	70	70	72
Differential phase (Notes 4,10)	(°)	5,0	4,5	6,5
AM noise (Note 11)	(dB)	61	60,7	61
Linearity (Notes 4,12)	(%)	70	70	75
Power output, saturated (Note 8)	(kW)	14,5	14,5	16
Efficiency (Notes 8,13)	(%)	32	32	32

(Notes are given on pages 8 and 9)

TYPICAL OPERATING CONDITIONS—Television Sound Amplifier Service
(For T.V. transmitter giving 2,5kW power output) (Note 16)

Z153/50Z in ZM153 Mount

Frequency range	(MHz)	470-478	526-534	590-598
Channel		21	28	36
Beam voltage	(kV)	13	13	13
Beam current	(A)	0,65	0,65	0,65
Modulating anode voltage	(kV)	4,6	4,6	4,6
Modulating anode current	(mA)	0	0	0
Electromagnet current (Note 3)	(A)	10	10,1	10,3
Bandwidth to 1,0dB points (Note 14)	(MHz)	0,5	0,5	0,5
Body current (Note 15)				
with zero power input	(mA)	5,0	5,4	5,0
at 2,5kW power output, sound frequency	(mA)	7,0	7,5	7,3
Drive power (Note 7)				
at 2,5kW power output	(W)	0,08	0,10	0,09
Efficiency, min.	(%)	30	30	30

(Notes 3 to 15 are given on pages 8 and 9).

Z163/50Z in ZM163 Mount

Frequency range	(MHz)	598-606	654-662	702-710
Channel		37	44	50
Beam voltage	(kV)	13	13	13
Beam current	(A)	0,65	0,65	0,65
Modulating anode voltage	(kV)	4,6	4,6	4,6
Modulating anode current	(mA)	0	0	0
Electromagnet current (Note 3)	(A)	10,3	10,2	10,3
Bandwidth (Note 14)	(MHz)	0,5	0,5	0,5
Body current (Note 15)				
with zero input power	(mA)	5,0	4,5	3,5
at 2,5KW output, sound frequency	(mA)	8,0	8,5	9,0
Drive power (Note 7)				
at 2,5kW output	(W)	0,09	0,11	0,10
Efficiency, min.	(%)	30	30	30

Z173/50Z in ZM173 Mount

Frequency range	(MHz)	710-718	782-790	846-854
Channel		51	60	68
Beam voltage	(kV)	13	13	13
Beam current	(A)	0,65	0,65	0,65
Modulating anode voltage	(kV)	4,6	4,5	4,55
Modulating anode current	(mA)	0	0	0
Electromagnet current (Note 3)	(A)	10,4	10,5	10,7
Bandwidth (Note 14)	(MHz)	0,5	0,5	0,5

Z173/50Z in ZM173 Mount – continued

Body current (Note 15)				
with zero input power	(mA)	4,0	4,5	3,0
at 2,5kW input power, sound frequency	(mA)	8,0	9,5	8,7
Drive power (Note 7)				
at 2,5kW power output	(W)	0,11	0,14	0,13
Efficiency, min.	(%)	30	30	30

TYPICAL OPERATING CONDITIONS—Television Combined Vision and Sound Service (For T.V. transmitter giving power outputs of 2,25kW vision and 0,45kW sound)

Information regarding operation at reduced power levels is available on request from the manufacturer.

Z153/50Z in ZM153 Mount

Frequency	(MHz)	470-478	526-534	590-598
Channel		21	28	36
Beam voltage	(kV)	12,5	12,5	12,5
Beam current	(A)	2,9	2,9	2,9
Modulating anode voltage	(kV)	12,5	12,5	12,5
Modulating anode current	(mA)	1,0	1,0	1,0
Electromagnet current (Note 3)	(A)	10,8	11,2	11,4
Bandwidth (Note 17)	(MHz)	8,0	8,0	8,0
Body current				
with zero input power	(mA)	10	11	12,5
at 2,5kW output, vision frequency	(mA)	11,5	13	14
Drive power (Notes 8,18)				
at 2,5kW power output	(W)	0,1	0,12	0,11
Intermodulation products (Note 19)	(dB)	-50,5	-51	-51,5

Z163/50Z in ZM163 Mount

Frequency	(MHz)	598-606	654-662	702-710
Channel		37	44	50
Beam voltage	(kV)	12,5	12,5	12,5
Beam current	(A)	2,9	2,9	2,9
Modulating anode voltage	(kV)	12,5	12,5	12,5
Modulating anode current	(mA)	1,0	1,0	1,0
Electromagnet current (Note 3)	(A)	10,8	10,4	10,7
Bandwidth (Note 17)	(MHz)	8,0	8,0	8,0
Body current				
with zero input power	(mA)	11	12	11,5
at 2,5kW output, vision frequency	(mA)	12	13,5	12,8
Drive power (Notes 8,18)				
at 2,5kW power output	(W)	0,1	0,13	0,13
Intermodulation products (Note 19)	(dB)	-50,5	-51	-51,5

(Notes are given on pages 8 and 9)

TYPICAL OPERATING CONDITIONS — Television Combined Vision and Sound — continued

Z173/50Z in ZM173 Mount

Frequency	(MHz)	710–718	782–790	846–854
Channel		51	60	68
Beam voltage	(kV)	12,5	12,5	12,5
Beam current	(A)	2,9	2,9	2,9
Modulating anode voltage	(kV)	12,5	12,5	12,5
Modulating anode current	(mA)	1,0	1,2	1,5
Electromagnet current (Note 3)	(A)	10,4	10,8	11,2
Bandwidth	(MHz)	8,0	8,0	8,0
Body current				
with zero input power	(mA)	11	12,5	13
at 2,5kW output, vision frequency	(mA)	13	14	13,9
Drive power (Notes 8, 18)				
at 2,5kW power output	(W)	0,1	0,09	0,095
Intermodulation products (Note 19)	(dB)	−51,5	−51	−50,5

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

Z153/50Z in ZM153 Mount — Vision Amplifier Service

Test Conditions

Heater voltage	(V)	5,0/5,5
Electromagnet current	(A)	9,0/13
Frequency range	(MHz)	470–598
Bandwidth (Note 5)	(MHz)	8,0
Power output (Note 23)	(kW)	12,5

Range of Characteristics

		min.	max.
Heater current	(A)	38	44
Beam voltage	(kV)	–	14
Body current (Note 6)	(mA)	–	150
Mod. anode current	(mA)	–	5,0
R.F. drive power (Note 7)	(W)	–	1,25
Efficiency (Note 13)	(%)	32	–

Z163/50Z in ZM163 Mount — Vision Amplifier Service

Test Conditions

Heater voltage	(V)	5,0/5,5
Electromagnet current	(A)	9,0/13
Frequency range	(MHz)	598–710
Bandwidth (Note 5)	(MHz)	8,0
Power output (Note 23)	(kW)	12,5

Range of Characteristics

		min.	max.
Heater current	(A)	38	44
Beam voltage	(kV)	–	14
Body current (Note 6)	(mA)	–	150
Mod. anode current	(mA)	–	5,0
R.F. drive power (Note 7)	(W)	–	1,25
Efficiency (Note 13)	(%)	32	–

Z173/50Z in ZM173 Mount — Vision Amplifier Service

Test Conditions

Heater voltage	(V)	5,0/5,5
Electromagnet current	(A)	9,0/13
Frequency range	(MHz)	710-854
Bandwidth (Note 5)	(MHz)	8,0
Power output (Note 23)	(kW)	12,5

Range of Characteristics

		min.	max.
Heater current	(A)	38	44
Beam voltage	(kV)	-	14
Body current (Note 6)	(mA)	-	150
Mod. anode current	(mA)	-	5,0
R.F. drive power (Note 7)	(W)	-	1,25
Efficiency (Note 13)	(%)	32	-

MECHANICAL DATA – Klystrons

Length overall, max.	(mm.)	(in.)
Z153/50Z		44,125
Z163/50Z		40,1
Z173/50Z		40,1
Diameter overall, max.		
Weight, nett., approx.	(kg)	(lb)
Z153/50Z	84	185
Z163/50Z	75	165
Z173/50Z	57	125

Mounting position, all tubes vertical, collector downwards

MOUNT ASSEMBLIES – General Data

Electromagnet

voltage	(V)	100
current (Note 24)	(A)	9,0/13
resistance at 20°C ambient		
cold	(Ω)	5,7
hot	(Ω)	7,3

R.F. connectors

input Type N coaxial panel jack (50Ω); mates with UG-21D/U or equivalent

output Special quick-fit for EIA 1,625in. rigid 50Ω line or 3,125in. coaxial line if preferred

Weight of assembly, nett. approx.	kg	lb
ZM153	354	780
ZM163	354	780
ZM173	354	780

(Notes are given on pages 8 and 9)

COOLING DATA

Volume of steam produced by collector dissipation	(m^3/min/kW)	0,043
	(ft^3/min/kW)	1,5
Volume of water converted into steam	(l/min/kW)	0,027
	(UK gal/min/kW)	0,006
Boiler feed water for operation at 12,5kW peak sync. output, min.	(l/min)	2,27
	(UK gal/min)	0,5
Air flow for gun envelope and tube body, min. (Note 25)	(m^3/min)	2,83
	(ft^3/min)	100
Static pressure head (water gauge) at 2,83m^3/min. (100ft^3/min) (Note 26)	(mm)	51
	(in)	2,0
Inlet air temperature, max.	(°C)	45
Max. permissible temperature of any part of klystron	(°C)	175

Notes

Note 3. Individual tubes should be operated at the value specified in the test data sheet supplied with the tube.

Note 4. For the purpose of defining bandwidth, differential gain and differential phase, the following carrier output amplitude levels are assumed:

Peak sync. level	100%
Black level	76%
Peak white level	20%

Note 5(a). The klystron broadband response will be adjusted by using a c.w. swept input signal corresponding to mid-grey output level (42% of carrier amplitude) so that the portion of the band 3,0MHz either side of the band centre at f_v + 2,0MHz shall be level to within ± 0,5dB of the level at f_v. Band edges at f_v – 2,0MHz and f_v + 6,0MHz shall be within the range 0,5dB to –1,0dB of the level at f_v.

Note 5(b). As the amplitude of the swept input is varied between the levels corresponding to white and sync. level at the output of the klystron, the portion of the band 3,0MHz either side of the band centre shall remain within ±1,0dB of the level at f_v.

Note 6. When vision and sound klystrons are operated from a common h.t. supply a combined body current max. value of 150mA applies. However, for normal operation with a composite programme signal consisting of peak sync. pulses, blanking level and picture information, the combined body currents should be less than 50mA; if it is greater than this, operating conditions should be carefully checked to detect abnormal adjustments.

Note 7. Defined as the power delivered to a matched load substituted for the input terminal of the klystron.

Note 8. For full specified performance at 12,5kW, saturated output power is typically 14kW. If the klystron is required to be used as a c.w. amplifier, the maximum permitted output power is 8,0kW.

Note 9. With a test wave-form similar to that described in Note 12, but with sine waves of 4,43MHz and peak-to-peak amplitude of 10% of black to white separation, superimposed on each step of the staircase from black level to peak white, the ratio of the minimum to maximum amplitude of the sine waves, after passing the demodulated waveform at the output of the klystron through a suitable band-pass filter, shall not be less than 0,7. The results obtained from these tests will be in the form of a smooth curve of varying slope and without inflections greater than 3%.

Note 10. Phase response. With the test wave-form described in Note 9 above, the phase of the 4,43MHz sine wave signal on any step shall not differ by more than 10% from the 4,43MHz signal at black level. The results obtained from this test will be in the form of a smooth curve of varying slope and without inflections greater than 2^o.

Note 11. A.M. noise. There shall be no random or periodic noise generated within the klystron and having a level greater than –60dB as measured as a peak-to-peak voltage referred to the rectified level of the peak sync. signal. With the focus current adjusted for minimum noise, the -60dB performance will hold over a range of ±5% of the focus current optimum value.

Note 12. Linearity. The linearity of the klystron, when operating at a peak sync. output power level of 12,5kW, will be such that a video test waveform consisting of a 10-step staircase from black to white level occurring on each line, the ratio of the minimum step amplitude to maximum step amplitude measured at the output of the klystrons, will not be less than 0,65. The results obtained from these tests will be in the form of a smooth curve of varying slope and with no inflections greater than 3%. The linearity of the output characteristic, measured as above, shall not vary by more than 1% for any setting of the focus current within ±2% of the recommended current.

Note 13. Minimum efficiency at 12,5kW output under typical conditions.

Note 14. Output shall be level to ±0,5dB for 250kHz either side of the carrier.

Note 15. See Note 6. 50mA applies to a single sound klystron.

Note 16. In order to economically operate vision and sound klystrons from a common h.t. supply, but with sound output at one fifth of the vision output, it is usual to operate the sound klystron with its beam current reduced to approx. one fifth that of the vision klystron. This is accomplished by operating the modulating anode at reduced voltage. Any potential divider network used to supply the modulating anode must allow for a possible variation in modulating anode current between 0 and 1,5mA.

Note 17. The klystron response will be adjusted as in Note 5(a), but additionally the response at f_v+6,0MHz will be within ±0,5dB of the level at f_v. Variation of the response with swept level will be as in Note 5(b), but additionally the response at f_v+6,0MHz will be within ±1,0dB of the level at f_v.

Note 18. Drive power for 2,5kW peak sync. vision signal.

Note 19. The intermodulation products are measured by using a test signal comprising three c.w. tones at the following levels:

Vision frequency f_v	-8,0dB
Sound frequency f_v+6,0MHz	-7,0dB
Colour sub-carrier f_v+4,43MHz	-17dB

The signal is adjusted to give the above levels at the klystron output. The levels are referred to the 2,25kW peak sync. power level.

The maximum level of -50dB applies to all I.P.'s in the frequency range f_v-1,75MHz to f_v+6,0MHz.

Note 20. New tubes should be operated at 5,0V. Heater voltage may require to be increased as life progresses.

Note 21. Cooling air must be filtered to reduce precipitation of dust.

(continued)

Notes–continued

Note 22. The klystron is so tuned that for constant input power the variation in output power is less than 1,0dB over the specified bandwidth at all power levels between -2,0dB and -14dB with respect to the specified output.

Note 23. Input frequency is set to 2,75MHz below the centre of the 8,0MHz channel, and the input and beam powers adjusted to give the specified output.

Note 24. The magnet supply should be current regulated so that as the magnet coils warm up, the magnet current remains constant to within 2% of the value specified for the individual tube on the test data sheet supplied with each tube.

Note 25. Cooling air must be filtered to reduce precipitation of dust.

Note 26. Measured at input to mount assembly.

Retrofit Conversion Kits

When, in existing equipment, it is desired to substitute the Z153/50Z, Z163/50Z or Z173/50Z for ITT types Z151/50Z, Z161/50Z and Z171/50Z respectively, (or tubes of similar type of other manufacturers), the associated mount assemblies can be quickly adapted for the purpose by the use of the following available conversion kits:

Z-CON153 – For substitution of Z151/50Z by Z153/50Z
Z-CON163 – For substitution of Z161/50Z by Z163/50Z
Z-CON173 – For substitution of Z171/50Z by Z173/50Z

Fig. 1 Typical Beam Characteristic

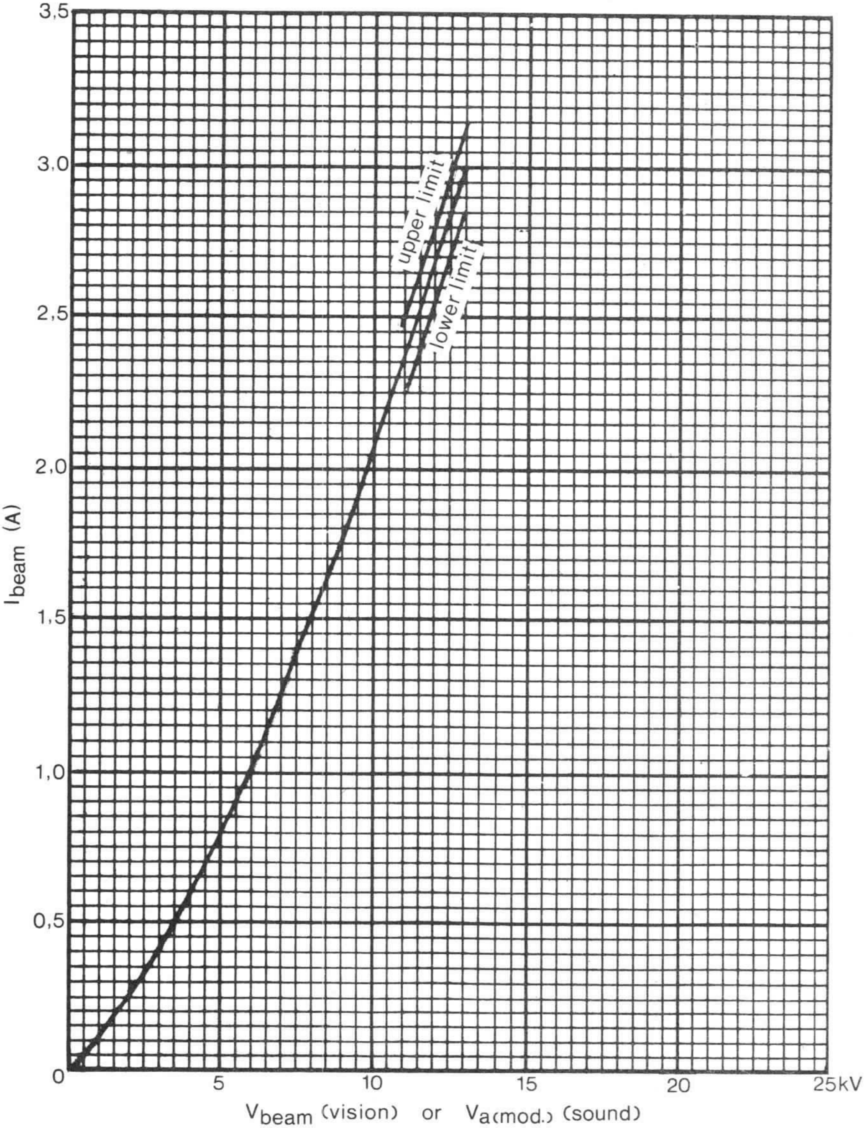


Fig. 2 Z173/50Z Klystron Outline

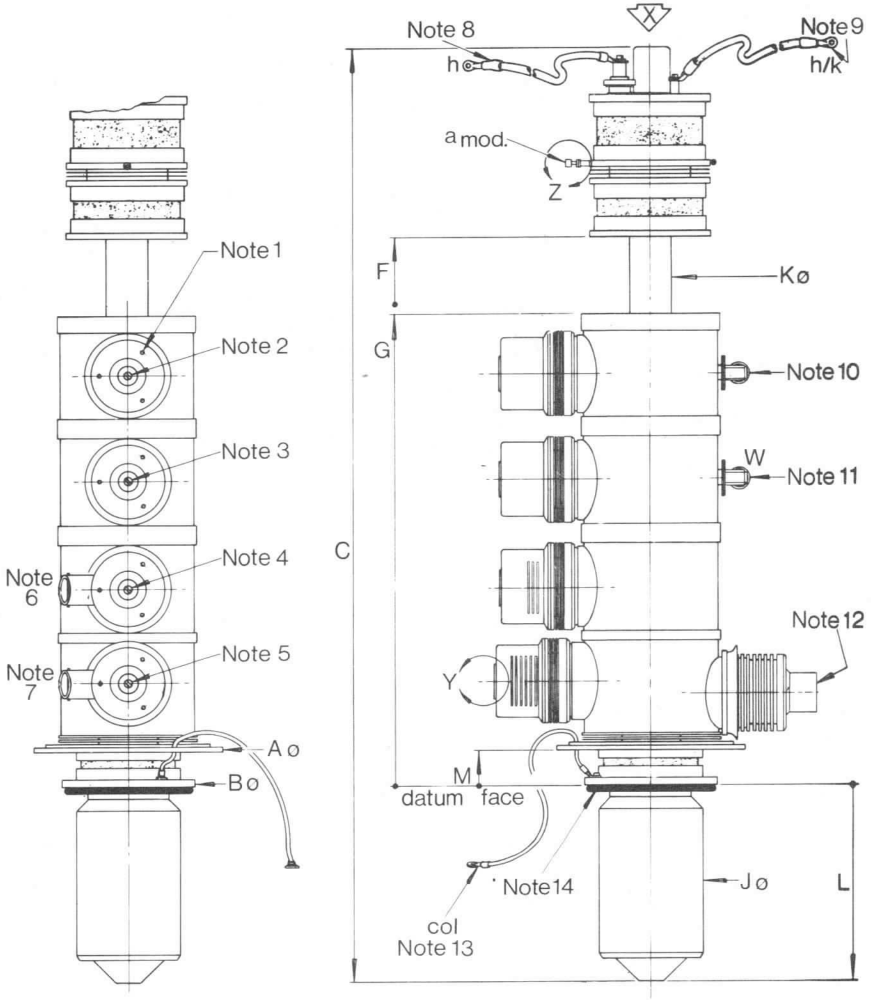
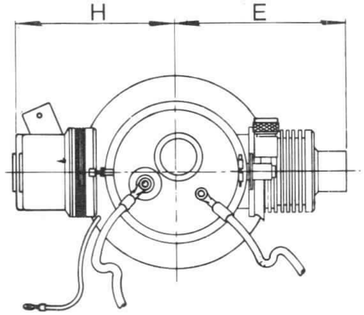
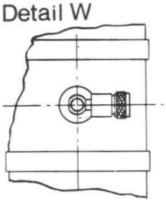


Fig. 2 Z173/50Z Klystron Outline — continued

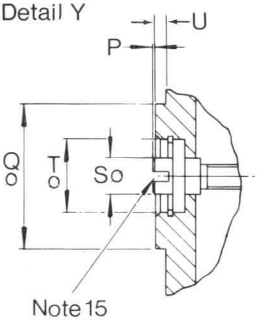
Plan view at arrow X



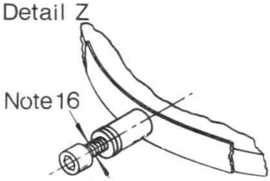
Detail W



Detail Y



Detail Z



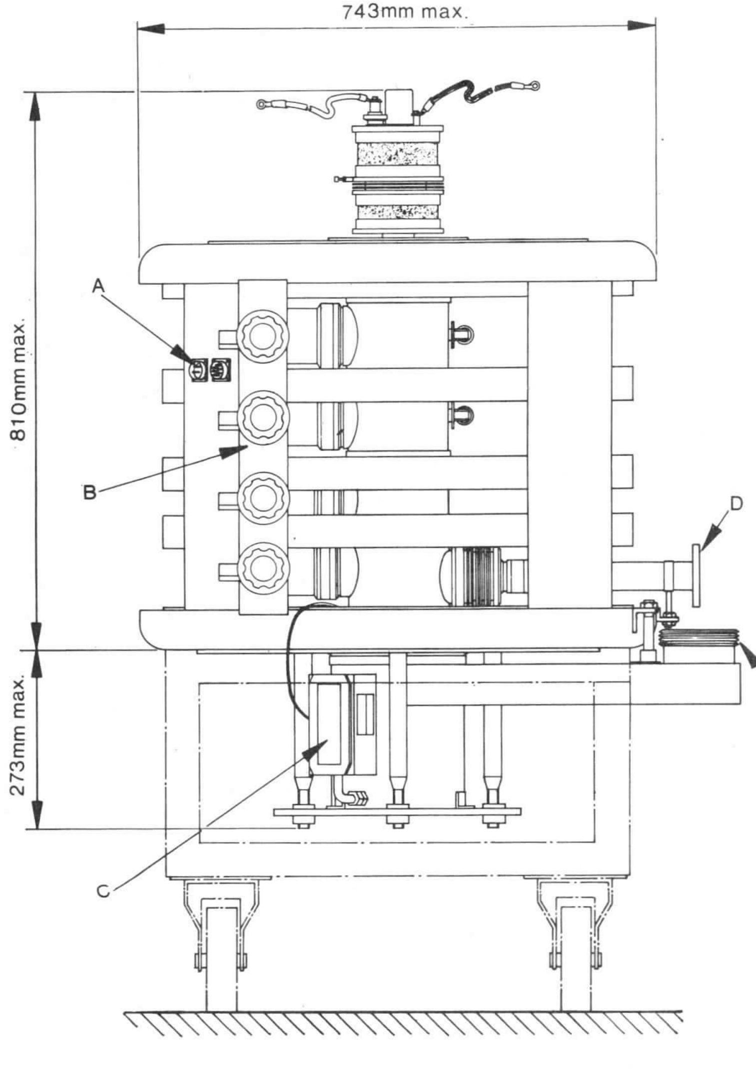
Notes

1. Three holes tapped 6-32 UNC-2B 0,312in. deep equispaced on D p.c.d., typical position tolerance 0,005in. dia.
2. Input cavity tuner adjuster.
3. Second cavity tuner adjuster.
4. Penultimate cavity tuner adjuster.
5. Output cavity tuner adjuster.
6. Air inlet.
7. Air inlet
8. Heater lead (red). Length 15in. min. Lug 0,25in. diameter.
9. Heater/cathode lead (black). Length 15in. min. Lug 0,312in. diameter.
10. R.F. input socket, type N (UG-21D/U).
11. R.F. load socket, type N (UG-21D/U).
12. R.F. output line.
13. Collector lead (green). Length 36in. min. 2BA terminal.
14. 'O' ring, size No. 428 to BS1806.
15. Slot N wide x R deep (cavity tuning screw).
16. Connecting lug, V diameter.

Dimensions

	mm	in.
A	203,2 max.	8,00 max.
B	142,87 ± 0,51	5,625 ± 0,02
C	1 018,5 max.	40,10 max.
D	60,33 t.p.	2,375 t.p.
E	179,3	7,05
F	590,8	23,26
G	508,3	20,01
H	165,1	6,50
J	111,13 ± 0,51	4,375 ± 0,02
K	44,45 ± 0,25	1,750 ± 0,01
L	216,0	8,50
M	38,23 ± 0,76	1,505 ± 0,03
N	2,44 + 0,10 − 0,00	0,096 + 0,004 − 0,000
P	0,8 max.	0,03 max.
Q	38,05 + 0,00 − 0,05	1,498 + 0,000 − 0,002
R	3,68 ± 0,25	0,145 ± 0,010
S	9,52 ± 0,40	0,375 ± 0,015
T	19,05 + 0,13 − 0,00	0,750 + 0,005 − 0,000
U	3,18 max.	0,125 max.
V	4,17 max.	0,164 max.

Fig. 3 Z173/50Z Klystron in ZM173 Mount Assembly



A. Magnet interlock connector.
B. Cavity tuner panel.
C. Level trip.
D. R.F. output.
E. Steam outlet.

SPECIAL VALVES

Water-Cooled L-Band Power Amplifier Klystron

Code: 4KM100LA

The 4KM100LA is a water-cooled, magnetically focused power amplifier klystron which operates in the frequency range 470 to 610 MHz. The valve is intended primarily for use in television visual service but is also suitable for television sound or for tropospheric-scatter communications service.

In television visual service the 4KM100LA will provide a minimum of 25kW of peak synchronising power with a power gain of 40 dB and a 1 dB bandwidth of 8 MHz. Random amplitude modulation noise is more than 60 dB below black level.

Tuning is effected by means of four resonant cavities which are external to, but enclose, the cylindrical ceramic windows of the klystron. Load couplers are provided to permit external loading of these cavities for extreme wide-band operation.

The electron gun utilises a semi-confined flow field which minimises focusing adjustments and produces a very stable beam. The cathode loading of only 100mA/cm^2 at a beam voltage of 19kV is conservative in the interest of long life.

Effective protection from internal arcs is provided by a special modulating anode. Both input and output r.f. couplings are fixed. The valve incorporates a built-in vacuum pump in the form of a titanium getter which should be energised whenever heater power is applied. The normal getter operating current is 20A at approximately 3·7V.

A focusing electromagnet and klystron supporting structure, to be supplied as an additional accessory, is available.

RADIO FREQUENCY PERFORMANCE

Frequency range	470 to 610	MHz
Output power minimum (Note 1)	25	kW
Power gain, minimum (Note 1)	40	dB

NOTE 1.—In television visual service.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
COMPONENTS GROUP

STC

Code: 4KM100LA

CONTINUED

TYPICAL OPERATING CONDITIONS

Television Visual Amplifier Service

Frequency	550	MHz
Direct beam voltage	18	kV
Direct beam current	4·8	A
Beam power efficiency (Note 2)	29	%
Driving power (Note 2)	1·2	W
1 dB bandwidth	8	MHz
Power gain (Note 2)	43	dB
Output power (saturation drive) (Note 2)	25	kW
Electromagnet current	9·5	A

NOTE 2.—Peak synchronous value. The saturated output power is 0·5 dB higher.

MAXIMUM RATINGS

Direct beam voltage	23	kV
Direct beam current	6	A
Direct body current	150	mA
Collector dissipation	100	kW

CATHODE

Matrix, unipotential type

HEATER

Heater voltage	26	V
Heater current, nominal	11	A
Heater starting current, maximum	23	A
Cathode heating time, minimum	15	min.

GETTER

Getter voltage, a.c.	3·7 ± 5%	V
Getter current	20	A

ELECTROMAGNET POWER SUPPLY

Voltage (adjustable)	0 to 150	V
Current, maximum	12	A

Code: 4KM100LA

CONTINUED

COOLING REQUIREMENTS

The maximum temperature of any part of the klystron must not be allowed to exceed 175°C.

The collector, klystron body and electromagnet are water-cooled by means of integral water jacket systems.

The cathode and cavities are cooled by forced-air.

Recommended cooling data are as follows:

Collector		
Water flow	30	gal/min
	136,4	l/min
At water pressure drop of	20	lb/in^2
	1,4	kg/cm^2
Body and Electromagnet		
Water flow	2	gal/min
	9,1	l/min
At a pressure drop of	45	lb/in^2
	3,2	kg/cm^2
Cathode		
Air flow (Note 3)	5	ft^3/min
	0,142	m^3/min
Cavities		
Air flow	50	ft^3/min
	1,4	m^3/min

NOTE 3.—Required only if ambient air temperature exceeds 25°C.

MECHANICAL DATA

Mounting position	Main axis vertical, collector downwards			
Dimensions	As shown in outline drawing			
R.F. Coupling				
Input	Type "N" coaxial fitting			
Output	$3\frac{1}{8}$ inch (79,375 mm) 50Ω line			
Weights, approximately				
Klystron		119 lb	54	kg
Electromagnet and supporting assembly		1 800 lb	816,5	kg

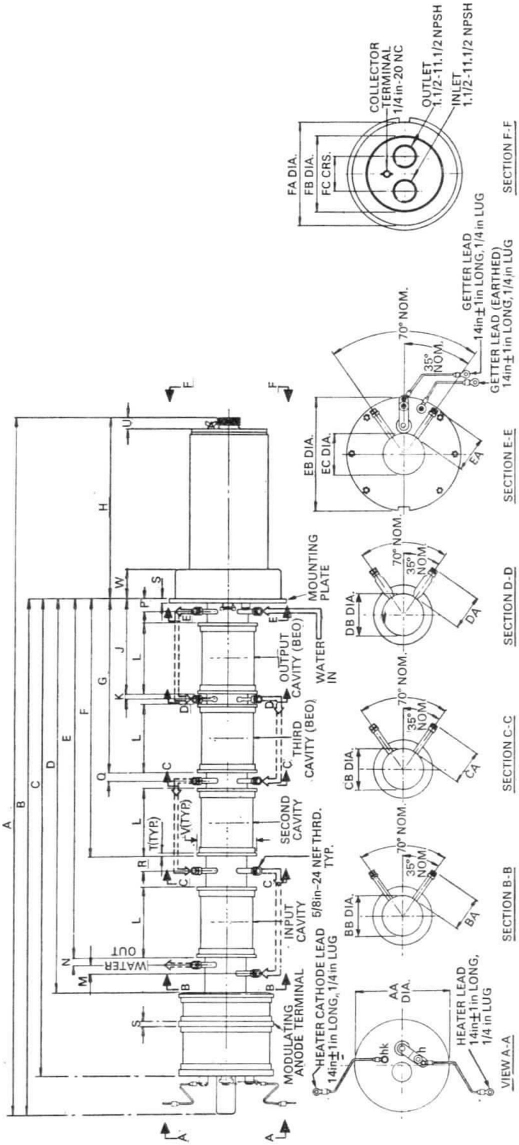
Code: 4KM100LA

CONTINUED

4KM100LA Outline

DIMS.	NOM.
A	60.875
B	45.150
C	41.900
D	34.467
E	31.341
F	22.499
G	14.999
H	15.707
J	8.124
K	0.453
L	6.000
M	0.625
N	0.636
P	1.124
Q	0.875
R	1.443
S	0.375
T	0.250
U	0.812
V	5.125
W	2.563
AA	8.125
BA	3.000
BB	3.500
CA	3.000
CB	3.500
DA	3.000
DB	3.500
FA	3.000
EB	10.000
EC	3.500
FA	9.160
FB	6.670
FC	3.125

DIMENSIONS ARE INCHES



SPECIAL VALVES

Water-Cooled
L-Band Power Amplifier Klystron

Code: 4KM100LF

The 4KM100LF is a water-cooled, magnetically focused power amplifier klystron which operates in the frequency range 590 to 720 MHz. The valve is intended primarily for use in television visual service but is also suitable for television sound or for tropospheric-scatter communications service.

In television visual service the 4KM100LF will provide a minimum of 25 kW of peak synchronising power with a power gain of 40 dB and a 1 dB bandwidth of 8 MHz. Random amplitude modulation noise is more than 60 dB below black level.

Tuning is effected by means of four resonant cavities which are external to, but enclose, the cylindrical ceramic windows of the klystron. Load couplers are provided to permit external loading of these cavities for extreme wide-band operation.

The electron gun utilises a semi-confined flow field which minimises focusing adjustments and produces a very stable beam. The cathode loading of only 100mA/cm² at a beam voltage of 19kV is conservative in the interest of long life.

Effective protection from internal arcs is provided by a special modulating anode. Both input and output r.f. couplings are fixed. The valve incorporates a built-in vacuum pump in the form of a titanium getter which should be energised whenever heater power is applied. The normal getter operating current is 20A at approximately 3·7V.

A focusing electromagnet and klystron supporting structure, to be supplied as an additional accessory, is available.

RADIO FREQUENCY PERFORMANCE

Frequency range	590 to 720	MHz
Output power minimum (Note 1)	25	kW
Power gain, minimum (Note 1)	40	dB

NOTE 1.—In television visual service.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
COMPONENTS GROUP

STC

Code: 4KM100LF

CONTINUED

TYPICAL OPERATING CONDITIONS

Television Visual Amplifier Service

Frequency	660	MHz
Direct beam voltage	17·5	kV
Direct beam current	4·5	A
Beam power efficiency (Note 2)	31	%
Driving power (Note 2)	2·5	W
1 dB bandwidth	8	MHz
Power gain (Note 2)	43	dB
Output power (saturation drive) (Note 2)	25	kW
Electromagnet current	8·9	A

NOTE 2.—Peak synchronous value. The saturated power output is 0·5 dB higher.

MAXIMUM RATINGS

Direct beam voltage	23	kV
Direct beam current	6	A
Direct body current	150	mA
Collector dissipation	100	kW

CATHODE

Matrix, unipotential type

HEATER

Heater voltage	26	V
Heater current, nominal	11	A
Heater starting current, maximum	23	A
Cathode heating time, minimum	15	min.

GETTER

Getter voltage, a.c.	3·7 ± 5%	V
Getter current	20	A

ELECTROMAGNET POWER SUPPLY

Voltage (adjustable)	0 to 120	V
Current, maximum	12	A

Code: 4KM100LF

CONTINUED

COOLING REQUIREMENTS

The maximum temperature of any part of the klystron must not be allowed to exceed 175°C.

The collector, klystron body and electromagnet are water-cooled by means of integral water jacket systems.

The cathode and cavities are cooled by forced-air.

Recommended cooling data are as follows:

Collector		
Water flow	30	gal/min
	136,4	l/min
At a water pressure drop of	20	lb/in^2
	1,4	kg/cm^2
Body and Electromagnet		
Water flow	2	gal/min
	9,1	l/min
At a pressure drop of	45	lb/in^2
	3,2	kg/cm^2
Cathode		
Air flow (Note 3)	5	ft^3/min
	0,142	m^3/min
Cavities		
Air flow	50	ft^3/min
	1,4	m^3/min

NOTE 3.—Required only if ambient air temperature exceeds 25°C.

MECHANICAL DATA

Mounting position	Main axis vertical, collector downwards			
Dimensions	As shown in outline drawing			
R.F. coupling				
Input	Type "N" coaxial fitting			
Output	$3\frac{1}{8}$ inch (79,375 mm) 50Ω line			
Weights, approximately				
Klystron		119 lb	54	kg
Electromagnet and supporting assembly		1 800 lb	816,5	kg

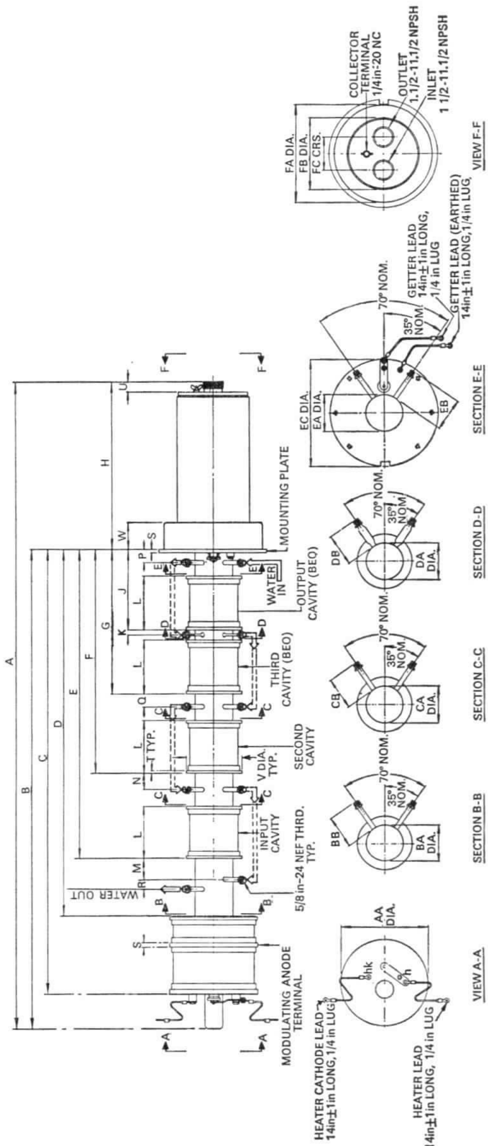
Code: 4KM100LF

CONTINUED

4KM100LF Outline

DIM	NOM.
A	60.875
B	45.150
C	41.900
D	34.467
E	29.087
F	20.987
G	13.500
H	15.707
J	7.625
K	0.421
L	5.000
M	1.967
N	1.543
P	1.016
Q	1.235
R	0.907
S	0.375
T	0.250
U	0.812
V	5.125
W	2.563
AA	8.125
BA	3.500
BB	3.000
CA	3.500
CB	3.500
DA	3.500
DB	3.000
EA	3.500
EB	3.000
EC	10.000
FA	9.160
FB	6.670
FC	3.125

DIMENSIONS ARE INCHES



SPECIAL VALVES

Water-Cooled L-Band Power Amplifier Klystron

Code: 4KM100LH

The 4KM100LH, which has four integral cavities, is a magnetically focused power amplifier klystron designed for use in the frequency range 720 to 890 MHz. Intended primarily for television visual service, it is also suitable for television sound or for tropospheric communications service.

In television visual service the 4KM100LH will provide a minimum of 25kW of peak synchronising power with a power gain of 40 dB and a 1 dB bandwidth of 8 MHz. Random amplitude modulation noise is more than 60 dB below black level.

The electron gun utilises a semi-confined flow field which minimises focusing adjustments and produces a very stable beam. The cathode loading of only 100mA/cm^2 at a beam voltage of 19kV is conservative in the interest of long life.

Effective protection from internal arcs is provided by a special modulating anode. Both input and output r.f. couplings are fixed. The valve incorporates a built-in vacuum pump in the form of a titanium getter which should be energised whenever heater power is applied. The normal getter operating current is 20A at approximately 3·7V.

A focusing electromagnet and klystron supporting structure for use with the 4KM100LH is available.

RADIO FREQUENCY PERFORMANCE

Frequency range	720 to 890	MHz
Power gain, minimum (Note 1)	40	dB
Output power minimum (Note 1)	25	kW

NOTE 1.—In television visual service.

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
C O M P O N E N T S G R O U P

STC

Code: 4KM100LH

CONDITIONS

TYPICAL OPERATING CONDITIONS

Television Visual Amplifier Service

Frequency	816	MHz
Direct beam voltage	19	kV
Direct beam current	4·9	A
Beam power efficiency (Note 2)	27	%
Driving power (Note 2)	2	W
1 dB bandwidth	8	MHz
Power gain (Note 2)	41	dB
Output power (saturation drive) (Note 2)	25	kW
Electromagnet current	12	A

NOTE 2.—Peak synchronous value. The saturated power output is 0·5 dB higher.

MAXIMUM RATINGS

Direct beam voltage	20	kV
Direct beam current	6	A
Direct body current	150	mA
Collector dissipation	100	kW

CATHODE

Matrix, unipotential type

HEATER

Heater voltage	26	V
Heater current, nominal	11	A
Heater starting current, maximum	23	A
Cathode heating time, minimum	15	min.

GETTER

Getter voltage, a.c.	3·7 ± 5%	V
Getter current	20	A

ELECTROMAGNET POWER SUPPLY

Voltage (adjustable)	120	V
Current, maximum	12	A

Code: 4KM100LH

CONTINUED

COOLING REQUIREMENTS

The maximum temperature of any part of the klystron must not be allowed to exceed 175°C.

The collector and klystron body are water-cooled by means of integral water jacket systems.

The cathode and cavities are cooled by forced air.

Recommended cooling data are as follows:

Collector

Water flow	30	gal/min
	136,4	l/min
At a pressure drop of	20	lb/in²
	1,4	kg/cm²

Body

Cooling water flow	3	gal/min
	13,6	l/min
Typical pressure drop (Note 3)	20	lb/in²
	1,4	kg/cm²

NOTE 3.—The body cooling water system is connected in series with the focusing coils cooling system. Typical pressure drop through body and focusing coils is 40 lb/in² (2,81 kg/cm²). Maximum body pressure not to exceed 60 lb/in² (4,2 kg/cm²).

Cathode

Air flow (Note 4)	5	ft³/min
	0,142	m³/min

Cavities

Air flow	100	ft³/min
	2,8	m³/min

NOTE 4.—Required only if ambient air temperature exceeds 25°C.

MECHANICAL DATA

Mounting position	Main axis vertical, collector downwards
Dimensions	As shown in outline drawing
R.F. coupling	
Input	Type "N" coaxial fitting
Output (Note 5)	3⅛ inch (79,375 mm) 50Ω line

Weights, approximately

Klystron	180 lb	81,65	kg
Electromagnet and supporting assembly	1 800 lb	816,5	kg

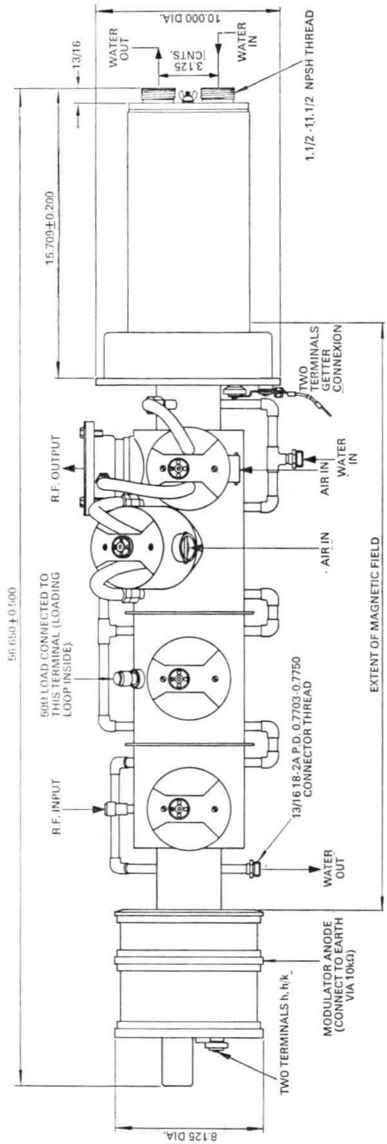
NOTE 5.—When the klystron output window and the aerial feeder are to be connected, any physical misalignment between then must be adjusted by a flexible coupling or other means to ensure that the output window is not subjected to any mechanical strain.

STC

Code: 4KM100LH

CONTINUED

4KM100LH Outline



SPECIAL VALVES

Vapour-Cooled
L-Band Power Amplifier Klystron
Code: Z181/150 Z

This is a vapour-cooled, magnetically focused power amplifier klystron which operates in the frequency range 720 to 890 MHz. It has four integral cavities. The valve is intended primarily for use in television visual service but is also suitable for television sound or for tropospheric-scatter communications service.

In television visual service the klystron l will provide a minimum of 40kW of peak synchronising power with a power gain of 40 dB and a 1 dB bandwidth of 8 MHz. Random amplitude modulation noise is more than 60 dB below black level.

The electron gun utilises a semi-confined flow field which minimises focusing adjustments and produces a very stable beam. The cathode loading of only 125mA/cm² at a beam voltage of 21kV is conservative in the interest of long life.

Effective protection from internal arcs is provided by a special modulating anode. Both input and output r.f. couplings are fixed. The valve incorporates a built-in vacuum pump in the form of a titanium getter which should be energised whenever heater power is applied. The normal getter operating current is 20A at approximately 3·7V.

A focusing electromagnet and klystron supporting structure, to be supplied as an additional accessory, is available.

RADIO FREQUENCY PERFORMANCE

Frequency range	720 to 890	MHz
Output power minimum (Note 1)	40	kW
Power gain minimum (Note 1)	40	dB

NOTE 1.—In television visual service.

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STC

Code: Z181/150Z

CONTINUED

TYPICAL OPERATING CONDITIONS

Television Visual Amplifier Service

Frequency	726	MHz
Direct beam voltage	21·5	kV
Direct beam current	6·2	A
Beam power efficiency (Note 2)	30	%
Driving power (Note 2)	3·2	W
1 dB bandwidth	8	MHz
Power gain (Note 2)	41	dB
Output power (saturation drive) (Note 2)	40	kW
Electromagnet current	11	A

NOTE 2.—Peak synchronous value. The saturated output power is 0·5 dB higher.

MAXIMUM RATINGS

Direct beam voltage	23	kV
Direct beam current	7	A
Direct body current	150	mA
Collector dissipation	150	kW

CATHODE

Matrix, unipotential type

HEATER

Heater voltage	26	V
Heater current, nominal	11	A
Heater starting current, maximum	23	A
Cathode heating time, minimum	15	min.

GETTER

Getter voltage, a.c.	3·7 ± 5%	V
Getter current	20	A

ELECTROMAGNET POWER SUPPLY

Voltage (adjustable)	120	V
Current, maximum	12	A

Code: Z181/150Z

CONTINUED

COOLING REQUIREMENTS

The maximum temperature of any part of the klystron must not be allowed to exceed 175°C.

The collector is vapour-cooled by means of a boiler of the upward steam exit type intended for use with an external condenser. The boiler is an integral part of the klystron.

The cathode and cavities are cooled by forced-air and the klystron body and focusing coils by water circulated through a common system.

Recommended cooling data are as follows:

Collector		
Volume of steam produced by collector dissipation	1·5	$ft^3/min/kW$
	0,043	$m^3/min/kW$
Volume of water converted into steam	0·006	gal/min/kW
	0,027	l/min/kW
Cathode		
Air flow	5	ft^3/min
	0,14	m^3/min
Cavities		
Air flow	100	ft^3/min
	2,8	m^3/min
Body		
Cooling water flow	3	gal/min
	13,6	l/min
Typical pressure drop (Note 3)	20	lb/in^2
	1,4	kg/cm^2

NOTE 3.—The body cooling water system is connected in series with the focusing coils cooling system. Typical pressure drop through the body and focusing coils is 40 lb/in^2 (2,81 kg/cm^2). Maximum body pressure not to exceed 60 lb/in^2 (4,2 kg/cm^2).

MECHANICAL DATA

Mounting position	Main axis vertical, collector uppermost			
Dimensions	As shown in outline drawing			
R.F. coupling				
Input	Type "N" coaxial fitting			
Output (Note 4)	$3\frac{1}{8}$ inch (79,375 mm) 50Ω line			
Weights, approximately				
Klystron		210 lb	95,3	kg
Electromagnet and supporting structure		1 800 lb	816,5	kg

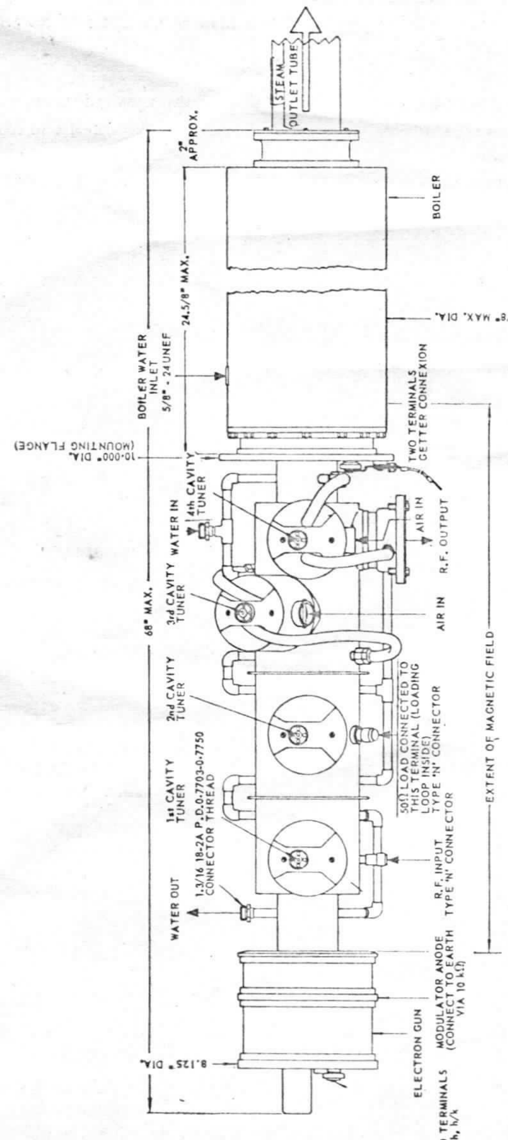
NOTE 4.—When the klystron output window and the aerial feeder are to be connected, any physical misalignment between them must be adjusted by a flexible coupling or other means to ensure that the output window is not subjected to any mechanical strain.

STC

Code: Z181/150Z

CONTINUED

Dimensioned Outline



Note: Dimensions should not be used for equipment design without prior reference to STC Valve Division.

Forced-Air-Cooled, Pulse Modulated Three-Cavity Klystron

Code: Z211/1G (CV5314)

The Z211/1G is a three-cavity klystron amplifier intended for pulsed operation at a duty cycle of 3 per cent in the frequency range 950 to 1 213 MHz.

CATHODE

Indirectly heated, BN type			
Heater voltage		12·6	V
Heater current, nominal		1·9	A
Cathode heating time, minimum		2	min
Maximum peak cathode current		2·5	A

CHARACTERISTICS

Gain, approx.		34	dB

MECHANICAL DATA

Dimensions	As shown in Figure 2.		
Mounting position (Note 1)	Vertical, collector upwards.		
Net weight	9·37 lb	4·26	kg

Note 1.—A field coil system, cavities and mounting assembly are available under code 326–LRU–20A.

COOLING REQUIREMENTS

Forced-air-cooling of the collector is required.			
For a collector dissipation of		1	kW
Air flow, minimum	35 ft^3/min	990	l/min
At a pressure drop of 0·3 inch (7,6 mm) of water.			

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Code: Z211/1G (CV5314)

CONTINUED

MAGNETIC FIELD

A magnetic field is required for focusing the electron beam: this is provided by the field coil system of the 326–LRU–20A assembly which is operated from a 340V d.c. supply. The field coil current should be 2·2A ± 3%. A suitable distribution of field intensity relative to the klystron is shown in Figure 1.

The 326–LRU–20A system must be assembled so that, when closed the input (bottom) cavity is concentric with the steel rings at the top and bottom of the assembly. This should be checked with the lining-up jig provided.

When inserting the klystron, the second and output cavities must not be screwed down into position until the contact fingers on all three cavities have closed on the klystron.

It is important to ensure, by the use of a magnet or magnetometer, that each field coil produces a magnetic field of the same polarity. If this condition is not established, the klystron will suffer serious damage as soon as the h.t. is applied.

LIMIT RATINGS (Note 2)

Maximum collector voltage	16	kV
Maximum collector dissipation	1	kW
Maximum resonator voltage	16	kV
Maximum resonator dissipation for any single drift tube section	3	W
Modulator voltage		
Maximum peak pulse	5·5	kV
Minimum negative bias for hold-off	−150	V
Maximum value of modulator resistor	250	kΩ
Maximum modulator dissipation	12	W
Maximum average cathode current	70	mA
Maximum duty cycle for peak cathode current of 2·5A	3·5	%

Note 2. Electrode potentials are given relative to cathode potential.

Code: Z211/1G (CV5314)

CONTINUED

TYPICAL OPERATING CONDITIONS

Collector and resonator voltage	15	kV
Modulator bias voltage	−150	V
Modulator peak pulse voltage	5	kV
Modulator pulse duration, half height (Note 3)	3·75	μs
Average cathode current	60	mA
C.W. input power to first cavity	3	W
Peak power output (final cavity)	7	kW
Frequency range	960 to 1 213	MHz
Duty cycle, approx.	3	%

Note 3. Spectrum controlled pulse as used in TACAN equipment.

OPERATING NOTES

Normally the collector and cavity resonators are earthed and negative e.h.t. is applied to the cathode. Under these conditions, high voltage insulation of the heater supply and modulator circuits is essential.

It should be arranged that

(*a*) any fault in the field coils or power supply circuit removes both the modulator pulse and e.h.t. supplies;

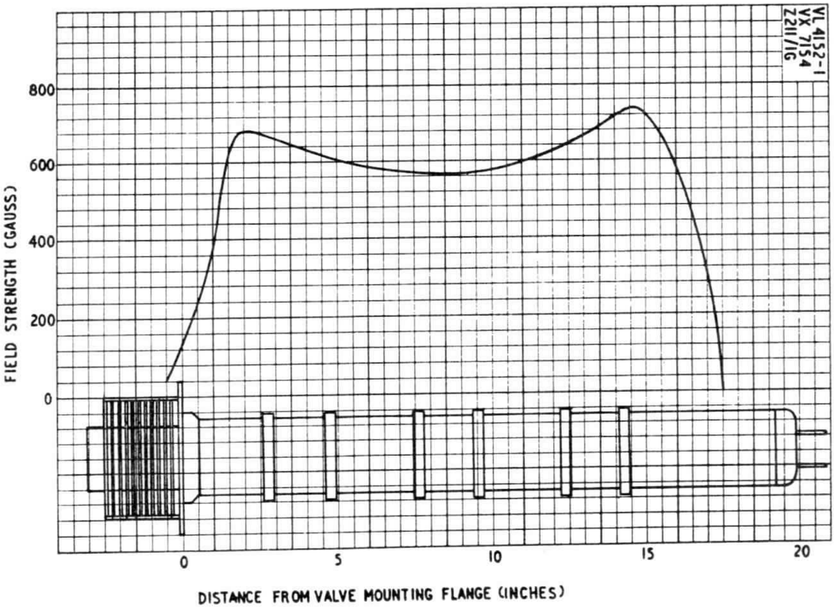
(*b*) a failure of the e.h.t. supply will remove the modulator pulse.

It is essential that the valve envelope be kept clean and free of dust.

Code: Z211/1G (CV5314)

CONTINUED

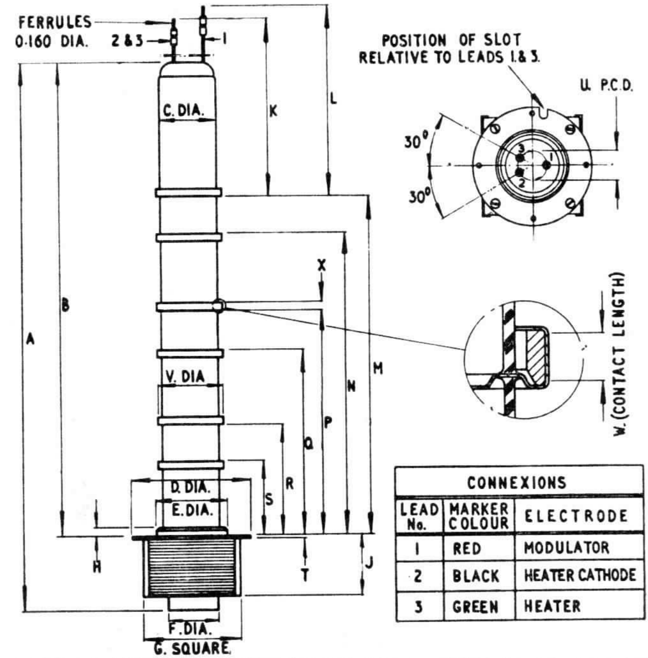
Fig. 1.—Typical Magnetic Focusing Field



Code: Z211/1G (VC5314)

CONTINUED

Fig. 2.—Z211/1G Outline



CONNEXIONS		
LEAD No.	MARKER COLOUR	ELECTRODE
1	RED	MODULATOR
2	BLACK	HEATER CATHODE
3	GREEN	HEATER

DIM.	MILLIMETRES	INCHES	DIM.	MILLIMETRES	INCHES
A	584,2 MAX.	23 MAX.	M	359,70 $\pm$ 2,03	14.161 $\pm$ 0.080
B	504,8 MAX.	$19\frac{7}{8}$ MAX.	N	320,30 $\pm$ 2,03	12.611 $\pm$ 0.080
C	61,46 MAX.	2.420 MAX.	P	239,29 $\pm$ 2,29	9.421 $\pm$ 0.090
D	127,0 $\pm$ 0,8	$5 \pm \frac{1}{32}$	Q	199,92 $\pm$ 2,29	7.871 $\pm$ 0.090
E	$76{,}20 \, ^{+0{,}10}_{-0{,}00}$	$3.000 \, ^{+0.004}_{-0.000}$	R	118,90 $\pm$ 2,29	4.681 $\pm$ 0.090
F	54,0 MAX.	$2\frac{1}{8}$ MAX.	S	79,53 $\pm$ 2,03	3.131 $\pm$ 0.080
G	104,0 MAX.	$4\frac{3}{32}$ MAX.	T	3,2 $\pm$ 0,4	$\frac{1}{8} \pm \frac{1}{64}$
H	9,5 APP.	$\frac{3}{8}$ APP.	U	31,8 APP.	$1\frac{1}{4}$ APP.
J	63,5 $\pm$ 1,6	$2\frac{1}{2} \pm \frac{1}{16}$	V	71,12 $\pm$ 0,10	2.800 $\pm$ 0.004
K	450,9 $\pm$ 3,2	$17\frac{3}{4} \pm \frac{1}{8}$	W	7,37 MIN.	0.290 MIN.
L	469,9 $\pm$ 3,2	$18\frac{1}{2} \pm \frac{1}{8}$	X	9,5 $\pm$ 0,4	$\frac{3}{8} \pm \frac{1}{64}$

SPECIAL VALVES

Reflex Klystron

Code: Z237/1KW (CV5437)

The Z237/1KW is a reflex klystron developed for use as a frequency-modulated oscillator in multi-channel radio-telephony systems where high linearity is required. The following data refer specifically to its operation at 3520 ± 15 Mc/s, at which frequency it is currently used.

CATHODE

Indirectly heated, oxide coated		
Heater voltage	6·3	V
Heater current, nominal	0·65	A
Cathode heating time	60	s

MECHANICAL DATA

Dimensions	As shown in outline drawing			
Base	B9A			
Net weight		1·4 oz	40	g
Mounting	The valve is mounted by means of the disc seals, in a waveguide cavity.			

CIRCUIT

The Z237/1KW should be used in the waveguide cavity shown on page 3. The valve is designed to operate into a 2 inch × $\frac{2}{3}$ inch (50,8 mm × 16,9 mm) waveguide, the iris giving correct coupling into this waveguide. The tuning piston allows the frequency to be set accurately to 3520 Mc/s.

MAXIMUM RATINGS

Maximum direct resonator voltage	350	V
Maximum direct resonator current	55	mA
Maximum direct reflector voltage	−200	V
Maximum direct grid voltage	−150	V
Maximum total dissipation for all electrodes except heater*	18	W

*This rating may be increased if forced-air-cooling is used.

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Code: Z237/1KW (CV5437)

CONTINUED

TYPICAL OPERATING CONDITIONS

Direct resonator voltage	300	V
Direct reflector voltage*	—90 to —140	V
Direct grid voltage†	—10 to —150	V
Direct resonator current	50	mA

*This is adjusted to give maximum output power at a frequency of 3 520 Mc/s.

†This is adjusted to give a resonator current of 50 mA.

PERFORMANCE

With the operating conditions previously specified, the following performance should be obtained

Power output, minimum	125	mW
Modulation sensitivity	0·85 to 1·7 Mc/s/V	

MODULATION

Frequency modulation is achieved by variation of the reflector voltage with respect to cathode. The direct reflector current will not exceed 2 μA. For a typical valve the second and third harmonics are, respectively, 80 db and 110 db down on the fundamental over a range of 5 Mc/s for a deviation of 125 kc/s r.m.s.

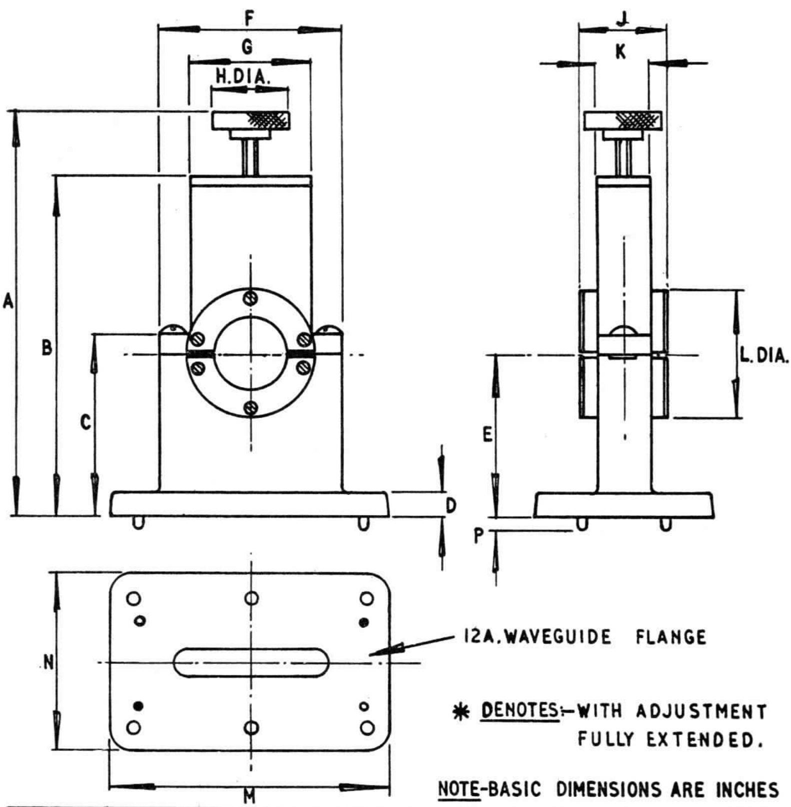
MODULATION LINEARITY

With the reflector voltage adjusted for optimum linearity, the slope change for a $\pm$5 Mc/s deviation will not exceed 2%.

Waveguide Cavity

Code: 495-LVA-451

495-LVA-451 Outline



NOTE—BASIC DIMENSIONS ARE INCHES

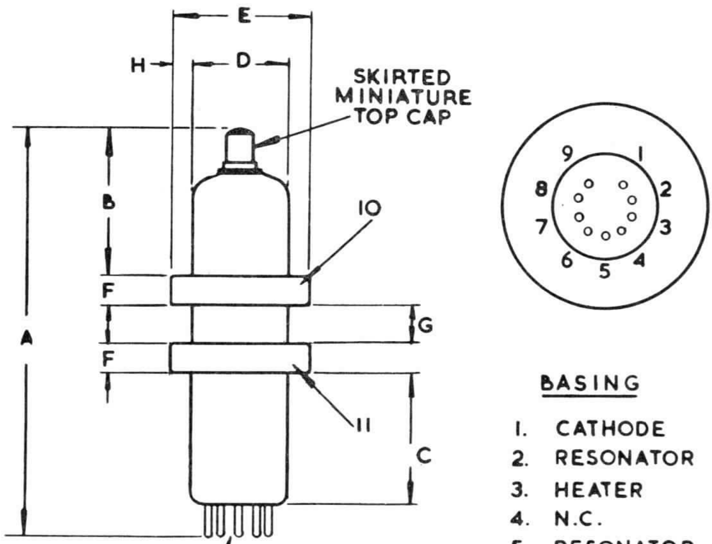
DIM	MILLIMETRES	INCHES	DIM	MILLIMETRES	INCHES
A	141,3 MAX. ✱	5 9/16 MAX. ✱	H	25,4 ±0,8	1 ± 1/32
B	112,7 MAX.	4 7/16 MAX.	J	31,8 MAX.	1 1/4 MAX.
C	61,9 MAX.	2 7/16 MAX.	K	17,5 ±0,8	11/16 ± 1/32
D	8,7 MAX.	11/32 MAX.	L	41,3 ±0,8	1 5/8 ± 1/32
E	54,17 ±0,38	2·133 ±0·015	M	92,1 ±0,4	3 5/8 ± 1/64
F	60,3 ±0,4	2 3/8 ± 1/64	N	58,7 ±0,4	2 5/16 ± 1/64
G	39,7 ±0,4	1 9/16 ± 1/64	P	4,0 MAX.	5/32 MAX.

STC

Code: Z237/1KW (CV5437)

CONTINUED

Z237/1KW Outline



BASING

1. CATHODE
2. RESONATOR
3. HEATER
4. N.C.
5. RESONATOR
6. N.C.
7. HEATER.
8. RESONATOR
9. GRID.
10. RESONATOR
11. RESONATOR

T.C. REFLECTOR

DIM	MILLIMETRES	INCHES	DIM	MILLIMETRES	INCHES
A	76·2 ± 7·9	3 ± 5/16	F	4·8 ± 0·4	3/16 ± 1/64
B	31·8 ± 4.0	1 1/4 ± 5/32	G	8·13 ± 0·25	0·320 ± 0·010
C	20·6 ± 2·4	13/16 ± 3/32	H	3·81 MIN.	0·150 MIN.
D	21·7 MAX	0·855 MAX	NOTE:-		
E	29·57 ± 0·13	1·164 ± 0·005	BASIC FIGURES ARE INCHES.		

MICROWAVE POWER
INDICATOR TUBES

SPECIAL VALVES

Power Indicator Tubes

Codes: NE17 (CV359)
NE18 (CV360)

The NE17 and NE18 are neon gas filled power indicator tubes for use in waveguides to measure peak power. The tubes are of similar physical dimensions: type NE18 is more sensitive than type NE17.

MECHANICAL DATA

Overall length, approximately	4·7 in	120	mm
Maximum diameter, approximately	0·5 in	12,7	mm

ELECTRICAL DATA

	NE17	NE18	
Peak power range	100 to 200	100 to 200	kW
Frequency range	2·8 to 10	2·8 to 10	Gc/s
Glow height*	>3	>4·5	cm

* Measured at approximately 175 kW peak power of 1 μsec duration and repetition rate of 600 p.p.s.

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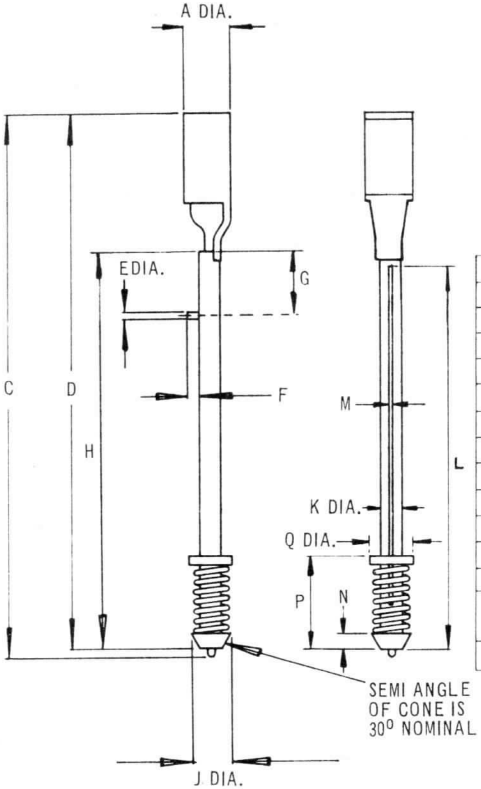
STC

Codes: NE17 (CV359)
NE18 (CV360)

CONTINUED

NE17 and NE18 Outline



DIM.	INCHES	MILLIMETRES
A	0·433 MAX.*	11,0 MAX.
C	4·803 MAX.	122,0 MAX.
D	4·646 MAX.	118,0 MAX.
E	1/16 ± 1/64	1,58 ± 0,39
F	3/32 ± 1/64	2,38 ± 0,39
G	0·562 ± 0·050	14,27 ± 1,27
H	3·453 ± 0·050	87,71 ± 1,27
J	0·343 ± 0·005	8,71 ± 0,13
K	0·203 ± 0·010	5,16 ± 0,25
L	3·000 MIN.	76,2 MIN.
M	1/32 ± 1/64	0,79 ± 0,185
N	0·140 ± 0·005	3,56 ± 0,13
P	0·778 MIN. ◪	19,77 MIN. ◪
	0·625 MAX. ◒	15,8 MAX. ◒
Q	0·375 ± 0·015	9,52 ± 0,38

NOTES:-

* THIS DIMENSION IS MEASURED OVER THE LABEL AND TROPICAL VARNISH.

◪ DIMENSION WITH SPRING FREE.

◒ DIMENSION WITH SPRING COMPRESSED.

DIMENSIONS J & N TOGETHER WITH CONE SEMI-ANGLE MEAN THAT THE DIAMETER OF THE HOLE IN THE WAVE-GUIDE SHOULD BE IN THE RANGE
0·200 – 0·330 INCHES
5,08 – 8,32 MM.

STC

SPECIAL VALVES

Power Indicator Tube

Code: NE19 (CV263)

The NE19 is a gas-filled indicating tube which is suitable for measuring peak r.f. power up to 1kW within the frequency range 2·8 to 11 Gc/s.

ELECTRICAL DATA

Peak power range	Up to 1	kW
Frequency range	2·8 to 11	Gc/s

TYPICAL OPERATING CONDITIONS*

Frequency	9·4	Gc/s
Peak power	850	W
Pulse recurrence frequency	2 000	p.p.s.
Pulse width	0·5	μs
Glow height	45	mm

MECHANICAL DATA

Dimensions — As shown in outline drawing

* Tube mounted in Wattmeter Absorption Type 2 (A.M. reference 10AF/525).

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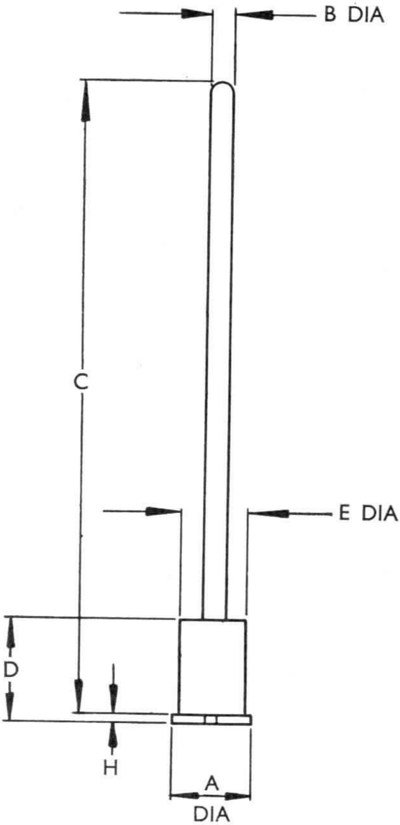
Code: NE19 (CV263)

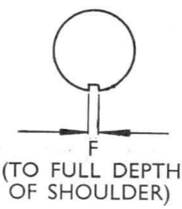
CONTINUED

NE19 Outline



DIM	INCHES	MILLIMETRES
A	0·550 ± 0·005	13,97 ± 0,13
B	0·146 MAX.	3,7 MAX.
C	4·645 ± 0·039	118,0 ± 1,0
D	0·750 ± 0·020	19,05 ± 0,051
E	0·440 ± 0·005	11,18 ± 0,130
F	0·0625 ± 0·010	1,59 ± 0,25
H	0·0625 + 0·020 − 0·000	1,59 + 0,51 − 0,00

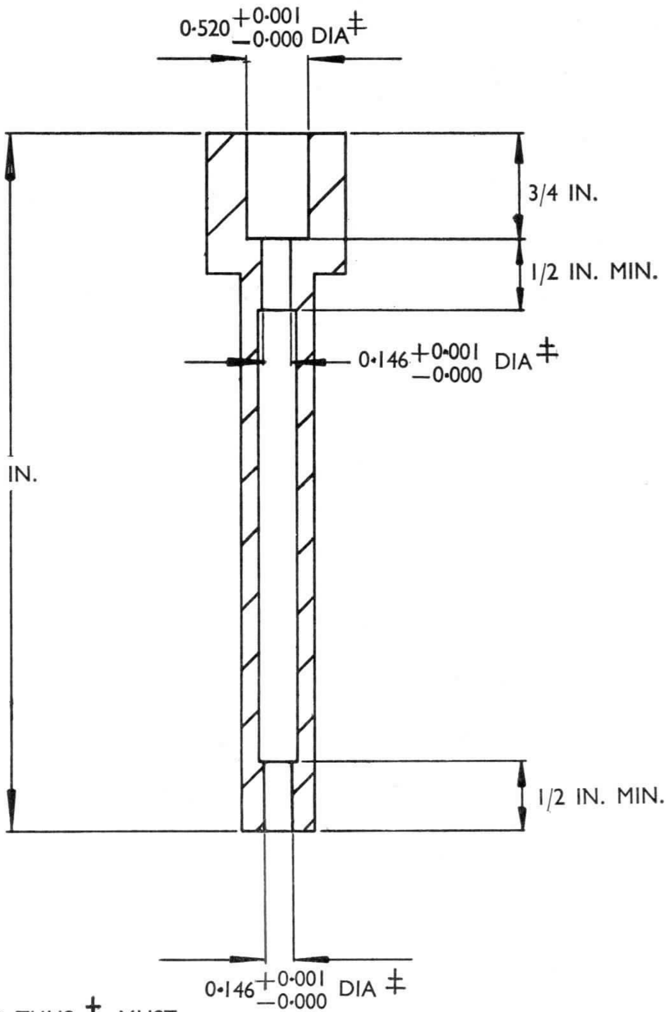
NOTE 1:—
CONCENTRICITY OF TUBE AND CAP SHALL MEET THE REQUIREMENTS OF TEST JIG NE19(CV263) SHEET 3.3



Code: NE19 (CV263)

CONTINUED

NE19 Concentricity Gauge (Sheet 3.3)



NOTES
HOLES INDICATED THUS ‡ MUST BE CONCENTRIC TO WITHIN 0·001

MATERIAL:—BRASS

VARACTOR
DIODES

VARACTOR DIODES

General Information

INTRODUCTION

The varactor diodes described in this publication are hermetically encapsulated epitaxial types with gold-bonded internal leads.

Four basic types of encapsulation are used for compatibility with type of circuit employed and frequency of operation. Inquiries are invited for alternative encapsulation to meet special requirements or for varactor diodes other than those on which data is given.

Diodes can be tested in customers' approved circuits where required.

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VARACTOR DIODES

General Information

CLASSIFICATION OF TYPES

The basic categories of varactor diodes, described as stud, cartridge and pill types respectively, are produced with a ceramic insulator. In addition, there is a sub-category of the stud type, which has a glass insulator, and a type with wire ends and a glass-metal encapsulation.

Within each main category there are one or more series of diodes, all of which have a common physical outline but different electrical characteristics. These series are classified as follows:

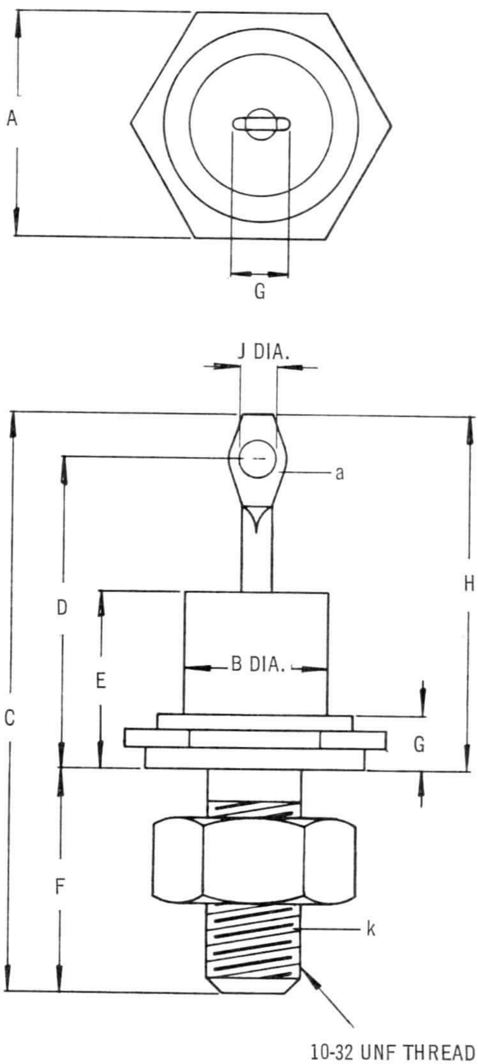
VA Series	Stud type with glass insulator.
VB Series	Stud type with ceramic insulator.
VH Series	Cartridge type with ceramic insulator.
VJ Series	Cartridge type with ceramic insulator. (Alternative version).
VM Series	Wire-ended with glass-metal encapsulation.
VS Series	Pill type with ceramic insulator.

VARACTOR DIODES

General Information

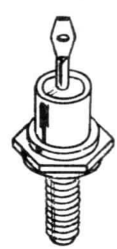
PHYSICAL OUTLINES

Outline of VA Series



DIM	MILLIMETRES	INCHES
A	11,07 + 0,00 − 0,25	0.436 + 0.000 − 0.010
B	7,37 MAX.	0.290 MAX.
C	30,2 MAX.	1 3/16 MAX.
D	15,1 ± 0,8	19/32 ± 1/32
E	9,5 MAX.	3/8 MAX.
F	11,1 ± 0,4	7/16 ± 1/64
G	3,2 MAX.	1/8 MAX.
H	19,1 MAX.	3/4 MAX.
J	1,78 ± 0,13	0.070 ± 0.005

Millimetre dimensions are derived from original inch dimensions

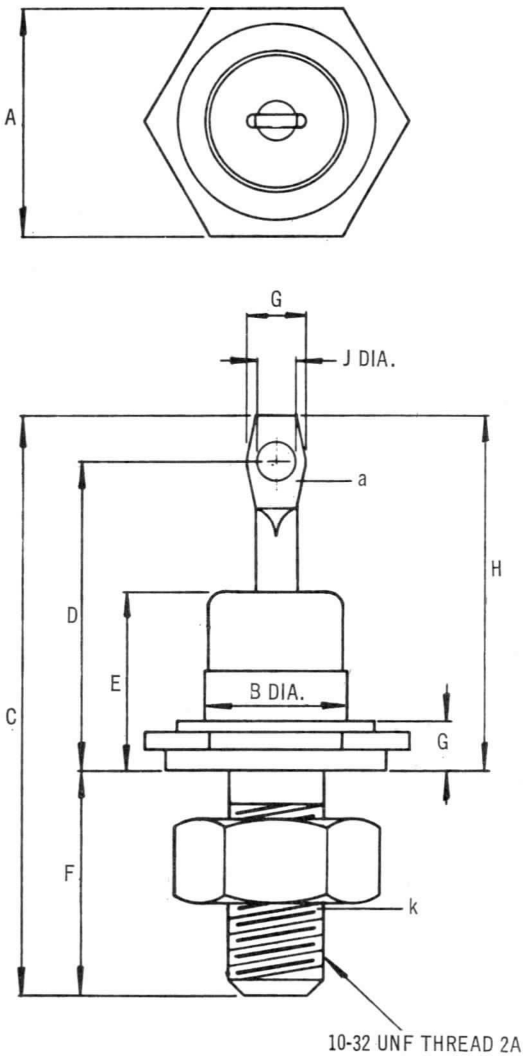


ACTUAL SIZE

General Information

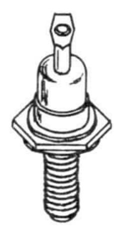
CONTINUED

Outline of VB Series



DIM.	MILLIMETRES	INCHES
A	11,07 $^{+0,00}_{-0,25}$	0·436 $^{+0.000}_{-0.010}$
B	7,37 MAX.	0.290 MAX.
C	30,2 MAX.	$1\frac{3}{16}$ MAX.
D	15,1 ± 0,8	$\frac{19}{32} \pm \frac{1}{32}$
E	9,5 MAX.	$\frac{3}{8}$ MAX.
F	11,1 ± 0,4	$\frac{7}{16}$ ± 1/64
G	3,2 MAX.	$\frac{1}{8}$ MAX.
H	19,1 MAX.	$\frac{3}{4}$ MAX.
J	1,78 ± 0,13	0.070 ± 0.005

Millimetre dimensions are derived from original inch dimensions



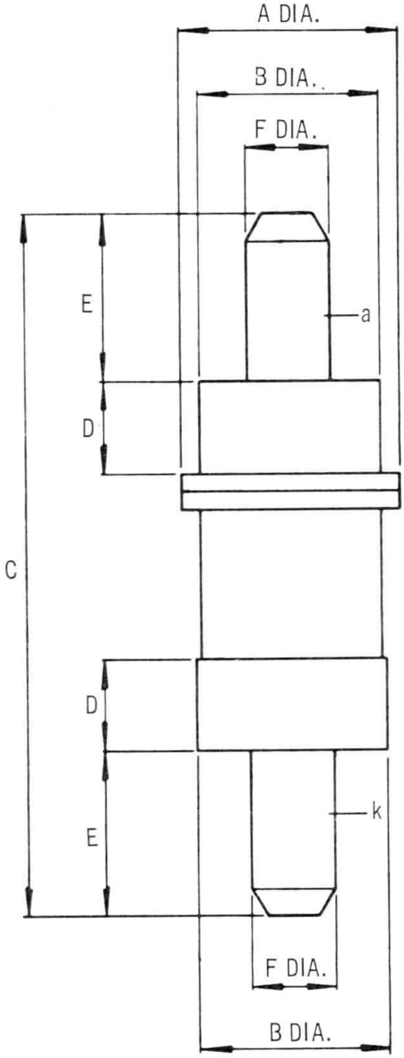
ACTUAL SIZE

General Information

CONTINUED

Outline of VH Series

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM.	MILLIMETRES		INCHES	
	Min	Max	Min	Max
A	5,944	6,147	0.234	0.242
B	5,207	5,461	0.205	0.215
C	19,4	20,17	0.764	0.794
D	2,36		0.093	
E	4,572	4,826	0.180	0.190
F	2,237	2,413	0.092	0.095

Millimetre dimensions are derived from original inch dimensions

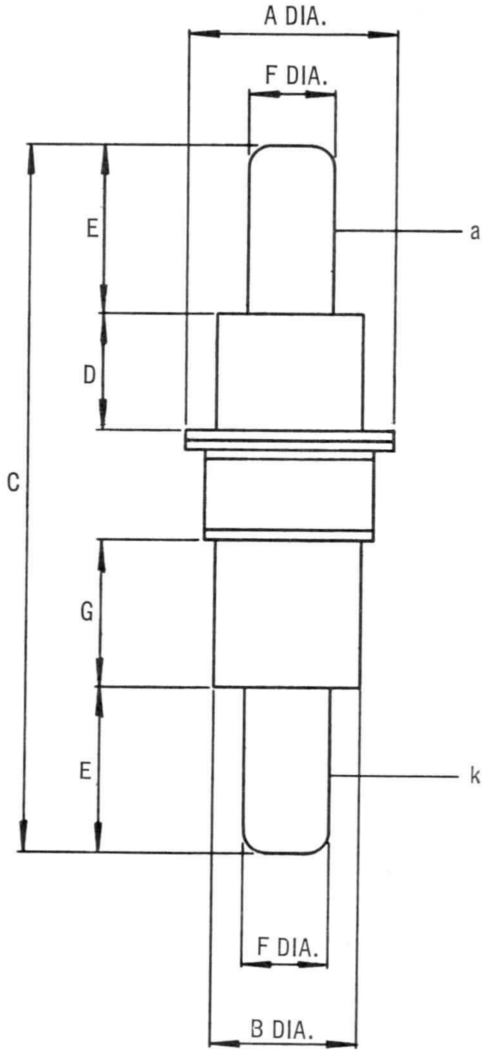
ACTUAL SIZE

General Information

CONTINUED

Outline of VJ Series

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM	MILLIMETRES	INCHES
A	5,97 MAX.	0.235 MAX.
B	4,06 ± 0,13	0.160 ± 0.005
C	19,79 ± 0,38	0.779 ± 0.015
D	3,05 MIN.	0.120 MIN.
E	4,70 ± 0,13	0.185 ± 0.005
F	2,39 ± 0,5	0.094 ± 0.002
G	3,43 MIN.	0.135 MIN.

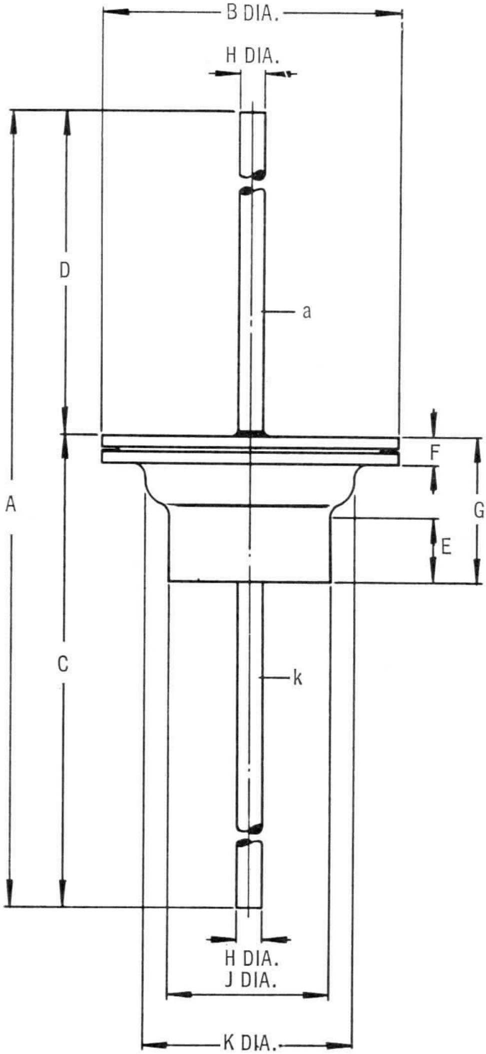
Millimetre dimensions are derived from original inch dimensions

ACTUAL SIZE

General Information

CONTINUED

Outline of VM Series



DIM	MILLIMETRES	INCHES
A	54,0 MAX.	$2\frac{1}{8}$ MAX.
B	6,10 MAX.	0.240 MAX.
C	27,0 APPROX.	$1\frac{1}{16}$ APPROX.
D	25,4 APPROX.	1 APPROX.
E	0,76 MIN.	0.030 MIN.
F	0,64 MAX.	0.025 MAX.
G	3,18 MAX.	0.125 MAX.
H	0,46 MIN. 0,56 MAX.	0.018 MIN. 0.022 MAX.
J	3,43 MAX.	0.135 MAX.
K	4,32 MAX.	0.170 MAX.

Millimetre dimensions are derived from original inch dimensions

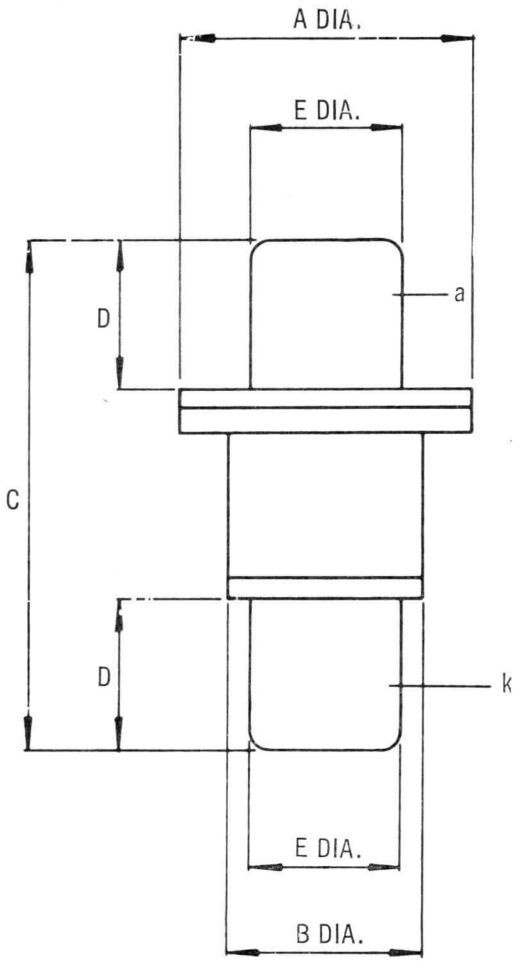
ACTUAL SIZE

General Information

CONTINUED

Outline of VS Series

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM.	MILLIMETRES	INCHES
A	3,2 MAX.	0.125 MAX.
B	2,4 MAX.	0.093 MAX.
C	5,33 ± 0,25	0.215 ± 0.010
D	1,57 ± 0,08	0.062 ± 0.003
E	1,57 ± 0,08	0.063 ± 0.003

Millimetre dimensions are derived from original inch dimensions

ACTUAL SIZE

VARACTOR DIODES

General Information

REFERENCE CODING SYSTEM

Each varactor diode is allotted an individual reference code which is related to its basic structure, semi-conductor material and electrical characteristics. The first three letters of the code correspond to one of the basic series referred to in CLASSIFICATION OF TYPES Section. (Var/Gen A.)

The example and table given below illustrate the coding system.

EXAMPLE

V B C 10 5 C

- V — V = Varactor diode
- B — Structure
  - A = Stud-glass
  - B = Stud-ceramic
  - H = Cartridge-ceramic
  - J = Cartridge-ceramic
  - M = Wire-ended, glass-metal seal
  - S = Pill-ceramic
- C — Semiconductor type
- 10 — Indicates V_B (See Table 1)
- 5 — Indicates $C_{j(-6)}$ (See Table 2)
- C — Indicates quality level (Note 1)

Table 1

CODE	V_B min. (V)
3	18
4	30
5	48
6	60
7	90
8	120
9	150
10	180
11	200
12	250

Table 2

CODE	$C_{j(-6)}$ (Note 2) (pF) MIN.	MAX.
1	0·12	0·25
2	0·25	0·50
3	0·5	1
4	1	2
5	2	4
6	4	8
7	8	16
8	16	32
9	32	64

Note 1. The quality level is indicated by a letter A, B, C, etc., and is expressed as f_c min for cartridge and pill types and as R_s max for stud types. The significance of the letter is shown in individual data sheets. In the example shown above the letter C indicates a quality level of $R_s = 5\Omega$.

Note 2. Approximate value for coding purposes. See data sheets for precise individual tolerances.

VARACTOR DIODES

General Information

CHARACTERISTICS

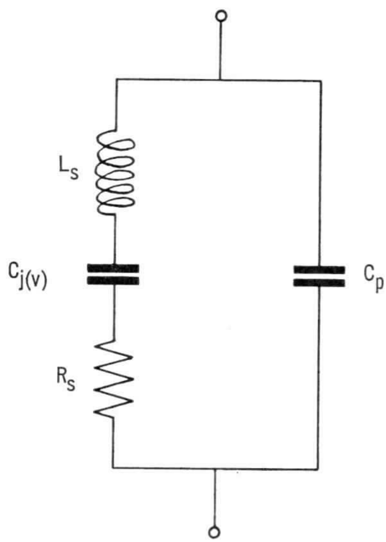
(*a*) Equivalent Circuit

At high frequencies the conductance of a p–n junction becomes negligible and the equivalent circuit is simply the junction capacitance in series with the semiconductor resistance.

The encapsulation introduces parasitic series inductance and shunt capacitance so that the equivalent circuit of the complete varactor diode is as follows:

SYMBOL

EQUIVALENT CIRCUIT



L_S = LEAD INDUCTANCE

C_p = CASE CAPACITANCE

$C_{j(V)}$ = JUNCTION CAPACITANCE AT VOLTAGE V.

R_S = SERIES RESISTANCE

Typical values of L_s and C_p are given in the following table

Encapsulation	Type	Insulation	L_s (nH)	C_p (pF)
Stud	VA	Glass	4	0·75
Stud	VB	Ceramic	4	0·55
Cartridge	VH	Ceramic	2	0·4
Cartridge	VJ	Ceramic	2	0·6
Metal-glass (wire-ended)	VM	Glass	—	0·5
Pill	VS	Ceramic	0·8	0·25

General Information

CONTINUED

(b) Typical Capacitance Characteristics

For low bias voltages, the capacitance is given by:

$$C_{j\,(v)} = C_{j\,(-6)} \left\{ \frac{\phi + 6}{\phi - V} \right\}^{\gamma}$$

where: V = bias
ϕ = 0·6V approx.
γ = 0·4 approx.

For example, $C_{j\,(-4)} = 1{\cdot}3\ C_{j\,(-6)}$.

VARACTOR DIODES

General Information

PARAMETERS OF VARACTOR DIODES

Parameter	Symbol/Formula	Condition of Measurement
Junction capacitance	$C_{j(v)}$ $C_{j(-6)}$	15 mV. 1MHz signal at bias V. 15 mV. 1MHz signal at −6V bias.
Breakdown voltage	V_B	10μA reverse current.
Series resistance	R_s	600MHz at zero bias for stud type.
Cut-off frequency (Notes 1 and 2)	$f_c = \frac{1}{2\pi R_s C_{j(VB)}}$	Measured at nominal breakdown voltage V_B and f_c determined from Q measurement at 800MHz, approx. R_s applies to cartridge or pill.
Thermal resistance	θ	Measured on infinite heat sink.
Junction temperature (175°C maximum)	$T_j = T_{h.s.} + \theta P_j$ where $T_{h.s.}$ = heat sink temperature P_j = diode power loss	

Note 1. Cut-off frequency is defined as the frequency at which Q = 1.

Note 2. Cut-off frequencies at other bias voltages can be quoted on request.

VARACTOR DIODES

General Information

VARACTOR DIODES AVAILABLE IN ALTERNATIVE ENCAPSULATIONS

Capacitance Code	Voltage Code							
	4	5	6	7	8	9	10	11
2	PC	PC	PC	PC	PCS	PCS	PCS	PCS
3	PC	PC	PC	PC	PCS	PCS	PCS	PCS
4	PCS	PCS	PCS	PCS	PCS	PCS	PCS	PCS
5	PCS	PCS	PCS	PCS	PCS	PCS	PCS	PCS
6	PCS	PCS	PCS	PCS	PCS	PCS	PCS	PCS
7	PCS	PCS	PCS	PCS	PCS	CS	CS	CS
8	*PCS	*PCS	*PCS	*PCS	CS	CS	CS	CS
9	*PCS	*PCS	*PCS	CS	*CS	*CS	*CS	*CS

Legend

P = Pill types (VS series).

C = Cartridge and wire-ended metal-glass types (VH, VJ and VM series).

S = Stud types (VA and VB series).

Diode types within the shaded area are preferred types.

* Letters surmounted by an asterisk indicate diodes available to special order only.

VARACTOR DIODES

General Information

APPLICATIONS

The more usual applications of varactor diodes are:

Harmonic generators.
Up-converters.
Tuning devices.
Use as parametric amplifiers.

For the first class of application, the capacitance-voltage law is not of great significance, but the series resistance (or cut-off frequency) and the ability of a diode to generate harmonics of the input frequency are important. Diodes in the present STC range are designed primarily for this class of operation, to which, therefore, the applications information given here relates.

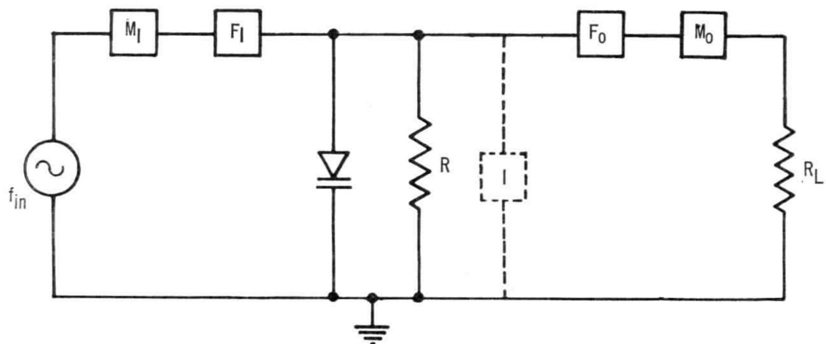
Frequency Multipliers

(a) Shunt Diode

A basic circuit of a frequency multiplier incorporating a varactor diode is shown below.

This is the basic shunt connection of the varactor diode and since one electrode is earthed a good heat sink can be provided.

An essential feature of all varactor frequency multiplier circuits is that the diode forms part of every resonant circuit in the stage.



M_I = Input impedance matching circuit.
M_O = Output impedance matching circuit.
F_I = Band-pass filter to pass input frequency.
F_O = Band-pass filter to pass output frequency.
R = Resistor to develop diode bias. In practice, values range from 10kΩ to 1MΩ. It is best to start with 100kΩ and to adjust to optimum when all other circuit adjustments have been made.
R_L = Load.
I = Idler circuit tuned to an intermediate frequency for use in triplers, etc.
f_{in} = Input frequency.

General Information

CONTINUED

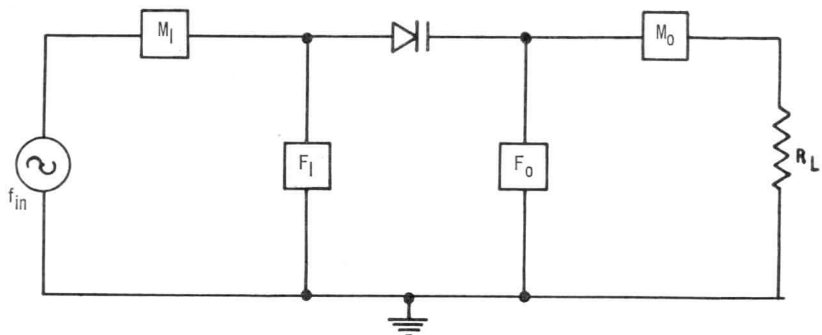
(b) Series Diode

The alternative basic circuit to that just described is given below.

This circuit is sometimes useful at low power levels but its use entails the following disadvantages:

It is not easy to provide a good heat sink for the diode because neither terminal is earthed.

The unwanted harmonic currents have to flow through the filter resistances.



F_I = Filter circuit, resonant at input frequency.

F_o = Filter circuit, resonant at output frequency.

M_I = Input impedance matching circuit.

M_o = Output impedance matching circuit.

R_L = Load.

f_{in} = Input frequency.

VARACTOR DIODES

General Information

TYPICAL PERFORMANCE DATA

The following tables show the typical measured performance, including circuit losses, of a representative selection from the range of varactor diodes. Junction temperatures do not exceed 110°C at 25°C ambient.

Frequency Input (MHz)	Frequency Output (MHz)	Power Input (W)	Power Output (W)	Efficiency (%)	Attenuation (dB)	Varactor Types
Frequency Doublers						
125	250	25	19	76	1·1	VBC108C: VBC118D
250	500	20	16	80	1	VBC107C
250	500	15	12	80	1	VBC77C
500	1 000	5	3·4	68	1·7	VJC75D
500	1 000	5	3	60	2·2	VBC75B
500	1 000	15	9	60	2·2	VBC86C: VBC87C
500	1 000	15	10	66	1·8	VJC87D
500	1 000	20	13	65	1·9	VBC107C
500	1 000	30	19	63	2	VJC87D
500	1 000	30	18	60	2·2	VBC98C
500	1 000	45	25	56	2·5	VBC108C
1 000	2 000	10	6	60	1·7	VSE66M: VJE66M
2 000	4 000	3	1·8	60	2·2	VHC65D: VSC65D
Frequency Triplers						
150	450	5	3·2	64	1·9	VBC78B
150	450	10	6	60	2·2	VBC87D
150	450	10	6·5	65	1·9	VBC98C: VBC107C VBC89C: VBC88C
150	450	20	12·5	62·5	2	VBC98C: VBC107C VBC108C: VBC118D
150	450	30	18	60	2·2	VBC108C: VBC118D VBC109C: VBC119D
150	450	50	30	60	2·2	VBC119D
240	720	15	8	53	2·8	VBC77C
3 000	9 000	0·4	0·15	37·5	4·3	VHC64E
Frequency Quadruplers						
60	240	0·9	0·5	55	2·9	VMC77M
250	1 000	4	2	50	3	VJE66M: VJC76D
High Order Multipliers						
40	400	0·5	0·1	20	7	VMC86
800	4 000	0·5	0·1	20	7	VHC64 (selected)
800	6 400	1	0·1	10	10	VHC64 (selected)
800	6 400	0·05	0·004	8	13	VHC43 (selected)

VARACTOR DIODES

General Information

USE OF DIODE PERFORMANCE TABLES AND GRAPHS

This section contains instructions for using the three diode performance tables and graphs comprising Section K.

It should be noted that:

(*a*) The majority of the types of diodes referred to in the performance tables have a γ characteristic approximately equal to 0·42. Compared with these types, diodes which have the same C_o, V_B and R_S characteristics, but with γ greater than 0·42, will handle less power and be more efficient at lower powers; that is, maximum efficiency will be greater and will occur at a lower power level.

Correspondingly, diodes with γ less than 0·42 will handle more power and have a lower maximum efficiency.

(*b*) The efficiency at the tabulated input power corresponds to unity on the power ratio axis of the appropriate graph.

(*c*) The input and output resistances are proportional to R_S.

(*d*) Generally, the variation of input and output resistance follows the efficiency curve.

Selection of Varactor Diodes

(*a*) When input power and frequency data are known.

Step 1. Determine the multiplying factor to achieve the required output frequency and postulate a single stage or series of stages, for example doubler, tripler or quadrupler. Take each stage successively but at each stage allow for about 15% circuit loss; that is, assume that only about 85% of the determined output power is available for the next stage.

Step 2. Look at the table appropriate to the stage class and select the column giving the input frequency nearest to that required. If the frequency in the selected column is substantially different from that required, use the frequencies given in the columns on each side of it for two calculations and interpolate the final results; take input power directly proportional to frequency.

Step 3. Run down the appropriate column(s) until the power shown is between 1·1 and 0·25 times that available. (This is the reciprocal of the power ratio in Step 4 below.)

Step 4. Select a diode type and determine the power ratio $\frac{P_{in}}{P_{table}}$.Read from the appropriate curve (indicated in the table by letters A, B or C followed by a numeral) the efficiency corresponding to this power ratio. Normally, for maximum efficiency the power ratio is in the region 1 to 1·5. By knowledge of the power input, determine the theoretical output.

Step 5. The difference between the power input and theoretical output will be the diode loss; the product of power loss and thermal resistance (found in data sheets) yields the junction temperature rise.

Step 6. In most practical cases the actual power output will be approximately 85% of the theoretical value, due to circuit losses.

Examples of the use of this selection procedure are given at the end of this Section.

General Information

CONTINUED

(*b*) When Output Power and Frequency Data are known.

The performance of a diode for a given multiplying factor may be found by roughly estimating the efficiency and then using the procedure given under (*a*) to obtain successive approximations.

Examples.

Example 1. Frequency Doubler Selection.

It is required to choose, for frequency doubling, a diode with the following parameters:

Input frequency	125 MHz	Power input	25W
Output frequency	250 MHz	Diode efficiency	80%

Step 2. Any diode with a tabulated power of at least a quarter of 25W at 125 MHz may be considered.

Referring to Table 1 the nearest reference frequency is 100 MHz.

Step 3. At 100 MHz the following diodes have a suitable power handling capacity, 119C, 109B, 118D, 118A, 108C, 108A and, possibly, 98C.

Step 4. Taking the 119C diode with a tabulated power of 16W,

$$\text{Power ratio } \frac{P_{in}}{P_{table}} = \frac{25}{16} \simeq 1{\cdot}6.$$

From curve A5 of the doubler efficiency graph,
Diode efficiency = 87%.

Allowing for 15% loss of power in the circuit and a diode efficiency of 87%,
Power output $\simeq$ 25W $\times$ 0·85 $\times$ 0·87 = 18·5W.

Since the 109B, 118A and 108A diodes each have a smaller tabulated power than that of the 119C, their efficiency, determined from the common efficiency curve, is also lower.

Considering type 118D, with a tabulated power of 8W,
Power ratio $\simeq$ 3·2.
Efficiency from curve A4 = 84%.
Power output $\simeq$ 25W $\times$ 0·85 $\times$ 0·84 = 17·8W.

For type 108C, with a tabulated power of 6·8W,
Power ratio $\simeq$ 3·7.
Efficiency from curve A4 = 78%.
Power output $\simeq$ 25W $\times$ 0·85 $\times$ 0·78 = 16·6W.

Step 5. In the case of type 119C the diode power loss is 6·5W. The thermal resistance of the stud version of this diode, the VBC119C, as shown in its data sheet is 4°C/W. Thus,

Junction temperature rise = 6·5 $\times$ 4 = 26°C

General Information

CONTINUED

Example 2. Frequency Tripler Selection

It is required to choose, for frequency tripling, a diode with the following parameters:

Input frequency	150 MHz	Input power	1W
Output frequency	450 MHz	Diode efficiency	70%

Step 2. Since a large number of diodes listed in Table 2 have a power handling capacity of 1W, choose from the table a type with a tabulated power of 1W at 150 MHz: by direct proportion with frequency this corresponds to 0·67W at 100 MHz and 1·33W at 200 MHz.

Step 3. On the bases above, the table shows that the most suitable types are 86C, 86E, 76C and 76E.

Step 4. To determine diode efficiency over the range of diodes initially selected, types 86C and 76C are assessed, as follows:

Diode Efficiency at 100 MHz

Type 86C: Power ratio $= \frac{0{\cdot}67}{0{\cdot}76} \simeq 0{\cdot}88.$

Efficiency from curve B3 = 94%.

Type 76C Power ratio $= \frac{0{\cdot}67}{0{\cdot}49} \simeq 0{\cdot}88.$

Efficiency from curve B3 = 94%.

Thus at 100 MHz all diodes will have an efficiency greater than 94%.

Diode Efficiency at 200 MHz

Type 86C Power ratio $= \frac{1{\cdot}33}{1{\cdot}55} \simeq 0{\cdot}88.$

Efficiency from curve B4 = 86%.

Type 76C Power ratio $= \frac{1{\cdot}33}{0{\cdot}98} \simeq 1{\cdot}36.$

Efficiency from curve B4 = 87%.

Therefore at 200 MHz all diodes will have an efficiency greater than 86%.

Diode Efficiency at 150 MHz

By interpolation, at 150 MHz, all diodes will have an efficiency of about 90%.

Step 5. Diode loss will be approximately 100mW: the product of this and the thermal resistance for the particular diode chosen (obtained from the appropriate data sheet) will give the junction temperature rise.

Step 6. Approximate overall circuit efficiency will be 85% of 90% = 76% and approximate output power will be 760mW for a 1W input.

VARACTOR DIODES

General Information

VARACTOR DIODE SELECTION TABLES AND GRAPHS

The following Tables 1, 2 and 3 contain approximate performance data in respect of varactor diodes which are suitable for use as frequency doublers, triplers and quadruplers respectively.

Tabulated data are arranged in descending order of input power. Each table is followed by a complementary graph showing curves of diode efficiency versus power ratio. The curves to be used in connexion with a particular diode are indicated in the input frequency columns of the tables.

The codes given to the diode types in the tables are basic: when these types are associated with specific encapsulations they carry a commercial reference code which will be found in the appropriate data sheets.

General Information

CONTINUED

Table 1.—Diode Performance. Frequency Doublers

Diode Type	12·5 MHz P_{in} (W)	12·5 MHz Curve	25 MHz P_{in} (W)	25 MHz Curve	50 MHz P_{in} (W)	50 MHz Curve	100 MHz P_{in} (W)	100 MHz Curve	200 MHz P_{in} (W)	200 MHz Curve	400 MHz P_{in} (W)	400 MHz Curve	800 MHz P_{in} (W)	800 MHz Curve	1 600 MHz P_{in} (W)	1 600 MHz Curve	3 200 MHz P_{in} (W)	3 200 MHz Curve	6 400 MHz P_{in} (W)	6 400 MHz Curve
119C	2	A2	4	A3	8	A4	16	A5	32	A6	64	A7								
109B	1·7	A2	3·4	A3	6·8	A4	13·6	A5	27·2	A6	54·4	A7								
118D	1	A1	2	A2	4	A3	8	A4	16	A5	32	A6	64	A7						
118A	1	A2	2	A3	4	A4	8	A5	16	A6	32	A7								
89C	0·92	A2	1·8	A3	3·7	A4	7·4	A5	14·7	A6	29·4	A7								
108C	0·9	A1	1·7	A2	3·4	A3	6·8	A4	13·6	A5	27·2	A6	54·4	A7						
108A	0·9	A2	1·7	A3	3·4	A4	6·8	A5	13·6	A6	27·2	A7								
98C	0·6	A1	1·3	A2	2·6	A3	5·1	A4	10·2	A5	20·4	A6	41	A7						
88D	0·5	A1	0·9	A2	1·8	A3	3·7	A4	7·4	A5	14·7	A6	29·5	A7						
107B	0·4	A1	0·9	A2	1·7	A3	3·4	A4	6·8	A5	13·6	A6	27·2	A7						
107E			0·9	A1	1·7	A2	3·4	A3	6·8	A4	13·6	A5	27·2	A6	54·4	A7				
97B	0·3	A1	0·6	A2	1·3	A3	2·6	A4	5·1	A5	10·2	A6	20·4	A7						
97E			0·6	A1	1·3	A2	2·6	A3	5·1	A4	10·2	A5	20·4	A6	40·8	A7				
87B	0·2	A1	0·5	A2	0·9	A3	1·8	A4	3·7	A5	7·4	A6	15·7	A7						
87E			0·5	A1	0·9	A2	1·8	A3	3·7	A4	7·4	A5	15·7	A6	31·5	A7				
96A	0·2	A1	0·3	A2	0·6	A3	1·3	A4	2·6	A5	5·1	A6	10·2	A7						
96D			0·3	A1	0·6	A2	1·3	A3	2·6	A4	5·1	A6	10·2	A6	20·4	A7				
77B	0·2	A1	0·3	A2	0·6	A3	1·2	A4	2·3	A5	4·6	A5	9·3	A7						
77E			0·3	A1	0·6	A2	1·2	A3	2·3	A4	4·6	A5	9·3	A6	18·6	A7				
86C			0·2	A1	0·5	A2	0·9	A3	1·8	A4	3·7	A5	7·4	A6	15·7	A7				
86E					0·5	A1	0·9	A2	1·8	A3	3·7	A4	7·4	A5	14·7	A6	29·5	A7		
76C			0·2	A1	0·3	A2	0·6	A3	1·2	A4	2·3	A5	4·6	A6	9·2	A7				
76E					0·3	A1	0·6	A2	1·2	A3	2·3	A4	4·6	A5	9·3	A6	18·6	A7		
85A			0·1	A1	0·2	A2	0·5	A3	0·9	A4	1·8	A5	3·7	A6	7·4	A7				
85D					0·2	A1	0·5	A2	0·9	A3	1·8	A4	3·7	A5	7·4	A6	14·7	A7		
66B	0·038	A1	0·075	A2	0·15	A3	0·3	A4	0·6	A5	1·2	A6	2·4	A7						
66C			0·075	A1	0·15	A2	0·3	A3	0·6	A4	1·2	A5	2·4	A6	4·8	A7				
66E					0·15	A1	0·3	A2	0·6	A3	1·2	A4	2·4	A5	4·8	A6	9·6	A7		
75A			0·075	A1	0·15	A2	0·3	A3	0·6	A4	1·2	A5	2·3	A6	4·6	A7				
75D					0·15	A1	0·3	A2	0·6	A3	1·2	A4	2·3	A5	4·6	A6	9·3	A7		
65C			0·038	A1	0·08	A2	0·15	A3	0·3	A4	0·6	A5	1·2	A6	2·4	A7				
65D					0·08	A1	0·15	A2	0·3	A3	0·6	A4	1·2	A5	2·4	A6	4·8	A7		
64B			0·02	A1	0·04	A2	0·075	A3	0·15	A4	0·3	A5	0·6	A6	1·2	A7				
64C					0·04	A1	0·075	A2	0·15	A3	0·3	A4	0·6	A5	1·2	A6	2·4	A7		
64F							0·075	A1	0·15	A2	0·3	A3	0·6	A4	1·2	A5	2·4	A6	4·8	A7
54B			0·013	A1	0·026	A2	0·05	A3	0·1	A4	0·2	A5	0·4	A6	0·8	A7				
54C					0·026	A1	0·05	A2	0·1	A3	0·2	A4	0·4	A5	0·8	A6	1·6	A7		
54F							0·05	A1	0·1	A2	0·2	A3	0·4	A4	0·8	A5	1·6	A6	3·3	A7

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General Information

CONTINUED

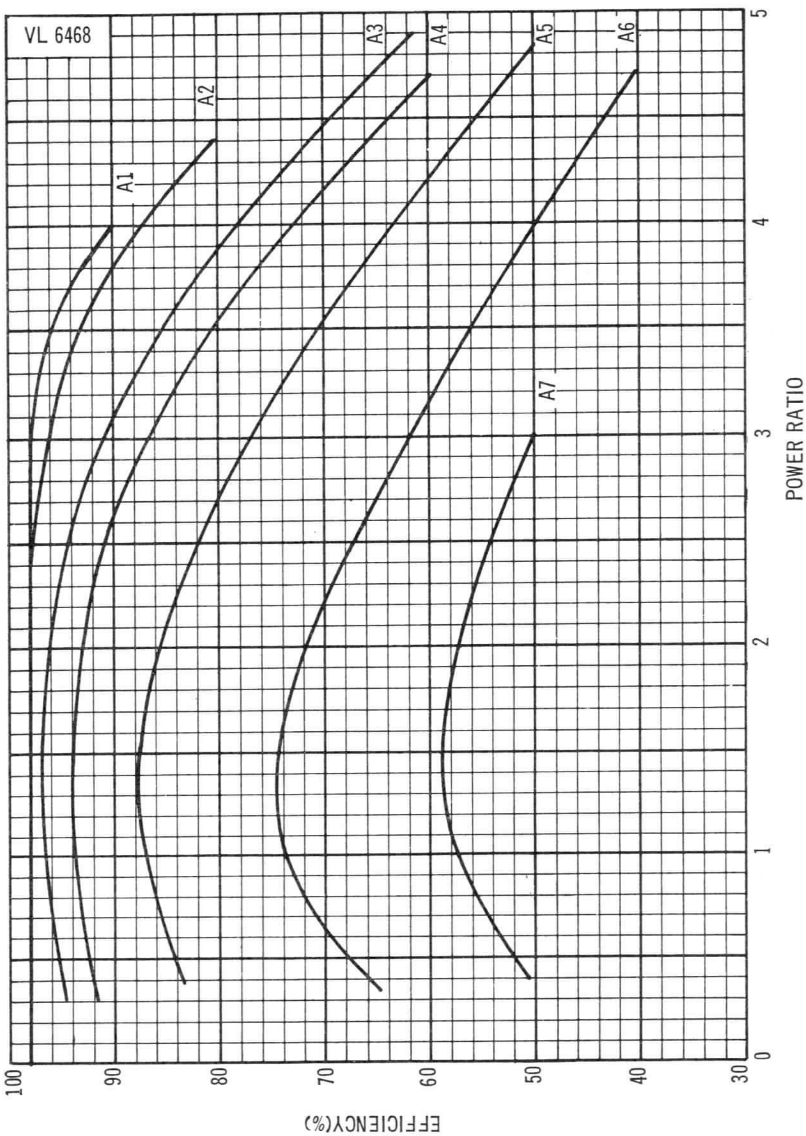
Table 1.—Diode Performance. Frequency Doublers (continued)

Diode Type	Input Frequency (MHz) 12·5		25		50		100		200		400		800		1 600		3 200		6 400	
	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve
63B			0·009	A1	0·019	A2	0·038	A3	0·075	A4	0·15	A5	0·3	A6	0·6	A7				
63C					0·019	A1	0·038	A2	0·075	A3	0·15	A4	0·3	A5	0·6	A6	1·2	A7		
63F							0·038	A1	0·075	A2	0·15	A3	0·3	A4	0·6	A5	1·2	A6	2·4	A7
53B			0·006	A1	0·013	A2	0·026	A3	0·05	A4	0·1	A5	0·2	A6	0·4	A7				
53C					0·013	A1	0·026	A2	0·05	A3	0·1	A4	0·2	A5	0·4	A6	0·8	A7		
53F							0·026	A1	0·05	A2	0·1	A3	0·2	A4	0·4	A5	0·8	A6	1·6	A7
52B			0·003	A1	0·006	A2	0·013	A3	0·026	A4	0·05	A5	0·1	A6	0·2	A7				
52C					0·006	A1	0·013	A2	0·026	A3	0·05	A4	0·1	A5	0·2	A6	0·4	A7		
52F							0·013	A1	0·026	A2	0·05	A3	0·1	A4	0·2	A5	0·4	A6	0·8	A7
43B			0·003	A1	0·006	A2	0·013	A3	0·026	A4	0·05	A5	0·1	A6	0·2	A7				
43C					0·006	A1	0·013	A2	0·026	A3	0·05	A4	0·1	A5	0·2	A6	0·4	A7		
43F							0·013	A1	0·026	A2	0·05	A3	0·1	A4	0·2	A5	0·4	A6	0·8	A7
42B			0·002	A1	0·003	A2	0·006	A3	0·013	A4	0·026	A5	0·05	A6	0·1	A7				
42C					0·003	A1	0·006	A2	0·013	A3	0·026	A4	0·05	A5	0·1	A6	0·2	A7		
42F							0·006	A1	0·013	A2	0·026	A3	0·05	A4	0·1	A5	0·2	A6	0·4	A7

General Information

CONTINUED

Efficiency Curves. Frequency Doublers
(To be used in conjunction with Table 1)



General Information

CONTINUED

Table 2.—Diode Performance. Frequency Triplers

Diode Type	Input Frequency (MHz): 12·5		25		50		100		200		400		800		1 600		3 200		6 400	
	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve
119C	1·7	B2	3·4	B3	6·7	B4	13·4	B5	26·9	B6	53·8	B7								
109B	1·4	B2	2·9	B3	5·7	B4	11·4	B5	22·9	B6	45·8	B7								
118D	0·8	B1	1·7	B2	3·4	B3	6·7	B4	13·4	B5	26·9	B6	53·8	B7						
118A	0·8	B2	1·7	B3	3·4	B4	6·7	B5	13·4	B6	26·9	B7								
89C	0·8	B2	1·5	B3	3·1	B4	6·1	B5	12·2	B6	24·5	B7								
108C	0·7	B1	1·4	B2	2·9	B3	5·7	B4	11·4	B5	22·9	B6	45·8	B7						
108A	0·7	B2	1·4	B3	2·9	B4	5·7	B5	11·4	B6	22·6	B7								
98C	0·6	B1	1·1	B2	2·2	B3	4·4	B4	8·7	B5	17·4	B6	34·9	B7						
88D	0·4	B1	0·8	B2	1·5	B3	3·1	B4	6·1	B5	12·2	B6	24·5	B7						
107E			0·7	B1	1·4	B2	2·9	B3	5·7	B4	11·4	B5	22·9	B6	45·6	B7				
107B	0·4	B1	0·7	B2	1·4	B3	2·9	B4	5·7	B5	11·4	B6	22·9	B7						
97B	0·3	B1	0·6	B2	1·1	B3	2·2	B4	4·4	B5	8·7	B6	17·4	B7						
97E			0·6	B1	1·1	B2	2·2	B3	4·4	B4	8·7	B5	17·4	B6	34·9	B7				
87B	0·2	B1	0·4	B2	0·8	B3	1·5	B4	3·1	B5	6·1	B6	12·2	B7						
87E			0·4	B1	0·8	B2	1·5	B3	3·1	B4	6·1	B5	12·2	B6	24·5	B7				
96A	0·1	B1	0·3	B2	0·6	B3	1·1	B4	2·2	B5	4·4	B6	8·7	B7						
96D			0·3	B1	0·6	B2	1·1	B3	2·2	B4	4·4	B5	8·7	B6	17·4	B7				
77B	0·1	B1	0·3	B2	0·5	B3	1	B4	2	B5	3·9	B6	7·8	B7						
77E			0·3	B1	0·5	B2	1	B3	2	B4	3·9	B5	7·8	B6	15·7	B7				
86C			0·2	B1	0·4	B2	0·8	B3	1·5	B4	3	B5	6·1	B6	12·2	B7				
86E					0·4	B1	0·8	B2	1·5	B3	3	B4	6·1	B5	12·2	B6	24·3	B7		
76C			0·1	B1	0·3	B2	0·5	B3	1	B4	2	B5	3·9	B6	7·8	B7				
76E					0·3	B1	0·5	B2	1	B3	2	B4	3·9	B5	7·8	B6	15·7	B7		
85A			0·1	B1	0·2	B2	0·4	B3	0·8	B4	1·5	B5	3	B6	6·1	B7				
85D					0·2	B1	0·4	B2	0·8	B3	1·5	B4	3	B5	6·1	B6	12·2	B7		
66B	0·032	B1	0·063	B2	0·13	B3	0·25	B4	0·5	B5	1	B6	2	B7						
66C			0·063	B1	0·13	B2	0·25	B3	0·5	B4	1	B5	2	B6	4	B7				
66E					0·13	B1	0·25	B2	0·5	B3	1	B4	2	B5	4	B6	8	B7		
75A			0·063	B1	0·13	B2	0·25	B3	0·49	B4	0·98	B5	2	B6	3·9	B7				
75D					0·13	B1	0·25	B2	0·49	B3	0·98	B4	2	B5	3·9	B6	7·8	B7		
65C			0·032	B1	0·063	B2	0·13	B3	0·25	B4	0·5	B5	1	B6	2	B7				
65D					0·063	B1	0·13	B2	0·25	B3	0·5	B4	1	B5	2	B6	4	B7		
64B			0·016	B1	0·032	B2	0·063	B3	0·13	B4	0·25	B5	0·5	B6	1	B7				
64C					0·032	B1	0·063	B2	0·13	B3	0·25	B4	0·5	B5	1	B6	2	B7		
64F							0·063	B1	0·13	B2	0·25	B3	0·5	B4	1	B5	2	B6	4	B7
54B			0·011	B1	0·021	B2	0·043	B3	0·086	B4	0·17	B5	0·34	B6	0·69	B7				
54C					0·021	B1	0·043	B2	0·086	B3	0·17	B4	0·34	B5	0·69	B6	1·4	B7		

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General Information

CONTINUED

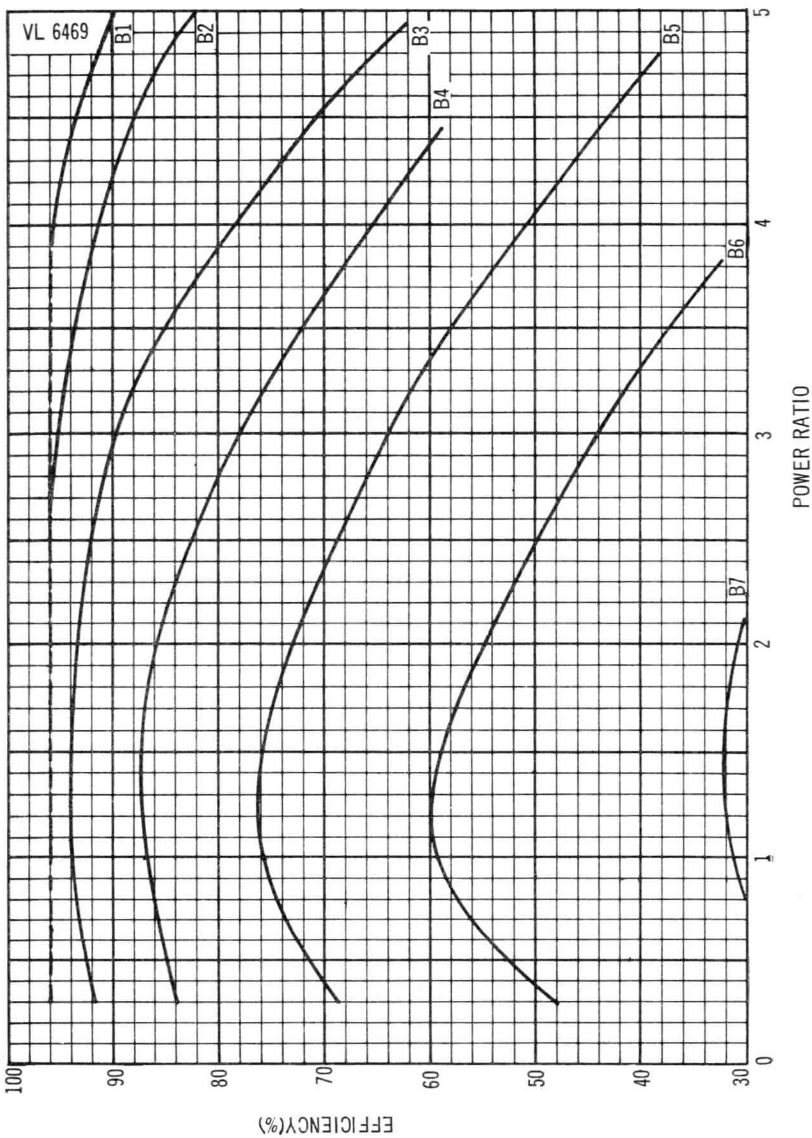
Table 2.—Diode Performance. Frequency Triplers (continued)

Diode Type	Input Frequency (MHz)																			
	12·5		25		50		100		200		400		800		1 600		3 200		6 400	
	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve
54F							0·043	B1	0·086	B2	0·17	B3	0·34	B4	0·69	B5	1·4	B6	2·7	B7
63B			0·008	B1	0·016	B2	0·032	B3	0·064	B4	0·13	B5	0·26	B6	0·51	B7				
63C					0·016	B1	0·032	B2	0·064	B3	0·13	B4	0·26	B5	0·51	B6	1	B7		
63F							0·032	B1	0·064	B2	0·13	B3	0·26	B4	0·51	B5	1	B6	2	B7
53B			0·006	B1	0·011	B2	0·021	B3	0·043	B4	0·086	B5	0·17	B6	0·34	B7				
53C					0·011	B1	0·021	B2	0·043	B3	0·086	B4	0·17	B5	0·34	B6	0·68	B7		
53F							0·021	B1	0·043	B2	0·086	B3	0·17	B4	0·34	B5	0·68	B6	1·37	B7
52B			0·003	B1	0·006	B2	0·011	B3	0·021	B4	0·043	B5	0·086	B6	0·17	B7				
52C					0·006	B1	0·011	B2	0·021	B3	0·043	B4	0·086	B5	0·17	B6	0·34	B7		
52F							0·011	B1	0·021	B2	0·043	B3	0·086	B4	0·17	B5	0·34	B6	0·68	B7
43B			0·003	B1	0·006	B2	0·011	B3	0·021	B4	0·043	B5	0·086	B6	0·17	B7				
43C					0·006	B1	0·011	B2	0·021	B3	0·043	B4	0·086	B5	0·17	B6	0·34	B7		
43F							0·011	B1	0·021	B2	0·043	B3	0·086	B4	0·17	B5	0·34	B6	0·68	B7
42B			0·002	B1	0·003	B2	0·006	B3	0·011	B4	0·021	B5	0·043	B6	0·086	B7				
42C					0·003	B1	0·006	B2	0·011	B3	0·021	B4	0·043	B5	0·086	B6	0·17	B7		
42F							0·006	B1	0·011	B2	0·021	B3	0·043	B4	0·086	B5	0·17	B6	0·34	B7

General Information

CONTINUED

Efficiency Curves. Frequency Triplers
(To be used in conjunction with Table 2)



STC

General Information

CONTINUED

Table 3.—Diode Performance. Frequency Quadruplers

Diode Type	Input Frequency (MHz) 12·5		25		50		100		200		400		800		1 600		3 200	
	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve	P_{in} (W)	Curve
119C	1·5	C2	3	C3	6	C4	12	C5	24	C6								
109B	1·3	C2	2·6	C3	5·1	C4	10·2	C5	20·5	C6								
118D	0·8	C1	1·5	C2	3	C3	6	C4	12	C5	24	C6						
118A	0·8	C2	1·5	C3	3	C4	6	C5	12	C6								
89C	0·7	C2	1·4	C3	2·8	C4	5·3	C5	10·6	C6								
108C	0·6	C1	1·3	C2	2·6	C3	5·1	C4	10·2	C5	20·5	C6						
108A	0·6	C2	1·3	C3	2·6	C4	5·1	C5	10·2	C6								
98C	0·5	C1	1	C2	2	C3	4	C4	8	C5	16	C6						
88D	0·3	C1	0·7	C2	1·4	C3	2·8	C4	5·3	C5	10·6	C6						
107B	0·3	C1	0·6	C2	1·3	C3	2·6	C4	5·1	C5	10·3	C6						
107E			0·6	C1	1·3	C2	2·6	C3	5·1	C4	10·2	C5	20·5	C6				
97B	0·3	C1	0·5	C2	1	C3	2	C4	4	C5	8	C6						
97E			0·5	C1	1	C2	2	C3	4	C4	8	C5	16	C6				
87B	0·2	C1	0·3	C2	0·7	C3	1·4	C4	2·8	C5	5·3	C6						
87E			0·3	C1	0·7	C2	1·4	C3	2·8	C4	5·3	C5	10·6	C6				
96A	0·1	C1	0·3	C2	0·5	C3	1	C4	2	C5	4	C6						
96D			0·3	C1	0·5	C2	1	C3	2	C4	4	C5	8	C6				
77B	0·1	C1	0·2	C2	0·4	C3	0·9	C4	1·8	C5	3·5	C6						
77E			0·2	C1	0·4	C2	0·9	C3	1·8	C4	3·5	C5	7	C6				
86C			0·2	C1	0·3	C2	0·7	C3	1·4	C4	2·8	C5	5·3	C6				
86E					0·3	C1	0·7	C2	1·4	C3	2·8	C4	5·3	C5	10·6	C6		
76C			0·1	C1	0·2	C2	0·4	C3	0·9	C4	1·8	C5	3·5	C6				
76E					0·2	C1	0·4	C2	0·9	C3	1·8	C4	3·5	C5	7	C6		
85A			0·1	C1	0·2	C2	0·3	C3	0·7	C4	1·3	C5	2·7	C6				
85D			0·2	C1	0·3	C2	0·7	C3	1·3	C4	2·7	C5	5·3	C6				
66B	0·028	C1	0·056	C2	0·11	C3	0·23	C4	0·45	C5	0·9	C6						
66C			0·056	C1	0·11	C2	0·23	C3	0·45	C4	0·9	C5	1·8	C6				
66E					0·11	C1	0·23	C2	0·45	C3	0·9	C4	1·8	C5	3·6	C6		
75A			0·056	C1	0·11	C2	0·23	C3	0·45	C4	0·9	C5	1·8	C6				
75D					0·11	C1	0·23	C2	0·45	C3	0·9	C4	1·8	C5	3·6	C6		
65A			0·028	C1	0·056	C2	0·11	C3	0·22	C4	0·45	C5	0·9	C6				
65D					0·056	C1	0·11	C2	0·22	C3	0·45	C4	0·9	C5	1·8	C6		
64B			0·014	C1	0·028	C2	0·056	C3	0·11	C4	0·22	C5	0·45	C6				
64C					0·028	C1	0·056	C2	0·11	C3	0·22	C4	0·45	C5	0·9	C6		
64F							0·056	C1	0·11	C2	0·22	C3	0·45	C4	0·9	C5	1·8	C6
54B	0·01	C1	0·019	C2	0·038	C3	0·077	C4	0·15	C5	0·31	C6						
54C					0·019	C1	0·038	C2	0·077	C3	0·15	C4	0·31	C5	0·62	C6		
54F							0·038	C1	0·077	C2	0·15	C3	0·31	C4	0·62	C5	1·2	C6

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General Information

CONTINUED

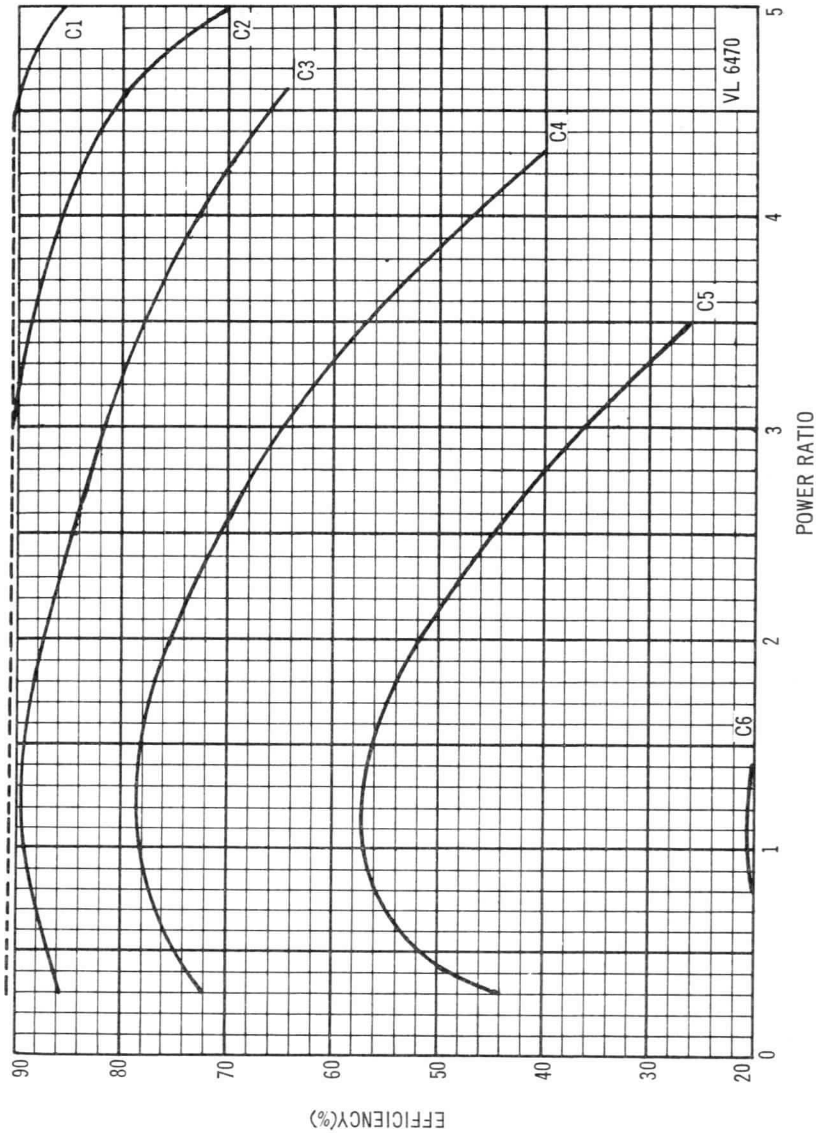
Table 3.—Diode Performance. Frequency Quadruplers (continued)

Diode Type	Input Frequency (MHz) 12·5 Pin (W)	12·5 Curve	25 Pin (W)	25 Curve	50 Pin (W)	50 Curve	100 Pin (W)	100 Curve	200 Pin (W)	200 Curve	400 Pin (W)	400 Curve	800 Pin (W)	800 Curve	1 600 Pin (W)	1 600 Curve	3 200 Pin (W)	3 200 Curve
63B			0·007	C1	0·014	C2	0·028	C3	0·056	C4	0·11	C5	0·22	C6				
63C					0·014	C1	0·028	C2	0·056	C3	0·11	C4	0·22	C5	0·45	C6		
63F							0·028	C1	0·056	C2	0·11	C3	0·22	C4	0·45	C5	0·9	C6
53B			0·005	C1	0·01	C2	0·019	C3	0·038	C4	0·077	C5	0·15	C6				
53C					0·01	C1	0·019	C2	0·038	C3	0·077	C4	0·15	C5	0·31	C6		
53F							0·019	C1	0·038	C2	0·077	C3	0·15	C4	0·31	C5	0·61	C6
52B			0·002	C1	0·005	C2	0·01	C3	0·019	C4	0·038	C5	0·077	C6				
52C					0·005	C1	0·01	C2	0·019	C3	0·038	C4	0·077	C5	0·15	C6		
52F							0·01	C1	0·019	C2	0·038	C3	0·077	C4	0·15	C5	0·31	C6
43B			0·002	C1	0·005	C2	0·01	C3	0·019	C4	0·038	C5	0·077	C6				
43C					0·005	C1	0·01	C2	0·019	C3	0·038	C4	0·077	C5	0·15	C6		
43F							0·01	C1	0·019	C2	0·038	C3	0·077	C4	0·15	C5	0·31	C6
42B			0·001	C1	0·002	C2	0·005	C3	0·01	C4	0·019	C5	0·038	C6				
42C					0·002	C1	0·005	C2	0·01	C3	0·019	C4	0·038	C5	0·077	C6		
42F							0·005	C1	0·01	C2	0·019	C3	0·038	C4	0·077	C5	0·15	C6

General Information

CONTINUED

Efficiency Curves. Frequency Quadruplers
(To be used in conjunction with Table 3)



VARACTOR DIODES

General Information

DATA SHEETS

This Section comprises the following data sheets:

VAC70 Series }
VBC70 Series }

VAC80 Series }
VBC80 Series }

VAC90 Series }
VBC90 Series }

VAC100 Series }
VBC100 Series }

VAC110 Series }
VBC110 Series }

VHC40 Series }
VJC40 Series }

VHC50 Series }
VJC50 Series }

VHC60 Series }
VJC60 Series }

VHC70 Series }
VJC70 Series }

VHC80 Series }
VJC80 Series }

VHC100 Series }
VJC100 Series }

VHE66M }
VJE66M }
VSE66M }

VMC77

VSC40 Series

VSC50 Series

VSC60 Series

VARACTOR DIODES

VAC70 Series. Stud type with glass seal
VBC70 Series. Stud type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	VAC75 VBC75	VAC76 VBC76	VAC77 VBC77	VAC78 VBC78	Conditions
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	8 to 16	16 to 32	Measured at $f_{in} = 1$ MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	20 to 40	40 to 80	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	90	90	90	90	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	9	7	6	5	
Series resistance at zero bias, maximum	$R_{s(o)}$						Measured at $f_{in} \simeq$ 600 MHz
			VAC75A VBC75A	VAC76A VBC76A	VAC77A VBC77A	VAC78A VBC78A	
"A" Quality		Ω	3·5	3	2·5	2	
			VAC75B VBC75B	VAC76B VBC76B	VAC77B VBC77B	VAC78B VBC78B	
"B" Quality		Ω	3	2·5	2	1·5	
			VAC75C VBC75C	VAC76C VBC76C	VAC77C VBC77C	VAC78C VBC78C	
"C" Quality		Ω	2·5	2	1·5	1·2	
			VAC75D VBC75D	VAC76D VBC76D			
"D" Quality		Ω	2	1·5			
				VAC76E VBC76E			
"E" Quality		Ω		1·2			

Characteristic	Symbol	Units	VAC70 Series	VBC70 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

VARACTOR DIODES

VAC80 Series. Stud type with glass seal
VAC80 Series. Stud type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value					Conditions
			VAC85 VBC85	VAC86 VBC86	VAC87 VBC87	VAC88 VBC88	VAC89 VBC89	
Junction capacitance at − 6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	8 to 16	16 to 32	32 to 64	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	20 to 40	40 to 80	80 to 160	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	120	120	120	120	120	At 10μA reverse current
Thermal resistance, typical	θ (typ.)	°C/W	9	7	6	5	4	
Series resistance at zero bias, maximum	$R_{s(o)}$							Measured at $f_{in} \simeq$ 600 MHz
			VAC85A VBC85A	VAC86A VBC86A	VAC87A VBC87A	VAC88A VBC88A	VAC89A VBC89A	
"A" Quality		Ω	3·5	3	2·5	2	1·5	
			VAC85B VBC85B	VAC86B VBC86B	VAC87B VBC87B	VAC88B VBC88B	VAC89B VBC89B	
"B" Quality		Ω	3	2·5	2	1·5	1·2	
			VAC85C VBC85C	VAC86C VBC86C	VAC87C VCB87C	VAC88C VBC88C	VAC89C VBC89C	
"C" Quality		Ω	2·5	2	1·5	1·2	0·9	
			VAC85D VBC85D	VAC86D VBC86D	VAC87D VBC87D			
"D" Quality		Ω	2	1·5	1·2			
				VAC86E VBC86E	VAC87E VBC87E			
"E" Quality		Ω		1·2	0·9			

Characteristic	Symbol	Units	VAC80 Series	VBC80 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

April 1967

VARACTOR DIODES

VAC90 Series. Stud type with glass seal
VBC90 Series. Stud type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value				Conditions
			VAC95 VBC95	VAC96 VBC96	VAC97 VBC97	VAC98 VBC98	
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	8 to 16	16 to 32	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	20 to 40	40 to 80	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	150	150	150	150	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	9	7	6	5	
Series resistance at zero bias, maximum	$R_{s(o)}$						Measured at $f_{in} \simeq$ 600 MHz
			VAC95A VBC95A	VAC96A VBC96A	VAC97A VBC97A	VAC98A VBC98A	
"A" Quality		Ω	6	4	3	2	
			VAC95B VBC95B	VAC96B VBC96B	VAC97B VBC97B	VAC98B VBC98B	
"B" Quality		Ω	5	3·5	2·5	1·5	
			VAC95C VBC95C	VAC96C VBC96C	VAC97C VBC97C	VAC98C VBC98C	
"C" Quality		Ω	4	3	2	1·2	
				VAC96D VBC96D	VAC97D VBC97D		
"D" Quality		Ω		2	1·5		
					VAC97E VBC97E		
"E" Quality		Ω			1·2		

Characteristic	Symbol	Units	VAC90 Series	VBC90 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

April 1967

VAC100 Series. Stud type with glass seal
VBC100 Series. Stud type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	VAC105 VBC105	VAC106 VBC106	VAC107 VBC107	VAC108 VBC108	VAC109 VBC109	Conditions
Junction capacitance at − 6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	8 to 16	16 to 32	32 to 64	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	20 to 40	40 to 80	80 to 160	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	180	180	180	180	180	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	9	7	6	5	4	
Series resistance at zero bias, maximum	$R_{s(o)}$							Measured at $f_{in} \simeq$ 600 MHz
			VAC105A VBC105A	VAC106A VBC106A	VAC107A VBC107A	VAC108A VBC108A		
"A" Quality		Ω	8	5	3·5	2·5		
			VAC105B VBC105B	VAC106B VBC106B	VAC107B VBC107B	VAC108B VBC108B	VAC109B VBC109B	
"B" Quality		Ω	6	4	2·5	1·5	1·2	
			VAC105C VBC105C	VAC106C VBC106C	VAC107C VBC107C	VAC108C VBC108C		
"C" Quality		Ω	5	3·5	2	1·2		
					VAC107D VBC107D			
"D" Quality		Ω			1·5			
					VAC107E VBC107E			
"E" Quality		Ω			1·2			

Characteristic	Symbol	Units	VAC100 Series	VBC100 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

April 1967

VARACTOR DIODES

VAC110 Series. Stud type with glass seal
VBC110 Series. Stud type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value: VAC115 VBC115	VAC116 VBC116	VAC117 VBC117	VAC118 VBC118	VAC119 VBC119	Conditions
Junction capacitance at − 6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	8 to 16	16 to 32	32 to 64	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	20 to 40	40 to 80	80 to 160	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	200	200	200	200	200	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	9	7	6	5	4	
Series resistance at zero bias, maximum	$R_{s(o)}$							Measured at $f_{in} \simeq$ 600MHz
			VAC115A VBC115A	VAC116A VBC116A	VAC117A VBC117A	VAC118A VBC118A		
"A" Quality		Ω	10	6	4	2·5		
			VAC115B VBC115B	VAC116B VBC116B	VAC117B VBC117B	VAC118B VBC118B		
"B" Quality		Ω	8	5	3·5	2		
			VAC115C VBC115C	VAC116C VBC116C	VAC117C VBC117C	VAC118C VBC118C	VAC119C VBC119C	
"C" Quality		Ω	6	4	3	1·5	1·2	
			VAC115D VBC115D			VAC118D VBC118D		
"D" Quality		Ω	5			1·2		

Characteristic	Symbol	Units	VAC110 Series	VBC110 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

April 1967

VARACTOR DIODES

VHC40 Series. Cartridge type with ceramic seal
VJC40 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value					Conditions
			VHC42 VJC42	VHC43 VJC43	VHC44 VJC44	VHC45 VJC45	VHC46 VJC46	
Junction capacitance at −6V bias	$C_{j\,(-6)}$	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	30	30	30	30	30	At 10µA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	70	35	25	18	14	
Cut-off frequency, minimum	$f_{c\,(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VHC42A VJC42A	VHC43A VJC43A	VHC44A VJC44A	VHC45A VJC45A	VHC46A VJC46A	
"A" Quality		GHz	40	40	40	25	15	
			VHC42B VJC42B	VHC43B VJC43B	VHC44B VJC44B	VHC45B VJC45B	VHC46B VJC46B	
"B" Quality		GHz	60	60	60	40	25	
			VHC42C VJC42C	VHC43C VJC43C	VHC44C VJC44C	VHC45C VJC45C	VHC46C VJC46C	
"C" Quality		GHz	90	90	90	60	40	
			VHC42D VJC42D	VHC43D VJC43D				
"D" Quality		GHz	120	120				
			VHC42E VJC42E	VHC43E VJC43E				
"E" Quality		GHz	150	150				
			VHC42F VJC42F	VHC43F VJC43F				
"F" Quality		GHz	180	180				

Characteristic	Symbol	Units	VHC40 Series	VJC40 Series
Case capacitance, approximate	C_p	pF	0·4	0·6
Internal lead inductance, approximate	L_s	nH	2	2

STC VARACTOR DIODES

VHC50 Series. Cartridge type with ceramic seal
VJC50 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	VHC52 VJC52	VHC53 VJC53	VHC54 VJC54	VHC55 VJC55	VHC56 VJC56	Conditions
Junction capacitance at −6V bias	$C_{j\,(-6)}$	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	48	48	48	48	48	At 10µA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	65	33	23	17	13	
Cut-off frequency, minimum	$f_{c(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VHC52A VJC52A	VHC53A VJC53A	VHC54A VJC54A	VHC55A VJC55A	VHC56A VJC56A	
"A" Quality		GHz	40	40	40	25	15	
			VHC52B VJC52B	VHC53B VJC53B	VHC54B VJC54B	VHC55B VJC55B	VHC56B VJC56B	
"B" Quality		GHz	60	60	60	40	25	
			VHC52C VJC52C	VHC53C VJC53C	VHC54C VJC54C	VHC55C VJC55C	VHC56C VJC56C	
"C" Quality		GHz	90	90	90	60	40	
			VHC52D VJC52D	VHC53D VJC53D	VHC54D VJC54D	VHC55D VJC55D	VHC56D VJC56D	
"D" Quality		GHz	120	120	120	90	60	
			VHC52E VJC52E	VHC53E VJC53E	VHC54E VJC54E	VHC55E VJC55E	VHC56E VJC56E	
"E" Quality		GHz	150	150	150	120	90	
			VHC52F VJC52F	VHC53F VJC53F	VHC54F VJC54F			
"F" Quality		GHz	180	180	180			

Characteristic	Symbol	Units	VHC50 Series	VJC50 Series
Case capacitance, approximate	C_p	pF	0·4	0·6
Internal lead inductance, approximate	L_s	nH	2	2

VARACTOR DIODES

VHC60 Series. Cartridge type with ceramic seal
VJC60 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value					Conditions
			VHC62 VJC62	VHC63 VJC63	VHC64 VJC64	VHC65 VJC65	VHC66 VJC66	
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	60	60	60	60	60	At 10μA reverse current
Thermal resistance, typical	θ(typ.)	°C/W	60	30	22	16	12	
Cut-off frequency, minimum	$f_{c(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VHC62A VJC62A	VHC63A VJC63A	VHC64A VJC64A	VHC65A VJC65A	VHC66A VJC66A	
"A" Quality		GHz	40	40	40	24	15	
			VHC62B VJC62B	VHC63B VJC63B	VHC64B VJC64B	VHC65B VJC65B	VHC66B VJC66B	
"B" Quality		GHz	60	60	60	40	25	
			VHC62C VJC62C	VHC63C VJC63C	VHC64C VJC64C	VHC65C VJC65C	VHC66C VJC66C	
"C" Quality		GHz	90	90	90	60	40	
			VHC62D VJC62D	VHC63D VJC63D	VHC64D VJC64D	VHC65D VJC65D	VHC66D VJC66D	
"D" Quality		GHz	120	120	120	90	60	
			VHC62E VJC62E	VHC63E VJC63E	VHC64E VJC64E	VHC65E VJC65E	VHC66E VJC66E	
"E" Quality		GHz	150	150	150	120	90	
			VHC62F VJC62F	VHC63F VJC63F	VHC64F VJC64F	VHC65F VJC65F	VHC66F VJC66F	
"F" Quality		GHz	180	180	180	150	120	

Characteristic	Symbol	Units	VHC60 Series	VJC60 Series
Case capacitance, approximate	C_p	pF	0·4	0·6
Internal lead inductance, approximate	L_s	nH	2	2

April 1967

VARACTOR DIODES

VHC70 Series. Cartridge type with ceramic seal
VJC70 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value: VHC75 VJC75	Value: VHC76 VJC76	Conditions
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	5 to 10	10 to 20	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	90	90	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	16	12	
Series resistance at zero bias, maximum	$R_{s(o)}$				Measured at $f_{in} \simeq$ 600 MHz
			VHC75A VJC75A	VHC76A VJC76A	
"A" Quality		Ω	3·5	3	
			VHC75B VJC75B	VHC76B VJC76B	
"B" Quality		Ω	3	2·5	
			VHC75C VJC75C	VHC76C VJC76C	
"C" Quality		Ω	2·5	2	
			VHC75D VJC75D	VHC76D VJC76D	
"D" Quality		Ω	2	1·5	
			VHC75E VJC75E	VHC76E VJC76E	
"E" Quality		Ω	1·5	1	

Characteristic	Symbol	Units	VHC70 Series	VJC70 Series
Case capacitance, approximate	C_p	pF	0·4	0·6
Internal lead inductance, approximate	L_s	nH	2	2

VARACTOR DIODES

VHC80 Series. Cartridge type with ceramic seal
VJC80 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value		Conditions
			VHC86 VJC86	VHC87 VJC87	
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	4 to 8	8 to 16	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	10 to 20	20 to 40	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	120	120	At 10µA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	10	8	
Series resistance at zero bias, maximum	$R_{s\,(o)}$				Measured at $f_{in} \simeq$ 600 MHz
			VHC86A VJC86A	VHC87A VJC87A	
"A" Quality		Ω	3	2·5	
			VHC86B VJC86B	VHC87B VJC87B	
"B" Quality		Ω	2·5	2	
			VHC86C VJC86C	VHC87C VJC87C	
"C" Quality		Ω	2	1·5	
			VHC86D VJC86D	VHC87D VJC87D	
"D" Quality		Ω	1·5	1·2	
			VHC86E VJC86E	VHC87E VJC87E	
"E" Quality		Ω	1·2	0·9	

Characteristic	Symbol	Units	VHC80 Series	VJC80 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

April 1967

VARACTOR DIODES

VHC100 Series. Cartridge type with ceramic seal
VJC100 Series. Cartridge type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	Value	Conditions
			VHC107 VJC107	
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	8 to 16	Measured at f_{in} = 1 MHz
Junction capacitance at zero bias	$C_{j(o)}$	pF	20 to 40	
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	180	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	8	
Series resistance at zero bias, maximum	$R_{s(o)}$			Measured at $f_{in} \simeq$ 600 MHz
			VHC107A VJC107A	
"A" Quality		Ω	3·5	
			VHC107B VJC107B	
"B" Quality		Ω	2·5	
			VHC107C VJC107C	
"C" Quality		Ω	2	
			VHC107D VJC107D	
"D" Quality		Ω	1	
			VHC107E VJC107E	
"E" Quality		Ω	1·2	

Characteristic	Symbol	Units	VHC100 Series	VJC100 Series
Case capacitance, approximate	C_p	pF	0·75	0·55
Internal lead inductance, approximate	L_s	nH	4	4

STC VARACTOR DIODES

PROVISIONAL DATA

VHE66M (Cartridge Type)
Codes: VJE66M (Cartridge Type)
VSE66M (Pill Type)

These epitaxial type varactor diodes are designed for high power, high frequency harmonic generation.

The suffix letter M in the codes of these types indicates that the diodes have been tested to a specified harmonic multiplier performance.

ELECTRICAL CHARACTERISTICS (At 25°C ambient temperature)

Characteristic	Symbol	Units	Value			Conditions
			VHE66M	VJE66M	VSE66M	
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	4 to 8	4 to 8	4 to 8	Measured with signal (f_{in}) of 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V (d.c.)	70	70	70	Reverse current = 10μA
Series resistance at −6V bias, typical	$R_{S(-6)}$	Ω	0·5	0·5	0·5	Measured with signal (f_{in}) of 600 MHz
Thermal resistance, typical	θ	°C/W	12	12	15	
Case capacitance, approx.	C_p	pF	0·4	0·6	0·25	
Internal lead inductance, approx.	L_s	nH	2	2	0·8	
Power output typical	$P_{o(typ.)}$	W	6	6	6	Doubler test circuit P_{in} = 10W; f_{in} = 1 GHz; f_{out} = 2GHz
Power output minimum	$P_{o(min.)}$	W	5·5	5·5	5·5	(as above)
Diode efficiency, typical	η	%	60	60	60	(as above)

April 1967

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
COMPONENTS GROUP

PROVISIONAL DATA

**Codes: VHE66M
VJE66M
VSE66M**

STC

CONTINUED

LIMIT RATINGS

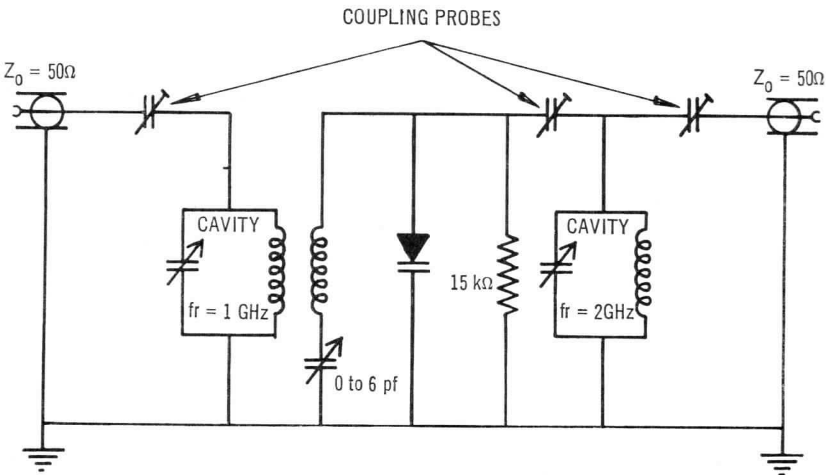
Characteristic	Symbol	Units	Value			Conditions
			VHE66M	VJE66M	VSE66M	
Junction temperature, maximum	$T_{j(max.)}$*	°C	175	175	175	*$T_j = T_{h.s.} + \theta P_j$ Where: $T_{h.s.}$ = Heat sink temperature P_j = Diode loss
Storage temperature	$T_{(stg.)}$	°C	−65 to +200	−65 to +200	−65 to +200	

TYPICAL PERFORMANCE IN QUADRUPLER APPLICATION (250 to 1 000 MHz)

R.F. power input (P_{in})	4 W
R.F. power output (P_{out})	2·2 W

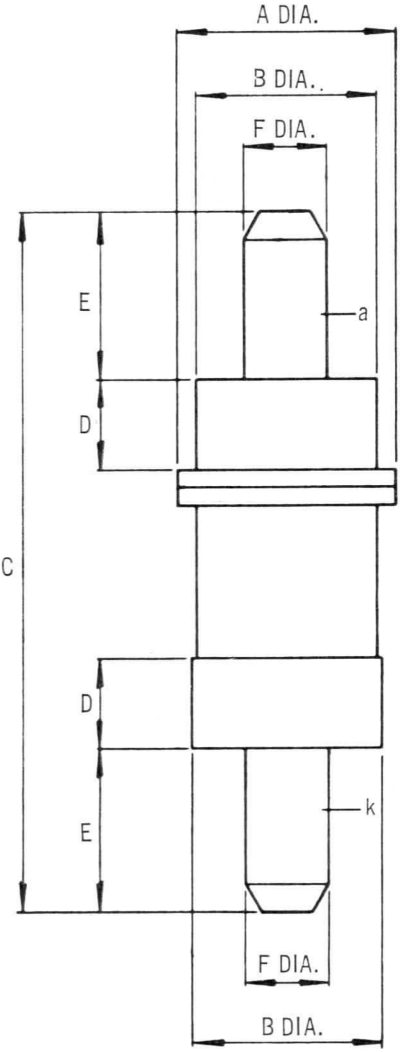
VHE66M
VJE66M
VSE66M

Harmonic Doubler Test Circuit



VHE66M Outline

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM.	MILLIMETRES		INCHES	
	Min	Max	Min	Max
A	5,944	6,147	0.234	0.242
B	5,207	5,461	0.205	0.215
C	19,4	20,17	0.764	0.794
D	2,36		0.093	
E	4,572	4,826	0.180	0.190
F	2,237	2,413	0.092	0.095

Millimetre dimensions are derived from original inch dimensions

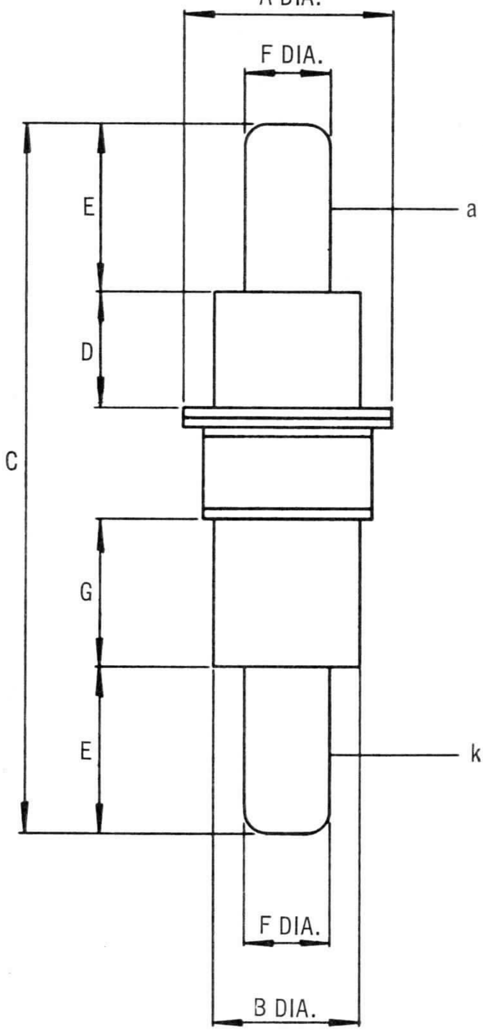
ACTUAL SIZE

Code: VJE66M

CONTINUED

VJE66M Outline

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM	MILLIMETRES	INCHES
A	5,97 MAX.	0.235 MAX.
B	4,06 ± 0,13	0.160 ± 0.005
C	19,79 ± 0,38	0.779 ± 0.015
D	3,05 MIN.	0.120 MIN.
E	4,70 ± 0,13	0.185 ± 0.005
F	2,39 ± 0,5	0.094 ± 0.002
G	3,43 MIN.	0.135 MIN.

Millimetre dimensions are derived from original inch dimensions

ACTUAL SIZE

PROVISIONAL DATA

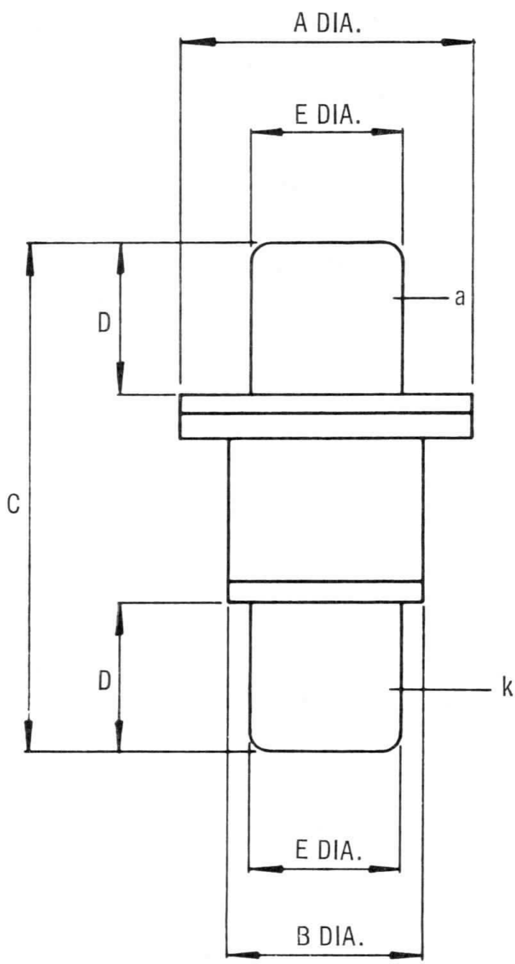
STC

Code: VSE66M

CONTINUED

VSE66M Outline

Note. Dimensions are subject to minor changes to comply with International standardisation now in progress.



DIM.	MILLIMETRES	INCHES
A	3,2 MAX.	0.125 MAX.
B	2,4 MAX.	0.093 MAX.
C	5,33 ± 0,25	0.215 ± 0.010
D	1,57 ± 0,08	0.062 ± 0.003
E	1,57 ± 0,08	0.063 ± 0.003

Millimetre dimensions are derived from original inch dimensions

ACTUAL SIZE

April 1967

STC **VARACTOR DIODES**

PROVISIONAL DATA

Code: VMC77M (Wire-ended)

This epitaxial type varactor diode is designed for low power harmonic generation.

The suffix letter M of the VMC77M code indicates that the diode has been tested to a specified harmonic multiplier performance.

ELECTRICAL CHARACTERISTICS (at 25°C ambient temperature)

Characteristic	Symbol	Units	Value	Conditions
Junction capacitance at −6V bias	$C_{j(-6)}$	pF	8 to 16	Measured with signal (f_{in}) of 1 MHz
Reverse breakdown voltage, min.	$V_{B(min.)}$	V(d.c.)	90	Reverse current = 10μA
Thermal resistance, typical	θ	°C/W	220	Measured with lead lengths of 3/8 in.
		°C/W	165	Measured with lead lengths of 1/8 in.
Case capacitance, approx.	C_p	pF	0·5	
Power output: typical	$P_{o(typ.)}$	W	0·52	Quadrupler test circuit P_{in} = 0·9W; f_{in} = 60MHz; f_{out} = 240MHz
minimum	$P_{o(min.)}$	W	0·49	
Diode efficiency, typical	η	%	58	

LIMIT RATINGS (at 25°C ambient temperature unless otherwise stated)

Characteristic	Symbol	Units	Value	Conditions
Junction temperature, max.	$T_{j(max.)}$*	°C	175°	*$T_j = T_{h.s.} + \theta P_j$ Where: $T_{h.s.}$ = Heat sink temp. P_j = Diode loss
Storage temperature	$T_{stg.}$	°C	−65 to +200	

TYPICAL PERFORMANCE IN QUADRUPLER APPLICATION (60 MHz to 240 MHz)

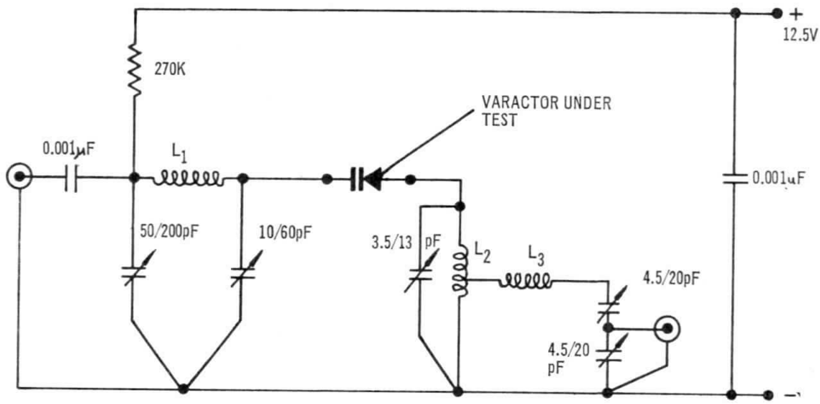
R.F. power input (P_{in}) 900 mW
R.F. power output (P_{out}) 520 mW

Standard Telephones and Cables Limited
Valve Division, Brixham Road, Paignton, Devon
Telephone: Paignton 50762 Telex: 4230
London Sales Office, Telephone: Footscray 3333 Telex: 21836
COMPONENTS GROUP

Code: VMC77M

CONTINUED

Harmonic Quadrupler Test Circuit



L_1 5 TURNS. 16 SWG.
WOUND 3/8 IN DIA. SPACED.

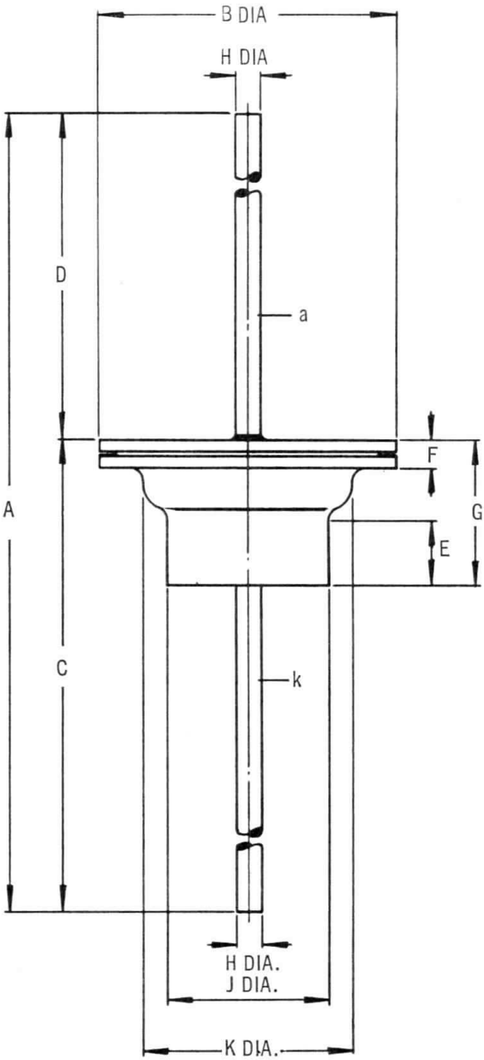
L_2 2 TURNS. 16 SWG.
WOUND 1/4 IN DIA. SPACED TAPPED 1 TURN.

L_3 4 TURNS. 16 SWG.
WOUND 1/4 IN DIA. SPACED.

Code: VMC77M

CONTINUED

VMC77M Outline



DIM	MILLIMETRES	INCHES
A	54,0 MAX.	2 1/8 MAX.
B	6,10 MAX.	0.240 MAX.
C	27,0 APPROX.	1 1/16 APPROX.
D	25,4 APPROX.	1 APPROX.
E	0,76 MIN.	0.030 MIN.
F	0,64 MAX.	0.025 MAX.
G	3,18 MAX.	0.125 MAX.
H	0,46 MIN. 0,56 MAX.	0.018 MIN. 0.022 MAX.
J	3,43 MAX.	0.135 MAX.
K	4,32 MAX.	0.170 MAX.

Millimetre dimensions are derived from original inch dimensions

ACTUAL SIZE

VARACTOR DIODES

VSC40 Series. Pill type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	VSC42	VSC43	VSC44	VSC45	VSC46	Conditions
Junction capacitance at −6V bias	$C_{j\,(-6)}$	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	30	30	30	30	30	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	100	50	36	26	20	
Cut-off frequency, minimum	$f_{c(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VSC42A	VSC43A	VSC44A	VSC45A	VSC46A	
"A" Quality		GHz	40	40	40	25	15	
			VSC42B	VSC43B	VSC44B	VSC45B	VSC46B	
"B" Quality		GHz	60	60	60	40	25	
			VSC42C	VSC43C	VSC44C	VSC45C	VSC46C	
"C" Quality		GHz	90	90	90	60	40	
			VSC42D	VSC43D	VSC44D	VSC45D	VSC46D	
"D" Quality		GHz	120	120	120	90	60	
			VSC42E	VSC43E	VSC44E	VSC45E	VSC46E	
"E" Quality		GHz	150	150	150	120	90	
			VSC42F	VSC43F				
"F" Quality		GHz	180	180				

Characteristic	Symbol	Units	Value
Case capacitance, approximate	C_p	pF	0·25
Internal lead inductance, approximate	L_s	nH	0·8

VARACTOR DIODES

VSC50 Series. Pill type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristics	Symbol	Units	Value					Conditions
			VSC52	VSC53	VSC54	VSC55	VSC56	
Junction capacitance at − 6V bias	$C_{j(-6)}$	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	48	48	48	48	48	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	93	47	33	24	19	
Cut-off frequency, minimum	$f_{c(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VSC52A	VSC53A	VSC54A	VSC55A	VSC56A	
"A" Quality		GHz	40	40	40	25	15	
			VSC52B	VSC53B	VSC54B	VSC55B	VSC56B	
"B" Quality		GHz	60	60	60	40	25	
			VSC52C	VSC53C	VSC54C	VSC55C	VSC56C	
"C" Quality		GHz	90	90	90	60	40	
			VSC52D	VSC53D	VSC54D	VSC55D	VSC56D	
"D" Quality		GHz	120	120	120	90	60	
			VSC52E	VSC53E	VSC54E	VSC55E	VSC56E	
"E" Quality		GHz	150	150	150	120	90	
			VSC52F	VSC53F	VSC54F			
"F" Quality		GHz	180	180	180			

Characteristic	Symbol	Units	Value
Case capacitance, approximate	C_p	pF	0·25
Internal lead inductance, approximate	L_s	nH	0·8

VARACTOR DIODES

VSC60 Series. Pill type with ceramic seal

Note.—Preferred types are shown in shaded areas.

Characteristic	Symbol	Units	VSC62	VSC63	VSC64	VSC65	VSC66	Conditions
Junction capacitance at −6V bias	C_j (—6)	pF	0·25 to 0·5	0·5 to 1	1 to 2	2 to 4	4 to 8	Measured at f_{in} = 1 MHz
Reverse breakdown voltage, minimum	$V_{B(min.)}$	V	60	60	60	60	60	At 10μA reverse current
Thermal resistance, typical	$\theta_{(typ.)}$	°C/W	86	43	31	22	17	
Cut-off frequency, minimum	$f_{c(min.)}$							Determined from Q at nominal V_B measured at 1 GHz
			VSC62A	VSC63A	VSC64A	VSC65A	VSC66A	
"A" Quality		GHz	40	40	40	25	15	
			VSC62B	VSC63B	VSC64B	VSC65B	VSC66B	
"B" Quality		GHz	60	60	60	40	25	
			VSC62C	VSC63C	VSC64C	VSC65C	VSC66C	
"C" Quality		GHz	90	90	90	60	40	
			VSC62D	VSC63D	VSC64D	VSC65D	VSC66D	
"D" Quality		GHz	120	120	120	90	60	
			VSC62E	VSC63E	VSC64E	VSC65E	VSC66E	
"E" Quality		GHz	150	150	150	120	90	
			VSC62F	VSC63F	VSC64F	VSC65F	VSC66F	
"F" Quality		GHz	180	180	180	150	120	

Characteristic	Symbol	Units	Value
Case capacitance, approximate	C_p	pF	0·25
Internal lead inductance, approximate	L_s	nH	0·8

THERMOCOUPLES

SPECIAL VALVES

U.H.F. Thermocouples

Code: T2H/60JA & B

These thermocouples are suitable for monitoring within the frequency range 300 Mc/s to 6000 Mc/s and are designed for building into the walls of resonators, wave-guides, and coaxial-lines, without leakage or appreciable loss.

They are small disc-seal tubes with an end cap. On one side of the disc is the R.F. pick-up loop of which the thermo-junction of manganin and constantan form a part.

The loop is incomplete for D.C. but the H.F. circuit is completed to the disc through a decoupling capacitor of approximately 35 pF. At the lower frequency end of the range an additional decoupling capacitance may be required.

The JA types are so connected that the output is positive at the end cap. The JB types have the end cap negative to the disc. The disc is notched on its periphery to provide location of the plane of the loop with respect to the mounting.

DIMENSIONS

Maximum overall length	54	mm
Maximum disc diameter	22.65	mm
Maximum bulb diameter	10.3	mm

CHARACTERISTICS

Type	Nominal Resistance of couple	Maximum safe heater current	Heater current required to produce in couple an open circuit e.m.f. of 15 mV
T2H/60JA & B	6 Ω	60 mA	38 mA

Standard Telephones and Cables Limited
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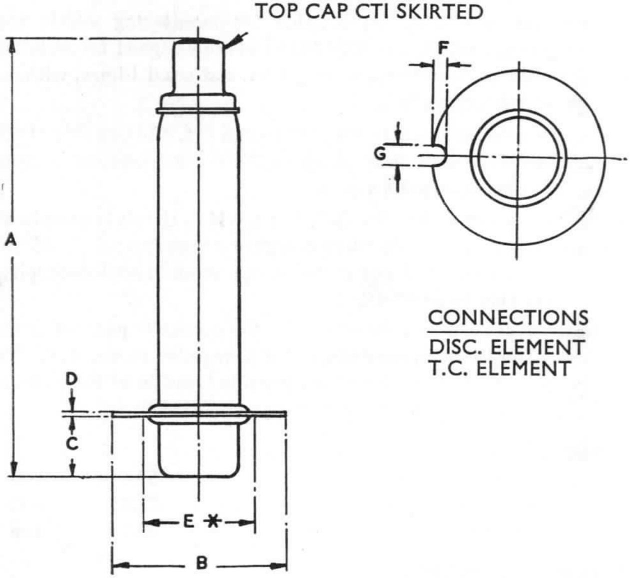
VALVE DIVISION, FOOTSCRAY, KENT Telephone: Footscray 3333

SPECIAL VALVES

U.H.F. Thermocouples

Code: T2H/60JA & B



DIM.	MILLIMETRES		INCHES	
A	49·2 ± 4·8		1 15/16 ± 3/16	
B	22·23 ± 0·20		0·875 ± 0·008	
C	6·0	MIN.	0·24	MIN.
	8·5	MAX.	0·33	MAX.
D	0·30	MAX.	0·012	MAX.
* E	15·87	MIN.	0 625	MIN.
F	1·57	+0·13 −0·00	0·062	+0·005 −0·000
G	2·36	+0·13 −0·00	0·093	+0·005 −0·000

NOTE: BASIC FIGURES ARE INCHES

*DENOTES MIN. CLAMPING DIAMETER