

# PHILIPS

Data handbook



Electronic  
components  
and materials

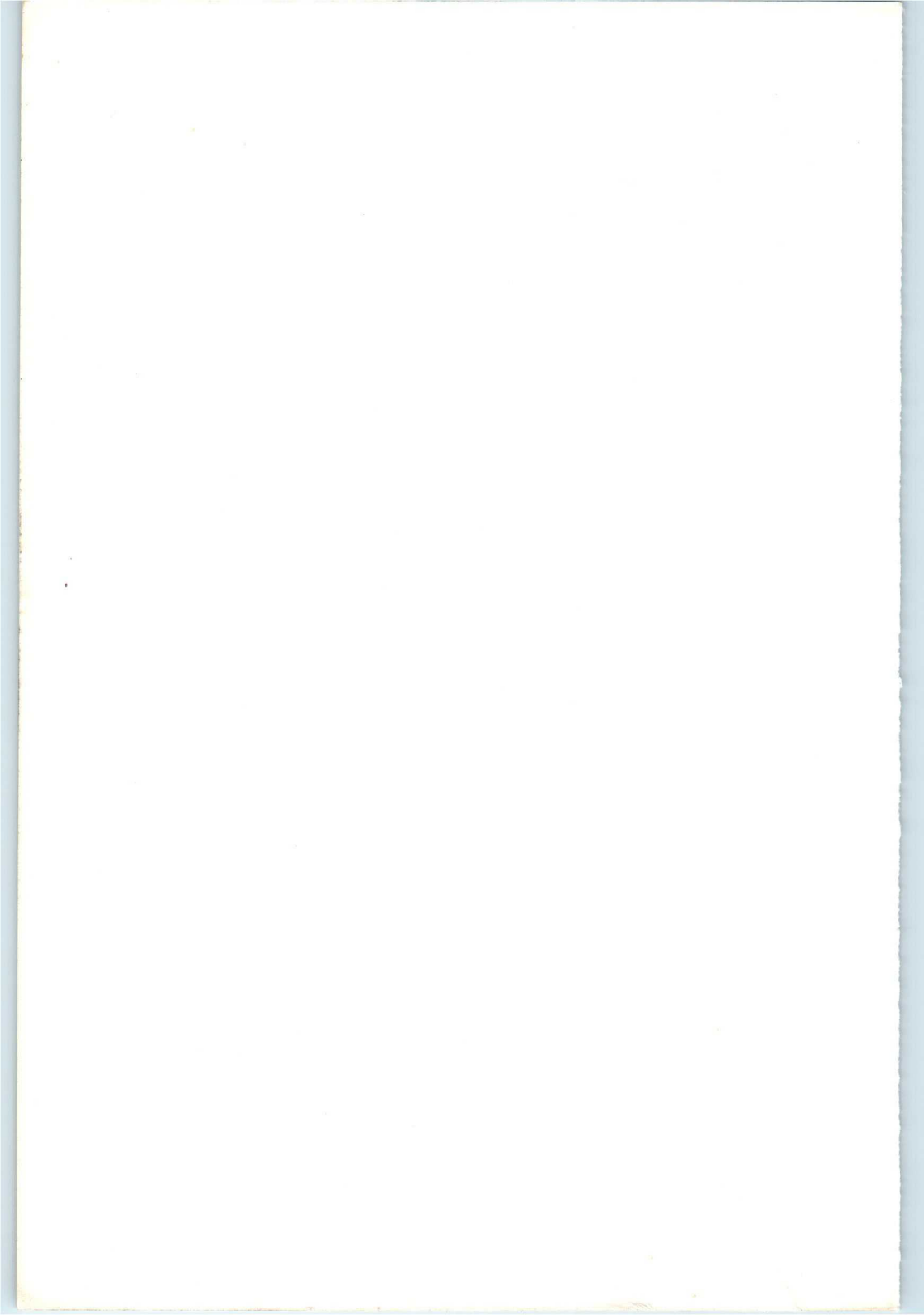
## Electron tubes

Part 9 December 1971

Transmitting triodes for communication

Triodes for r.f. heating

Associated accessories





# ELECTRON TUBES

Part 9

December 1971

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General section

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Transmitting tubes for communication  
and Tubes for R.F. heating

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TRIODES

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Associated accessories

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## DATA HANDBOOK SYSTEM

To provide you with a comprehensive source of information on electronic components, subassemblies and materials, our Data Handbook System is made up of three series of handbooks, each comprising several parts.

The three series, identified by the colours noted, are:

**ELECTRON TUBES** (9 parts) BLUE

**SEMICONDUCTORS AND INTEGRATED CIRCUITS** (5 parts) RED

**COMPONENTS AND MATERIALS** (7 parts) GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued annually; the contents of each series are summarized on the following pages.

We have made every effort to ensure that each series is as accurate, comprehensive and up-to-date as possible, and we hope you will find it to be a valuable source of reference. Where ratings or specifications quoted differ from those published in the preceding edition they will be pointed out by arrows. You will understand that we can not guarantee that all products listed in any one edition of the handbook will remain available, or that their specifications will not be changed, before the next edition is published. If you need confirmation that the published data about any of our products are the latest available, may we ask that you contact our representative. He is at your service and will be glad to answer your inquiries.

## ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

**Part 1** **January 1971**  
Transmitting tubes (Tetrodes, Pentodes)      Associated accessories

**Part 2** **March 1971**  
Tubes for microwave equipment

**Part 3** **March 1970**  
Special Quality tubes      Miscellaneous devices

**Part 4** **April 1971**  
Receiving tubes

**Part 5** **May 1971**  
Cathode-ray tubes  
Photo tubes      Associated accessories  
Camera tubes

**Part 6** **June 1971**  
Photomultipliers tubes      Radiation counter tubes  
Channel electron multipliers      Semiconductor radiation detectors  
Scintillators      Neutron generator tubes  
Photoscintillators      Photo diodes  
Associated accessories

**Part 7** **July 1971**  
Voltage stabilizing and reference tubes      Thyratrons  
Counter, selector, and indicator tubes      Ignitrons  
Trigger tubes      Industrial rectifying tubes  
Switching diodes      High-voltage rectifying tubes

**Part 8** **August 1971**  
T. V. Picture tubes

**Part 9** **January 1971**  
Transmitting tubes (Triodes)      Associated accessories  
Tubes for R. F. heating (Triodes)

August 1971

# SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

<b>Part 1</b>	<b>Diodes and Thyristors</b>	<b>September 1971</b>
General	Thyristors, diacs, triacs	
Signal diodes	Rectifier stacks	
Variable capacitance diodes	Accessories	
Voltage regulator diodes	Heatsinks	
Rectifier diodes		
<b>Part 2</b>	<b>Low frequency; Deflection</b>	<b>October 1971</b>
General	Deflection transistors	
Low frequency transistors (low power)	Accessories	
Low frequency power transistors		
<b>Part 3</b>	<b>High frequency; Switching</b>	<b>November 1971</b>
General	Switching transistors	
High frequency transistors	Accessories	
<b>Part 4</b>	<b>Special types</b>	<b>December 1971</b>
General	Photoconductive devices	
Transmitting transistors	Photodiodes	
Microwave devices	Phototransistors	
Field effect transistors	Light emitting diodes	
Dual transistors	Infra-red sensitive devices	
Microminiature devices for thick- and thin-film circuits	Accessories	
<b>Part 5</b>	<b>Integrated Circuits</b>	<b>March 1971</b>
General	Linear integrated circuits	
Digital integrated circuits		
DTL (FC family)		
TTL (FJ family)		
MOS (FD family)		

# COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

## **Part 1 Circuit Blocks, Input/Output Devices, October 1971** **Electro-mechanical Components \*), Peripheral Devices**

Circuit blocks 40-Series	Input/output devices
Counter modules 50-Series	Electro-mechanical components *)
Norbits 60-Series, 61-Series	Peripheral devices
Circuit blocks 90-Series	

## **Part 2 Resistors, Capacitors December 1971**

Fixed resistors	Paper capacitors and film capacitors
Variable resistors	Electrolytic capacitors
Non-linear resistors	Variable capacitors
Ceramic capacitors	

## **Part 3 Radio, Audio, Television February 1971**

FM tuners	Audio and mains transformers
Coils * *)	Television tuners
Piezoelectric ceramic resonators	Components for black and white television
and filters	Components for colour television
Loudspeakers	Deflection assemblies for camera tubes

## **Part 4 Magnetic Materials, Piezoelectric Ceramics April 1971**

Ferrites for radio, audio	Ferroxcube potcores and square cores
and television	Ferroxcube transformer cores
Small coils, assemblies and	Piezoxide
assembling parts	Permanent magnet materials

## **Part 5 Memory Products, Magnetic Heads, Quartz Crystals, June 1971** **Microwave Devices, Variable Transformers**

Ferrite memory cores	Quartz crystal units, crystal filters
Matrix planes, matrix stacks	Isolators, circulators
Complete memories	Variable mains transformers
Magnetic heads	

## **Part 6 Electric Motors and Accessories, August 1971** **Timing and Control Devices**

Stepper motors	Small d. c. motors
Small synchronous motors	Tachogenerators and servomotors
Asynchronous motors	Indicators for built-in test equipment

## **Part 7 Circuit Blocks September 1971**

Circuit blocks 100kHz Series	Circuit blocks for ferrite core
Circuit blocks 1-Series	memory drive
Circuit blocks 10-Series	

\*) From October 1971 published in Part 1 instead of Part 5.

\* \*) Also included (under "Small coils, etc.") in Part 4.

December 1971

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## General section

List of symbols

General operational recommendations

Bases



# TRANSMITTING TUBES FOR COMMUNICATION

## TUBES FOR R.F. HEATING

### LIST OF SYMBOLS



#### 1. Symbols denoting electrodes and electrode connections

Anode	a
Beam plates	bp
Filament or heater	f
Filament or heater tap or star point of three star connected filaments	f <sub>c</sub>
Grid	g
Tube pin which must not be connected externally	i. c.
Cathode	k
External conductive coating	m
Internal shield	s

#### Remarks

- a. Similar electrodes of the same electrode system are distinguished by means of an additional numeral; the electrode nearest to the cathode has the smallest number. Example: with pentodes g<sub>1</sub>, g<sub>2</sub>, g<sub>3</sub>.
- b. Equivalent electrodes of a multi-unit tube are distinguished by means of an apostrophe; e.g. the anodes of a double tetrode are indicated by a and a'.

#### 2. Symbols denoting voltages

##### Remarks

- a. In the case of indirectly heated tubes the voltages on the various electrodes are with respect to the cathode, in the case of d.c. fed, directly heated tubes with respect to the negative side of the filament, and in the case of a.c. fed, directly heated tubes with respect to the electrical centre of the filament, unless otherwise stated.
- b. The symbols quoted below represent the average values of the concerning voltages, unless otherwise stated.

Anode voltage	V <sub>a</sub>
Anode a.c. voltage	V <sub>a~</sub>
Anode voltage in cut-off or cold condition	V <sub>a0</sub>
Supply voltage of tube electrodes	V <sub>b</sub>
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2. Symbols denoting voltages (continued)

Filament or heater voltage	$V_f$
Grid voltage	$V_g$
Grid a. c. voltage	$V_{g\sim}$
A. C. input voltage	$V_i$
Voltage between heater and cathode	$V_{kf}$
Peak value of a voltage	$V_p$
RMS value of a voltage	$V_{RMS}$
Secondary transformer voltage	$V_{tr}$

3. Symbols denoting currents

Remarks

- The positive electrical current is directed opposite to the direction of the electron current.
- The symbols quoted below represent the average values of the concerning currents, unless otherwise stated.

Anode current	$I_a$
Filament or heater current	$I_f$
Grid current	$I_g$
Cathode current	$I_k$
Peak value of a current	$I_p$
RMS value of a current	$I_{RMS}$
Saturation current	$I_{sat}$

4. Symbols denoting powers

Anode dissipation	$W_a$
Driver output power	$W_{dr}$
Grid dissipation	$W_g$
Input power	$W_i$
Anode supply d. c. power	$W_{ia}$
Output power in the load	$W_{load}$
Modulation power	$W_{mod}$
Tube output power	$W_o$
Peak envelope output power	$W_{oPEP}$
Oscillator output power	$W_{osc}$

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5. Symbols denoting capacitances

In general the published capacitance values refer to the cold tube

Capacitance between the anode and all other elements except the control grid	$C_a$
Capacitance between anode and filament (all other elements being earthed)	$C_{af}$
Capacitance between anode and grid (all other elements being earthed)	$C_{ag}$
Capacitance between anode and cathode (all other elements not connected to the cathode being earthed)	$C_{ak}$
Capacitance between grid and filament (all other elements being earthed)	$C_{gf}$
Capacitance between control grid and all other elements except anode	$C_g$
Capacitance between two grids (all other elements being earthed)	$C_{g_1g_2}$
Capacitance between grid and cathode (all other elements not connected to the cathode being earthed)	$C_{gk}$
Input capacitance of a push-pull circuit	$C_i$
Capacitance between cathode and all other elements	$C_k$
Output capacitance of a push-pull circuit	$C_o$



6. Symbols denoting resistances

External a. c. resistance in an anode lead or matching resistance	$R_{a\sim}$
Matching resistance of a push-pull amplifier (anode to anode)	$R_{aa\sim}$
Filament or heater resistance	$R_f$
Filament or heater resistance in cold condition	$R_{f0}$
External resistor in a grid lead	$R_g$
External resistor in a cathode lead	$R_k$

7. Symbols denoting various quantities

Bandwidth	$B$
Harmonic distortion factor	$d$
n-th harmonic distortion	$d_n$
Total harmonic distortion	$d_{tot}$

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7. Symbols denoting various quantities (continued)

Intermodulation distortion	$d_i$
n-th order intermodulation distortion	$d_{i_n}$
Frequency	$f$
Pulse repetition rate	$f_{imp}$
Height above sea level	$h$
Modulation factor	$m$
Pressure drop of cooling air or cooling water	$p_i$
Required flow of cooling air or cooling water	$q$
Thermal resistance	$R_{th}$
Mutual conductance	$S$
Temperature of anode or anode block	$t_a$
Ambient temperature	$t_{amb}$
Bulb temperature	$t_{bulb}$
Cathode heating time	$T_h$
Inlet temperature of cooling air or cooling water	$t_i$
Pulse duration	$T_{imp}$
Outlet temperature of cooling air or cooling water	$t_o$
Seal temperature	$t_s$
Waiting time (= time which has to pass between switching on of the filament or heater voltage and switching on of the other voltages)	$T_w$
Duty factor	$\delta$
Efficiency	$\eta$
Wavelength	$\lambda$
Amplification factor	$\mu$
Amplification factor of grid No. 2 with respect to grid No. 1	$\mu_{g_2g_1}$



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# GENERAL OPERATIONAL RECOMMENDATIONS TRANSMITTING TUBES FOR COMMUNICATION TUBES FOR R.F. HEATING



## 1. GENERAL

1.1 In this handbook section data and curves are given for transmitting tubes and tubes for R.F. heating.

1.2 The tubes are classified into three groups

- Preferred types        - to be considered when designing new equipment
- Maintenance types   - still in production but to be avoided when designing new equipment.
- Obsolescent types    - will be supplied until present stocks are exhausted.

Full details are given of preferred types. Data on maintenance and obsolescent types is given in condensed form.

## 2. CHARACTERISTIC DATA

2.1 The characteristic data given in the data sheets is general and independent of specific application. This data (e.g. filament/heater current, amplification factor, transconductance, capacitances etc.) is applicable to a typical tube and deviations from the stated values are likely to occur in practice.

### 2.2 Filament/heater supply

The published value of filament/heater voltage is generally that which should be present directly at the tube terminals. Filaments fed with direct current should have their supply polarity reversed at regular intervals (say monthly), to ensure uniform wear of the filament with consequent longer life.

Reduction of filament voltage is sometimes recommended to compensate e.g. the heating by back-bombardment at high frequencies; see the relevant data sheets.

Special precautions must be taken when operating the filaments/heaters of transmitting tubes in series and the manufacturer should be consulted before doing so.

#### 2.2.1 Pure tungsten cathodes (filaments)

The published value of filament voltage is the maximum voltage required for a new tube to supply the rated output power. A lower voltage (giving longer life) will often suffice and every tube with a pure tungsten cathode is supplied together with a list stating the saturation current at various filament voltages. Thus, knowing the required emission current, the most suitable filament voltage can be selected. Alternatively the filament voltage can be adjusted until the required output power, or maximum permissible distortion, is reached

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and, (to obtain peak output power) further adjusted after modulation is applied. Regular adjustment (say monthly) will be necessary to maintain the required conditions and, towards the end of tube life, the filament voltage may be raised above the nominal.

To compensate for mains supply fluctuations, automatic or manual control of the filament voltage should be exercised, especially when operating at nominal, or higher than nominal, filament voltage.

#### 2.2.2 Thoriated tungsten cathodes (filaments)

The maximum working life from these cathodes is obtained when the filament voltage is held within 1% of the nominal. Underheating and overheating may be harmful so temporary deviations from the nominal voltage must not exceed  $\pm 5\%$ , unless otherwise specified.

#### 2.2.3 Quick heating cathodes (filaments)

In general, tubes with quick heating cathodes should have their filaments in parallel only. When a sinusoidal voltage is used for heating the filament, the frequency must not be in the range 200 Hz to 5000 Hz.

When a non-sinusoidal voltage from a d.c. -a.c. converter is used the r.m.s. value should be adjusted to the published value of filament voltage.

If required the heating time can be further reduced by applying a higher value for a short time. The manufacturer should be consulted before doing so.

#### 2.2.4 Indirectly heated oxide coated cathodes

For maximum life the heater voltage should be as near as possible to the nominal value and the maximum permissible deviation must not exceed 10%, unless otherwise specified.

R.F. voltages between heater and cathode may induce faulty r.f. insulation with resultant r.f. power losses. To overcome these losses an increase in the driving power would be required resulting in an increase of cathode temperature with a consequent reduction of tube life. Such r.f. voltages should therefore be avoided e.g. by using one of the following techniques:

- by-passing the heater to cathode insulation and decoupling the heater at v.h.f. and u.h.f.
- r.f. blocking with series chokes in heater supply leads and decoupling with capacitors.

#### 2.2.5 Switching on the filament voltage

Unless a maximum switch-on value of filament current is stated in the data sheet, switching on at full filament voltage is permissible. The published values of the maximum permissible filament current during switch on, refer to the absolute maximum of the instantaneous value under worst case conditions. With a.c. feed this will exist when switching on at the instantaneous peak voltage of the highest mains voltage that may occur. In practice the filament current during switching on can be limited by means of a filament transformer with high magnetic leakage or a series choke or resistor in the primary of the

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transformer. If necessary this choke or resistor may be short circuited by means of a relay after a delay of, say, 15 seconds.

#### 2.2.6 By-passing the filament

Tubes with directly heated cathodes must have the filament terminals at the same r.f. potential. For this purpose it is usual to connect a capacitor, that has low reactance with respect to the operating frequency, near to and between the filament terminals. As an added safety precaution it should be established that the resonance of this capacitor together with the inductance of the filament structure falls well below the operating frequency.

#### 2.3 Switching on of the electrode voltages

Unless prescribed otherwise simultaneous switching on of filament, anode, control-grid, and screen-grid voltages is permissible for tubes with an internal anode. Tubes with an external anode should in general not have their positive voltages applied until the cathode has reached its operating temperature. This can be checked by monitoring the filament current.

#### 2.4 Anode return

If the filament is fed with d.c. the anode return lead should be connected to the negative end of the filament. If the filament is fed with a.c. the anode return lead should be connected to the transformer mid-tap or to a tapped resistor shunted across the filament.

#### 2.5 Inter-electrode capacitances

The published values of capacitances are average values measured on the cold tube with no operating voltages; individual deviations may however occur.

The definitions of the capacitance symbols are given in the appropriate list in I. E. C. Publication 100.

#### 2.6 Amplification factor $\mu$ and transconductance $S$

The published values are average values and individual deviations may occur. Normally the conditions at which the values have been measured, are stated.

#### 2.7 Saturation current $I_{sat}$

Each large tube with a pure tungsten cathode is marked with the value of filament voltage at which the saturation current has the value specified in the data sheet.

#### 2.8 Accessories

Proper functioning of the tubes can be guaranteed only if accessories (sockets, cooling devices etc.) have been supplied, or approved, by the tube manufacturer.

### 3. **LIMITING VALUES**

3.1 Limiting values mean the maximum, or minimum, permissible values of the parameters listed. These limits are given either for all operating conditions together, or for a particular application.



3.2 The limiting values are applicable up to the maximum frequency stated. When operating at higher frequencies the limiting values must be decreased in accordance with the published data or curves.

### 3.3 Derating the limiting values

If no limiting values have been published for a specific application the derating factors listed in the following table must be applied. The values for class C telegraphy have been expressed as unity; the limiting values for other applications have been expressed as a factor of this unity.

A rectified 3-phase supply with or without filtering is equivalent to a d.c. supply.

The derating factors are determined by the physical limits of the tube and contain no safety margins. Where mains voltage fluctuations occur further derating must be applied (see section 3.5). The nature of operation, e.g. the industrial application of heating generators may necessitate further safety derating (see section 5.4).

Wo = tungsten filament

Th = thoriated tungsten filament

		V <sub>a</sub>	I <sub>a</sub>	I <sub>g</sub>	W <sub>1a</sub>	W <sub>a</sub>	W <sub>g2</sub>
R.F. class C telegraphy		1	1	1	1	1	1
Anode mod.	Th	0.8	0.833	1	0.67	0.67	0.67
	Wo	0.8	0.5	1	0.4	0.4	0.4
R.F. class B	Th	1	0.833	1	0.833 <sup>1)</sup>	1	0.67
	Wo	1	0.5	1	0.5	1	0.5
A.F. class B		1	1	1	1	1	1
A.F. class AB		1	1	1	1	1	1
A.F. class A		1	1		W <sub>a</sub>	1	1
Self-rectifying oscillator	Th	1.13	0.53	0.53	0.665	1	
	Wo	1.13	0.32	0.32	0.4	1	
Two-phase half-wave without filter	Th	0.9	0.89	0.89	1	1	
	Wo	0.9	0.6	0.6	1	1	

<sup>1)</sup> or 1.5 W<sub>a</sub>.

### 3.4 Rating system

The limiting values should be used in accordance with the "Absolute maximum rating system" as defined by I. E. C. Publication 134.

### 3.5 Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.



These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment components variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

- 3.6 Each limiting value should be regarded independently of other values; under no circumstances is any limiting value to be exceeded (e.g. if the anode voltage is decreased to a value lower than its limiting value, it is not permissible to exceed the limiting value of anode current or anode dissipation). Unless otherwise stated, the limiting values for currents and voltages are measured with a moving coil instrument.

### 3.7 Electrode voltages

The voltages ( $V_a$ ,  $V_{g1}$ ,  $V_{g2}$  etc.) listed under limiting values should not be exceeded even with a cold tube. Special attention should be paid to this point when a screen-grid is supplied via a series resistor.

When designing equipment to be supplied from non-stabilized mains, the maximum mains voltage occurring determines the nominal operating voltages of the tube. These nominal voltages must be lower than the limiting values. Should the transmitting tubes, and thus the voltage supply, be temporarily under a lower load their voltages will increase and these increased values, occurring at the highest mains voltage, determine the nominal operating voltages.

The limiting values of voltage are d.c. values. If an a.c. or an unsmoothed d.c. supply is used, the limiting values must be decreased in accordance with the derating factors shown in the table (section 3.3).

### 3.8 Anode dissipation

The limiting value of the anode dissipation  $W_a$  should not be exceeded when mains voltage fluctuations occur, or when grid drive fails. To prevent damage to the tube, in the latter case, adequate fixed bias or a quick action relay in the anode lead should be provided. When forced-air or water-cooling is sufficient only for an anode dissipation smaller than the absolute maximum, the smaller value must be regarded as the limiting value.

### 3.9 Anode input power

Usually the data sheets show the limiting value of input power  $W_{i_a}$  to be smaller than the product of limiting values of anode voltage and anode current; the latter two limits should not therefore occur simultaneously.

In practice the input power  $W_{i_a}$  is not always the product of the d.c. values of  $I_a$  and  $V_a$ . For pulsating supply voltages the form factor should be taken into

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account.

- 3.10 For the screen-grid dissipation the product of screen-grid voltage and current can always be taken.

The screen-grid should be protected against failure of anode voltage.

3.11 Control-grid dissipation

The control-grid dissipation  $W_g$  or  $W_{g1}$  can be approximated, by taking the power supplied to the grid bias source ( $-V_g \times I_g$ ) from the grid driving power (approx.  $0.95 \times V_{g_p} \times I_g$ ). When an a.c., or unsmoothed d.c., voltage supply is used the form factor should be taken into account.

3.12 Grid resistance

By the maximum permissible grid resistance  $R_g$  is meant the d.c. resistance in the grid circuit. A higher value may cause instability.

## 4. OPERATING CONDITIONS

### 4.1 General

In the published data, operating conditions for various applications have been given, stating the maximum frequency at which the conditions apply. If it is required to operate a tube at higher frequencies the manufacturer should be consulted. The published values of operating conditions are average values derived from measurements made on nominal tubes working under optimum conditions. Thus, small deviations from the published value can occur if measurements are made on a particular tube. However some of the measured values of voltage or current must be adjusted to give the published figure. As an example, the published value of output power is an average value which can be reached in practice by adjusting e.g. the r.f. or a.f. input voltage  $V_{g_p}$ , when the published value of output power is not obtained at the nominal value of  $V_{g_p}$ . When designing a multi-stage transmitter it is good practice to leave a margin in the output power and input voltage to allow for adjustments similar to that just described. The published output power  $W_o$  of transmitting tubes is the tube output, which means the anode dissipation  $W_a$  taken from the anode input  $W_{i_a}$ . When a tube is used in a common grid circuit (grounded grid circuit), the published value of the output power includes the power transferred from the input.

Unless otherwise stated losses in the anode circuit and coupling losses are not taken into account.

The quoted grid input power is assumed to be  $0.9 \times$  the product of the average grid current  $I_g$  and the peak value of the grid voltage  $V_{g_p}$ . Losses in the grid circuit and the bleeder are sometimes accounted for by stating the required driver output power.

At high frequencies where reduced ratings have to be applied, the required driving power will often be considerably higher than the grid input power, and in some cases, may be determined almost exclusively by circuit losses.

### 4.2 R.F. class C telegraphy and F.M. telephony

A class C amplifier or oscillator is one in which the grid bias is appreciably



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greater than the cut-off voltage so that anode current flows for less than one half of each cycle of the alternating grid voltage. Working to the values published in the data sheets will ensure good output power and efficiency.

If a grid resistor is used for obtaining automatic bias, care must be taken that the anode current does not become too high if the r.f. driving power should fail. A safety device in the anode or screen-grid lead should be incorporated for this purpose.

#### 4.3 R.F. class C anode and screen-grid modulation

In an r.f. class C anode modulated stage the anode voltage is modulated with a.f., and at 100% modulation the voltage is varied from zero to twice the d.c. value. With tetrodes or pentodes the screen-grid should also be modulated to prevent it being overloaded. The average values of the grid bias and r.f. driving voltage remain constant during modulation. With 100% modulation the average anode dissipation is 1.5 times the value without modulation and this is taken into account although the published limiting value of anode dissipation refers to the unmodulated power. Automatic grid bias by means of a grid leak can be used, but, to obtain minimum distortion, some fixed bias is recommended.

The modulation power published is the power required by the modulated r.f. stage. When the modulating stage is being calculated 5% to 10% must be added to allow for losses in transformer and choke.

#### 4.4 R.F. class B telephony

A class B amplifier is one in which the grid is biased to the cut-off voltage so that anode current flows for approximately one half of each cycle of the alternating grid voltage. The published data for r.f. class B telephony has been determined, by trial and error, to give a straight modulation characteristic.

#### 4.5 R.F. class AB SSB amplifier

The given operating conditions are from measurements made in a circuit without feedback and with constant screen-grid voltage. They show the best compromise between output power and linearity. Linearity is measured with a double tone test signal in which the two tones have equal amplitude and lie 1000 Hz apart in frequency. The amplitudes of the distortion products  $d_3$  and  $d_5$  are in dB referred to the amplitude of either of the two equal tones. The published values of  $d_3$  and  $d_5$  are the worst encountered at any driving level and occur usually slightly below full output power. Distortion products of orders other than  $d_3$  and  $d_5$  are in general, negligible. If the amplitudes of the distortion products are referred to the peak envelope amplitude, the figures for  $d_3$  and  $d_5$  go down 6 dB.

#### 4.6 A.F. class B amplifier

With this amplifier the anode dissipation is dependent on the input signal voltage so that maximum anode dissipation is obtained when the signal is about 60% of the value at full drive. When this is not present continuously, as is the case with broadcast and telephony services, it is permissible for the limiting value of



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anode dissipation to be exceeded by 10%.

To suppress even harmonics, separate controllable grid bias for each tube, or a balancing circuit, should be incorporated. This data is purely arbitrary, i.e. the same output can be obtained with less modulation of the anode current (with smaller load resistance and lower peak grid current) although the efficiency would be lower. The requirements of the complete a.f. amplifier determines which kind of operation is preferred.

#### 4.7 Industrial operating conditions

Section 5.4 gives some general information on the application of power tubes in industrial apparatus. With a single phase mains connection a hum filter will sometimes be omitted as is normal in three phase mains connection. Operating conditions and derating factors are given for this kind of operation (section 3.3). It must be ensured that no limiting values are exceeded because of fluctuations in the mains supply or by tolerances in other components. The published value of  $W_O$  is the actual tube output power. The output power of a self-oscillating circuit  $W_{OSC}$  is obtained by deducting the grid dissipation  $W_g$  and the losses in the grid resistor  $W_{Rg}$  from the output power  $W_O$ . The power in the load  $W_l$  is obtained by deducting the losses in the output circuit from  $W_{OSC}$ . A favourable load output characteristic may be obtained by automatically controlling the grid voltage and current, depending on the matching. A non-linear device e.g. a tungsten lamp or an P.T.C. resistor may perform this function adequately and help to prevent overloading the grid.

With self oscillating circuits the frequency must be held within the available frequency band. This may be done by having large circuit capacitance, small stable self inductance, undercritical inductive coupling with the output circuit, electrostatic screening between oscillator and output circuit etc.

If the frequency of an industrial oscillator has to be limited to a narrow frequency band, crystal controlled driving stages may be used, then however, it is rather difficult to obtain matching between the tube input and output. A greater safety margin in the tube will be necessary with the output still depending on the load, or special measures, such as automatic tuning and/or matching control, will have to be taken.

For smaller tubes in industrial applications operating conditions have been given for when power is supplied from a single phase full-wave rectifier, a three phase half-wave rectifier (which is nearly equivalent to d.c.) and with raw a.c. In the latter case the output is about 0.6 times that obtained with d.c. and the peak inverse voltage is equal to the full anode voltage (this is of special importance as the grid voltage is in anti-phase to the anode voltage). With a single-phase, half-wave rectified anode voltage the useful output is nearly equal to that with a d.c. supply. To obtain the most favourable mains loading when using a self rectifying oscillator, a quasi push-pull circuit can be used, in which two tubes function alternately on each half wave. The best mains loading for three-phase, self rectification is obtained by using 6 tubes in a triple push-pull circuit.

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#### 4.8 Intermittent service

When data concerning intermittent service is published it is conditional that, although the cathode may be heated continuously, the on-period is no more than 5 minutes and that the off-period is equally long or longer.

### 5. APPLICATION OF THE OPERATING CONDITIONS

#### 5.1 General

It is not always possible to operate the tube under the specified operating conditions. In some applications deviations from the published values are likely to occur causing the limiting values to be exceeded. Depending on the kind of service the following classification can be made:

- Fixed transmitters for broadcasting and telecommunication service, operated by a trained staff. (5.2)
- Mobile transmitters. (5.3)
- Equipment for industrial applications (r.f. heating, supersonics etc.) (5.4)
- Amateur transmitters and special applications. (5.5)
- Pulse operated equipment. (5.6)

#### 5.2 Fixed transmitters

With fixed transmitters it is usually possible to use the tubes under ideal working conditions viz.

- only very small mains voltage deviations as the supply is derived from a special high tension line.
- stabilized mains voltage supply.
- a fairly constant and optimum transmitter load.
- the presence of safety devices which prevent tube damage under any circumstances.
- the presence of a well trained staff for the immediate repair of faults.

and thus it is permissible to operate near the limiting values.

#### 5.3 Mobile transmitters

Mobile transmitters are transmitters which can be operated whilst mobile; they often have to function with widely varying supply voltages and with loads that are neither constant nor optimum. Safety devices are usually poor, especially in small transmitters, so the use of the tube at the published maximum operating conditions is not recommended. The actual operating conditions chosen will depend upon specific circumstances. Because the electrode system in the smaller quick heating or oxide coated transmitting tubes is rugged and can withstand the vibration and occasional shocks experienced in normally used road vehicles the tubes are ideal for mobile transmitters.



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However in aircraft and vehicles used over rough ground it is advisable to shockmount the tubes. The oxide coated cathode is fairly insensitive to heater voltage variation and the high specific emission allows lower anode voltages to be used. Generally, when used in any apparatus that is likely to be subjected to shocks or vibration, tubes with thoriated tungsten cathodes require shock damping. If a special device is used to clamp a tube into its socket it must be ensured that the maximum permissible temperature is not exceeded in any part of the envelope.

#### 5.4 Industrial application, r.f. heating, supersonics etc.

For the following reasons, in industrial equipment the tube seldom operates under ideal conditions.

- Large, uncompensated mains voltage fluctuations.
- Voltage supply with no provision against hum.
- Variable load.
- Relative large tolerances on the stability of the operating frequency.
- Intermittent service.
- Service personnel often untrained in the servicing of the electronic power equipment.

Thus the design of industrial equipment differs from that of fixed transmitters and generally demands the use of self oscillating triodes. The most reliable operation of the tube, and hence the equipment, is obtained by selecting a nominal supply potential which, at the maximum mains voltage, does not exceed the limiting value.

In equipment powered by a.c. or unsmoothed d.c., the pulsating waveform is such that the average values of voltage and current chosen must be lower than if they were supplied by a normal d.c. supply.

Special attention should be paid to the grid current and dissipation since, in most cases, they are critical values.

Special cases of intermittent service make it possible to increase the limiting values and information on these possibilities will be supplied on request.

##### 5.4.1 Multiple tube operation

Since industrial generators are largely self oscillating, single tube operation is generally preferred. This mode of operation minimizes the risk of interaction between the tube and circuit stray reactances that could lead to parasitic oscillations. Whenever, for various reasons, such as the suppression of the even harmonics or the need for higher power at higher frequencies, push-pull or parallel operation is chosen, increased attention must be paid to the prevention of interaction between the tubes, be they in push-pull or parallel, through their connections or other stray circuit reactances.

#### 5.5 Amateur transmitters and special adjustments

The maximum permissible load of a tube is determined by the physical maxima

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of the tube incorporated in the limiting values. No guaranteed tube life can be given if the limiting values are exceeded although this does not imply that exceeding the limits will always result in an immediate breakdown of the tube. In the case of I.C.A.S. (Intermittent Commercial and Amateur Service) for instance, higher operating conditions have been given (see section 4.8) but generally no guarantee of tube life is given. Information about special circuits, adjustments and operating conditions will be supplied on request.

#### 5.6 Pulsed operation

When a tube is used under pulsed operation the pulse duration must be so short that no part of the tube reaches an abnormally high temperature and flash-overs do not develop. In general the average load will be considerably less than the maximum limiting load value.

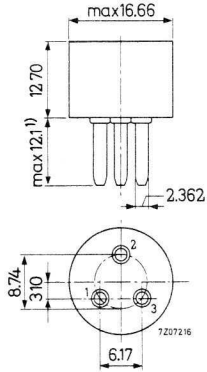
General information on this kind of information is not available but, if requested, information will be given on specific applications.





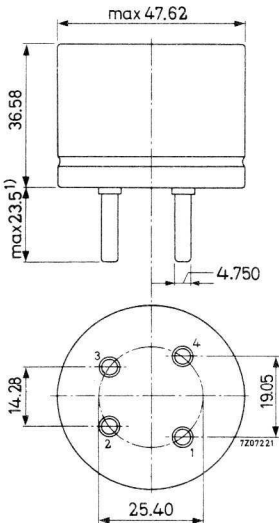


Pee Wee 3-pin base  
(IEC 67-I-19a)



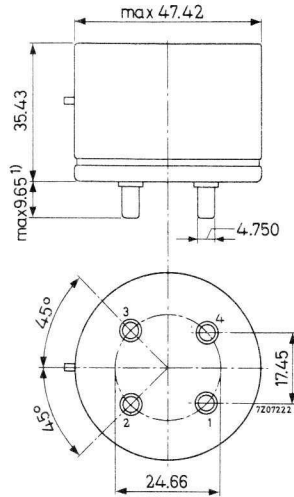
1) Including solder

Super Jumbo 4-pin base  
(IEC 67-I-28a)



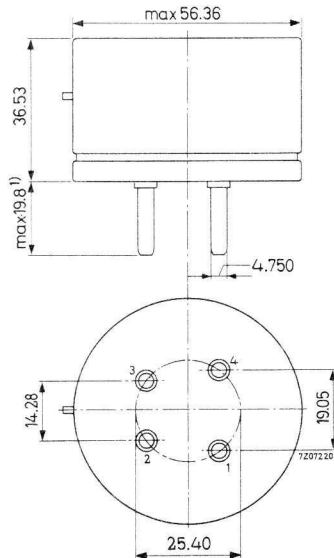
1) Including solder

Jumbo 4-pin base  
(IEC 67-I-23)



1) Including solder

Super Jumbo 4-pin base with bayonet  
(IEC 67-I-24)

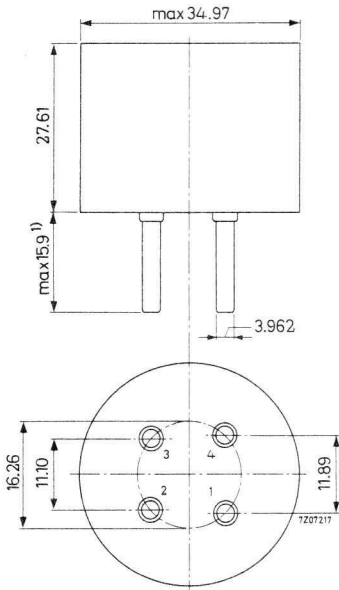


1) Including solder



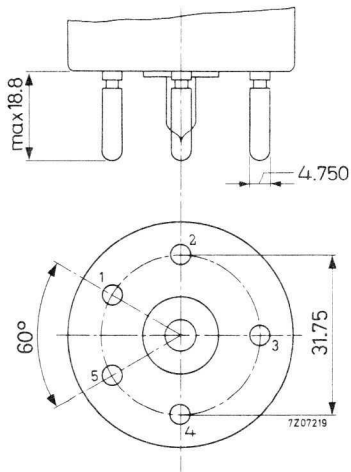
# BASES

Medium 4-pin base  
(IEC 67-I-2)

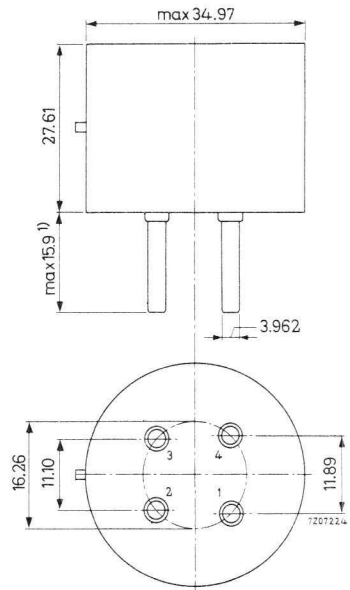


1) Including solder

Giant 5-pin base  
(IEC 67-I-21c)

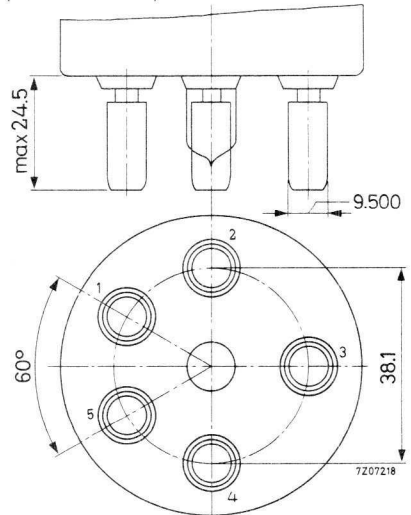


Medium 4-pin base with bayonet  
(IEC 67-I-3)

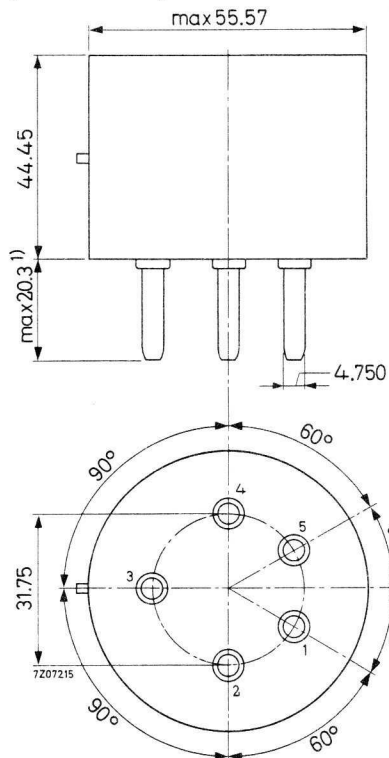


1) Including solder

Super Giant 5-pin base  
(IEC 67-I-22a)

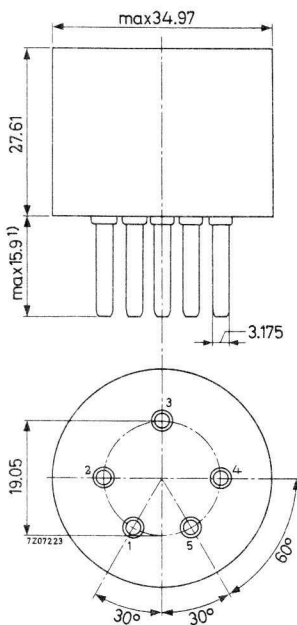


Medium shell Giant 5-pin base  
with bayonet  
(IEC 67-I-21a)



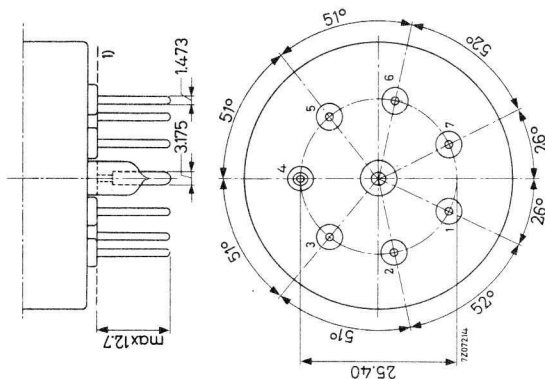
1) Including solder

Medium 5-pin base  
(IEC 67-I-4a)



1) Including solder

Septar 7-pin base  
(IEC 67-I-20a)



1) The reference line is established by the seating plane of the base and is determined by the three highest bosses.



# Triodes





R.F. POWER TRIODES

QUICK REFERENCE DATA

TAL12/10

λ (m)	Freq. (Mc/s)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
>60	< 5	12	10.5			10	7.7	12	17
>15	<20	10	10.5	8	2	8	6	10	16.6
				6	2			8	16.2

TAW12/10

λ (m)	Freq. (Mc/s)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
>60	< 5	12	15	12	3.7	10	7.7	12	30
>15	<20	10	12	10	3.3	8	6	10	25
6	50	6.5	6.5					8	19.5
4	75	4	3.5						

HEATING : direct; filament tungsten, two-phase

Filament voltage, per phase

V<sub>f</sub> = 22 V

Filament current, per phase

I<sub>f</sub> = 38 A

The starting current must never exceed 78 A per phase

Each tube is marked with the value of the filament voltage at which the saturation current has a value of 8 A

CAPACITANCES

Anode to all other elements except grid

C<sub>a</sub> = 4 pF

Grid to all other elements except anode

C<sub>g</sub> = 24.8 pF

Anode to grid

C<sub>ag</sub> = 22 pF

COOLING: TAL12/10 forced air cooled

TAW12/10 water cooled

<sup>1)</sup> Two tubes

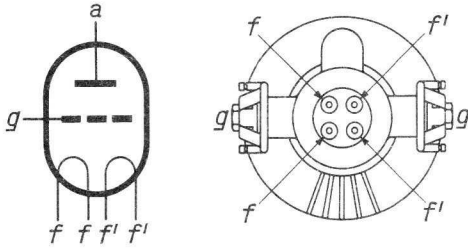
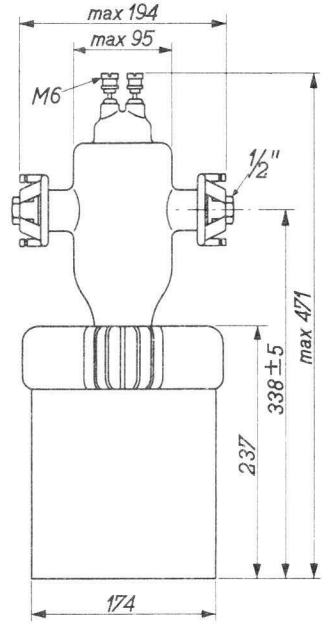
7Z2 3754

**MECHANICAL DATA**

**TAL12/10**

Dimensions in mm

Filament bracket	: 40604
Protective cap for grid seals:	40632
Supporting ring	: 40603
Foot	: K501
Net weight	: 13.5 kg



Mounting position: exactly vertical with anode down

<u>Pressure loss</u>	$P_i = 117$ mm H <sub>2</sub> O
at Inlet temperature	$t_i = 20$ °C
and Cooling air flow	$q = 5.4$ m <sup>3</sup> /min

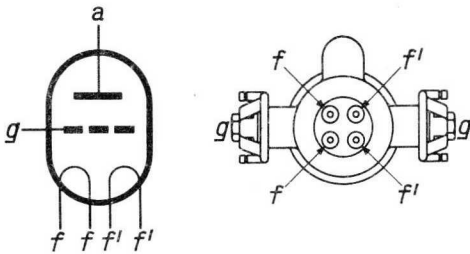
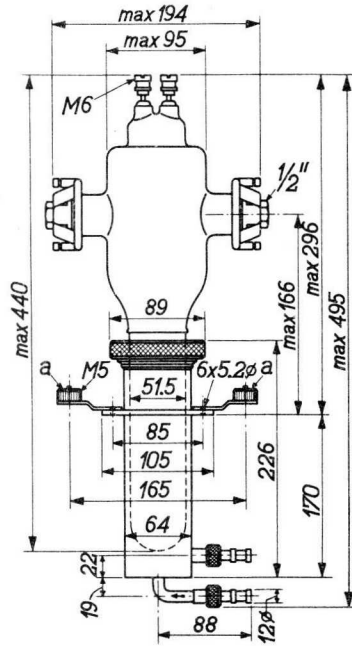


**MECHANICAL DATA**

**TAW12/10**

Dimensions in mm

Filament bracket	: 40604
Protective cap for grid seals	: 40632
Water-jacket	: K700
Net weight of the tube	: 2 kg
Net weight of the water-jacket: 2.1 kg	
O-ring	: 3322 026 87801



Mounting position: exactly vertical with anode down

Pressure loss

$$P_i = 0.3 \text{ atm}$$

with cooling water flow

$$q = 12 \text{ l/min}$$

**TYPICAL CHARACTERISTICS**

Amplification factor	$\mu$	=	22
Mutual conductance	$S (I_a = 0.5 \text{ A})$	=	7 mA/V
Saturation current	$I_{\text{sat}}$	=	8 A

**LIMITING VALUES (Absolute limits)**

		<b>TAL12/10</b>	<b>TAW12/10</b>
Anode voltage	$V_a$	= max. 12	max. 12 kV
Anode dissipation	$W_a$	= max. 4	max. 7.5 kW
Grid dissipation	$W_g$	= max. 300	max. 300 W
Grid circuit resistance	$R_g$	= max. 10	max. 10 k $\Omega$
Required cooling air flow	$q \left\{ \begin{array}{l} t_i = 20 \text{ }^\circ\text{C} \\ W_a = 4 \text{ kW} \end{array} \right\}$	= min. 5.4	- m <sup>3</sup> /min
Inlet temperature of cooling air	$t_i$	= max. 45	- $^\circ\text{C}$
Anode temperature	$t_a$	= max. 150	- $^\circ\text{C}$
Required cooling water flow	$q (W_a = 7.5 \text{ kW})$	= -	min. 12 l/min
Outlet temperature of cooling water	$t_o$	= -	max. 50 $^\circ\text{C}$
Temperature rise of cooling water	$t_o - t_i$	= -	max. 11 $^\circ\text{C}$
Temperature of bulb and seals		= max. 150	max. 150 $^\circ\text{C}$

R.F. POWER TRIODES

QUICK REFERENCE DATA									
$\lambda$ (m)	Freq. (Mc/s)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
>11	<28	12	22	12	5	10	9,5	12	42
		10	18					10	16

**HEATING:** direct; filament tungsten

Filament voltage

$V_f = 21.5 \text{ V}$

Filament current

$I_f = 78 \text{ A}$

Cold filament resistance

$R_{fo} = 0.0224 \text{ } \Omega$

The starting current must never exceed 160 A

Each tube is marked with the value of the filament voltage at which the saturation current has a value of 11 A

**TYPICAL CHARACTERISTICS**

Amplification factor

$\mu = 38$

Mutual conductance

$S (I_a = 1 \text{ A}) = 10 \text{ mA/V}$

Saturation current

$I_{sat} = 11 \text{ A}$

**CAPACITANCES**

Filament to anode

	TAL12/20	TAW12/20
$C_{af} =$	1.9	1.4 pF

Grid to filament

$C_{gf} = 23.5 \text{ pF}$

Grid to anode

$C_{ag} = 25 \text{ pF}$

**COOLING:** TAL12/20 forced air cooled

TAW12/20 water cooled

It is necessary to direct a low-velocity air flow to the grid seals at frequencies higher than 20 Mc/s

<sup>1)</sup> Two tubes

**MECHANICAL DATA**

**TAL12/20**

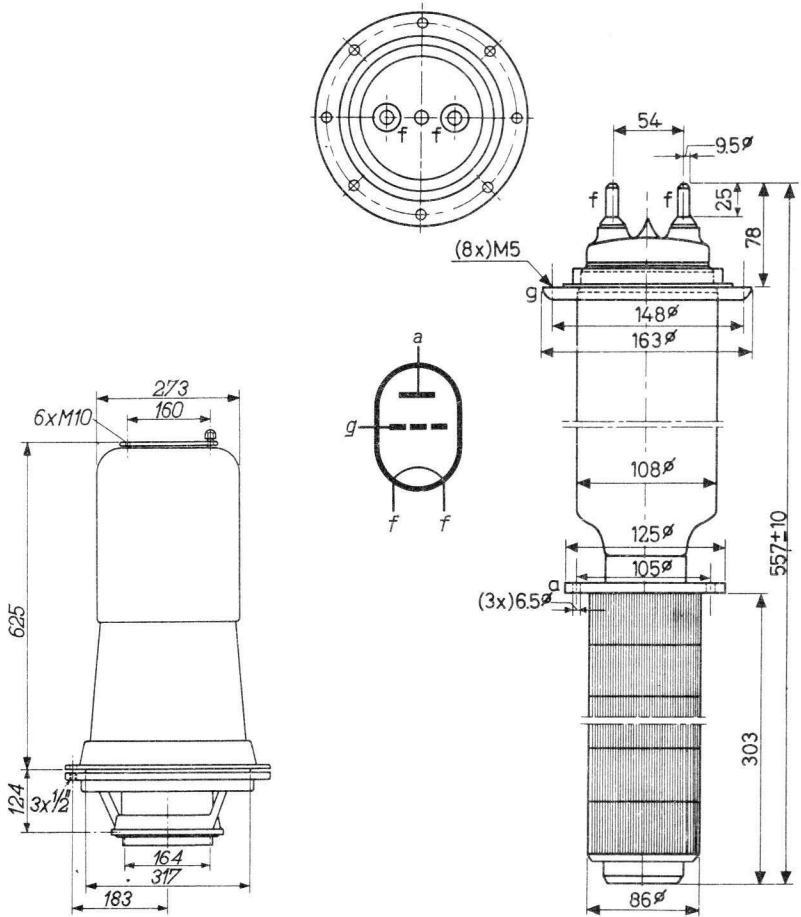
Dimensions in mm

Grid connector : 40664

Cooling house : K503

Filament connector with cable : 40662

Net weight of the tube: 7.5 kg



K503/01

Housing with canalized outlet of the air

Mounting position:

exactly vertical with anode down

Pressure loss

at Inlet temperature

and Cooling air flow

$P_i = 130 \text{ mm H}_2\text{O}$

$t_i = 20 \text{ }^\circ\text{C}$

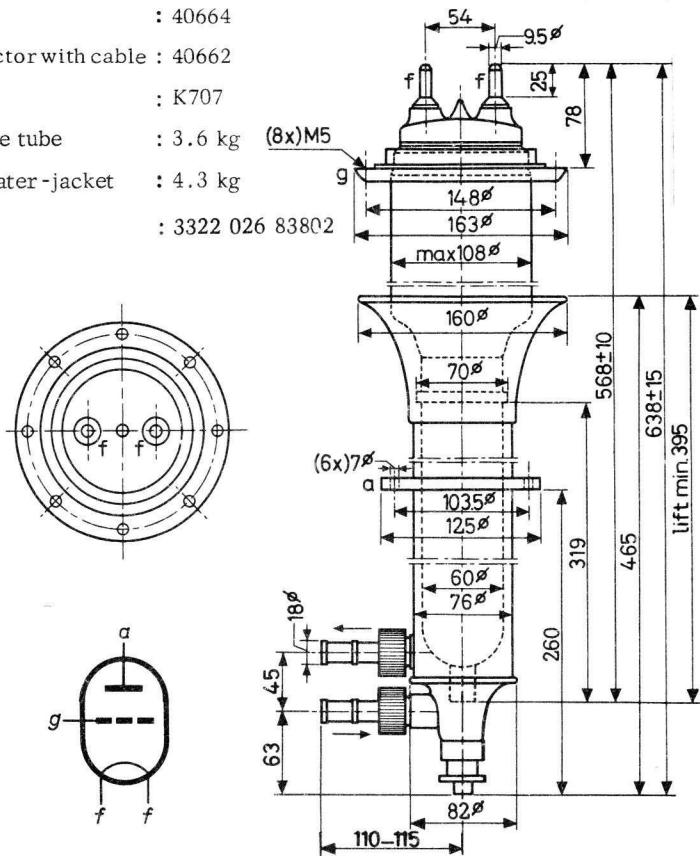
$q = 21.2 \text{ m}^3/\text{min}$

**MECHANICAL DATA**

**TAW12/20**

Dimensions in mm

Grid connector	: 40664
Filament connector with cable	: 40662
Water-jacket	: K707
Net weight of the tube	: 3.6 kg
Net weight of water-jacket	: 4.3 kg
O-ring	: 3322 026 83802



Mounting position: exactly vertical with anode down

<u>Pressure loss</u>	$p_i = 0.5$	atm
with Cooling water flow	$q = 20$	l/min

**LIMITING VALUES** (Absolute limits)

**TAL12/20 TAW12/20**

Anode voltage	$V_a$	= max. 12	max. 12	kV
Anode dissipation	$W_a$	= max. 18	max. 18	kW
Grid dissipation	$W_g$	= max. 500	max. 500	W
Grid circuit resistance	$R_g$	= max. 10	max. 20	k $\Omega$
Required cooling air flow	$q \left\{ \begin{array}{l} t_i = 20 \text{ }^\circ\text{C} \\ W_a = 18 \text{ kW} \end{array} \right\}$	= min. 21.2	-	m <sup>3</sup> /min
Anode temperature	$t_a$	= max. 180	-	°C
Required cooling water flow	$q (W_a = 18 \text{ kW})$	= -	min. 20	l/min
Outlet temperature of cooling water	$t_o$	= -	max. 60	°C
Temperature rise of cooling water	$t_o - t_i$	= -	max. 14	°C
Temperature of bulb and seals		= max. 150	max. 150	°C



**OPERATING CONDITIONS R.F. CLASS C**

	Telegraphy			Anode modulation	
	$\lambda$				
Wavelength	$\lambda$	>11	>11	>11	m
Anode voltage	$V_a$	= 12	10	10	kV
Grid voltage	$V_g$	= -600	-500	-900	V
Anode current	$I_a$	= 2.7	2.7	1.4	A
Grid current	$I_g$	= 0.4	0.42	0.5	A
Peak grid A.C. voltage	$V_{gp}$	= 1800	1600	2100	V
Grid input power	$W_{ig}$	= 720	670	1050	W
Anode input power	$W_{ia}$	= 32.4	27	14	kW
Anode dissipation	$W_a$	= 10.4	9	4.5	kW
Output power	$W_o$	= 22	18	9.5	kW
Efficiency	$\eta$	= 68	67	68	%
Modulation depth	m	=		100	%
Modulation power	$W_{mod}$	=		7	kW



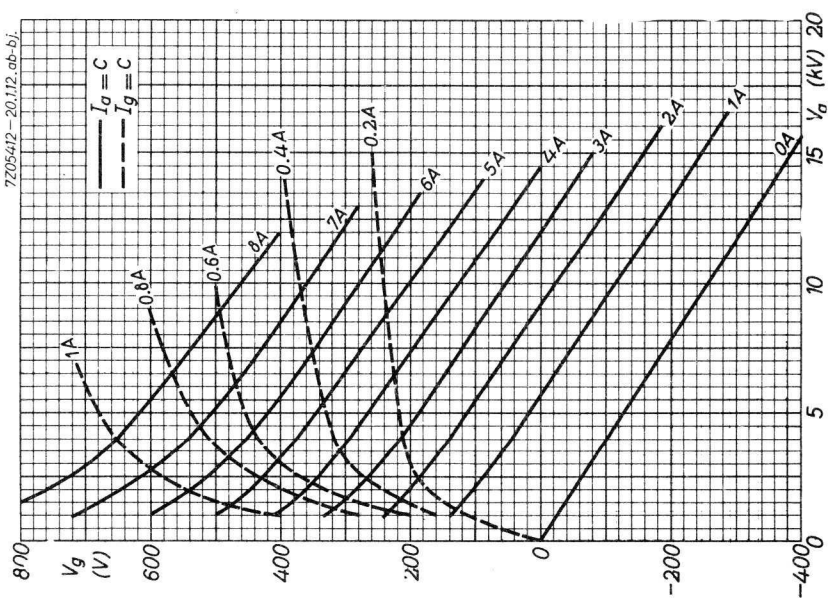
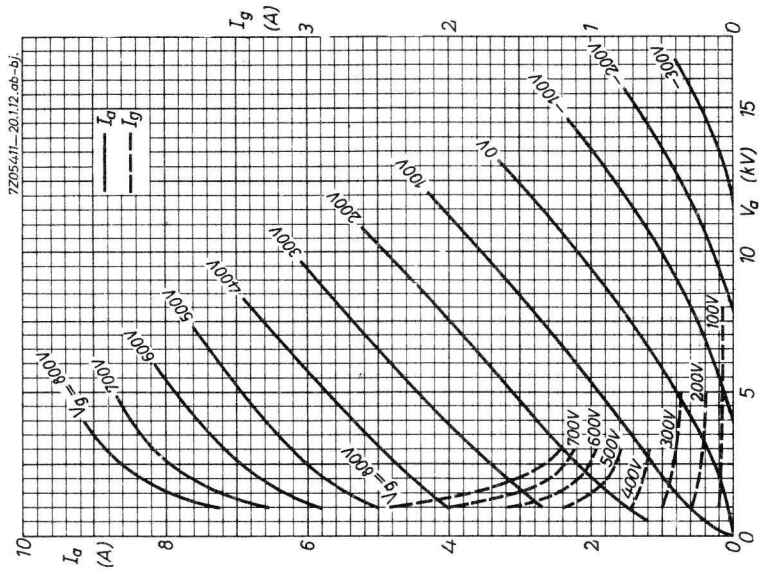
**OPERATING CONDITIONS R.F. CLASS B TELEPHONY**

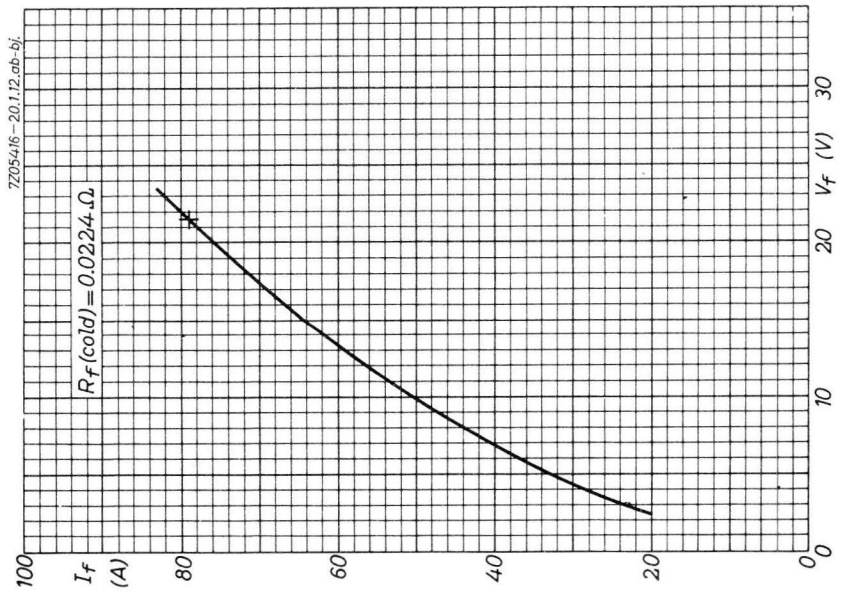
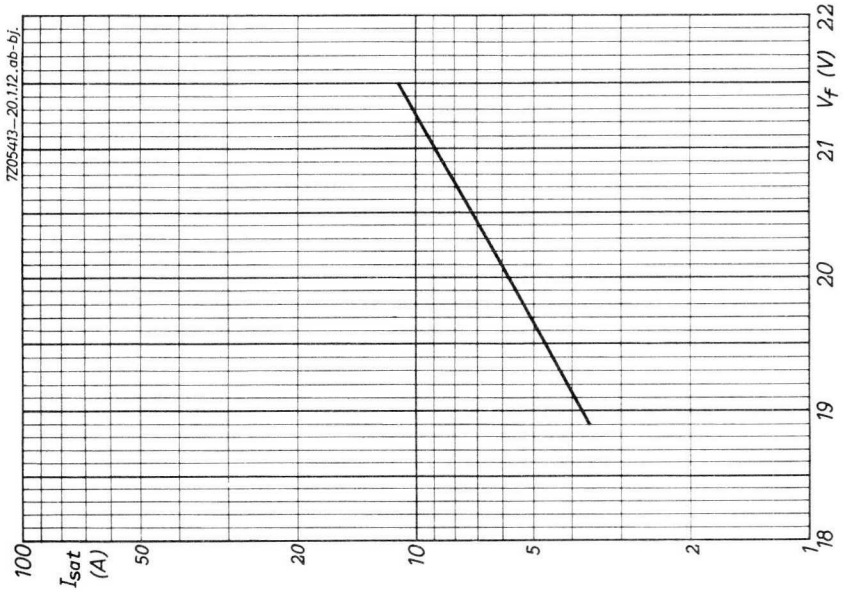
Wavelength	$\lambda$	>	11	m
Anode voltage	$V_a$	=	12	kV
Grid voltage	$V_g$	=	-200	V
Anode current	$I_a$	=	1.54	A
Peak grid A.C. voltage	$V_{gp}$	=	435	V
Anode input power	$W_{ia}$	=	18.5	kW
Anode dissipation	$W_a$	=	13.5	kW
Output power	$W_o$	=	5	kW
Efficiency	$\eta$	=	27	%
Modulation depth	m	=	100	%
Grid current	$I_g$	=	0.24	A
Grid input power	$W_{ig}$	=	210	W

**OPERATING CONDITIONS AS A.F. CLASS B AMPLIFIER AND MODULATOR**  
two tubes

Anode voltage	$V_a$	=	12		10	kV
Grid voltage	$V_g$	=	-250		-200	V
Load resistance	$R_{aa\sim}$	=	5.6		10.5	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0	1900	0	1100 V
Anode current	$I_a$	=	2x0.32	2x2.45	2x0.25	2x1.1 A
Grid current	$I_g$	=	0	2x0.33	0	2x0.17 A
Grid input power	$W_{ig}$	=	0	2x280	0	2x85 W
Anode input power	$W_{ia}$	=	2x3.8	2x29	2x2.5	2x11 kW
Anode dissipation	$W_a$	=	2x3.8	2x8	2x2.5	2x3 kW
Output power	$W_o$	=	0	42	0	16 kW
Efficiency	$\eta$	=	-	72.5	-	73 %
Total harmonic distortion	$d_{tot}$	=	-	3.1	-	1.7 %







## AIR COOLED R.F. POWER TRIODE

## QUICK REFERENCE DATA

$\lambda$ (m)	Freq. (MHz)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
>15	<20	15	48.5	15	9	12	27	12	80
		12	38	12	8.5			12	38.5
		10	31	10	8	10	21.5	10	77
11	27	15	45			12	26	10	32
						10	20.5		
8	37.5	10	26						

**HEATING:** direct; filament tungsten, three-phase

Filament voltage, per phase	V <sub>f</sub>	max. 28.3 V
Filament current, per phase	I <sub>f</sub>	48.5 A
Cold filament resistance, per phase	R <sub>fo</sub>	0.046 $\Omega$

The filament current must never exceed a peak value of 100 A per phase at any time during the initial energizing schedule

Each tube is marked with the value of the filament voltage at which the saturation current has a value of 23 A

## CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	2.6 pF
Grid to all other elements except anode	C <sub>g</sub>	72 pF
Anode to grid	C <sub>ag</sub>	31 pF

**COOLING:** forced air

<sup>1)</sup> Two tubes

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a$	=	12	kV
Anode current	$I_a$	=	1.25	A
Amplification factor	$\mu$	=	25	
Mutual conductance	$S$	=	16.5	mA/V
Saturation current	$I_{sat}$	=	23	A

**TEMPERATURE LIMIT (Absolute limit)**

Temperature of seals max. 180 °C

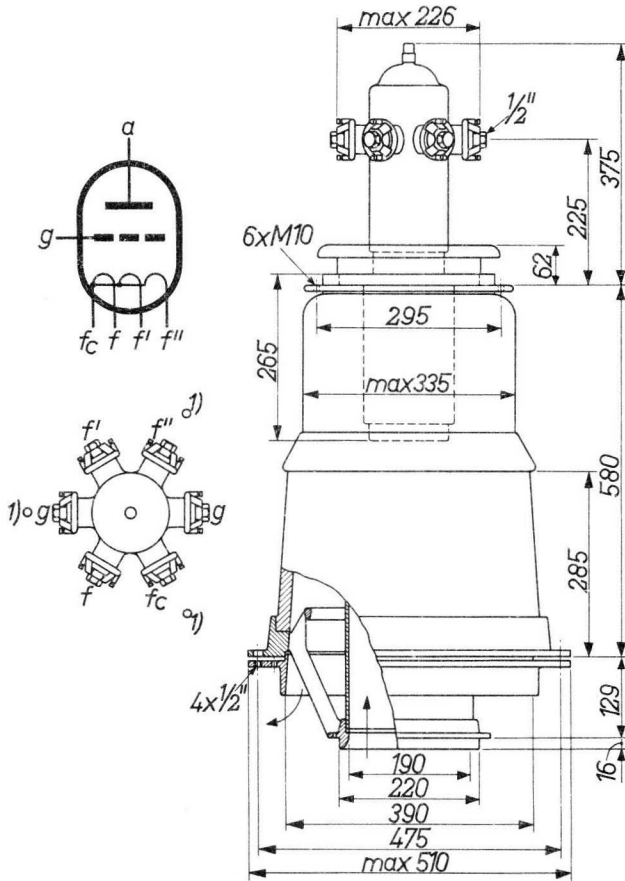
**LIMITING VALUES (Absolute limits)**

Anode voltage	$V_a$	max.	15	kV
Negative grid voltage	$-V_g$	max.	1000	V
Anode current	$I_a$	max.	5	A
Grid current	$I_g$	max.	0.6	A
Anode input power	$W_{Ia}$	max.	75	kW
Anode dissipation	$W_a$	max.	18	kW

**MECHANICAL DATA**

Dimensions in mm

Protective caps for grid- and filament seals: 40632  
 Filament bracket (for D.C. supply) : 40606  
 Net weight : 20 kg



Tube mounted in cooler housing  
 type K505

Mounting position: vertical with anode down

1) Holes for locating pins



**WATER COOLED R.F. POWER TRIODE**

**QUICK REFERENCE DATA**

$\lambda$ (m)	Freq. (Mc/s)	C teleg.		B teleph.		$C_a$ mod.		B mod. <sup>1)</sup>	
		$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)
>15	<20	15	48.5	15	9	12	27	12	107
		12	38	12	8.5			12	38.5
		10	31	10	8	10	21.5	10	77
11	27	15	45			12	26	10	32
						10	20.5		
8	37.5	10	26						

**HEATING:** direct; filament tungsten, three-phase

Filament voltage, per phase  $V_f = \text{max. } 28.3 \text{ V}$   
 Filament current, per phase  $I_f = 48.5 \text{ A}$   
 Cold filament resistance, per phase  $R_{fo} = 0.046 \text{ } \Omega$

The filament current must never exceed a peak value of 100 A per phase at any time during the initial energizing schedule

Each tube is marked with the value of the filament voltage at which the saturation current has a value of 23 A

**CAPACITANCES**

Anode to all other elements except grid  $C_a = 2.6 \text{ pF}$   
 Grid to all other elements except anode  $C_g = 72 \text{ pF}$   
 Anode to grid  $C_{ag} = 31 \text{ pF}$

**COOLING:** water/air flow to seals

<sup>1)</sup> Two tubes

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a = 12 \text{ kV}$
Anode current	$I_a = 1.25 \text{ A}$
Amplification factor	$\mu = 25$
Mutual conductance	$S = 16.5 \text{ mA/V}$
Saturation current	$I_{\text{sat}} = 23 \text{ A}$

**COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ (°C)	$q_{\text{min}}^{1)}$ (l/min)	$p_i$ (atm)
10	20	10	0.03
	50	22	0.15
20	20	18	0.09
	50	40	0.4
30	20	27	0.21
	50	59	1.0

See also the cooling curves

**COOLING**

It is necessary to direct a low-velocity air flow to the anode and grid seals at frequencies above 10 Mc/s. Cooling of the grid seals can be effected by means of the caps No.40632

**TEMPERATURE LIMITS** (Absolute limits)

Temperature of seals	= max. 180 °C
Inlet temperature of cooling water	$t_i = \text{max. } 50 \text{ °C}$

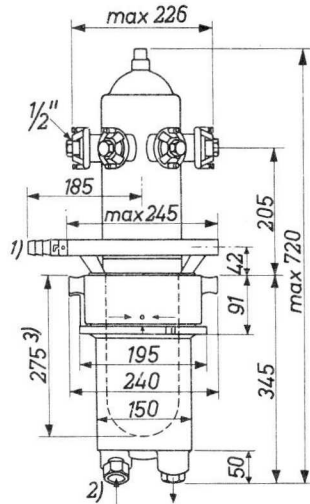
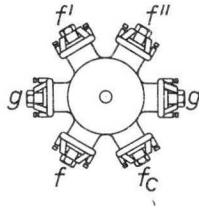
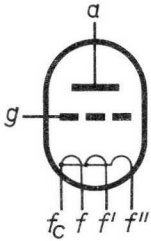
1) At temperatures  $t_i$  between 20 and 50 °C the required quantity of water can be found by proportional interpolation



## MECHANICAL DATA

Dimensions in mm

Water-jacket	: K715
Protective caps for grid and filament seals:	40632
Filament bracket (for D.C. supply)	: 40606
Net weight of the tube	: 6.8 kg
Net weight of the water-jacket	: 16.7 kg



Tube mounted in water-jacket  
type K715

Mounting position: vertical with anode down

1) Use connecting hose with an inner diameter of 1"

2) Coupling for metal tubing with an outer diameter of 28 mm

3) For removing the tube from its water-jacket the free height above the tube must be at least 275 mm

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**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	= max.	15	kV
Negative grid voltage	$-V_g$	= max.	1000	V
Anode current	$I_a$	= max.	5	A
Grid current	$I_g$	= max.	0.6	A
Anode input power	$W_{ia}$	= max.	75	kW
Anode dissipation	$W_a$	= max.	30	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	>15	>15	>15	11	8	m
Frequency	f	=	<20	<20	<20	27	37.5	Mc/s
Anode voltage	$V_a$	=	15	12	10	15	10	kV
Grid voltage	$V_g$	=	-900	-700	-600	-900	-600	V
Anode current	$I_a$	=	4.2	4.2	4.2	4.2	4.2	A
Grid current	$I_g$	=	0.42	0.5	0.53	0.42	0.6	A
Peak grid A.C. voltage	$V_{gp}$	=	1470	1350	1160	1470	1200	V
Grid input power	$W_{ig}$	=	560	610	560	560	650	W
Anode input power	$W_{ia}$	=	63	50.4	42	63	42	kW
Anode dissipation	$W_a$	=	14.5	12.4	11	18	16	kW
Output power	$W_o$	=	48.5	38	31	45	26	kW
Efficiency	$\eta$	=	77	75.5	74	71.5	62	%

## R.F. CLASS B TELEPHONY

## LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	= max.	15	kV
Anode current	$I_a$	= max.	2.5	A
Anode input power	$W_{ia}$	= max.	37.5	kW
Anode dissipation	$W_a$	= max.	30	kW

## OPERATING CONDITIONS

Wavelength	$\lambda$	>15	>15	>15	m
Frequency	f	<20	<20	<20	Mc/s
Anode voltage	$V_a$	= 15	12	10	kV
Grid voltage	$V_g$	= -500	-400	-315	V
Anode current	$I_a$	= 1.8	2.2	2.5	A
Peak grid A.C. voltage	$V_{gp}$	= 500	470	440	V
Anode input power	$W_{ia}$	= 27	26.5	25	kW
Anode dissipation	$W_a$	= 18	18	17	kW
Output power	$W_o$	= 9	8.5	8	kW
Efficiency	$\eta$	= 33	32	32	%
Modulation depth	m	= 100	100	100	%
Grid current	$I_g$	= 0.3	0.36	0.4	A
Grid input power	$W_{ig}$	= 270	305	317	W



## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	= max.	12	kV
Negative grid voltage	$-V_g$	= max.	1000	V
Anode current	$I_a$	= max.	2.9	A
Grid current	$I_g$	= max.	0.6	A
Anode input power	$W_{ia}$	= max.	35	kW
Anode dissipation	$W_a$	= max.	20	kW

## OPERATING CONDITIONS

Wavelength	$\lambda$	=	>15	>15	11	11	m
Frequency	$f$	=	<20	<20	27	27	Mc/s
Anode voltage	$V_a$	=	12	10	12	10	kV
Grid voltage	$V_g$	=	-1000	-900	-1000	-900	V <sup>1)</sup>
Anode current	$I_a$	=	2.9	2.9	2.9	2.9	A
Grid current	$I_g$	=	0.4	0.45	0.45	0.5	A
Peak grid A.C. voltage	$V_{gp}$	=	1600	1550	1650	1600	V
Grid input power	$W_{ig}$	=	580	630	670	700	W
Anode input power	$W_{ia}$	=	35	29	35	29	kW
Anode dissipation	$W_a$	=	8	7.5	9	8.5	kW
Output power	$W_o$	=	27	21.5	26	20.5	kW
Efficiency	$\eta$	=	77	74	74	70.5	%
Modulation depth	$m$	=	100	100	100	100	%
Modulation power	$W_{mod}$	=	17.5	14.5	17.5	14.5	kW

<sup>1)</sup> Grid bias partially obtained by the grid resistor

## A.F. CLASS B AMPLIFIER AND MODULATOR

## LIMITING VALUES (Absolute limits)

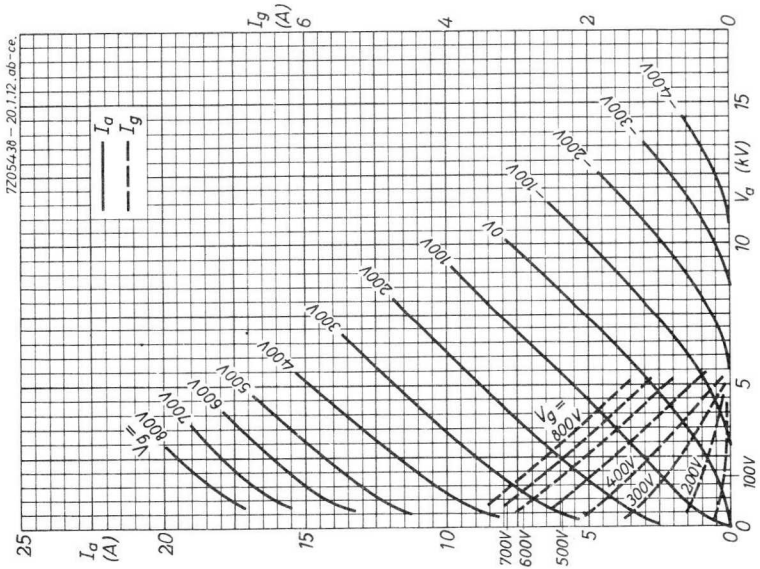
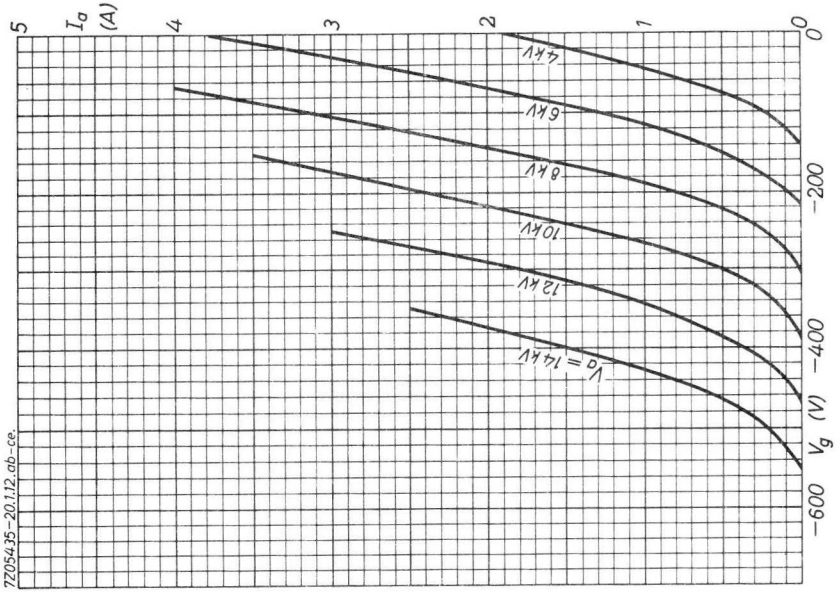
Anode voltage	$V_a$	=	max.	15	kV
Anode current	$I_a$	=	max.	6	A
Anode input power	$W_{ia}$	=	max.	90	kW
Anode dissipation	$W_a$	=	max.	30	kW

## OPERATING CONDITIONS, two tubes in push-pull

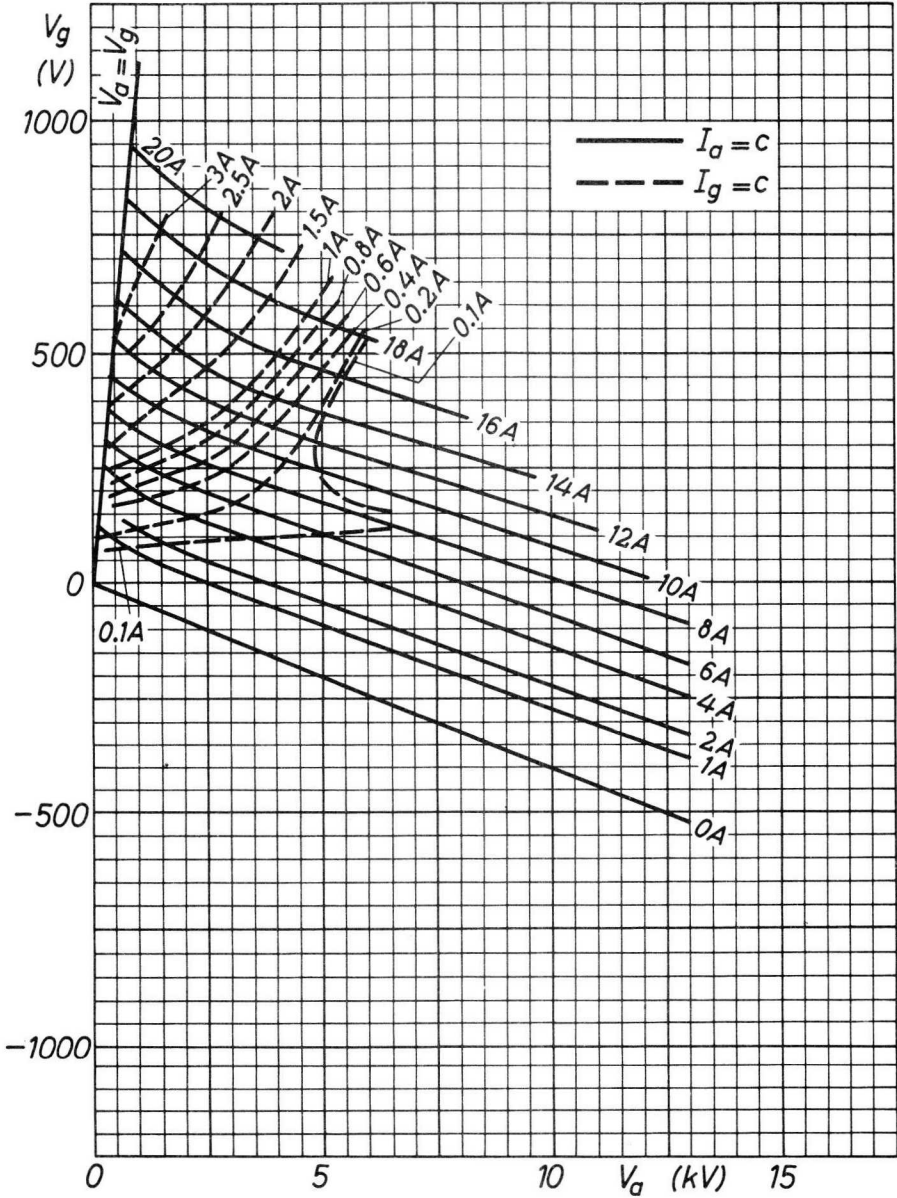
Anode voltage	$V_a$	=	12	12	kV
Grid voltage	$V_g$	=	-400	-425	V
Load resistance	$R_{aa\sim}$	=	2.4	5.8	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0 2400	0 1480	V
Anode current	$I_a$	=	2x0.35 2x6	2x0.15 2x2.25	A
Grid current	$I_g$	=	0 2x0.6	0 2x0.19	A
Peak grid current	$I_{gp}$	=	0 2x3.3	0 2x1.25	A
Grid input power	$W_{ig}$	=	0 2x650	0 2x127	W
Anode input power	$W_{ia}$	=	2x4.2 2x72	2x1.8 2x27	kW
Anode dissipation	$W_a$	=	2x4.2 2x18.5	2x1.8 2x7.7	kW
Output power	$W_o$	=	0 107	0 38.5	kW
Total distortion	$d_{tot}$	=	- 4	- 3.7	%
Efficiency	$\eta$	=	- 74.5	- 71.5	%

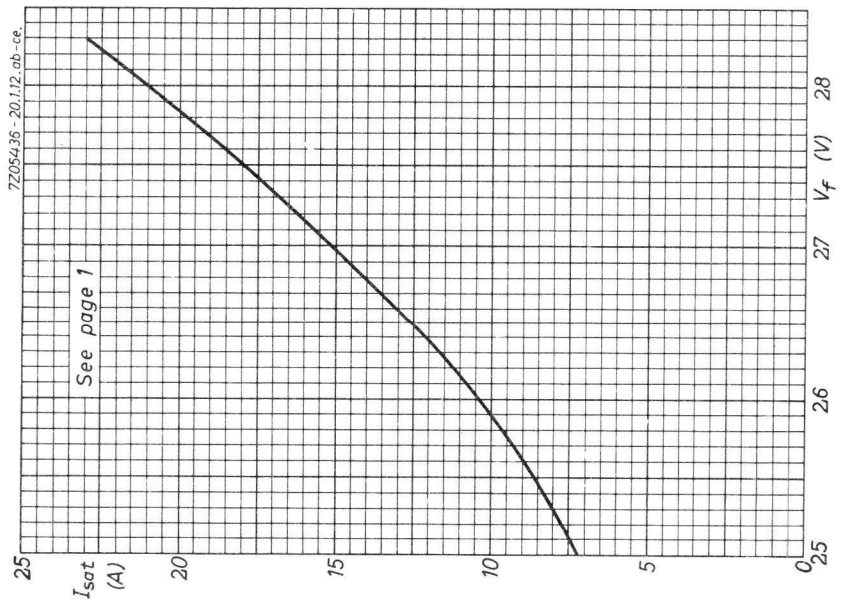
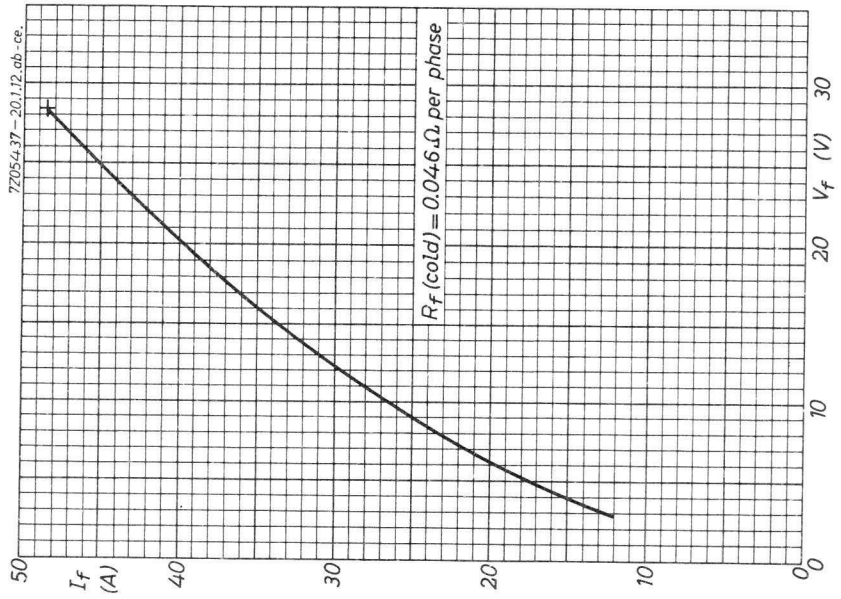
Anode voltage	$V_a$	=	10	10	kV
Grid voltage	$V_g$	=	-325	-345	V
Load resistance	$R_{aa\sim}$	=	2.1	5	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0 2050	0 1330	V
Anode current	$I_a$	=	2x0.3 2x5.4	2x0.14 2x2.25	A
Grid current	$I_g$	=	0 2x0.6	0 2x0.2	A
Peak grid current	$I_{gp}$	=	0 2x3	0 2x1.35	A
Grid input power	$W_{ig}$	=	0 2x555	0 2x120	W
Anode input power	$W_{ia}$	=	2x3 2x54	2x1.4 2x22.5	kW
Anode dissipation	$W_a$	=	2x3 2x15.5	2x1.4 2x6.5	kW
Output power	$W_o$	=	0 77	0 32	kW
Total distortion	$d_{tot}$	=	- 3.5	- 4	%
Efficiency	$\eta$	=	- 71.5	- 71	%

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## R.F. POWER TRIODE

### QUICK REFERENCE DATA

$\lambda$ (m)	Freq. (Mc/s)	C telegr.		C osc.		B teleph.		$C_a$ mod.	
		$V_a$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)
4	75	2500	390			2500	65	2000	204
		2000	295			2000	64	1500	153
		1500	210			1500	59	1000	95
		1000	126						
2	150			2500	376				
				2000	282				
1.5	200			2000	198				

**HEATING:** direct; filament thoriated tungsten

Filament voltage  $V_f = 6.3$  V

Filament current  $I_f = 5.4$  A

### CAPACITANCES

Anode to all other elements except grid  $C_a = 0.1$  pF

Grid to all other elements except anode  $C_g = 4.3$  pF

Anode to grid  $C_{ag} = 5.2$  pF

### TYPICAL CHARACTERISTICS

Amplification factor  $\mu = 25$

Mutual conductance  $S (I_a = 44 \text{ mA}) = 2.8 \text{ mA/V}$

**COOLING:** radiation/low-velocity air flow

It is necessary to direct a low-velocity air flow to the bottom and the top seal if the tube is used at or near the limiting values at frequencies above 50 Mc/s.

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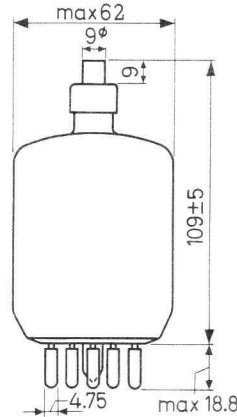
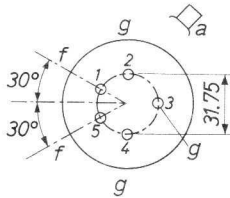
**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a = \text{max. } 2500 \text{ V}$
Anode dissipation	$W_a = \text{max. } 135 \text{ W}^1)$
Grid dissipation	$W_g = \text{max. } 16 \text{ W}$
Grid circuit resistance with fixed grid bias	$R_g = \text{max. } 0.1 \text{ M}\Omega$
Grid circuit resistance with automatic grid bias	$R_g = \text{max. } 0.2 \text{ M}\Omega$
Cathode current	$I_k = \text{max. } 250 \text{ mA}$
Peak cathode current	$I_{kp} = \text{max. } 1.6 \text{ A}$
Temperature of anode seal	$= \text{max. } 220 \text{ }^\circ\text{C}$
Bottom temperature	$= \text{max. } 180 \text{ }^\circ\text{C}$

**MECHANICAL DATA**

Dimensions in mm

- Base : giant 5p
- Anode connector : 40624
- Socket : 2422 512 01001
- Socket with grounded grid connections: 40215/01
- Net weight : 110 g



Mounting position: vertical with base up or down

1) Anode red hot, temperature = 850 °C

## OPERATING CONDITIONS R.F. CLASS C TELEGRAPHY

Wavelength	$\lambda$	=	4	4	4	4	m
Anode voltage	$V_a$	=	2500	2000	1500	1000	V
Grid voltage	$V_g$	=	-200	-150	-110	-80	V
Anode current	$I_a$	=	205	205	205	205	mA
Grid current	$I_g$	=	40	40	40	40	mA
Peak grid A.C. voltage	$V_{gp}$	=	390	340	300	260	V
Grid input power	$W_{ig}$	=	14	13	11	10	W
Anode input power	$W_{ia}$	=	512	410	308	205	W
Anode dissipation	$W_a$	=	122	115	98	79	W
Output power	$W_o$	=	390	295	210	126	W
Efficiency	$\eta$	=	76	72	68	61.5	%

## OPERATING CONDITIONS R.F. CLASS B TELEPHONY

Wavelength	$\lambda$	=	4	4	4	m
Anode voltage	$V_a$	=	2500	2000	1500	V
Grid voltage	$V_g$	=	-87	-67	-45	V
Anode current	$I_a$	=	77	97	120	mA
Peak grid A.C. voltage	$V_{gp}$	=	100	100	100	V
Anode input power	$W_{ia}$	=	193	194	180	W
Anode dissipation	$W_a$	=	128	130	121	W
Output power	$W_o$	=	65	64	59	W
Efficiency	$\eta$	=	34	33	33	%
Modulation depth	$m$	=	100	100	100	%
Grid current	$I_g$	=	20	28	52	mA
Grid input power	$W_{ig}$	=	3.6	5.1	9.4	W

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**OPERATING CONDITIONS R.F. CLASS C ANODE MODULATION; two tubes**

Wavelength	$\lambda$	=	4	4	4	m
Anode voltage	$V_a$	=	2000	1500	1000	V
Grid voltage	$V_g$	=	-225	-180	-130	V
Anode current	$I_a$	=	255	255	255	mA
Grid current	$I_g$	=	80	80	80	mA
Peak grid A.C. voltage	$V_{gp}$	=	415	370	320	V
Grid input power	$W_{ig}$	=	30	27	23	W
Anode input power	$W_{ia}$	=	510	382	255	W
Anode dissipation	$W_a$	=	102	76	65	W
Output power	$W_o$	=	408	306	190	W
Efficiency	$\eta$	=	80	80	74.5	%
<hr/>						
Modulation depth	$m$	=	100	100	100	%
Modulation power	$W_{mod}$	=	255	191	126	W

**OPERATING CONDITIONS AS R.F. CLASS C OSCILLATOR; two tubes**

Wavelength	$\lambda$	=	2	2	1.5	m
Anode voltage	$V_a$	=	2500	2000	2000	V
Anode current	$I_a$	=	410	410	346	mA
Grid current	$I_g$	=	80	80	80	mA
Grid resistor	$R_g$	=	2500	1875	1875	$\Omega$
Anode input power	$W_{ia}$	=	1025	820	692	W
Anode dissipation	$W_a$	=	245	230	270	W
Grid input power	$W_{ig}$	=	28	26	26	W
Output power	$W_o$	=	752	564	396	W
Efficiency	$\eta$	=	73	69	57	%

**OPERATING CONDITIONS AS R.F. CLASS C OSCILLATOR** for high frequency heating and diathermy generators

A. With anode voltage from single-phase full-wave rectifier without filter

Wavelength	$\lambda$	=	7.3 m
Anode voltage	$V_a$	=	2000 V <sup>1)</sup>
Anode current	$I_a$	=	170 mA
Grid current	$I_g$	=	34 mA
Grid resistor	$R_g$	=	3750 $\Omega$
Anode input power	$W_{ia}$	=	420 W
Anode dissipation	$W_a$	=	120 W
Grid input power	$W_{ig}$	=	10 W
Output power	$W_o$	=	290 W
Efficiency	$\eta$	=	69 %

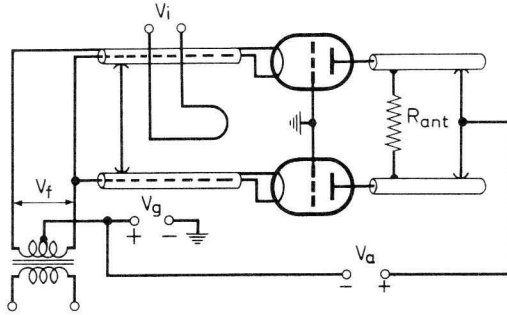
B. With anode and grid alternating voltage. Phase-shift of  $180^\circ$  between  $V_a$  and  $V_g$

Wavelength	$\lambda$	=	7.3 m
Anode voltage	$V_a$	=	2500 $V_{RMS}$
Anode current	$I_a$	=	90 mA
Grid current	$I_g$	=	20 mA
Grid resistor	$R_g$	=	1700 $\Omega$
Grid voltage	$V_g$	=	85 $V_{RMS}$
Anode input power	$W_{ia}$	=	255 W
Anode dissipation	$W_a$	=	85 W
Output power	$W_o$	=	170 W
Efficiency	$\eta$	=	67 %

<sup>1)</sup> Mean value

OPERATING CONDITIONS R.F. CLASS C TELEGRAPHY

grounded grid, two tubes



Wavelength	$\lambda$	=	3	3	3	3	m
Anode voltage	$V_a$	=	2500	2000	1500	1000	V
Grid voltage	$V_g$	=	-200	-150	-110	-80	V
Anode current	$I_a$	=	410	410	410	410	mA
Grid current	$I_g$	=	80	80	80	80	mA
Peak grid A.C. voltage	$V_{gp}$	=	390	340	300	260	V
Grid input power	$W_{ig}$	=	158	136	118	100	W
Anode input power	$W_{ia}$	=	1025	820	615	410	W
Anode dissipation	$W_a$	=	245	230	195	158	W
Output power	$W_o$	=	780+130	590+110	420+96	252+80	W <sup>1)</sup>
Efficiency	$\eta$	=	76	72	68	61.5	% <sup>2)</sup>

1) Power transferred from driving stage included

2) Pure tube efficiency

A.F. CLASS B AMPLIFIER AND MODULATOR

LIMITING VALUES (Absolute limits)

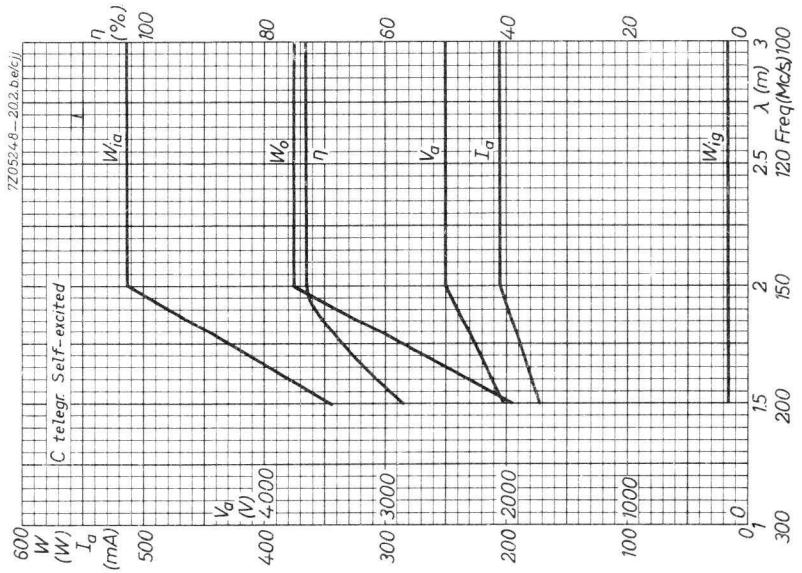
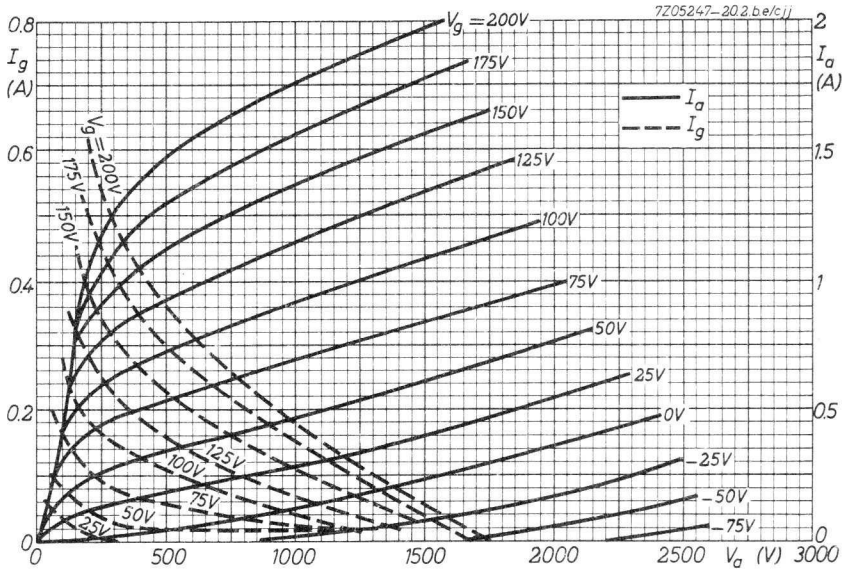
Anode voltage	$V_a$	=	max.	2500	V
Anode dissipation	$W_a$	=	max.	135	W
Grid dissipation	$W_g$	=	max.	16	W
Cathode current	$I_k$	=	max.	250	mA
Peak cathode current	$I_{kp}$	=	max.	1.6	A

OPERATING CONDITIONS, two tubes

Anode voltage	$V_a$	=	2500	2000	V
Grid voltage	$V_g$	=	-86	-65	V
Load resistance	$R_{aa\sim}$	=	18.2	12.0	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0 412	0 394	V
Anode current	$I_a$	=	2x30 2x178	2x30 2x208	mA
Grid current	$I_g$	=	0 2x42	0 2x42	mA
Grid input power	$W_{ig}$	=	0 2x7.8	0 2x7.3	W
Anode input power	$W_{ia}$	=	2x75 2x445	2x60 2x416	W
Anode dissipation	$W_a$	=	2x75 2x95	2x60 2x101	W
Output power	$W_o$	=	0 700	0 630	W
Total harmonic distortion	$d_{tot}$	=	- 5.0	- 3.7	%
Efficiency	$\eta$	=	- 78.5	- 76	%

Anode voltage	$V_a$	=	1500	1000	V
Grid voltage	$V_g$	=	-46	-23	V
Load resistance	$R_{aa\sim}$	=	8.5	5.0	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0 340	0 295	V
Anode current	$I_a$	=	2x30 2x210	2x30 2x210	mA
Grid current	$I_g$	=	0 2x40	0 2x40	mA
Grid input power	$W_{ig}$	=	0 2x6.1	0 2x5.4	W
Anode input power	$W_{ia}$	=	2x45 2x315	2x30 2x210	W
Anode dissipation	$W_a$	=	2x45 2x90	2x30 2x73	W
Output power	$W_o$	=	0 450	0 274	W
Total harmonic distortion	$d_{tot}$	=	- 2.9	- 2.2	%
Efficiency	$\eta$	=	- 71.5	- 65	%

7Z2 3785





## R.F. POWER TRIODE

QUICK REFERENCE DATA									
$\lambda$ (m)	Freq. (Mc/s)	C telegr.		C grounded grid		B teleph.		C <sub>a</sub> mod.	
		V <sub>a</sub> (V)	W <sub>o</sub> (W)	V <sub>a</sub> (V)	W <sub>o</sub> (W)	V <sub>a</sub> (V)	W <sub>o</sub> (W)	V <sub>a</sub> (V)	W <sub>o</sub> (W)
2	150	2500	390			2500	65		
		2000	295			2000	64	2000	205
		1500	210			1500	59	1500	154
		1000	126					1000	96
3	100			2500	910				
				2000	700				
				1500	516				
				1000	332				
		C osc. industrial						B mod. two tubes	
		V <sub>a</sub> $\approx$ (V)	W <sub>o</sub> (W)	V <sub>a</sub> $\sim$ (V)	W <sub>o</sub> (W)			V <sub>a</sub> (V)	W <sub>o</sub> (W)
6	50	2000	290	2500	170			2500	700
								1000	274

**HEATING:** direct; filament thoriated tungsten

Filament voltage

$$V_f = 6.3 \text{ V}$$

Filament current

$$I_f = 5.8 \text{ A}$$

### CAPACITANCES

Anode to all other elements except grid

$$C_a = 0.1 \text{ pF}$$

Grid to all other elements except anode

$$C_g = 4.9 \text{ pF}$$

Anode to grid

$$C_{ag} = 5.0 \text{ pF}$$

### TYPICAL CHARACTERISTICS

Anode voltage

$$V_a = 2500 \text{ V}$$

Anode current

$$I_a = 60 \text{ mA}$$

Amplification factor

$$\mu = 25$$

Mutual conductance

$$S = 2.8 \text{ mA/V}$$

7Z2 3440

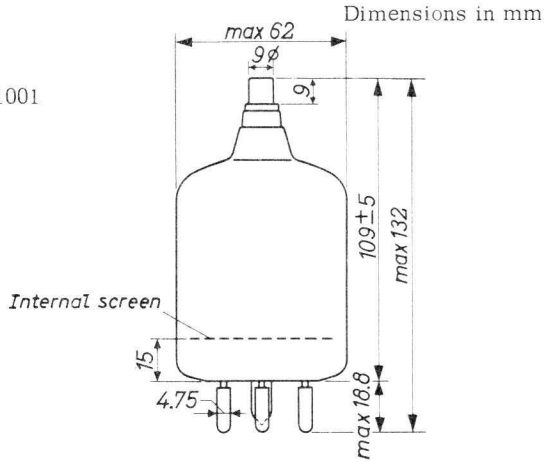
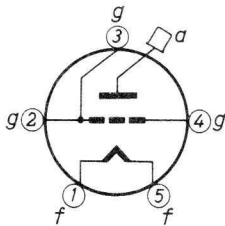
**TEMPERATURE LIMITS** (Absolute limits)

Temperature of anode seal = max. 220 °C  
 Bottom temperature = max. 180 °C

It is recommended to direct a low-velocity air flow on bottom and top seal if the tube is used at or near the limiting values at frequencies above 50 Mc/s

**MECHANICAL DATA**

Base : giant 5p  
 Socket : 2422 512 01001  
 Anode connector: 40624  
 Net weight : 125 g



Mounting position: vertical with base up or down

**COOLING:** radiation/low-velocity air flow

## R.F. CLASS C TELEGRAPHY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	150	Mc/s
Anode voltage	$V_a$	= max.	3000	V
Anode current	$I_a$	= max.	255	mA
Anode dissipation	$W_a$	= max.	150	W
Anode input power	$W_{ia}$	= max.	512	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current	$I_g$	= max.	45	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	$M\Omega$
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	$M\Omega$



## OPERATING CONDITIONS

Frequency	f	=	150	150	150	150	Mc/s
Anode voltage	$V_a$	=	2500	2000	1500	1000	V
Grid voltage	$V_g$	=	-200	-150	-110	-80	V
Anode current	$I_a$	=	205	205	205	205	mA
Grid current	$I_g$	=	40	40	40	40	mA
Peak grid A.C. voltage	$V_{gp}$	=	390	340	300	260	V
Grid input power	$W_{ig}$	=	14	13	11	10	W
Anode input power	$W_{ia}$	=	512	410	308	205	W
Anode dissipation	$W_a$	=	122	115	98	79	W
Output power	$W_o$	=	390	295	210	126	W
Efficiency	$\eta$	=	76	72	68	61.5	%

7Z2 3442

**R.F. CLASS B TELEPHONY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	150	Mc/s
Anode voltage	$V_a$	= max.	3000	V
Anode current	$I_a$	= max.	170	mA
Anode dissipation	$W_a$	= max.	150	W
Anode input power	$W_{ia}$	= max.	200	W
Grid current	$I_g$	= max.	55	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	MΩ
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	MΩ

**OPERATING CONDITIONS**

Frequency	f	=	150	150	150	Mc/s
Anode voltage	$V_a$	=	2500	2000	1500	V
Grid voltage	$V_g$	=	-87	-67	-45	V
Anode current	$I_a$	=	77	97	120	mA
Peak grid A.C. voltage	$V_{gp}$	=	100	100	100	V
Anode input power	$W_{ia}$	=	193	194	180	W
Anode dissipation	$W_a$	=	128	130	121	W
Output power	$W_o$	=	65	64	59	W
Efficiency	$\eta$	=	34	33	33	%
Modulation factor	m	=	100	100	100	%
Grid current	$I_g$	=	20	28	52	mA
Grid input power	$W_{ig}$	=	3.6	5.1	9.4	W

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	150	Mc/s
Anode voltage	$V_a$	= max.	2400	V
Anode current	$I_a$	= max.	170	mA
Anode dissipation	$W_a$	= max.	100	W
Anode input power	$W_{ia}$	= max.	340	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current	$I_g$	= max.	45	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	$M\Omega$
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	$M\Omega$

## OPERATING CONDITIONS

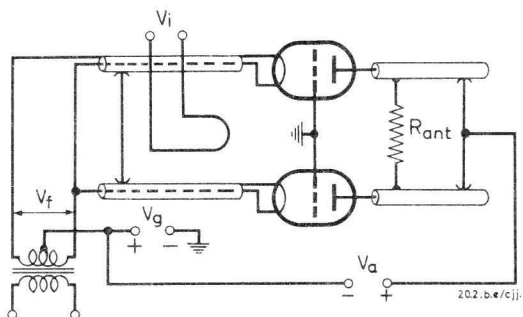
Frequency	f	=	150	150	150	Mc/s
Anode voltage	$V_a$	=	2000	1500	1000	V
Grid voltage	$V_g$	=	-225	-180	-130	V
Anode current	$I_a$	=	128	128	128	mA
Grid current	$I_g$	=	40	40	40	mA
Peak grid A.C. voltage	$V_{gp}$	=	415	370	320	V
Grid input power	$W_{ig}$	=	15	14	12	W
Anode input power	$W_{ia}$	=	256	192	128	W
Anode dissipation	$W_a$	=	51	38	32	W
Output power	$W_o$	=	205	154	96	W
Efficiency	$\eta$	=	80	80	75	%
Modulation factor	m	=	100	100	100	%
Modulation power	$W_{mod}$	=	128	96	64	W

## R.F. CLASS C TELEGRAPHY, grounded grid

### LIMITING VALUES (Absolute limits)

Frequency	$f$	up to	150	Mc/s
Anode voltage	$V_a$	= max.	3000	V
Anode current	$I_a$	= max.	205	mA
Anode dissipation	$W_a$	= max.	150	W
Anode input power	$W_{ia}$	= max.	512	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current	$I_g$	= max.	45	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	$M\Omega$
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	$M\Omega$

### OPERATING CONDITIONS. two tubes



Frequency	$f$	=	100	100	100	100	Mc/s
Anode voltage	$V_a$	=	2500	2000	1500	1000	V
Grid voltage	$V_g$	=	-200	-150	-110	-80	V
Anode current	$I_a$	=	410	410	410	410	mA
Grid current	$I_g$	=	80	80	80	80	mA
Peak grid A.C. voltage	$V_{gp}$	=	390	340	300	260	V
Grid input power	$W_{ig}$	=	158	136	118	100	W
Anode input power	$W_{ia}$	=	1025	820	615	410	W
Anode dissipation	$W_a$	=	245	230	195	158	W
Output power	$W_o$	=	780+130	590+110	420+96	252+80	W 1)
Efficiency	$\eta$	=	76	72	68	61.5	% 2)

1) Power transferred from driving stage included

2) Pure tube efficiency

7Z2 3445

**R.F. CLASS C OSCILLATOR** for high-frequency heating and diathermy generators, with anode voltage from single-phase full-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	150	Mc/s
Anode voltage	$V_a$	= max.	2700	V <sup>1)</sup>
Anode current	$I_a$	= max.	180	mA
Anode dissipation	$W_a$	= max.	150	W
Anode input power	$W_{ia}$	= max.	512	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current	$I_g$	= max.	40	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	M $\Omega$
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	M $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	50	Mc/s
Anode voltage	$V_a$	=	2000	V <sup>1)</sup>
Anode current	$I_a$	=	170	mA
Grid current	$I_g$	=	34	mA
Grid resistor	$R_g$	=	3750	$\Omega$
Anode input power	$W_{ia}$	=	420	W
Anode dissipation	$W_a$	=	120	W
Grid input power	$W_{ig}$	=	10	W
Output power	$W_o$	=	290	W
Efficiency	$\eta$	=	69	%

<sup>1)</sup> Mean value

**R.F. CLASS C OSCILLATOR** for industrial use with self-rectification. Phase shift of  $180^\circ$  between  $V_a$  and  $V_g$

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	150	Mc/s
Anode voltage	$V_a$	= max.	2825	$V_{RMS}$
Anode current	$I_a$	= max.	110	mA
Anode dissipation	$W_a$	= max.	150	W
Anode input power	$W_{ia}$	= max.	340	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current	$I_g$	= max.	35	mA
Grid circuit resistance with fixed grid bias	$R_g$	= max.	0.1	$M\Omega$
Grid circuit resistance with automatic grid bias	$R_g$	= max.	0.2	$M\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	50	Mc/s
Anode voltage	$V_a$	=	2500	$V_{RMS}$
Anode current	$I_a$	=	90	mA
Grid current	$I_g$	=	20	mA
Grid resistor	$R_g$	=	1700	$\Omega$
Grid voltage	$V_g$	=	85	$V_{RMS}$
Anode input power	$W_{ia}$	=	255	W
Anode dissipation	$W_a$	=	85	W
Output power	$W_o$	=	170	W
Efficiency	$\eta$	=	67	%



**A.F. CLASS B AMPLIFIER AND MODULATOR**

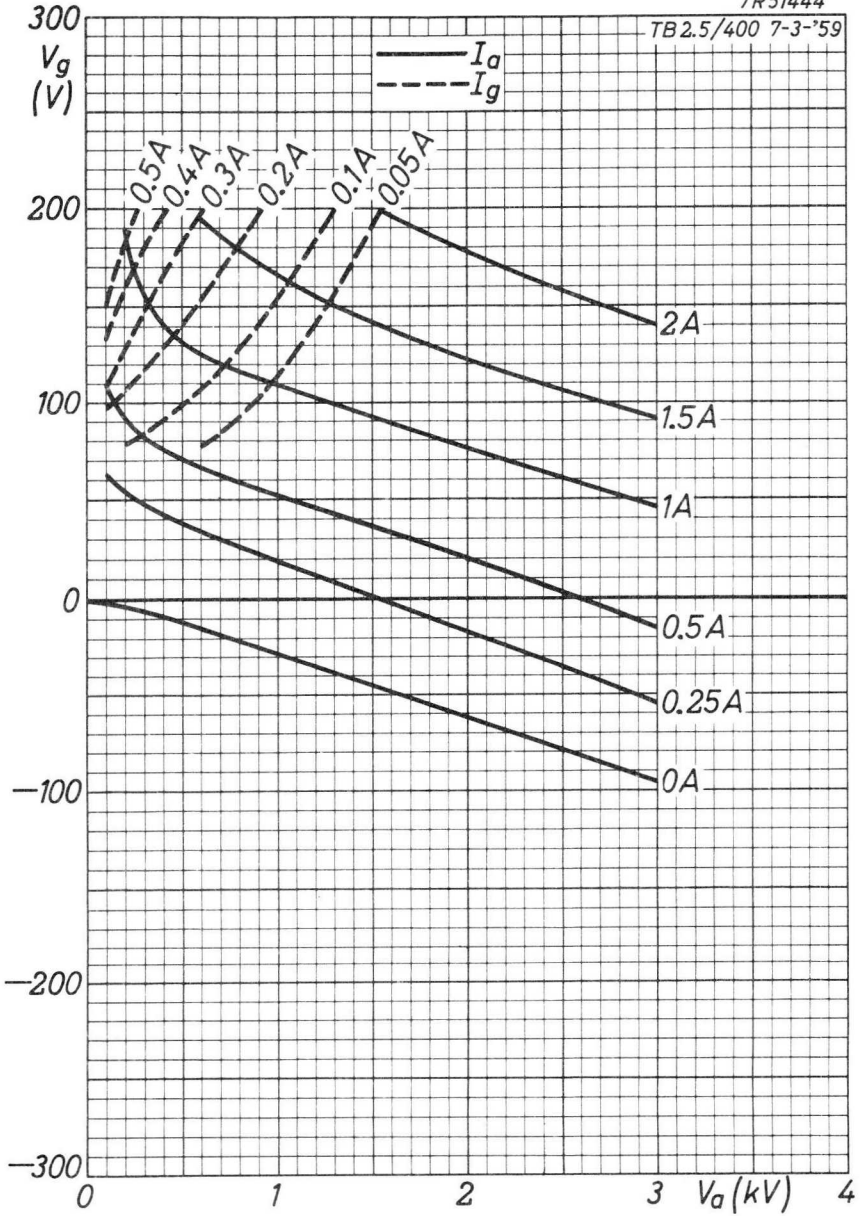
**LIMITING VALUES** (Absolute limits)

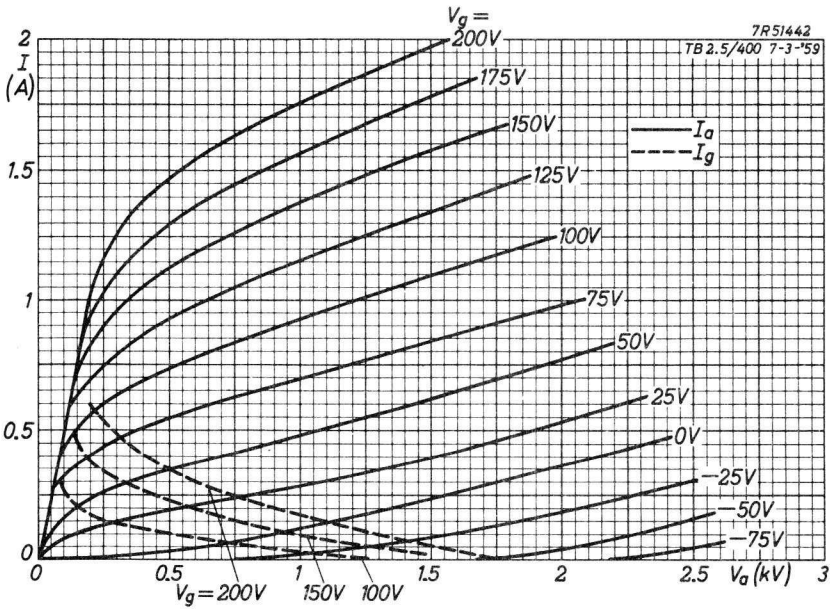
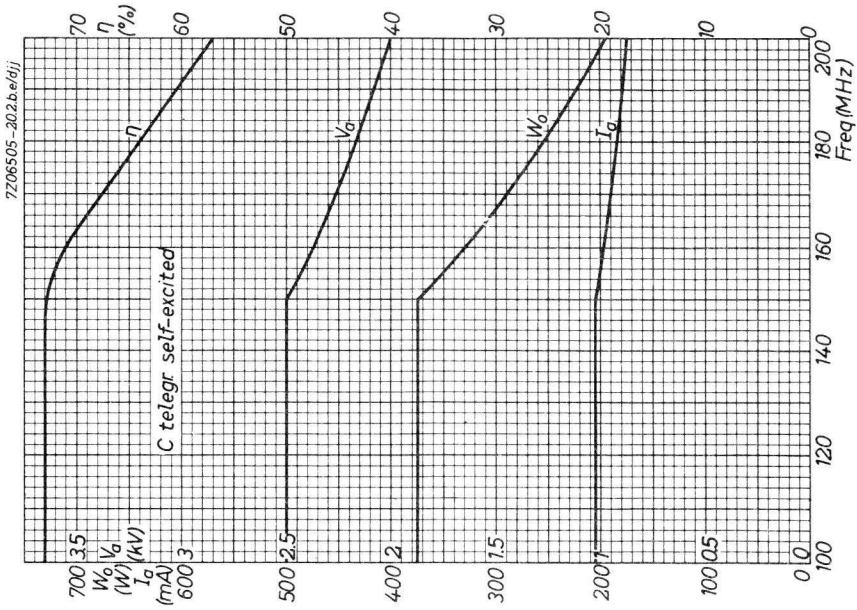
Anode voltage	$V_a$	=	max.	3000	V
Anode current	$I_a$	=	max.	210	mA
Anode dissipation	$W_a$	=	max.	150	W
Anode input power	$W_{ia}$	=	max.	512	W
Grid current	$I_g$	=	max.	45	mA

**OPERATING CONDITIONS,** two tubes

Anode voltage	$V_a$	=	2500	1000	V
Grid voltage	$V_g$	=	-86	-23	V
Load resistance	$R_{aa\sim}$	=	18.2	5.0	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0 412	0 295	V
Anode current	$I_a$	=	2x30 2x178	2x30 2x210	mA
Grid current	$I_g$	=	0 2x42	0 2x40	mA
Grid input power	$W_{ig}$	=	0 2x7.8	0 2x5.4	W
Anode input power	$W_{ia}$	=	2x75 2x445	2x30 2x210	W
Anode dissipation	$W_a$	=	2x75 2x95	2x30 2x73	W
Output power	$W_o$	=	0 700	0 274	W
Total harmonic distortion	$d_{tot}$	=	- 5.0	- 2.2	%
Efficiency	$\eta$	=	- 78.5	- 65	%









## R.F. POWER TRIODE

QUICK REFERENCE DATA								
Freq. (Mc/s)	C teleg. .		C grounded grid		C osc.		B mod.	
	V <sub>a</sub> (kV)	W <sub>o</sub> (W)	V <sub>a</sub> (kV)	W <sub>o</sub> <sup>1)</sup> (W)	V <sub>a</sub> (kV)	W <sub>o</sub> <sup>1)</sup> (W)	V <sub>a</sub> (kV)	W <sub>o</sub> <sup>1)</sup> (W)
100	4	1200			4	2320	4	1550
	3	840	3	1936	3	1626	3	1360
	2.5	750	2.5	1747			2.5	1140
	2	585	2	1374				
	1.5	425	1.5	1040				
Freq. (Mc/s)	C oscillator, industrial							
	⌚		⌚					
	V <sub>a</sub> (kV)	W <sub>o</sub> (W)	V <sub>a</sub> (kV)	W <sub>o</sub> (W)				
50	3.5	1100	4	630				
	2.25	685	3	415				

**HEATING:** direct, parallel supply; filament thoriated tungsten

Filament voltage  $V_f = 5 \text{ V} \begin{matrix} + 5\% \\ -10\% \end{matrix}$

Filament current  $I_f = 14.1 \text{ A}$

**CAPACITANCES**

Anode to all other elements except grid  $C_a = 0.16 \text{ pF}$

Grid to all other elements except anode  $C_g = 6.3 \text{ pF}$

Anode to grid  $C_{ag} = 5.0 \text{ pF}$

**TYPICAL CHARACTERISTICS**

Anode voltage  $V_a = 3 \text{ kV}$

Anode current  $I_a = 90 \text{ mA}$

Mutual conductance  $S = 5 \text{ mA/V}$

Amplification factor  $\mu = 25$

<sup>1)</sup> Two tubes

**TEMPERATURE LIMITS (Absolute limits)**

Bulb temperature	$t_{bulb}$	=	max. 350 °C
Anode seal temperature	$t_a$	=	max. 220 °C
Pin temperature	$t_{pin}$	=	max. 180 °C

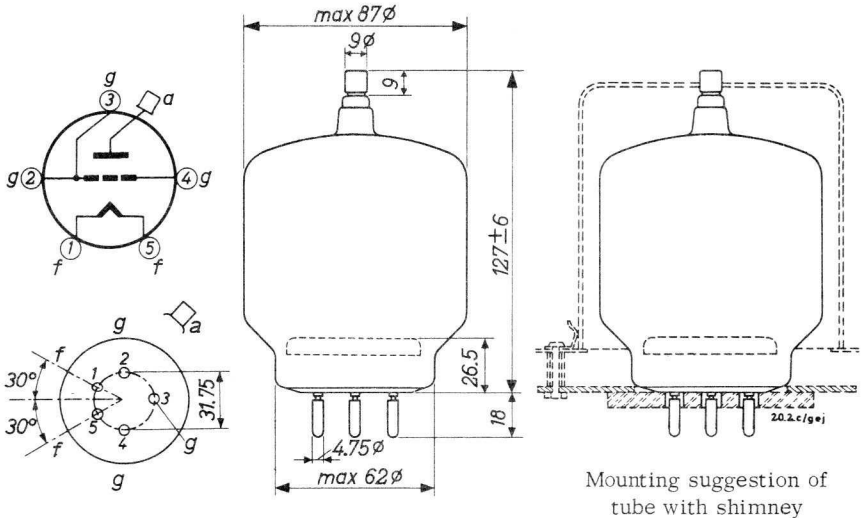
**COOLING**

In cases where the maximum permissible temperatures are likely to be exceeded, as would normally be the case at frequencies above 30 Mc/s with full ratings, a low-velocity air flow has to be directed onto the anode seal and the bottom of the envelope. The cooling will be facilitated by the use of a blower and a glass chimney type 40666

**MECHANICAL DATA**

Dimensions in mm

Socket	: 2422 512 01001	Base	: Giant 5p.
Anode connector (clip)	: 40624	Net weight	: 190 g
Chimney	: 40666		



Mounting position: vertical with base up or down

In order to prevent overheating of the grid pins by high-frequency current it is recommended to include the three grid socket connections in the circuit

## R.F. CLASS C TELEGRAPHY OR F.M. TELEPHONY

## LIMITING VALUES (Absolute limits)

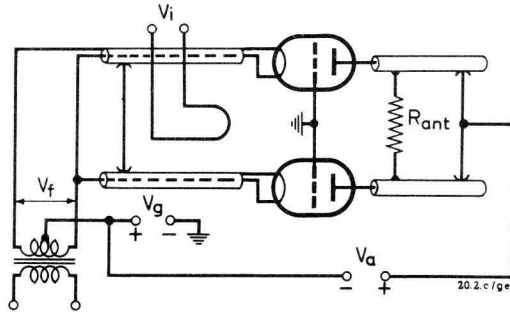
Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	4	kV
Anode input power	$W_{ia}$	= max.	1550	W
Anode dissipation	$W_a$	= max.	350	W
Negative grid voltage	$-V_g$	= max.	500	V
Grid dissipation	$W_g$	= max.	40	W
Grid circuit resistance	$R_g$	= max.	100	k $\Omega$
Cathode current	$I_k$	= max.	500	mA

## OPERATING CONDITIONS

Frequency	f	=	100	100	100	100	100	Mc/s
Anode voltage	$\hat{V}_a$	=	4	3	2.5	2	1.5	kV
Grid voltage	$V_g$	=	-350	-250	-200	-150	-120	V
Peak grid A.C. voltage	$V_{gp}$	=	535	430	380	320	295	V
Anode current	$I_a$	=	380	363	400	400	400	mA
Grid current	$I_g$	=	80	69	69	80	80	mA
Driving power	$W_{dr}$	=	40	27	23.5	23	21.5	W
Anode input power	$W_{ia}$	=	1520	1090	1000	800	600	W
Anode dissipation	$W_a$	=	320	250	250	215	175	W
Output power	$W_o$	=	1200	840	750	585	425	W
Efficiency	$\eta$	=	79	77	75	73	71	%



**R.F. CLASS C TELEGRAPHY OR F.M. TELEPHONY** (continued)  
**OPERATING CONDITIONS,** grounded grid, two tubes



Frequency	$f$	=	100	100	100	100	Mc/s
Anode voltage	$V_a$	=	3	2.5	2	1.5	kV
Grid voltage	$V_g$	=	-250	-200	-150	-120	V
Peak grid							
A.C. voltage	$V_{gp}$	=	430	380	320	295	V
Anode current	$I_a$	=	726	800	800	800	mA
Grid current	$I_g$	=	138	138	160	160	mA
Driving power	$W_{dr}$	=	310	294	250	233	W
Anode input power	$W_{ia}$	=	2180	2000	1600	1200	W
Anode dissipation	$W_a$	=	500	500	430	350	W
Output power	$W_o$	=	1680+256	1500+247	1170+204	850+190	W <sup>1)</sup>
Efficiency	$\eta$	=	77	75	73	71	%

<sup>1)</sup> Power transferred from driving stage included



**R.F. CLASS C OSCILLATOR****LIMITING VALUES** (Absolute limits)

Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	4	kV
Anode input power	$W_{ia}$	= max.	1550	W
Anode dissipation	$W_a$	= max.	350	W
Negative grid voltage	$-V_g$	= max.	500	V
Grid dissipation	$W_g$	= max.	40	W
Grid circuit resistance	$R_g$	= max.	100	k $\Omega$
Cathode current	$I_k$	= max.	500	mA

**OPERATING CONDITIONS,** two tubes

Frequency	f	=	100	100	Mc/s
Anode voltage	$V_a$	=	4	3	kV
Anode current	$I_a$	=	760	726	mA
Grid current	$I_g$	=	160	138	mA
Grid resistor	$R_g$	=	2200	1800	$\Omega$
Driving power	$W_{dr}$	=	80	54	W
Anode input power	$W_{ia}$	=	3040	2180	W
Anode dissipation	$W_a$	=	640	500	W
Output power	$W_o$	=	2320	1626	W
Efficiency	$\eta$	=	77	75	%

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from single-phase full-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 50	up to 100	up to 150	Mc/s
Anode voltage	$V_a = \text{max.}$	3.8	max. 2.7	max. 1.8	kV
Anode input power	$W_{ia} = \text{max.}$	1500	max. 975	max. 650	W
Anode dissipation	$W_a = \text{max.}$	350	max. 350	max. 350	W
Negative grid voltage	$-V_g = \text{max.}$	500	max. 500	max. 500	V
Grid dissipation	$W_g = \text{max.}$	40	max. 40	max. 40	W
Grid circuit resistance	$R_g = \text{max.}$	100	max. 100	max. 100	k $\Omega$
Cathode current	$I_k = \text{max.}$	450	max. 450	max. 450	mA

**OPERATING CONDITIONS**

Frequency	f	=	50	50	Mc/s
Anode voltage	$V_a =$		3.5	2.25	kV
Anode current	$I_a =$		325	340	mA
Grid current	$I_g =$		65	60	mA
Grid resistor	$R_g =$		4500	3330	$\Omega$
Anode input power	$W_{ia} =$		1400	935	W
Anode dissipation	$W_a =$		300	250	W
Output power	$W_o =$		1100	685	W
Efficiency	$\eta =$		78	73	%
Output power in the load	$W_l =$		900	560	W

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with self rectification,  
 180° phase shift between  $V_a$  and  $V_g$

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 50	up to 100	up to 150	Mc/s
Transformer voltage	$V_{tr}$	= max. 4.5	max. 3.5	max. 2.25	kV <sub>RMS</sub>
Anode input power	$W_{ia}$	= max. 900	max. 730	max. 500	W
Anode dissipation	$W_a$	= max. 350	max. 350	max. 350	W
Negative grid voltage	$-V_g$	= max. 500	max. 500	max. 500	V
Grid dissipation	$W_g$	= max. 40	max. 40	max. 40	W
Grid circuit resistance	$R_g$	= max. 100	max. 100	max. 100	kΩ
Cathode current	$I_k$	= max. 285	max. 285	max. 285	mA



**OPERATING CONDITIONS**

Frequency	f	=	50	50	Mc/s
Transformer voltage	$V_{tr}$	=	4	3	kV <sub>RMS</sub>
Anode current	$I_a$	=	190	180	mA
Driving voltage	$V_g$	=	280	110	V <sub>RMS</sub>
Grid current	$I_g$	=	35	32	mA
Grid resistor	$R_g$	=	5500	3000	Ω
Anode input power	$W_{ia}$	=	840	600	W
Anode dissipation	$W_a$	=	210	185	W
Output power	$W_o$	=	630	415	W
Efficiency	$\eta$	=	75	69	%
Output power in the load	$W_l$	=	515	350	W

**A.F. CLASS B AMPLIFIER AND MODULATOR** two tubes in push-pull

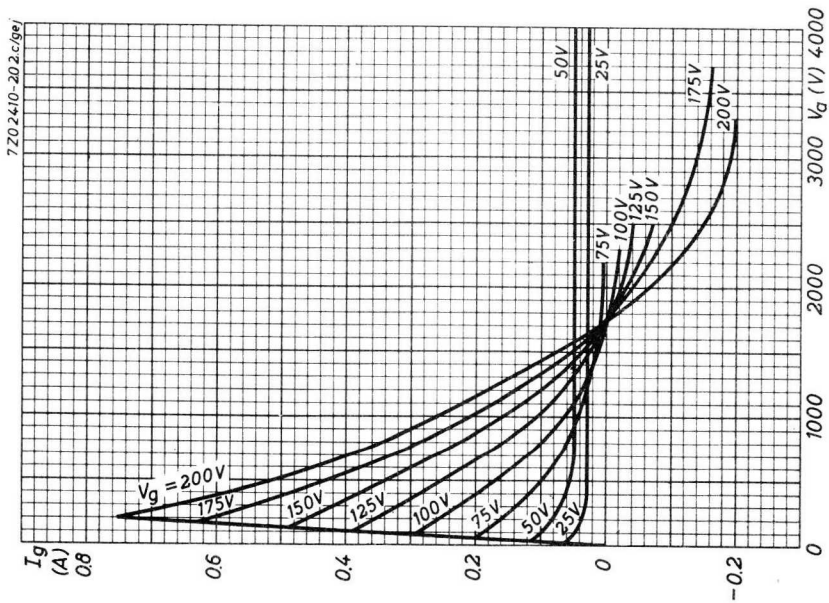
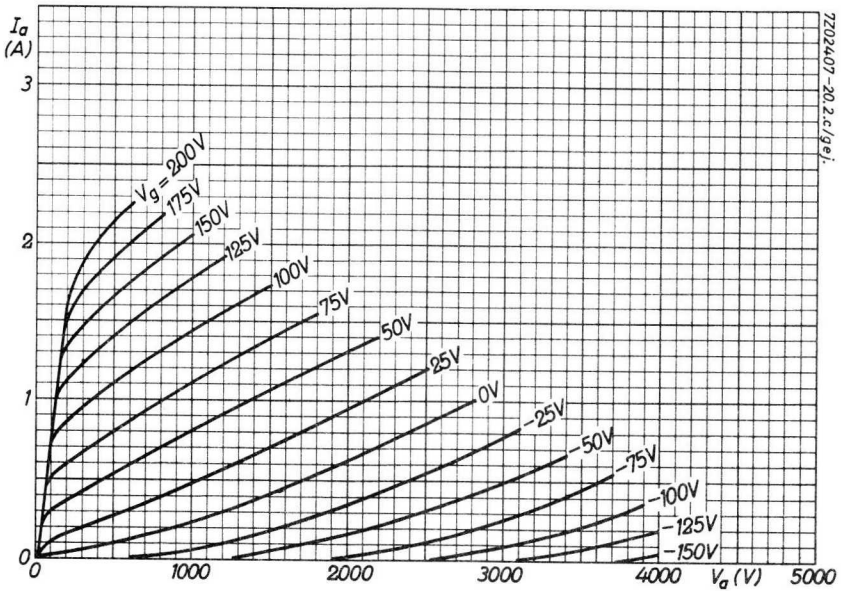
**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	= max.	4	kV
Anode input power	$W_{ia}$	= max.	1550	W
Anode dissipation	$W_a$	= max.	350	W
Negative grid voltage	$-V_g$	= max.	500	V
Grid dissipation	$W_g$	= max.	40	W
Grid circuit resistance	$R_g$	= max.	100	k $\Omega$
Cathode current	$I_k$	= max.	500	mA

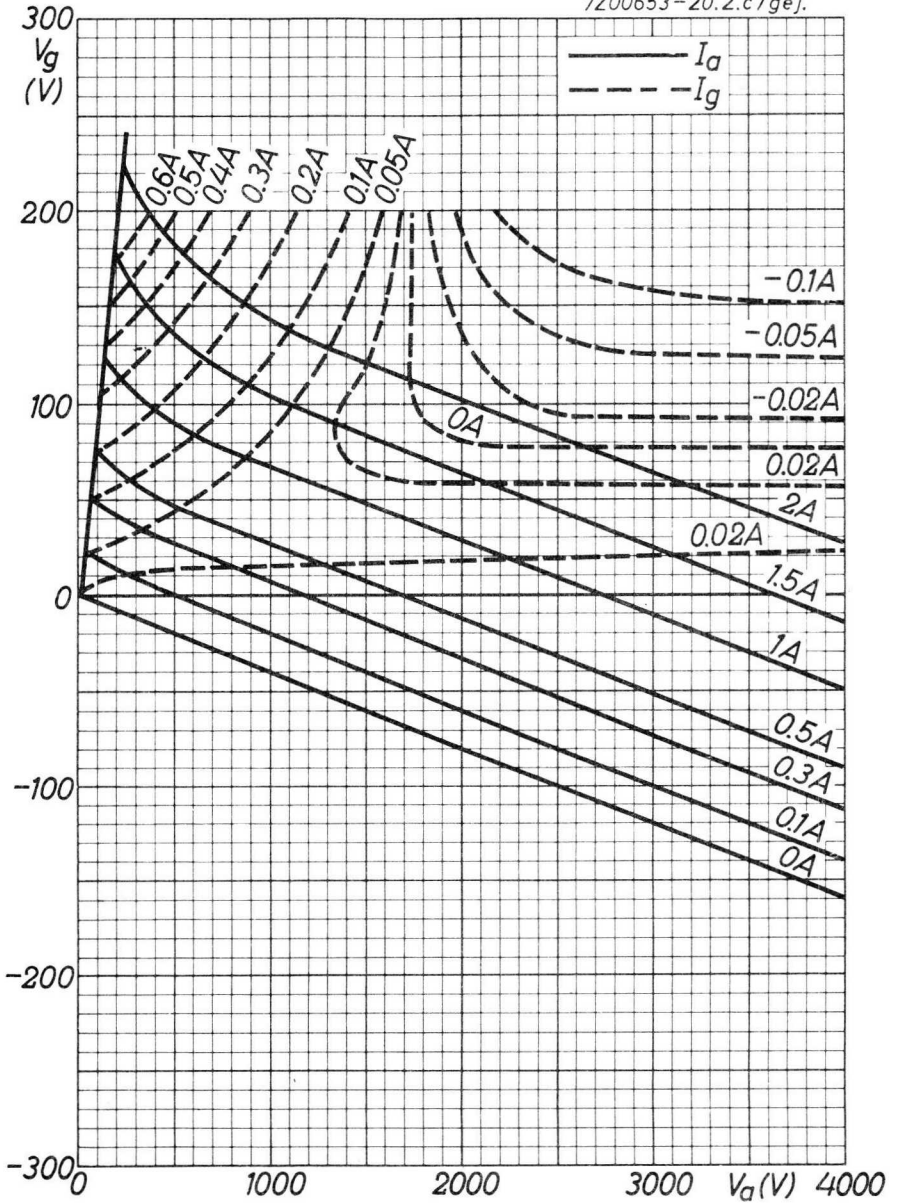
**OPERATING CONDITIONS**

$V_a$	=	4	3	2.5	kV
$V_g$	=	-135	-102	-77.5	V <sup>1)</sup>
$R_{aa\sim}$	=	20	14.5	12	k $\Omega$
$V_{ggp}$	=	0 485	0 475	0 400	V
$I_a$	=	2x88 2x270	2x60 2x290	2x90 2x300	mA
$I_g$	=	0 2x30	0 2x60	0 2x55	mA
$W_{dr}$	=	0 2x7	0 2x13	0 2x10	W
$W_{ia}$	=	2x350 2x1080	2x180 2x870	2x225 2x750	W
$W_a$	=	2x350 2x305	2x180 2x190	2x225 2x180	W
$W_o$	=	0 1550	0 1360	0 1140	W
$d_{tot}$	=	- < 2.5	- < 2.5	- < 2.5	%
$\eta$	=	- 71.7	- 78.1	- 76	%

<sup>1)</sup> To be adjusted for zero signal anode current



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## R.F. POWER TRIODE

## QUICK REFERENCE DATA

$\lambda$ (m)	Freq. (Mc/s)	C telegr.		C grounded grid		C <sub>a</sub> mod.		B mod. <sup>2)</sup>	
		V <sub>a</sub> (V)	W <sub>o</sub> (W)	V <sub>a</sub> (V)	W <sub>o</sub> <sup>1)</sup> (W)	V <sub>a</sub> (V)	W <sub>o</sub> (W)	V <sub>a</sub> (V)	W <sub>o</sub> (W)
3	100	4000	1690	4000	1950	3000	1050	4000	2290
		3500	1430	3500	1650			3500	2440
		3000	1175	3000	1375			3000	2310
		2500	950	2500	1120			2500	2000

**HEATING:** direct; filament thoriated tungsten

Filament voltage  $V_f = 10$  V

Filament current  $I_f = 9.9$  A

## CAPACITANCES

Anode to all other elements except grid  $C_a = 0.17$  pF

Grid to all other elements except anode  $C_g = 8.0$  pF

Anode to grid  $C_{ag} = 7.0$  pF

## TYPICAL CHARACTERISTICS

Amplification factor  $\mu = 28$

Mutual conductance  $S (I_a = 125 \text{ mA}) = 4.5$  mA/V

## TEMPERATURE LIMITS (Absolute limits)

Temperature of anode seal = max. 220 °C

Temperature of bottom pin seals = max. 180 °C

Bulb temperature = max. 250 °C

<sup>1)</sup> Power transferred from driving stage included

<sup>2)</sup> Two tubes

**COOLING**

In general cooling of the tube is not necessary at normal ambient temperature at frequencies below 50 Mc/s.

When the tube is used at or near the limiting values at frequencies above 50 Mc/s, it will be necessary to direct a low-velocity air flow on the anode seal and the bottom of the envelope.

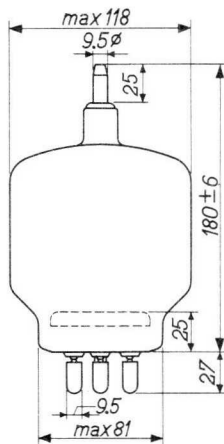
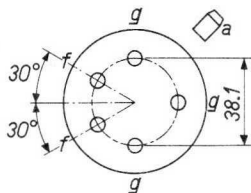
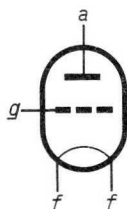
**MECHANICAL DATA**

Dimensions in mm

Socket : 2422 512 00001

Anode connector: 40626

Net weight : 420 g



Mounting position: vertical with base up or down



## R.F. CLASS C TELEGRAPHY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	4000	V
Anode dissipation	$W_a$	= max.	450	W
Grid dissipation	$W_g$	= max.	50	W
Grid current	$I_g$	= max.	115	mA
Cathode current	$I_k$	= max.	650	mA

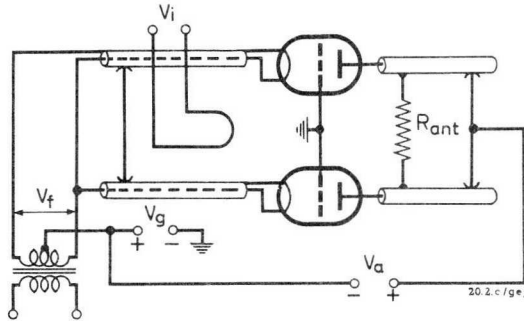
## OPERATING CONDITIONS (controlled)

Wavelength	$\lambda$	=	3	3	3	3	m
Anode voltage	$V_a$	=	4000	3500	3000	2500	V
Grid voltage	$V_g$	=	-350	-300	-250	-200	V
Anode current	$I_a$	=	535	535	535	535	mA
Grid current	$I_g$	=	115	115	115	115	mA
Peak grid A.C. voltage	$V_{gp}$	=	580	520	460	405	V
Grid input power	$W_{ig}$	=	60	54	48	42	W
Anode input power	$W_{ia}$	=	2140	1880	1600	1340	W
Anode dissipation	$W_a$	=	450	450	425	390	W
Output power	$W_o$	=	1690	1430	1175	950	W
Efficiency	$\eta$	=	79	76	73.5	71	%

## OPERATING CONDITIONS (self excited)

Wavelength	$\lambda$	=	3	3	3	3	m
Anode voltage	$V_a$	=	4000	3500	3000	2500	V
Grid resistor	$R_g$	=	3000	2600	2200	1800	$\Omega$
Anode current	$I_a$	=	535	535	535	535	mA
Grid current	$I_g$	=	115	115	115	115	mA
Peak grid A.C. voltage	$V_{gp}$	=	580	520	460	405	V
Grid input power	$W_{ig}$	=	60	54	48	42	W
Anode input power	$W_{ia}$	=	2140	1880	1600	1340	W
Anode dissipation	$W_a$	=	450	450	425	390	W
Output power	$W_o$	=	1630	1376	1127	908	W
Efficiency	$\eta$	=	76.5	73	70.5	67.5	%

**OPERATING CONDITIONS R.F. CLASS C TELEGRAPHY (continued)**  
 Grounded grid circuit, two tubes



Wavelength	$\lambda$	=	3	3	3	3	m
Anode voltage	$V_a$	=	4000	3500	3000	2500	V
Grid voltage	$V_g$	=	-350	-300	-250	-200	V
Anode current	$I_a$	=	2x535	2x535	2x535	2x535	mA
Grid current	$I_g$	=	2x115	2x115	2x115	2x115	mA
Peak grid voltage	$V_{gp}$	=	580	520	460	405	V
Grid input power	$W_{ig}$	=	2x320	2x274	2x248	2x212	W
Anode input power	$W_{ia}$	=	2x2140	2x1880	2x1600	2x1340	W
Anode dissipation	$W_a$	=	2x450	2x450	2x425	2x390	W
Output power	$W_o$	=	3380+520	2860+440	2350+400	1900+340	W <sup>1)</sup>
Efficiency	$\eta$	=	79	76	73.5	71	% <sup>2)</sup>

1) Power transferred from driving stage included

2) Pure tube efficiency

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	3000	V
Anode dissipation	$W_a$	= max.	300	W
Grid dissipation	$W_g$	= max.	50	W
Grid current	$I_g$	= max.	115	mA
Cathode current	$I_k$	= max.	550	mA

## OPERATING CONDITIONS

Wavelength	$\lambda$	=	3	m
Anode voltage	$V_a$	=	3000	V
Grid voltage	$V_g$	=	-375	V
Anode current	$I_a$	=	450	mA
Grid current	$I_g$	=	85	mA
Peak grid A.C. voltage	$V_{gp}$	=	580	V
Grid input power	$W_{ig}$	=	42	W
Anode input power	$W_{ia}$	=	1350	W
Anode dissipation	$W_a$	=	300	W
Output power	$W_o$	=	1050	W
Efficiency	$\eta$	=	78	%
Modulation factor	m	=	100	%
Modulation power	$W_{mod}$	=	675	W

**A.F. CLASS B AMPLIFIER AND MODULATOR**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	=	max.	4000	V
Anode dissipation	$W_a$	=	max.	450	W
Grid dissipation	$W_g$	=	max.	50	W
Cathode current	$I_k$	=	max.	700	mA
Peak cathode current	$I_{kp}$	=	max.	5	A
Grid current	$I_g$	=	max.	130	mA
Grid circuit resistance	$R_g$	=	max.	50	k $\Omega$

**OPERATING CONDITIONS**, two tubes

Anode voltage	$V_a$	=	4000	3500	V
Grid voltage	$V_g$	=	-135	-114	V
Load resistance	$R_{aa\sim}$	=	14.5	10.2	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0    566	0    563	V
Anode current	$I_a$	=	2x70    2x368	2x70    2x442	mA
Grid current	$I_g$	=	0    2x93	0    2x115	mA
Grid input power	$W_{ig}$	=	0    2x24	0    2x29	W
Anode input power	$W_{ia}$	=	2x280    2x1474	2x245    2x1550	W
Anode dissipation	$W_a$	=	2x280    2x329	2x245    2x330	W
Output power	$W_o$	=	0    2290	0    2440	W
Total distortion	$d_{tot}$	=	-    5	-    5	%
Efficiency	$\eta$	=	-    77.7	-    78.8	%
Anode voltage	$V_a$	=	3000	2500	V
Grid voltage	$V_g$	=	-94	-75	V
Load resistance	$R_{aa\sim}$	=	7.5	5.2	k $\Omega$
Peak grid to grid voltage	$V_{ggp}$	=	0    560	0    530	V
Anode current	$I_a$	=	2x70    2x500	2x70    2x555	mA
Grid current	$I_g$	=	0    2x130	0    2x126	mA
Grid input power	$W_{ig}$	=	0    2x33	0    2x30	W
Anode input power	$W_{ia}$	=	2x210    2x1500	2x175    2x1387	W
Anode dissipation	$W_a$	=	2x210    2x345	2x175    2x387	W
Output power	$W_o$	=	0    2310	0    2000	W
Total distortion	$d_{tot}$	=	-    5	-    3.5	%
Efficiency	$\eta$	=	-    77	-    72	%

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from two-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	3600	V
Negative grid voltage	$-V_g$	= max.	320	V
Anode current	$I_a$	= max.	475	mA
Grid current	$I_g$	= max.	100	mA
Anode input power	$W_{ia}$	= max.	2200	W
Anode dissipation	$W_a$	= max.	450	W
Grid dissipation	$W_g$	= max.	50	W

**OPERATING CONDITIONS**

Transformer voltage	$V_{tr}$	= 4000 <sup>1)</sup>	3350 <sup>2)</sup>	$V_{RMS}$
Anode voltage	$V_a$	= 3600	3000	V <sup>3)</sup>
Anode current	$I_a$	= 450	400	mA
Grid current	$I_g$	= 100	85	mA
Grid resistor	$R_g$	= 3.0	3.0	k $\Omega$
Anode input power	$W_{ia}$	= 2000	1480	W
Anode dissipation	$W_a$	= 450	400	W
Output power	$W_o$	= 1500	1040	W
Efficiency	$\eta$	= 75	70	%

<sup>1)</sup> Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements.

<sup>2)</sup> Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded.

<sup>3)</sup> D.C. value

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	100	Mc/s
Anode voltage	$V_a$	= max.	4000	V
Negative grid voltage	$-V_g$	= max.	500	V
Anode current	$I_a$	= max.	535	mA
Grid current	$I_g$	= max.	115	mA
Anode input power	$W_{ia}$	= max.	2200	W
Anode dissipation	$W_a$	= max.	450	W
Grid dissipation	$W_g$	= max.	50	W

**OPERATING CONDITIONS**

Transformer voltage	$V_{tr}$	= 3400 <sup>1)</sup>	2900 <sup>2)</sup>	$V_{RMS}$
Anode voltage	$V_a$	= 4000	3400	V <sup>3)</sup>
Anode current	$I_a$	= 535	450	mA
Grid current	$I_g$	= 115	100	mA
Grid resistor	$R_g$	= 3.0	3.0	k $\Omega$
Anode input power	$W_{ia}$	= 2140	1530	W
Anode dissipation	$W_a$	= 450	390	W
Output power	$W_o$	= 1630	1090	W
Efficiency	$\eta$	= 76.5	71	%

1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements.

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded.

3) D.C. value.

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE with self rectification**

**LIMITING VALUES (Absolute limits)**

Frequency	f	up to	100	Mc/s
Transformer voltage	$V_{tr}$	= max.	4500	$V_{RMS}$
Negative grid voltage	$-V_g$	= max.	500	V
Anode current	$I_a$	= max.	280	mA
Grid current	$I_g$	= max.	55	mA
Anode input power	$W_{ia}$	= max.	1450	W
Anode dissipation	$W_a$	= max.	450	W
Grid dissipation	$W_g$	= max.	50	W

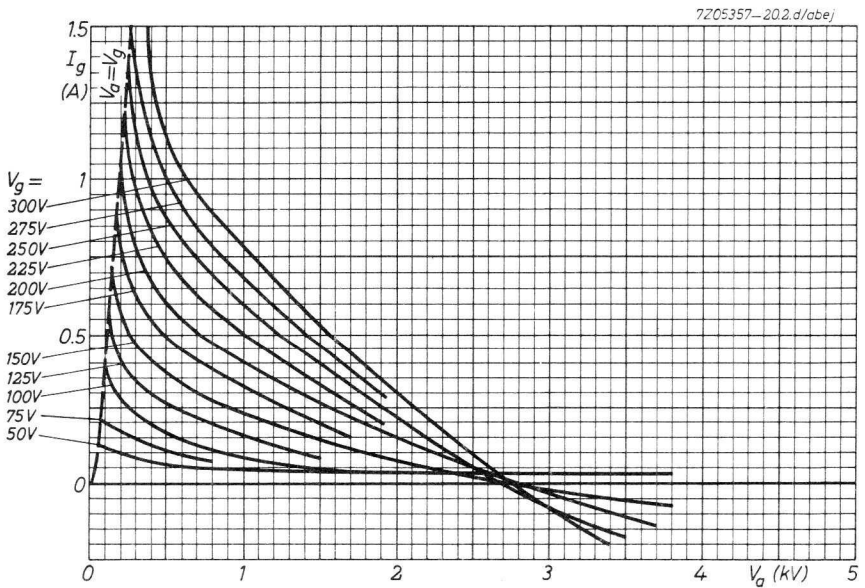
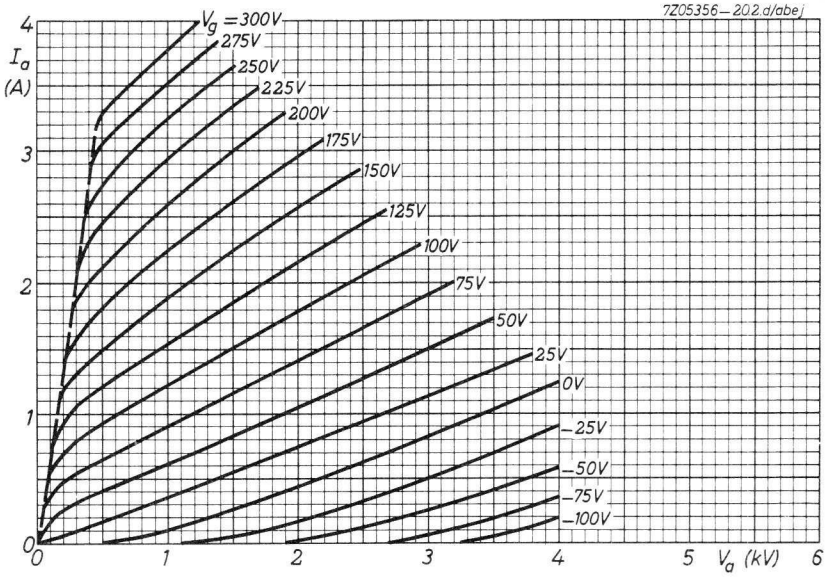


**OPERATING CONDITIONS**

Transformer voltage	$V_{tr}$	= 4500 <sup>1)</sup>	3800 <sup>2)</sup>	$V_{RMS}$
Anode current	$I_a$	= 280	240	mA
Grid current	$I_g$	= 55	47	mA
Grid resistor	$R_g$	= 3.4	3.4	k $\Omega$
Anode input power	$W_{ia}$	= 1400	1010	W
Anode dissipation	$W_a$	= 350	295	W
Output power	$W_o$	= 1000	670	W
Efficiency	$\eta$	= 71.5	66	%

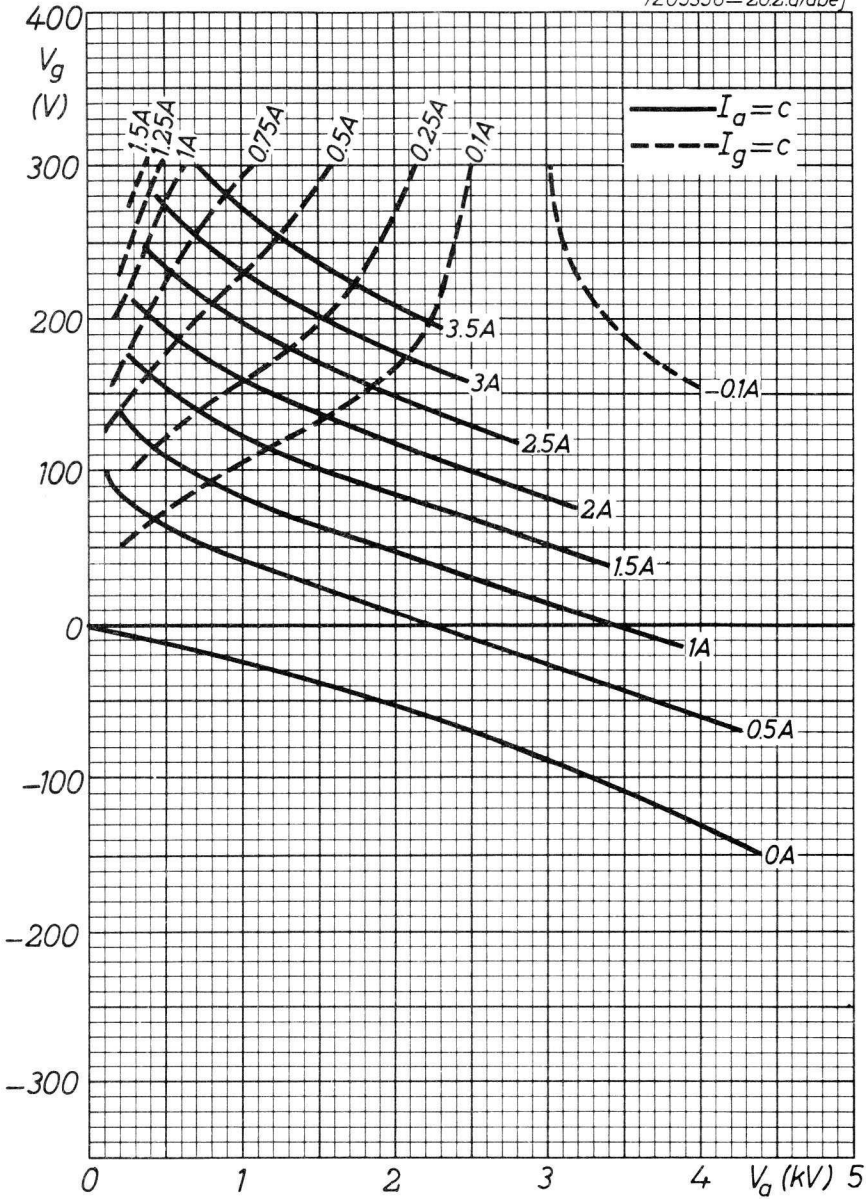
1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements.

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded.

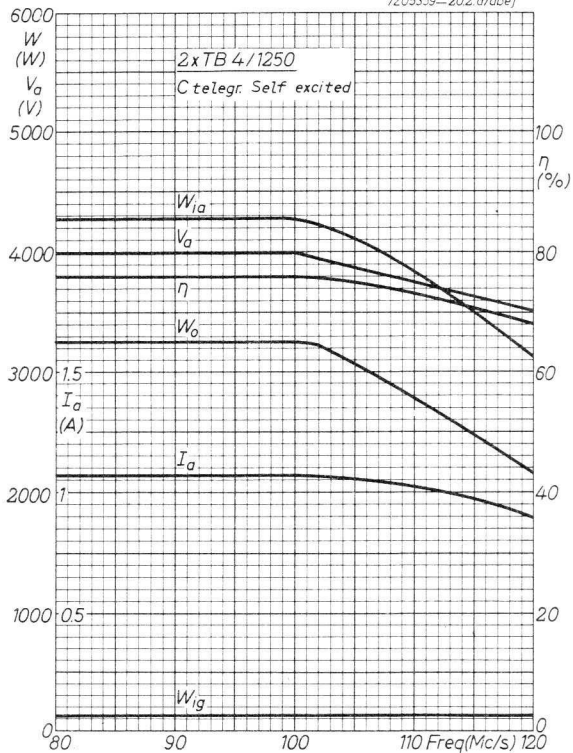




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## R.F INDUSTRIAL TRIODE

Radiation cooled triode of metal-glass construction intended for use as an industrial oscillator

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	1.58	kW
Frequency for full ratings	f	max. 50	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### A. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

with anode voltage from a three-phase rectifier

#### OPERATING CONDITIONS continuous service

Frequency	f	50	50	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	1.55	1.58	1.55	kW
Anode voltage	$V_a$	6	5	4	kV
Anode current	$I_a$	350	430	535	mA
Anode input power	$W_{ia}$	2100	2150	2140	W
Anode dissipation	$W_a$	460	480	490	W
Anode output power	$W_o$	1640	1670	1650	W
Anode efficiency	$\eta_a$	78	78	77	%
Oscillator efficiency	$\eta_{\text{osc}}$	74	73.5	72.5	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	15	15.5	20	%
Grid resistor	$R_g$	4.2	3.5	2.7	k $\Omega$
Grid current, on load	$I_g$	120	130	150	mA
Grid voltage, negative	$-V_g$	500	456	405	V
Grid dissipation	$W_g$	23	29	41	W
Grid resistor dissipation	$W_{Rg}$	60	59	61	W



## B. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE,

with anode voltage from three-phase rectifier,

OPERATING CONDITIONS, intermittent service

Frequency	$f$	50	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	3.05	2.28	kW
Anode voltage	$V_a$	6	6	kV
Anode current	$I_a$	700	630	mA
Anode input power	$W_{ia}$	4200	3150	W
Anode dissipation	$W_a$	1000	750	W
Anode output power	$W_o$	3200	2400	W
Anode efficiency	$\eta_a$	76	76	%
Oscillator efficiency	$\eta_{\text{osc}}$	72.5	72.5	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	16	17	%
Grid resistor	$R_g$	3.3	2.7	k $\Omega$
Grid current, on load	$I_g$	170	160	mA
Grid voltage, negative	$-V_g$	560	432	V
Grid dissipation	$W_g$	55	48	W
Grid resistor dissipation	$W_{Rg}$	95	69	W

## LIMITING VALUES (Absolute max. rating system)

Frequency for full ratings	$f$	up to	50	MHz
Anode voltage	$V_a$	max.	7	kV
Anode current	$I_a$	max.	750	mA
Anode input power	$W_{ia}$	max.	5	kW
Anode dissipation	$W_a$	max.	See page 7	
Grid voltage	$-V_g$	max.	1250	V
Grid current, on load	$I_g$	max.	185	mA
off load	$I_g$	max.	300	mA
Grid dissipation	$W_g$	max.	100	W
Grid circuit resistance	$R_g$	max.	15	k $\Omega$
Cathode current, mean	$I_k$	max.	1.1	A
Envelope temperature	$t_{\text{env}}$	max.	330	$^{\circ}\text{C}$
Seal temperature	$t$	max.	220	$^{\circ}\text{C}$

**C. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE,**

with anode voltage from single-phase rectifier without filter

**OPERATING CONDITIONS**, continuous service

Frequency	f	50	50	MHz
Oscillator output power ( $W_O - W_{\text{feedb}}$ )	$W_{\text{osc}}$	1.565	1.525	kW
Anode voltage	$V_a$	5.4	4.5	kV
Anode current	$I_a$	320	380	mA
Anode input power	$W_{ia}$	2125	2100	W
Anode dissipation	$W_a$	490	500	W
Anode output power	$W_O$	1635	1600	W
Anode efficiency	$\eta_a$	77	76	%
Oscillator efficiency	$\eta_{\text{osc}}$	74	73	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	13	15.5	%
Grid resistor	$R_g$	4.2	3.5	k $\Omega$
Grid current, on load	$I_g$	110	120	mA
Grid voltage, negative	$-V_g$	462	420	V
Grid dissipation	$W_g$	15	25	W
Grid resistor dissipation	$W_{Rg}$	50	50	W

**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	f	up to	50	MHz
Anode voltage	$V_a$	max.	6.3	kV
Anode current	$I_a$	max.	500	mA
Anode input power	$W_{ia}$	max.	2.5	kW
Anode dissipation	$W_a$	max.	500	W
Grid voltage	$-V_g$	max.	1250	V
Grid current, on load	$I_g$	max.	185	mA
off load	$I_g$	max.	280	mA
Grid dissipation	$W_g$	max.	100	W
Grid circuit resistance	$R_g$	max.	15	k $\Omega$
Cathode current, mean	$I_k$	max.	780	mA
Envelope temperature	$t_{\text{env}}$	max.	330	$^{\circ}\text{C}$
Seal temperature	t	max.	220	$^{\circ}\text{C}$

## D. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE,

with self rectification

## OPERATING CONDITIONS, continuous service

Frequency	$f$	50	MHz
Oscillator output power ( $W_0 - W_{\text{feedb}}$ )	$W_{\text{osc}}$	990	W
Transformer voltage, RMS	$V_{\text{tr}}$	4.5	kV
Anode current	$I_a$	280	mA <sup>1)</sup>
Anode input power	$W_{\text{ia}}$	1400	W
Anode dissipation	$W_a$	380	W
Anode output power	$W_0$	1020	W
Anode efficiency	$\eta_a$	78	%
Oscillator efficiency	$\eta_{\text{osc}}$	71	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	18	%
Grid resistor	$R_g$	2.7	k $\Omega$
Grid current, on load	$I_g$	80	mA <sup>1)</sup>
Grid voltage, negative	$-V_g$	216	V
Grid dissipation	$W_g$	14	W
Grid resistor dissipation	$W_{Rg}$	17	W

## LIMITING VALUES (Absolute max. rating system)

Frequency for full ratings	$f$	up to	50	MHz
Transformer voltage, RMS	$V_a$	max.	5	kV
Anode current	$I_a$	max.	320	mA <sup>1)</sup>
Anode input power	$W_{\text{ia}}$	max.	1600	W
Anode dissipation	$W_a$	max.	500	W
Grid voltage, at peak of mains frequency sine wave	$-V_g$	max.	1350	V
Grid current, on load	$I_g$	max.	110	mA <sup>1)</sup>
off load	$I_g$	max.	150	mA <sup>1)</sup>
Grid dissipation	$W_g$	max.	100	W
Grid circuit resistance	$R_g$	max.	15	k $\Omega$
Cathode current, mean	$I_k$	max.	470	mA <sup>1)</sup>
Envelope temperature	$t_{\text{env}}$	max.	330	$^{\circ}\text{C}$
Seal temperature	$t$	max.	220	$^{\circ}\text{C}$

1) Average over any mains frequency cycle.

**HEATING** : direct; filament thoriated tungsten

Filament voltage	$V_f$	5	V
Filament current	$I_f$	32.5	A

The filament is designed to accept temporary fluctuations of +5 % and -10 %.

**CAPACITANCES**

Anode to filament	$C_{af}$	0.2	pF
Grid to filament	$C_{gf}$	7.5	pF
Anode to grid	$C_{ag}$	5.1	pF

**CHARACTERISTICS** measured at  $V_a = 4$  kV,  $I_a = 120$  mA

Transconductance	S	3.3	mA/V
Amplification factor	$\mu$	21	

**COOLING**

In general cooling of the tube working at the published operating conditions with matched load is not necessary. When the tube is mounted in a small cabinet adequate ventilation must be provided.

At non-matched load, combined with the highest operating frequencies a low-velocity air flow on the tube is necessary. A small fan will suffice; it is recommended to mount the fan underneath the tube socket.

**ACCESSORIES**

Socket	catalogue nr.	2422 511 05001
Anode connector	type	40665

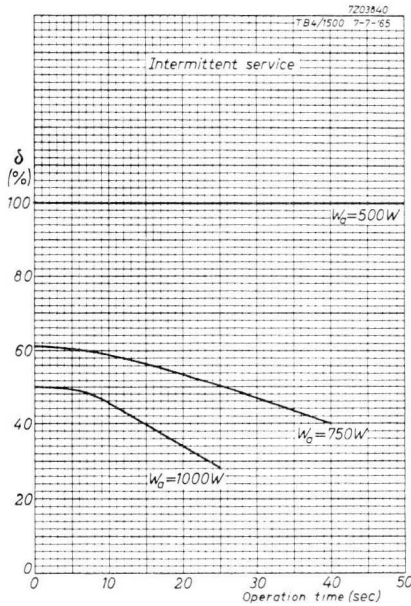
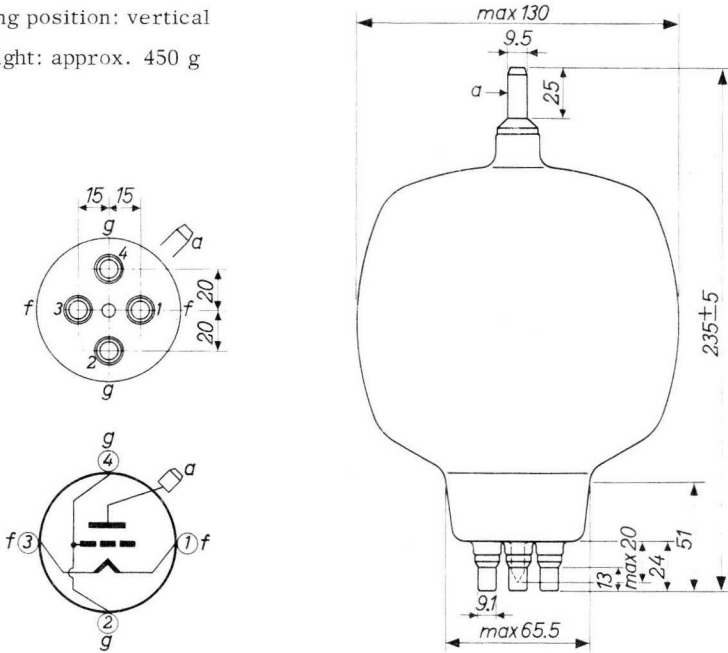


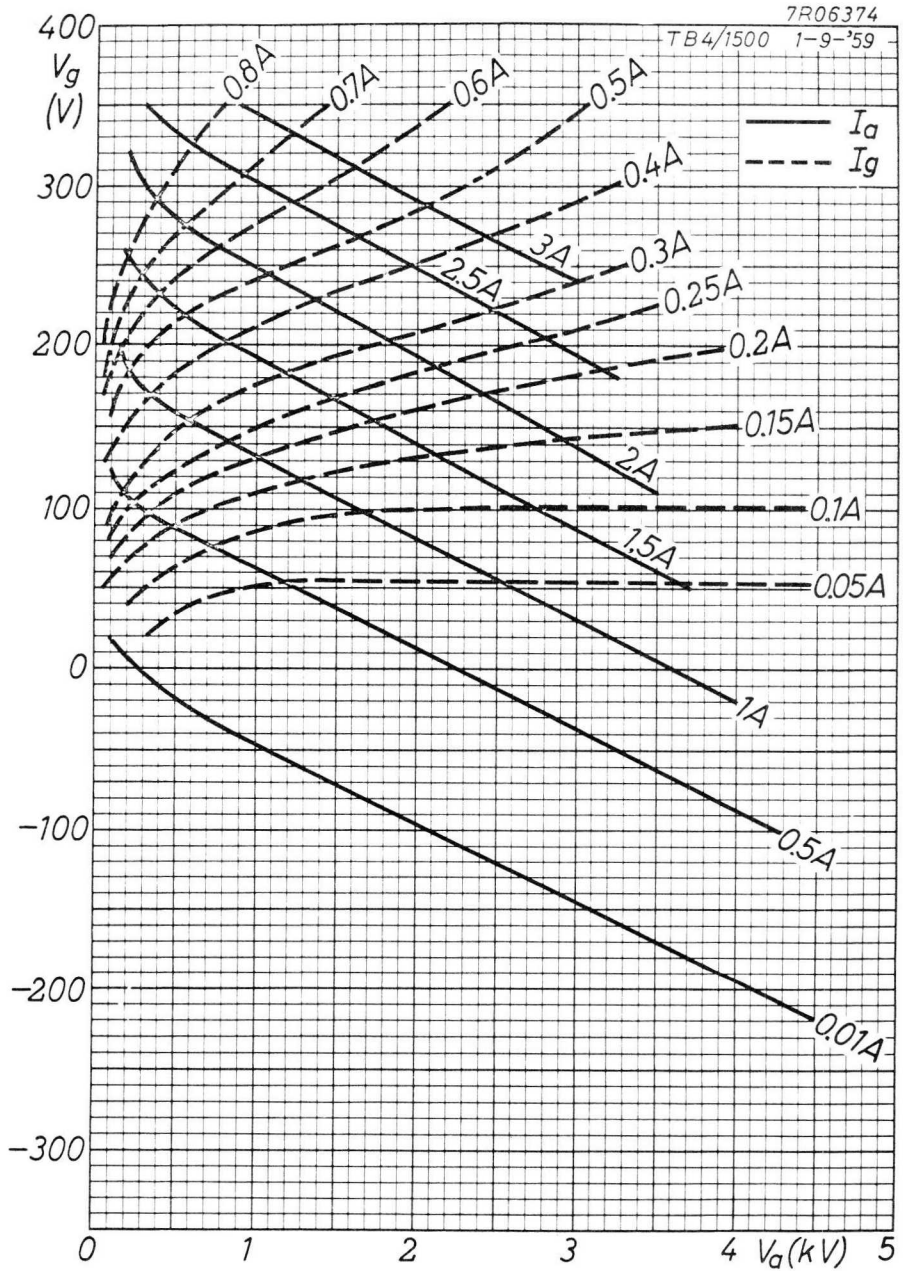
**MECHANICAL DATA**

Mounting position: vertical

Net weight: approx. 450 g

Dimensions in mm





## R.F. INDUSTRIAL TRIODE

Radiation cooled triode of glass construction intended for use as an industrial oscillator

### QUICK REFERENCE DATA

Oscillator output power ( $W_O - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	2.73	kW
Frequency for full ratings	f	max. 50	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### A. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

with anode voltage from a three-phase rectifier

#### OPERATING CONDITIONS , continuous service

Frequency	f	50	50	50	50	MHz
Oscillator output power ( $W_O - W_{\text{feedb}}$ )	$W_{\text{osc}}$	2.73	2.61	2.04	1.44	kW
Anode voltage	$V_a$	6	5	4	3	kV
Anode current	$I_a$	600	700	700	700	mA
Anode input power	$W_{ia}$	3600	3500	2800	2100	W
Anode dissipation	$W_a$	760	780	640	540	W
Anode output power	$W_O$	2840	2720	2160	1560	W
Anode efficiency	$\eta_a$	79	78	77	74	%
Oscillator efficiency	$\eta_{\text{osc}}$	76	75	73	69	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	13	17	20	25	%
Grid resistor	$R_g$	3	2.5	2	1.5	k $\Omega$
Grid current, on load	$I_g$	150	160	180	200	mA
Grid voltage, negative	$-V_g$	450	400	360	300	V
Grid dissipation	$W_g$	43	46	55	60	W
Grid resistor dissipation	$W_{Rg}$	67	64	65	60	W
Recommended grid blocking capacitor	at high frequencies about	100 pF				
	at 1 MHz	about	1000 pF			



**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	f	up to	50	MHz
Anode voltage	$V_a$	max.	7	kV
Anode current	$I_a$	max.	750	mA
Anode input power	$W_{ia}$	max.	4000	W
Anode dissipation	$W_a$	max.	800	W
Grid voltage	$-V_g$	max.	1250	V
Grid current, on load	$I_g$	max.	300	mA
off load	$I_g$	max.	400	mA
Grid dissipation	$W_g$	max.	150	W
Grid circuit resistance	$R_g$	max.	10	k $\Omega$
Cathode current, mean	$I_k$	max.	1.2	A
peak	$I_{kp}$	max.	4.3	A
Envelope temperature	$t_{env}$	max.	350	$^{\circ}C$
Seal temperature	t	max.	220	$^{\circ}C$



**B. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE**

with anode voltage from a three-phase rectifier

**OPERATING CONDITIONS** , intermittent service

Frequency	$f$	50	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	4.25	3.24	kW
Anode voltage	$V_a$	6	5	kV
Anode current	$I_a$	950	900	mA
Anode input power	$W_{ia}$	5700	4500	W
Anode dissipation	$W_a$	1300	1125	W
Anode output power	$W_o$	4400	3375	W
Oscillator efficiency	$\eta_a$	77	75	%
Oscillator efficiency	$\eta_{\text{osc}}$	74	72	%
Feedback ratio	$V_{gp}/V_{ap}$	17	20	%
Grid resistor	$R_g$	2.5	2	$k\Omega$
Grid current, on load	$I_g$	190	190	mA
Grid voltage, negative	$-V_g$	475	380	V
Grid dissipation	$W_g$	63	63	W
Grid resistor dissipation	$W_{Rg}$	90	72	W

**LIMITING VALUES** ( Absolute max. rating system)

Frequency for full ratings	$f$	max.	50	MHz
Anode voltage	$V_a$	max.	7	kV
Anode current	$I_a$	max.	1000	mA
Anode input power	$W_{ia}$	max.	7000	W
Anode dissipation	$W_a$	max.	see page 7	
Grid voltage	$-V_g$	max.	1250	V
Grid current, on load	$I_g$	max.	300	mA
off load	$I_g$	max.	400	mA
Grid dissipation	$W_g$	max.	150	W
Grid circuit resistance	$R_g$	max.	10	$k\Omega$
Cathode current, mean	$I_k$	max.	1.4	A
peak	$I_{kp}$	max.	4.3	A
Envelope temperature	$t_{\text{env}}$	max.	350	$^{\circ}\text{C}$
Seal temperature	$t$	max.	220	$^{\circ}\text{C}$

**C. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE**

with anode voltage from single-phase rectifier without filter

**OPERATING CONDITIONS** , continuous service

Frequency	$f$	50	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	2655	2451	W
Anode voltage	$V_a$	5.4	4.5	kV
Anode current	$I_a$	530	600	mA
Anode input power	$W_{\text{ia}}$	3520	3320	W
Anode dissipation	$W_a$	770	770	W
Anode output power	$W_o$	2750	2550	W
Anode efficiency	$\eta_a$	78	77	%
Oscillator efficiency	$\eta_{\text{osc}}$	75	74	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	13	15.5	%
Grid resistor	$R_g$	3	2.5	$k\Omega$
Grid current, on load	$I_g$	140	150	mA
Grid voltage, negative	$-V_g^a$	420	375	V
Grid dissipation	$W_g$	36	43	W
Grid resistor dissipation	$W_{Rg}$	59	56	W

**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	$f$	up to	50	MHz
Anode voltage	$V_a$	max.	6.3	kV
Anode current	$I_a$	max.	670	mA
Anode input power	$W_{\text{ia}}$	max.	4000	W
Anode dissipation	$W_a$	max.	800	W
Grid voltage	$-V_g^a$	max.	1250	V
Grid current, on load	$I_g$	max.	270	mA
off load	$I_g$	max.	400	mA
Grid dissipation	$W_g$	max.	150	W
Grid circuit resistance	$R_g$	max.	10	$k\Omega$
Cathode current, mean	$I_k$	max.	1.0	A
peak	$I_{kp}$	max.	3.3	A
Envelope temperature	$t_{\text{env}}$	max.	350	$^{\circ}\text{C}$
Seal temperature	$t$	max.	220	$^{\circ}\text{C}$

**D. R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE**

with self rectification

**OPERATING CONDITIONS**

Frequency	$f$	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	1.49	kW
Transformer voltage, RMS	$V_{\text{tr}}$	5.2	kV
Anode current	$I_a$	360	mA <sup>1)</sup>
Anode input power	$W_{\text{ia}}$	2080	W
Anode dissipation	$W_a$	520	W
Anode output power	$W_o$	1560	W
Anode efficiency	$\eta_a$	75	%
Oscillator efficiency	$\eta_{\text{osc}}$	72	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	17	%
Grid resistor	$R_g$	1.8	k $\Omega$
Grid current, on load	$I_g$	100	mA <sup>1)</sup>
Grid voltage, negative	$-\bar{V}_g$	180	V
Grid dissipation	$W_g$	54	W
Grid resistor dissipation	$W_{Rg}$	18	W
Recommended grid blocking capacitor		at high frequencies about 100	pF
		at about 1 MHz	about 1000 pF

**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	$f$	up to	50	MHz
Transformer voltage, RMS	$V_{\text{tr}}$	max.	5.6	kV
Anode current	$I_a$	max.	400	mA <sup>1)</sup>
Anode input power	$W_{\text{ia}}$	max.	2250	W
Anode dissipation	$W_a$	max.	800	W
Grid voltage, at peak of mains frequency				
	sine wave	$-\bar{V}_g$	max.	1250 V
Grid current, on load	$I_g$	max.	160	mA <sup>1)</sup>
off load	$I_g$	max.	210	mA <sup>1)</sup>
Grid dissipation	$W_g$	max.	150	W
Grid circuit resistance	$R_g$	max.	10	k $\Omega$
Cathode current, mean	$I_k$	max.	610	mA <sup>1)</sup>
peak	$I_{kp}$	max.	4.3	A
Envelope temperature	$t_{\text{env}}$	max.	350	$^{\circ}\text{C}$
Seal temperature	$t$	max.	220	$^{\circ}\text{C}$

1) Averaged over any mains frequency cycle

**HEATING** : direct; filament thoriated tungsten

Filament voltage	Vf	6.3	V
Filament current	If	32.5	A

The filament is designed to accept temporary fluctuations of +5 % and -10 %.

**CAPACITANCES**

Anode to filament	Caf	0.25	pF
Grid to filament	Cgf	10.5	pF
Anode to grid	Cag	6.2	pF

**CHARACTERISTICS** measured at  $V_a = 4 \text{ kV}$ ,  $I_a = 190 \text{ mA}$

Transconductance	S	5.1	mA/V
Amplification factor	$\mu$	22	

**COOLING**

In general cooling of the tube is not necessary at matched load. When the tube is mounted in a small cabinet adequate ventilation must be provided.

At non-matched load or at high anode voltages, combined with the highest operating frequencies a low-velocity air flow directed on the tube is necessary. A small fan will suffice; it is recommended to mount the fan underneath the tube socket.

**ACCESSORIES**

Socket	catalogue nr.	2422 511 05001
Anode connector	type	40665

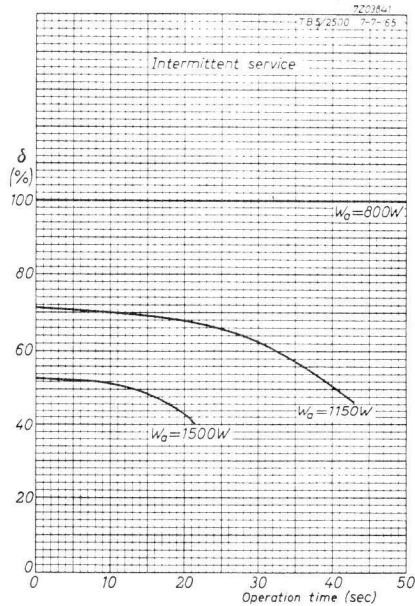
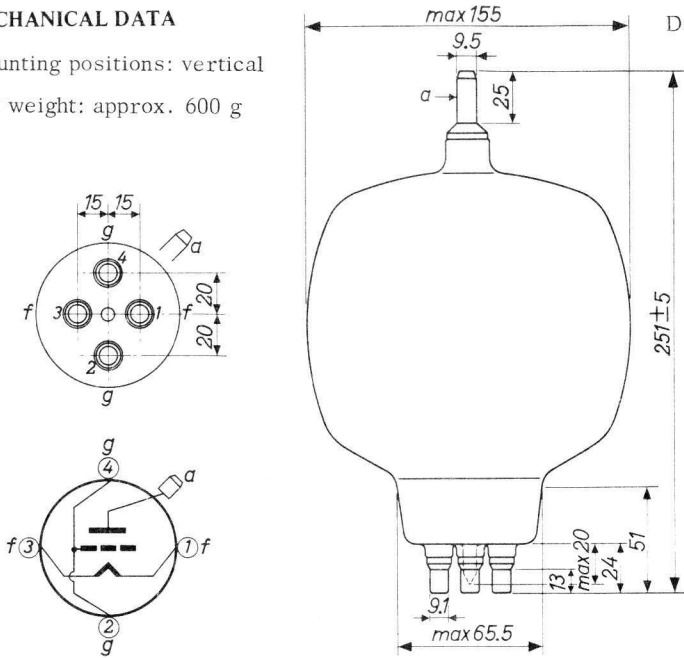


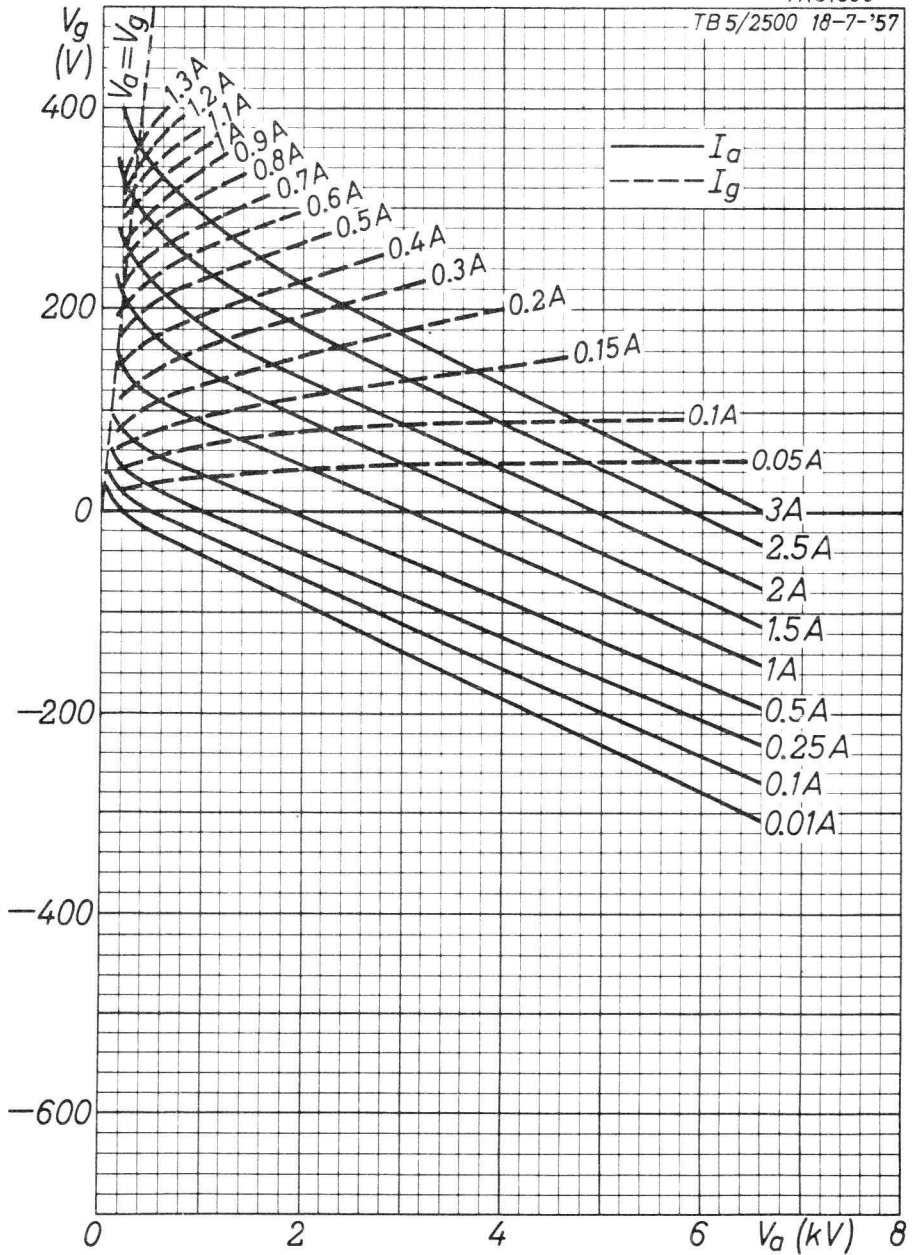
**MECHANICAL DATA**

Mounting positions: vertical

Net weight: approx. 600 g

Dimensions in mm





## WATER COOLED INDUSTRIAL R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (Mc/s)	three phase	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	7	17.7
	6	14.3

**HEATING:** direct, filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	6.3 V	+ 5%	
				-10%	
Filament current	I <sub>f</sub>	=	130 A		
Cold filament resistance	R <sub>f0</sub>	=	0.005 Ω		

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	1.2 pF
Grid to all other elements except anode	C <sub>g</sub>	=	44.5 pF
Anode to grid	C <sub>ag</sub>	=	33.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	6 kV
Anode current	I <sub>a</sub>	=	2.5 A
Mutual conductance	S	=	23 mA/V
Amplification factor	μ	=	17.5

### TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals = max. 220 °C



**WATER COOLING CHARACTERISTICS**

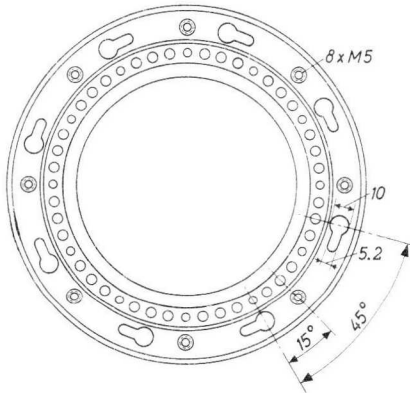
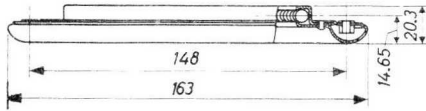
$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)	$t_o$ (°C)
5	20	2.3	0.02	56
	50	4.6	0.07	68
10	20	4.5	0.06	55
	50	9.0	0.21	67
15	20	7.0	0.14	53
	50	14.0	0.45	66

Water inlet temperature  $t_i = \text{max. } 50 \text{ } ^\circ\text{C}$

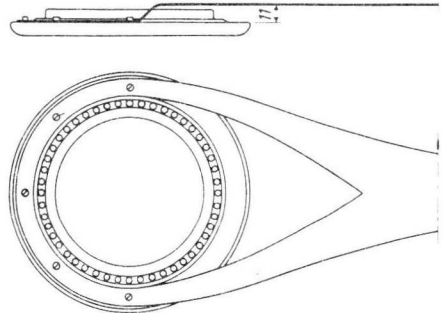
At water inlet temperatures between  $20 \text{ } ^\circ\text{C}$  and  $50 \text{ } ^\circ\text{C}$  the required quantity of water can be found by linear interpolation

**MECHANICAL DATA**

Dimensions in mm



Grid connector 40664



Connection of the grid lead

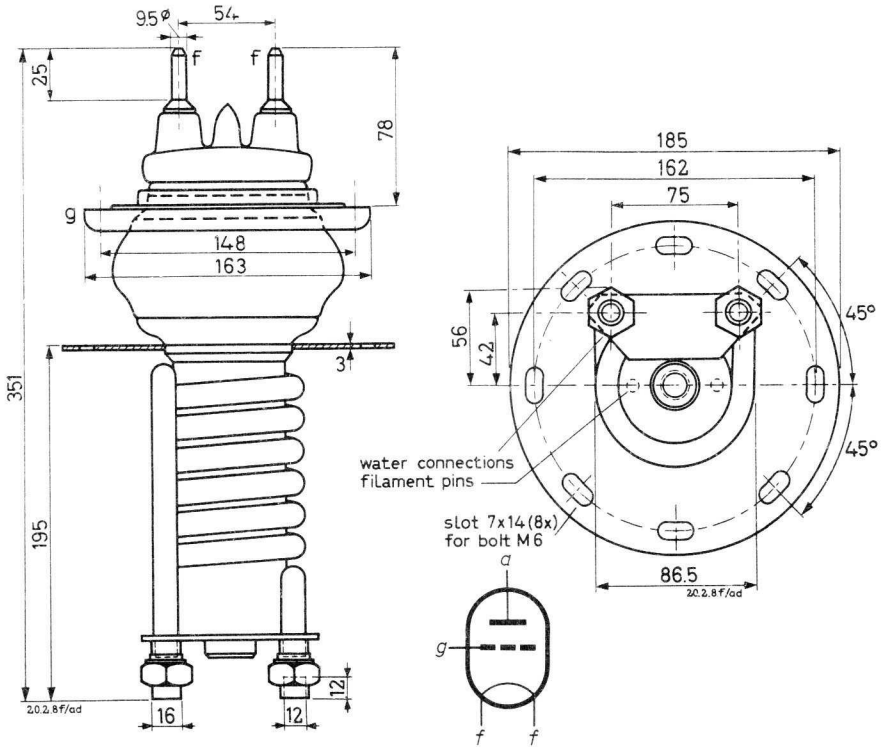
The rounded side of the grid connector should face the anode. To ensure a uniform R.F. current distribution in the grid seal at frequencies higher than 4 Mc/s, the grid lead should be connected as shown in the figure at right

**MECHANICAL DATA** (continued)

Dimensions in mm

Filament connectors with cable	40662
Grid connector	40664

Net weight 3.8 kg



Mounting position: vertical with anode down



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

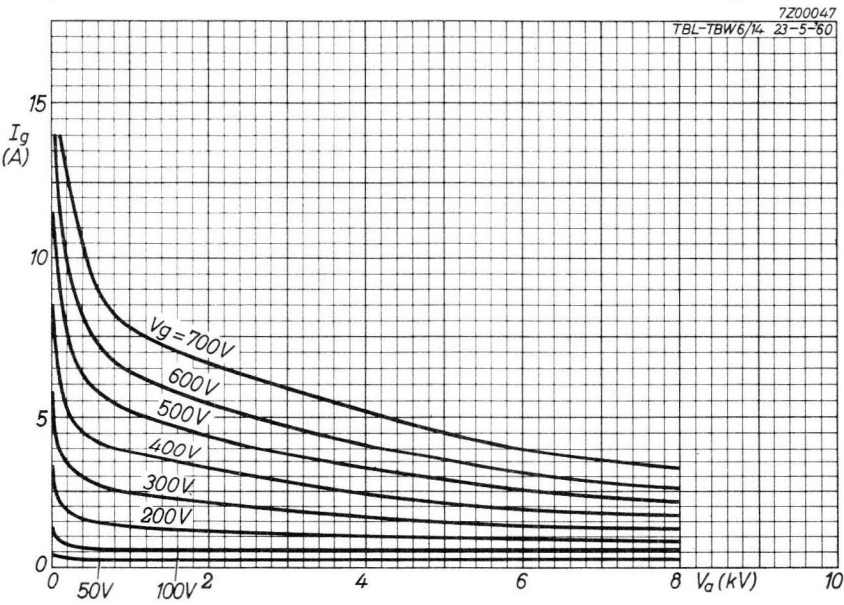
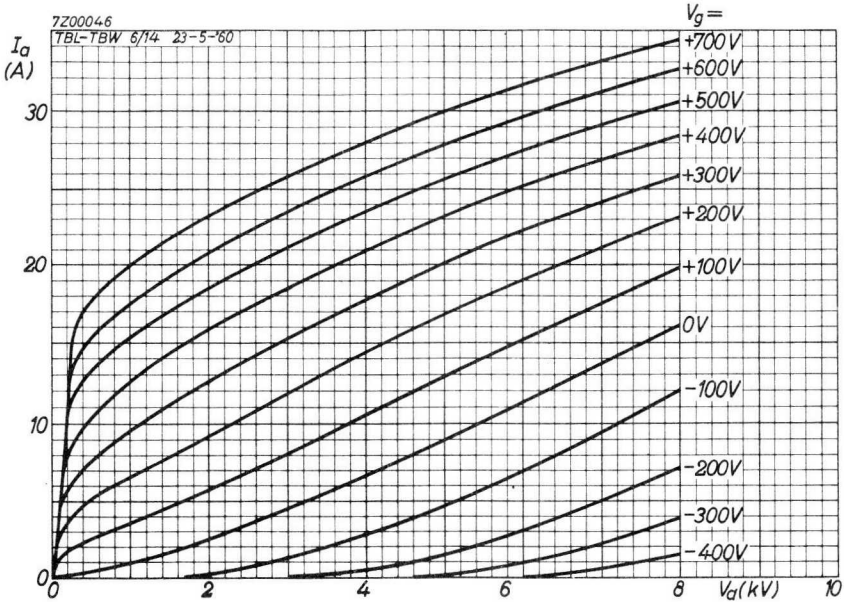
**LIMITING VALUES** (Absolute limits)

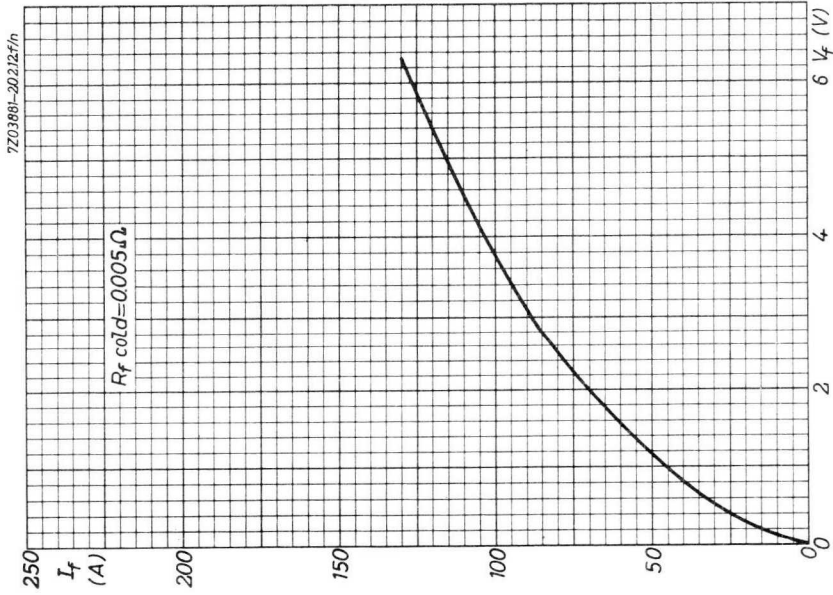
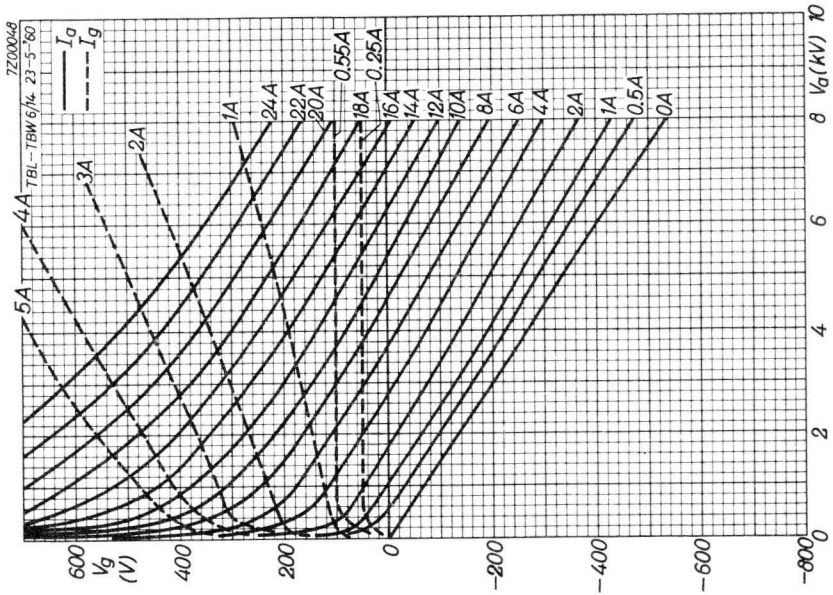
Frequency	f	up to	30	MHz
Anode voltage	$V_a$	max.	8	kV
Anode input power	$W_{ia}$	max.	30	kW
Anode dissipation	$W_a$	max.	15	kW
Anode current	$I_a$	max.	4.0	A
Negative grid voltage	$-V_g$	max.	1600	V
Grid current, loaded	$I_g$	max.	1.5	A
Grid current, unloaded	$I_g$	max.	2.0	A
Grid circuit resistance	$R_g$	max.	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	30	30	MHz
Anode voltage	$V_a$	7	6	kV
Anode current, loaded	$I_a$	3.5	3.3	A
Anode current, unloaded	$I_a$	0.7	0.51	A
Grid current, loaded	$I_g$	0.95	0.8	A
Grid current, unloaded	$I_g$	1.35	1.1	A
Grid resistor	$R_g$	950	1000	$\Omega$
Load resistance	$R_{a\sim}$	1000	870	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	25	26	%
Anode input power	$W_{ia}$	24.5	19.8	kW
Anode dissipation	$W_a$	6.8	5.5	kW
Output power	$W_o$	17.7	14.3	kW
Efficiency	$\eta$	72	72	%
Output power in the load	$W_l$	14	11	kW <sup>1)</sup>

1) Useful power in the load, measured in a circuit having an efficiency of about 85%.







## WATER COOLED R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA									
General purposes									
$\lambda$ (m)	Freq. (MHz)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
4	75	6	6.9	6	1.9			6	13.3
		5	5.6	5	1.45	5	4.7	5	6.6
		4	4			4.5	4.1	4.5	6.0
						4	3.5	4	5.3
						3.5	3	3.5	4.6
						3	2.2	3	3.3
Television service									
Freq. (MHz)	Neg. mod.		Pos. sync.		Pos. mod.		Neg. sync.		
	V <sub>a</sub> (kV)	W <sub>o</sub> sync (kW)	W <sub>o</sub> black (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> white (kW)				
75	5	9	5.35	5	9				

**HEATING:** direct, filament thoriated tungsten

Filament voltage V<sub>f</sub> 12.6 V

Filament current I<sub>f</sub> 33 A

### CAPACITANCES

Anode to all other elements except grid C<sub>a</sub> 0.3 pF

Grid to all other elements except anode C<sub>g</sub> 16 pF

Anode to grid C<sub>ag</sub> 11 pF

<sup>1)</sup> Two tubes

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a$	4 kV
Anode current	$I_a$	1 A
Amplification factor	$\mu$	32
Mutual conductance	S	17 mA/V

**COOLING :** Water and low velocity air flow

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature	$t_i$	max. 50 °C
Temperature of filament seals		max. 210 °C
Temperature of anode and grid seals		max. 180 °C

**WATER COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)	$t_o$ (°C)
2	20	1.5	0.06	44
	50	3	0.22	62
4	20	3	0.22	42
	50	6	0.73	61
6	20	5	0.54	39
	50	10	1.8	59

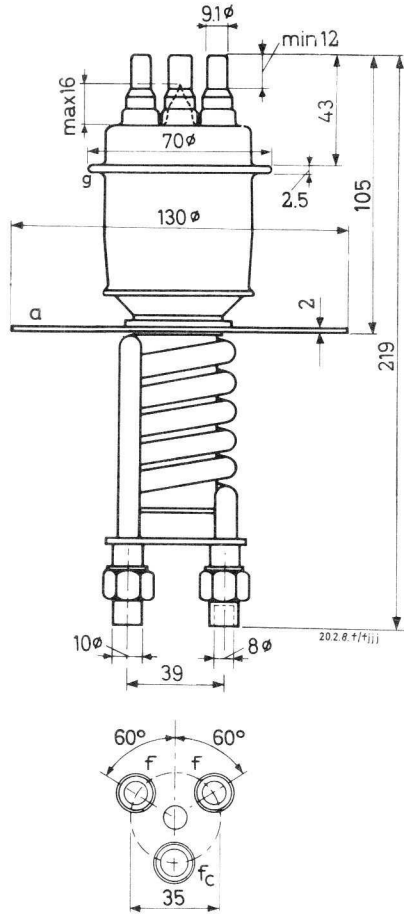
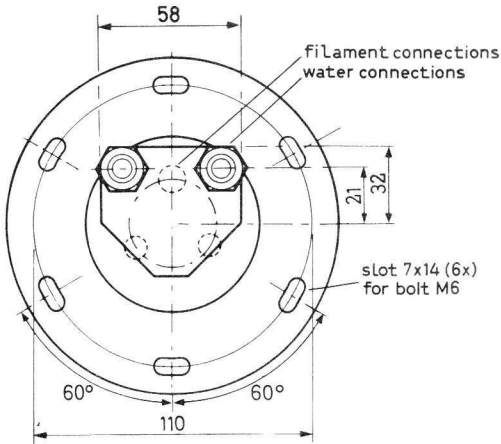
At water inlet temperatures between 20 °C and 50 °C the required quantity of water can be found by linear interpolation.

In general no air cooling will be required at ambient temperatures below 35 °C. At higher temperatures a low velocity air flow to the grid and filament seals will be necessary.

**MECHANICAL DATA**

Filament connectors	40634
Grid connector	40622
Net weight	0.8 kg

Dimensions in mm



The use of wing nuts for connecting the water connections should be avoided

The centre tap  $f_c$  must not be used for filament current supply. The connectors 40634, however, must be used for the cooling of all three filament pins, thus also of pin  $f_c$ .

Mounting position: vertical with anode down

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 For further data except cooling curves, please  
 refer to type TBW6/6000  
 -----



## WATER COOLED INDUSTRIAL R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA		
Freq. (Mc/s)	Class C oscillator	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
50	6.0	6.0

**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	12.6 V
Filament current	I <sub>f</sub>	=	33 A

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.3 pF
Grid to all other elements except anode	C <sub>g</sub>	=	16 pF
Anode to grid	C <sub>ag</sub>	=	11 pF

### TYPICAL CHARACTERISTICS

Anode current	I <sub>a</sub>	=	1 A
Anode voltage	V <sub>a</sub>	=	6 kV
Amplification factor	μ	=	32
Mutual conductance	S	=	15 mA/V

7Z2 8644

**WATER COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)	$t_o$ (°C)
2	20	1.5	0.06	44
	50	3	0.22	62
4	20	3	0.22	42
	50	6	0.73	61
6	20	5	0.54	39
	50	10	1.8	59

At water inlet temperatures between 20 °C and 50 °C the required quantity of water can be found by linear interpolation.

In general no air cooling will be required at frequencies up to 30 Mc/s and at ambient temperatures below 35 °C. At higher temperatures or at higher frequencies a low velocity air flow to the grid and filament seals will be necessary.

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature	$t_i$ = max.	50 °C
Temperature of filament seals	= max.	210 °C
Temperature of anode and grid seals	= max.	180 °C

**ACCESSORIES**

Filament connectors	40634
Connector for centre pin of the filament	40649
Grid connector	40650 or 40622

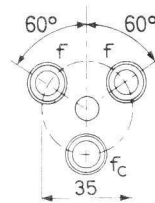
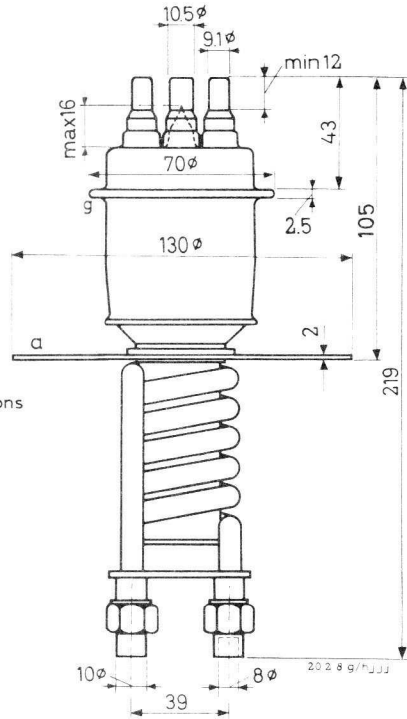
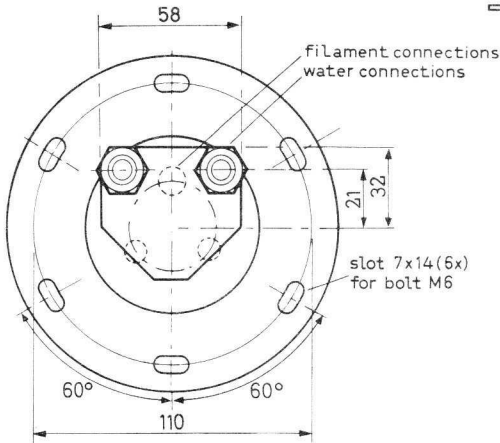
The centre filament pin  $f_c$  must not be used for filament current supply. However, the connector 40649 should be used for cooling of this pin.

The grid connector 40650 must not be used at frequencies higher than 30 Mc/s.

**MECHANICAL DATA**

Net weight 0.8 kg

Dimensions in mm



The use of wing nuts for connecting the water connections should be avoided

Mounting position: Vertical with anode down



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

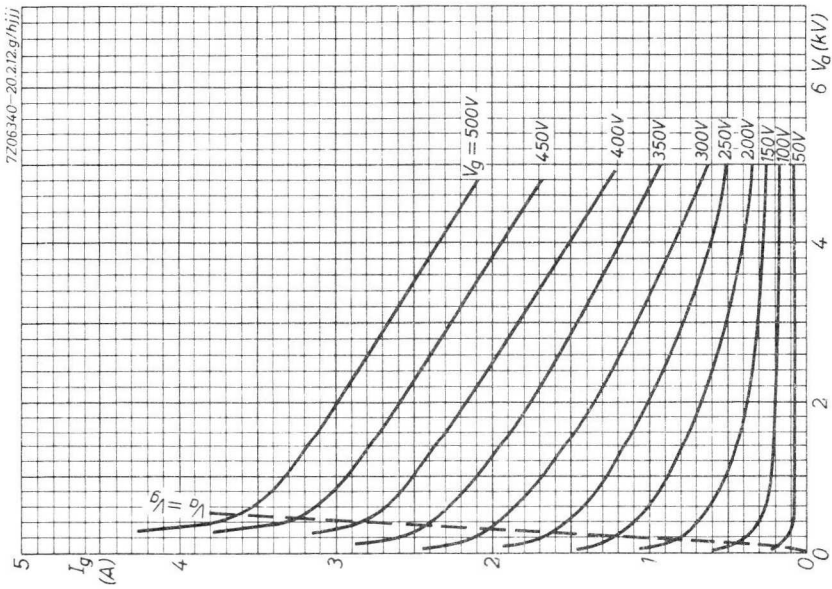
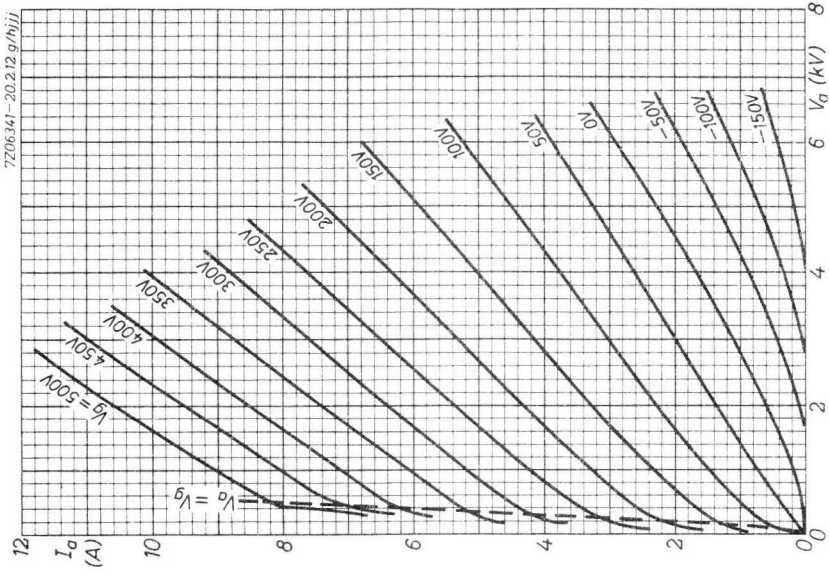
**LIMITING VALUES** (Absolute limits)

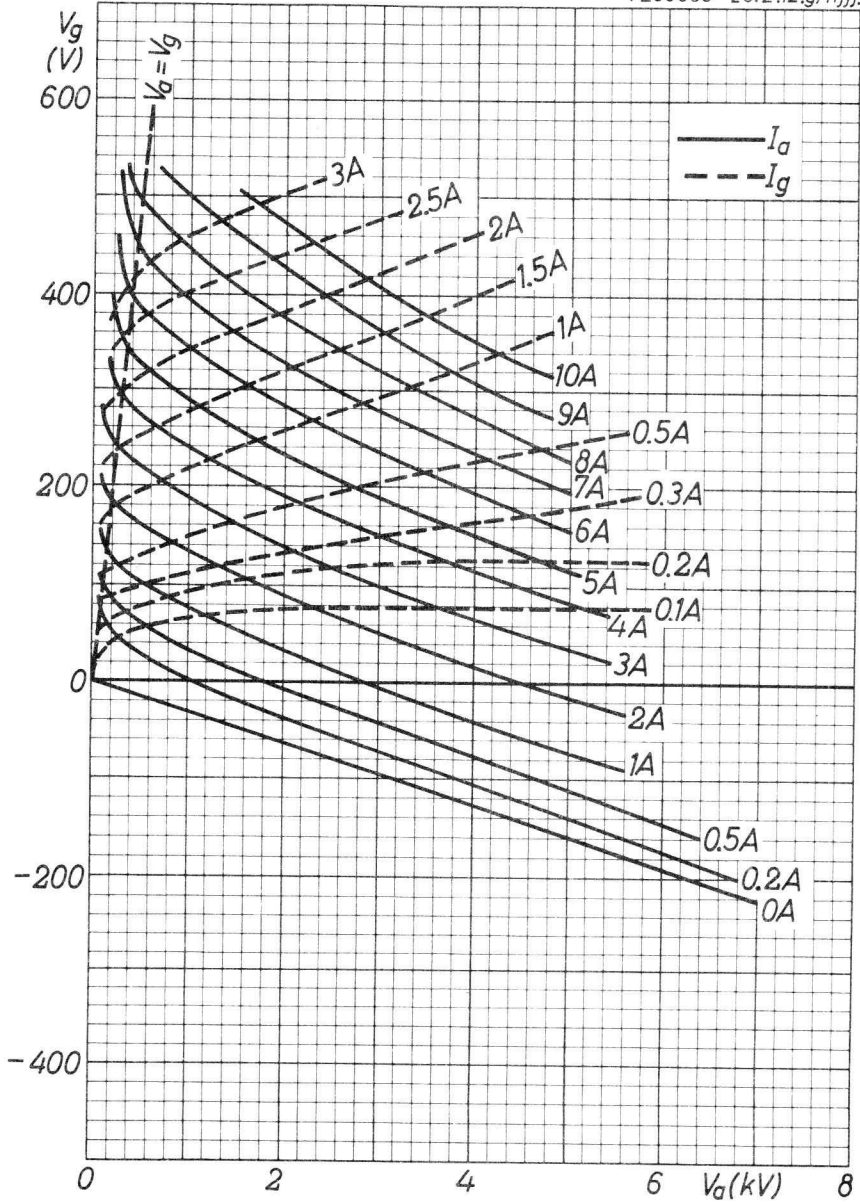
Frequency	f	up to	55 Mc/s
Anode voltage	$V_a$	= max.	7 kV
Negative grid voltage	$-V_g$	= max.	1250 V
Anode current	$I_a$	= max.	1.8 A
Grid current, loaded	$I_g$	= max.	0.5 A
Grid current, unloaded	$I_g$	= max.	0.7 A
Anode input power	$W_{ia}$	= max.	11 kW
Anode dissipation	$W_a$	= max.	6 kW
Grid resistor	$R_g$	= max.	10 k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	50 Mc/s
Transformer voltage	$V_{tr}$	=	5.1 kV <sub>RMS</sub>
Anode voltage	$V_a$	=	6.0 kV
Anode current	$I_a$	=	1.5 A
Grid current	$I_g$	=	0.4 A
Grid input power	$W_{ig}$	=	300 W
Anode input power	$W_{ia}$	=	9 kW
Anode dissipation	$W_a$	=	2.7 kW
Output power	$W_o$	=	6 kW
Efficiency	$\eta$	=	67 %







## WATER COOLED INDUSTRIAL R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq.	Three phase	
(MHz)	$V_a$ (kV)	$W_p$ <sup>1)</sup> (kW)
50	7.2	6.1
	6.2	5.0



**HEATING:** direct; filament thoriated tungsten

Filament voltage	=	12.6 V	=	+5 % -10 %
Filament current	=	33 A		

### CAPACITANCES

Anode to all other elements except grid	=	1.0 pF		
Grid to all other elements except anode	=	14.2 pF		
Anode to grid	=	7.9 pF		

### TYPICAL CHARACTERISTICS

Anode voltage	=	6 kV		
Anode current	=	1 A		
Mutual conductance	=	12 mA/V		
Amplification factor	=	24		

<sup>1)</sup> Useful power in the load

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature  $t_i$  = max. 50 °C

Temperature of the seals = max. 220 °C

**WATER COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)	$t_o$ (°C)
2	20	1	0.032	56
	50	2	0.084	68
4	20	2.2	0.10	49
	50	4.4	0.49	65
6	20	4	0.41	43
	50	8	1.4	62

At water inlet temperatures between 20 and 50 °C the required quantity of water can be found by linear interpolation.

At frequencies above 4 MHz a low velocity air flow should be directed to the seals.

At frequencies above 4 MHz both grid terminals should be connected in parallel and care should be taken to distribute the R.F. current equally over both grid terminals to avoid excessive temperatures.

→ **ACCESSORIES**

Filament and grid connectors ( 4 required) type 40634



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits), continuous service

Frequency	f	up to	50 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode input power	$W_{ia}$	= max.	12 kW
Anode dissipation	$W_a$	= max.	6 kW
Anode current	$I_a$	= max.	1.8 A
Negative grid voltage	$-V_g$	= max.	1250 V
Grid current, loaded	$I_g$	= max.	0.4 A
Grid current, unloaded	$I_g$	= max.	0.5 A
Grid circuit resistance	$R_g$	= max.	10 k $\Omega$

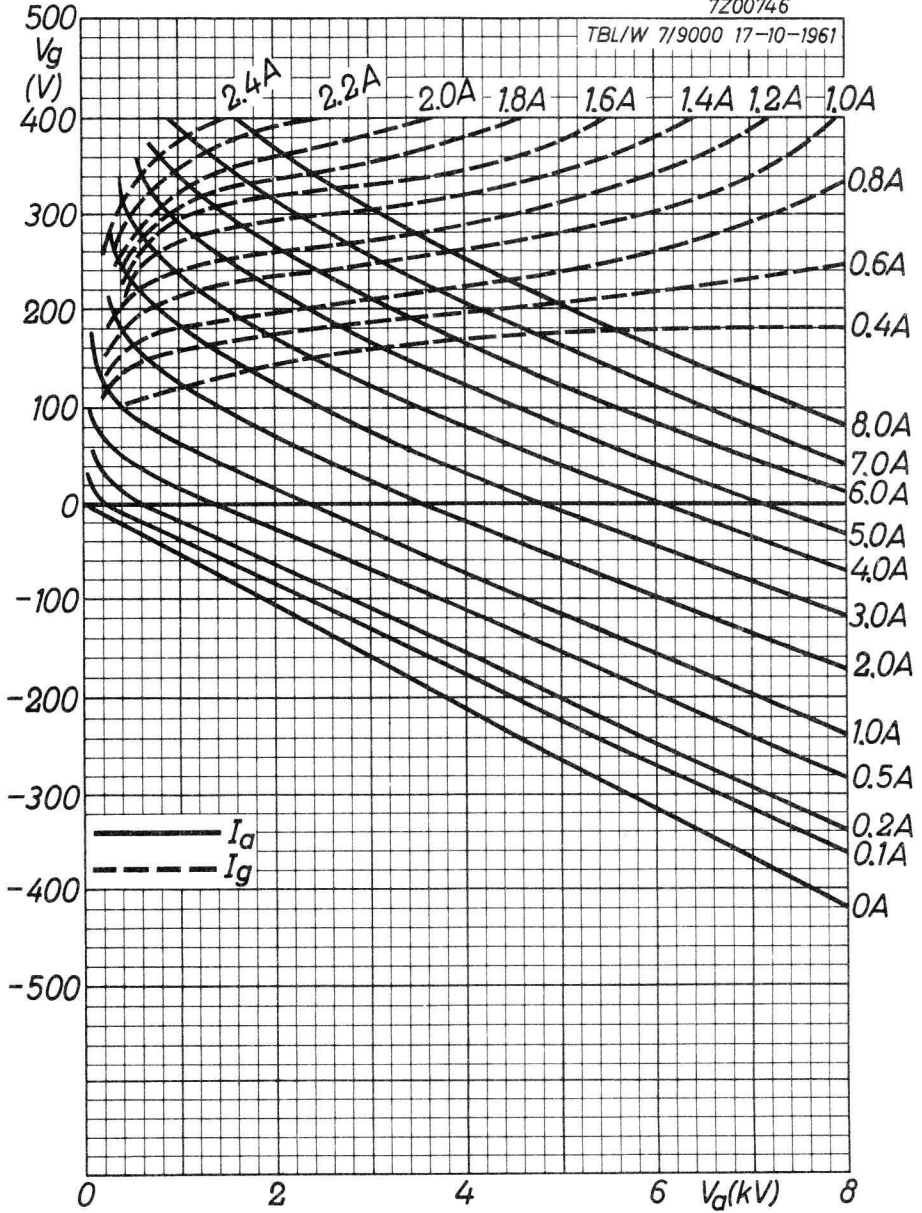
**OPERATING CHARACTERISTICS** , continuous service

Frequency	f	=	50	50 MHz
Anode voltage	$V_a$	=	7200	6200 V
Anode current, loaded	$I_a$	=	1.5	1.4 A
Anode current, unloaded	$I_a$	=	0.37	0.40 A
Grid current, loaded	$I_g$	=	0.36	0.37 A
Grid current, unloaded	$I_g$	=	0.47	0.47 A
Grid resistor	$R_g$	=	1850	1500 $\Omega$
Load resistance	$R_{a\sim}$	=	2300	2100 $\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	17	17 %
Anode input power	$W_{ia}$	=	10.8	8.68 kW
Anode dissipation	$W_a$	=	3.3	2.5 kW
Efficiency	$\eta$	=	70	71 %
Output power in the load	$W_p$	=	6.1	5.0 kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load, measured in a circuit having an efficiency of 85 %

7Z00746

TBL/W 7/9000 17-10-1961







## WATER COOLED INDUSTRIAL R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	Three phase	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	29.0
	10	23.3
	8	17.9

**HEATING :** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	8.0	V	+ 5%	-10%
Filament current	I <sub>f</sub>	=	98	A		
Cold filament resistance	R <sub>f</sub>	=	0.008	Ω		

The filament current must never exceed a peak value of 210 A instantaneously at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.4	pF
Grid to all other elements except anode	C <sub>g</sub>	=	37	pF
Anode to grid	C <sub>ag</sub>	=	30	pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	12	kV
Anode current	I <sub>a</sub>	=	2	A
Amplification factor	μ	=	34	
Mutual conductance	S	=	20	mA/V

7Z2 8647

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature  $t_i = \text{max. } 50 \text{ } ^\circ\text{C}$   
 Temperature off all seals = max. 220  $^\circ\text{C}$

**WATER COOLING CHARACTERISTICS**

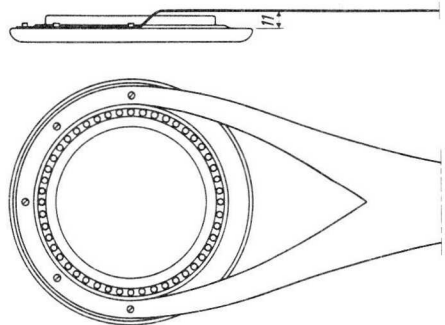
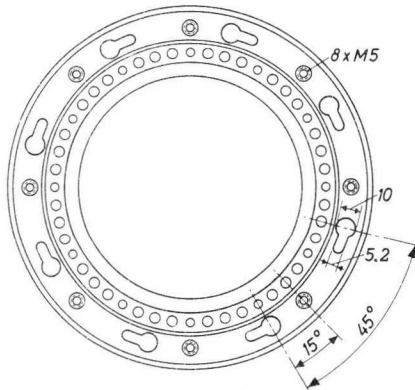
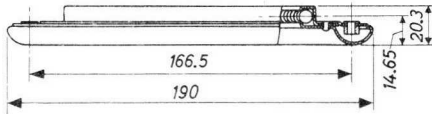
$W_a$ (kW)	$t_i$ ( $^\circ\text{C}$ )	$q_{\text{min}}$ (l/min)	$P_i$ (atm.)
10	20	4.2	0.08
	50	8.4	0.27
15	20	6.5	0.16
	50	13.0	0.50
20	20	9.3	0.30
	50	18.6	1.0

At water inlet temperatures between 20  $^\circ\text{C}$  and 50  $^\circ\text{C}$  the required quantity of water can be found by linear interpolation

Generally a low velocity air flow to the seals is required

**MECHANICAL DATA**

Dimensions in mm



Grid connector 40663

Connection of the grid lead

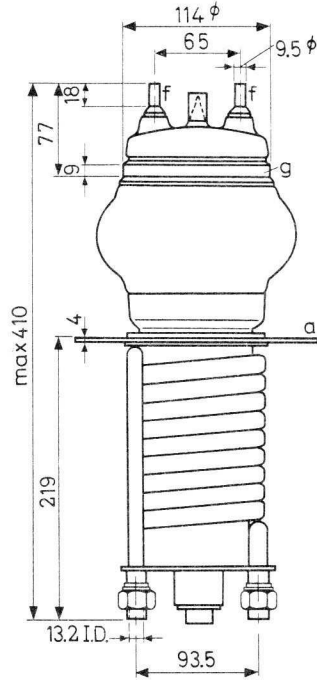
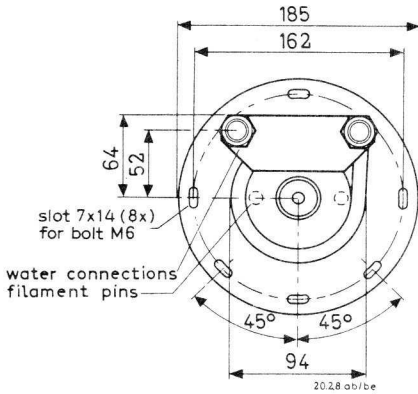
The rounded side of the grid connector should face the anode. To ensure a uniform R.F. current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown at right.

7Z2 3556

**MECHANICAL DATA** (continued)

Filament connectors with cable	40662
Grid connector	40663
Net weight	5.2 kg

Dimensions in mm



Mounting position: vertical with anode down



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

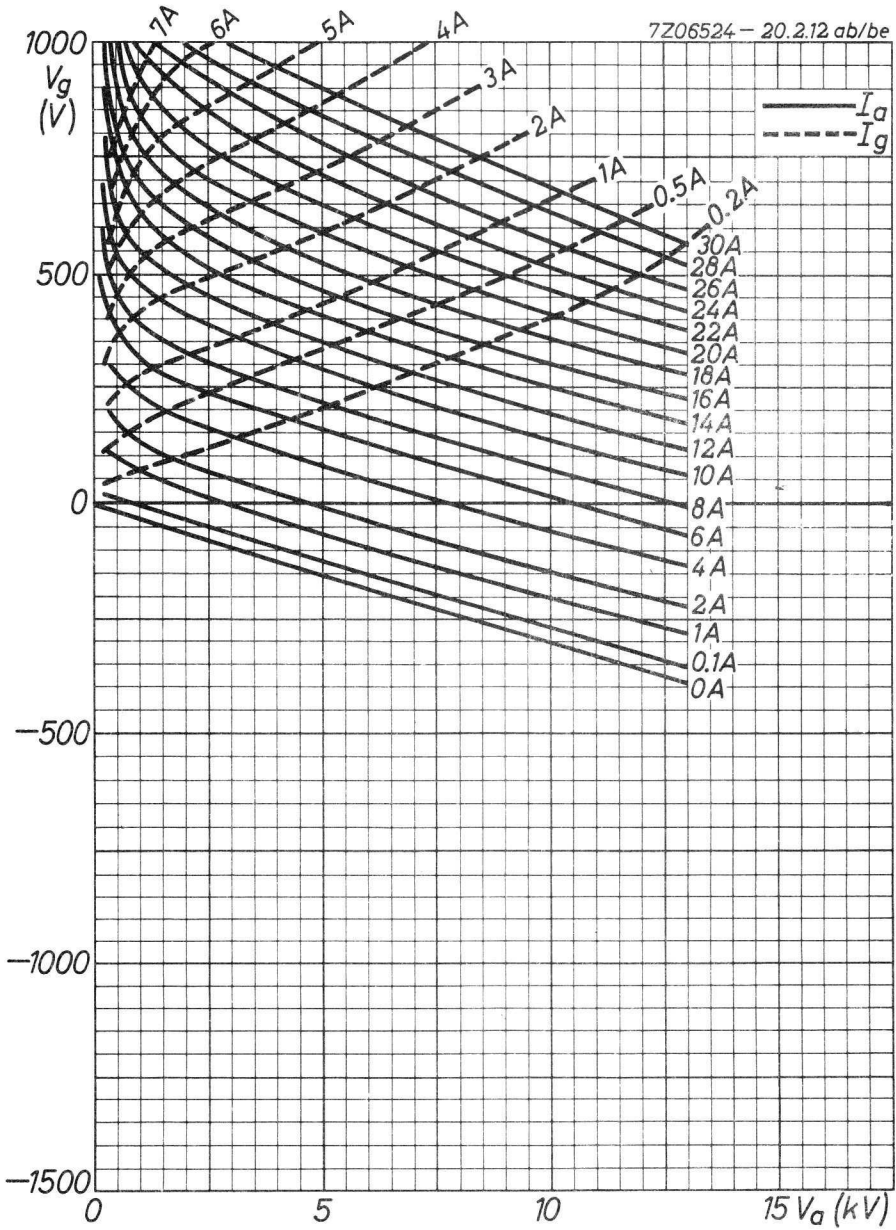
LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	4.8	A
Anode dissipation	$W_a$	= max.	20	kW
Anode input power	$W_{ia}$	= max.	60	kW
Negative grid voltage	$-V_g$	= max.	1500	V
Grid current	$I_g$	= max.	0.8	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

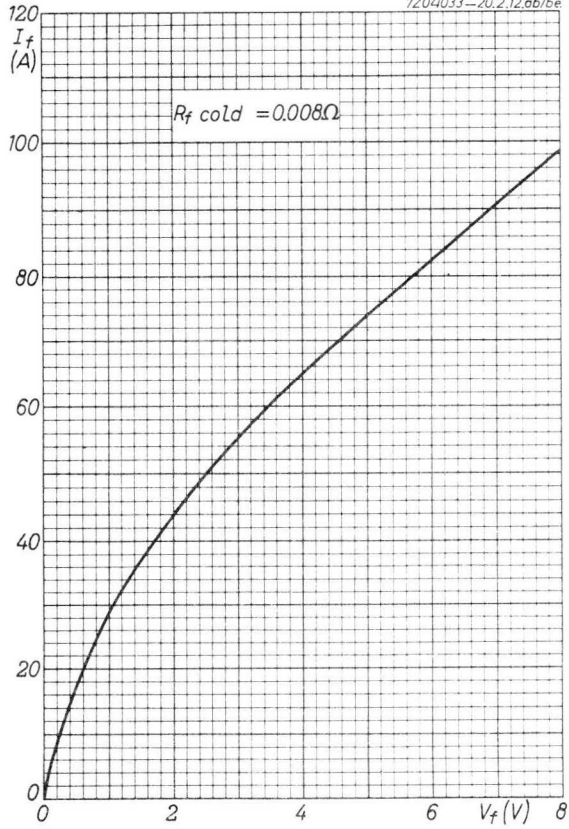
OPERATING CONDITIONS

Frequency	f	=	30	30	30	MHz
Transformer voltage	$V_{tr}$	=	8.9	7.4	6.0	kV
Anode voltage	$V_a$	=	12	10	8	kV
Anode current, loaded	$I_a$	=	3.2	3.2	3.2	A
Anode current, unloaded	$I_a$	=	0.52	0.50	0.48	A
Grid current, loaded	$I_g$	=	0.50	0.50	0.50	A
Grid current, unloaded	$I_g$	=	0.74	0.77	0.80	A
Grid resistor	$R_g$	=	2.0	1.6	1.1	k $\Omega$
Load resistance	$R_{a\sim}$	=	1800	1450	1100	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	16	17	19	%
Anode input power	$W_{ia}$	=	38.4	32.0	25.6	kW
Anode dissipation	$W_a$	=	9.4	8.7	7.7	kW
Output power	$W_o$	=	29.0	23.3	17.9	kW
Efficiency	$\eta$	=	75.5	72.5	70	%
Output power in the load	$W_l$	=	25	20	15.5	kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load measured in a circuit having an efficiency of 90%



7Z04033-20.2.12.ab/be



## WATER COOLED INDUSTRIAL R.F. POWER TRIODE WITH INTEGRAL HELICAL COOLER

QUICK REFERENCE DATA		
Freq. (MHz)	C osc. industrial	
	$V_a$ (kV)	$W_o$ (kW)
30	12	39
	10	31.3
	8	23.2

**HEATING:** direct; filament thoriated tungsten

Filament voltage	$V_f =$	8 V	$+ 5 \%$	$-10 \%$
Filament current	$I_f =$	130 A		
Cold filament resistance	$R_f =$	0.006 $\Omega$		

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	$C_a =$	0.9 pF
Grid to all other elements except anode	$C_g =$	45 pF
Anode to grid	$C_{ag} =$	23.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a =$	12 kV
Anode current	$I_a =$	2 A
Amplification factor	$\mu =$	21
Mutual conductance	$S =$	25 mA/V

### TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals	$= \text{max.}$	220 $^{\circ}\text{C}$	
Water inlet temperature $t_i$	$= \text{max.}$	50 $^{\circ}\text{C}$	7Z2 8649

**COOLING:** Generally a low velocity air flow to the seals is required

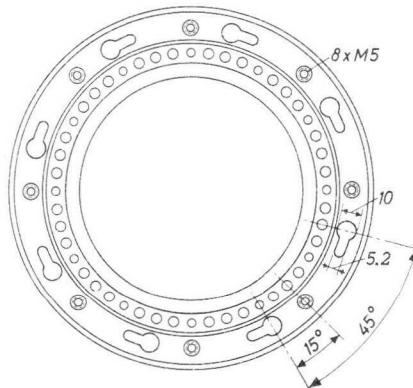
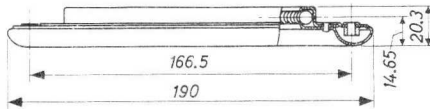
**WATER COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm.)
10	20	4.2	0.08
	50	8.4	0.27
15	20	6.5	0.16
	50	13.0	0.5
20	20	9.3	0.3
	50	18.6	1.0

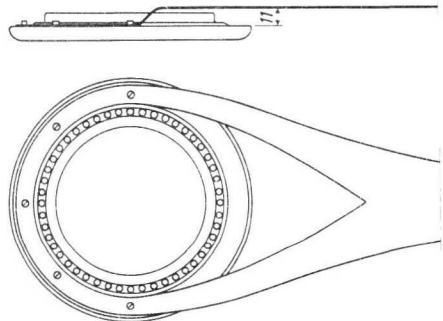
At water inlet temperatures between 20 °C and 50 °C the required quantity of water can be found by linear interpolation

**MECHANICAL DATA**

Dimensions in mm



Grid connector 40663



Connection of the grid lead

The rounded side of the grid connector should face the anode. To ensure a uniform RF current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown in the figure at right.





**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

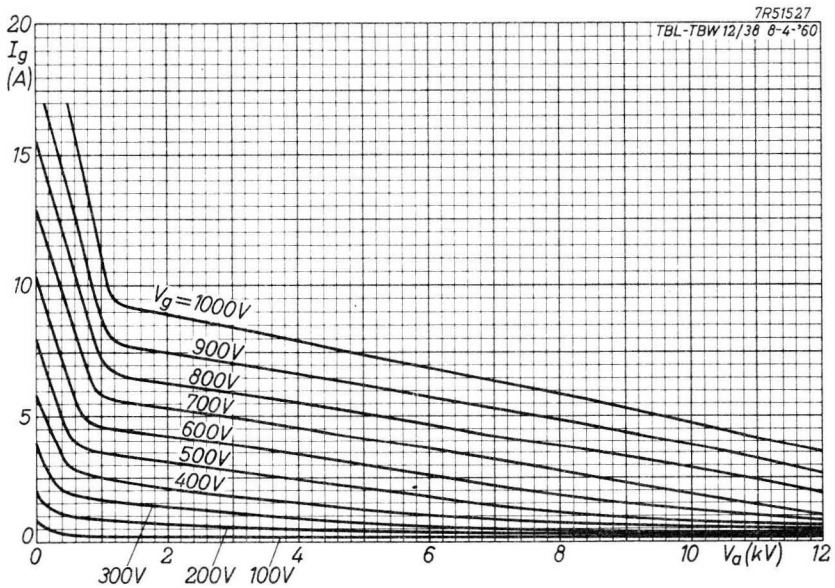
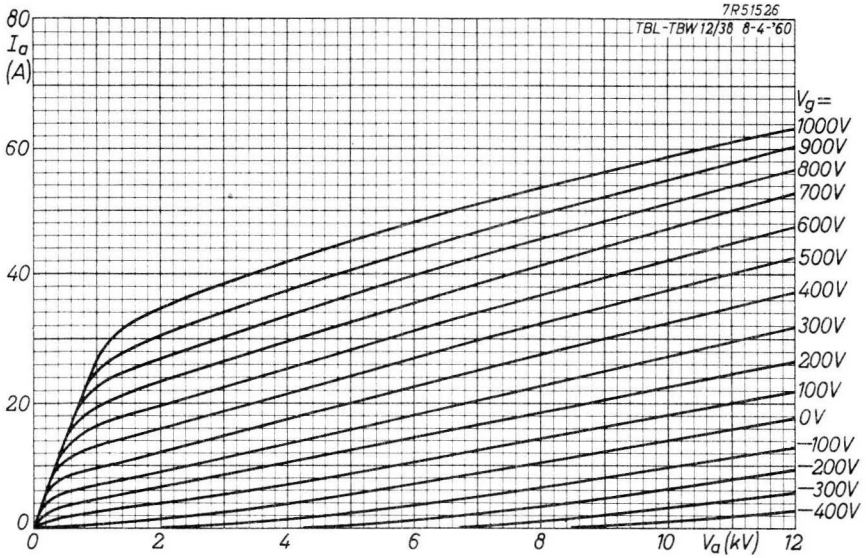
**LIMITING VALUES** (Absolute limits)

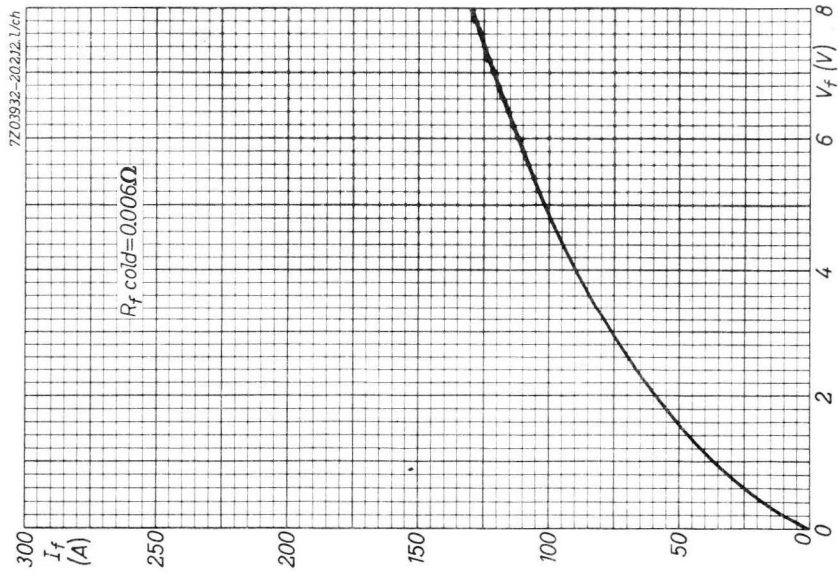
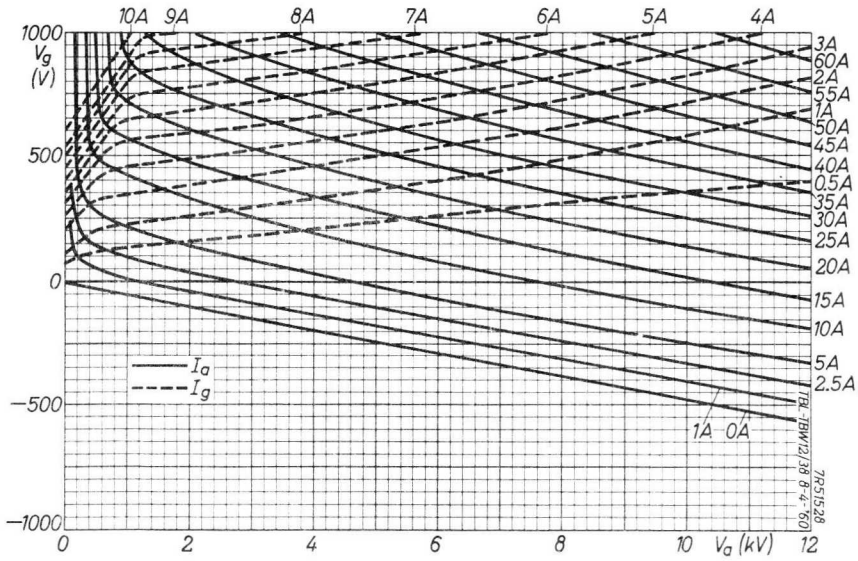
Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	5	A
Anode dissipation	$W_a$	= max.	20	kW
Anode input power	$W_{ia}$	= max.	60	kW
Negative grid voltage	$-V_g$	= max.	2	kV
Grid current, loaded	$I_g$	= max.	1.5	A
Grid current, unloaded	$I_g$	= max.	2.0	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	12	10	8	kV
Anode current, loaded	$I_a$	=	4.5	4.5	4.5	A
Anode current, unloaded	$I_a$	=	0.65	0.63	0.62	A
Grid current, loaded	$I_g$	=	0.9	0.9	0.9	A
Grid current, unloaded	$I_g$	=	1.22	1.3	1.35	A
Grid resistor	$R_g$	=	1100	1000	900	$\Omega$
Load resistance	$R_{a\sim}$	=	1450	1100	800	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	16	19	24	%
Anode input power	$W_{ia}$	=	54	45	36	kW
Anode dissipation	$W_a$	=	15	13.7	12.8	kW
Output power	$W_o$	=	39	31.3	23.2	kW
Efficiency	$\eta$	=	72.5	70	64.5	%
Output power in the load	$W_\ell$	=	30	25	18	kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load, measured in a circuit having an efficiency of about 85%. 7Z2 3565





## AIR COOLED COAXIAL R.F. POWER TRIODE

QUICK REFERENCE DATA				
Frequency (MHz)	C telegr.		C an. mod.	
	$V_a$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)
175	2500	475	2000	505
300	2000	460	1600	370
470	1750	405	1400	275
600	1600	350	1280	225
900	1300	155	1040	107
Industrial oscillator class C				
Frequency (MHz)	AC operation		Single-phase full-wave with filter	
	$V_{tr}$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)
470	1750	235	1750	385

**HEATING** : direct; filament thoriated tungsten

Frequency	$f$	< 600	600 to 750	750 to 900	MHz
Filament voltage	$V_f$	= 3.4	3.3	3.2	V
Filament current	$I_f$	= 19	-	-	A

### CAPACITANCES

Anode to all except grid	$C_a$	< 0.12	pF
Grid to all except anode	$C_g$	= 9	pF
Anode to grid	$C_{ag}$	= 4	pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	= 2000	V
Anode current	$I_a$	= 150	mA
Amplification factor	$\mu$	= 32	
Mutual conductance	S	= 10	mA/V

**AIR COOLING CHARACTERISTICS**

$W_a$ (W)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
< 300	0	45	0.45	24.0
	1500	35	0.46	22.5
	3000	25	0.49	21.5

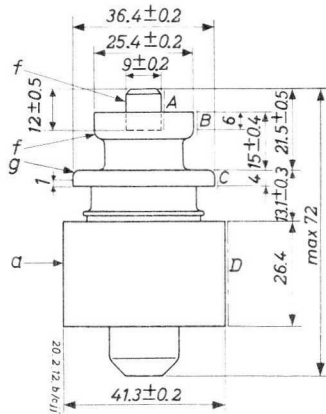
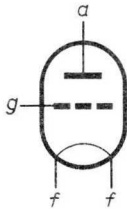
Temperature of envelope = max. 200 °C

Generally it will be necessary to direct an air flow to the centre filament seal.

**MECHANICAL DATA**

Dimensions in mm

Net weight: 143 g



Eccentricity of the electrode connections: The electrode connections A, B and C are within cylindrical surfaces having a diameter of 9.5, 25.9 and 36.9 mm respectively and being coaxial with the cylindrical surface D.

Mounting position: vertical with anode up or down

## R.F. CLASS C TELEGRAPHY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	175	300	470	600	900	MHz
Anode voltage	$V_a$	= max.	2500	2000	1750	1600	1300	V
Anode current	$I_a$	= max.	400	400	400	400	400	mA
Anode input power	$W_{i_a}$	= max.	1000	800	700	640	520	W
Anode dissipation	$W_a$	= max.	300	300	300	300	300	W
Negative grid voltage	$-V_g$	= max.	300	300	300	300	300	V
Grid current	$I_g$	= max.	120	120	120	120	120	mA

## OPERATING CONDITIONS

Data for grounded grid circuit except for the data at 175 MHz which refer to a grounded cathode circuit.

Frequency	f	=	175	300	470	600	900	MHz
Anode voltage	$V_a$	=	2500	2000	1750	1600	1300	V
Anode current	$I_a$	=	260	335	380	400	350	mA
Grid voltage	$V_g$	=	-200	-120	-105	-90	-60	V
Grid current	$I_g$	=	100	100	100	100	100	mA
Peak grid AC voltage	$V_{g_p}$	=	275	-	-	-	-	V
Grid input power	$W_{i_g}$	=	25	-	-	-	-	W
Anode input power	$W_{i_a}$	=	650	670	665	640	455	W
Anode dissipation	$W_a$	=	175	210	260	290	300	W
Output power	$W_o$	=	475	460	405	350	155	W
Efficiency	$\eta$	=	73	69	61	55	34	%

## R.F. CLASS C ANODE MODULATION

### LIMITING VALUES (Absolute limits)

Frequency	f	up to	175	300	470	600	900	MHz
Anode voltage	$V_a$	= max.	2000	1600	1400	1280	1040	V
Anode current	$I_a$	= max.	335	335	335	335	335	mA
Anode input power	$W_{i_a}$	= max.	670	536	465	429	348	W
Anode dissipation	$W_a$	= max.	200	200	200	200	200	W
Negative grid voltage	$-V_g$	= max.	300	300	300	300	300	V
Grid current	$I_g$	= max.	120	120	120	120	120	mA

### OPERATING CONDITIONS

Data for grounded grid circuit except for the data at 175 MHz which refer to a grounded cathode circuit

Frequency	f	=	175	300	470	600	900	MHz
Anode voltage	$V_a$	=	2000	1600	1400	1280	1040	V <sup>1)</sup>
Anode current	$I_a$	=	335	335	332	332	290	mA
Grid voltage	$V_g$	=	$-200^2)$	$-140^2)$	-120	-100	-80	V
Grid current	$I_g$	=	120	120	110	100	80	mA
Peak grid AC voltage	$V_{g_p}$	=	275	-	-	-	-	V
Grid input power	$W_{i_g}$	=	30	-	-	-	-	W
Anode input power	$W_{i_a}$	=	670	536	465	425	302	W
Anode dissipation	$W_a$	=	165	166	190	200	200	W
Output power	$W_o$	=	505	370	275	225	102	W
Efficiency	$\eta$	=	75.5	69	59	53	34	%
Modulation depth	m	=	100	100	100	100	100	%
Modulation power	$W_{mod}$	=	335	268	233	213	151	W

<sup>1)</sup> With respect to cathode

<sup>2)</sup> Partially fixed bias



## R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE with self-rectification

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	470	MHz
Transformer voltage	$V_{tr}$	= max.	1800	V(RMS)
Anode current	$I_a$	= max.	210	mA
Anode input power	$W_{ia}$	= max.	400	W
Anode dissipation	$W_a$	= max.	170	W
Negative grid voltage	$-V_g$	= max.	500	V
Grid current, loaded	$I_g$	= max.	85	mA
Grid current, unloaded	$I_g$	= max.	120	mA
Grid circuit resistance	$R_g$	= max.	5	k $\Omega$



## OPERATING CONDITIONS

Frequency	f	=	470	MHz
Transformer voltage	$V_{tr}$	=	1750	V(RMS)
Anode current, loaded	$I_a$	=	185	mA
Anode current, unloaded	$I_a$	=	105	mA
Grid current, loaded	$I_g$	=	75	mA
Grid current, unloaded <sup>1)</sup>	$I_g$	=	80	mA
Grid circuit resistance under matched conditions	$R_g$	=	400	$\Omega$
Anode input power	$W_{ia}$	=	365	W
Anode dissipation	$W_a$	=	130	W
Tube output power	$W_o$	=	235	W
Tube efficiency	$\eta$	=	64	%
Output power in the load <sup>2)</sup>	$W_\ell$	=	165	W

<sup>1)</sup> The grid resistance is obtained by a current stabilising device

<sup>2)</sup> Measured by a calorimetric method

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from a single-phase full-wave rectifier with filter.

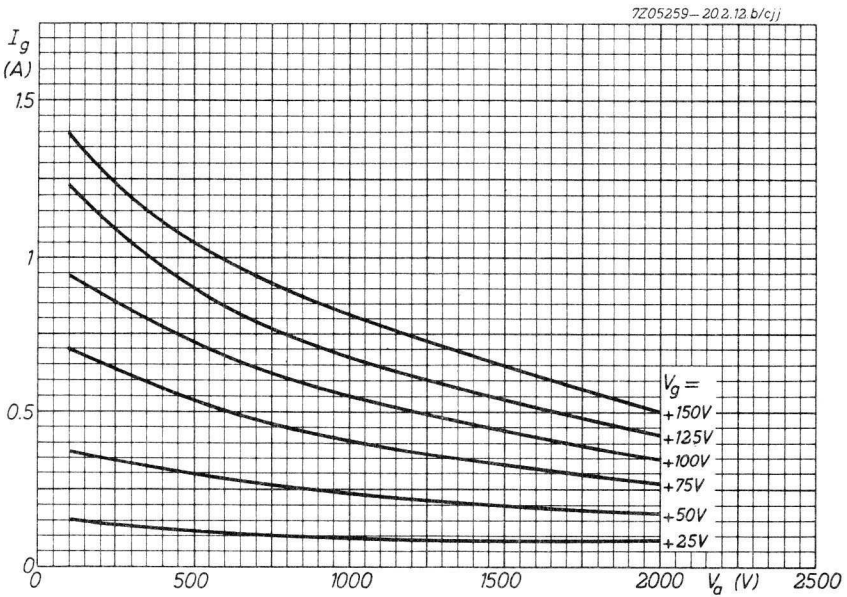
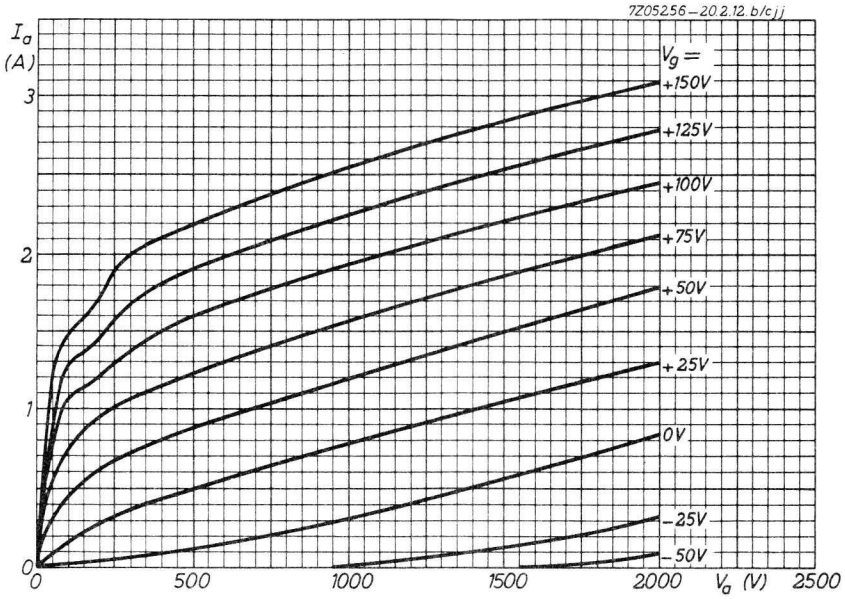
**LIMITING VALUES** (Absolute limits)

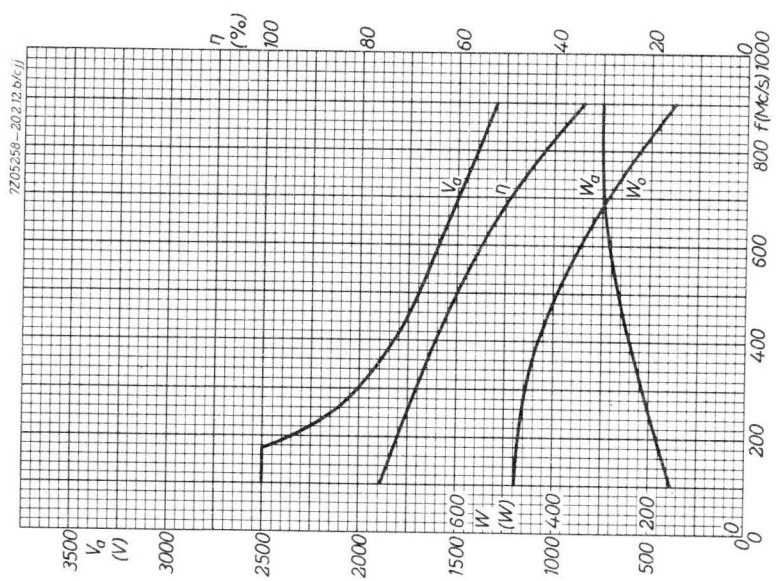
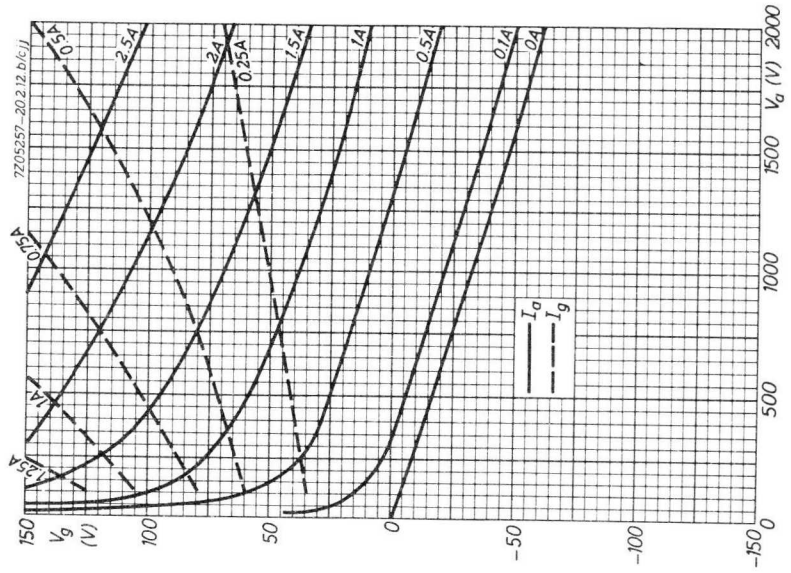
Frequency	f	up to	470	MHz
Anode voltage	$V_a$	= max.	1800	V
Anode current	$I_a$	= max.	400	mA
Anode input power	$W_{i_a}$	= max.	700	W
Anode dissipation	$W_a$	= max.	300	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current, loaded	$I_g$	= max.	110	mA
Grid current, unloaded	$I_g$	= max.	120	mA
Grid circuit resistance	$R_g$	= max.	5	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	470	MHz
Anode voltage	$V_a$	=	1750	V
Anode current, loaded	$I_a$	=	340	mA
Anode current, unloaded	$I_a$	=	170	mA
Grid current, loaded	$I_g$	=	95	mA
Grid current, unloaded <sup>1)</sup>	$I_g$	=	100	mA
Grid circuit resistance under matched conditions	$R_g$	=	1000	$\Omega$
Anode input power	$W_{i_a}$	=	595	W
Anode dissipation	$W_a$	=	210	W
Tube output power	$W_o$	=	385	W
Tube efficiency	$\eta$	=	65	%
Output power in the load	$W_l$	=	270	W

<sup>1)</sup> The grid resistance is obtained by a current stabilising device.





## AIR COOLED COAXIAL R.F. POWER TRIODE

QUICK REFERENCE DATA						
Frequency (MHz)	C teleg. grounded grid		Industrial oscillator class C			
			DC operation		AC operation	
	$V_a$ (V)	$W_o$ (W)	$V_a$ (V)	$W_o$ (W)	$V_{tr}$ (V)	$W_o$ (W)
470	2000	595	2000	480	1800	230
640	1800	490				
730	1800	460				
810	1800	408	1800	284		

**HEATING:** direct; filament thoriated tungsten

Frequency	f	$< 600$	600 to 750	750 to 900	MHz
Filament voltage	$V_f$	= 3.4	3.3	3.2	V
Filament current	$I_f$	= 19	-	-	A

### CAPACITANCES

Anode to all except grid	$C_a$	$< 0.12$	pF
Grid to all except anode	$C_g$	= 11.5	pF
Anode to grid	$C_{ag}$	= 6.5	pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	$= 2000$	V
Anode current	$I_a$	= 200	mA
Amplification factor	$\mu$	= 33	
Mutual conductance	S	= 10	mA/V

## TEMPERATURE LIMITS (Absolute limits)

Temperature of seal between filament terminals	= max. 200 °C
Temperature of other seals	= max. 250 °C

## COOLING CHARACTERISTICS

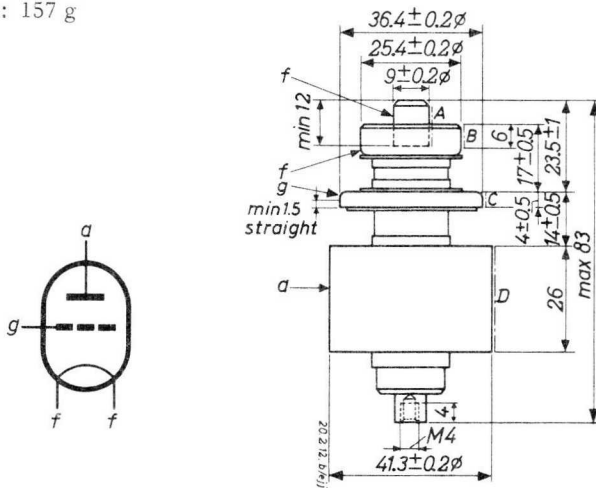
$W_a$ (W)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
400	0	45	0.65	12
	1500	35	0.65	12
	3000	25	0.65	12

The required quantity of air is independent of the anode dissipation and the frequency.

## MECHANICAL DATA

Dimensions in mm

Net weight: 157 g



Eccentricity of the electrode connections: The electrode connections A, B and C are within cylindrical surfaces having a diameter of 9.5, 25.9 and 36.9 mm respectively and being concentric with the cylindrical surface D.

Mounting position: vertical with the anode up or down.

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	470	600	900	MHz
Anode voltage	$V_a$	= max.	2200	2100	2000	V
Anode current	$I_a$	= max.	400	400	400	mA
Anode input power	$W_{i_a}$	= max.	880	840	800	W
Anode dissipation	$W_a$	= max.	400	400	400	W
Negative grid voltage	$-V_g$	= max.	300	300	300	V
Grid current	$I_g$	= max.	120	120	120	mA

**OPERATING CONDITIONS** in grounded grid circuit

Frequency	f	=	470	640	730	810	MHz
Anode voltage	$V_a$	=	2000	1800	1800	1800	V 1)
Anode current	$I_a$	=	400	400	400	400	mA
Grid voltage	$V_g$	=	-140	-120	-120	-120	V
Grid current	$I_g$	=	120	100	100	100	mA
Grid input power	$W_{i_g}$	=	120	105	105	105	W
Anode input power	$W_{i_a}$	=	800	720	720	720	W
Anode dissipation	$W_a$	=	290	310	340	392	W
Output power	$W_o$	=	510+85	410+80	380+80	328+80	W 2)
Tube efficiency	$\eta$	=	63.5	57	53	45.5	%

1) With respect to cathode

2) Power transferred from driving stage included

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	470	900	MHz
Anode voltage	$V_a$	= max.	2200	2000	V
Anode current	$I_a$	= max.	400	400	mA
Anode input power	$W_{i_a}$	= max.	880	800	W
Anode dissipation	$W_a$	= max.	400	400	W
Negative grid voltage	$-V_g$	= max.	300	300	V
Grid current, loaded	$I_g$	= max.	120	120	mA
Grid current, unloaded	$I_g$	= max.	130	130	mA
Grid circuit resistance	$R_g$	= max.	10	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	470	810	MHz
Anode voltage	$V_a$	=	2000	1800	V
Anode current, loaded	$I_a$	=	380	380	mA
Anode current, unloaded	$I_a$	=	170	-	mA
Grid circuit resistance	$R_g$	=	1000	1000	$\Omega$ <sup>1)</sup>
Grid current, loaded	$I_g$	=	110	110	mA
Grid current, unloaded	$I_g$	=	120	120	mA
Anode input power	$W_{i_a}$	=	760	684	W
Anode dissipation	$W_a$	=	280	400	W
Tube output power	$W_o$	=	480	284	W
Tube efficiency	$\eta$	=	63	41	%
Output power in the load	$W_f$	=	340	200	W

1) The grid circuit resistance is obtained by a current stabilising device. The stated value applies to loaded conditions.



R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE in grounded grid circuit  
with self rectification

**LIMITING VALUES** (Absolute limits)

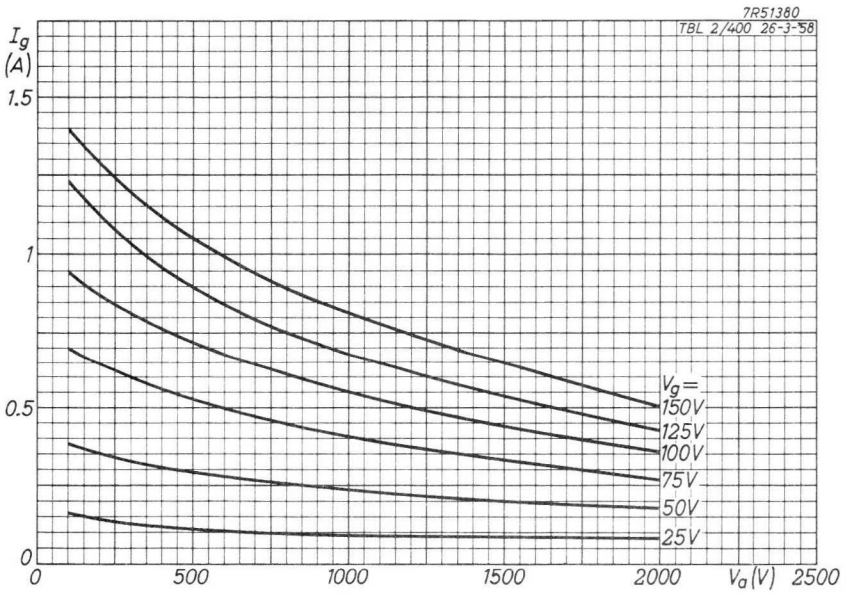
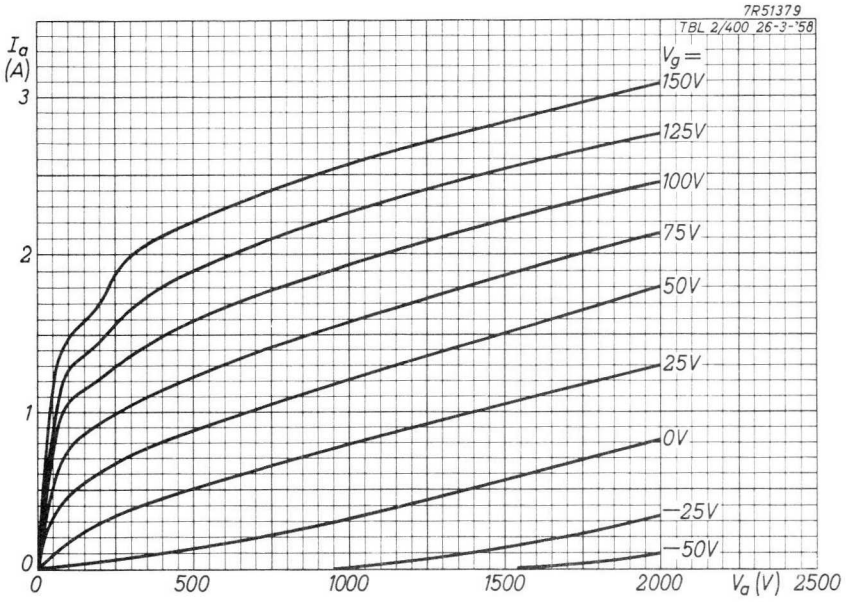
-----  
Voltages with respect to cathode  
-----

Frequency	$f$	up to	470	MHz
Transformer voltage	$V_{tr}$	= max.	2000	V(RMS)
Anode current	$I_a$	= max.	210	mA
Anode input power	$W_{i_a}$	= max.	450	W
Anode dissipation	$W_a$	= max.	170	W
Negative grid voltage	$-V_g$	= max.	300	V
Grid current, loaded	$I_g$	= max.	85	mA
Grid current, unloaded	$I_g$	= max.	120	mA
Grid circuit resistance	$R_g$	= max.	5	k $\Omega$

**OPERATING CHARACTERISTICS**

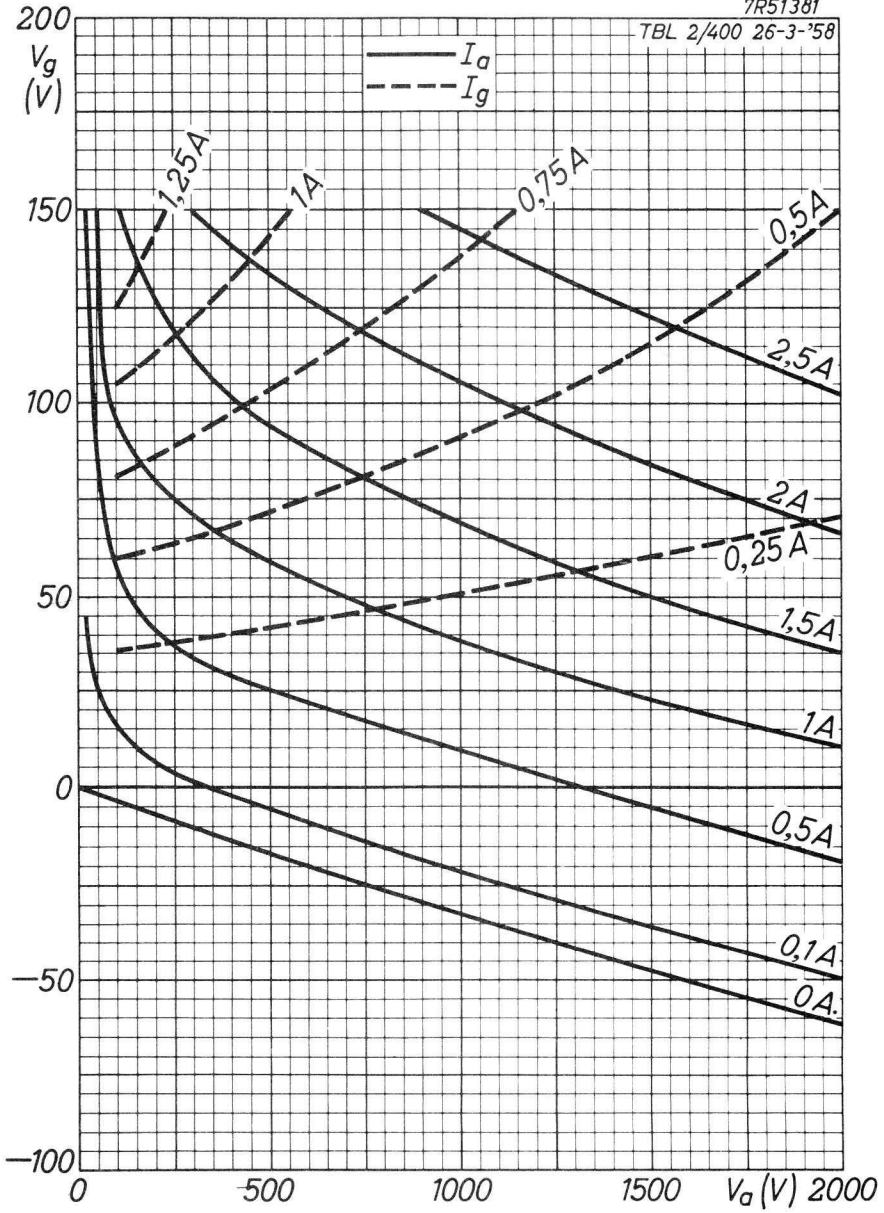
-----  
Voltages with respect to cathode  
-----

Frequency	$f$	=	470	MHz
Transformer voltage	$V_{tr}$	=	1800	V(RMS)
Anode current, loaded	$I_a$	=	190	mA
Anode current, unloaded	$I_a$	=	110	mA
Grid current, loaded	$I_g$	=	70	mA
Grid current, unloaded	$I_g$	=	100	mA
Grid circuit resistance	$R_g$	=	400	$\Omega$
Anode input power	$W_{i_a}$	=	380	W
Anode dissipation	$W_a$	=	150	W
Tube output power	$W_o$	=	230	W
Tube efficiency	$\eta$	=	60	%
Output power in the load	$W_l$	=	160	W



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## AIR COOLED COAXIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Frequency (MHz)	C telegr. grounded grid	
	$V_a$ (V)	$W_o$ (W)
400	2500	670
625	2200	580

HEATING : direct; filament thoriated tungsten

Frequency	f	< 600	600 to 750	> 750	MHz
Filament voltage	$V_f$	= 3.4	3.3	3.2	V
Filament current	$I_f$	= 19	-	-	A

### CAPACITANCES

Anode to all except grid	$C_a$	= 0.05	pF
Grid to all except anode	$C_g$	= 11	pF
Anode to grid	$C_{ag}$	= 3.8	pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	= 2400	V
Anode current	$I_a$	= 240	mA
Amplification factor	$\mu$	= 70	
Mutual conductance	S	= 14	mA/V

**TEMPERATURE LIMITS** (Absolute limits)

Temperature of envelope = max. 200 °C

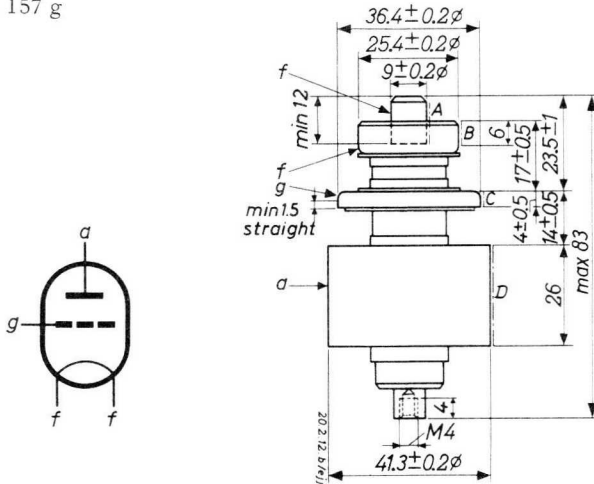
**COOLING CHARACTERISTICS**

$W_a$ (W)	$h$ (m)	$t_1$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
	0	45	0.9	24
500	1500	35	0.9	20
	3000	25	1.0	21

**MECHANICAL DATA**

Dimensions in mm

Net weight: 157 g



Eccentricity of the electrode connections: The electrode connections A, B and C are within cylindrical surfaces having a diameter of 9.5, 25.9 and 36.9 mm respectively and being concentric with the cylindrical surface D.

Mounting position: vertical with the anode up or down

## R.F. CLASS C TELEGRAPHY or F.M. TELEPHONY

## LIMITING VALUES (Absolute limits)

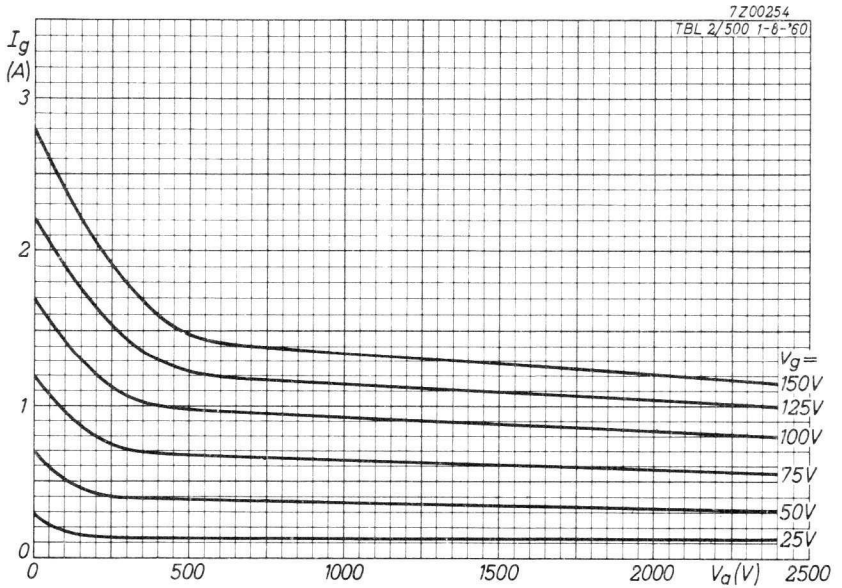
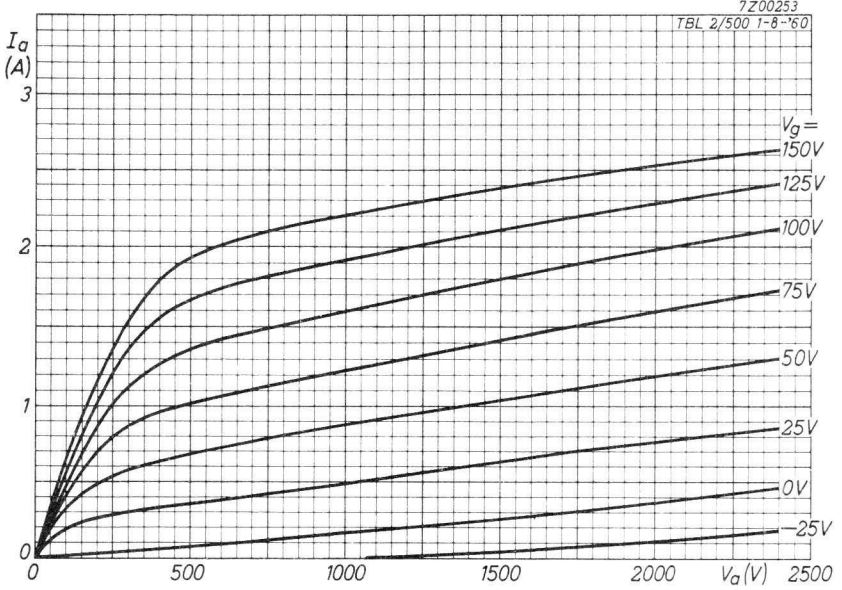
Frequency	f	up to	400	625	940	MHz
Anode voltage	$V_a$	= max.	2700	2500	2000	V
Anode current	$I_a$	= max.	400	400	400	mA
Anode input power	$W_{i_a}$	= max.	1000	880	800	W
Anode dissipation	$W_a$	= max.	500	500	500	W
Negative grid voltage	$-V_g$	= max.	300	300	300	V
Grid current	$I_g$	= max.	175	175	160	mA

## OPERATING CONDITIONS in grounded grid circuit

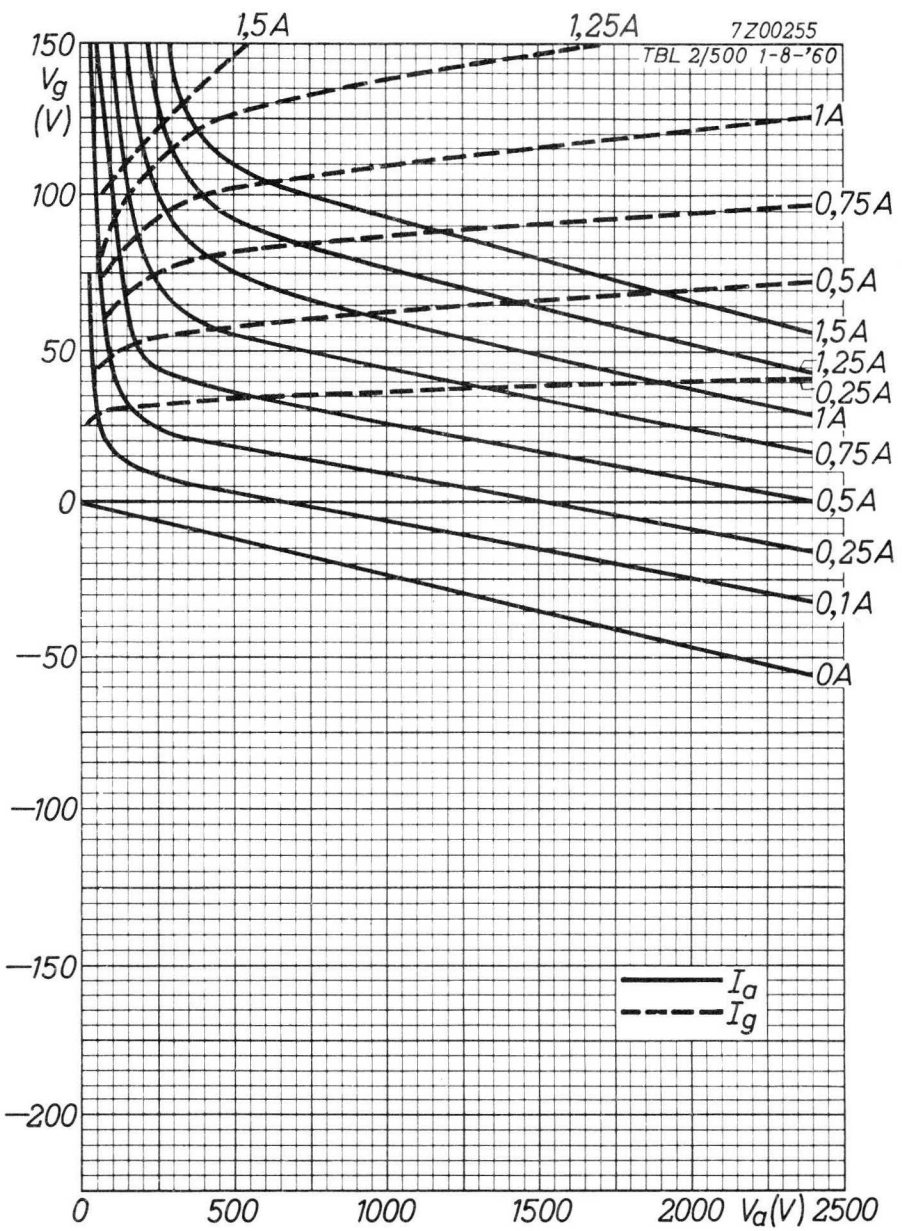
Frequency	f	=	400	625	MHz
Anode voltage	$V_a$	=	2500	2200	V
Negative grid voltage	$-V_g$	=	70	60	V
Anode current	$I_a$	=	380	380	mA
Grid current	$I_g$	=	160	170	mA
Grid input power	$W_{i_g}$	=	70	65	W
Anode input power	$W_{i_a}$	=	950	835	W
Anode dissipation	$W_a$	=	330	302	W
Tube output power	$W_o$	=	620+50	533+47	W <sup>1)</sup>
Tube efficiency	$\eta$	=	65	64	%
Output power in the load	$W_l$	=	470	405	W <sup>2)</sup>
Power gain	$W_o/W_i$	=	9.6	8.9	

<sup>1)</sup> Power transferred from driving stage included

<sup>2)</sup> Measured in a circuit having an efficiency of 70%









## AIR COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	three phase	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	7	17.7
	6	14.3

**HEATING:** direct, filament thoriated tungsten

Filament voltage	V <sub>f</sub> =	6.3 V	+ 5 % -10 %
Filament current	I <sub>f</sub> =	130 A	
Cold filament resistance	R <sub>f0</sub> =	0.005 Ω	

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub> =	1.2 pF
Grid to all other elements except anode	C <sub>g</sub> =	44.5 pF
Anode to grid	C <sub>ag</sub> =	33.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub> =	6 kV
Anode current	I <sub>a</sub> =	2.5 A
Mutual conductance	S =	23 mA/V
Amplification factor	μ =	17.5

### TEMPERATURE LIMITS (Absolute limits)

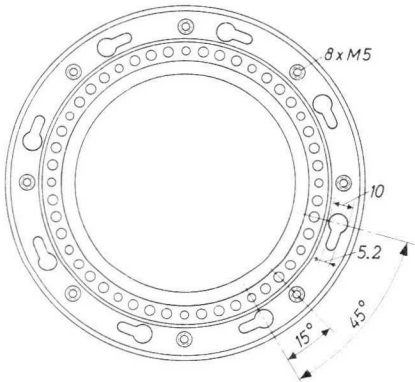
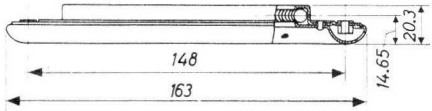
Temperature of all seals = max. 220 °C

AIR COOLING CHARACTERISTICS

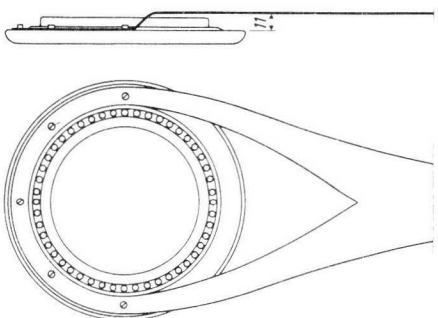
$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
5	0	45	5.9	15
	0	35	5.2	12
	1500	35	6.2	14
	3000	25	6.6	15
7.5	0	45	9.0	34
	0	35	8.0	27
	1500	35	9.5	32
	3000	25	10.2	34
10	0	45	12.3	63
	0	35	11	50
	1500	35	13	59
	3000	25	14	64

MECHANICAL DATA

Dimensions in mm



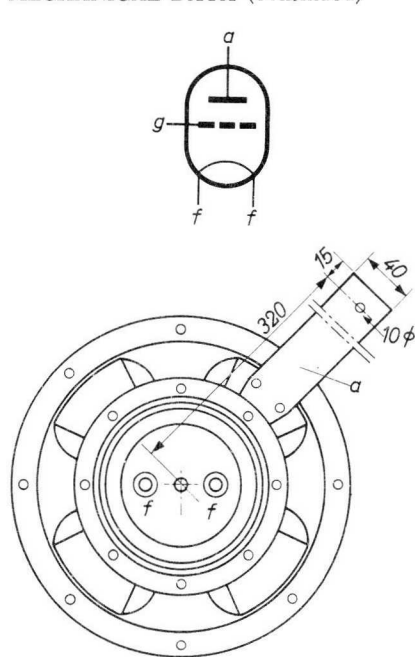
Grid connector 40664



Connection of the grid lead

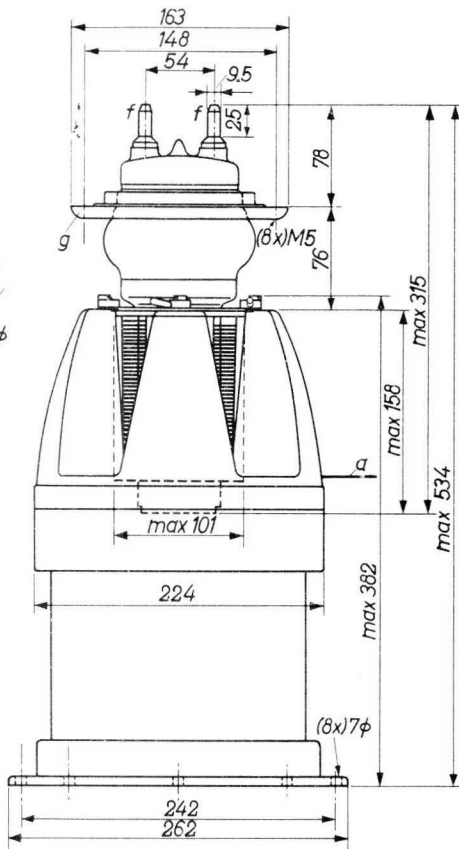
The rounded side of the grid connector should face the anode. To ensure a uniform R.F. current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown in the figure at right

MECHANICAL DATA (continued)



ACCESSORIES

- Filament connectors with cable : 40662
- Grid connector : 40664
- Insulating pedestal or air distributor : K508
- : K509
- Net weight of tube : 3.8 kg
- Net weight of pedestal: 7.4 kg



Dimensions in mm

Mounting position: vertical with anode down



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode input power	$W_{ia}$	= max.	30 kW
Anode dissipation	$W_a$	= max.	10 kW <sup>1)</sup>
Anode dissipation	$W_a$	= max.	15 kW <sup>2)</sup>
Anode current	$I_a$	= max.	4.0 A
Negative grid voltage	$-V_g$	= max.	1600 V
Grid current, loaded	$I_g$	= max.	1.5 A
Grid current, unloaded	$I_g$	= max.	2.0 A
Grid circuit resistance	$R_g$	= max.	10 kΩ

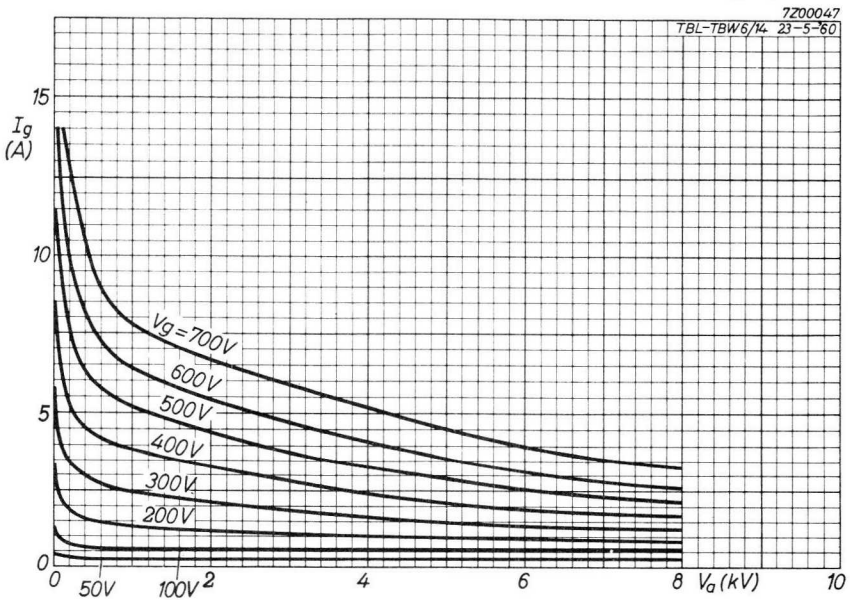
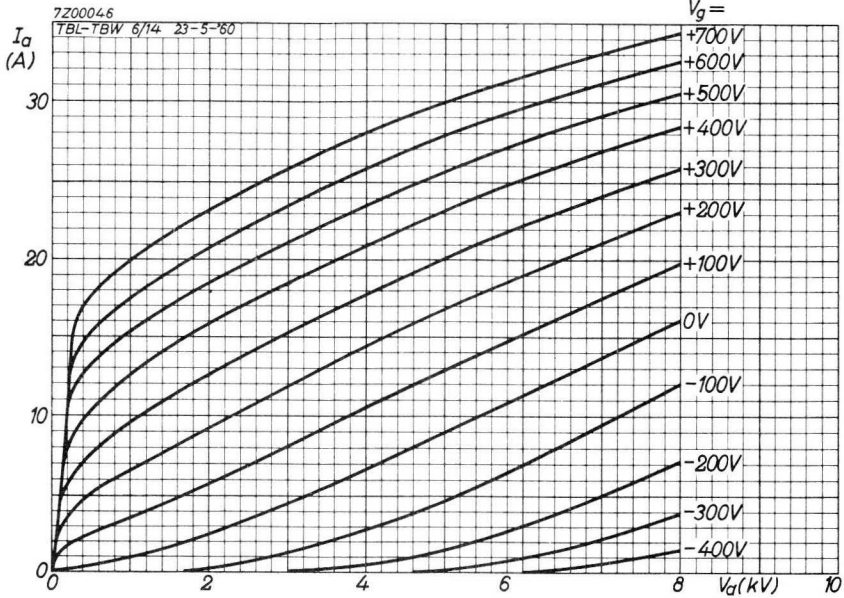
**OPERATING CONDITIONS**

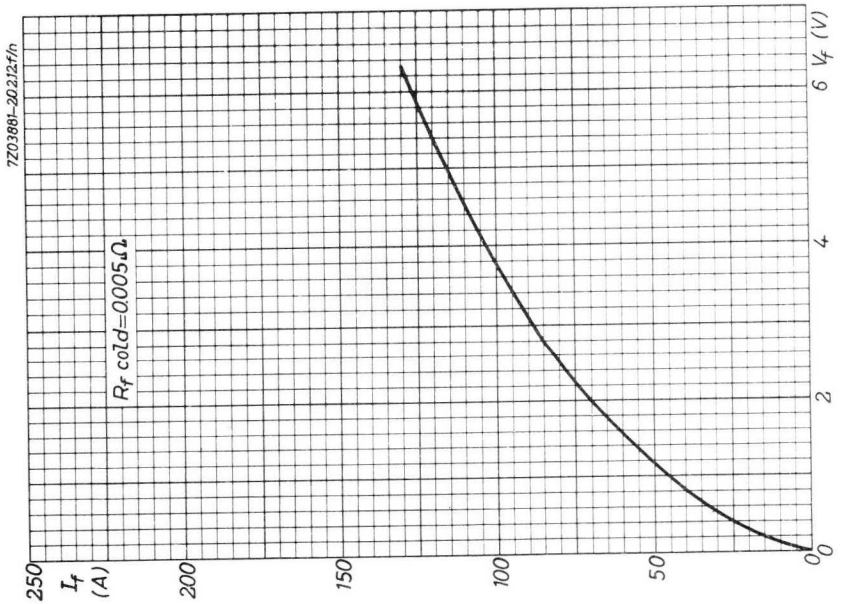
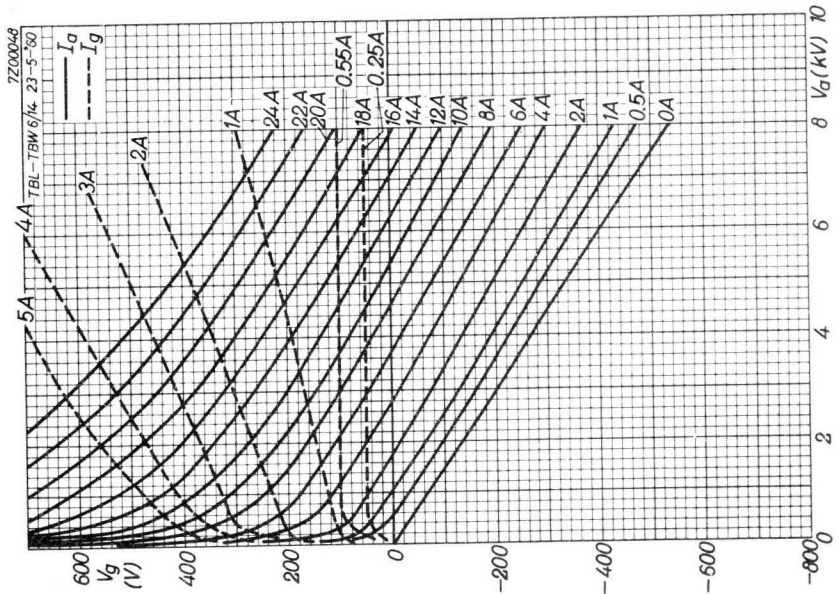
Frequency	f	=	30	30 MHz
Anode voltage	$V_a$	=	7	6 kV
Anode current, loaded	$I_a$	=	3.5	3.3 A
Anode current, unloaded	$I_a$	=	0.7	0.51 A
Grid current, loaded	$I_g$	=	0.95	0.8 A
Grid current, unloaded	$I_g$	=	1.35	1.1 A
Grid resistor	$R_g$	=	950	1000 Ω
Load resistance	$R_{a\sim}$	=	1000	870 Ω
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	25	26 ‰
Anode input power	$W_{ia}$	=	24.5	19.8 kW
Anode dissipation	$W_a$	=	6.8	5.5 kW
Output power	$W_o$	=	17.7	14.3 kW
Efficiency	$\eta$	=	72	72 ‰
Output power in the load	$W_l$	=	14	11 kW <sup>3)</sup>

1) Continuous service with adequate cooling.

2) Intermittent service. See also page 7.

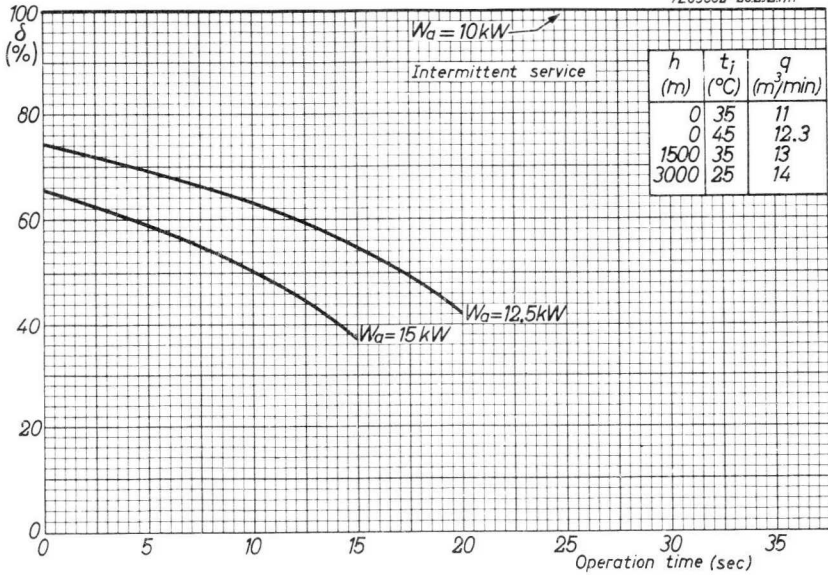
3) Useful power in the load, measured in a circuit having an efficiency of about 85%.



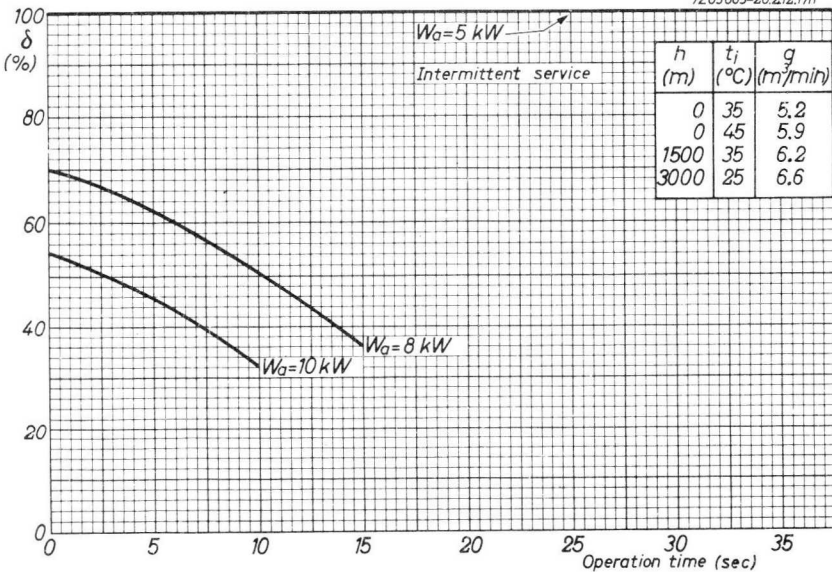


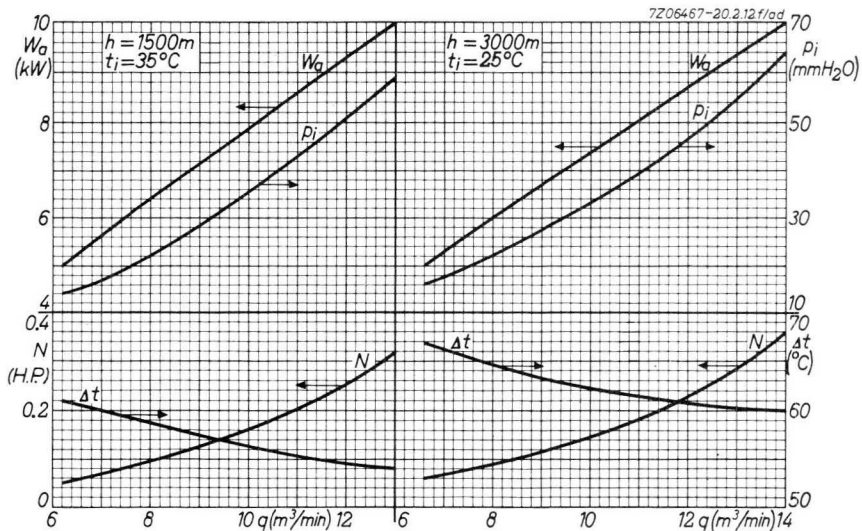
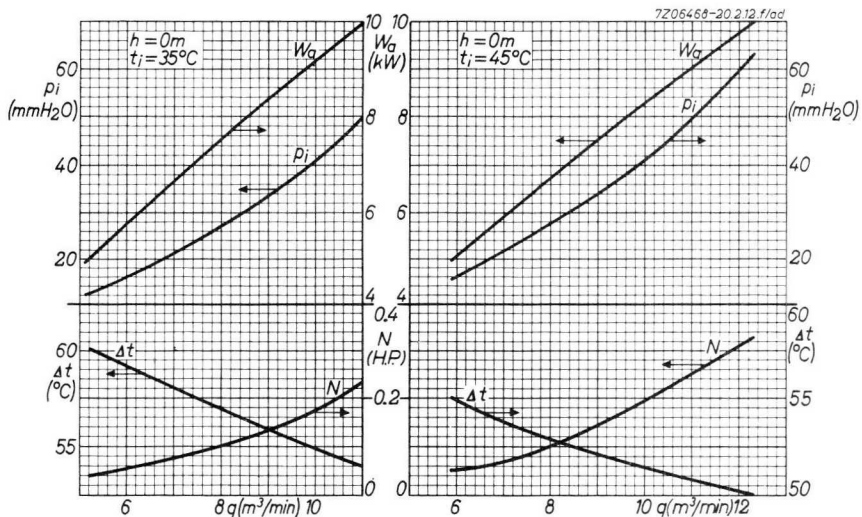


7Z03882-20.212.f/h



7Z03883-20.212.f/h





## AIR COOLED COAXIAL R.F. POWER TRIODE

QUICK REFERENCE DATA						
Freq. (MHz)	C teleg. grounded grid		B television			
			Neg. mod. Pos. sync.		Pos. mod. Neg. sync.	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW) sync.	V <sub>a</sub> (kV)	W <sub>o</sub> (kW) white
110	5	17				
48 to 88			5	17	5	17
170 to 220			4	12	4	12

**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub> = 6.3 V
Filament current	I <sub>f</sub> = 154 A
Cold filament resistance	R <sub>fo</sub> = 0.0054 Ω

The filament current must never exceed a peak value of 500 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub> = 0.6 pF <sup>1)</sup>
Grid to all other elements except anode	C <sub>g</sub> = 65 pF
Anode to grid	C <sub>ag</sub> = 29 pF

### TYPICAL CHARACTERISTICS

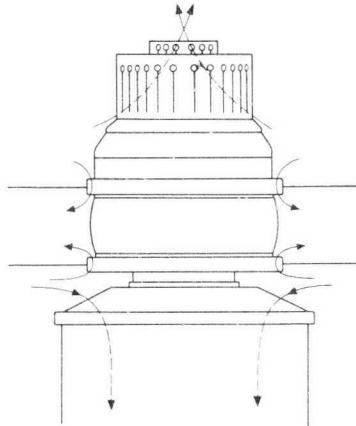
Anode current	I <sub>a</sub> = 1 A
Anode voltage	V <sub>a</sub> = 4 kV
Amplification factor	μ = 60
Mutual conductance	S = 60 mA/V

<sup>1)</sup> Anode fully screened from filament terminals by a flat metal screen connected to the grid terminal

**AIR COOLING CHARACTERISTICS.** See also cooling curves

$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
5.5	0	35	5.0	16
	1500	35	5.9	16
	3000	25	5.7	16
8	0	35	7.7	35
	1500	35	9	40
	3000	25	9	36
10	0	35	11	65
	1500	35	13	75
	3000	25	13	66

Recommended direction of air flow



Generally it is necessary to direct an air flow on the grid, anode and filament seals. E.g. at 220 MHz an air flow of 0.6 m<sup>3</sup>/min on each of these seals is necessary.

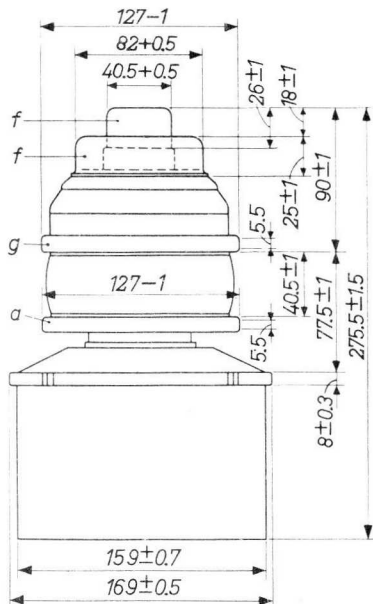
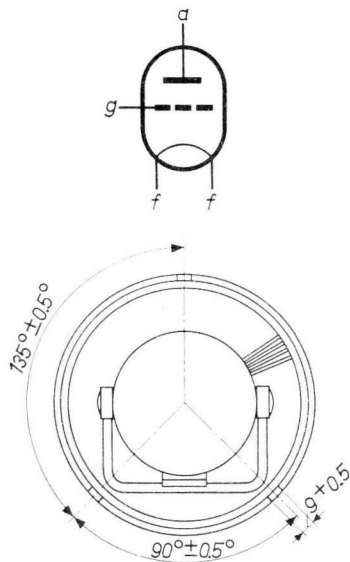
**TEMPERATURE LIMITS** (Absolute limits)

Temperature of seals = max. 180 °C

**MECHANICAL DATA**

Net weight: 9.5 kg

Dimensions in mm



Eccentricity of outer diameters of the electrode terminals and of the protruding edge of the radiator housing with respect to the radiator housing is max. 1 mm

Mounting position: vertical with anode up or down

**ACCESSORIES**

Insulating pedestal	40654
Grid and anode connector	40651
Inner filament connector	40652
Outer filament connector	40653

**R.F. CLASS C TELEGRAPHY**, grounded grid

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 110 MHz
Anode voltage	$V_a$	= max. 5.5 kV
Negative grid voltage	$-V_g$	= max. 500 V
Anode current	$I_a$	= max. 6 A
Grid current	$I_g$	= max. 1.5 A
Anode input power	$W_{ia}$	= max. 30 kW
Anode dissipation	$W_a$	= max. 10 kW

**OPERATING CONDITIONS**

Frequency	f	=	110 MHz
Anode voltage	$V_a$	=	5 kV
Grid voltage	$V_g$	=	-300 V
Anode current	$I_a$	=	4.8 A
Grid current	$I_g$	=	1.2 A
Peak grid A.C. voltage	$V_{gp}$	=	520 V
Grid input power	$W_{ig}$	=	2560 W
Anode input power	$W_{ia}$	=	24 kW
Anode dissipation	$W_a$	=	9 kW
Output power	$W_o$	=	15 + 2 kW <sup>1)</sup>
Efficiency	$\eta$	=	62.5 % <sup>2)</sup>

<sup>1)</sup> Power transferred from driving stage included

<sup>2)</sup> Pure tube efficiency

**R.F. CLASS B TELEPHONY FOR TELEVISION SERVICE**; linear, grounded-grid amplifier

Negative modulation, positive synchronisation (CCIR and FCC system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 88	up to 220	MHz
Anode voltage	$V_a$	= max. 5.5	max. 4.5	kV
Anode input power	$W_{ia}$ sync	= max. 25	max. 22	kW
Anode dissipation	$W_a$ sync	= max. 10	max. 10	kW
Anode current	$I_a$ sync	= max. 6	max. 6	A
Grid current	$I_g$ sync	= max. 1.2	max. 1.2	A

**OPERATING CONDITIONS** (at centre frequency of the resonance curve)

Frequency	f	= 48 to 88	170 to 220	MHz
Bandwidth	B (-1.5 dB)	= -	7	MHz
Bandwidth	B (-3 dB)	= 6	12	MHz
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	= -90	-75	V
Peak grid A.C. voltage	$V_{gp}$	sync = 270	255	V
		black = 200	180	V
Anode current	$I_a$	sync = 4.8	4.8	A
		black = 3.6	3.6	A
Grid current	$I_g$	sync = 1.0	1.0	A
		black = 0.35	0.35	A
Grid input power	$W_{ig}$ sync	= 1.4	1.3	kW
Output power	$W_o$	sync = 17	12	kW
		black = 9.6	6.75	kW



**R.F. CLASS B TELEPHONY FOR TELEVISION SERVICE ; linear, grounded-grid amplifier**

Positive modulation, negative synchronisation (RTF and BBC system)

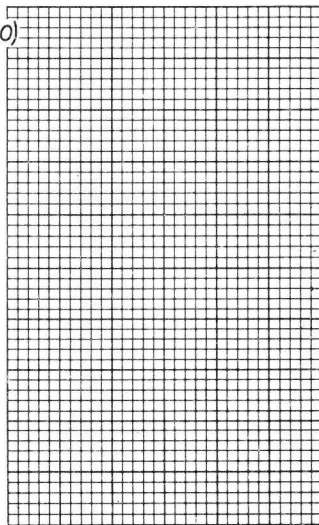
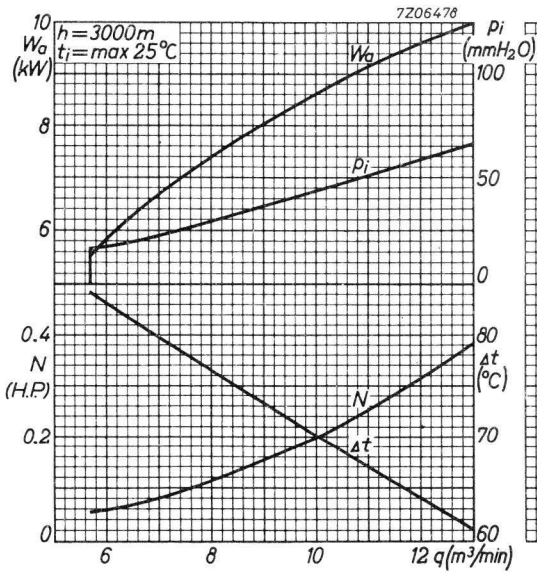
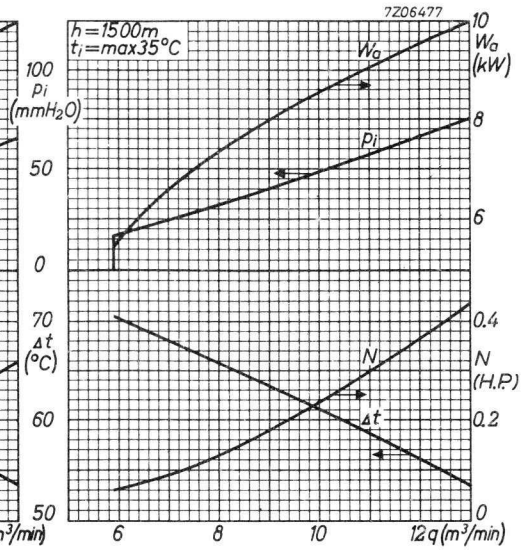
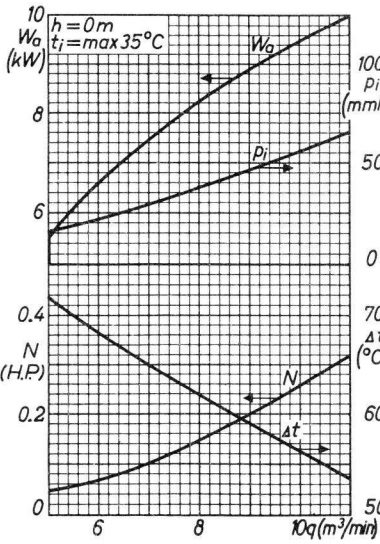
**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 88	up to 220	MHz
Anode voltage	$V_a$	= max. 5.5	max. 4.5	kV
Anode input power	$W_{ia}$	white = max. 25	max. 22	kW
Anode current	$I_a$	white = max. 6	max. 6	A
Grid current	$I_g$	white = max. 1.2	max. 1.2	A
Anode dissipation	$W_a$	white = max. 10	max. 10	kW

**OPERATING CONDITIONS**(at centre frequency of the resonance curve)

Frequency	f	= 48 to 88	170 to 220	MHz
Bandwidth	B (-3 dB)	= 6	12	MHz
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	= -90	-75	V
Peak grid A.C. voltage	$V_{gp}$	white =	270	255
		black =	110	95
Anode current	$I_a$	white =	4.8	4.8
		black =	1.45	1.45
Grid current	$I_g$	white =	1	1
		black =	0.2	0.2
Grid input power	$W_{ig}$	white =	1.4	1.3
Output power	$W_o$	white =	17	12
		black =	1.7	1.2







## AIR COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA				
Industrial R.F. oscillator class C				
Freq. (MHz)	Three phase rectifier			
	Continuous		Intermittent	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
50	7	4.85	6	5.9
	6	4.1		

**HEATING** : direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub> = 6.3 V $\begin{matrix} + 5\% \\ -10\% \end{matrix}$
Filament current	I <sub>f</sub> = 65 A

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub> < 0.5 pF
Grid to all other elements except anode	C <sub>g</sub> = 13 pF
Anode to grid	C <sub>ag</sub> = 7.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub> = 6 kV
Anode current	I <sub>a</sub> = 0.24 A
Amplification factor	μ = 23
Mutual conductance	S = 7 mA/V

### TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals	= max. 220 °C
Temperature of external parts of the anode	= max. 270 °C

7Z2 3531

**COOLING**

Continuous service

$W_a$ (kW)	$q_{min}$ (m <sup>3</sup> /min)	$p_i$ (mm H <sub>2</sub> O)
1.3	1.6	16
1.7	2.1	25

For intermittent service see figure page A

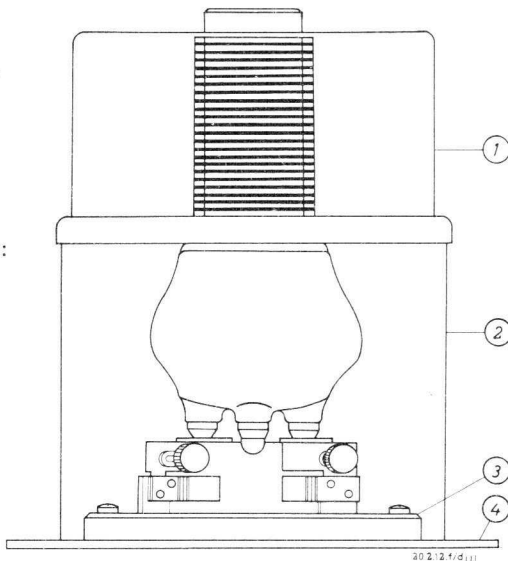
At higher altitudes and/or temperatures a corresponding higher amount of air should be applied

**RECOMMENDED COOLING DEVICE**

- (1) = metal housing (see page 3)
- (2) = glass cylinder
- (3) = socket 2422 511 05001
- (4) = ground plate (see page 3)

Dimensions of the glass cylinder:

- Height : 118 mm
- Outside diameter : 150 mm
- Inside diameter : 144 mm

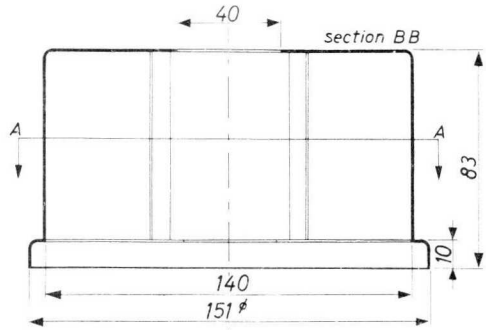


The cooling air should preferably be supplied through the space under the ground plate (4). This ground plate should have holes of sufficient cross section to pass the required air flow.

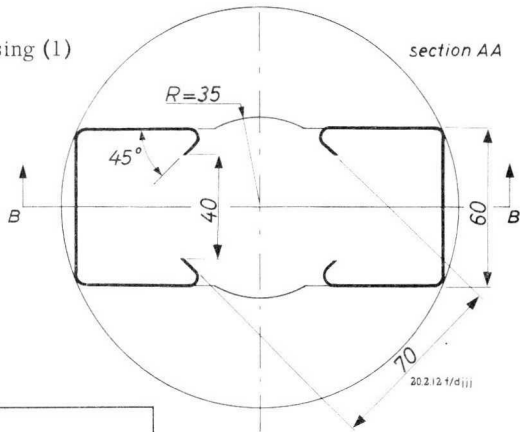
The housing (1) should be connected to the anode connector. At frequencies above 4 MHz both grid terminals should be connected in parallel. At the highest frequencies care should be taken to distribute the R.F. current equally between both grid terminals to avoid excessive grid seal temperatures.

RECOMMENDED COOLING DEVICE (continued)

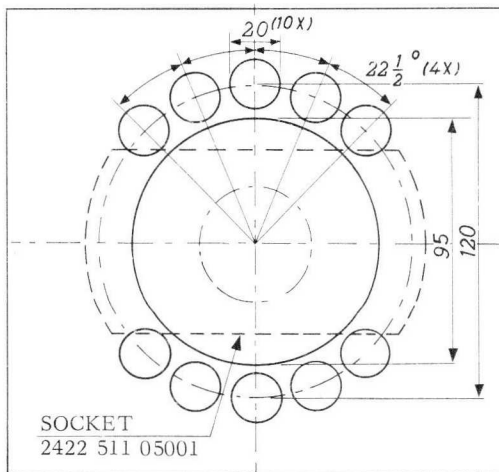
Dimensions in mm



Metal housing (1)



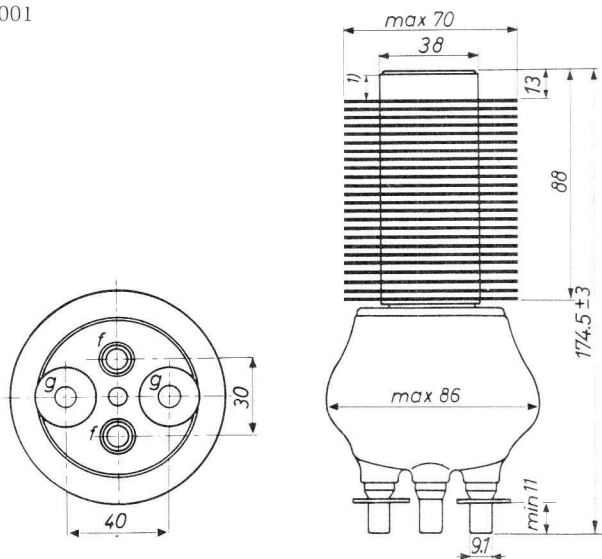
Ground plate (4)



7Z2 8656

**MECHANICAL DATA** (dimensions in mm)

Socket: 2422 511 05001



Mounting position: vertical with anode up or down

<sup>1)</sup> Area for anode connector

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits) continuous service

Frequency	f	up to	50 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode current	$I_a$	= max.	1 A
Anode input power	$W_{ia}$	= max.	7 kW
Anode dissipation	$W_a$	= max.	1.7 kW
Negative grid voltage	$-V_g$	= max.	1250 V
Grid current, loaded	$I_g$	= max.	0.4 A
Grid current, unloaded	$I_g$	= max.	0.5 A
Grid resistor	$R_g$	= max.	10 k $\Omega$



**OPERATING CONDITIONS**, continuous service

Frequency	f	=	50	50 MHz
Transformer voltage	$V_{tr}$	=	6.0	5.1 kV <sub>RMS</sub>
Anode voltage	$V_a$	=	7	6 kV
Anode current, loaded	$I_a$	=	0.9	0.9 A
Anode current, unloaded	$I_a$	=	0.2	0.2 A <sup>1)</sup>
Grid current, loaded	$I_g$	=	0.25	0.28 A
Grid current, unloaded	$I_g$	=	0.30	0.35 A <sup>1)</sup>
Grid resistor	$R_g$	=	2.5	2 k $\Omega$
Load resistance	$R_{a\sim}$	=	3.85	3.3 k $\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	15	16 %
Anode input power	$W_{ia}$	=	6.3	5.4 kW
Anode dissipation	$W_a$	=	1.45	1.3 kW
Output power	$W_o$	=	4.85	4.1 kW
Efficiency	$\eta$	=	77	76 %
Output power in the load	$W_\ell$	=	4.0	3.3 kW <sup>2)</sup>

1) In a typical circuit

2) Useful power in the load measured in a circuit having an efficiency of 85%.

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits) intermittent service

Frequency	f	up to	50 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode current	$I_a$	= max.	1.5 A
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	2.1 kW <sup>1)</sup>
Negative grid voltage	$-V_g$	= max.	1250 V
Grid current, loaded	$I_g$	= max.	0.4 A
Grid current, unloaded	$I_g$	= max.	0.5 A
Grid resistor	$R_g$	= max.	10 k $\Omega$

**OPERATING CONDITIONS**, intermittent service

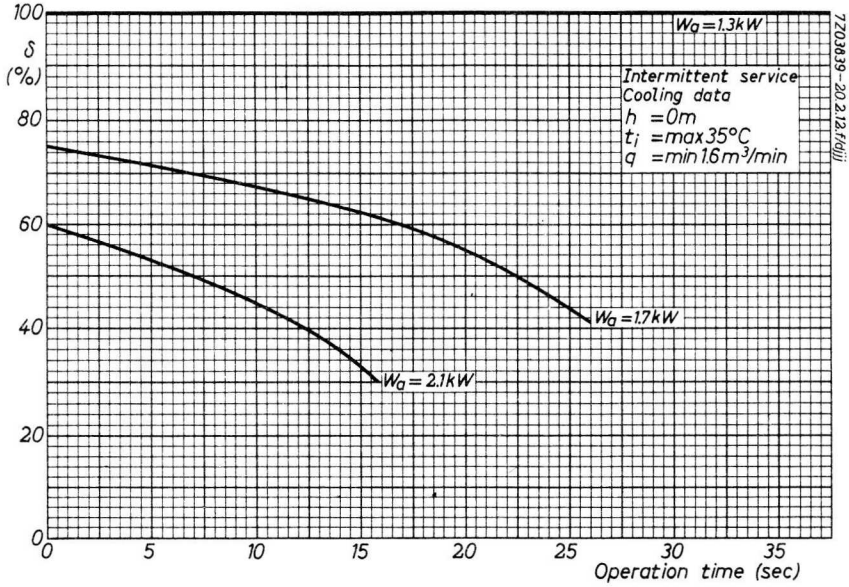
Frequency	f	=	50 MHz
Transformer voltage	$V_{tr}$	=	5.1 kV <sub>RMS</sub>
Anode voltage	$V_a$	=	6 kV
Anode current, loaded	$I_a$	=	1.33 A
Anode current, unloaded	$I_a$	=	0.33 A <sup>2)</sup>
Grid current, loaded	$I_g$	=	0.38 A
Grid current, unloaded	$I_g$	=	0.48 A <sup>2)</sup>
Grid resistor	$R_g$	=	1450 $\Omega$
Load resistance	$R_{a\sim}$	=	2200 $\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	17 %
Anode input power	$W_{ia}$	=	8 kW
Anode dissipation	$W_a$	=	2.1 kW <sup>1)</sup>
Output power	$W_o$	=	5.9 kW
Efficiency	$\eta$	=	74 %
Output power in the load	$W_{\ell}$	=	4.75 kW <sup>3)</sup>

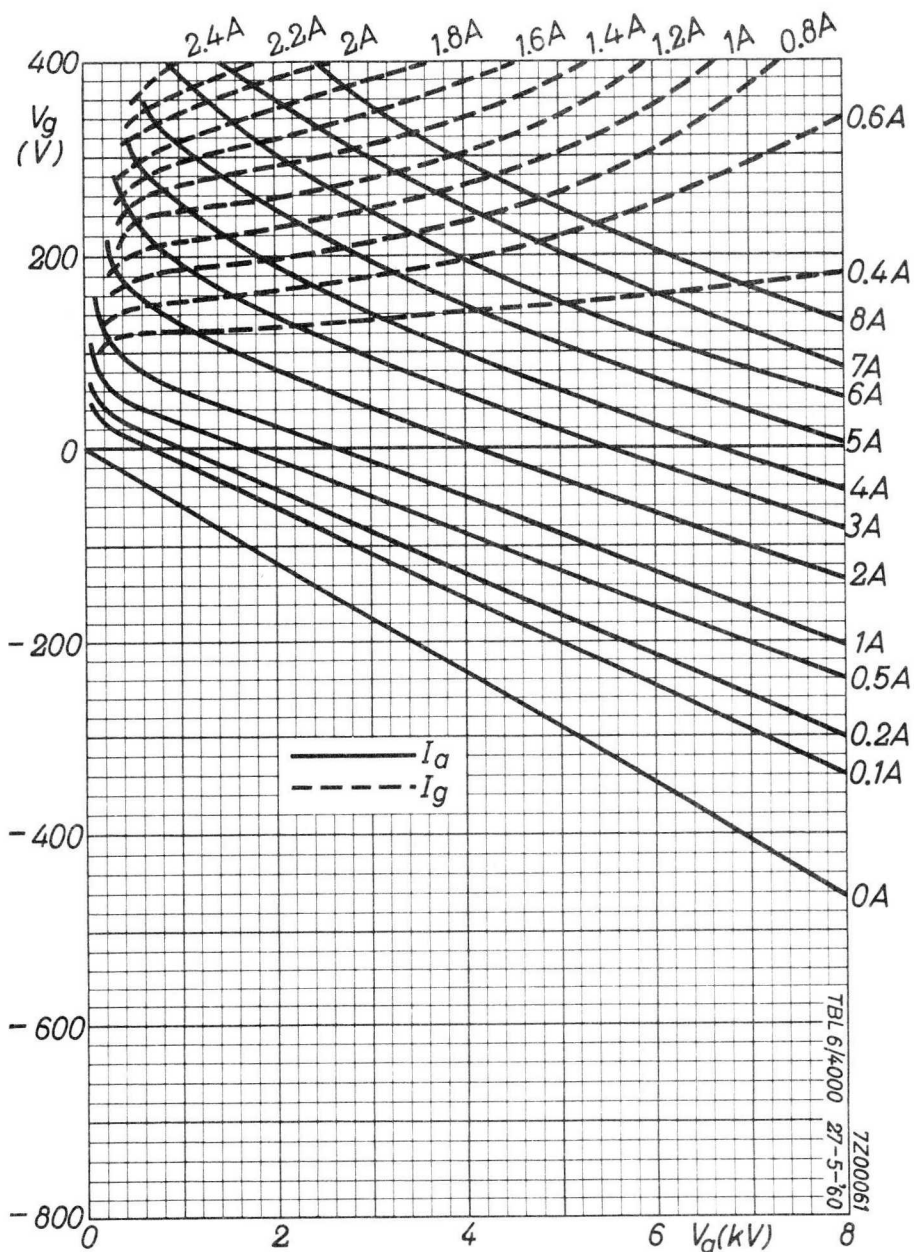
<sup>1)</sup> See figure page A

<sup>2)</sup> In a typical circuit

<sup>3)</sup> Useful power in the load measured in a circuit having an efficiency of 85%.







TBL 6/4000 27-5-'60  
7200061

## AIR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA									
General purposes									
$\lambda$ (m)	Freq. (MHz)	C teleg.		B teleph.		$C_a$ mod.		B mod. <sup>1)</sup>	
		$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)
4	75	6	6.9	6	1.9			6	13.3
		5	5.6	5	1.45	5	4.7	5	6.6
		4	4			4.5	4.1	4.5	6.0
						4	3.5	4	5.3
						3.5	3	3.5	4.6
						3	2.2	3	3.3
Television service									
Freq. (MHz)	Neg. mod.		Pos. sync.		Pos. mod.		Neg. sync.		
	$V_a$ (kV)	$W_o$ sync (kW)	$W_o$ black (kW)	$V_a$ (kV)	$W_o$ white (kW)				
75	5	9	5.35	5	9				

**HEATING:** direct; filament thoriated tungsten

Filament voltage  $V_f = 12.6$  V

Filament current  $I_f = 33$  A

### CAPACITANCES

Anode to all other elements except grid  $C_a = 0.3$  pF

Grid to all other elements except anode  $C_g = 16$  pF

Anode to grid  $C_{ag} = 11$  pF

**COOLING:** forced air

<sup>1)</sup> Two tubes

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a = 4$ kV
Anode current	$I_a = 1$ A
Amplification factor	$\mu = 32$
Mutual conductance	$S = 17$ mA/V

**AIR COOLING CHARACTERISTICS**, see also the cooling curves

$W_a$ (kW)	$h$ (m)	$t_i$ max. (°C)	$q_{min.}$ (m <sup>3</sup> /min)	$p_i$ (mm H <sub>2</sub> O)
1	0	35	3	8
	0	45	3.1	8
	1500	35	3.7	9
	3000	25	4.1	10
3	0	35	5.2	23
	0	45	6.1	29
	1500	35	6.2	26
	3000	25	6.6	26
5	0	35	9.2	68
	0	45	10.7	90
	1500	35	11.2	81
	3000	25	11.6	79

**MECHANICAL DATA**

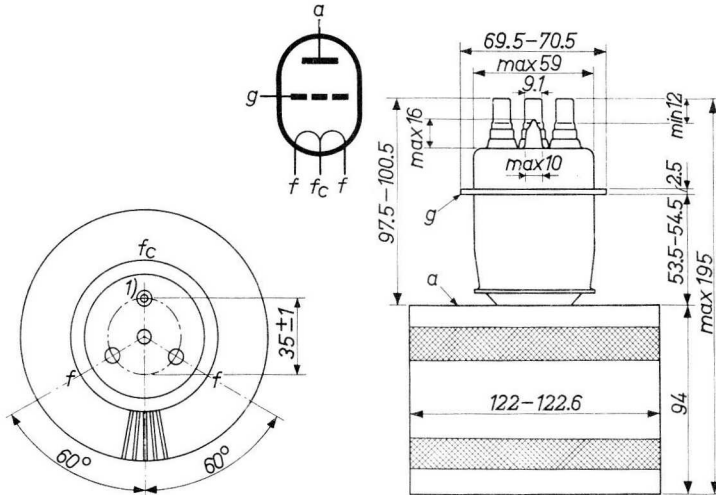
Dimensions in mm

Grid connector : 40650 <sup>2)</sup>  
or 40622

Filament connectors: 40634

Insulating pedestal : 40630

Tube net weight : 4.6 kg



Mounting position: vertical with anode up or down

The centre tap  $f_c$  must not be used for filament current supply. The connectors type 40634, however, must be used for the cooling of all three filament pins, thus also of pin  $f_c$

1) This pin is marked "O"

2) The connector 40650 should be used only below 30 MHz

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6 kV
Negative grid voltage	$-V_g$	= max.	1000 V
Anode current	$I_a$	= max.	1.5 A
Grid current	$I_g$	= max.	0.35 A
Grid dissipation	$W_g$	= max.	120 W
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	5 kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	= 4	4	4 m
Frequency	f	= 75	75	75 MHz
Anode voltage	$V_a$	= 6	5	4 kV
Grid voltage	$V_g$	= -400	-300	-200 V
Anode current	$I_a$	= 1.5	1.5	1.37 A
Grid current	$I_g$	= 0.31	0.33	0.35 A
Peak grid A.C. voltage	$V_{gp}$	= 740	640	500 V
Grid input power	$W_{ig}$	= 210	190	160 W
Anode input power	$W_{ia}$	= 9	7.5	5.5 kW
Anode dissipation	$W_a$	= 2.1	1.9	1.5 kW
Output power	$W_o$	= 6.9	5.6	4 kW
Efficiency	$\eta$	= 76.5	75	73 %

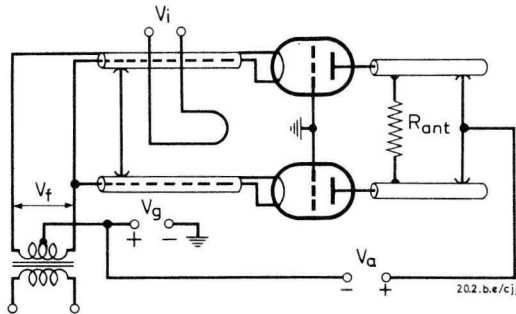
**R.F. CLASS C TELEGRAPHY, grounded grid**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6 kV
Positive cathode to grid voltage	$V_{kg}$	= max.	1000 V
Anode current	$I_a$	= max.	1.5 A
Grid current	$I_g$	= max.	0.35 A
Grid dissipation	$W_g$	= max.	120 W
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	5 kW

For frequencies from 75 MHz tap to 220 MHz See page C

**OPERATING CONDITIONS, two tubes**



For data please refer to page 6

**R.F. CLASS C TELEGRAPHY**, grounded grid (continued)

**OPERATING CONDITIONS**, two tubes (continued)

$\lambda$	=	4	2.7 <sup>1)</sup>	2.7 <sup>1)</sup>	1.36 <sup>1)</sup> m
f	=	75	110	110	220 MHz
V <sub>a</sub>	=	6	5	4	4 kV
V <sub>g</sub>	=	-400	-300	-200	-200 V
I <sub>a</sub>	=	2x1.5	2x1.5	2x1.37	2x1.25 A
I <sub>g</sub>	=	2x0.31	2x0.33	2x0.35	2x0.2 A
V <sub>gp</sub>	=	740	640	500	450 V
W <sub>ig</sub>	=	2x1120	2x920	2x675	2x380 W
W <sub>ia</sub>	=	2x9	2x7.5	2x5.5	2x5 kW
W <sub>a</sub>	=	2x2.1	2x2.2	2x1.7	2x2.5 kW
W <sub>o</sub>	=	13.8+1.82	10.6+1.46	7.6+1.03	5+0.6 kW <sup>2)</sup>
$\eta$	=	76.5	71	69	50 % <sup>3)</sup>

<sup>1)</sup> When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged.

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation.

<sup>2)</sup> Power transferred from driving stage included.

<sup>3)</sup> Pure tube efficiency.



**R.F. CLASS B TELEPHONY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75	MHz
Anode voltage	$V_a$	= max.	6	kV
Anode current	$I_a$	= max.	1.1	A
Anode input power	$W_{ia}$	= max.	6.6	kW
Anode dissipation	$W_a$	= max.	5	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	4	4	m
Frequency	f	=	75	75	MHz
Anode voltage	$V_a$	=	6	5	kV
Grid voltage	$V_g$	=	-180	-145	V
Anode current	$I_a$	=	0.99	0.9	A
Peak grid A.C. voltage	$V_{gp}$	=	250	225	V
Anode input power	$W_{ia}$	=	5.9	4.5	kW
Anode dissipation	$W_a$	=	4	3.05	kW
Output power	$W_o$	=	1.9	1.45	kW
Efficiency	$\eta$	=	32	32	%
Modulation factor	m	=	100	100	%
Grid current	$I_g$	=	0.3	0.32	A
Grid input power	$W_{ig}$	=	140	130	W



## R.F. CLASS C ANODE MODULATION

### LIMITING VALUES (Absolute limits)

Frequency	f	up to	75	MHz
Anode voltage	$V_a$	= max.	5	kV
Negative grid voltage	$-V_g$	= max.	1000	V
Anode current	$I_a$	= max.	1.3	A
Grid current	$I_g$	= max.	0.35	A
Grid dissipation	$W_g$	= max.	120	W
Anode input power	$W_{ia}$	= max.	6.5	kW
Anode dissipation	$W_a$	= max.	3.4	kW

### OPERATING CONDITIONS

Wavelength	$\lambda$	=	4	4	4	4	4	m
Frequency	f	=	75	75	75	75	75	MHz
Anode voltage	$V_a$	=	5	4.5	4	3.5	3	kV
Grid voltage	$V_g$	=	-400	-350	-300	-300	-250	V <sup>1)</sup>
Anode current	$I_a$	=	1.2	1.2	1.2	1.2	1	A
Grid current	$I_g$	=	0.3	0.3	0.3	0.3	0.3	A
Peak grid A. C. voltage	$V_{gp}$	=	690	650	600	600	510	V
Grid input power	$W_{ig}$	=	190	180	165	165	140	W
Anode input power	$W_{ia}$	=	6	5.4	4.8	4.2	3	kW
Anode dissipation	$W_a$	=	1.3	1.3	1.3	1.2	0.8	kW
Output power	$W_o$	=	4.7	4.1	3.5	3.0	2.2	kW
Efficiency	$\eta$	=	78	76	73	71.5	73	%
Modulation factor	m	=	100	100	100	100	100	%
Modulation power	$W_{mod}$	=	3.0	2.7	2.4	2.1	1.5	kW

<sup>1)</sup> Grid bias partially obtained by the grid resistor

**A.F. CLASS B AMPLIFIER AND MODULATOR**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	= max.	6	kV
Anode current	$I_a$	= max.	1.5	A
Anode input power	$W_{ia}$	= max.	9	kW
Anode dissipation	$W_a$	= max.	5	kW
Grid circuit resistance	$R_g$	= max.	15	k $\Omega$

**OPERATING CONDITIONS**, two tubes

$V_a$	=	6	5	4.5	kV
$V_g$	=	-165	-138	-125	V
$R_{aa\sim}$	=	4900	6400	6100	$\Omega$
$V_{ggp}$	=	0 910	0 661	0 655	V
$I_a$	=	2x0.125 2x1.5	2x0.11 2x0.91	2x0.1 2x0.92	A
$I_g$	=	0 2x0.28	0 2x0.14	0 2x0.09	A
$W_{ig}$	=	0 2x115	0 2x42	0 2x27	W
$W_{ia}$	=	2x0.75 2x9	2x0.55 2x4.55	2x0.45 2x4.15	kW
$W_a$	=	2x0.75 2x2.35	2x0.55 2x1.25	2x0.45 2x1.15	kW
$W_o$	=	0 13.3	0 6.6	0 6	kW
$d_{tot}$	=	- 4.3	- 3.3	- 3.7	%
$\eta$	=	- 74	- 73	- 72	%

$V_a$	=	4	3.5	3	kV
$V_g$	=	-112	-100	-90	V
$R_{aa\sim}$	=	4900	4200	4400	$\Omega$
$V_{ggp}$	=	0 632	0 618	0 570	V
$I_a$	=	2x0.1 2x0.94	2x0.075 2x0.95	2x0.065 2x0.8	A
$I_g$	=	0 2x0.19	0 2x0.18	0 2x0.2	A
$W_{ig}$	=	0 2x54	0 2x50	0 2x52	W
$W_{ia}$	=	2x0.4 2x3.75	2x0.26 2x3.3	2x0.2 2x2.4	kW
$W_a$	=	2x0.4 2x1.1	2x0.26 2x1	2x0.2 2x0.75	kW
$W_o$	=	0 5.3	0 4.6	0 3.3	kW
$d_{tot}$	=	- 2.6	- 2.9	- 3.3	%
$\eta$	=	- 71	- 70	- 69	%

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**GRID MODULATED R.F. CLASS C AMPLIFIER** for television service; negative modulation, positive synchronisation (American and European system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 75	up to 220	MHz
Anode voltage	$V_a$	= max. 5	max. 4	kV
Anode input power	$W_{ia}$	sync = max. 9.5	max. 6.5	kW
Anode dissipation	$W_a$	sync = max. 5	max. 4	kW
Anode current	$I_a$	sync = max. 1.9	max. 1.6	A
Grid dissipation	$W_g$	sync = max. 120	max. 120	W
Negative grid voltage	$-V_g$	= max. 1000	max. 1000	V

**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	= 48 to 75	170 to 220 <sup>1)</sup>	MHz
Bandwidth (-1.5 db)	B	= 5.25	6.5	MHz <sup>2)</sup>
Bandwidth (-3 db)	B	= 8	10	MHz <sup>2)</sup>
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	sync = -200	-150	V
		black = -300	-225	V
		white = -550	-500	V
Peak grid to grid voltage	$V_{ggp}$	sync = 1000	1000	V <sup>3)</sup>
Anode current	$I_a$	sync = 3.8	3.2	A
		black = 2.8	2.6	A
Grid current	$I_g$	sync = 0.5	0.4	A
		black = 0.35	0.22	A
Grid input power	$W_{ig}$	sync = 250	350 to 450	W <sup>4)</sup>
Output power	$W_o$	sync = 9	6	kW
		black = 5.35	3.37	kW

1) When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged.

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation

2) These values are based on measurements on a circuit with a single LC section

3) Measured by the slide back method

4) Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power

**GRID MODULATED R.F. CLASS C AMPLIFIER** for television service; positive modulation, negative synchronisation (BBC system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	5 kV
Negative grid voltage	$-V_g$	= max.	1000 V
Anode current	$I_a$ white	= max.	1.9 A
Anode input power	$W_{ia}$ white	= max.	9.5 kW
Anode dissipation	$W_a$ white	= max.	5 kW
Grid dissipation	$W_g$ white	= max.	120 W



**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	=	48-75 MHz
Bandwidth ( $I_{ant} = 85\%$ ) ( $I_{ant} = 70\%$ )	B	=	5.25 MHz
		=	8 MHz
Anode voltage	$V_a$	=	5 kV
Grid voltage	$V_g$	white =	-200 V
		black =	-460 V
		sync =	-580 V
Peak grid to grid voltage	$V_{ggp}$ white	=	1000 V
Anode current	$I_a$	white =	3.8 A
		black =	0.8 A
Grid current	$I_g$	white =	0.5 A
		black =	0 A
Grid input power	$W_{ig}$ white	=	250 W
Output power	$W_o$	white =	9 kW
		black =	0.6 kW

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**R.F. CLASS B TELEPHONY** for television service (American and European system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 75	up to 220	MHz
Anode voltage	$V_a$	= max. 5	max. 4	kV
Anode input power	$W_{ia}$	sync = max. 9.5	max. 6.5	kW
Anode dissipation	$W_a$	sync = max. 5	max. 4	kW
Anode current	$I_a$	sync = max. 1.9	max. 1.6	A
Grid dissipation	$W_g$	sync = max. 120	max. 120	W

**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	= 48 to 75	170 to 220 <sup>1)</sup>	MHz
Bandwidth (-1.5 db)	B	= 5.25	6.5	MHz <sup>2)</sup>
Bandwidth (-3 db)	B	= 8	10	MHz <sup>2)</sup>
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	= -200	-150	V
Peak grid to grid voltage	$V_{ggp}$	sync = 1000	1000	V <sup>3)</sup>
		black = 800	750	V <sup>3)</sup>
		white = 0	200	V <sup>3)</sup>
Anode current	$I_a$	sync = 3.8	3.2	A
		black = 3	2.6	A
		white = 0.2	-	A
Grid current	$I_g$	sync = 0.5	0.4	A
		black = 0.22	0.22	A
		white = 0	-	A
Grid input power	$W_{ig}$	sync = 250	350 to 450	W <sup>4)</sup>
Output power	$W_o$	sync = 9	6	kW
		black = 5.35	3.37	kW

1) When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation

2) These values are based on measurements on a circuit with a single LC section

3) Measured by the slide back method

4) Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from two-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	5400 V
Negative grid voltage	$-V_g$	= max.	900 V
Anode current	$I_a$	= max.	1.35 A
Grid current	$I_g$	= max.	0.31 A
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	5 kW
Grid dissipation	$W_g$	= max.	120 W

**OPERATING CONDITIONS**

Transformer voltage	$V_{tr}$	= 6.0 <sup>1)</sup>	5.1 <sup>2)</sup> kV <sub>RMS</sub>
Anode voltage	$V_a$	= 5.4	4.6 kV <sup>3)</sup>
Anode current	$I_a$	= 1.35	1.15 A
Grid current	$I_g$	= 0.31	0.27 A
Grid resistor	$R_g$	= 1300	1100 $\Omega$
Grid input power	$W_{ig}$	= 210	160 W
Anode input power	$W_{ia}$	= 9	6.5 kW
Anode dissipation	$W_a$	= 2.3	1.84 kW
Output power	$W_o$	= 6.5	4.5 kW
Efficiency	$\eta$	= 72	70 %

1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded

3) D.C. value

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6000 V
Negative grid voltage	$-V_g$	= max.	1000 V
Anode current	$I_a$	= max.	1.5 A
Grid current	$I_g$	= max.	0.35 A
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	5 kW
Grid dissipation	$W_g$	= max.	120 W

**OPERATING CONDITIONS**

Frequency	f	=	75	75 MHz
Transformer voltage	$V_{tr}$	=	$5.1^{1)}$	$4.4^{2)}$ kV <sub>RMS</sub>
Anode voltage	$V_a$	=	6.0	5.1 kV <sup>3)</sup>
Anode current	$I_a$	=	1.5	1.25 A
Grid current	$I_g$	=	0.31	0.28 A
Grid resistor	$R_g$	=	1300	1100 $\Omega$
Grid input power	$W_{ig}$	=	210	160 W
Anode input power	$W_{ia}$	=	9	6.4 kW
Anode dissipation	$W_a$	=	1.9	1.74 kW
Output power	$W_o$	=	6.9	4.5 kW
Efficiency	$\eta$	=	76.5	70 %

1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded

3) D.C. value



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with self rectification

**LIMITING VALUES** (Absolute limits)

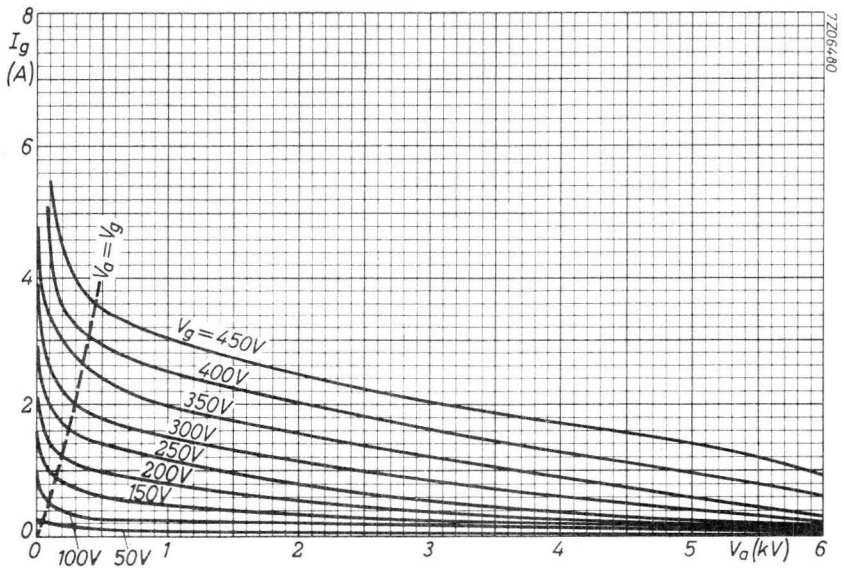
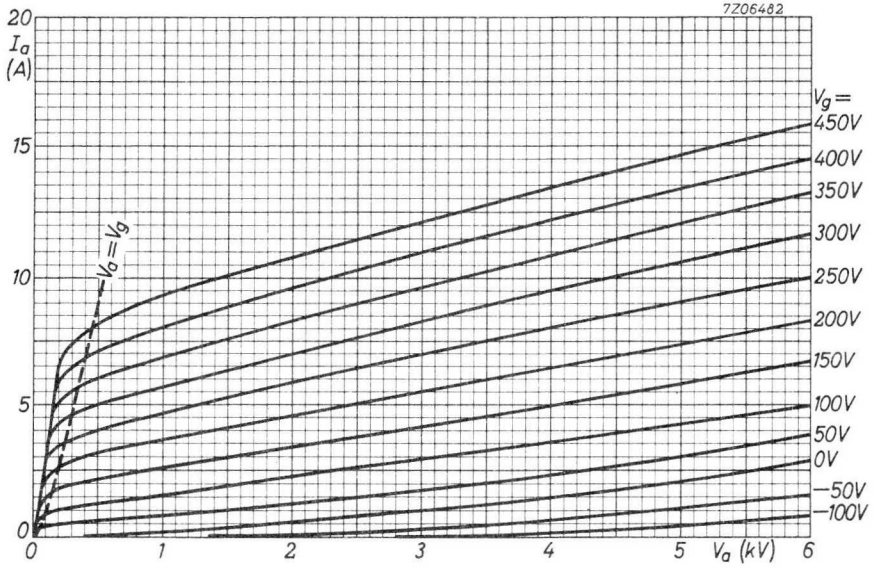
Frequency	f	up to	75	MHz
Transformer voltage	$V_{tr}$	= max.	6800	$V_{RMS}$
Negative grid voltage	$-V_g$	= max.	640	V
Anode current	$I_a$	= max.	0.8	A
Grid current	$I_g$	= max.	0.19	A
Anode input power	$W_{ia}$	= max.	9	kW
Anode dissipation	$W_a$	= max.	5	kW
Grid dissipation	$W_g$	= max.	120	W

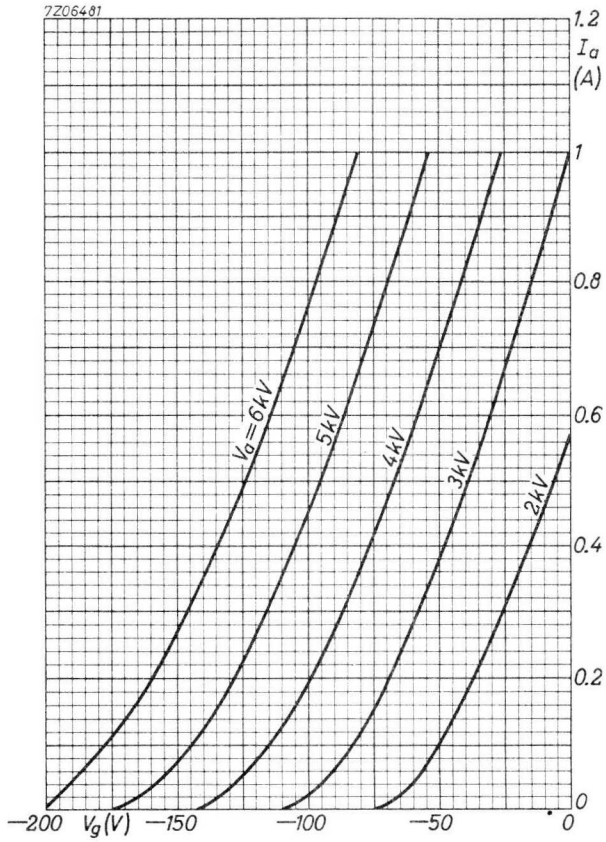
**OPERATING CONDITIONS**

Frequency	f	=	75	75	MHz
Transformer voltage	$V_{tr}$	=	6.8 <sup>1)</sup>	5.9 <sup>2)</sup>	$kV_{RMS}$
Anode current	$I_a$	=	0.8	0.7	A
Grid current	$I_g$	=	0.19	0.165	A
Grid resistor	$R_g$	=	1050	1050	$\Omega$
Grid input power	$W_{ig}$	=			W
Anode input power	$W_{ia}$	=	6.05	4.6	kW
Anode dissipation	$W_a$	=	1.5	1.24	kW
Output power	$W_o$	=	4.55	3.36	kW
Efficiency	$\eta$	=	75	73	%

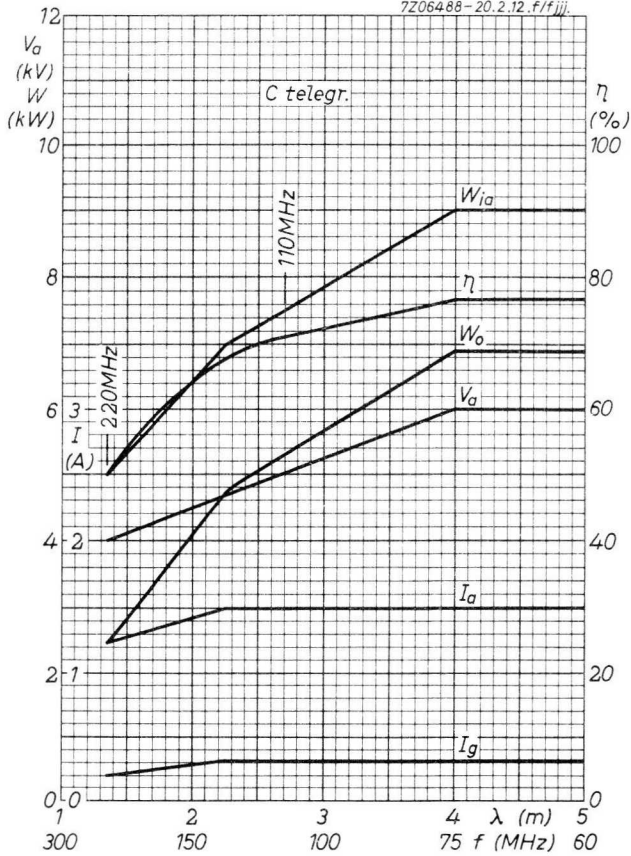
1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded  
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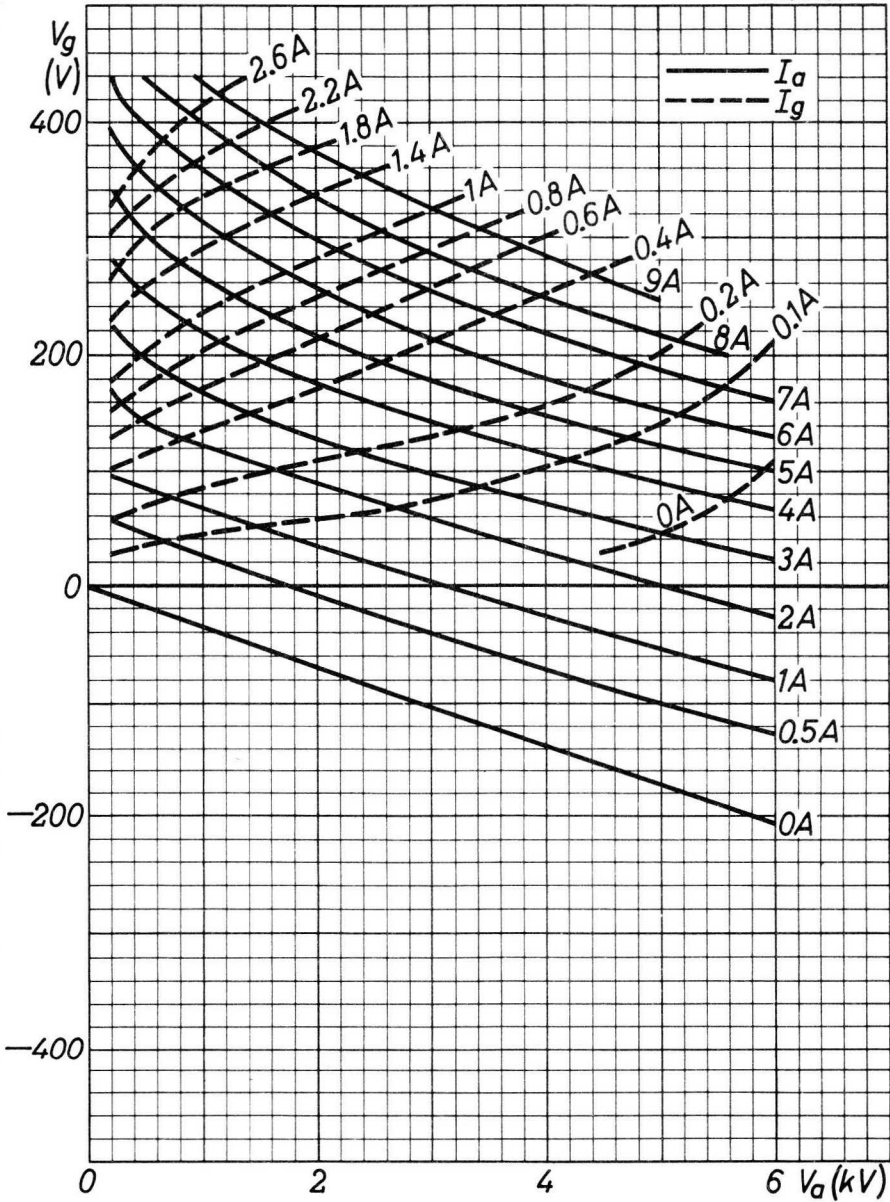


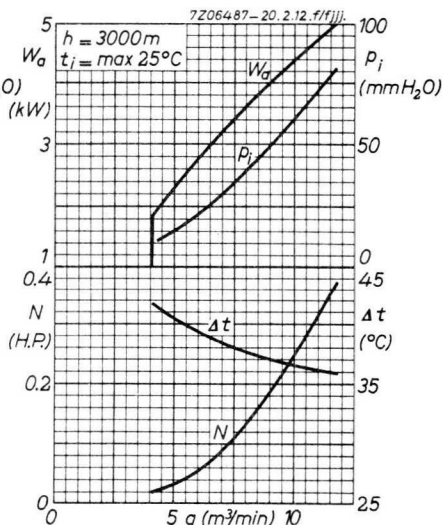
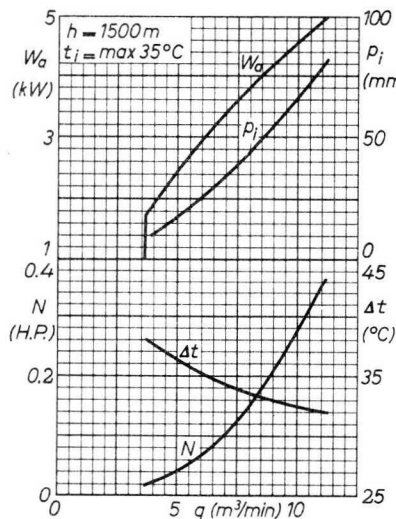
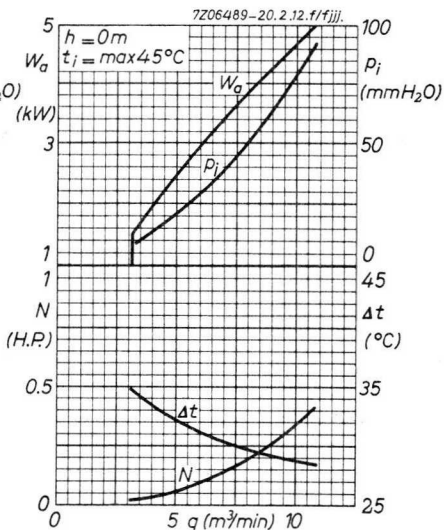
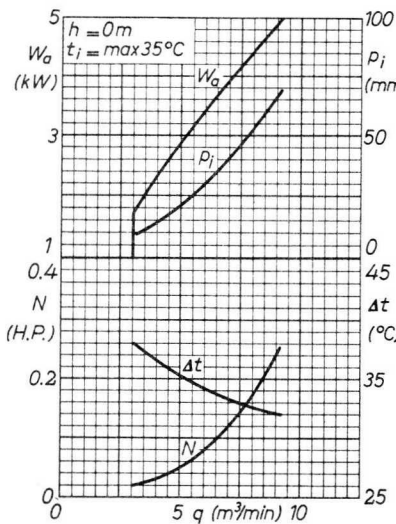


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7206483





## AIR COOLED R.F. POWER TRIODE

Triode for use in industrial R.F. generators and in telegraphy and telephony transmitters.

QUICK REFERENCE DATA							
$\lambda$	Freq.	C teleg.		C osc.		B mod. <sup>1)</sup>	
(m)	(MHz)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	30	6.5	9.5			7.0	20
		6.0	8.5			5.0	9.0
		5.0	7.1			4.0	7.1
6	50			6.0	6.0		

**COOLING** : forced air

**HEATING** : direct; filament thoriated tungsten

Filament voltage  $V_f = 12.6$  V

Filament current  $I_f = 33$  A

### CAPACITANCES

Anode to all other elements except grid  $C_a = 0.3$  pF

Grid to all other elements except anode  $C_g = 16$  pF

Anode to grid  $C_{ag} = 11$  pF

### TYPICAL CHARACTERISTICS

Anode current  $I_a = 1$  A

Anode voltage  $V_a = 6$  kV

Amplification factor  $\mu = 32$

Mutual conductance  $S = 15$  mA/V

<sup>1)</sup> Two tubes

**AIR COOLING CHARACTERISTICS**

$W_a$	$h$	$t_i$ max.	$q$ min.	$P_i$
(kW)	(m)	(°C)	(m <sup>3</sup> /min)	(mm H <sub>2</sub> O)
2	0	35	4.8	20
	0	45	5.7	25
	1500	35	5.7	23
	3000	25	6.1	23
3.5	0	35	6.2	32
	0	45	7.3	42
	1500	35	7.3	36
	3000	25	7.8	36
6	0	35	9.2	68
	0	45	10.7	91
	1500	35	11.2	81
	3000	25	11.7	80

See cooling curves

- Temperature of filament seals = max. 210 °C
- Temperature of grid and anode seals = max. 180 °C
- Filament connectors 40634
- Connector for centre pin of filament 40649 <sup>1)</sup>
- Grid connector 40650 <sup>2)</sup> or 40622
- Insulating pedestal (see page 4) 40630

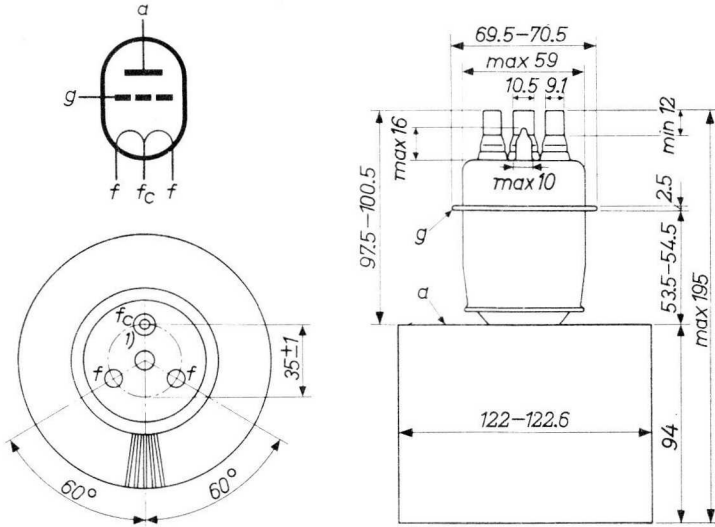
1) The centre tap  $f_c$  (diameter 10.5 mm; marked O) must not be used for filament current supply. The connector type 40649, however, must be used for the cooling of this pin.

2) See page 4. The connector 40650 should only be used below 30 MHz.



MECHANICAL DATA

Dimensions in mm



Mounting position: vertical with anode up or down.



<sup>1)</sup> See page 2

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	7.2	kV
Negative grid voltage	$-V_g$	= max.	1250	V
Anode current	$I_a$	= max.	2.2	A
Grid current	$I_g$	= max.	0.6	A
Anode input power	$W_{ia}$	= max.	14	kW
Anode dissipation	$W_a$	= max.	6	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	10	10	10	m
Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	6.5	6.0	5.0	kV
Grid voltage	$V_g$	=	-450	-400	-300	V
Anode current	$I_a$	=	2.0	2.0	2.0	A
Grid current	$I_g$	=	0.5	0.5	0.5	A
Peak grid A.C. voltage	$V_{gp}$	=	820	780	660	V
Grid input power	$W_{ig}$	=	370	350	297	W
Anode input power	$W_{ia}$	=	13	12	10	kW
Anode dissipation	$W_a$	=	3.5	3.5	2.9	kW
Output power	$W_o$	=	9.5	8.5	7.1	kW
Efficiency	$\eta$	=	73	71	71	%

**A.F. CLASS B AMPLIFIER AND MODULATOR**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a = \text{max. } 7.2 \text{ kV}$
Anode current	$I_a = \text{max. } 2.2 \text{ A}$
Anode input power	$W_{ia} = \text{max. } 14 \text{ kW}$
Anode dissipation	$W_a = \text{max. } 6 \text{ kW}$
Grid circuit resistance	$R_g = \text{max. } 15 \text{ k}\Omega$

**OPERATING CONDITIONS**, two tubes

$V_a =$	7	5	5	4	kV
$V_g =$	-250	-165	-165	-135	V
$R_{aa\sim} =$	4150	4800	5500	3800	$\Omega$
$V_{ggp} =$	0 1300	0 880	0 730	0 930	V
$I_a =$	2x0.2 2x2.0	2x0.15 2x1.25	2x0.15 2x1.1	2x0.1 2x1.25	A
$I_g =$	0 2x0.53	0 2x0.33	0 2x0.22	0 2x0.36	A
$I_{gp} =$	- 2x2.8	- 2x1.75	- 2x1.2	- 2x1.8	A
$W_{ig} =$	0 2x310	0 2x130	0 2x70	0 2x135	W
$W_{ia} =$	2x1.4 2x14	2x0.75 2x6.2	2x0.75 2x5.5	2x0.4 2x5.0	kW
$W_a =$	2x1.4 2x4.0	2x0.75 2x1.7	2x0.75 2x1.5	2x0.4 2x1.45	kW
$W_o =$	0 20	0 9	0 8.0	0 7.1	kW
$\eta =$	- 71.5	- 72.5	- 72.5	- 71	%



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

### LIMITING VALUES (Absolute limits)

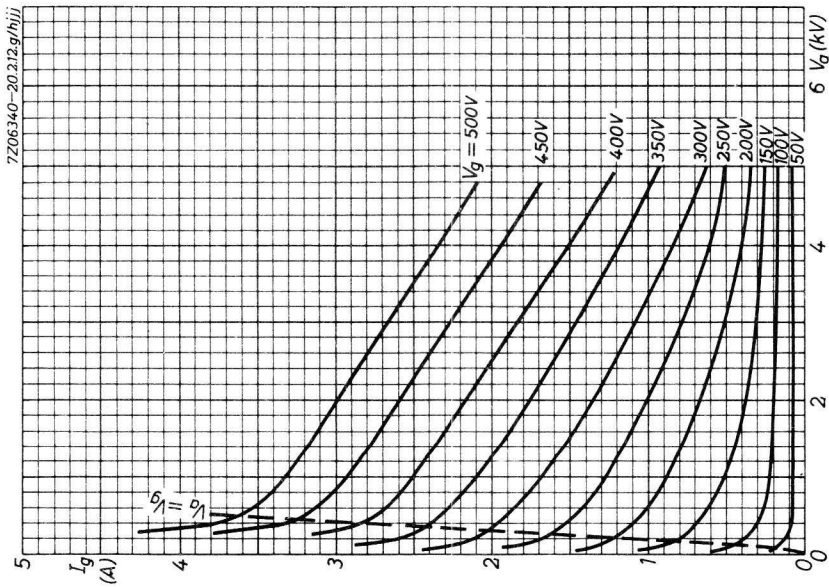
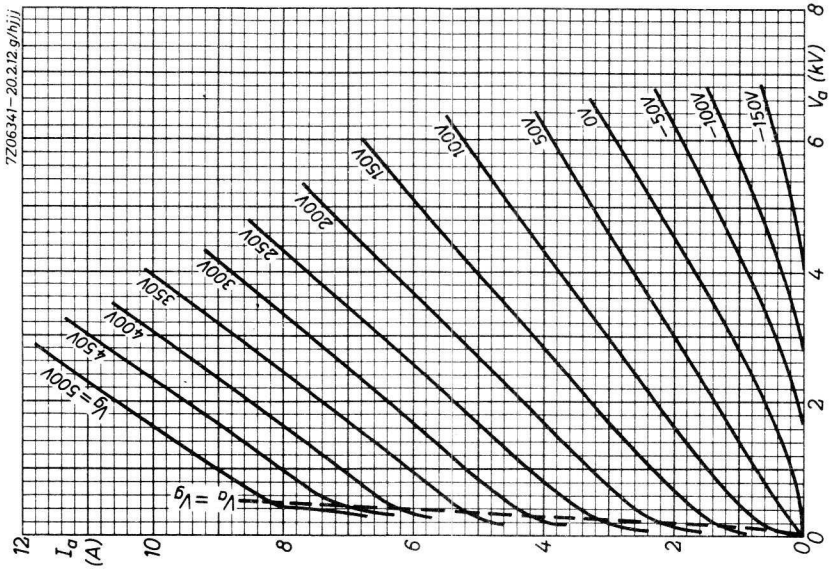
Frequency	f	up to	55 MHz
Anode voltage	$V_a$	= max.	7 kV
Negative grid voltage	$-V_g$	= max.	1250 V
Anode current	$I_a$	= max.	1.8 A
Grid current	$I_g$	= max.	0.5 A <sup>1)</sup>
Anode input power	$W_{ia}$	= max.	11 kW
Anode dissipation	$W_a$	= max.	6 kW
Grid circuit resistance	$R_g$	= max.	10 k $\Omega$

### OPERATING CONDITIONS

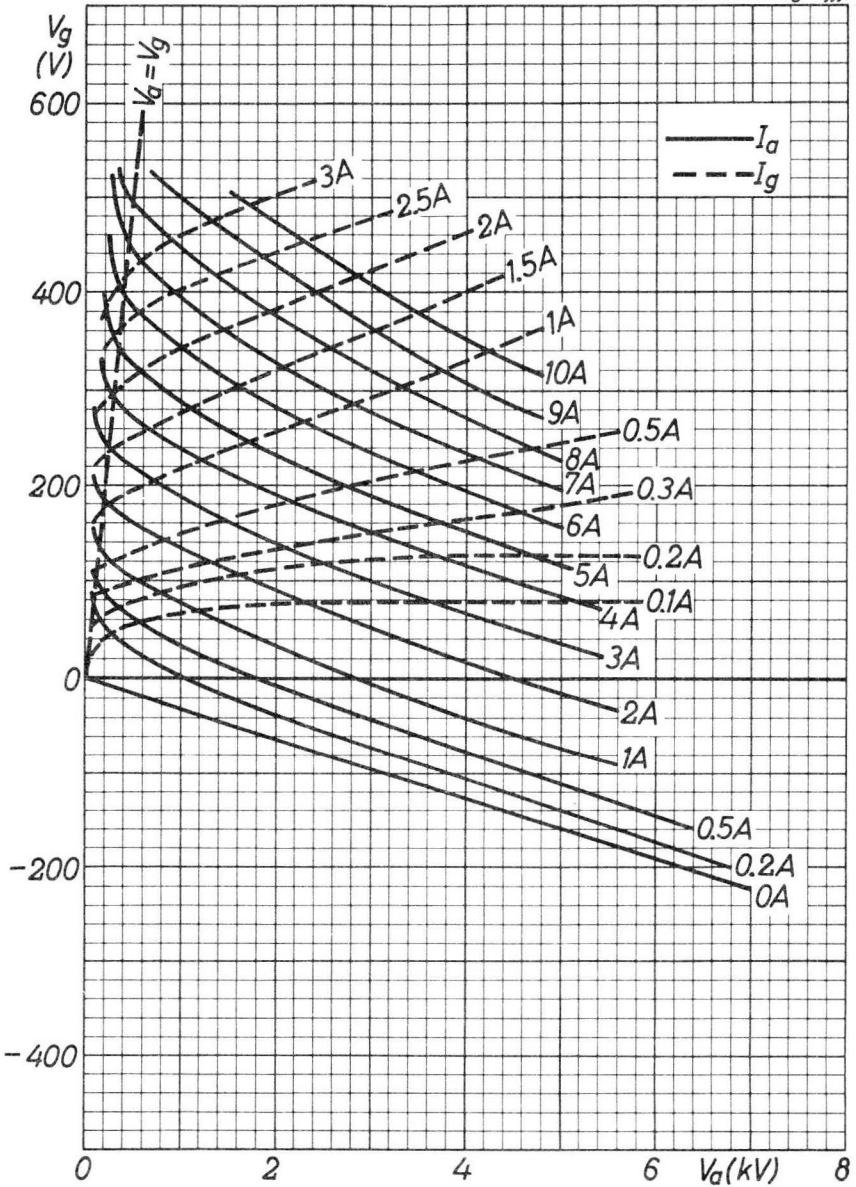
Frequency	f	=	50 MHz
Transformer voltage	$V_{tr}$	=	5100 V <sub>RMS</sub>
Anode voltage	$V_a$	=	6.0 kV
Anode current	$I_a$	=	1.5 A
Grid current	$I_g$	=	0.4 A <sup>1)</sup>
Grid resistor	$R_g$	=	1000 $\Omega$
Grid input power	$W_{ig}$	=	300 W
Anode input power	$W_{ia}$	=	9 kW
Anode dissipation	$W_a$	=	2.7 kW
Output power	$W_o$	=	6 kW <sup>2)</sup>
Efficiency	$\eta$	=	67 %

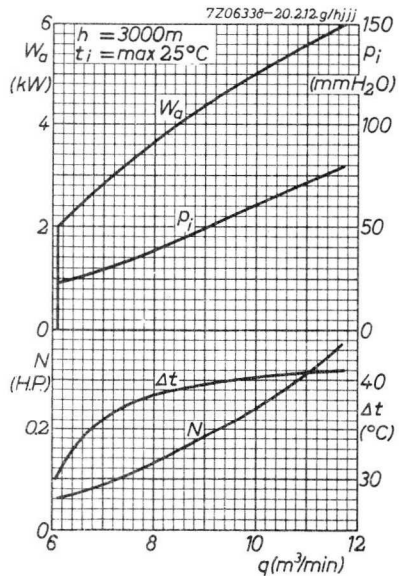
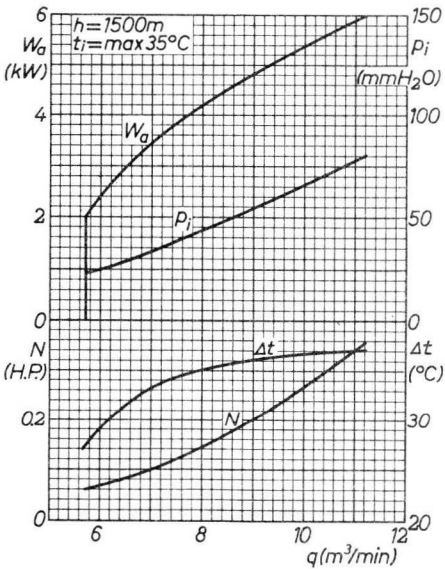
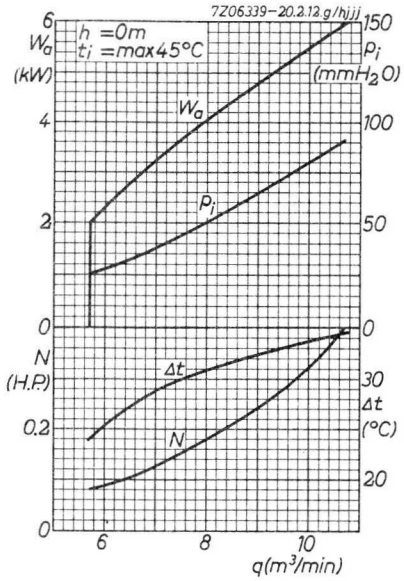
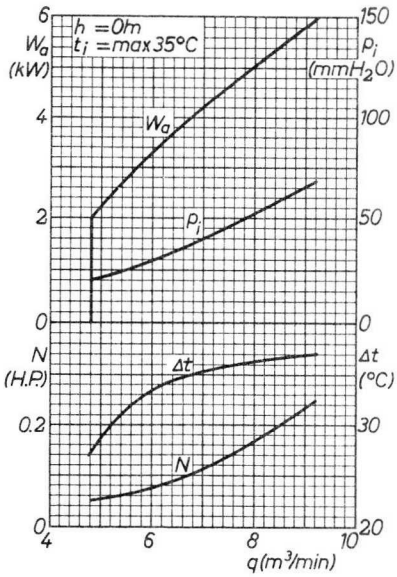
1) Unloaded 0.7 A

2) Available power (load + circuit losses)



7Z00655-20.2.12.g/hjjj.









## AIR COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq.	Three phase	
(MHz)	V <sub>a</sub> (kV)	W <sub>ℓ</sub> <sup>1)</sup> (kW)
50	7.2	6.1
	6.2	5.0



**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	12.6 V	+5 % -10 %
Filament current	I <sub>f</sub>	=	32 A	

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.4 pF
Grid to all other elements except anode	C <sub>g</sub>	=	13.5 pF
Anode to grid	C <sub>ag</sub>	=	7.4 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	6 kV
Anode current	I <sub>a</sub>	=	1 A
Mutual conductance	S	=	12 mA/V
Amplification factor	μ	=	24

<sup>1)</sup> Useful power in the load

**TEMPERATURE LIMITS** (Absolute limits)

Temperature of anode and seals = max. 220 °C

**AIR COOLING CHARACTERISTICS** for continuous service

For intermittent service see figure page A

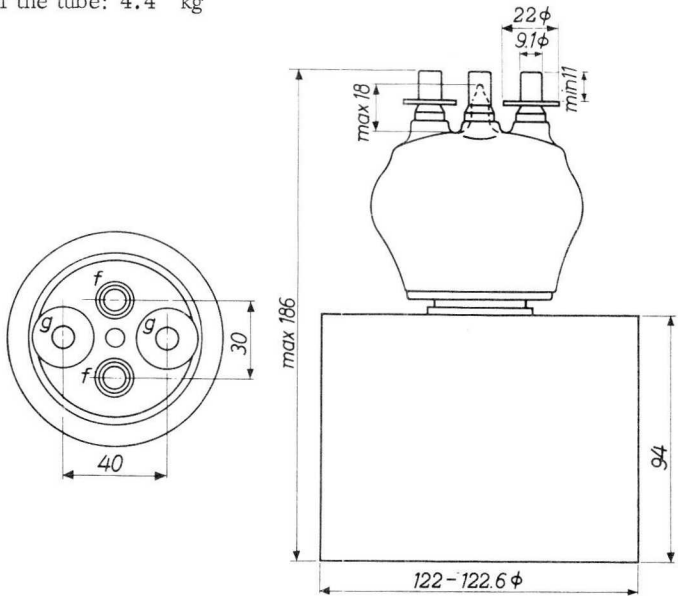
$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
2	0	35	4.8	20
	0	45	5.7	25
	1500	35	5.7	23
	3000	25	6.1	23
4	0	35	6.8	38
	0	45	7.9	49
	1500	35	7.8	42
	3000	25	8.4	42
6	0	35	9.2	68
	0	45	10.7	90
	1500	35	11.2	81
	3000	25	11.7	81

At frequencies above 4 MHz both grid terminals should be connected in parallel. At the highest frequencies care should be taken to distribute the R.F. current equally over both grid terminals to avoid excessive grid seal temperatures.

**MECHANICAL DATA**

Dimensions in mm

Net weight of the tube: 4.4 kg



Connectors for grid and filament 40634

Insulating pedestal 40630



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits), continuous service

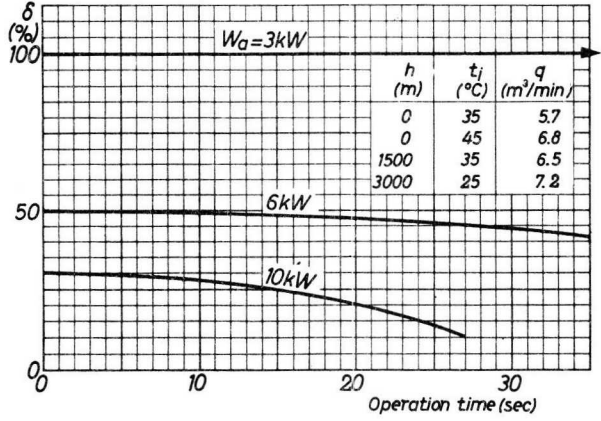
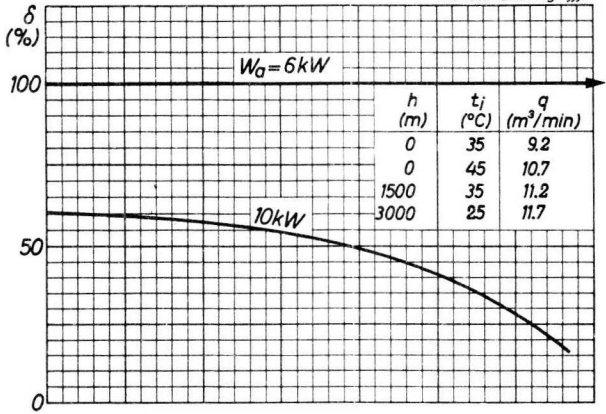
Frequency	f	up to	50 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode input power	$W_{ia}$	= max.	12 kW
Anode dissipation	$W_a$	= max.	6 kW
Anode current	$I_a$	= max.	1.8 A
Negative grid voltage	$-V_g$	= max.	1250 V
Grid current, loaded	$I_g$	= max.	0.4 A
Grid current, unloaded	$I_g$	= max.	0.5 A
Grid circuit resistance	$R_g$	= max.	10 k $\Omega$

**OPERATING CHARACTERISTICS** , continuous service

Frequency	f	=	50	50 MHz
Anode voltage	$V_a$	=	7200	6200 V
Anode current, loaded	$I_a$	=	1.5	1.4 A
Anode current, unloaded	$I_a$	=	0.37	0.40 A
Grid current, loaded	$I_g$	=	0.36	0.37 A
Grid current, unloaded	$I_g$	=	0.47	0.47 A
Grid resistor	$R_g$	=	1850	1500 $\Omega$
Load resistance	$R_{a\sim}$	=	2300	2100 $\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	17	17 %
Anode input power	$W_{ia}$	=	10.8	8.68 kW
Anode dissipation	$W_a$	=	3.3	2.5 kW
Efficiency	$\eta$	=	70	71 %
Output power in the load	$W_p$	=	6.1	5.0 kW <sup>1)</sup>

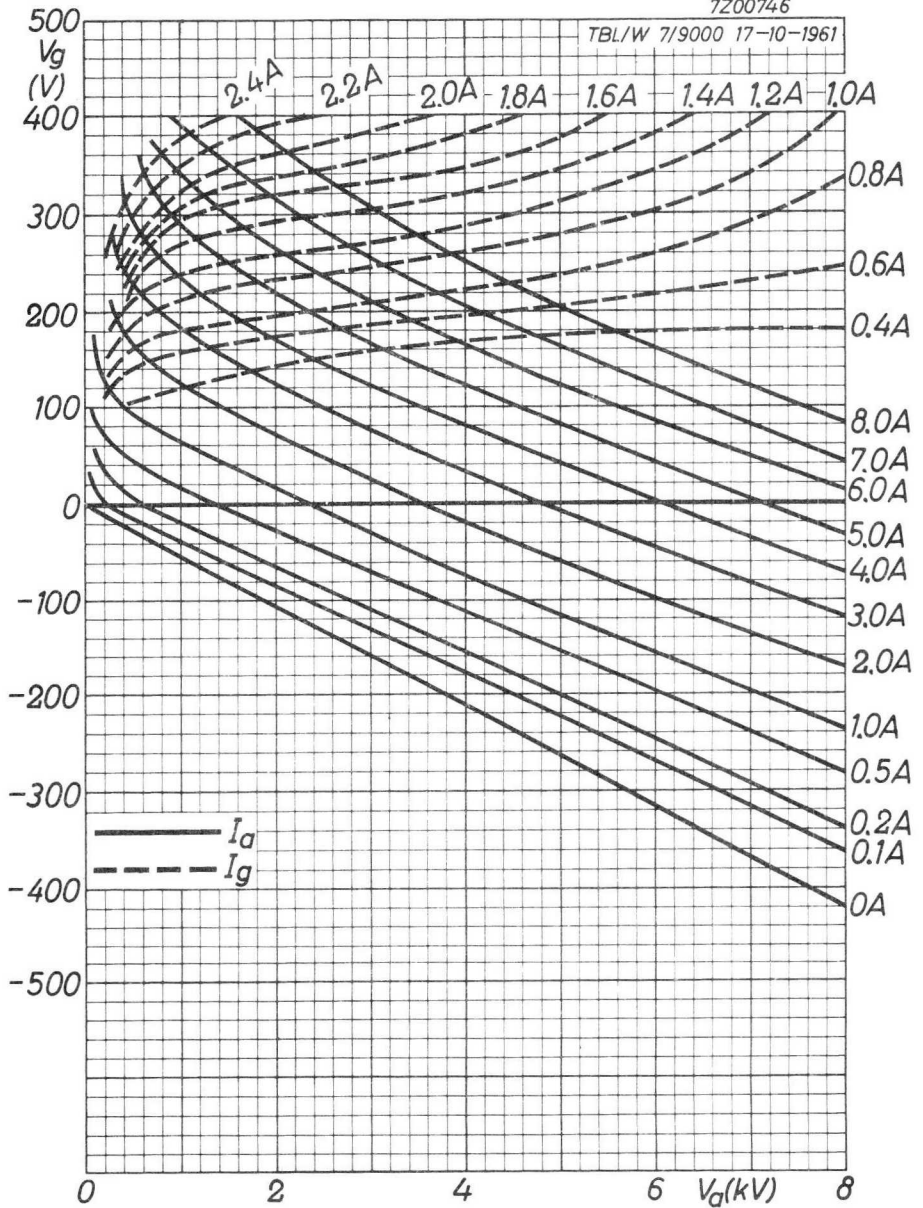
<sup>1)</sup> Useful power in the load, measured in a circuit having an efficiency of 85 %

7204023-20.2.12.g-ijj.



7Z00746

TBL/W 7/9000 17-10-1961



## AIR COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	three phase	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	29.0
	10	23.3
	8	17.9



**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	8.0 V	+ 5 % -10 %
Filament current	I <sub>f</sub>	=	98 A	
Cold filament resistance	R <sub>fo</sub>	=	0.008 Ω	

The filament current must never exceed a peak value of 210 A instantaneously at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.4 pF
Grid to all other elements except anode	C <sub>g</sub>	=	37 pF
Anode to grid	C <sub>ag</sub>	=	30 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	12 kV
Anode current	I <sub>a</sub>	=	2 A
Amplification factor	μ	=	34
Mutual conductance	S	=	20 mA/V

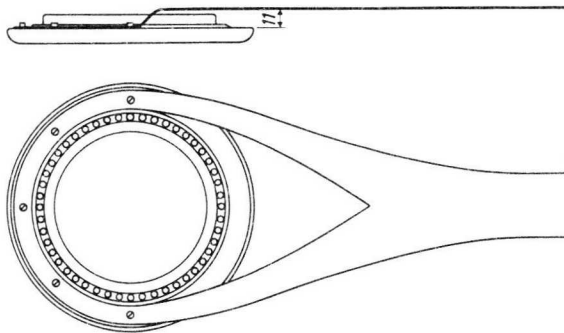
### TEMPERATURE LIMIT (Absolute limit)

Seal temperature = max. 220 °C 7Z2 8674

AIR COOLING CHARACTERISTICS

$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
7	0	35	6.6	10
	0	45	7.7	13
	1500	35	7.9	12
	3000	25	8.3	12
10	0	35	10.5	23
	0	45	12.3	31
	1500	35	12.6	28
	3000	25	13.2	27
15	0	35	18.1	60
	0	45	21.2	79
	1500	35	21.7	73
	3000	25	22.8	70

To ensure a uniform R.F. current distribution in the grid seal especially at frequencies higher than 4 MHz, the grid lead should be connected as shown below

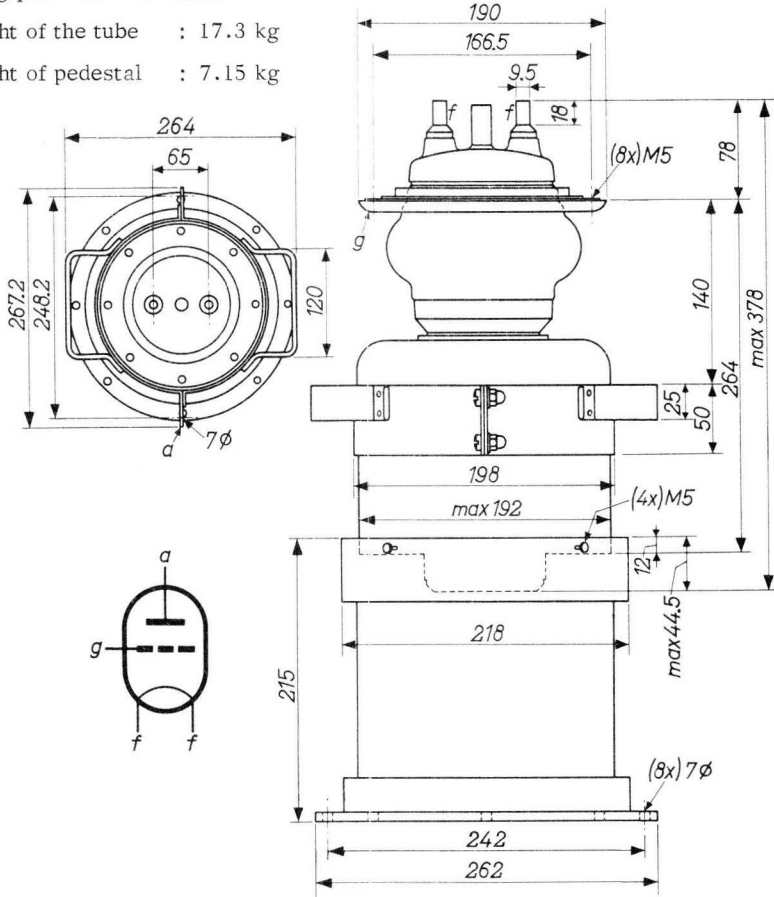




**MECHANICAL DATA**

Dimensions in mm

Filament connectors  
with cable : 40662  
Grid connector : 40663  
Insulating pedestal : 40648  
Net weight of the tube : 17.3 kg  
Net weight of pedestal : 7.15 kg



Mounting position: vertical with anode down

7Z2 8675

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

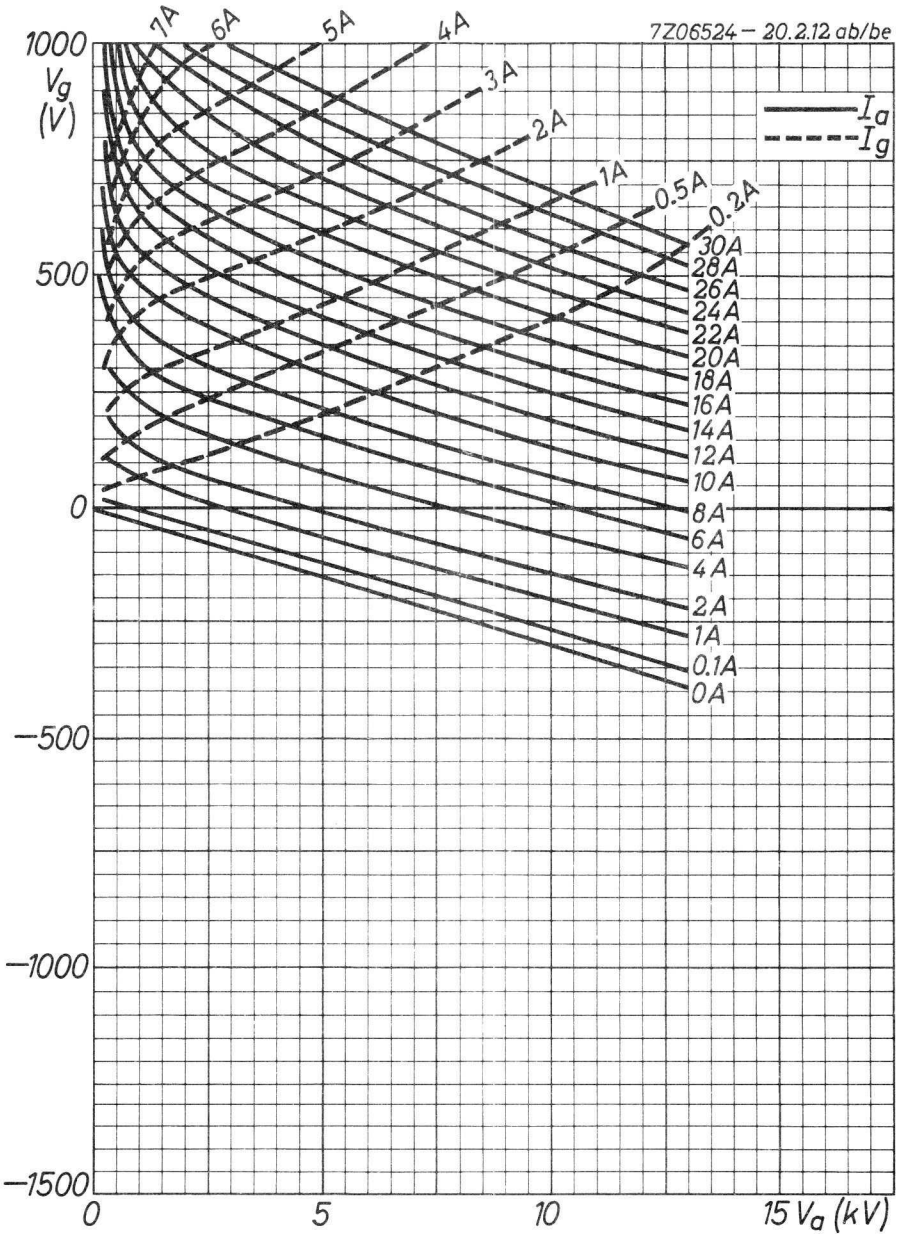
Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	4.8	A
Anode dissipation	$W_a$	= max.	15	kW
Anode input power	$W_{ia}$	= max.	60	kW
Negative grid voltage	$-V_g$	= max.	1500	V
Grid current	$I_g$	= max.	0.8	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**

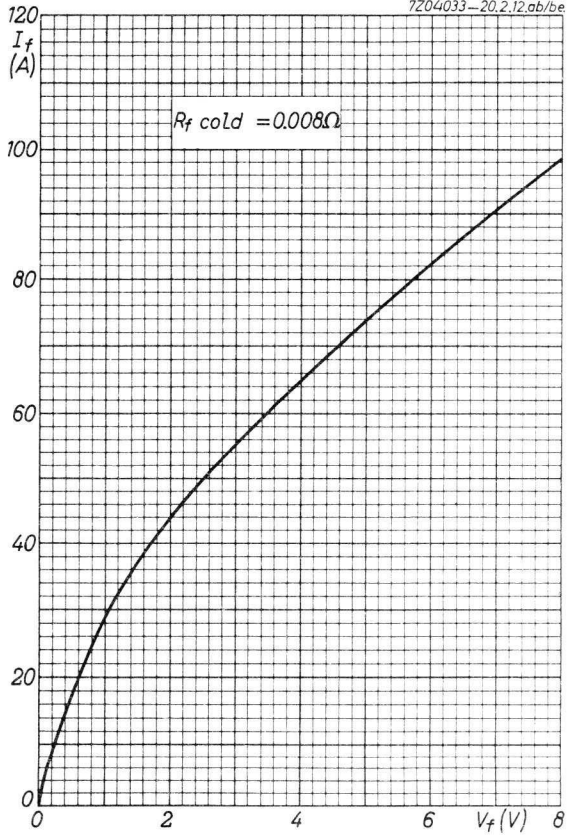
Frequency	f	=	30	30	30	MHz
Transformer voltage	$V_{tr}$	=	8.9	7.4	6.0	kV
Anode voltage	$V_a$	=	12	10	8	kV
Anode current, loaded	$I_a$	=	3.2	3.2	3.2	A
Anode current, unloaded	$I_a$	=	0.52	0.50	0.48	A
Grid current, loaded	$I_g$	=	0.50	0.50	0.50	A
Grid current, unloaded	$I_g$	=	0.74	0.77	0.80	A
Grid resistor	$R_g$	=	2.0	1.6	1.1	k $\Omega$
Load resistance	$R_{a\sim}$	=	1800	1450	1100	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	16	17	19	%
Anode input power	$W_{ia}$	=	38.4	32.0	25.6	kW
Anode dissipation	$W_a$	=	9.4	8.7	7.7	kW
Output power	$W_o$	=	29.0	23.3	17.9	kW
Efficiency	$\eta$	=	75.5	72.5	70	%
Output power in the load	$W_{\varrho}$	=	25	20	15.5	kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load measured in a circuit having an efficiency of about 90%

7Z06524 - 20.2.12 ab/be



7204033-20.2.12.ab/be



## AIR COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	three phase	
	$V_a$ (kV)	$W_o$ (kW)
30	12	39
	10	31.3
	8	23.2

**HEATING:** direct; filament thoriated tungsten

Filament voltage	$V_f$	$=$	8 V	$+ 5\%$ $-10\%$
Filament current	$I_f$	$=$	130 A	
Cold filament resistance	$R_{fo}$	$=$	0.006 $\Omega$	

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	$C_a$	$=$	0.9 pF
Grid to all other elements except anode	$C_g$	$=$	45 pF
Anode to grid	$C_{ag}$	$=$	23.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	$=$	12 kV
Anode current	$I_a$	$=$	2 A
Mutual conductance	$S$	$=$	25 mA/V
Amplification factor	$\mu$	$=$	21

### TEMPERATURE LIMITS (Absolute limits)

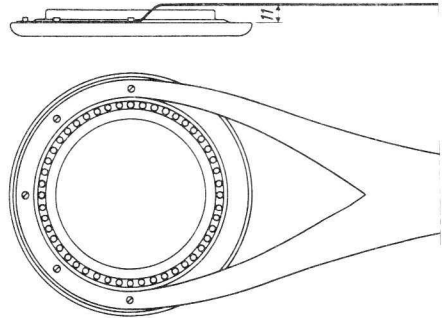
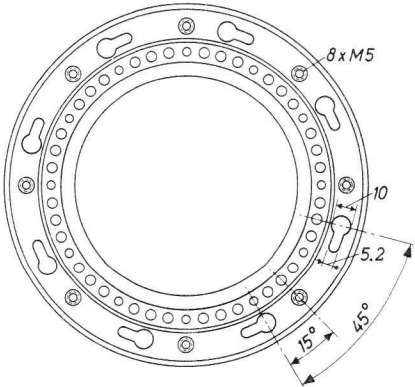
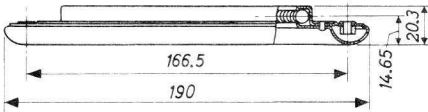
Temperature of all seals = max. 220 °C

**AIR COOLING CHARACTERISTICS** See also cooling curves on page 8

$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
7	0	35	6.6	10
	0	45	7.7	13
	1500	35	7.9	12
	3000	25	8.3	12
10	0	35	10.5	23
	0	45	12.3	31
	1500	35	12.6	28
	3000	25	13.2	27
15	0	35	18.1	60
	0	45	21.2	79
	1500	35	21.7	73
	3000	25	22.8	70

**MECHANICAL DATA**

Dimensions in mm



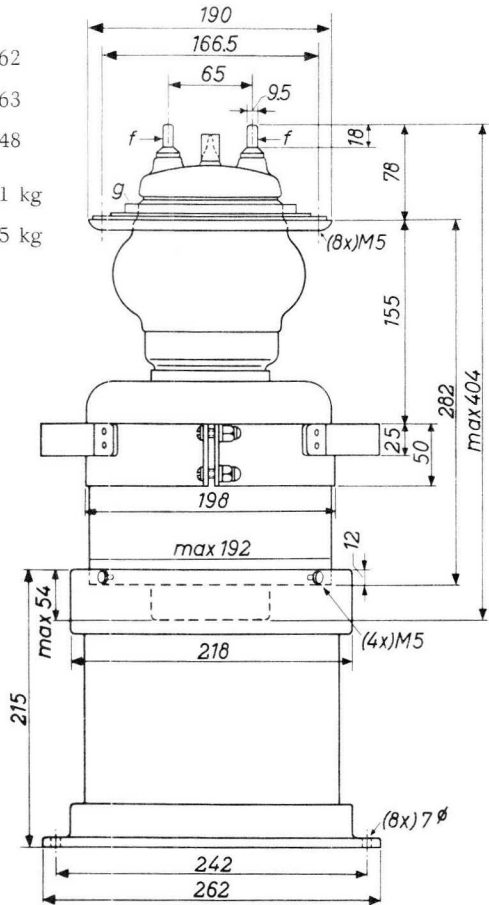
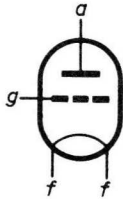
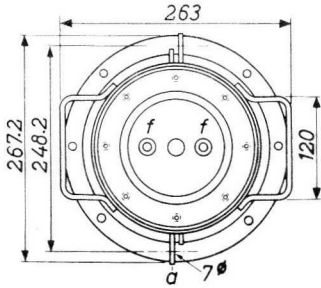
Grid connector 40663

Connection of the grid lead

The rounded side of the grid connector should face the anode. To ensure a uniform RF current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown in the figure at right.

**MECHANICAL DATA** (continued)

Filament connectors	: 40662
Grid connector	: 40663
Insulating pedestal	: 40648
Net weight of tube	: 16.1 kg
Net weight of pedestal	: 7.15 kg



Mounting position : vertical

Dimensions in mm

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits)

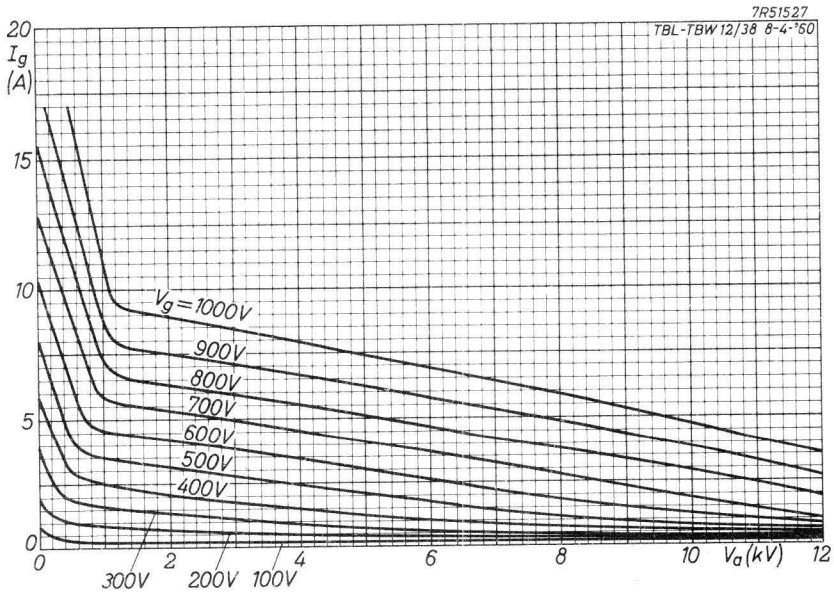
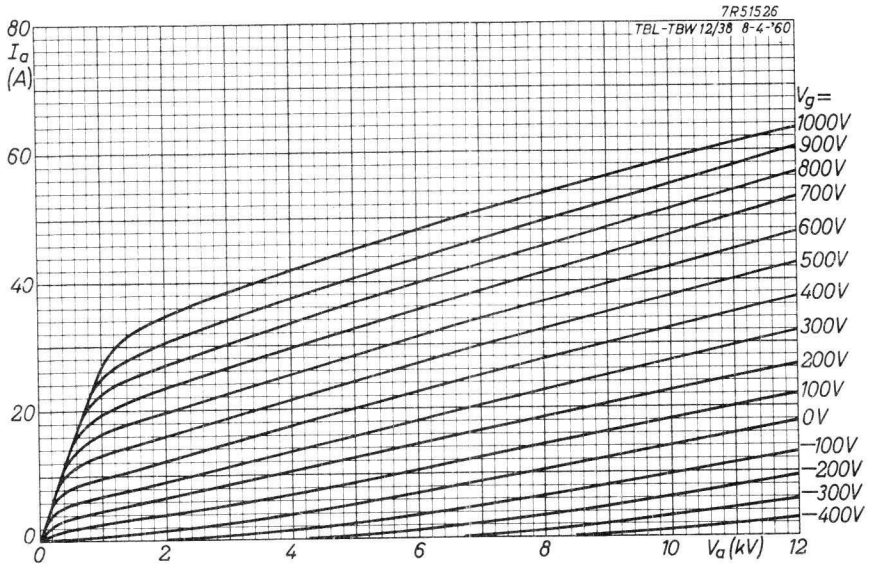
Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	5	A
Anode dissipation	$W_a$	= max.	15	kW
Anode input power	$W_{ia}$	= max.	60	kW
Negative grid voltage	$-V_g$	= max.	2	kV
Grid current, loaded	$I_g$	= max.	1.5	A
Grid current, unloaded	$I_g$	= max.	2.0	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

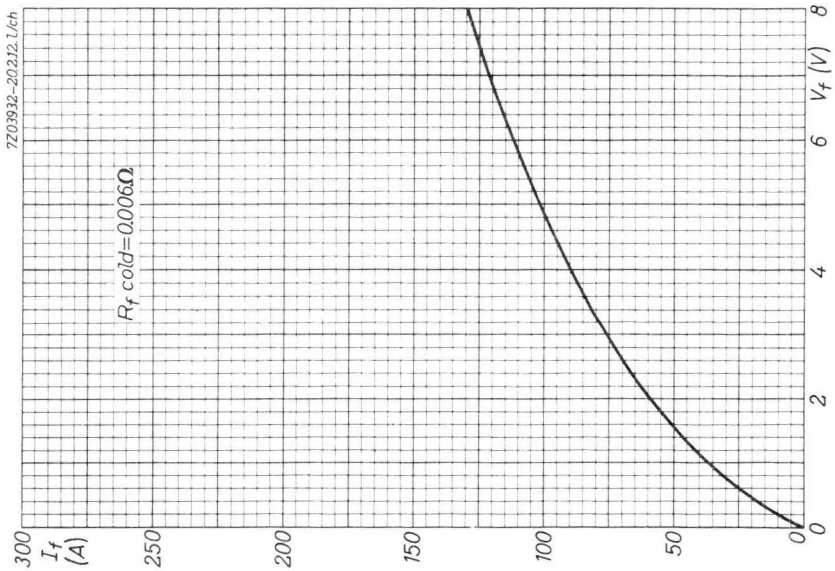
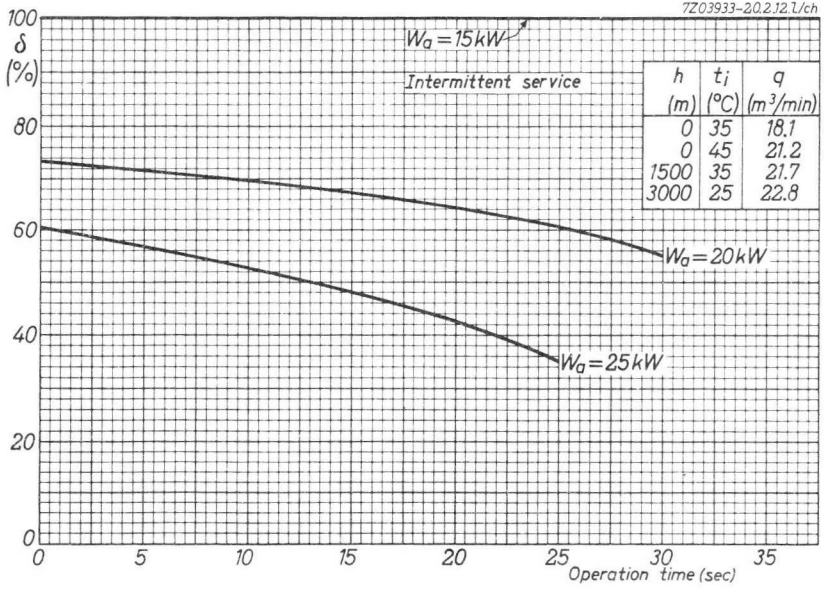
**OPERATING CONDITIONS**

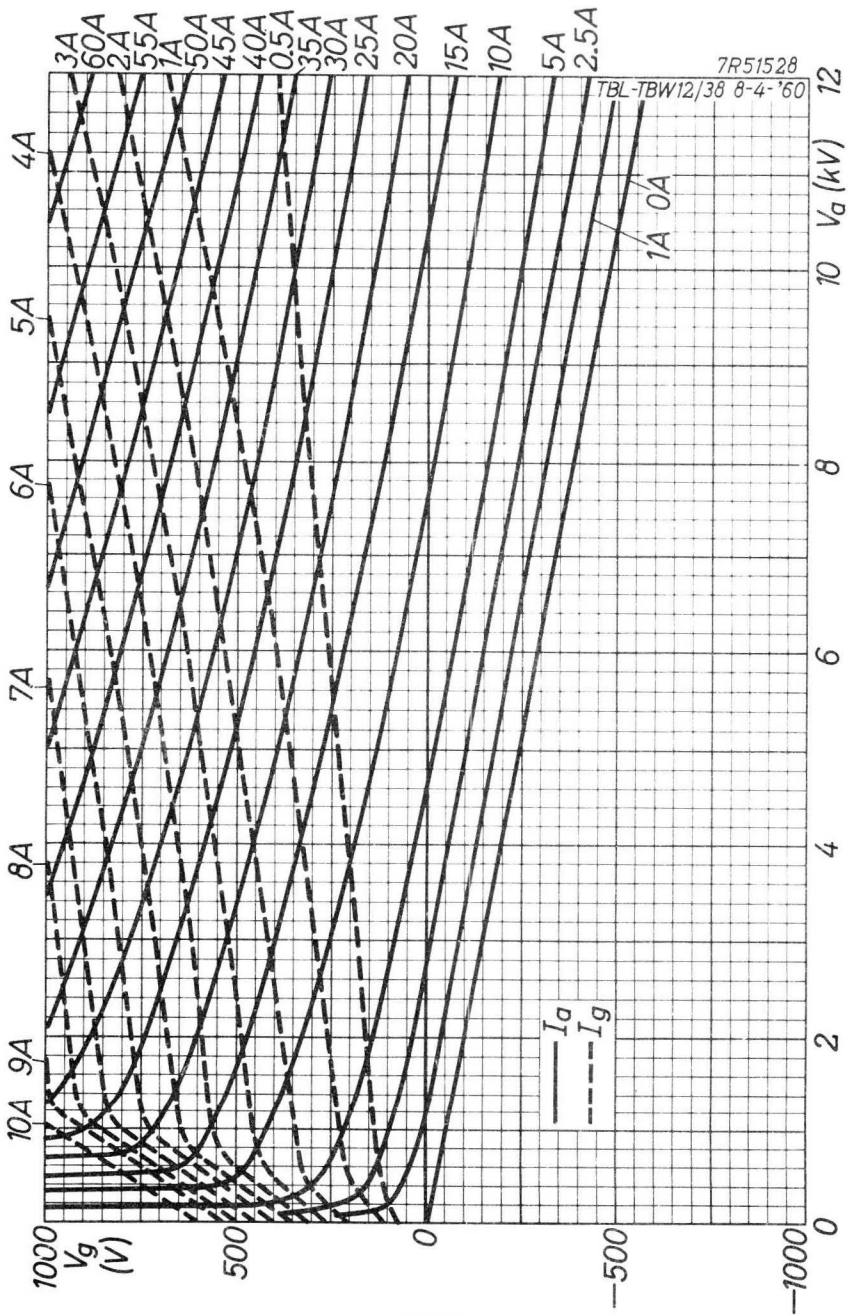
Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	12	10	8	kV
Anode current, loaded	$I_a$	=	4.5	4.5	4.5	A
Anode current, unloaded	$I_a$	=	0.65	0.63	0.62	A
Grid current, loaded	$I_g$	=	0.9	0.9	0.9	A
Grid current, unloaded	$I_g$	=	1.22	1.3	1.35	A
Grid resistor	$R_g$	=	1100	1000	900	$\Omega$
Load resistance	$R_{a\sim}$	=	1450	1100	800	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	16	19	24	%
Anode input power	$W_{ia}$	=	54	45	36	kW
Anode dissipation	$W_a$	=	15	13.7	12.8	kW
Output power	$W_o$	=	39	31.3	23.2	kW
Efficiency	$\eta$	=	72.5	70	64.5	%
Output power in the load	$W_l$	=	30	25	18	kW <sup>1)</sup>

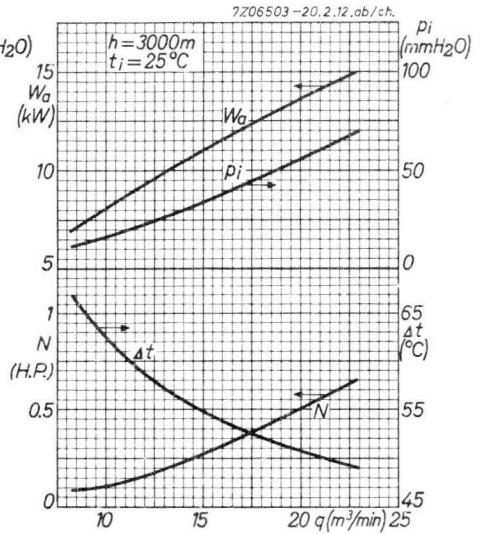
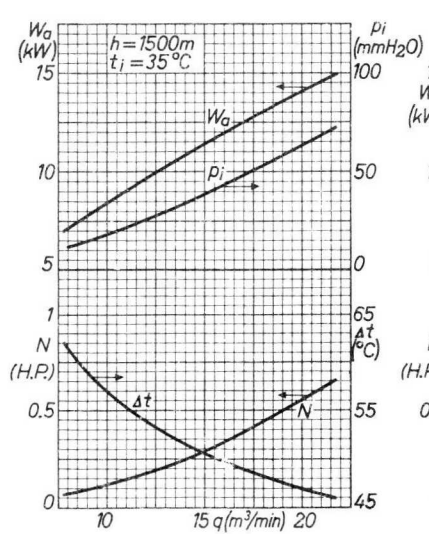
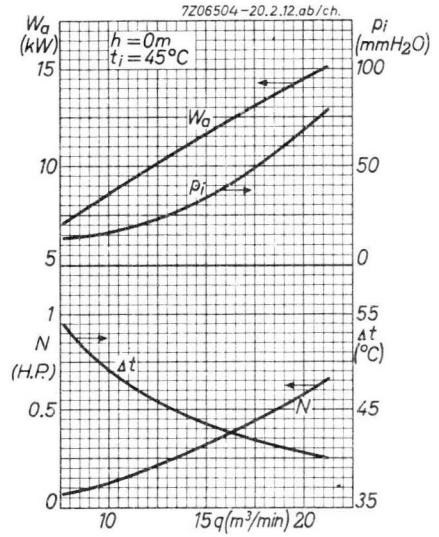
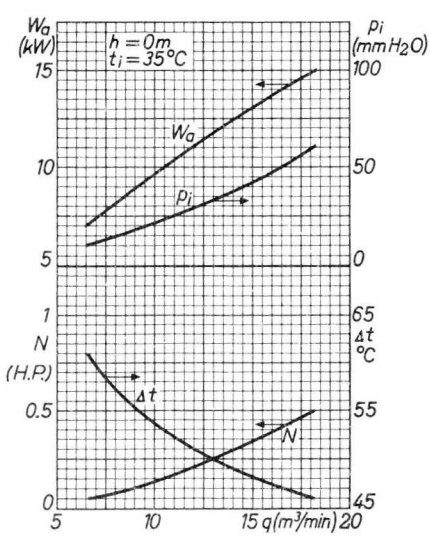
<sup>1)</sup> Useful power in the load, measured in a circuit having an efficiency of about 85%.











## AIR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA						
Freq. (MHz)	C telegr.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	41	10	27.5	10	19.2

**HEATING:** direct; filament thoriated tungsten

Filament voltage  $V_f = 8$  V

Filament current  $I_f = 130$  A

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

## CAPACITANCES

Anode to all other elements except grid  $C_a = 0.6$  pF

Grid to all other elements except anode  $C_g = 45$  pF

Anode to grid  $C_{ag} = 27$  pF

## TYPICAL CHARACTERISTICS

Anode voltage  $V_a = 12$  kV

Anode current  $I_a = 2$  A

Mutual conductance  $S = 25$  mA/V

Amplification factor  $\mu = 33$

## TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals = max. 220 °C

<sup>1)</sup> Two tubes

AIR COOLING CHARACTERISTICS

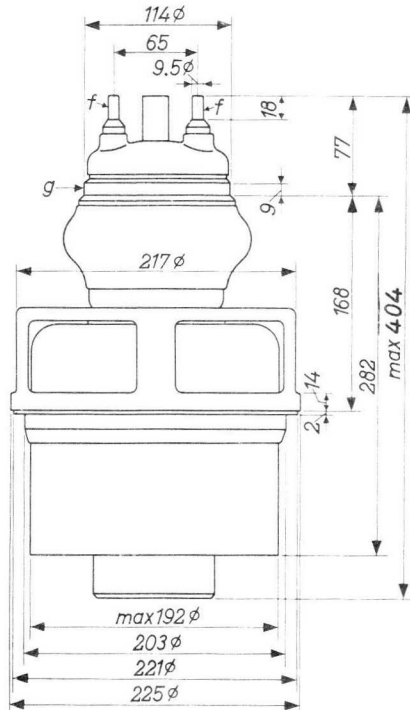
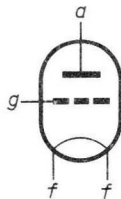
$W_a$ (kW)	h (m)	$t_1$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	Pi (mm H <sub>2</sub> O)
7	0	35	6.6	10
	0	45	7.7	13
	1500	35	7.9	12
	3000	25	8.3	12
10	0	35	10.5	23
	0	45	12.3	31
	1500	35	12.6	28
	3000	25	13.2	27
15	0	35	18.1	60
	0	45	21.2	79
	1500	35	21.7	73
	3000	25	22.8	70

MECHANICAL DATA

Dimensions in mm

Net weight of tube : 19 kg

Net weight of pedestal: 7.15 kg



Mounting position: vertical

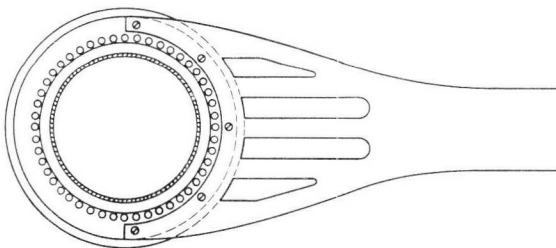
**ACCESSORIES**

Dimensions in mm

Connectors with cable for filament:	40662
Insulating pedestal	40648
Grid connector	40663



The rounded side of the grid connector should face the anode. To ensure a uniform R.F. current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown below



**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES (Absolute limits)**

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode input power	$W_{ia}$	= max.	60	kW
Anode dissipation	$W_a$	= max.	15	kW
Anode current	$I_a$	= max.	4.8	A
Negative grid voltage	$-V_g$	= max.	1500	V
Grid current	$I_g$	= max.	1.0	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	30	MHz
Anode voltage	$V_a$	=	12	kV
Grid voltage	$V_g$	=	-1000	V
Anode current	$I_a$	=	4.5	A
Grid current	$I_g$	=	0.8	A
Peak grid A.C. voltage	$V_{gp}$	=	1600	V
Grid input power	$W_{ig}$	=	1150	W
Anode input power	$W_{ia}$	=	54	kW
Anode dissipation	$W_a$	=	13	kW
Output power	$W_o$	=	41	kW
Efficiency	$\eta$	=	76	%



## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	10	kV <sup>1)</sup>
Anode input power	$W_{ia}$	= max.	40	kW
Anode dissipation	$W_a$	= max.	10	kW
Anode current	$I_a$	= max.	3.8	A
Negative grid voltage	$-V_g$	= max.	1500	V
Grid current	$I_g$	= max.	1.0	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

## OPERATING CONDITIONS

Frequency	f	=	30	MHz
Anode voltage	$V_a$	=	10	kV
Grid voltage	$V_g$	=	-1000	V <sup>2)</sup>
Anode current	$I_a$	=	3.5	A
Grid current	$I_g$	=	0.8	A
Peak grid A.C. voltage	$V_{gp}$	=	1500	V
Grid input power	$W_{ig}$	=	1080	W
Anode input power	$W_{ia}$	=	35	kW
Anode dissipation	$W_a$	=	7.5	kW
Output power	$W_o$	=	27.5	kW
Efficiency	$\eta$	=	78.5	%
Modulation factor	m	=	100	%
Modulation power	$W_{mod}$	=	17.5	kW

<sup>1)</sup> With 120% modulation and 3000 m above sea level

<sup>2)</sup> Grid bias partially obtained by a grid resistor

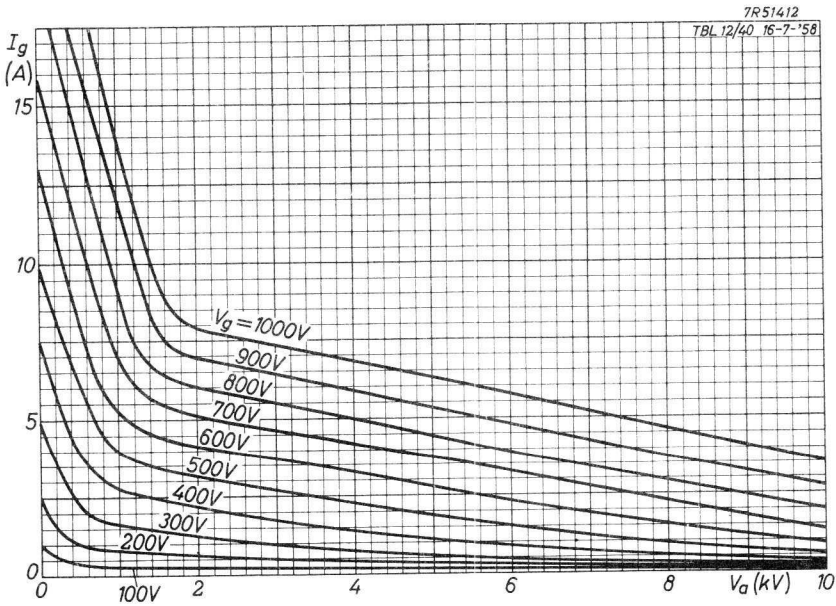
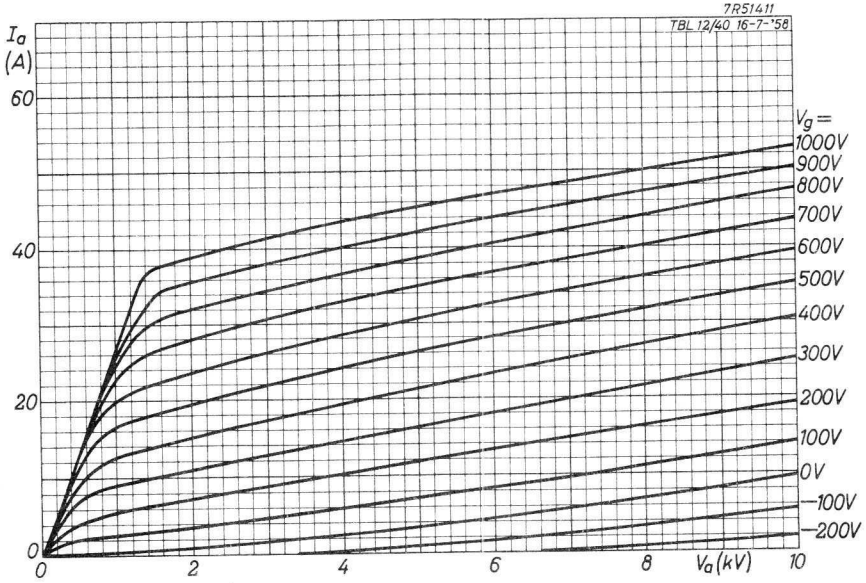
**A.F. CLASS B AMPLIFIER AND MODULATOR** (especially for use with a cathode-follower)

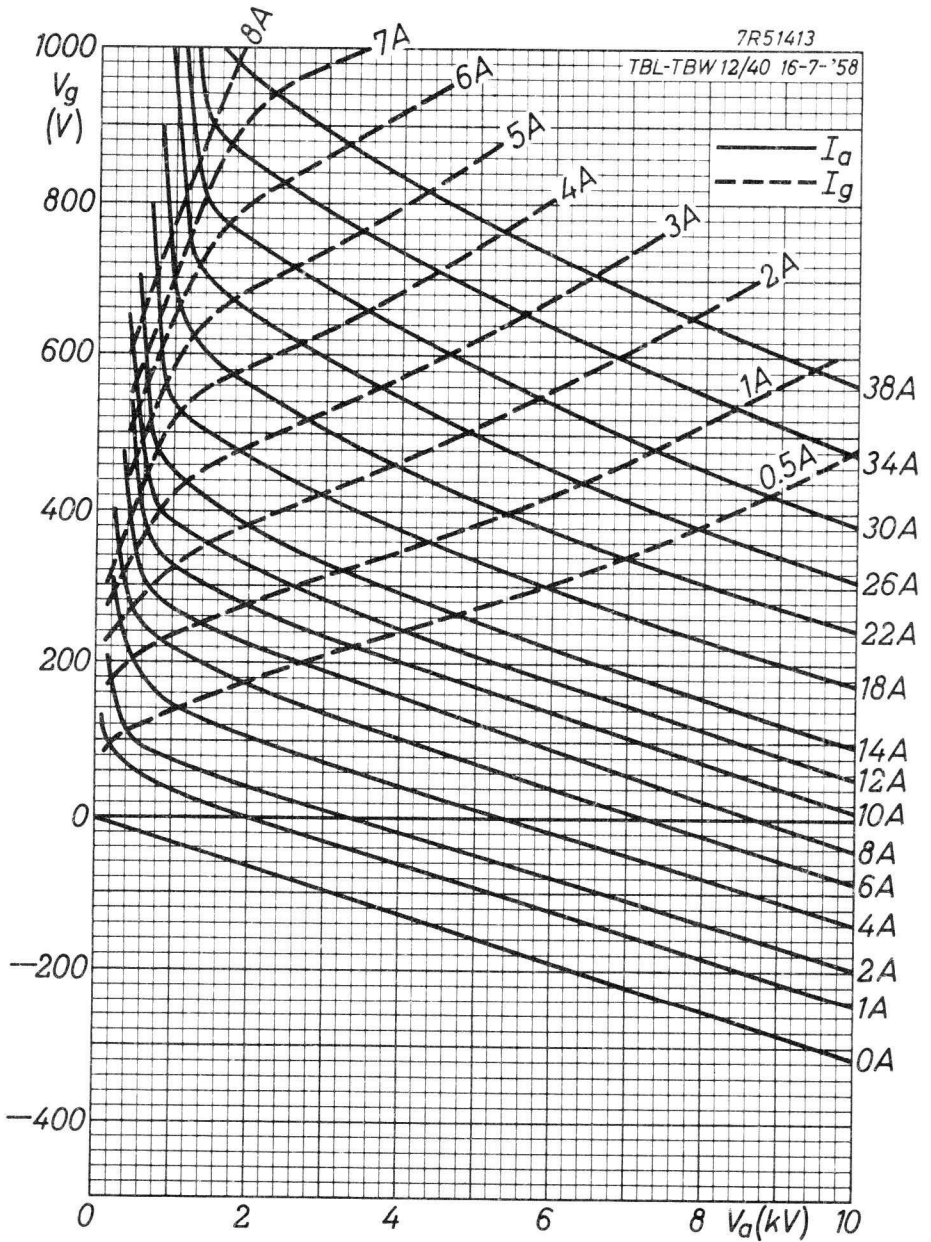
**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	= max.	13	kV
Anode input power	$W_{ia}$	= max.	60	kW
Anode dissipation	$W_a$	= max.	15	kW
Anode current	$I_a$	= max.	4.5	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**, two tubes

Anode voltage	$V_a$	=	10	kV
Grid voltage	$V_g$	=	-290	V
Load resistance	$R_{aa} \sim$	=	6240	$\Omega$
Peak grid to grid A.C. voltage	$V_{ggp}$	=	0	900 V
Anode current	$I_a$	=	2x0.1	2x1.6 A
Grid current	$I_g$	=	0	2x0.035 A
Peak grid current	$I_{gp}$	=	-	2x0.24 A
Grid input power	$W_{ig}$	=	0	2x14 W
Anode input power	$W_{ia}$	=	2x1.0	2x16 kW
Anode dissipation	$W_a$	=	2x1.0	2x6.4 kW
Output power	$W_o$	=	0	19.2 kW
Efficiency	$\eta$	=	-	60 %





## AIR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA							
General purposes							
$\lambda$ (m)	Freq. (MHz)	C telegr.		C an.mod.		B mod. 1)	
		$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)
20	15	12	108	10	80	12	202
15	20	12	94.5	10	54.5	10	116
12	25	11	70	9	42.5	10	77
11	27.5	10.5	59	8.5	36.5	9	62
10	30	10	50	8	31	8.5	54
						8	46.8
Television service							
Freq. (MHz)		Neg. mod., pos. sync. 1)					
		$V_a$ (kV)			$W_o$ sync (kW)		
48-68		6.5			100 2)		

**HEATING:** direct; filament thoriated tungsten

Filament voltage	$V_f = 17.5$ V
Filament current	$I_f = 196$ A
Cold filament resistance	$R_{fo} = 0.012$ $\Omega$

The filament current must never exceed a peak value of 420 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	$C_a = 3.4$ pF
Grid to all other elements except anode	$C_g = 116$ pF
Anode to grid	$C_{ag} = 86$ pF

1) Two tubes

2) Power transferred from driving stage included

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**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a$	=	3	10	kV
Anode current	$I_a$	=	50	5	A
Amplification factor	$\mu$	=	-	27	
Mutual conductance	$S$	=	-	50	mA/V
Maximum mutual conductance	$S_{max}$	=	92	-	mA/V

**TEMPERATURE LIMITS** (Absolute limits)

Temperature of seals = max. 180 °C

**AIR COOLING CHARACTERISTICS;** see also cooling curves

$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$p_i$ (mm H <sub>2</sub> O)
30	0	35	35	114
	0	45	40	143
	1500	35	42	136
	3000	25	44	132
45	0	35	54	275
	0	45	62.5	335
	1500	35	64.5	322
	3000	25	68	319

When the tube is used at frequencies above 6 MHz, special attention must be paid to the anode and grid-seal temperatures.

Cooling of these seals is effected by air flowing through the slots provided at the top of the cooler housing. In certain cases, e.g. at low anode dissipation and with cooling by the minimum quantity of air (according to the cooling curves), the air flow to the seals will not be sufficient to maintain the seal temperatures below the maximum permissible value at frequencies above 6 MHz.

Consequently, in these cases, a larger quantity of air must be supplied.

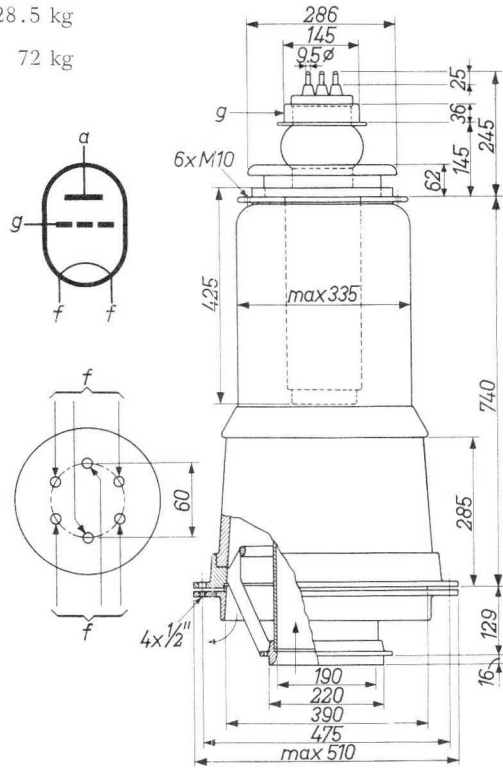
When using the special filament connectors type No. 40628, together with connecting leads of adequate cross-section, additional air cooling of the filament terminals is, as a rule, not necessary.

Care should be taken to ensure firm contact of the filament terminals in order to obtain equal distribution of current over these terminals.

**MECHANICAL DATA**

Dimensions in mm

- Clips for filament : 40628
- Cooler housing : K506
- Net weight of the tube: 28.5 kg
- Net weight of K506 : 72 kg



Tube mounted in cooler housing type K506

Mounting position: vertical with anode down

When connecting the filament the three pins of each group must be joined

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	4	15	30	MHz
Anode voltage	$V_a$	max.	15	13.5	10	kV
Anode current	$I_a$	max.	12	12	10	A
Anode input power	$W_{ia}$	max.	162	162	80	kW
Anode dissipation	$W_a$	max.		45		kW
Negative grid voltage	$-V_g$	max.		1200		V
Grid current	$I_g$	max.		3		A

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	20	15	12	11	10	m
Frequency	f	=	15	20	25	27.5	30	MHz
Anode voltage	$V_a$	=	12	12	11	10.5	10	kV
Grid voltage	$V_g$	=	-1000	-1000	-900	-850	-800	V
Anode current	$I_a$	=	12	10.5	8.5	7.5	6.7	A
Grid current	$I_g$	=	2.25	2	1.6	1.5	1.4	A
Peak grid A.C. voltage	$V_{gp}$	=	1700	1650	1450	1350	1300	V
Grid input power	$W_{ig}$	=	3.5	3	2.1	1.9	1.7	kW
Anode input power	$W_{ia}$	=	144	126	93.5	79	67	kW
Anode dissipation	$W_a$	=	36	31.5	23.5	20	17	kW
Output power	$W_o$	=	108	94.5	70	59	50	kW
Efficiency	$\eta$	=	75	75	75	75	75	%



R.F. CLASS C ANODE MODULATION

LIMITING VALUES (Absolute limits)

Frequency	f	up to	15	20	30	MHz
Anode voltage	$V_a$	= max.	10	10	8	kV
Anode input power	$W_{ia}$	= max.	105	80	50	kW
Anode dissipation	$W_a$	=	max. 30			kW
Anode current	$I_a$	=	max. 10.5			A
Negative grid voltage	$-V_g$	=	max. 1200			V
Grid current	$I_g$	=	max. 3.5			A



OPERATING CONDITIONS

f	=	15	15	20	25	27.5	30	MHz
$V_a$	=	10	10	10	9	8.5	8	kV
$V_g$	=	-1050	-1050	-1050	-925	-900	-850	V <sup>1)</sup>
$I_a$	=	10.5	8.5	7.0	6.2	5.7	5.25	A
$I_g$	=	3.5	2.6	2.0	2.0	1.9	1.8	A
$V_{gp}$	=	1960	1750	1650	1500	1450	1400	V
$W_{ig}$	=	6.2	4.1	3.0	2.7	2.5	2.3	kW
$W_{ia}$	=	105	85	70	56	48.5	42	kW
$W_a$	=	25	17	15.5	13.5	12	11	kW
$W_o$	=	80	68	54.5	42.5	36.5	31	kW
$\eta$	=	76	80	78	76	75	74	%
m	=	100	100	100	100	100	100	%
$W_{mod}$	=	52.5	42.5	35	28	24.5	21	kW

1) Grid bias partially obtained by the grid resistor

**A.F. CLASS B AMPLIFIER AND MODULATOR**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a = \text{max.}$	15	kV
Anode current	$I_a = \text{max.}$	12	A
Anode input power	$W_{ia} = \text{max.}$	162	kW
Anode dissipation	$W_a = \text{max.}$	45	kW
Grid circuit resistance	$R_g = \text{max.}$	20	k $\Omega$

**OPERATING CONDITIONS**, two tubes

$V_a =$	12	10	10	kV
$V_g =$	-450	-375	-400	V
$R_{aa\sim} =$	1200	1500	2060	$\Omega$
$V_{ggp} =$	0 2060	0 1680	0 1460	V
$I_a =$	2x0.65 2x12	2x0.5 2x7.9	2x0.2 2x5.4	A
$I_g =$	0 2x2.5	0 2x1.9	0 2x0.7	A
$W_{ig} =$	0 2x2.4	0 2x1.44	0 2x0.5	kW
$W_{ia} =$	2x7.8 2x144	2x5 2x79	2x2 2x54	kW
$W_a =$	2x7.8 2x43	2x5 2x21	2x2 2x15.5	kW
$W_o =$	0 202	0 116	0 77	kW
$\eta =$	- 70	- 75	- 71	%

$V_a =$	9	8.5	8	kV
$V_g =$	-350	-325	-300	V
$R_{aa\sim} =$	2080	2120	2210	$\Omega$
$V_{ggp} =$	0 1300	0 1200	0 1120	V
$I_a =$	2x0.25 2x4.8	2x0.25 2x4.4	2x0.25 2x4.1	A
$I_g =$	0 2x0.65	0 2x0.55	0 2x0.4	A
$W_{ig} =$	0 2x0.4	0 2x0.3	0 2x0.25	kW
$W_{ia} =$	2x2.25 2x43.2	2x2.1 2x37.4	2x2 2x32.8	kW
$W_a =$	2x2.25 2x12.2	2x2.1 2x10.4	2x2 2x9.4	kW
$W_o =$	0 62	0 54	0 46.8	kW
$\eta =$	- 72	- 72	- 71	%

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**R.F. CLASS B AMPLIFIER** for television service, negative modulation, positive synchronisation

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	68	MHz
Anode voltage	$V_a$	= max.	6.5	kV
Anode current	$I_a$	sync = max.	16	A
Anode input power	$W_{ia}$	sync = max.	100	kW
Anode dissipation	$W_a$	sync = max.	50	kW
Grid current	$I_g$	sync = max.	2	A

**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	=	48 to 68	MHz <sup>1)</sup>
Bandwidth (-1.5 dB)	B	=	5.5	MHz <sup>2)</sup>
Bandwidth (-3 dB)	B	=	7.5	MHz <sup>2)</sup>
Anode voltage	$V_a$	=	6.5	kV
Grid voltage	$V_g$	=	-250	V
Peak grid to grid A.C. voltage	$V_{ggp}$	sync =	1740	V <sup>3)</sup>
		black =	1300	V <sup>3)</sup>
Anode current	$I_a$	sync =	32	A
		black =	24	A
Grid current	$I_g$	sync =	3.4	A
		black =	2.2	A
Grid input power	$W_{ig}$	sync =	22.4	kW <sup>4)</sup>
Output power	$W_o$	sync =	80+20	kW <sup>5)</sup>
		black =	45+11	kW <sup>5)</sup>

<sup>1)</sup> In the frequency range of 60 to 68 MHz a special version of the tube is necessary.

<sup>2)</sup> This value of bandwidth is based on measurements on a circuit with a single LC section

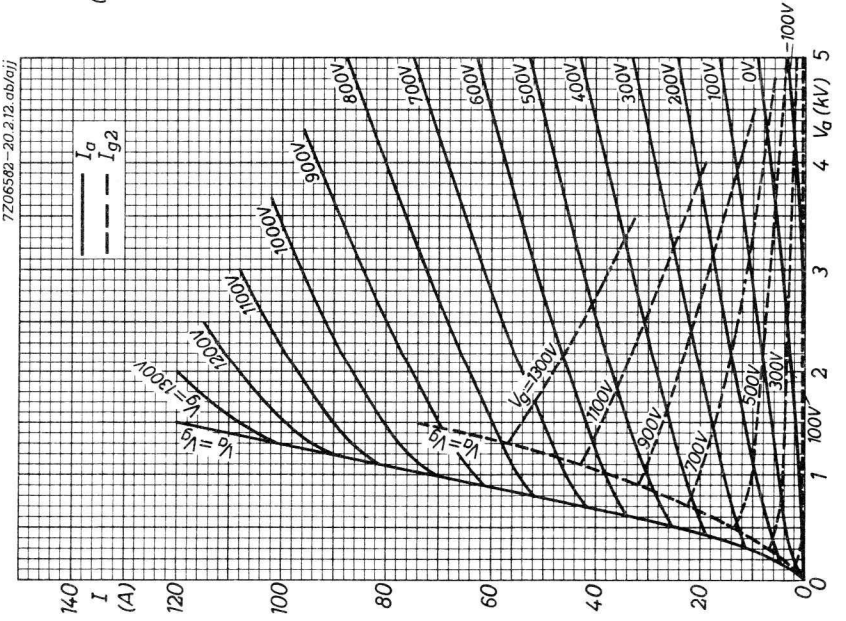
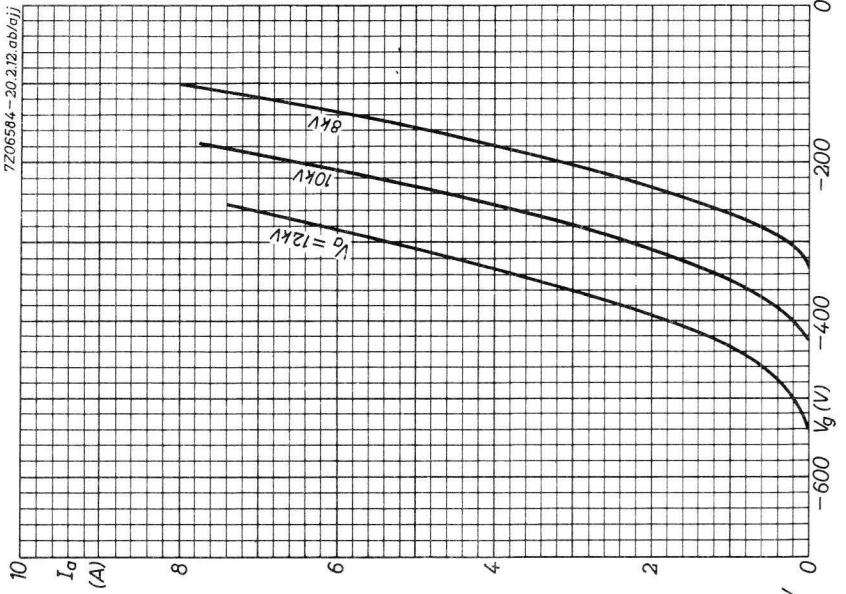
<sup>3)</sup> Measured by the slide back method

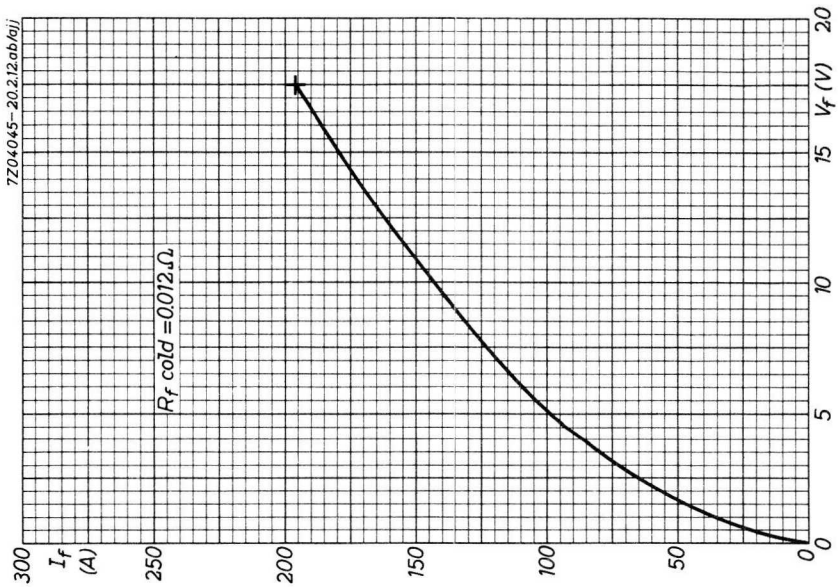
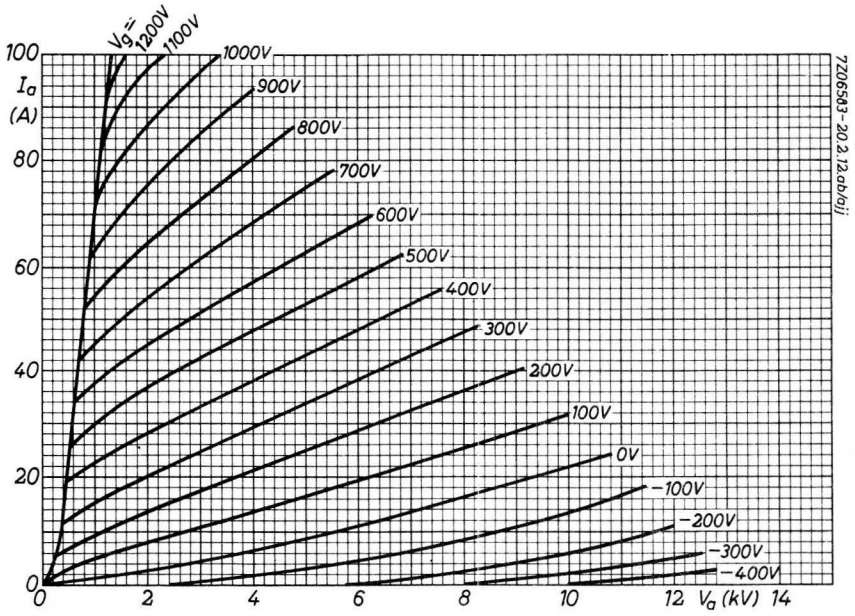
<sup>4)</sup> Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power.

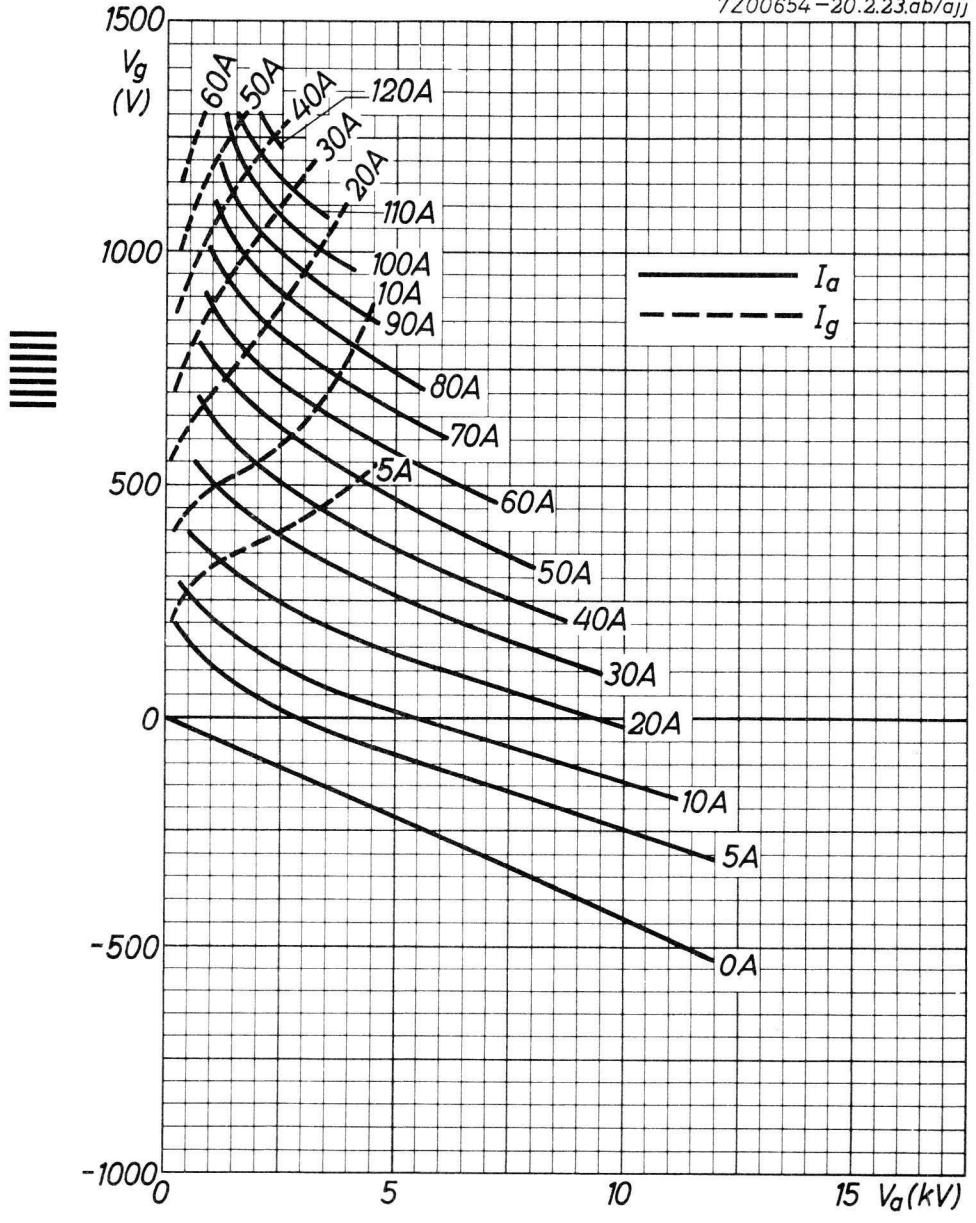
<sup>5)</sup> Power transferred from driving stage included.

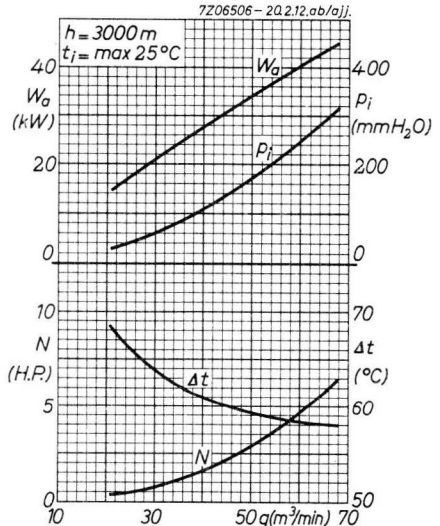
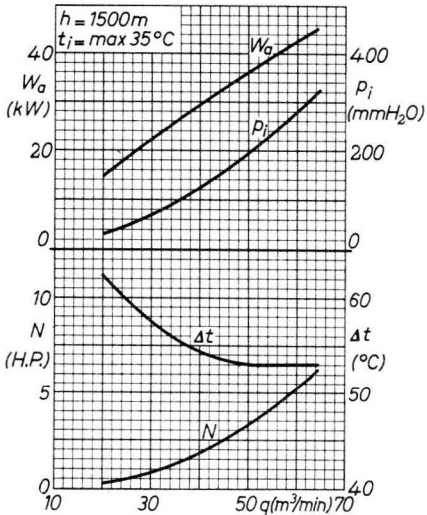
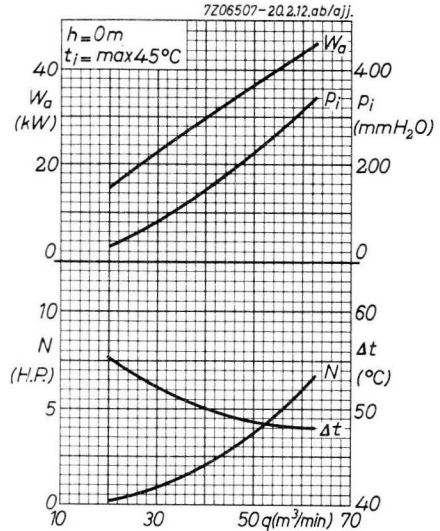
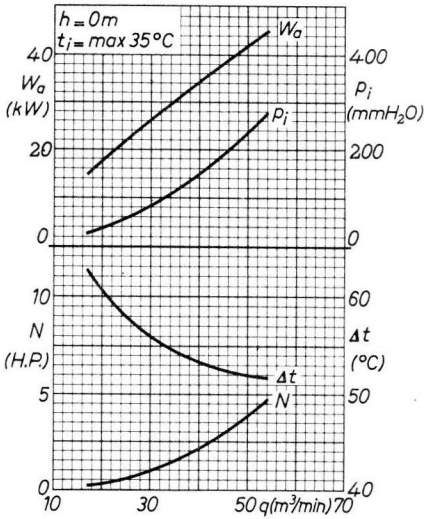
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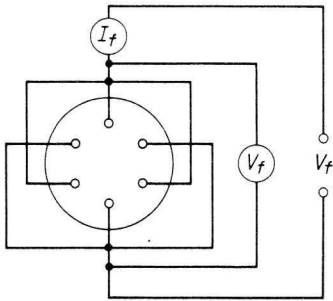






## AIR COOLED R.F. POWER TRIODE

This type is equivalent to type TBL12/100 except for the filament data

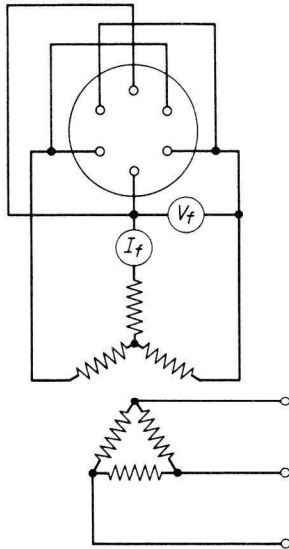


### Single-phase filament energizing

$$V_f = 17.5 \text{ V}$$

$$I_f = 196 \text{ A}$$

Filament current must never exceed a peak value of 420 A at any time during the initial energizing schedule



### Three-phase filament energizing

$$V_f = 15.5 \text{ V}$$

$$I_f = 131 \text{ A}$$

Filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

A safety device must be used to prevent filament energizing with one phase interrupted.



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## WATER COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	three phase	
	$V_a$ (kV)	$W_o$ (kW)
30	7	17.7
	6	14.3

**HEATING:** direct, filament thoriated tungsten

Filament voltage	$V_f$	$=$	$6.3$	$V$	$+ 5\%$
					$-10\%$
Filament current	$I_f$	$=$	$130$	$A$	
Cold filament resistance	$R_{fo}$	$=$	$0.005$	$\Omega$	

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	$C_a$	$=$	$1.2$	$pF$
Grid to all other elements except anode	$C_g$	$=$	$44.5$	$pF$
Anode to grid	$C_{ag}$	$=$	$33.5$	$pF$

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	$=$	$6$	$kV$
Anode current	$I_a$	$=$	$2.5$	$A$
Mutual conductance	$S$	$=$	$23$	$mA/V$
Amplification factor	$\mu$	$=$	$17.5$	

### TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals = max. 220 °C

## WATER COOLING CHARACTERISTICS

$W_a$ (kW)	$t_i$ (°C)	$Q_{min}$ (l/min)	$P_i$ (atm.)
5	20	4.5	0.03
	50	12	0.2
10	20	9.5	0.15
	50	22	0.6
15	20	15	0.3
	50	34	1.4

## MECHANICAL DATA

Dimensions in mm

Filament clips with cable : 40662

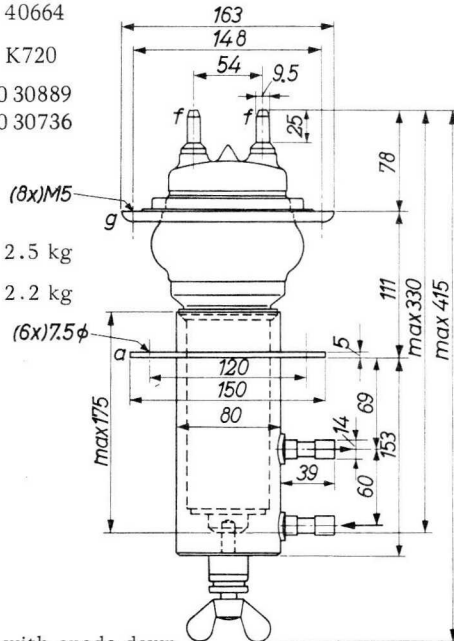
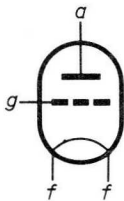
Grid connector : 40664

Water jacket : K720

→ O-ring large : 2622080 30889  
small : 2622080 30736

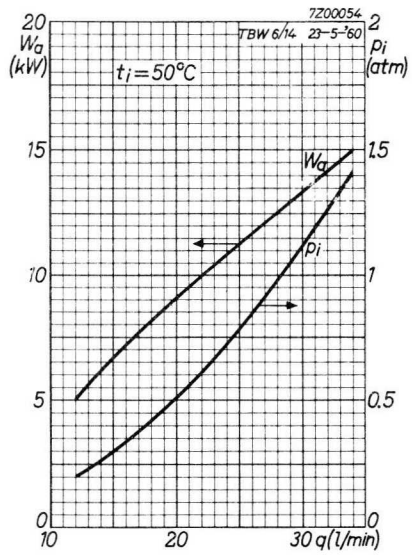
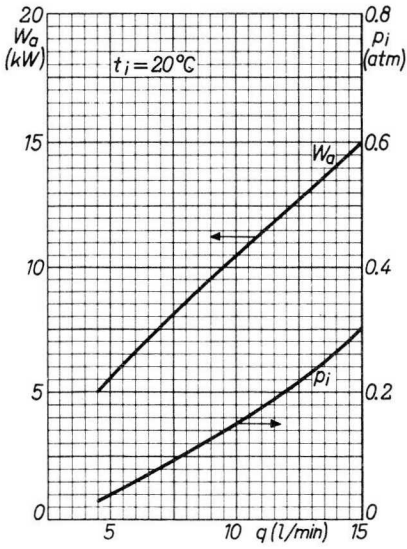
Net weight of tube : 2.5 kg

Net weight of water jacket: 2.2 kg



Mounting position: vertical with anode down

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For further data and curves (except cooling curves)  
please refer to type TBH 6/14  
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## WATER COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA									
General purposes									
$\lambda$ (m)	Freq. (MHz)	C telegr.		B teleph.		C <sub>a</sub> mod.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
4	75	6	6.9	6	1.9			6	13.3
		5	5.6	5	1.45	5	4.7	5	6.6
		4	4			4.5	4.1	4.5	6.0
						4	3.5	4	5.3
						3.5	3	3.5	4.6
						3	2.2	3	3.3
Television service									
Freq. (MHz)	Neg. mod.		Pos. sync.		Pos. mod.		Neg. sync.		
	V <sub>a</sub> (kV)	W <sub>o</sub> sync (kW)	W <sub>o</sub> black (kW)		V <sub>a</sub> (kV)	W <sub>o</sub> white (kW)			
75	5	9	5.35		5	9			

**HEATING:** direct, filament thoriated tungsten

Filament voltage

$$V_f = 12.6 \text{ V}$$

Filament current

$$I_f = 33 \text{ A}$$

### CAPACITANCES

Anode to all other elements except grid

$$C_a = 0.3 \text{ pF}$$

Grid to all other elements except anode

$$C_g = 16 \text{ pF}$$

Anode to grid

$$C_{ag} = 11 \text{ pF}$$

<sup>1)</sup> Two tubes

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a = 4$ kV
Anode current	$I_a = 1$ A
Mutual conductance	$S = 17$ mA/V
Amplification factor	$\mu = 32$

**COOLING:** water/low-velocity air flow

**WATER COOLING CHARACTERISTICS** See also the cooling curves

$W_a$ (kW)	$t_i$ (°C)	$q_{min}^{1)}$ (l/min)	$P_i$ (atm)
1	20	2.5	0.08
	50	3	0.1
2	20	2.5	0.08
	50	5	0.3
4	20	4	0.18
	50	9	0.9
6	20	6	0.4
	50	14	2.5

It is necessary to direct a low-velocity air flow to the anode and the grid seal at frequencies above 30 MHz

The air flow must be started upon or before application of the filament voltage

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature  $t_i = \text{max. } 50$  °C

Temperature of seals  $t = \text{max. } 180$  °C

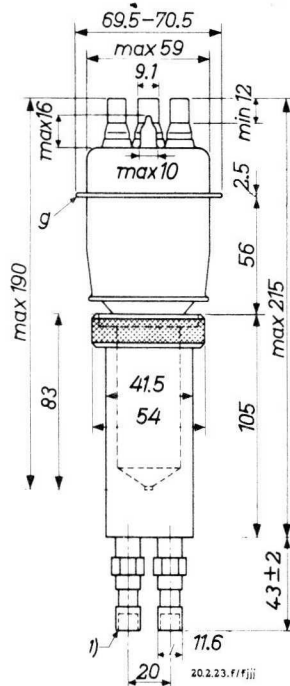
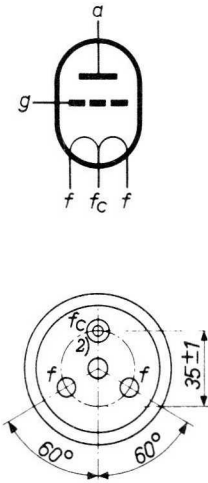
<sup>1)</sup> At inlet temperatures between 20 and 50 °C the required quantity of water can be found by proportional interpolation 7Z2 8687



**MECHANICAL DATA**

Dimensions in mm

- Filament connector: 40634
- Grid connector : 40650<sup>3)</sup> or 40622
- Net weight of tube : 0.45 kg
- Net weight of K713 : 0.52 kg
- O-ring : 3322 026 82801



Tube mounted in water jacket type K713

Mounting position: vertical with anode down

The centre tap  $f_c$  must not be used for filament current supply. The connectors type 40634, however, must be used for the cooling of all three filament pins, thus also of pin  $f_c$

<sup>1)</sup> 1/8" pipe thread

<sup>2)</sup> This pin is marked "O"

<sup>3)</sup> The connector 40650 should be used only below 30 MHz

When the tube is used with this connector at maximum ratings additional cooling of the grid seal will be required

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75	MHz
Anode voltage	$V_a$	= max.	6	kV
Negative grid voltage	$-V_g$	= max.	1000	V
Anode current	$I_a$	= max.	1.5	A
Grid current	$I_g$	= max.	0.35	A
Grid dissipation	$W_g$	= max.	120	W
Anode input power	$W_{ia}$	= max.	9	kW
Anode dissipation	$W_a$	= max.	6	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	4	4	4	m
Frequency	f	=	75	75	75	MHz
Anode voltage	$V_a$	=	6	5	4	kV
Grid voltage	$V_g$	=	-400	-300	-200	V
Anode current	$I_a$	=	1.5	1.5	1.37	A
Grid current	$I_g$	=	0.31	0.33	0.35	A
Peak grid A.C. voltage	$V_{gp}$	=	740	640	500	V
Grid input power	$W_{ig}$	=	210	190	160	W
Anode input power	$W_{ia}$	=	9	7.5	5.5	kW
Anode dissipation	$W_a$	=	2.1	1.9	1.5	kW
Output power	$W_o$	=	6.9	5.6	4	kW
Efficiency	$\eta$	=	76.5	75	73	%

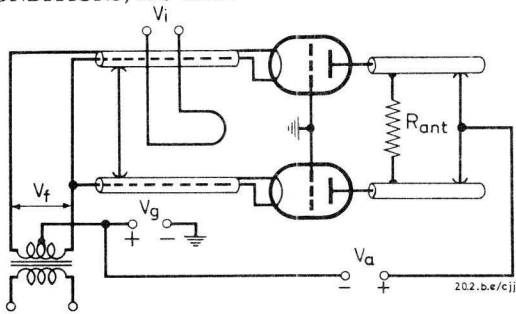
7Z2 8689

**R.F. CLASS C TELEGRAPHY, grounded grid**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6 kV
Positive cathode to grid voltage	$V_{kg}$	= max.	1000 V
Anode current	$I_a$	= max.	1.5 A
Grid current	$I_g$	= max.	0.35 A
Grid dissipation	$W_g$	= max.	120 W
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	6 kW
For frequencies from 75 MHz up to 220 MHz See page C			

**OPERATING CONDITIONS, two tubes**



For data please refer to page 6

7Z2 8690

**R.F. CLASS C TELEGRAPHY**, grounded grid (continued)

**OPERATING CONDITIONS**, two tubes (continued)

$\lambda$	=	4	2.7 <sup>1)</sup>	2.7 <sup>1)</sup>	1.36 <sup>1)</sup>	m
f	=	75	110	110	220	MHz
V <sub>a</sub>	=	6	5	4	4	kV
V <sub>g</sub>	=	-400	-300	-200	-200	V
I <sub>a</sub>	=	2x1.5	2x1.5	2x1.37	2x1.25	A
I <sub>g</sub>	=	2x0.31	2x0.33	2x0.35	2x0.2	A
V <sub>gp</sub>	=	740	640	500	450	V
W <sub>ig</sub>	=	2x1120	2x920	2x675	2x380	W
W <sub>ia</sub>	=	2x9	2x7.5	2x5.5	2x5	kW
W <sub>a</sub>	=	2x2.1	2x2.2	2x1.7	2x2.5	kW
W <sub>o</sub>	=	13.8+1.82	10.6+1.46	7.6+1.03	5+0.6	kW <sup>2)</sup>
$\eta$	=	76.5	71	69	50	% <sup>3)</sup>

<sup>1)</sup> When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged.

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation.

<sup>2)</sup> Power transferred from driving stage included.

<sup>3)</sup> Pure tube efficiency.

## R.F. CLASS B TELEPHONY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6 kV
Anode current	$I_a$	= max.	1.1 A
Anode input power	$W_{ia}$	= max.	6.6 kW
Anode dissipation	$W_a$	= max.	6 kW

## OPERATING CONDITIONS

Wavelength	$\lambda$	=	4	4 m
Frequency	f	=	75	75 MHz
Anode voltage	$V_a$	=	6	5 kV
Grid voltage	$V_g$	=	-180	-145 V
Anode current	$I_a$	=	0.99	0.9 A
Peak grid A.C. voltage	$V_{gp}$	=	250	225 V
Anode input power	$W_{ia}$	=	5.9	4.5 kW
Anode dissipation	$W_a$	=	4	3.05 kW
Output power	$W_o$	=	1.9	1.45 kW
Efficiency	$\eta$	=	32	32 %
Modulation factor	m	=	100	100 %
Grid current	$I_g$	=	0.3	0.32 A
Grid input power	$W_{ig}$	=	140	130 W



**R.F. CLASS C ANODE MODULATION**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75	MHz
Anode voltage	$V_a$	= max.	5	kV
Negative grid voltage	$-V_g$	= max.	1000	V
Anode current	$I_a$	= max.	1.3	A
Grid current	$I_g$	= max.	0.35	A
Grid dissipation	$W_g$	= max.	120	W
Anode input power	$W_{ia}$	= max.	6.5	kW
Anode dissipation	$W_a$	= max.	4	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	4	4	4	4	4	m
Frequency	f	=	75	75	75	75	75	MHz
Anode voltage	$V_a$	=	5	4.5	4	3.5	3	kV
Grid voltage	$V_g$	=	-400	-350	-300	-300	-250	V <sup>1)</sup>
Anode current	$I_a$	=	1.2	1.2	1.2	1.2	1	A
Grid current	$I_g$	=	0.3	0.3	0.3	0.3	0.3	A
Peakgrid A. C. voltage	$V_{gp}$	=	690	650	600	600	510	V
Grid input power	$W_{ig}$	=	190	180	165	165	140	W
Anode input power	$W_{ia}$	=	6	5.4	4.8	4.2	3	kW
Anode dissipation	$W_a$	=	1.3	1.3	1.3	1.2	0.8	kW
Output power	$W_o$	=	4.7	4.1	3.5	3.0	2.2	kW
Efficiency	$\eta$	=	78	76	73	71.5	73	%
Modulation factor	m	=	100	100	100	100	100	%
Modulation power	$W_{mod}$	=	3.0	2.7	2.4	2.1	1.5	kW

<sup>1)</sup> Grid bias partially obtained by the grid resistor

## A.F. CLASS B AMPLIFIER AND MODULATOR

## LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	=	max.	6	kV
Anode current	$I_a$	=	max.	1.5	A
Anode input power	$W_{ia}$	=	max.	9	kW
Anode dissipation	$W_a$	=	max.	6	kW
Grid circuit resistance	$R_g$	=	max.	15	k $\Omega$

## OPERATING CONDITIONS, two tubes

$V_a$	=	6	5	4.5	kV
$V_g$	=	-165	-138	-125	V
$R_{aa\sim}$	=	4900	6400	6100	$\Omega$
$V_{ggp}$	=	0 910	0 661	0 655	V
$I_a$	=	2x0.125 2x1.5	2x0.11 2x0.91	2x0.1 2x0.92	A
$I_g$	=	0 2x0.28	0 2x0.14	0 2x0.09	A
$W_{ig}$	=	0 2x115	0 2x42	0 2x27	W
$W_{ia}$	=	2x0.75 2x9	2x0.55 2x4.55	2x0.45 2x4.15	kW
$W_a$	=	2x0.75 2x2.35	2x0.55 2x1.25	2x0.45 2x1.15	kW
$W_o$	=	0 13.3	0 6.6	0 6	kW
$d_{tot}$	=	- 4.3	- 3.3	- 3.7	%
$\eta$	=	- 74	- 73	- 72	%

$V_a$	=	4	3.5	3	kV
$V_g$	=	-112	-100	-90	V
$R_{aa\sim}$	=	4900	4200	4400	$\Omega$
$V_{ggp}$	=	0 632	0 618	0 570	V
$I_a$	=	2x0.1 2x0.94	2x0.075 2x0.95	2x0.065 2x0.8	A
$I_g$	=	0 2x0.19	0 2x0.18	0 2x0.2	A
$W_{ig}$	=	0 2x54	0 2x50	0 2x52	W
$W_{ia}$	=	2x0.4 2x3.75	2x0.26 2x3.3	2x0.2 2x2.4	kW
$W_a$	=	2x0.4 2x1.1	2x0.26 2x1	2x0.2 2x0.75	kW
$W_o$	=	0 5.3	0 4.6	0 3.3	kW
$d_{tot}$	=	- 2.6	- 2.9	- 3.3	%
$\eta$	=	- 71	- 70	- 69	%

7Z2 3509

**GRID MODULATED R.F. CLASS C AMPLIFIER** for television service; negative modulation, positive synchronisation (American and European system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 75	up to 220	MHz
Anode voltage	$V_a$	= max. 5	max. 4	kV
Anode input power	$W_{ia}$	sync = max. 9.5	max. 6.5	kW
Anode dissipation	$W_a$	sync = max. 5	max. 4	kW
Anode current	$I_a$	sync = max. 1.9	max. 1.6	A
Grid dissipation	$W_g$	sync = max. 120	max. 120	W
Negative grid voltage	$-V_g$	= max. 1000	max. 1000	V

**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	= 48 to 75	170 to 220 <sup>1)</sup>	MHz
Bandwidth (-1.5 db)	B	= 5.25	6.5	MHz <sup>2)</sup>
Bandwidth (-3 db)	B	= 8	10	MHz <sup>2)</sup>
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	sync =	-200	-150 V
		black =	-300	-225 V
		white =	-550	-500 V
Peak grid to grid voltage	$V_{ggp}$	sync = 1000	1000	V <sup>3)</sup>
Anode current	$I_a$	sync =	3.8	3.2 A
		black =	2.8	2.6 A
Grid current	$I_g$	sync =	0.5	0.4 A
		black =	0.35	0.22 A
Grid input power	$W_{ig}$	sync = 250	350 to 450	W <sup>4)</sup>
Output power	$W_o$	sync =	9	6 kW
		black =	5.35	3.37 kW

1) When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged.

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation

2) These values are based on measurements on a circuit with a single LC section

3) Measured by the slide back method

4) Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power

7Z2 8694



**GRID MODULATED R.F. CLASS C AMPLIFIER** for television service; positive modulation, negative synchronisation (BBC system)

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	5 kV
Negative grid voltage	$-V_g$	= max.	1000 V
Anode current	$I_a$ white	= max.	1.9 A
Anode input power	$W_{ia}$ white	= max.	9.5 kW
Anode dissipation	$W_a$ white	= max.	6 kW
Grid dissipation	$W_g$ white	= max.	120 W



**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	=	48-75 MHz
Bandwidth ( $I_{ant} = 85\%$ ) ( $I_{ant} = 70\%$ )	B	=	5.25 MHz
		=	8 MHz
Anode voltage	$V_a$	=	5 kV
Grid voltage	$V_g$	white =	-200 V
		black =	-460 V
		sync =	-580 V
Peak grid to grid voltage	$V_{ggp}$ white	=	1000 V
Anode current	$I_a$	white =	3.8 A
		black =	0.8 A
Grid current	$I_g$	white =	0.5 A
		black =	0 A
Grid input power	$W_{ig}$ white	=	250 W
Output power	$W_o$	white =	9 kW
		black =	0.6 kW

7Z2 8695

R.F. CLASS B TELEPHONY for television service (American and European system)

## LIMITING VALUES (Absolute limits)

Frequency	f	up to 75	up to 220	MHz
Anode voltage	$V_a$	= max. 5	max. 4	kV
Anode input power	$W_{ia}$ sync	= max. 9.5	max. 6.5	kW
Anode dissipation	$W_a$ sync	= max. 5	max. 4	kW
Anode current	$I_a$ sync	= max. 1.9	max. 1.6	A
Grid dissipation	$W_g$ sync	= max. 120	max. 120	W

## OPERATING CONDITIONS, two tubes in push-pull

Frequency	f	= 48 to 75	170 to 220 <sup>1)</sup>	MHz
Bandwidth (-1.5 db)	B	= 5.25	6.5	MHz <sup>2)</sup>
Bandwidth (-3 db)	B	= 8	10	MHz <sup>2)</sup>
Anode voltage	$V_a$	= 5	4	kV
Grid voltage	$V_g$	= -200	-150	V
Peak grid to grid voltage	$V_{ggp}$	sync = 1000	1000	V <sup>3)</sup>
		black = 800	750	V <sup>3)</sup>
		white = 0	200	V <sup>3)</sup>
Anode current	$I_a$	sync = 3.8	3.2	A
		black = 3	2.6	A
		white = 0.2	-	A
Grid current	$I_g$	sync = 0.5	0.4	A
		black = 0.22	0.22	A
		white = 0	-	A
Grid input power	$W_{ig}$ sync	= 250	350 to 450	W <sup>4)</sup>
Output power	$W_o$	sync = 9	6	kW
		black = 5.35	3.37	kW

1) When using the tube above 108 MHz, particular attention must be paid to a careful design of the installation, otherwise the tube may be damaged

Therefore, our guarantee for the tubes operating at frequencies above 108 MHz can only be given after approval of the installation

2) These values are based on measurements on a circuit with a single LC section

3) Measured by the slide back method

4) Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power

7Z2 8696

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from two-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75	MHz
Anode voltage	$V_a$	= max.	5400	V
Negative grid voltage	$-V_g$	= max.	900	V
Anode current	$I_a$	= max.	1.35	A
Grid current	$I_g$	= max.	0.31	A
Anode input power	$W_{ia}$	= max.	9	kW
Anode dissipation	$W_a$	= max.	6	kW
Grid dissipation	$W_g$	= max.	120	W



**OPERATING CONDITIONS**

Transformer voltage	$V_{tr}$	=	6.0 <sup>1)</sup>	5.1 <sup>2)</sup>	kV <sub>RMS</sub>
Anode voltage	$V_a$	=	5.4	4.6	kV <sup>3)</sup>
Anode current	$I_a$	=	1.35	1.15	A
Grid current	$I_g$	=	0.31	0.27	A
Grid resistor	$R_g$	=	1300	1100	$\Omega$
Grid input power	$W_{ig}$	=	210	160	W
Anode input power	$W_{ia}$	=	9	6.5	kW
Anode dissipation	$W_a$	=	2.3	1.84	kW
Output power	$W_o$	=	6.5	4.5	kW
Efficiency	$\eta$	=	72	70	%

1) Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

2) Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded

3) D.C. value

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75 MHz
Anode voltage	$V_a$	= max.	6000 V
Negative grid voltage	$-V_g$	= max.	1000 V
Anode current	$I_a$	= max.	1.5 A
Grid current	$I_g$	= max.	0.35 A
Anode input power	$W_{ia}$	= max.	9 kW
Anode dissipation	$W_a$	= max.	6 kW
Grid dissipation	$W_g$	= max.	120 W

**OPERATING CONDITIONS**

Frequency	f	=	75	75 MHz
Transformer voltage	$V_{tr}$	=	5.1 <sup>1)</sup>	4.4 <sup>2)</sup> kV <sub>RMS</sub>
Anode voltage	$V_a$	=	6.0	5.1 kV <sup>3)</sup>
Anode current	$I_a$	=	1.5	1.25 A
Grid current	$I_g$	=	0.31	0.28 A
Grid resistor	$R_g$	=	1300	1100 $\Omega$
Grid input power	$W_{ig}$	=	210	160 W
Anode input power	$W_{ia}$	=	9	6.4 kW
Anode dissipation	$W_a$	=	1.9	1.74 kW
Output power	$W_o$	=	6.9	4.5 kW
Efficiency	$\eta$	=	76.5	70 %

<sup>1)</sup> Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

<sup>2)</sup> Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded

<sup>3)</sup> D.C. value 7Z2 8698

## R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE with self rectification

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	75	MHz
Transformer voltage	$V_{tr}$	= max.	6800	$V_{RMS}$
Negative grid voltage	$-V_g$	= max.	640	V
Anode current	$I_a$	= max.	0.8	A
Grid current	$I_g$	= max.	0.19	A
Anode input power	$W_{ia}$	= max.	9	kW
Anode dissipation	$W_a$	= max.	6	kW
Grid dissipation	$W_g$	= max.	120	W

## OPERATING CONDITIONS

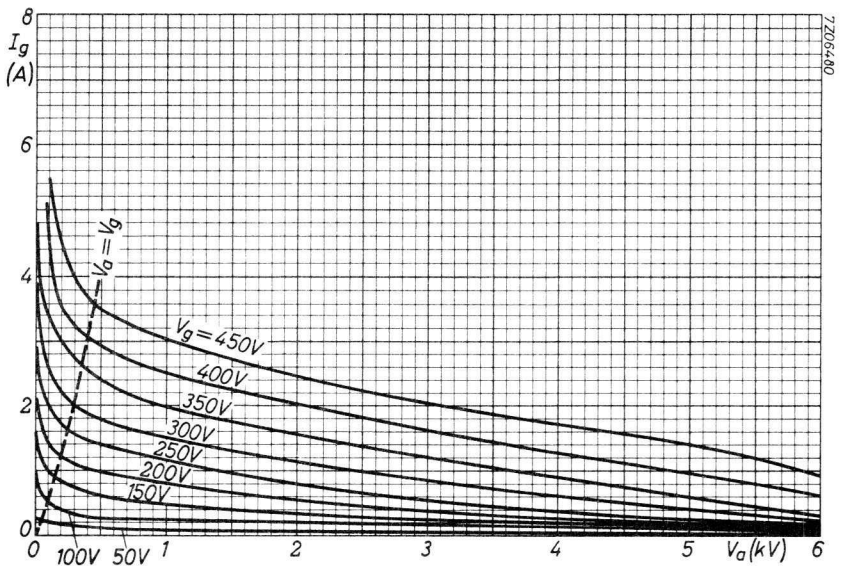
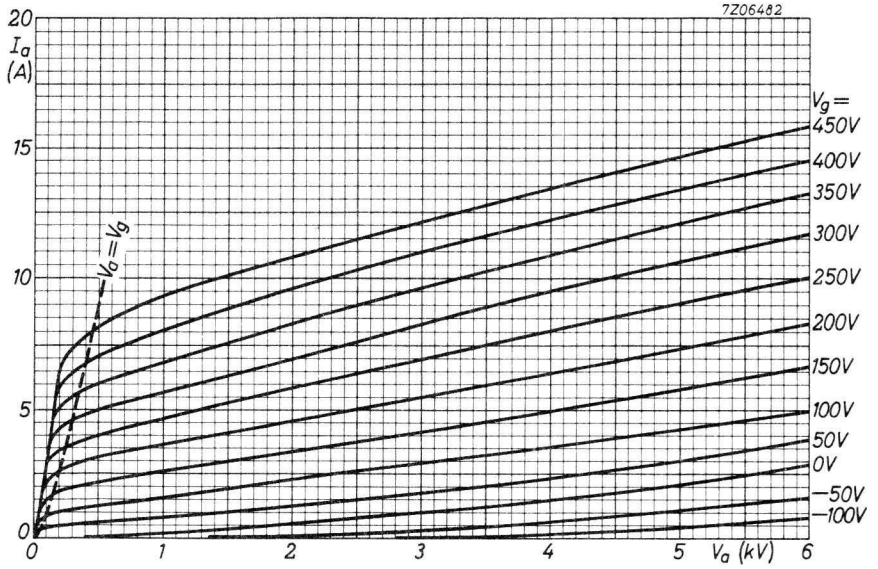
Frequency	f	=	75	75	MHz
Transformer voltage	$V_{tr}$	=	$6.8^1)$	$5.9^2)$	kV <sub>RMS</sub>
Anode current	$I_a$	=	0.8	0.7	A
Grid current	$I_g$	=	0.19	0.165	A
Grid resistor	$R_g$	=	1050	1050	
Grid input power	$W_{ig}$	=			W
Anode input power	$W_{ia}$	=	6.05	4.6	kW
Anode dissipation	$W_a$	=	1.5	1.24	kW
Output power	$W_o$	=	4.55	3.36	kW
Efficiency	$\eta$	=	75	73	%

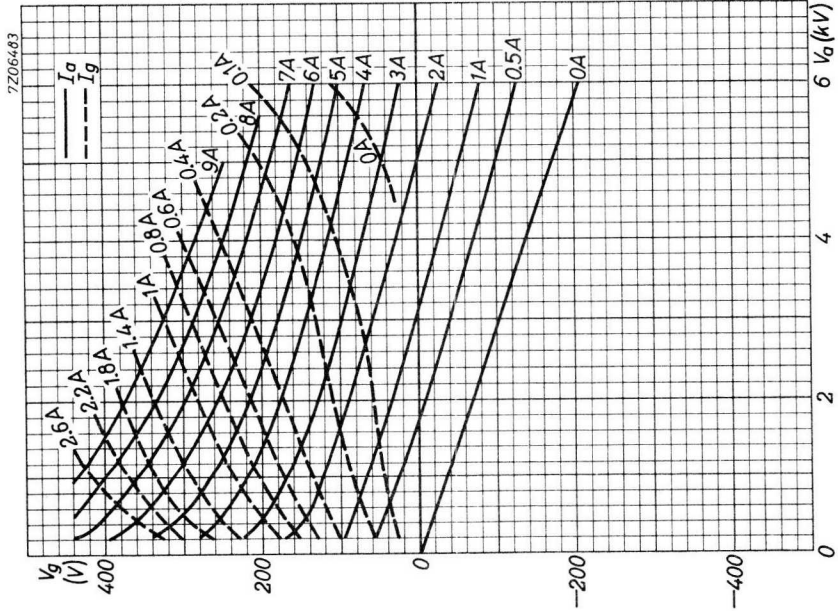
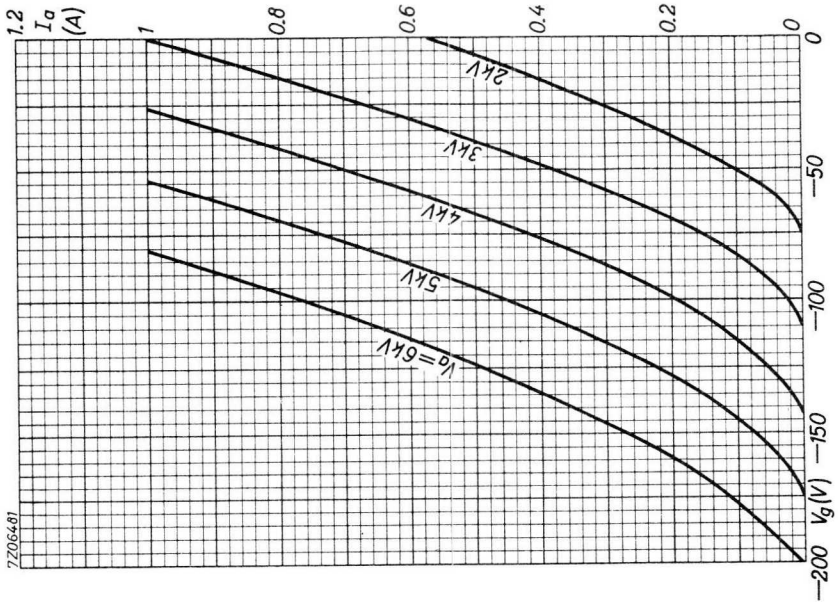
<sup>1)</sup> Care must be taken that under these operating conditions the absolute limiting values are not exceeded by variation of the supply voltage or the load or by tolerances in the circuit elements

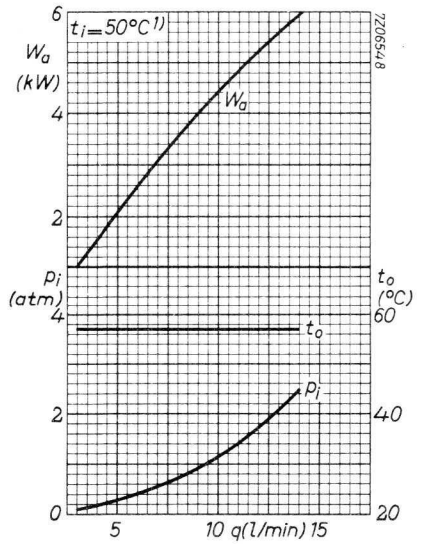
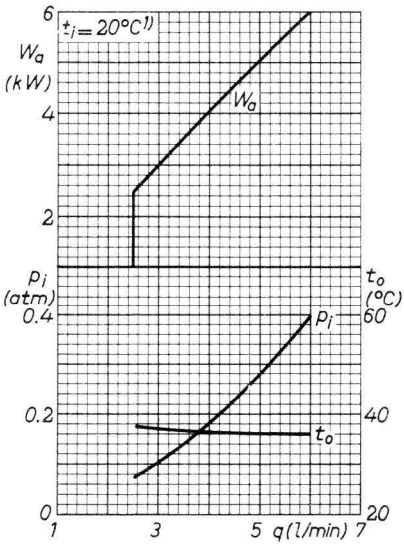
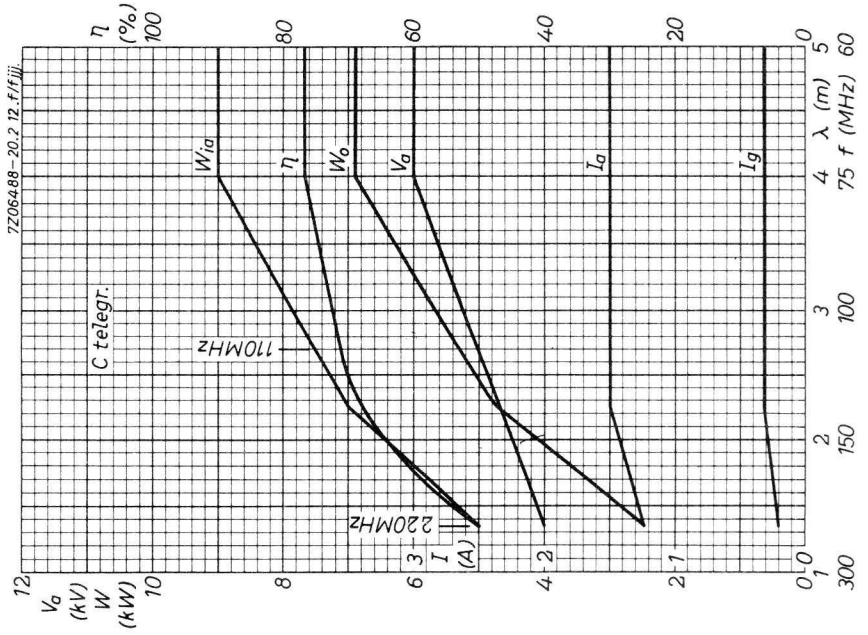
<sup>2)</sup> Under these conditions normal deviations of voltages and load are permissible. The absolute limiting values of the tube must, however, not be exceeded

7Z2 8699

# TBW6/6000









## WATER COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA							
$\lambda$ (m)	Freq. (MHz)	C telegr.		C osc.		B mod. <sup>1)</sup>	
		V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	30	6.5	9.5			7.0	20
		6.0	8.5			5.0	9.0
		5.0	7.1			4.0	7.1
6	50			6.0	6.0		

**COOLING:** water/low-velocity air flow

**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub> = 12.6 V
Filament current	I <sub>f</sub> = 33 A

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub> = 0.3 pF
Grid to all other elements except anode	C <sub>g</sub> = 16 pF
Anode to grid	C <sub>ag</sub> = 11 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub> = 6 kV
Anode current	I <sub>a</sub> = 1 A
Amplification factor	$\mu$ = 32
Mutual conductance	S = 15 mA/V

<sup>1)</sup> Two tubes

**WATER COOLING CHARACTERISTICS** , see also the cooling curves

$W_a$ (kW)	$t_i$ (°C)	$q_{min}^{1)}$ (l/min)	$P_i$ (atm)
1	20	2.5	0.08
	50	3	0.1
2	20	2.5	0.08
	50	5	0.3
4	20	4	0.18
	50	9	0.9
6	20	6	0.4
	50	14	2.5

**TEMPERATURE LIMITS** (Absolute limits)

Inlet temperature	$t_i$ = max.	50 °C
Temperature of filament seals	= max.	210 °C
Temperature of grid and anode seals	= max.	180 °C

**ACCESSORIES**

Filament connectors	40634
Connector centre pin of filament	40649 <sup>2)</sup>
Grid connector	40650 <sup>3)</sup> or 40622
Water jacket	K713

In general, no air cooling will be required at frequencies up to 30 MHz and at ambient temperatures below 35 °C.

At higher frequencies or at higher ambient temperatures a low-velocity air flow to the grid and filament seals will be necessary.

<sup>1)</sup> At water inlet temperatures between 20 and 50 °C the required quantity of water can be found by proportional interpolation

<sup>2)</sup> The centre tap  $f_c$  (diameter 10.5 mm; marked O) must not be used for filament current supply. The connector type 40649, however, must be used for the cooling of this pin

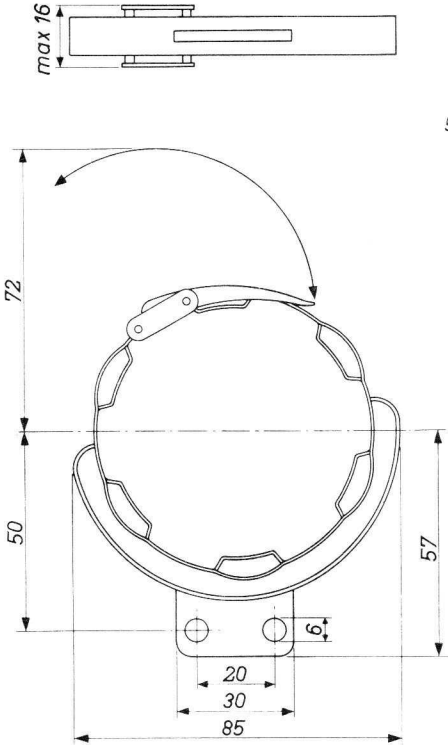
<sup>3)</sup> See page 3. The connector 40650 should only be used below 30 MHz

**MECHANICAL DATA**

Net weight of the tube : 0.45 kg

Net weight of water-jacket: 0.52 kg

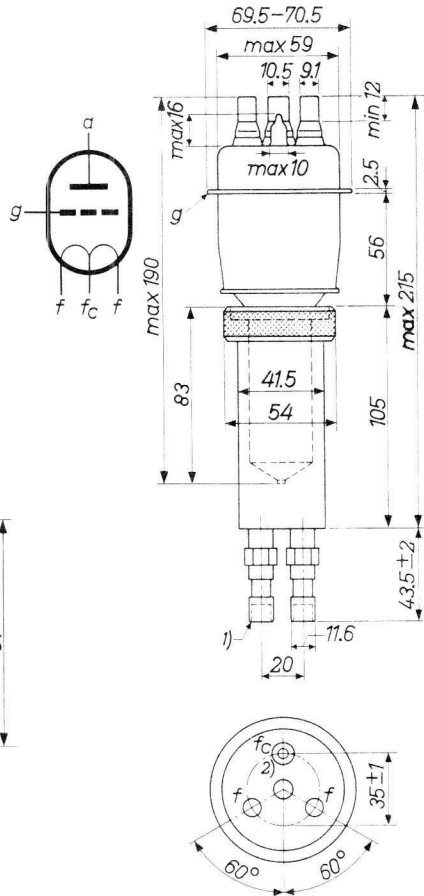
Dimensions in mm



Grid connector  
40650

→ O-ring : 3322 026 82801

Mounting position: vertical with anode down



1) 1/8" pipe thread

2) The centre tap  $f_c$  (diameter 10.5 mm; marked O) must not be used for filament current supply. The connector type 40649, however, must be used for the cooling of this pin

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	7.2	kV
Negative grid voltage	$-V_g$	= max.	1250	V
Anode current	$I_a$	= max.	2.2	A
Grid current	$I_g$	= max.	0.6	A
Anode input power	$W_{ia}$	= max.	14	kW
Anode dissipation	$W_a$	= max.	6	kW

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	10	10	10	m
Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	6.5	6.0	5.0	kV
Grid voltage	$V_g$	=	-450	-400	-300	V
Anode current	$I_a$	=	2.0	2.0	2.0	A
Grid current	$I_g$	=	0.5	0.5	0.5	A
Peak grid A.C. voltage	$V_{gp}$	=	820	780	660	V
Grid input power	$W_{ig}$	=	370	350	297	W
Anode input power	$W_{ia}$	=	13	12	10	kW
Anode dissipation	$W_a$	=	3.5	3.5	2.9	kW
Output power	$W_o$	=	9.5	8.5	7.1	kW
Efficiency	$\eta$	=	73	71	71	%

7Z2 3521

## A.F. CLASS B AMPLIFIER AND MODULATOR

## LIMITING VALUES (Absolute limits)

Anode voltage	$V_a = \text{max. } 7.2 \text{ kV}$
Anode current	$I_a = \text{max. } 2.2 \text{ A}$
Anode input power	$W_{ia} = \text{max. } 14 \text{ kW}$
Anode dissipation	$W_a = \text{max. } 6 \text{ kW}$
Grid circuit resistance	$R_g = \text{max. } 15 \text{ k}\Omega$

## OPERATING CONDITIONS, two tubes

$V_a =$	7	5	5	4	kV				
$V_g =$	-250	-165	-165	-135	V				
$R_{aa\sim} =$	4150	4800	5500	3800	$\Omega$				
$V_{ggp} =$	0	1300	0	880	0	730	0	930	V
$I_a =$	2x0.2	2x2.0	2x0.15	2x1.25	2x0.15	2x1.1	2x0.1	2x1.25	A
$I_g =$	0	2x0.53	0	2x0.33	0	2x0.22	0	2x0.36	A
$I_{gp} =$	-	2x2.8	-	2x1.75	-	2x1.2	-	2x1.8	A
$W_{ig} =$	0	2x310	0	2x130	0	2x70	0	2x135	W
$W_{ia} =$	2x1.4	2x14	2x0.75	2x6.2	2x0.75	2x5.5	2x0.4	2x5.0	kW
$W_a =$	2x1.4	2x4.0	2x0.75	2x1.7	2x0.75	2x1.5	2x0.4	2x1.45	kW
$W_o =$	0	20	0	9	0	8.0	0	7.1	kW
$\eta =$	-	71.5	-	72.5	-	72.5	-	71	%

**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

**LIMITING VALUES** (Absolute limits)

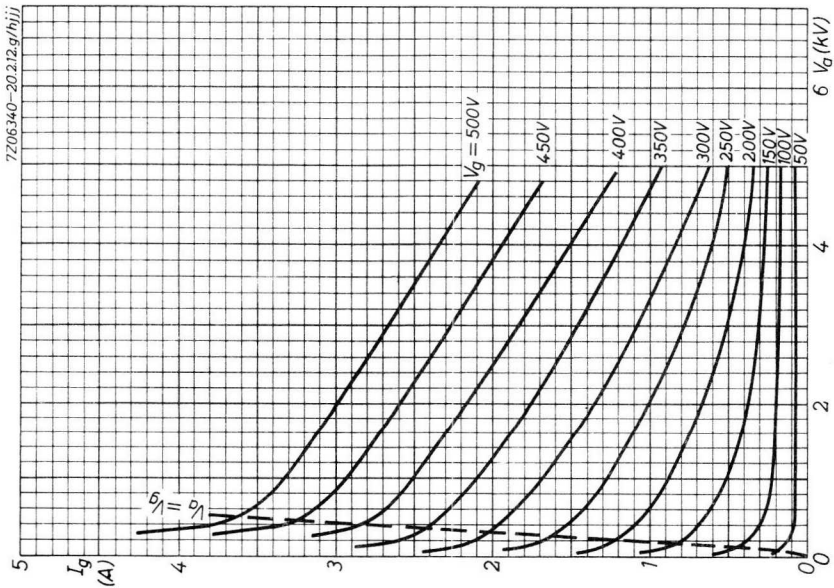
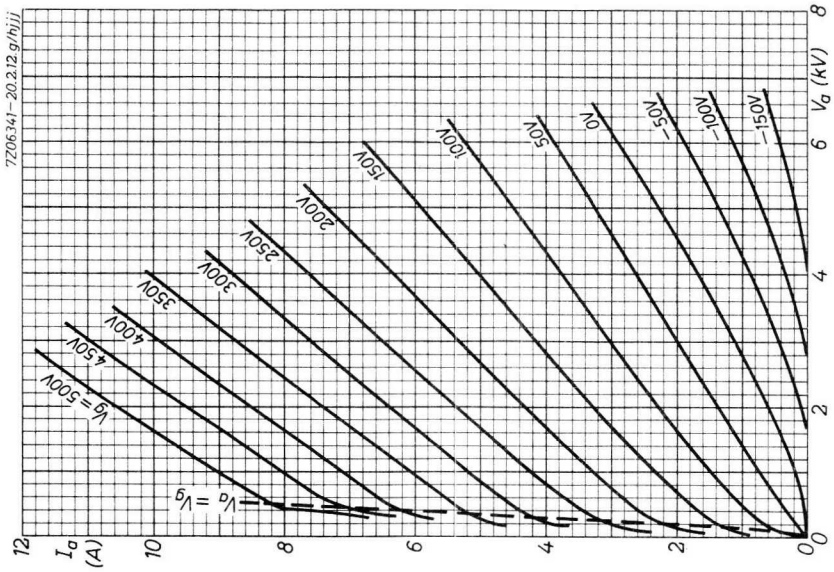
Frequency	f	up to	55	MHz
Anode voltage	$V_a$	= max.	7	kV
Negative grid voltage	$-V_g$	= max.	1250	V
Anode current	$I_a$	= max.	1.8	A
Grid current	$I_g$	= max.	0.5	A <sup>1)</sup>
Anode input power	$W_{ia}$	= max.	11	kW
Anode dissipation	$W_a$	= max.	6	kW
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

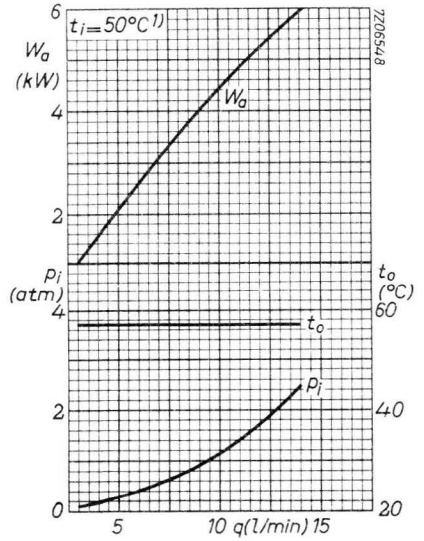
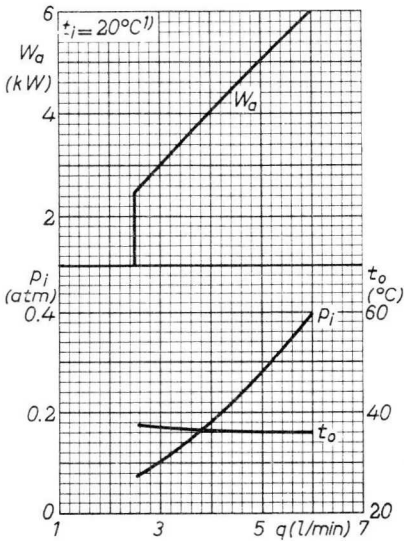
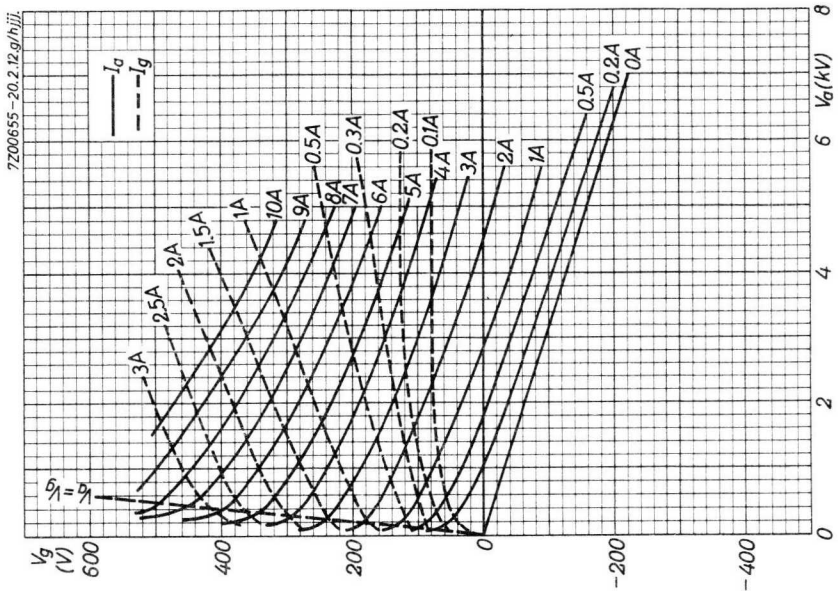
**OPERATING CONDITIONS**

Frequency	f	=	50	MHz
Transformer voltage	$V_{tr}$	=	5100	V <sub>RMS</sub>
Anode voltage	$V_a$	=	6.0	kV
Anode current	$I_a$	=	1.5	A
Grid current	$I_g$	=	0.4	A <sup>1)</sup>
Grid resistor	$R_g$	=	1000	$\Omega$
Grid input power	$W_{ig}$	=	300	W
Anode input power	$W_{ia}$	=	9	kW
Anode dissipation	$W_a$	=	2.7	kW
Output power	$W_o$	=	6	kW <sup>2)</sup>
Efficiency	$\eta$	=	67	%

<sup>1)</sup> Unloaded 0.7 A

<sup>2)</sup> Available power (load + circuit losses)







## WATER COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R. F. oscillator class C		
Freq.	Three phase	
(MHz)	$V_a$ (kV)	$W_l$ <sup>1)</sup> (kW)
50	7.2 6.2	6.1 5.0

**HEATING:** direct; filament thoriated tungsten

Filament voltage	$V_f$	=	12.6 V	+5 % -10 %
Filament current	$I_f$	=	32 A	

### CAPACITANCES

Anode to all other elements except grid	$C_a$	=	0.4 pF
Grid to all other elements except anode	$C_g$	=	13.5 pF
Anode to grid	$C_{ag}$	=	7.4 pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	=	6 kV
Anode current	$I_a$	=	1 A
Mutual conductance	S	=	12 mA/V
Amplification factor	$\mu$	=	24

<sup>1)</sup> Useful power in the load

**TEMPERATURE LIMITS** (Absolute limits)Water inlet temperature  $t_i = \text{max. } 50 \text{ } ^\circ\text{C}$ Temperature of the seals  $= \text{max. } 220 \text{ } ^\circ\text{C}$ **WATER COOLING CHARACTERISTICS**

$W_a$ (kW)	$t_i$ ( $^\circ\text{C}$ )	$q_{\text{min}}$ (l/min)	$P_i$ (atm)
2	20	2.5	0.06
	50	5	0.2
4	20	4	0.14
	50	9	0.7
6	20	6	0.3
	50	14	1.9

At water inlet temperatures between 20 and 50  $^\circ\text{C}$  the required quantity of water can be found by proportional interpolation.

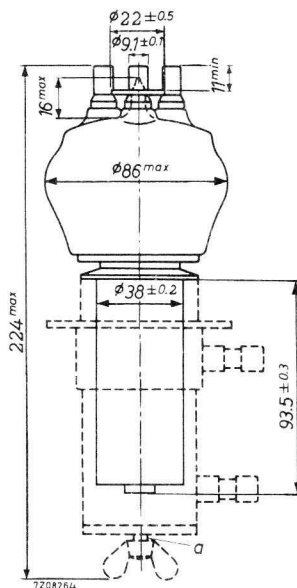
At frequencies above 4 MHz both grid terminals should be connected in parallel. At the highest frequencies care should be taken to distribute the R.F. current equally over both grid terminals to avoid excessive grid seal temperatures.

**MECHANICAL DATA**

Dimensions in mm

Net weight of the tube 0.57 kg

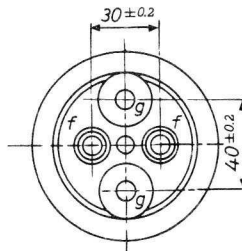
Net weight of water-jacket : 0.76 kg



Grid and filament connectors 40634

Water jacket K721

→ O-ring large : 2622080 30798  
small : 2622080 30733



**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase rectifier without filter

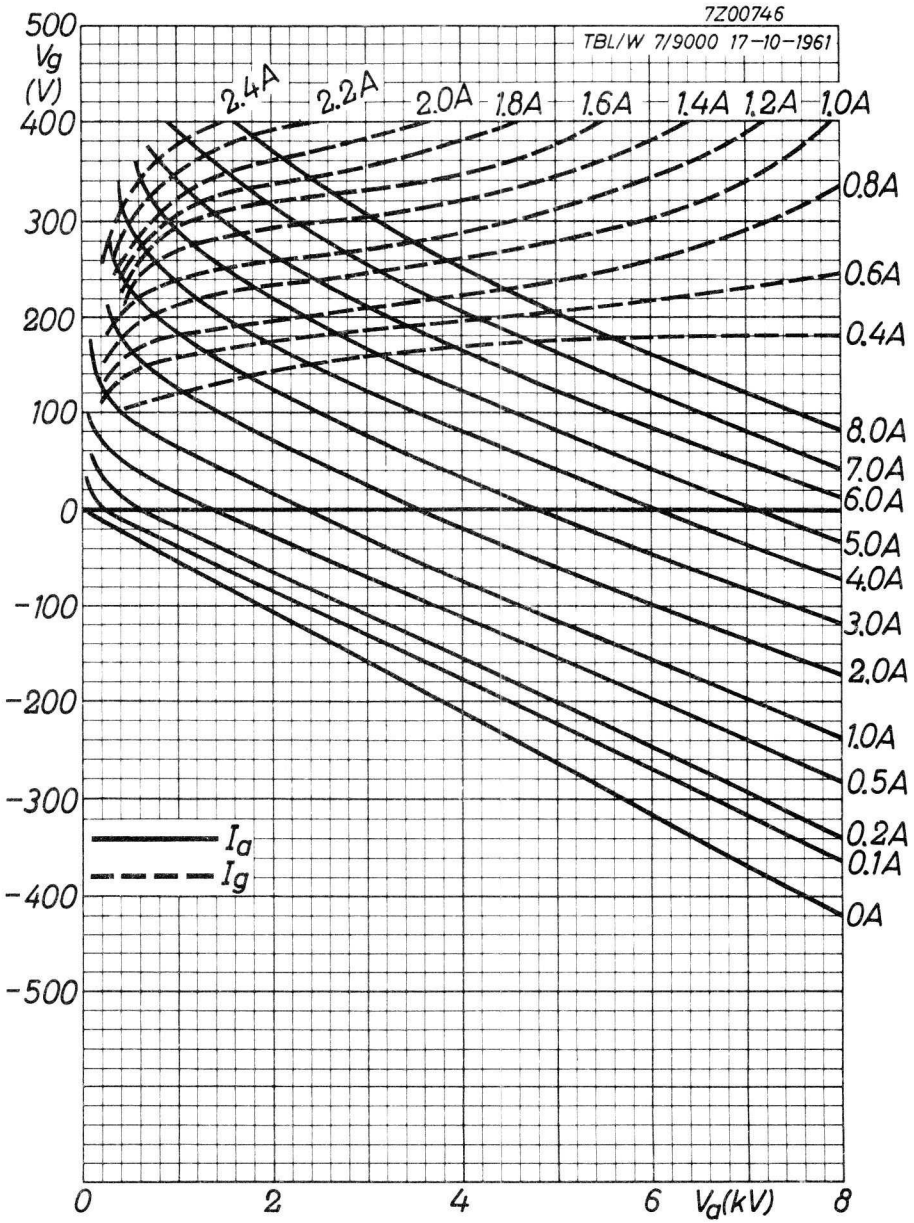
**LIMITING VALUES** (Absolute limits), continuous service

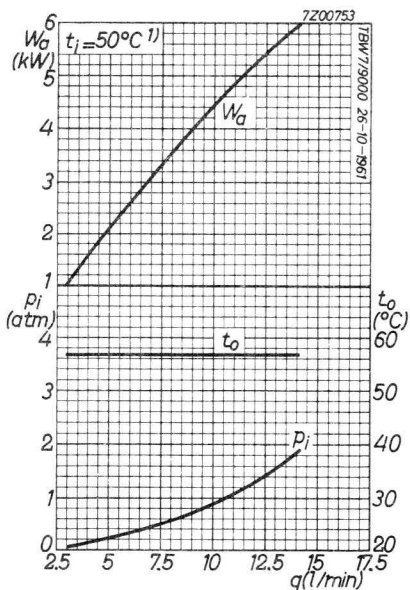
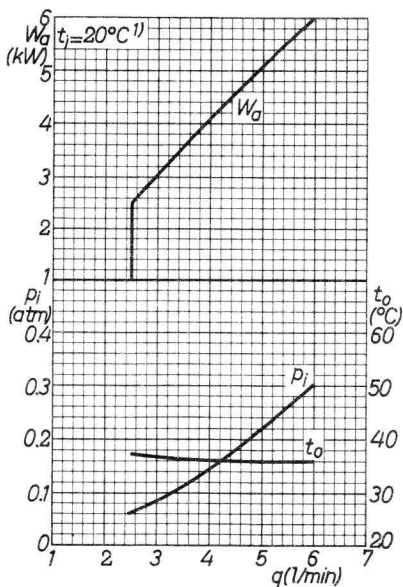
Frequency	f	up to	50 MHz
Anode voltage	$V_a$	= max.	8 kV
Anode input power	$W_{ia}$	= max.	12 kW
Anode dissipation	$W_a$	= max.	6 kW
Anode current	$I_a$	= max.	1.8 A
Negative grid voltage	$-V_g$	= max.	1250 V
Grid current, loaded	$I_g$	= max.	0.4 A
Grid current, unloaded	$I_g$	= max.	0.5 A
Grid circuit resistance	$R_g$	= max.	10 k $\Omega$

**OPERATING CHARACTERISTICS** , continuous service

Frequency	f	=	50	50 MHz
Anode voltage	$V_a$	=	7200	6200 V
Anode current, loaded	$I_a$	=	1.5	1.4 A
Anode current, unloaded	$I_a$	=	0.37	0.40 A
Grid current, loaded	$I_g$	=	0.36	0.37 A
Grid current, unloaded	$I_g$	=	0.47	0.47 A
Grid resistor	$R_g$	=	1850	1500 $\Omega$
Load resistance	$R_{a\sim}$	=	2300	2100 $\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	17	17 %
Anode input power	$W_{ia}$	=	10.8	8.68 kW
Anode dissipation	$W_a$	=	3.3	2.5 kW
Efficiency	$\eta$	=	70	71 %
Output power in the load	$W_{\ell}$	=	6.1	5.0 kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load, measured in a circuit having an efficiency of 85 %  
7Z2 3540





## WATER COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Industrial R.F. oscillator class C		
Freq. (MHz)	Three phase	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	29.0
	10	23.3
	8	17.9

**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	8.0 V	+ 5 % -10 %
Filament current	I <sub>f</sub>	=	98 A	
Cold filament resistance	R <sub>fo</sub>	=	0.008 Ω	

The filament current must never exceed a peak value of 210 A instantaneously at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.4 pF
Grid to all other elements except anode	C <sub>g</sub>	=	37 pF
Anode to grid	C <sub>ag</sub>	=	30 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	12 kV
Anode current	I <sub>a</sub>	=	2 A
Amplification factor	μ	=	34
Mutual conductance	S	=	20 mA/V

### TEMPERATURE LIMIT (Absolute limit)

Seal temperature = max. 220 °C

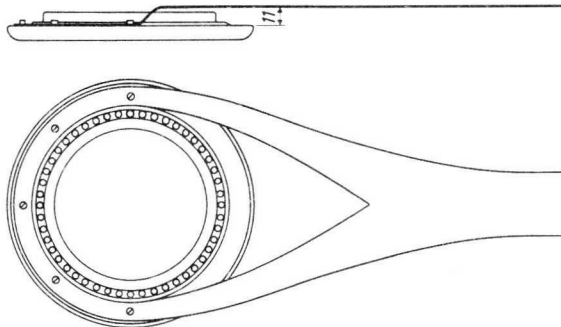
Generally a low velocity air flow to the seals is required

WATER COOLING CHARACTERISTICS

$t_i = \text{max. } 50 \text{ } ^\circ\text{C}$

$W_a$ (kW)	$t_i$ ( $^\circ\text{C}$ )	$q_{\text{min}}^{1)}$ (l/min)	$P_i$ (atm.)
5	20	6	0.02
	50	15	0.22
10	20	11	0.1
	50	25	0.7
15	20	16	0.25
	50	37	1.3
20	20	22	0.5
	50	49	2.3

To ensure a uniform R.F. current distribution in the grid seal especially at frequencies higher than 4 MHz, the grid lead should be connected as shown below.



<sup>1)</sup> At inlet temperatures between 20 and 50  $^\circ\text{C}$  the required quantity of water can be found by proportional interpolation





**R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE** with anode voltage from three-phase half-wave rectifier without filter

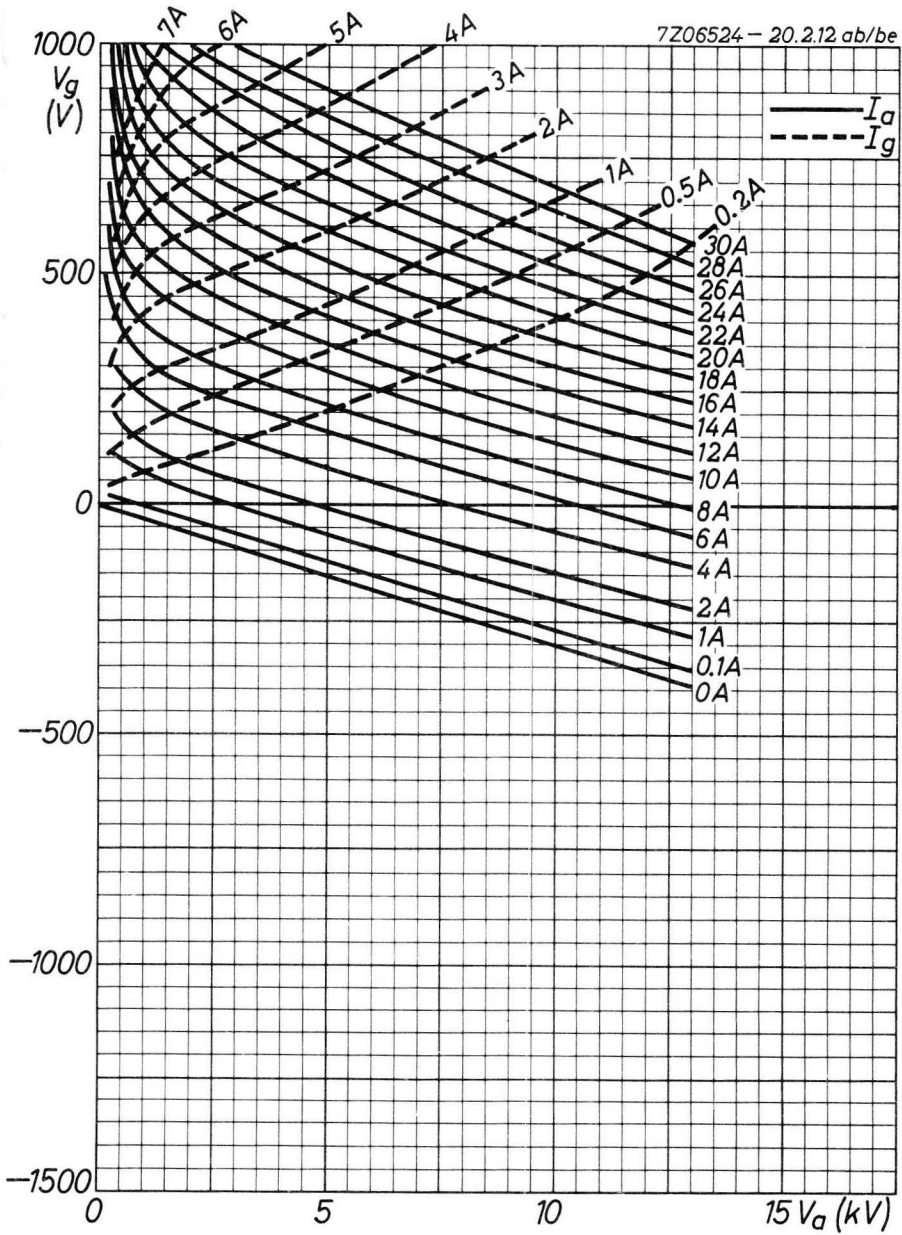
LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	4.8	A
Anode dissipation	$W_a$	= max.	20	kW
Anode input power	$W_{ia}$	= max.	60	kW
Negative grid voltage	$-V_g$	= max.	1500	V
Grid current	$I_g$	= max.	0.8	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

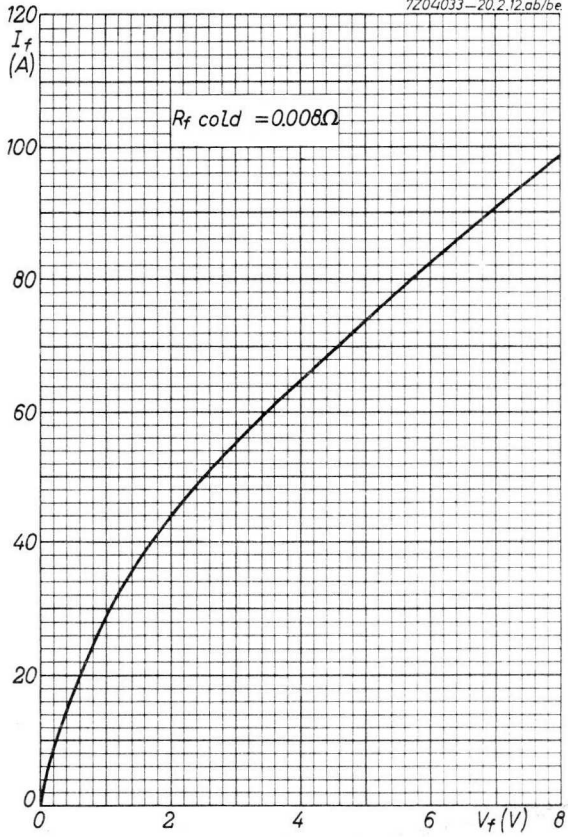
OPERATING CONDITIONS

Frequency	f	=	30	30	30	MHz
Transformer voltage	$V_{tr}$	=	8.9	7.4	6.0	kV
Anode voltage	$V_a$	=	12	10	8	kV
Anode current, loaded	$I_a$	=	3.2	3.2	3.2	A
Anode current, unloaded	$I_a$	=	0.52	0.50	0.48	A
Grid current, loaded	$I_g$	=	0.50	0.50	0.50	A
Grid current, unloaded	$I_g$	=	0.74	0.77	0.80	A
Grid resistor	$R_g$	=	2.0	1.6	1.1	k $\Omega$
Load resistance	$R_{a\sim}$	=	1800	1450	1100	$\Omega$
Feedback ratio under loaded conditions	$V_{g\sim}/V_{a\sim}$	=	16	17	19	%
Anode input power	$W_{ia}$	=	38.4	32.0	25.6	kW
Anode dissipation	$W_a$	=	9.4	8.7	7.7	kW
Output power	$W_o$	=	29.0	23.3	17.9	kW
Efficiency	$\eta$	=	75.5	72.5	70	%
Output power in the load	$W_p$	=	25	20	15.5	kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load measured in a circuit having an efficiency of 90%



7204033-20.2.12.ab/be



## WATER COOLED INDUSTRIAL R.F. POWER TRIODE

QUICK REFERENCE DATA		
Freq. (MHz)	C osc. industrial	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	39
	10	31.3
	8	23.2



**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	8 V	+ 5 %	-10 %
Filament current	I <sub>f</sub>	=	130 A		
Cold filament resistance	R <sub>f0</sub>	=	0.006 Ω		

The filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	0.9 pF
Grid to all other elements except anode	C <sub>g</sub>	=	45 pF
Anode to grid	C <sub>ag</sub>	=	23.5 pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	12 kV
Anode current	I <sub>a</sub>	=	2 A
Amplification factor	μ	=	21
Mutual conductance	S	=	25 mA/V

### TEMPERATURE LIMITS (Absolute limits)

Temperature of all seals	= max.	220 °C
Water inlet temperature t <sub>i</sub>	= max.	50 °C

**COOLING:** Generally a low velocity air flow to the seals is required

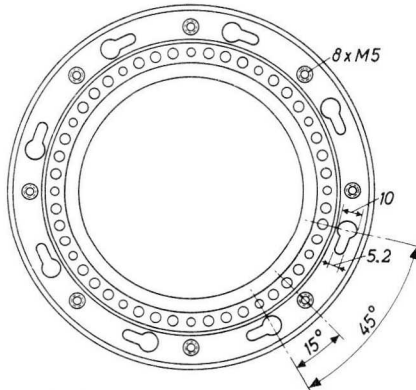
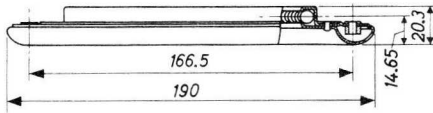
**WATER COOLING CHARACTERISTICS.** See also page A

$W_a$ (kW)	$t_i$ (°C)	$Q_{min}$ (l/min)	$P_i$ (atm.)
5	20	6	0.02
	50	15	0.22
10	20	11	0.1
	50	25	0.7
15	20	16	0.25
	50	37	1.3
20	20	22	0.5
	50	49	2.3

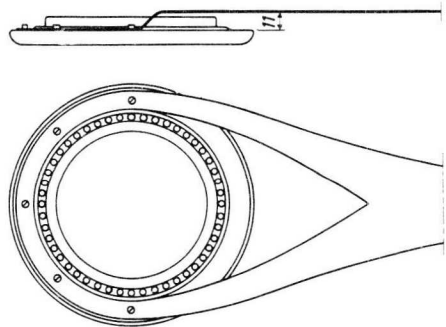
At water inlet temperatures between 20 °C and 50 °C the required quantity of water can be found by proportional interpolation

**MECHANICAL DATA**

Dimensions in mm



Grid connector 40663



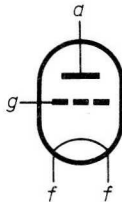
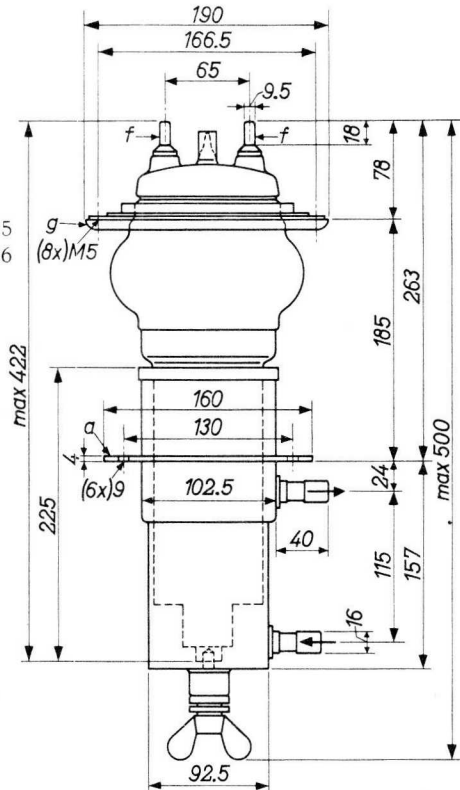
Connection of the grid lead

The rounded side of the grid connector should face the anode. To ensure a uniform RF current distribution in the grid seal at frequencies higher than 4 MHz, the grid lead should be connected as shown in the figure at right. 7Z2 3563

**MECHANICAL DATA** (continued)

Dimensions in mm

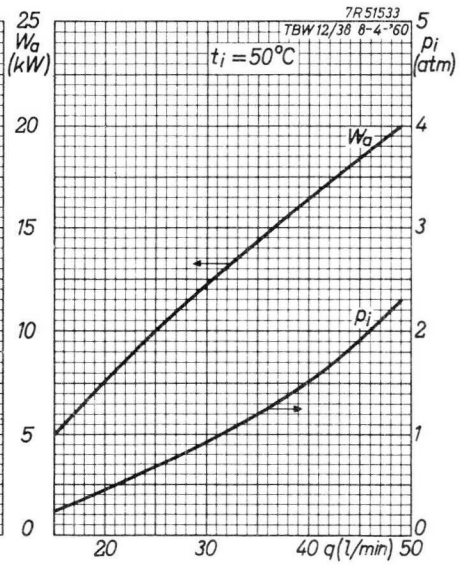
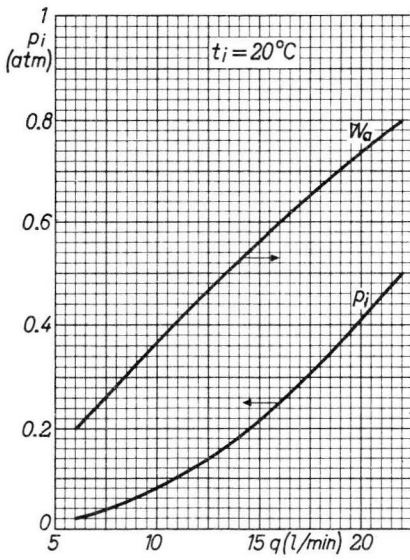
Water jacket	:	K722
Filament connectors	:	40662
Grid connector	:	40663
Net weight of the tube	:	3.0 kg
Net weight of water jacket	:	2.7 kg
→ O-ring	large	: 2622 080 30895
	small	: 2622 080 30736



Tube mounted in water jacket

Mounting position: vertical with anode down

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 For further data and curves (except cooling curves)  
 please refer to type TBH 12/38  
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## WATER COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA									
General purposes									
$\lambda$ (m)	Freq. (MHz)	C telegr.		B teleph.		C an. mod.		B mod. 1)	
		$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)	$V_a$ (kV)	$W_o$ (kW)
20	15	12	108	12	51.5	10	80	12	202
15	20	12	94.5			10	54.5	10	116
12	25	11	70			9	42.5	10	77
11	27.5	10.5	59			8.5	36.5	9	62
10	30	10	50			8	31	8.5	54
								8	46.8
Television service									
Freq. (MHz)		Neg. mod., pos. sync. 1)							
		$V_a$ (kV)				$W_o$ sync (kW)			
48-68		6.5				100 2)			

**HEATING:** direct; filament thoriated tungsten

Filament voltage	$V_f = 17.5$ V
Filament current	$I_f = 196$ A
Cold filament resistance	$R_{fo} = 0.012$ $\Omega$

The filament current must never exceed a peak value of 420 A at any time during the initial energizing schedule

### CAPACITANCES

Anode to all other elements except grid	$C_a = 3.4$ pF
Grid to all other elements except anode	$C_g = 116$ pF
Anode to grid	$C_{ag} = 86$ pF

1) Two tubes

2) Power transferred from driving stage included

**TYPICAL CHARACTERISTICS**

Anode voltage	$V_a$	=	3	10	kV
Anode current	$I_a$	=	50	5	A
Amplification factor	$\mu$	=	-	27	
Mutual conductance	$S$	=	-	50	mA/V
Maximum mutual conductance	$S_{max}$	=	92	-	mA/V

**TEMPERATURE LIMITS** (Absolute limits)

Water inlet temperature	$t_i$	= max.	50	°C
Temperature of seals		= max.	180	°C

**WATER COOLING CHARACTERISTICS;** see also cooling curves

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)
30	20	25	0.15
	50	45	0.45
50	20	32	0.25
	50	65	0.85
100	20	55	0.6
	50	120	3.0

At water inlet temperatures between 20 and 50 °C the required quantity of water can be found by proportional interpolation.

To keep the seal temperatures below 180 °C it will often be necessary to direct an air flow of sufficient velocity to the seals. This air flow must be started upon or before the application of the filament voltage.

Anode and grid seals can be cooled by connecting a blower of suitable size to the air inlet of the anticorona ring, attached to the tube. At frequencies below 6 MHz air cooling will, as a rule, not be necessary. Above 6 MHz air cooling must be used in order to prevent overheating of anode and grid seals.

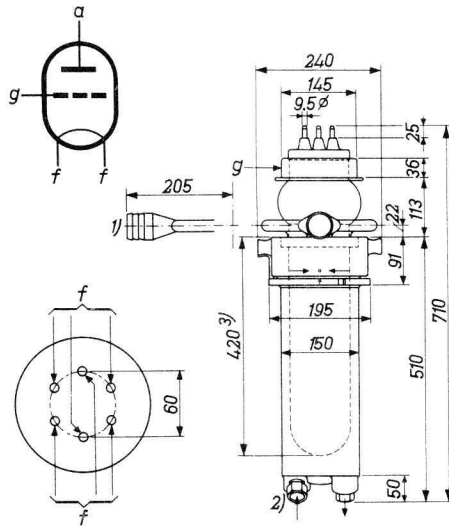
At maximum frequency (30 MHz) and at the published operating conditions at least 2.5 m<sup>3</sup> per minute is required with a pressure loss of about 500 mm water column.

## MECHANICAL DATA

Dimensions in mm

Water jacket : K714  
 Filament connectors: 40628  
 O-ring : 2622 080 30916

Net weight of tube : 14 kg  
 Net weight of water-jacket: 20.5 kg



Mounting position: vertical with anode down

When connecting the filament the three pins of each group must be joined.

When using the special filament connectors type No. 40628, together with connecting leads of adequate cross-section, additional air cooling of the filament terminals is, as a rule, not necessary.

Care should be taken to ensure form contact of the filament terminals in order to obtain equal distribution of current over these terminals.

1) Use connecting hose with an inner diameter of  $1\frac{3}{4}$ ".

2) Coupling for metal tubing with an outer diameter of 28 mm.

3) For removing the tube from its water-jacket the free height above the tube must be at least 420 mm.

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (absolute limits)

Frequency	f	up to	4	15	30	MHz
Anode voltage	$V_a$	max.	15	13.5	10	kV
Anode current	$I_a$	max.	12	12	10	A
Anode input power	$W_{ia}$	max.	162	162	80	kW
Anode dissipation	$W_a$	max.		50		kW
Negative grid voltage	$-V_g$	max.		1200		V
Grid current	$I_g$	max.		3		A

**OPERATING CONDITIONS**

Wavelength	$\lambda$	=	20	15	12	11	10	m
Frequency	f	=	15	20	25	27.5	30	MHz
Anode voltage	$V_a$	=	12	12	11	10.5	10	kV
Grid voltage	$V_g$	=	-1000	-1000	-900	-850	-800	V
Anode current	$I_a$	=	12	10.5	8.5	7.5	6.7	A
Grid current	$I_g$	=	2.25	2	1.6	1.5	1.4	A
Peak grid A.C. voltage	$V_{gp}$	=	1700	1650	1450	1350	1300	V
Grid input power	$W_{ig}$	=	3.5	3	2.1	1.9	1.7	kW
Anode input power	$W_{ia}$	=	144	126	93.5	79	67	kW
Anode dissipation	$W_a$	=	36	31.5	23.5	20	17	kW
Output power	$W_o$	=	108	94.5	70	59	50	kW
Efficiency	$\eta$	=	75	75	75	75	75	%

**R.F. CLASS B TELEPHONY** (two tubes)**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 4	up to 15	MHz
Anode voltage	$V_a$	= max. 15	max. 13.5	kV
Anode current	$I_a$	= max. 12.5		A
Anode input power	$W_{i_a}$	= max. 150		kW
Anode dissipation	$W_a$	= max. 100		kW

**OPERATING CONDITIONS** (two tubes)

Wavelength	$\lambda$	= 20	m
Frequency	f	= 15	MHz
Anode voltage	$V_a$	= 12	kV
Grid voltage	$V_g$	= -420	V
Anode current	$I_a$	= 12.2	A
Peak grid A.C. voltage	$V_{gp}$	= 700	V
Anode input power	$W_{i_a}$	= 146	kW
Anode dissipation	$W_a$	= 94.5	kW
Output power	$W_o$	= 51.5	kW
Efficiency	$\eta$	= 35	%
Modulation depth	m	= 100	%
Grid current	$I_g$	= 4.5	A
Grid input power	$W_{ig}$	= 5.7	kW



**R.F. CLASS C ANODE MODULATION**

**LIMITING VALUES (Absolute limits)**

Frequency	f	up to	15	20	30	MHz
Anode voltage	$V_a$	= max.	10	10	8	kV
Anode input power	$W_{ia}$	= max.	105	80	50	kW
Anode dissipation	$W_a$	= max.	30			kW
Anode current	$I_a$	= max.	10.5			A
Negative grid voltage	$-V_g$	= max.	1200			V
Grid current	$I_g$	= max.	3.5			A

**OPERATING CONDITIONS**

f	=	15	15	20	25	27.5	30	MHz
$V_a$	=	10	10	10	9	8.5	8	kV
$V_g$	=	-1050	-1050	-1050	-925	-900	-850	V <sup>1)</sup>
$I_a$	=	10.5	8.5	7.0	6.2	5.7	5.25	A
$I_g$	=	3.5	2.6	2.0	2.0	1.9	1.8	A
$V_{gp}$	=	1960	1750	1650	1500	1450	1400	V
$W_{ig}$	=	6.2	4.1	3.0	2.7	2.5	2.3	kW
$W_{ia}$	=	105	85	70	56	48.5	42	kW
$W_a$	=	25	17	15.5	13.5	12	11	kW
$W_o$	=	80	68	54.5	42.5	36.5	31	kW
$\eta$	=	76	80	78	76	75	74	%
m	=	100	100	100	100	100	100	%
$W_{mod}$	=	52.5	42.5	35	28	24.5	21	kW

<sup>1)</sup> Grid bias partially obtained by the grid resistor

## A.F. CLASS B AMPLIFIER AND MODULATOR

## LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	= max.	15	kV
Anode current	$I_a$	= max.	12	A
Anode input power	$W_{ia}$	= max.	162	kW
Anode dissipation	$W_a$	= max.	50	kW
Grid circuit resistance	$R_g$	= max.	20	k $\Omega$

## OPERATING CONDITIONS, two tubes

$V_a$	=	12	10	10	kV
$V_g$	=	-450	-375	-400	V
$R_{aa\sim}$	=	1200	1500	2060	$\Omega$
$V_{ggp}$	=	0      2060	0      1680	0      1460	V
$I_a$	=	2x0.65    2x12	2x0.5    2x7.9	2x0.2    2x5.4	A
$I_g$	=	0    2x2.5	0    2x1.9	0    2x0.7	A
$W_{ig}$	=	0    2x2.4	0    2x1.44	0    2x0.5	kW
$W_{ia}$	=	2x7.8    2x144	2x5    2x79	2x2    2x54	kW
$W_a$	=	2x7.8    2x43	2x5    2x21	2x2    2x15.5	kW
$W_o$	=	0    202	0    116	0    77	kW
$\eta$	=	-    70	-    75	-    71	%

$V_a$	=	9	8.5	8	kV
$V_g$	=	-350	-325	-300	V
$R_{aa\sim}$	=	2080	2120	2210	$\Omega$
$V_{ggp}$	=	0      1300	0      1200	0      1120	V
$I_a$	=	2x0.25    2x4.8	2x0.25    2x4.4	2x0.25    2x4.1	A
$I_g$	=	0    2x0.65	0    2x0.55	0    2x0.4	A
$W_{ig}$	=	0    2x0.4	0    2x0.3	0    2x0.25	kW
$W_{ia}$	=	2x2.25    2x43.2	2x2.1    2x37.4	2x2    2x32.8	kW
$W_a$	=	2x2.25    2x12.2	2x2.1    2x10.4	2x2    2x9.4	kW
$W_o$	=	0    62	0    54	0    46.8	kW
$\eta$	=	-    72	-    72	-    71	%

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**R.F. CLASS B AMPLIFIER** for television service, negative modulation, positive synchronisation

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	68	MHz
Anode voltage	$V_a$	= max.	6.5	kV
Anode current	$I_a$	sync = max.	16	A
Anode input power	$W_{ia}$	sync = max.	100	kW
Anode dissipation	$W_a$	sync = max.	50	kW
Grid current	$I_g$	sync = max.	2	A

**OPERATING CONDITIONS**, two tubes in push-pull

Frequency	f	=	48 to 68	MHz <sup>1)</sup>
Bandwidth (-1.5 dB)	B	=	5.5	MHz <sup>2)</sup>
Bandwidth (-3 dB)	B	=	7.5	MHz <sup>2)</sup>
Anode voltage	$V_a$	=	6.5	kV
Grid voltage	$V_g$	=	-250	V
Peak grid to grid A.C. voltage	$V_{ggp}$	sync =	1740	V <sup>3)</sup>
		black =	1300	V <sup>3)</sup>
Anode current	$I_a$	sync =	32	A
		black =	24	A
Grid current	$I_g$	sync =	3.4	A
		black =	2.2	A
Grid input power	$W_{ig}$	sync =	22.4	kW <sup>4)</sup>
Output power	$W_o$	sync =	80+20	kW <sup>5)</sup>
		black =	45+11	kW <sup>5)</sup>

<sup>1)</sup> In the frequency range of 60 to 68 MHz a special version of the tube is necessary.

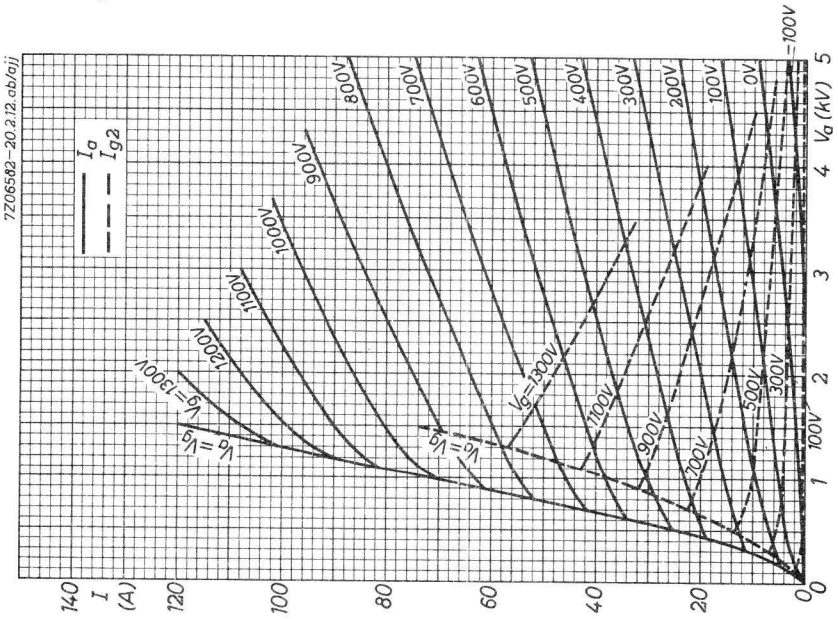
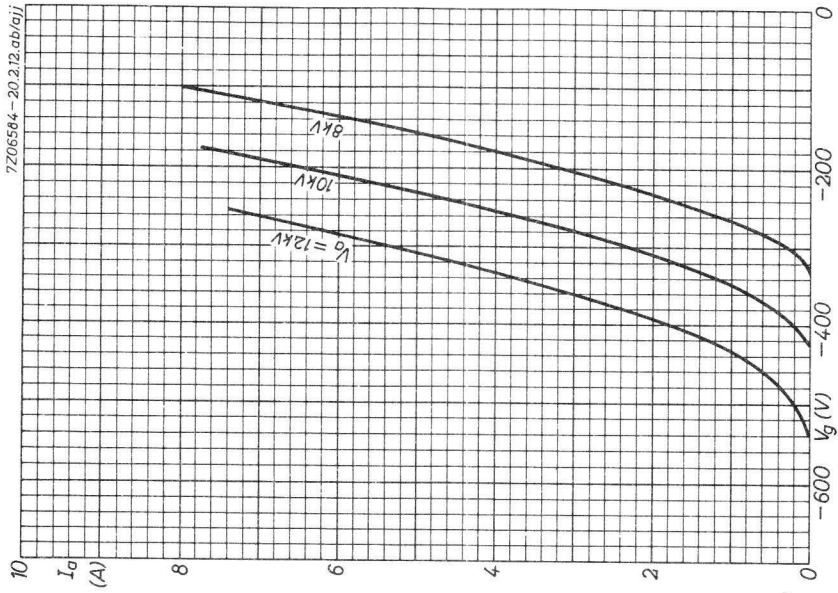
<sup>2)</sup> This value of bandwidth is based on measurements on a circuit with a single LC section

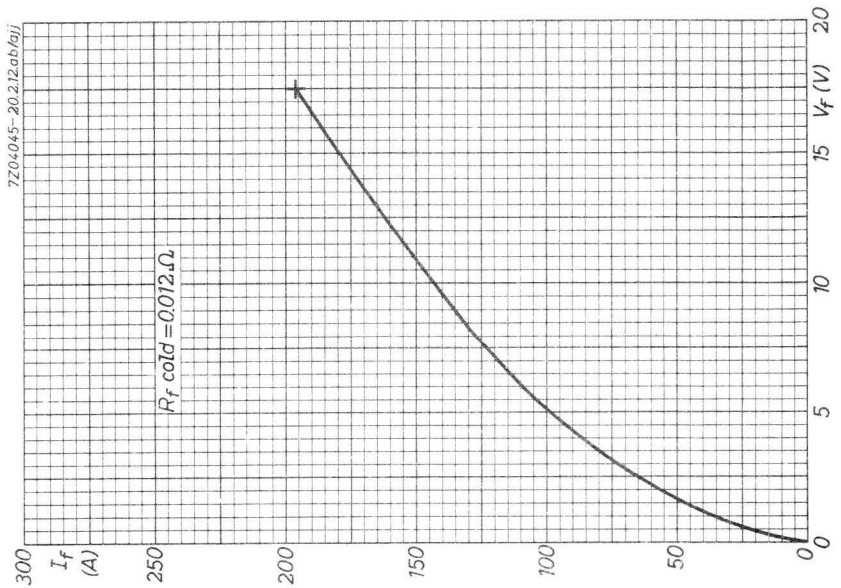
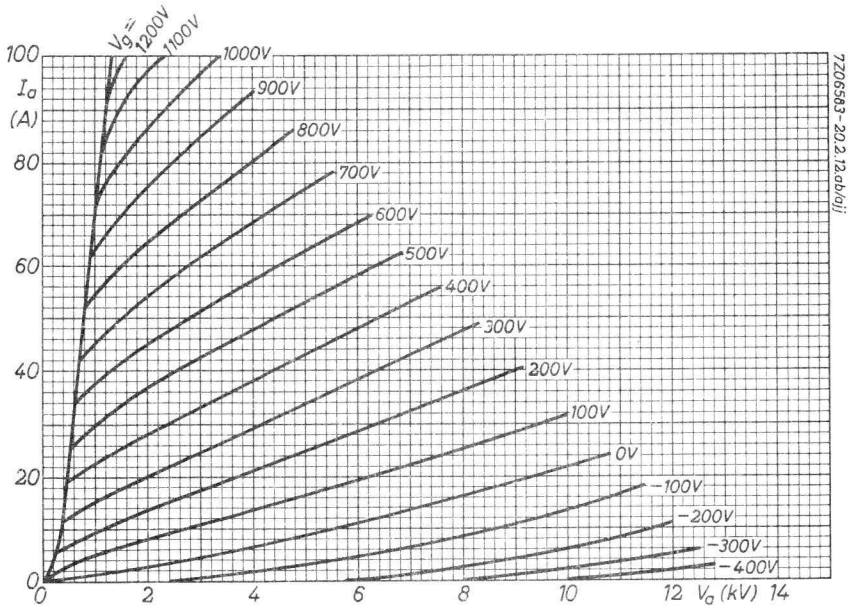
<sup>3)</sup> Measured by the slide back method

<sup>4)</sup> Driving power is accounted for largely by circuit losses. The indicated driving power is required to take care of losses in damping resistors, circuit losses and tube driving power.

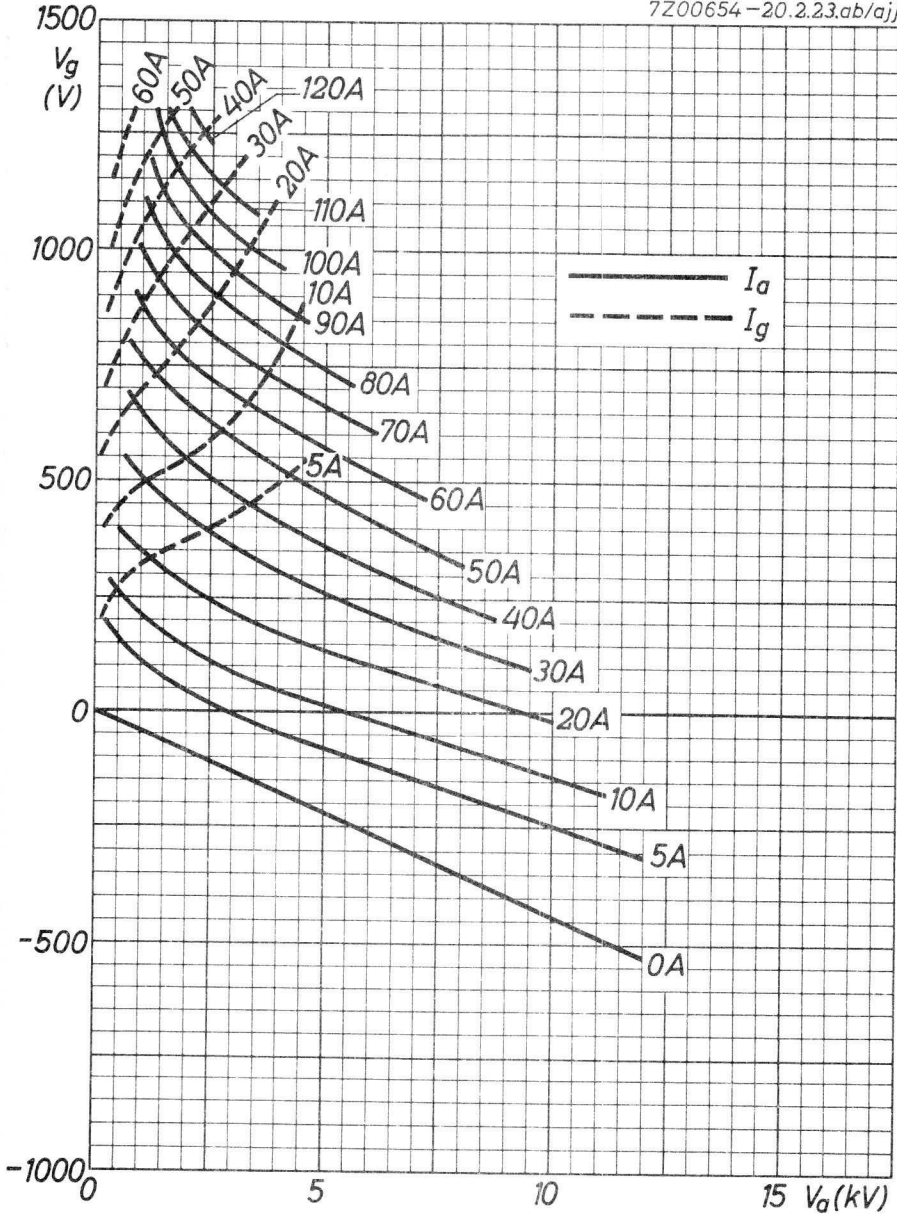
<sup>5)</sup> Power transferred from driving stage included.



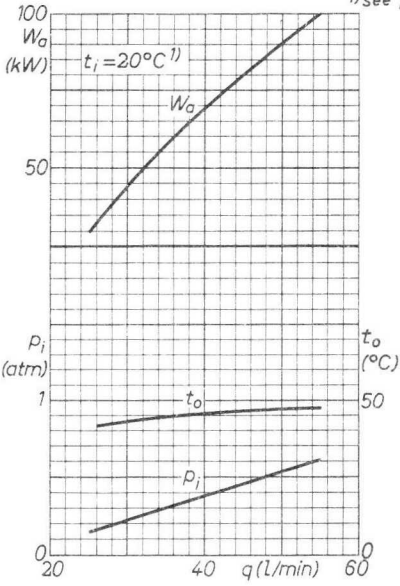




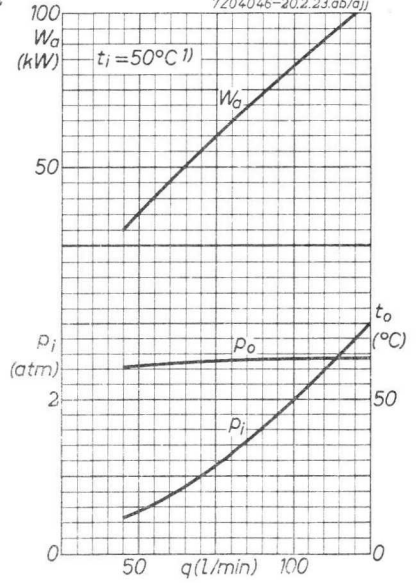
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1) see page 2

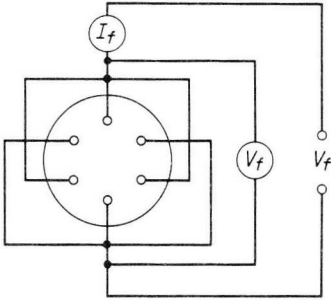


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## WATER COOLED R.F. POWER TRIODE

This type is equivalent to type TBW12/100 except for the filament data

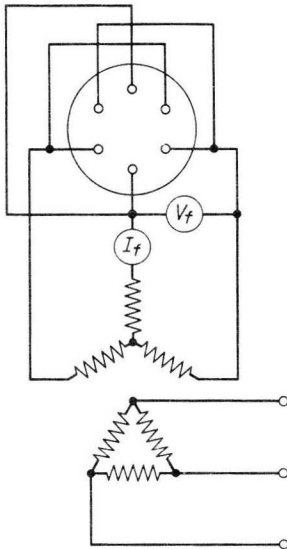


### Single-phase filament energizing

$$V_f = 17.5 \text{ V}$$

$$I_f = 196 \text{ A}$$

Filament current must never exceed a peak value of 420 A at any time during the initial energizing schedule



### Three-phase filament energizing

$$V_f = 15.5 \text{ V}$$

$$I_f = 131 \text{ A}$$

Filament current must never exceed a peak value of 280 A at any time during the initial energizing schedule

A safety device must be used to prevent filament energizing with one phase interrupted.

7Z2 3596



## WATER COOLED R.F. POWER TRIODE

### QUICK REFERENCE DATA

Frequency (MHz)	C telegraphy		C anode mod.		RF class B		AF class B Two tubes	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	15	120			15	110	12	78
30	12	90	11	66	12	110	10	78

**HEATING:** direct by A.C. or D.C.; filament thoriated tungsten

Filament voltage  $V_f = 12.6$  V

Filament current  $I_f = 160$  A

### CAPACITANCES

Grid to filament  $C_{gf} = 120$  pF

Anode to filament  $C_{af} = 1.4$  pF

Anode to grid  $C_{ag} = 50$  pF

### TYPICAL CHARACTERISTICS

Anode voltage  $V_a = 3$  kV

Anode current  $I_a = 1$  A

Amplification factor  $\mu = 58$

Mutual conductance  $S = 60$  mA/V

### TEMPERATURE LIMITS (Absolute limits)

Bulb temperature  $t = \text{max. } 220$  °C

Seal temperature  $t = \text{max. } 220$  °C

### COOLING

For cooling data see cooling curves.

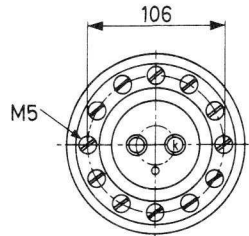
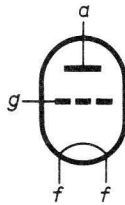
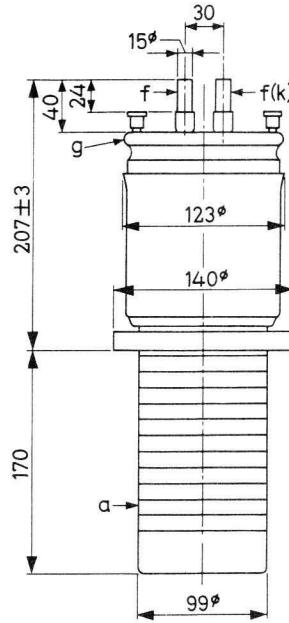
For water inlet temperatures between 20 °C and 50 °C the required quantity of water can be found by proportional interpolation.

At frequencies higher than 10 MHz a low velocity air flow should be directed to the grid and filament seals.

## MECHANICAL DATA

Net weight: 6.2 kg

Dimensions in mm



Mounting position: vertical with anode down

## ACCESSORIES

Water jacket	K724
Filament connector	40670
Grid connector	40671



R.F. CLASS C TELEGRAPHY or F.M. TELEPHONY

LIMITING VALUES (Absolute limits)

Frequency	f	up to 10	up to 30	MHz
Anode voltage	$V_a$	= max. 16	max. 12.5	kV
Anode dissipation	$W_a$	= max. 45	max. 45	kW
Negative grid voltage	$-V_g$	= max. 1000	max. 1000	V
Grid dissipation	$W_g$	= max. 1.3	max. 1.3	kW
Anode current	$I_a$	= max. 13	max. 13	A
Grid current	$I_g$	= max. 3.3	max. 3.3	A

OPERATING CONDITIONS

Frequency	f	= 10	30	30	30	MHz
Anode voltage	$V_a$	= 15	12	10	8	kV
Grid voltage	$V_g$	= -600	-550	-500	-450	V
Anode current	$I_a$	= 9.75	9.25	9.0	8.75	A
Grid current	$I_g$	= 2.2	2.2	2.1	1.85	A
Peak grid driving voltage	$V_{gp}$	= 1000	940	875	810	V
Grid driving power	$W_{dr}$	= 2.1	1.9	1.7	1.55	kW
Anode input power	$W_{i_a}$	= 146	111	90	70	kW
Anode dissipation	$W_a$	= 26	21	18	15	kW
Output power	$W_o$	= 120	90	72	55	kW
Efficiency	$\eta$	= 82	81	80	78.5	%



**R.F. CLASS B AMPLIFIER**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 10	up to 30	MHz
Anode voltage	$V_a$	= max. 16	max. 12.5	kV
Anode dissipation	$W_a$	= max. 45	max. 45	kW
Negative grid voltage	$-V_g$	= max. 1000	max. 1000	V
Grid dissipation	$W_g$	= max. 1.3	max. 1.3	kW
Anode current	$I_a$	= max. 13	max. 13	A
Grid current	$I_g$	= max. 3.3	max. 3.3	A

**OPERATING CONDITIONS**

Frequency	f	10	10	30	30	MHz
Anode voltage	$V_a$	= 15	15	12	12	kV
Grid voltage	$V_g$	= -260	-260	-210	-210	V
Anode current	$I_a$	= 10.1	7.75	12.7	9.85	A
Grid current	$I_g$	= 2.0	1.3	3.0	1.9	A
Peak grid driving voltage	$V_{gp}$	= 600	520	650	520	V
Grid driving power	$W_{dr}$	= 1080	610	1770	880	W
Anode input power	$W_{ia}$	= 151	116.3	153	118	kW
Anode dissipation	$W_a$	= 41	31.3	43	33	kW
Output power	$W_o$	= 110	85	110	85	kW
Efficiency	$\eta$	= 73	73	72	72	%

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	11.5	kV
Anode dissipation	$W_a$	= max.	30	kW
Negative grid voltage	$-V_g$	= max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	kW
Anode current	$I_a$	= max.	9	A
Grid current	$I_g$	= max.	3.3	A

## OPERATING CONDITIONS

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	11	10	kV
Grid voltage	$V_g$	=	-480	-440	V <sup>1)</sup>
Anode current	$I_a$	=	7.6	6.9	A
Grid current	$I_g$	=	3.1	3.1	A
Grid resistor	$R_g$	=	90	80	$\Omega$
Peak grid driving voltage	$V_{gp}$	=	880	810	V
Grid driving power	$W_{dr}$	=	2.7	2.4	kW
Anode input power	$W_{i_a}$	=	83.6	69	kW
Anode dissipation	$W_a$	=	17.6	14	kW
Output power	$W_o$	=	66	55	kW
Efficiency	$\eta$	=	79	79	%
Modulation depth	m	=	100	100	%
Modulation power	$W_{mod}$	=	41.8	34.5	kW

<sup>1)</sup> Partially obtained by the grid resistor and grid current.

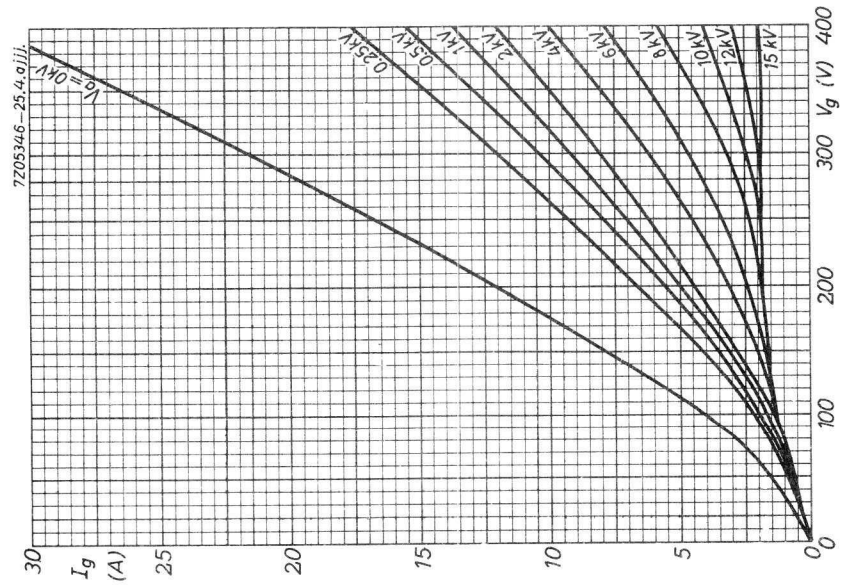
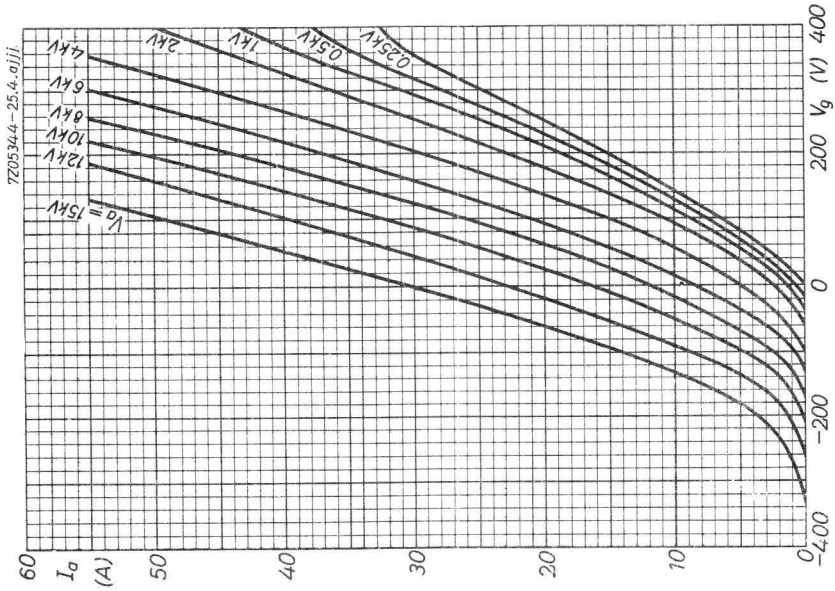
## A.F. CLASS B AMPLIFIER AND MODULATOR

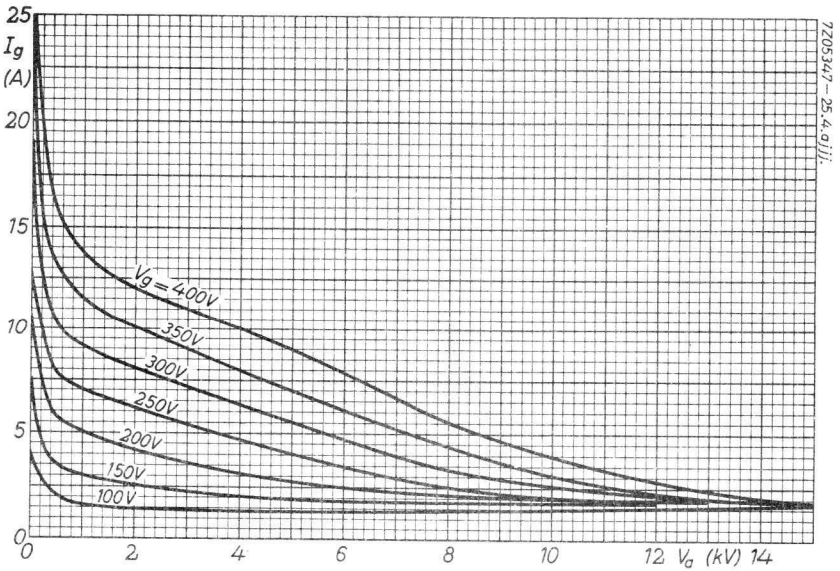
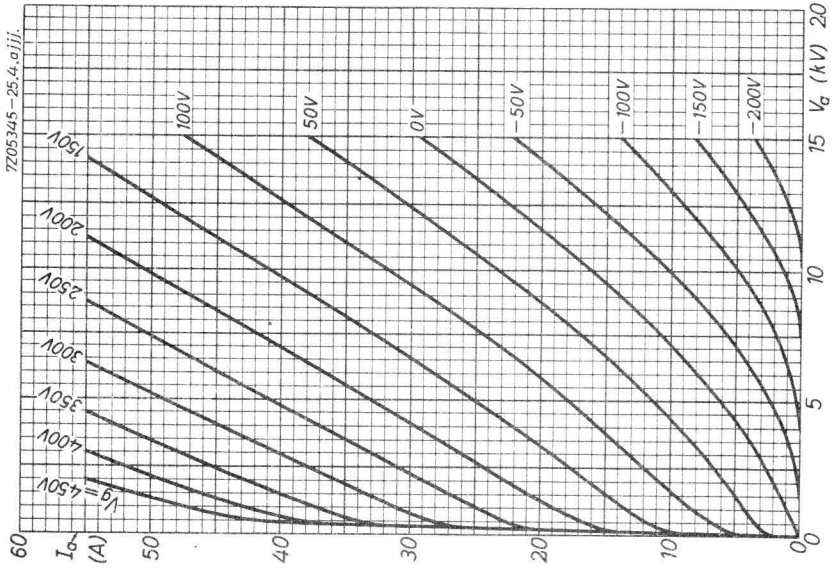
### LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	= max.	12	kV
Anode dissipation	$W_a$	= max.	45	kW
Negative grid voltage	$-V_g$	= max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	kW
Anode current	$I_a$	= max.	13	A
Grid current	$I_g$	= max.	3.3	A

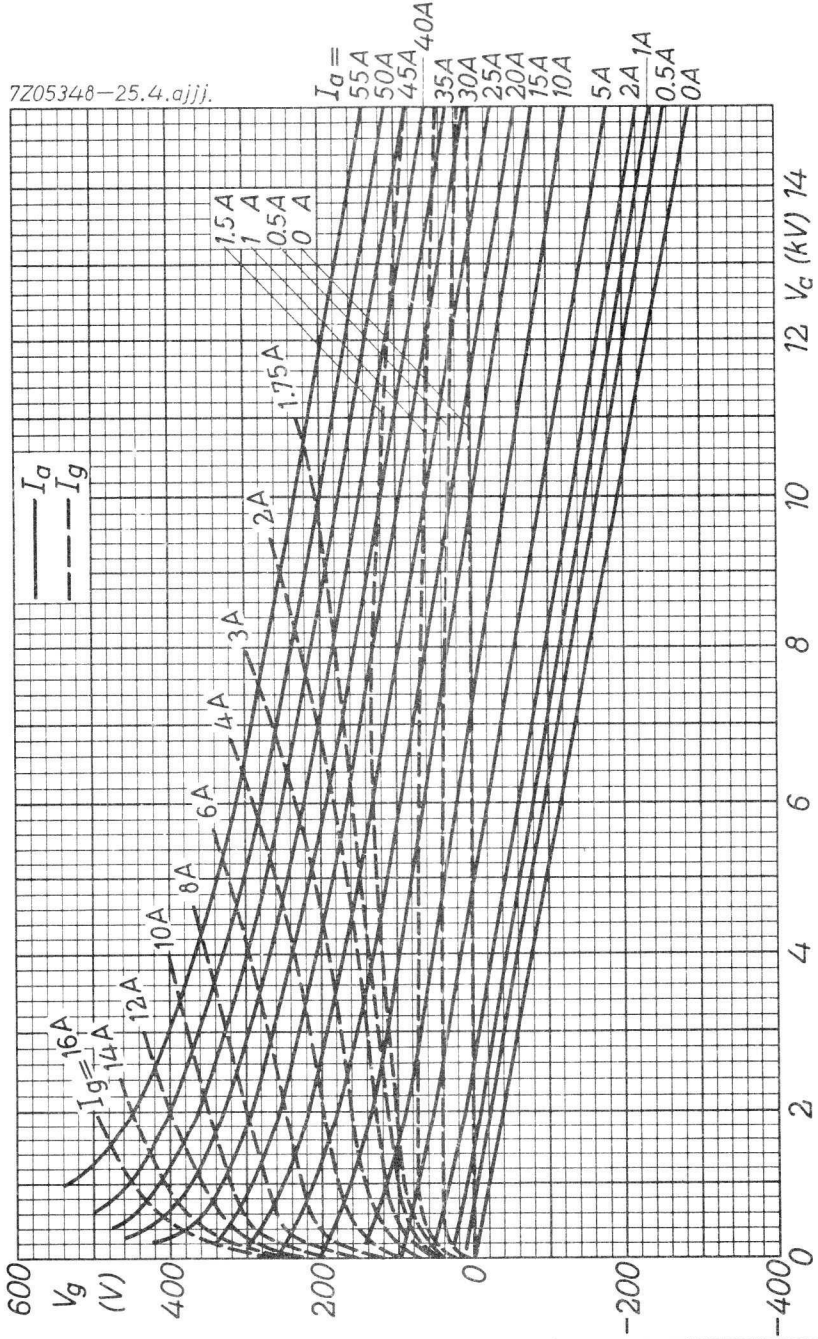
### OPERATING CONDITIONS (two tubes in push-pull)

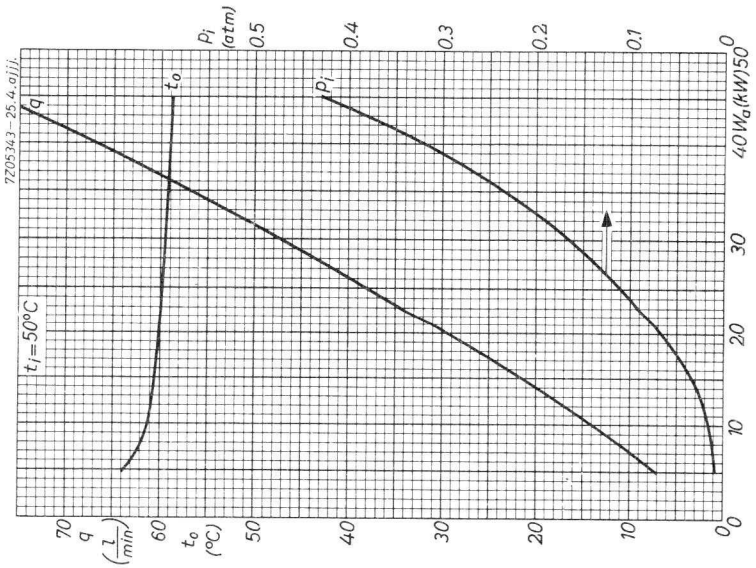
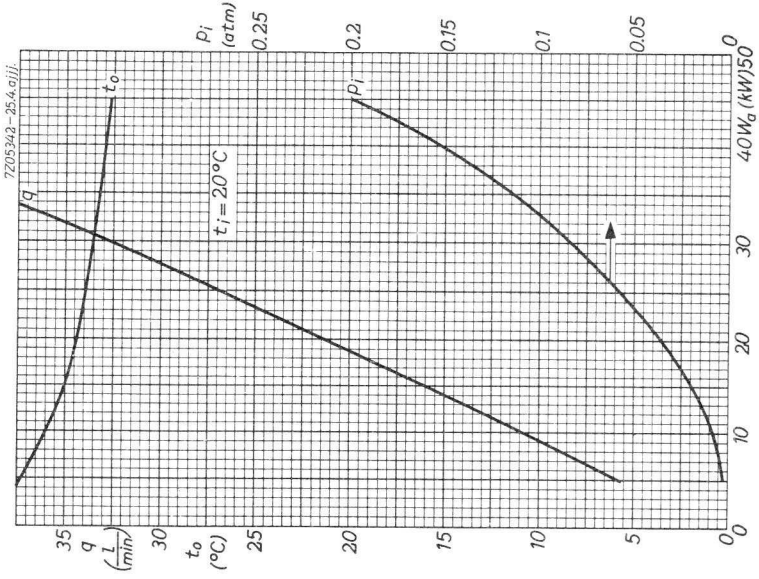
Anode voltage	$V_a$	=	12	10	kV		
Grid voltage	$V_g$	=	-205	-170	V		
Load resistance	$R_{aa\sim}$	=	2720	1810	$\Omega$		
Peak grid driving voltage	$V_{ggp}$	=	0	710	0	710	V
Anode current	$I_a$	=	2x0.4	2x4.75	2x0.4	2x5.75	A
Average grid current	$I_g$	=	0	2x0.45	0	2x0.72	A
Peak grid current	$I_{gp}$	=	0	2x2.9	0	2x4.0	A
Grid driving power	$W_{dr}$	=	0	2x150	0	2x235	W
Anode input power	$W_{i_a}$	=	2x4.0	2x57	2x4.0	2x57.5	kW
Anode dissipation	$W_a$	=	2x4.0	2x18	2x4.0	2x18.5	kW
Output power	$W_o$	=	0	78	0	78	kW
Efficiency	$\eta$	=	-	68.5	-	68	%





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## AIR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA								
Frequency (MHz)	C telegraphy		C anode mod.		RF class B		AF class B Two tubes	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	15	120			15	110	12	78
30	12	90	11	66	12	110	10	78

**HEATING:** direct by A.C. or D.C.; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	12.6	V
Filament current	I <sub>f</sub>	=	160	A

**CAPACITANCES**

Grid to filament	C <sub>gf</sub>	=	120	pF
Anode to filament	C <sub>af</sub>	=	1.4	pF
Anode to grid	C <sub>ag</sub>	=	50	pF

**TYPICAL CHARACTERISTICS**

Anode voltage	V <sub>a</sub>	=	3	kV
Anode current	I <sub>a</sub>	=	1	A
Amplification factor	μ	=	58	
Mutual conductance	S	=	60	mA/V

**TEMPERATURE LIMITS** (Absolute limits)

Bulb temperature	t	=	max. 220	°C
Seal temperature	t	=	max. 220	°C

**COOLING**

For cooling data see cooling curves. These curves are for an air inlet temperature of 25 °C.

At lower temperatures the amount of air should be the same.

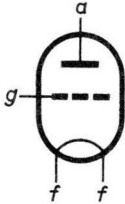
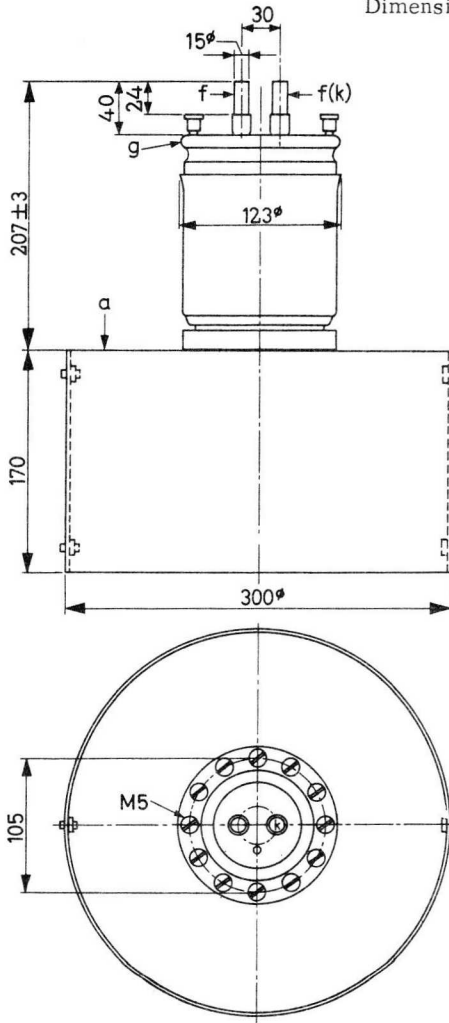
At higher temperatures the amount of air should be increased so that the outlet air temperature is not higher than at t<sub>i</sub> = 25 °C.

At frequencies higher than 10 MHz a low velocity air flow should be directed to the grid and filament seals.

MECHANICAL DATA

Net weight: 39 kg

Dimensions in mm



ACCESSORIES

Insulating pedestal	40672
Filament connector	40670
Grid connector	40671

Mounting position: vertical  
with anode down

## R.F. CLASS C TELEGRAPHY or F.M. TELEPHONY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	10	up to	30	MHz
Anode voltage	$V_a$	= max.	16	max.	12.5	kV
Anode dissipation	$W_a$	= max.	35	max.	35	kW
Negative grid voltage	$-V_g$	= max.	1000	max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	max.	1.3	kW
Anode current	$I_a$	= max.	13	max.	13	A
Grid current	$I_g$	= max.	3.3	max.	3.3	A

## OPERATING CONDITIONS

Frequency	f	=	10	30	30	30	MHz
Anode voltage	$V_a$	=	15	12	10	8	kV
Grid voltage	$V_g$	=	-600	-550	-500	-450	V
Anode current	$I_a$	=	9.75	9.25	9.0	8.75	A
Grid current	$I_g$	=	2.2	2.2	2.1	1.85	A
Peak grid driving voltage	$V_{gp}$	=	1000	940	875	810	V
Grid driving power	$W_{dr}$	=	2.1	1.9	1.7	1.55	kW
Anode input power	$W_{ia}$	=	146	111	90	70	kW
Anode dissipation	$W_a$	=	26	21	18	15	kW
Output power	$W_o$	=	120	90	72	55	kW
Efficiency	$\eta$	=	82	81	80	78.5	%



**R.F. CLASS B AMPLIFIER**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	10	up to	30	MHz
Anode voltage	$V_a$	= max.	16	max.	12.5	kV
Anode dissipation	$W_a$	= max.	35	max.	35	kW
Negative grid voltage	$-V_g$	= max.	1000	max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	max.	1.3	kW
Anode current	$I_a$	= max.	13	max.	13	A
Grid current	$I_g$	= max.	3.3	max.	3.3	A

**OPERATING CONDITIONS**

Frequency	f	=	10	10	30	30	MHz
Anode voltage	$V_a$	=	15	15	12	12	kV
Grid voltage	$V_g$	=	-260	-260	-210	-210	V
Anode current	$I_a$	=	10.1	7.75	12.7	9.85	A
Grid current	$I_g$	=	2.0	1.3	3.0	1.9	A
Peak grid driving voltage	$V_{gp}$	=	600	520	650	520	V
Grid driving power	$W_{dr}$	=	1080	610	1770	880	W
Anode input power	$W_{i_a}$	=	151	116.3	153	118	kW
Anode dissipation	$W_a$	=	41	31.3	43	33	kW
Output power	$W_o$	=	110	85	110	85	kW
Efficiency	$\eta$	=	73	73	72	72	%

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	11.5	kV
Anode dissipation	$W_a$	= max.	30	kW
Negative grid voltage	$-V_g$	= max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	kW
Anode current	$I_a$	= max.	9	A
Grid current	$I_g$	= max.	3.3	A

## OPERATING CONDITIONS

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	11	10	kV
Grid voltage	$V_g$	=	-480	-440	V <sup>1)</sup>
Anode current	$I_a$	=	7.6	6.9	A
Grid current	$I_g$	=	3.1	3.1	A
Grid resistor	$R_g$	=	90	80	$\Omega$
Peak grid driving voltage	$V_{gp}$	=	880	810	V
Grid driving power	$W_{dr}$	=	2.7	2.4	kW
Anode input power	$W_{i_a}$	=	83.6	69	kW
Anode dissipation	$W_a$	=	17.6	14	kW
Output power	$W_o$	=	66	55	kW
Efficiency	$\eta$	=	79	79	%
Modulation depth	m	=	100	100	%
Modulation power	$W_{mod}$	=	41.8	34.5	kW

<sup>1)</sup> Partially obtained by the grid resistor and grid current.

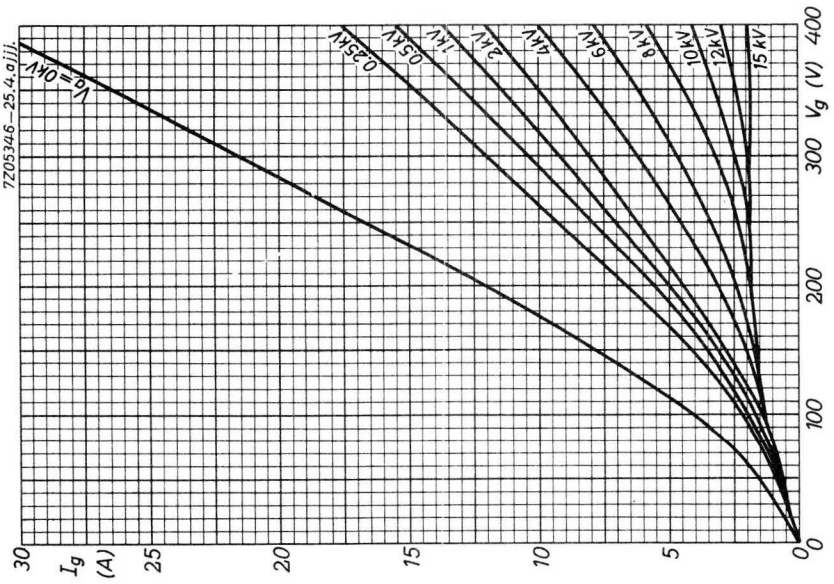
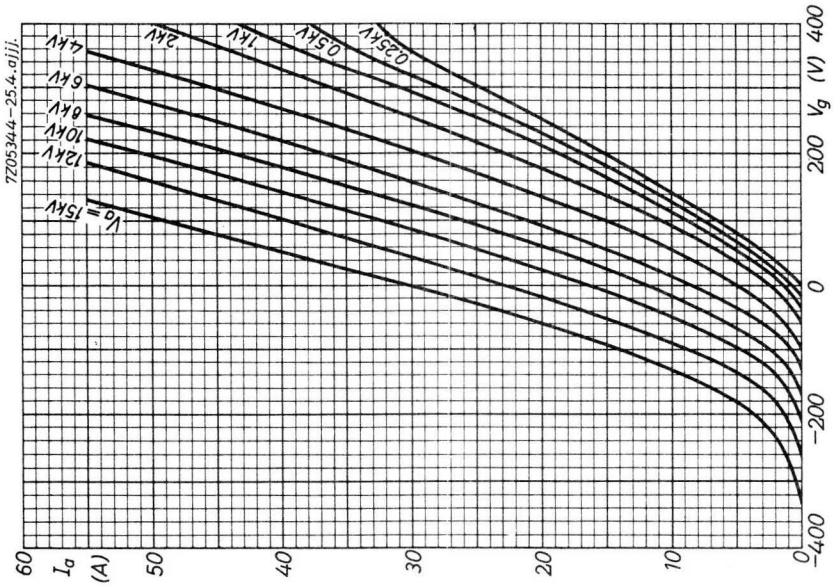
**A.F. CLASS B AMPLIFIER AND MODULATOR**

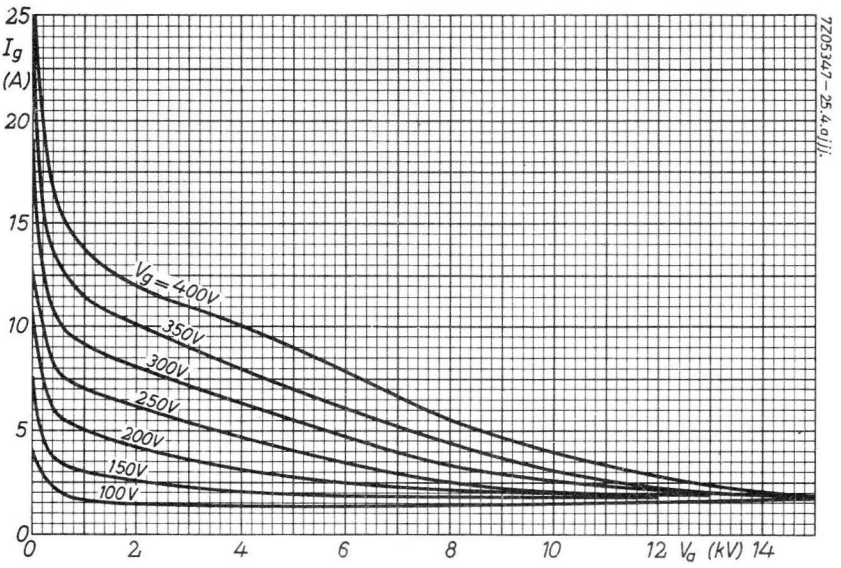
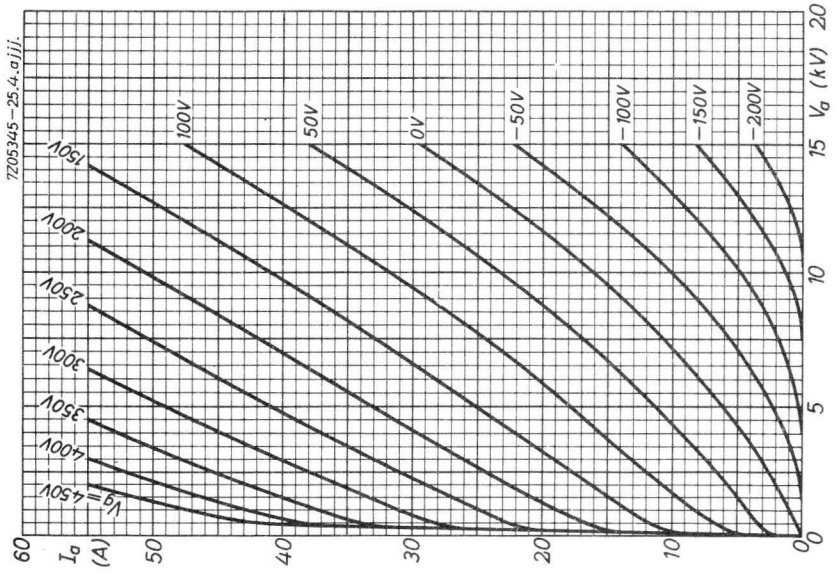
**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a = \text{max.}$	12	kV
Anode dissipation	$W_a = \text{max.}$	35	kW
Negative grid voltage	$-V_g = \text{max.}$	1000	V
Grid dissipation	$W_g = \text{max.}$	1.3	kW
Anode current	$I_a = \text{max.}$	13	A
Grid current	$I_g = \text{max.}$	3.3	A

**OPERATING CONDITIONS** (two tubes in push-pull)

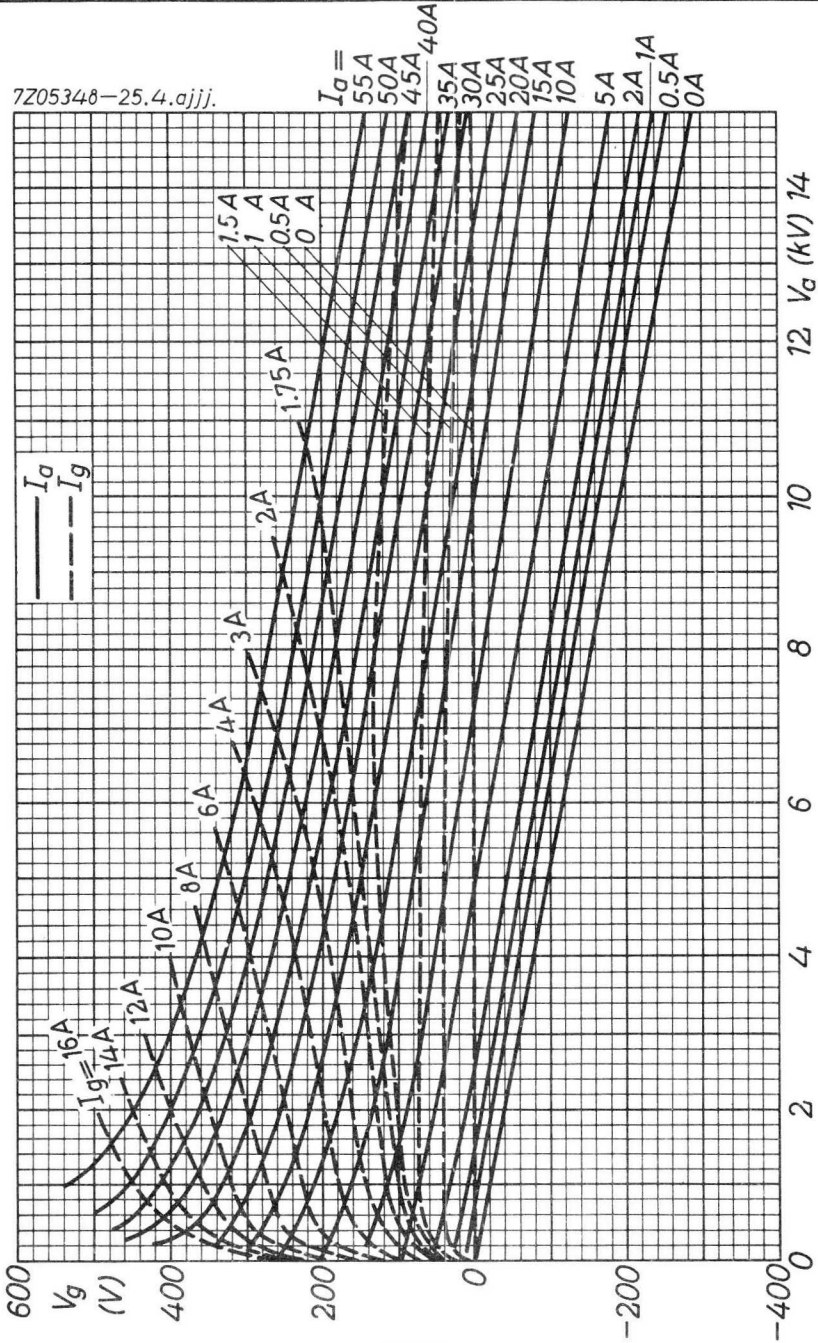
Anode voltage	$V_a =$	12	10	kV		
Grid voltage	$V_g =$	-205	-170	V		
Load resistance	$R_{aa\sim} =$	2720	1810	$\Omega$		
Peak grid driving voltage	$V_{ggp} =$	0	710	0	710	V
Anode current	$I_a =$	2x0.4	2x4.75	2x0.4	2x5.75	A
Average grid current	$I_g =$	0	2x0.45	0	2x0.72	A
Peak grid current	$I_{gp} =$	0	2x2.9	0	2x4.0	A
Grid driving power	$W_{dr} =$	0	2x150	0	2x235	W
Anode input power	$W_{i_a} =$	2x4.0	2x57	2x4.0	2x57.5	kW
Anode dissipation	$W_a =$	2x4.0	2x18	2x4.0	2x18.5	kW
Output power	$W_o =$	0	78	0	78	kW
Efficiency	$\eta =$	-	68.5	-	68	%

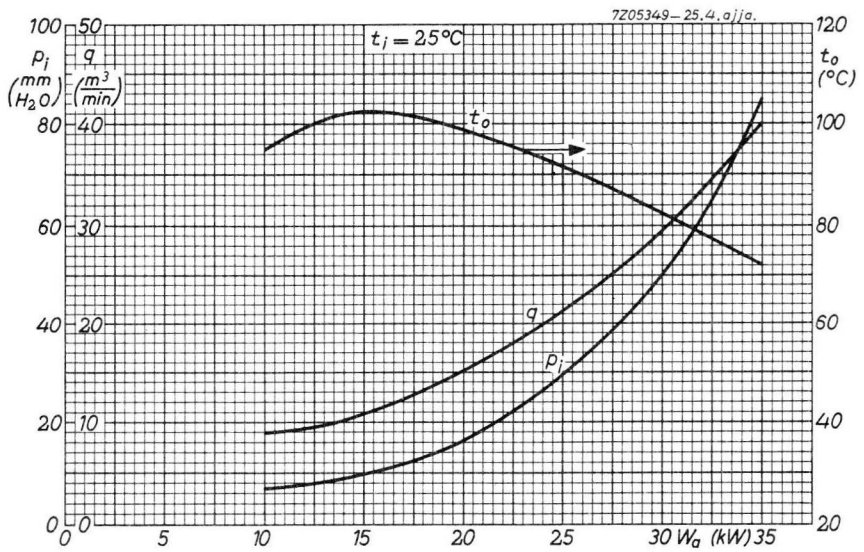






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**VAPOUR COOLED R.F. POWER TRIODE**

**QUICK REFERENCE DATA**

Frequency (MHz)	C telegraphy		C anode mod.		RF class B		AF class B Two tubes	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	15	120			15	110	12	78
30	12	90	11	66	12	110	10	78

**HEATING:** direct by A.C. or D.C.; filament thoriated tungsten

Filament voltage  $V_f = 12.6 \text{ V}$   
 Filament current  $I_f = 160 \text{ A}$

**CAPACITANCES**

Grid to filament  $C_{gf} = 120 \text{ pF}$   
 Anode to filament  $C_{af} = 1.4 \text{ pF}$   
 Anode to grid  $C_{ag} = 50 \text{ pF}$

**TYPICAL CHARACTERISTICS**

Anode voltage  $V_a = 3 \text{ kV}$   
 Anode current  $I_a = 1 \text{ A}$   
 Amplification factor  $\mu = 58$   
 Mutual conductance  $S = 60 \text{ mA/V}$

**TEMPERATURE LIMITS**

Bulb temperature  $t = \text{max. } 220 \text{ }^\circ\text{C}$   
 Seal temperature  $t = \text{max. } 220 \text{ }^\circ\text{C}$

**COOLING**

Cooling data for anode dissipation  $W_a = 60 \text{ kW}$

Total dissipation to be transferred by cooling system  
 $(W_a + W_g + 0.8 W_f) = 63 \text{ kW}$   
 equivalent to  $900 \text{ kcal/min}$

Volume of produced vapour  
 at back flow water temperature of  $20 \text{ }^\circ\text{C}$   $2.5 \text{ m}^3/\text{min}$   
 at back flow water temperature of  $90 \text{ }^\circ\text{C}$   $2.8 \text{ m}^3/\text{min}$



**COOLING** (continued)

Amount of back flowing water

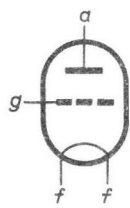
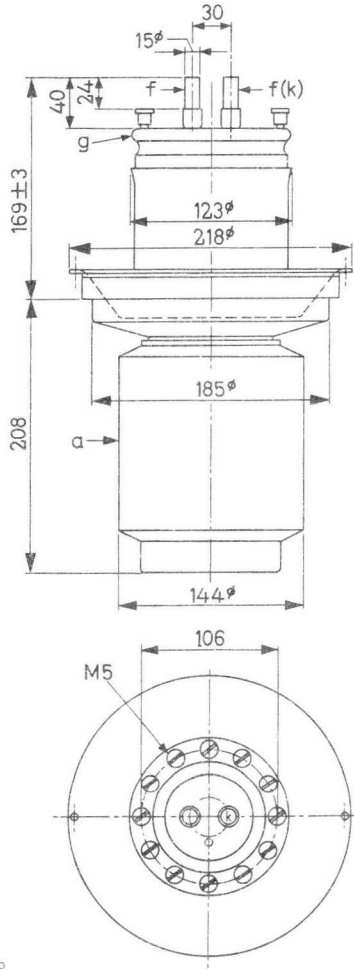
at back flow water temperature of 20 °C	1.5	l/min
at back flow water temperature of 90 °C	1.7	l/min

At frequencies higher than 10 MHz a low velocity air flow should be directed to the grid and filament seals.

**MECHANICAL DATA**

Net weight: 17 kg

Dimensions in mm



Mounting position; vertical  
with anode down

**ACCESSORIES**

Vapour cooling system	K728
Filament connectors with cable	40670
Grid connector	40671

## R.F. CLASS C TELEGRAPHY or F.M. TELEPHONY

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	10	up to	30	MHz
Anode voltage	$V_a$	= max.	16	max.	12.5	kV
Anode dissipation	$W_a$	= max.	60	max.	60	kW
Negative grid voltage	$-V_g$	= max.	1000	max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	max.	1.3	kW
Anode current	$I_a$	= max.	13	max.	13	A
Grid current	$I_g$	= max.	3.3	max.	3.3	A

## OPERATING CONDITIONS

Frequency	f	=	10	30	30	30	MHz
Anode voltage	$V_a$	=	15	12	10	8	kV
Grid voltage	$V_g$	=	-600	-550	-500	-450	V
Anode current	$I_a$	=	9.75	9.25	9.0	8.75	A
Grid current	$I_g$	=	2.2	2.2	2.1	1.85	A
Peak grid driving voltage	$V_{gp}$	=	1000	940	875	810	V
Grid driving power	$W_{dr}$	=	2.1	1.9	1.7	1.55	kW
Anode input power	$W_{ia}$	=	146	111	90	70	kW
Anode dissipation	$W_a$	=	26	21	18	15	kW
Output power	$W_o$	=	120	90	72	55	kW
Efficiency	$\eta$	=	82	81	80	78.5	%



**R.F. CLASS B AMPLIFIER**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	10	up to	30	MHz
Anode voltage	$V_a$	= max.	16	max.	12.5	kV
Anode dissipation	$W_a$	= max.	60	max.	60	kW
Negative grid voltage	$-V_g$	= max.	1000	max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	max.	1.3	kW
Anode current	$I_a$	= max.	13	max.	13	A
Grid current	$I_g$	= max.	3.3	max.	3.3	A

**OPERATING CONDITIONS**

Frequency	f	=	10	10	30	30	MHz
Anode voltage	$V_a$	=	15	15	12	12	kV
Grid voltage	$V_g$	=	-260	-260	-210	-210	V
Anode current	$I_a$	=	10.1	7.75	12.7	9.85	A
Grid current	$I_g$	=	2.0	1.3	3.0	1.9	A
Peak grid driving voltage	$V_{gp}$	=	600	520	650	520	V
Grid driving power	$W_{dr}$	=	1080	610	1770	880	W
Anode input power	$W_{i_a}$	=	151	116.3	153	118	kW
Anode dissipation	$W_a$	=	41	31.3	43	33	kW
Output power	$W_o$	=	110	85	110	85	kW
Efficiency	$\eta$	=	73	73	72	72	%

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	11.5	kV
Anode dissipation	$W_a$	= max.	30	kW
Negative grid voltage	$-V_g$	= max.	1000	V
Grid dissipation	$W_g$	= max.	1.3	kW
Anode current	$I_a$	= max.	9	A
Grid current	$I_g$	= max.	3.3	A

## OPERATING CONDITIONS

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	11	10	kV
Grid voltage	$V_g$	=	-480	-440	V <sup>1)</sup>
Anode current	$I_a$	=	7.6	6.9	A
Grid current	$I_g$	=	3.1	3.1	A
Grid resistor	$R_g$	=	90	80	$\Omega$
Peak grid driving voltage	$V_{gp}$	=	880	810	V
Grid driving power	$W_{dr}$	=	2.7	2.4	kW
Anode input power	$W_{i_a}$	=	83.6	69	kW
Anode dissipation	$W_a$	=	17.6	14	kW
Output power	$W_o$	=	66	55	kW
Efficiency	$\eta$	=	79	79	%
Modulation depth	m	=	100	100	%
Modulation power	$W_{mod}$	=	41.8	34.5	kW

<sup>1)</sup> Partially obtained by the grid resistor and grid current.

**A.F. CLASS B AMPLIFIER AND MODULATOR**

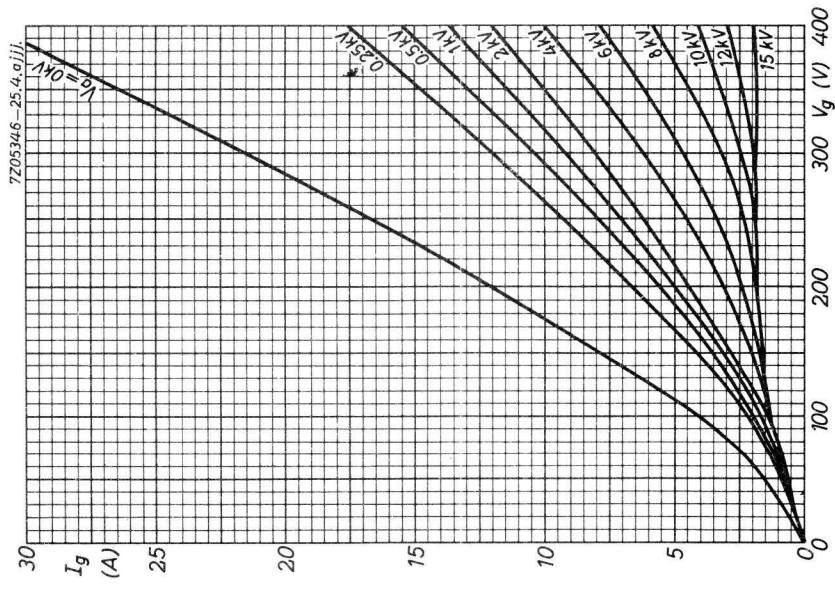
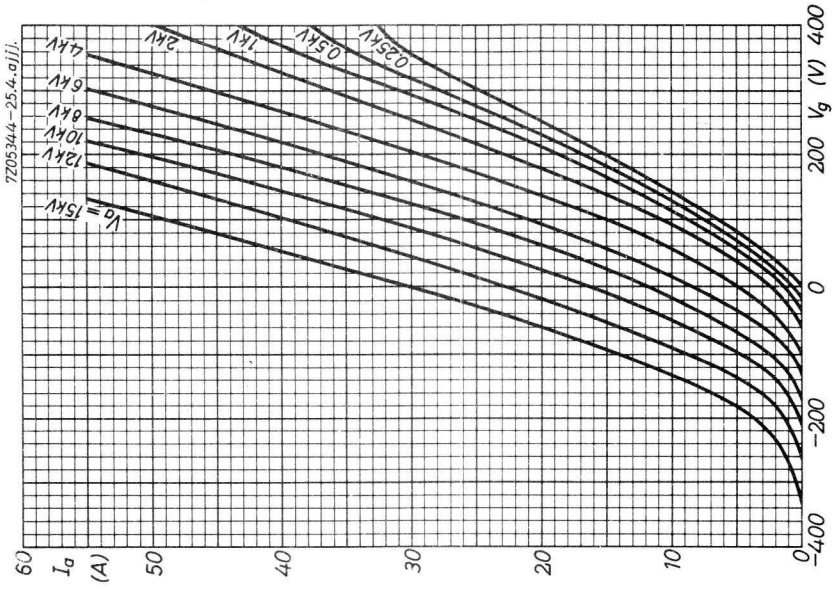
**LIMITING VALUES** (Absolute limits)

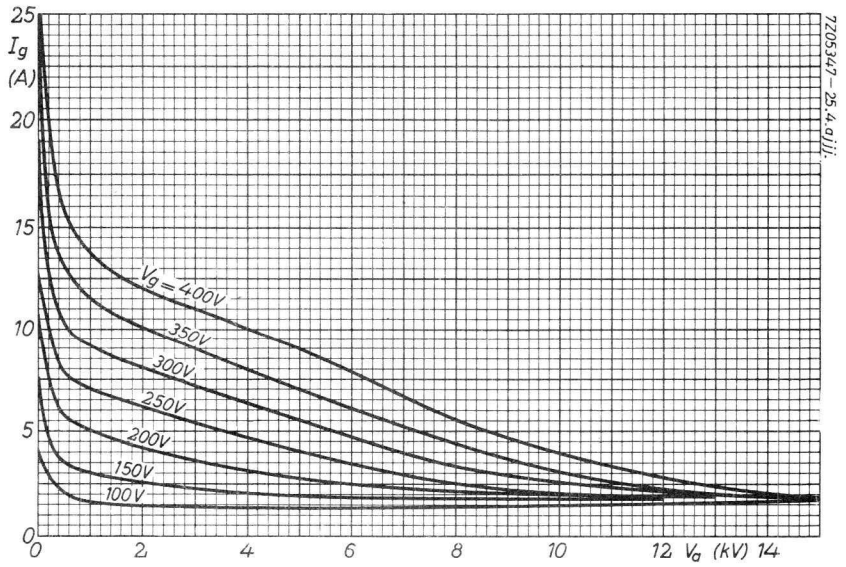
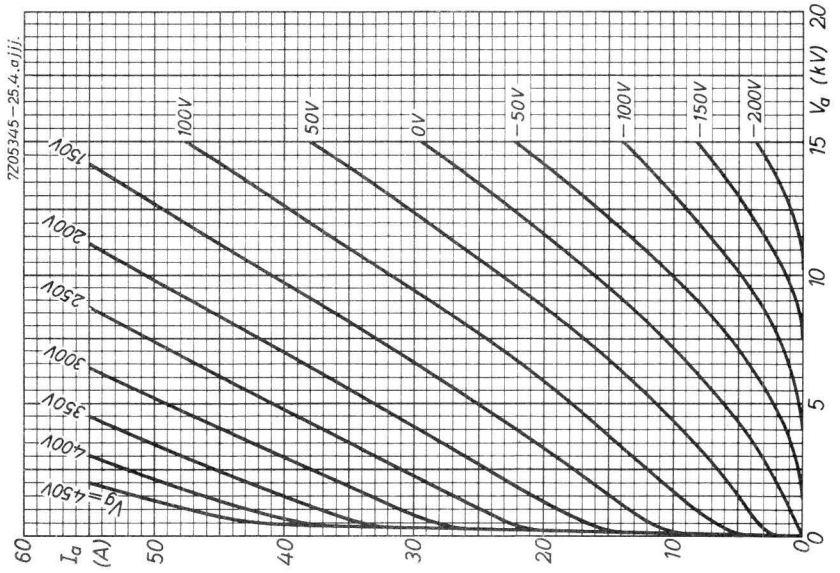
Anode voltage	$V_a = \text{max.}$	12	kV
Anode dissipation	$W_a = \text{max.}$	60	kW
Negative grid voltage	$-V_g = \text{max.}$	1000	V
Grid dissipation	$W_g = \text{max.}$	1.3	kW
Anode current	$I_a = \text{max.}$	13	A
Grid current	$I_g = \text{max.}$	3.3	A

**OPERATING CONDITIONS** (two tubes in push-pull)

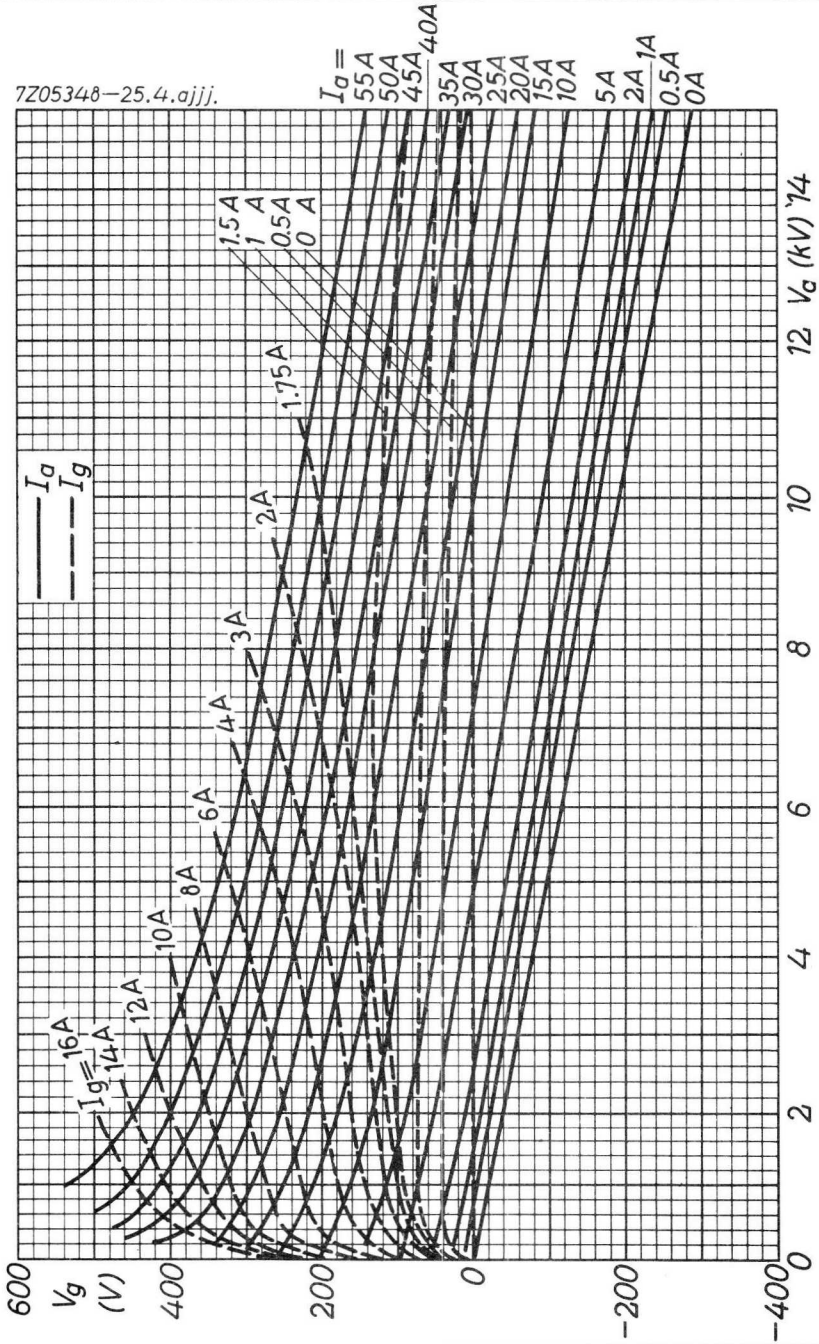
Anode voltage	$V_a =$	12	10	kV		
Grid voltage	$V_g =$	-205	-170	V		
Load resistance	$R_{aa\sim} =$	2720	1810	$\Omega$		
Peak grid driving voltage	$V_{ggp} =$	0	710	0	710	V
Anode current	$I_a =$	2x0.4	2x4.75	2x0.4	2x5.75	A
Average grid current	$I_g =$	0	2x0.45	0	2x0.72	A
Peak grid current	$I_{gp} =$	0	2x2.9	0	2x4.0	A
Grid driving power	$W_{dr} =$	0	2x150	0	2x235	W
Anode input power	$W_{i_a} =$	2x4.0	2x57	2x4.0	2x57.5	kW
Anode dissipation	$W_a =$	2x4.0	2x18	2x4.0	2x18.5	kW
Output power	$W_o =$	0	78	0	78	kW
Efficiency	$\eta =$	-	68.5	-	68	%







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**WATER COOLED R.F. POWER TRIODE**

QUICK REFERENCE DATA								
Frequency (MHz)	C teleg.		B teleph.		C an. mod.		A. F. class B <sup>1)</sup>	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	15	360					12	450
30	12	285	10	60	11	165	10	400
			8	50	10	135	8	300
			6	35	8	110	6	200



**HEATING** : direct by AC or DC; filament thoriated tungsten

Filament voltage  $V_f = 18 \text{ V}$   
 Filament current  $I_f = 280 \text{ A}$

**CAPACITANCES**

Anode to filament  $C_{af} = 7.5 \text{ pF}$   
 Grid to filament  $C_{gf} = 240 \text{ pF}$   
 Anode to grid  $C_{ag} = 120 \text{ pF}$

**TYPICAL CHARACTERISTICS**

Anode voltage  $V_a = 4 \text{ kV}$   
 Anode current  $I_a = 5 \text{ A}$   
 Amplification factor  $\mu = 55$   
 Mutual conductance  $S = 130 \text{ mA/V}$

<sup>1)</sup> Two tubes

**TEMPERATURE LIMITS** (Absolute limits)

Bulb temperature = max. 180 °C

Seal temperature = max. 180 °C

**COOLING CHARACTERISTICS** . See also cooling curves

$W_a$ (kW)	$t_i$ (°C)	$Q_{min}$ (l/min)	$P_i$ (atm)
10	20	12	0.003
	50	17	0.005
40	20	37	0.03
	50	54	0.07
80	20	75	0.12
	50	112	0.26
120	20	120	0.3
	50	179	0.6

For inlet temperatures  $t_i$  between 20 °C and 50 °C the required quantity of water can be found by proportional interpolation.

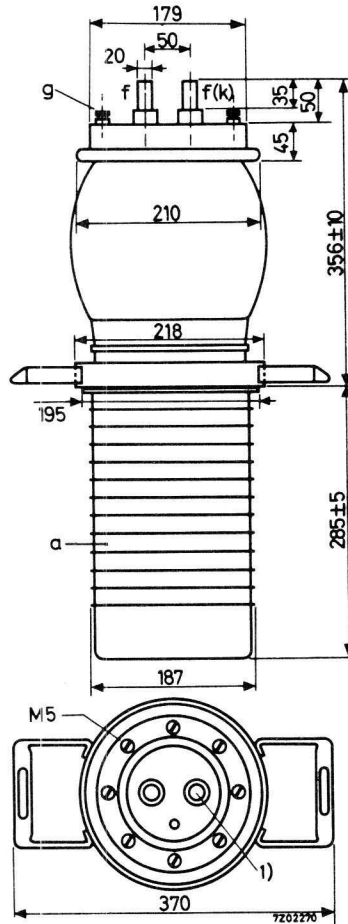
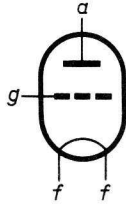
At frequencies higher than 10 MHz a low velocity air flow should be directed to the seals of grid and filament.

**MECHANICAL DATA**

Dimensions in mm

Net weight of tube : 32.5 kg

Net weight of water jacket: 30.5 kg



Mounting position: vertical with anode down

**ACCESSORIES**

Water jacket : K723

Filament connectors with cable: 40667

<sup>1)</sup> This pin should be used for connecting the anode return lead.

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES (Absolute limits)**

Frequency	f		up to 10	up to 30	MHz
Anode voltage	$V_a$	= max.	15	12	kV
Anode dissipation	$W_a$	= max.	120	120	kW
Negative grid voltage	$-V_g$	= max.	1200	1200	V
Grid dissipation	$W_g$	= max.	4	4	kW
Anode current	$I_a$	= max.	33	33	A
Grid current	$I_g$	= max.	8	8	A

**OPERATING CONDITIONS**

Frequency	f	=	10	10	30	30	MHz
Anode voltage	$V_a$	=	15	15	12	12	kV
Grid voltage	$V_g$	=	-520	-800	-480	-720	V
Anode current	$I_a$	=	29.3	24.7	29.3	24.7	A
Grid current	$I_g$	=	5.4	5.2	5.9	5.5	A
Peak driving voltage	$V_{gp}$	=	1090	1370	1050	1290	V
Driving power	$W_{dr}$	=	5.5	6.6	5.7	6.6	kW
Anode input power	$W_{ia}$	=	440	371	353	296	kW
Anode dissipation	$W_a$	=	80	61	68	51	kW
Output power	$W_o$	=	360	310	285	245	kW
Efficiency	$\eta$	=	81.8	83.5	80.8	82.6	%



**R.F. CLASS C ANODE MODULATION**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 30 MHz	
Anode voltage	$V_a$	= max.	11 kV
Anode dissipation	$W_a$	= max.	80 kW
Negative grid voltage	$-V_g$	= max.	1000 V
Grid dissipation	$W_g$	= max.	4 kW
Anode current	$I_a$	= max.	22 A
Grid current	$I_g$	= max.	8 A

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30 MHz
Anode voltage	$V_a$	=	11	10	8 kV
Grid voltage	$V_g$	=	-170	-140	-100 V
Grid resistor	$R_g$	=	40	44	33 $\Omega$
Anode current	$I_a$	=	19	17.3	18 A
Grid current	$I_g$	=	7.4	6.9	7.6 A
Peak driving voltage	$V_{gp}$	=	1000	930	855 V
Driving power	$W_{dr}$	=	7.1	6	6 kW
Anode input power	$W_{ia}$	=	209	173	144 kW
Anode dissipation	$W_a$	=	44	38	34 kW
Output power	$W_o$	=	165	135	110 kW
Efficiency	$\eta$	=	79	78	76.5 %
Modulation depth	m	=	100	100	100 %
Modulation power	$W_{mod}$	=	105	87	72 kW



**R.F. CLASS B TELEPHONY**

**LIMITING VALUES (Absolute limits)**

Frequency	f		up to 10	up to 30	MHz
Anode voltage	$V_a$	= max.	15	12	kV
Anode dissipation	$W_a$	= max.	120	120	kW
Negative grid voltage	$-V_g$	= max.	800	800	V
Grid dissipation	$W_g$	= max.	4	4	kW
Anode current	$I_a$	= max.	27	27	A
Grid current	$I_g$	= max.	8	8	A

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	10	8	6	kV
Grid voltage	$V_g$	=	-150	-115	-82	V
Anode current	$I_a$	=	17	18.2	17.9	A
Grid current	$I_g$	=	0.8	1.2	1.5	A
Peak driving voltage	$V_{gp}$	=	338	338	321	V
Driving power	$W_{dr}$	=	0.25	0.36	0.43	kW
Anode input power	$W_{ia}$	=	170	146	108	kW
Anode dissipation	$W_a$	=	110	96	73	kW
Output power	$W_o$	=	60	50	35	kW
Efficiency	$\eta$	=	35.3	34.3	32.6	%
Modulation depth	m	=	100	100	100	%
Grid current	$I_g$	=	5.9	6.8	7.2	A
Driving power	$W_{dr}$	=	3.6	4.1	4.1	kW

**A.F. CLASS B AMPLIFIER**

**LIMITING VALUES** (Absolute limits)

Anode voltage	$V_a$	= max.	12	kV
Anode dissipation	$W_a$	= max.	120	kW
Negative grid voltage	$-V_g$	= max.	800	V
Grid dissipation	$W_g$	= max.	4	kW
Anode current	$I_a$	= max.	33	A
Grid current	$I_g$	= max.	8	A

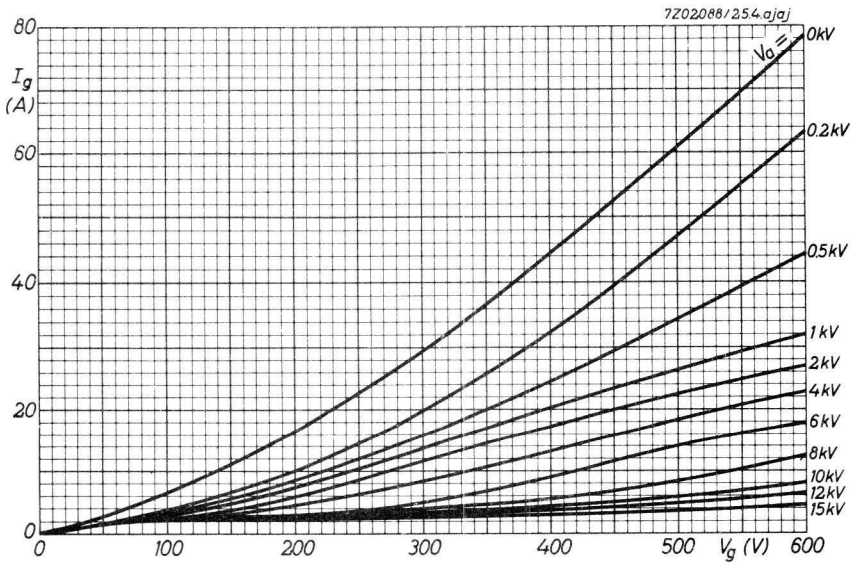
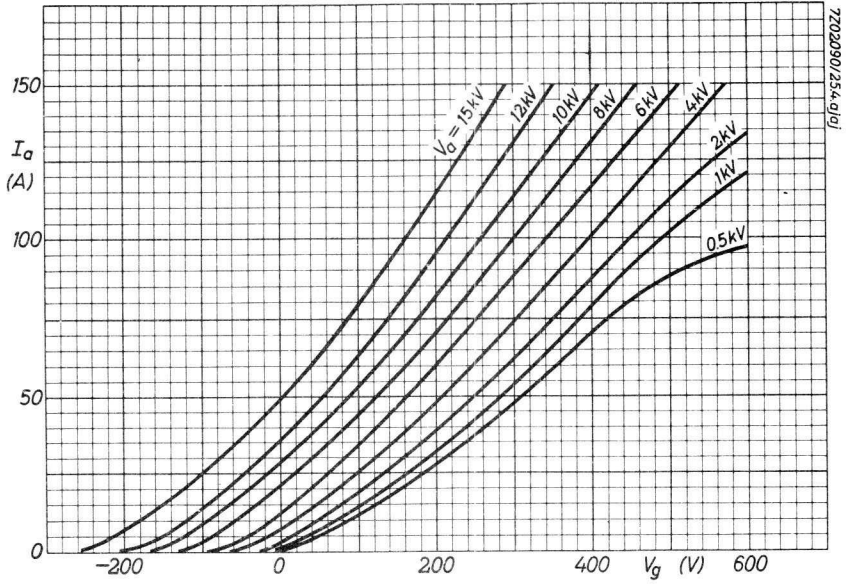
**OPERATING CONDITIONS,** two tubes in push-pull

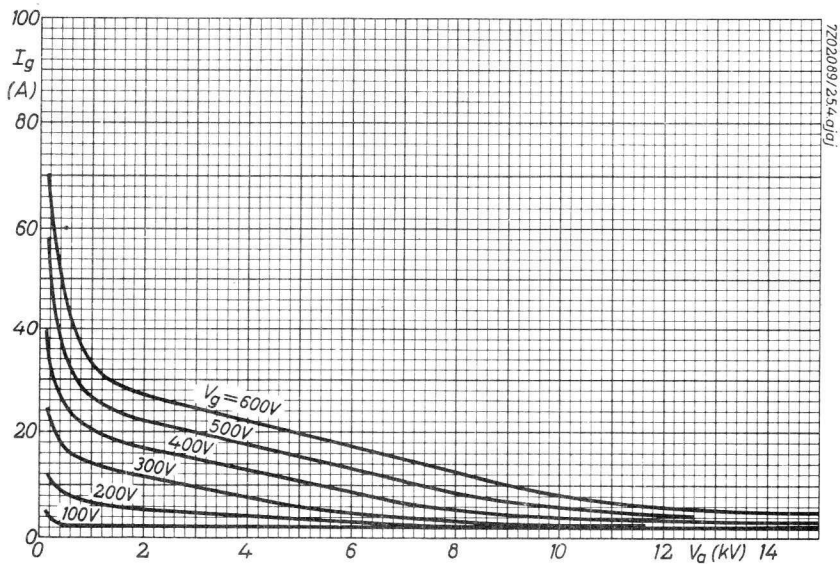
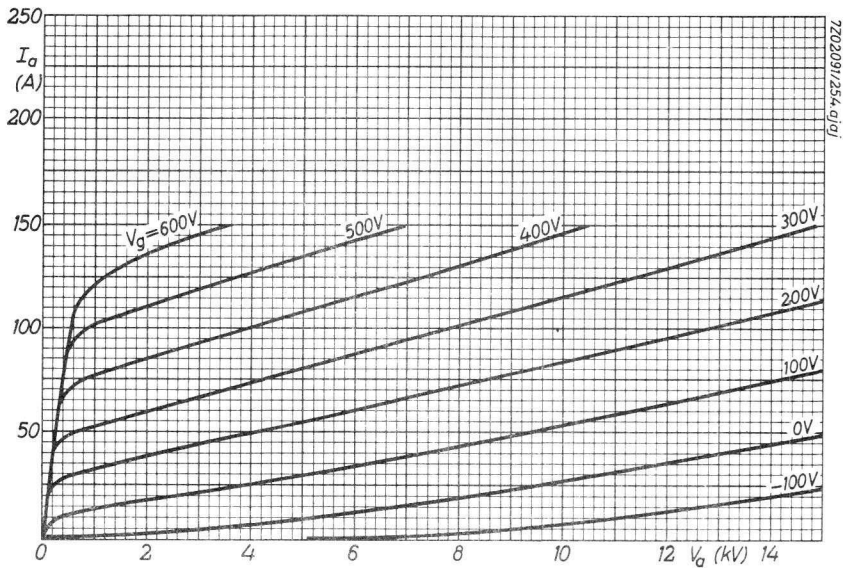
Anode voltage	$V_a$	=	12	10	kV
Grid voltage	$V_g$	=	-180	-150	V
Load resistance	$R_{aa\sim}$	=	552	410	$\Omega$
Peak driving voltage	$V_{ggp}$	=	0 1210	0 1205	V
Anode current	$I_a$	=	2x2 2x26	2x1.8 2x28	A
Grid current	$I_g$	=	0 2x4.4	0 2x4.8	A
Peak grid current	$I_{gp}$	=	0 2x23	0 2x24	A
Driving power	$W_{dr}$	=	0 2x2.4	0 2x2.6	kW
Anode input power	$W_{ia}$	=	2x24 2x312	2x18 2x280	kW
Anode dissipation	$W_a$	=	2x24 2x87	2x18 2x80	kW
Output power	$W_o$	=	0 450	0 400	kW
Efficiency	$\eta$	=	- 72	- 71.4	%



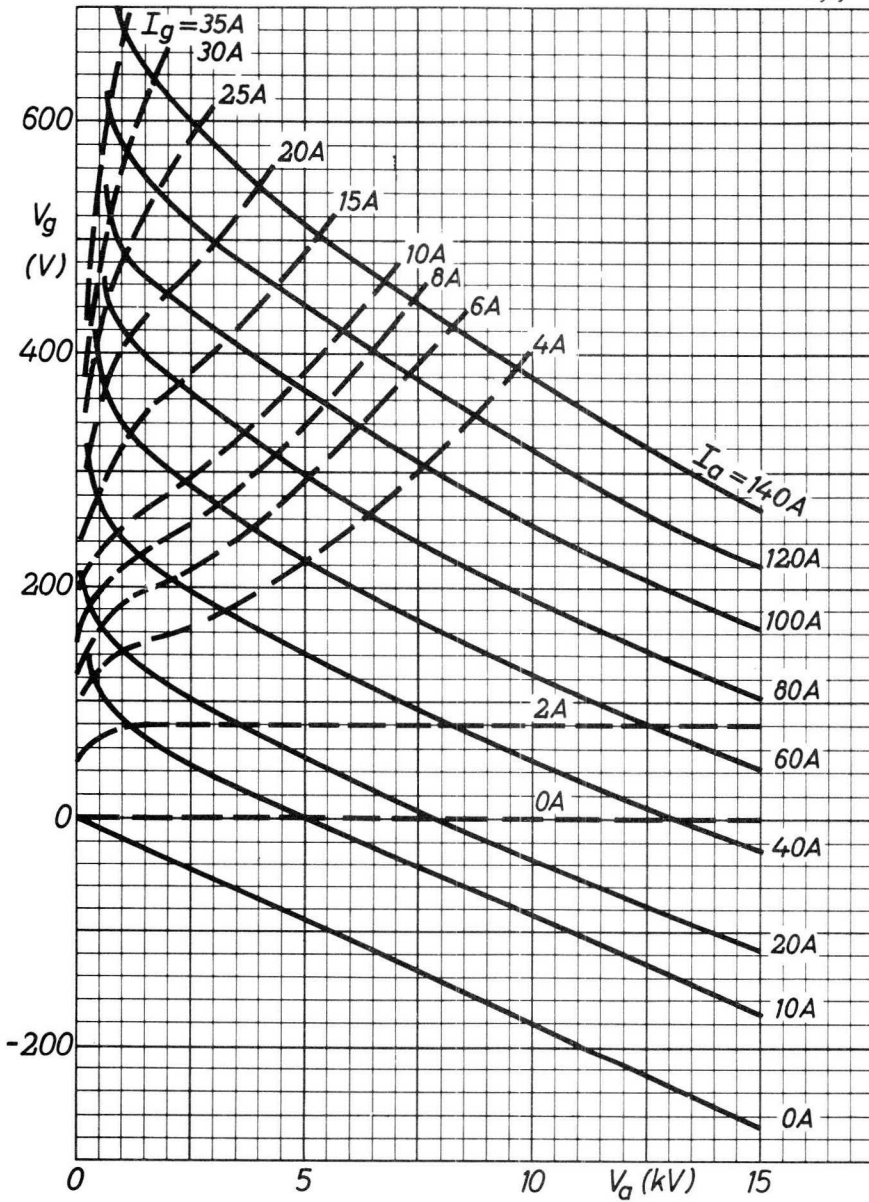
**OPERATING CONDITIONS, two tubes in push-pull (continued)**

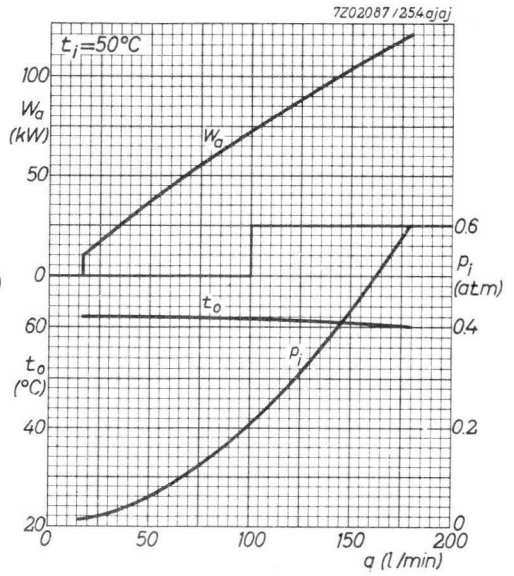
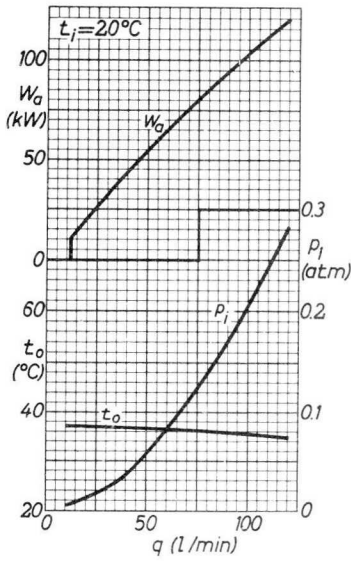
Anode voltage	$V_a$	=	8		6	kV
Grid voltage	$V_g$	=	-115		-82	V
Load resistance	$R_{aa\sim}$	=	338		268	$\Omega$
Peak driving voltage	$V_{ggp}$	=	0	1110	0	990 V
Anode current	$I_a$	=	2x1.6	2x27	2x1.4	2x25 A
Grid current	$I_g$	=	0	2x5	0	2x4.9 A
Peak grid current	$I_{gp}$	=	0	2x24	0	2x22 A
Driving power	$W_{dr}$	=	0	2x2.5	0	2x2.2 kW
Anode input power	$W_{ia}$	=	2x12.8	2x216	2x8.4	2x150 kW
Anode dissipation	$W_a$	=	2x12.8	2x66	2x8.4	2x50 kW
Output power	$W_o$	=	0	300	0	200 kW
Efficiency	$\eta$	=	-	69.5	-	67 %





7Z05640-25.4.ajaj







## VAPOUR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA								
Frequency (MHz)	C telegraphy		C anode mod.		B telephony		AF class B Two tubes	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
10	15	360					12	450
30	12	285	11	165	10	60	10	400
			10	135	8	50	8	300
			8	110	6	35	6	200

**HEATING:** direct by A.C. or D.C.; filament thoriated tungsten

Filament voltage  $V_f = 18$  V

Filament current  $I_f = 280$  A

**CAPACITANCES**

Grid to filament  $C_{gf} = 240$  pF

Anode to filament  $C_{af} = 7.5$  pF

Anode to grid  $C_{ag} = 120$  pF

**TYPICAL CHARACTERISTICS**

Anode voltage  $V_a = 4$  kV

Anode current  $I_a = 5$  A

Amplification factor  $\mu = 55$

Mutual conductance  $S = 130$  mA/V

**TEMPERATURE LIMITS** (Absolute limits)

Bulb temperature  $t = \text{max. } 180$  °C

Seal temperature  $t = \text{max. } 180$  °C

**COOLING**

Cooling data for anode dissipation  $W_a = 180$  kW

Total dissipation to be transferred by cooling system

$$(W_a + W_g + 0.8 W_f)$$

188 kW

equivalent to

2700 kcal/min

Volume of produced vapour

at back flow water temperature of 20 °C

7.3 m<sup>3</sup>/min

at back flow water temperature of 90 °C

8.3 m<sup>3</sup>/min

Amount of back flowing water

at back flow water temperature of 20 °C

4.4 l/min

at back flow water temperature of 90 °C

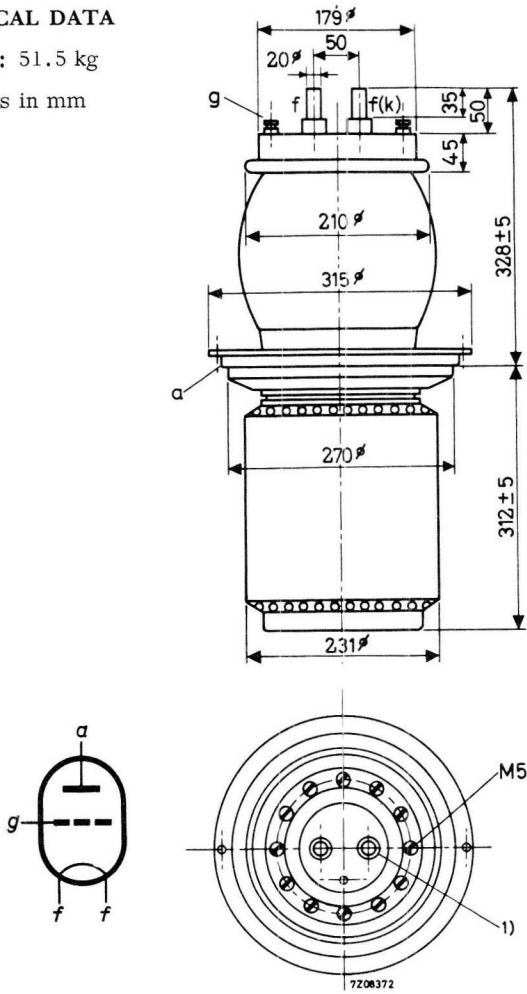
5.1 l/min



**MECHANICAL DATA**

Net weight: 51.5 kg

Dimensions in mm



Mounting position: vertical with anode down

**ACCESSORIES**

Vapour cooling system                    K729

Filament connectors with cable    40667

1) This pin should be used for connecting the anode return lead

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	10	up to	30	MHz
Anode voltage	$V_a$	= max.	15		12	kV
Anode dissipation	$W_a$	= max.	180		180	kW
Negative grid voltage	$-V_g$	= max.	1200		1200	V
Grid dissipation	$W_g$	= max.	4		4	kW
Anode current	$I_a$	= max.	33		33	A
Grid current	$I_g$	= max.	8		8	A

**OPERATING CONDITIONS**

Frequency	f	=	10	10	30	30	MHz
Anode voltage	$V_a$	=	15	15	12	12	kV
Grid voltage	$V_g$	=	-520	-800	-480	-720	V
Anode current	$I_a$	=	29.3	24.7	29.3	24.7	A
Grid current	$I_g$	=	5.4	5.2	5.9	5.5	A
Peak driving voltage	$V_{gp}$	=	1090	1370	1050	1290	V
Driving power	$W_{dr}$	=	5.5	6.6	5.7	6.6	kW
Anode input power	$W_{ia}$	=	440	371	353	296	kW
Anode dissipation	$W_a$	=	80	61	68	51	kW
Output power	$W_o$	=	360	310	285	245	kW
Efficiency	$\eta$	=	81.8	83.5	80.8	82.6	%

R.F. CLASS C ANODE MODULATION

LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	11	kV
Anode dissipation	$W_a$	= max.	120	kW
Negative grid voltage	$-V_g$	= max.	1000	V
Grid dissipation	$W_g$	= max.	4	kW
Anode current	$I_a$	= max.	22	A
Grid current	$I_g$	= max.	8	A

OPERATING CONDITIONS

Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	11	10	8	kV
Grid voltage	$V_g$	=	-170	-140	-100	V
Grid resistor	$R_g$	=	40	44	33	$\Omega$
Anode current	$I_a$	=	19	17.3	18	A
Grid current	$I_g$	=	7.4	6.9	7.6	A
Peak driving voltage	$V_{gp}$	=	1000	930	855	V
Driving power	$W_{dr}$	=	7.1	6.0	6.0	kW
Anode input power	$W_{ia}$	=	209	173	144	kW
Anode dissipation	$W_a$	=	44	38	34	kW
Output power	$W_o$	=	165	135	110	kW
Efficiency	$\eta$	=	79	78	76.5	%
Modulation depth	m	=	100	100	100	%
Modulation power	$W_{mod}$	=	105	87	72	kW

**R.F. CLASS B TELEPHONY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 10	up to 30	MHz
Anode voltage	$V_a$	= max. 15	12	kV
Anode dissipation	$W_a$	= max. 180	180	kW
Negative grid voltage	$-V_g$	= max. 800	800	V
Grid dissipation	$W_g$	= max. 4	4	kW
Anode current	$I_a$	= max. 27	27	A
Grid current	$I_g$	= max. 8	8	A

**OPERATING CONDITIONS**

Frequency	f	= 30	30	30	MHz
Anode voltage	$V_a$	= 10	8	6	kV
Grid voltage	$V_g$	= -150	-115	-82	V
Anode current	$I_a$	= 17	18.2	17.9	A
Grid current	$I_g$	= 0.8	1.2	1.5	A
Peak driving voltage	$V_{gp}$	= 338	338	321	V
Driving power	$W_{dr}$	= 0.25	0.36	0.43	kW
Anode input power	$W_{i_a}$	= 170	146	108	kW
Anode dissipation	$W_a$	= 110	96	73	kW
Output power	$W_o$	= 60	50	35	kW
Efficiency	$\eta$	= 35.3	34.3	32.6	%
Modulation depth	m	= 100	100	100	%
Grid current	$I_g$	= 5.9	6.8	7.2	A
Driving power	$W_{dr}$	= 3.6	4.1	4.1	kW

A.F. CLASS B AMPLIFIER AND MODULATOR

LIMITING VALUES (Absolute limits)

Anode voltage	$V_a$	=	max.	12	kV
Anode dissipation	$W_a$	=	max.	180	kW
Negative grid voltage	$-V_g$	=	max.	800	V
Grid dissipation	$W_g$	=	max.	4	kW
Anode current	$I_a$	=	max.	33	A
Grid current	$I_g$	=	max.	8	A

OPERATING CONDITIONS (Two tubes in push-pull)

Anode voltage	$V_a$	=	12	10	kV
Grid voltage	$V_g$	=	-180	-150	V
Load resistance	$R_{aa\sim}$	=	552	410	$\Omega$
Peak driving voltage	$V_{ggp}$	=	0 1210	0 1205	V
Anode current	$I_a$	=	2x2.0 2x26	2x1.8 2x28	A
Average grid current	$I_g$	=	0 2x4.4	0 2x4.8	A
Peak grid current	$I_{gp}$	=	0 2x23	0 2x24	A
Driving power	$W_{dr}$	=	0 2x2.4	0 2x2.6	kW
Anode input power	$W_{ia}$	=	2x24 2x312	2x18 2x280	kW
Anode dissipation	$W_a$	=	2x24 2x87	2x18 2x80	kW
Output power	$W_o$	=	0 450	0 400	kW
Efficiency	$\eta$	=	- 72	- 71.4	%

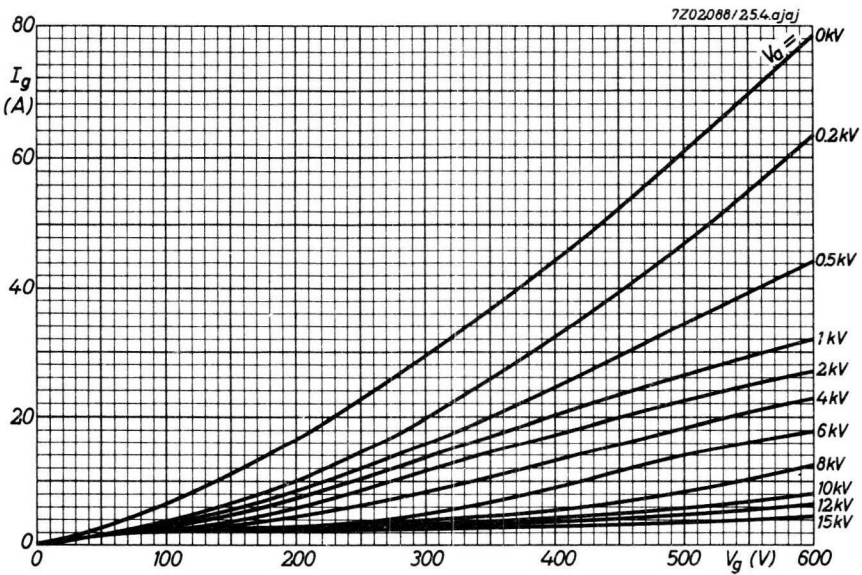
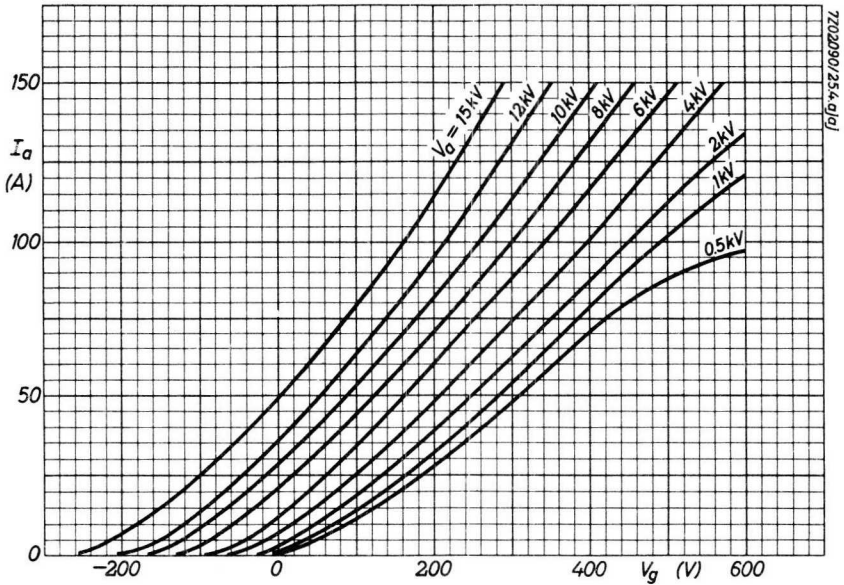


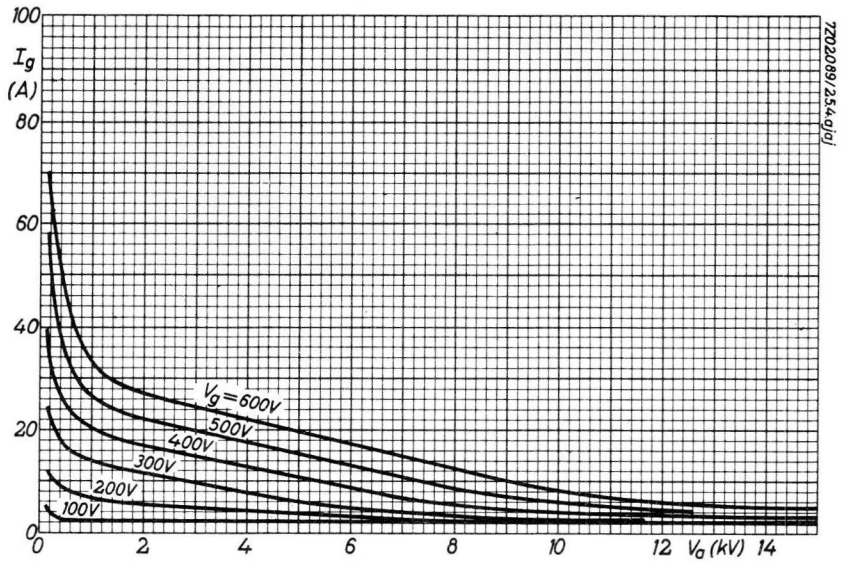
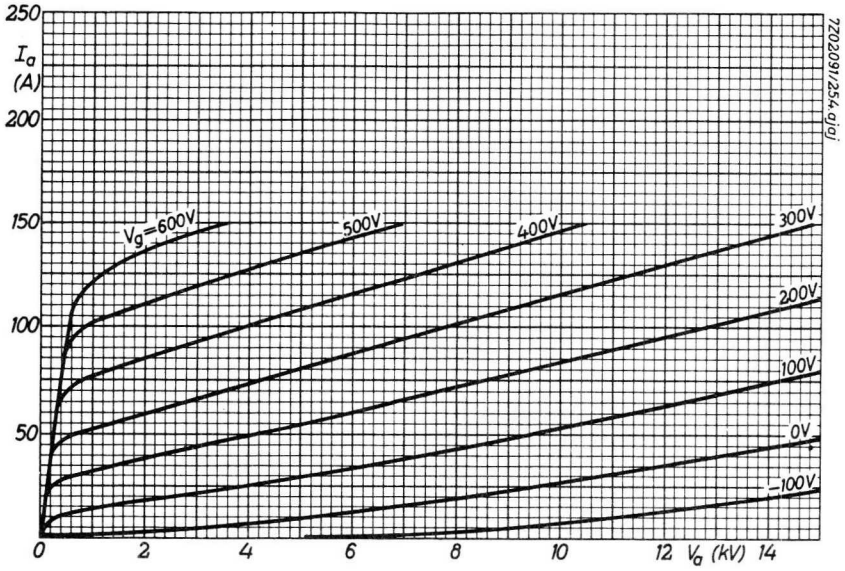
**A.F. CLASS B AMPLIFIER AND MODULATOR**

**OPERATING CONDITIONS** (Two tubes in push-pull; continued)

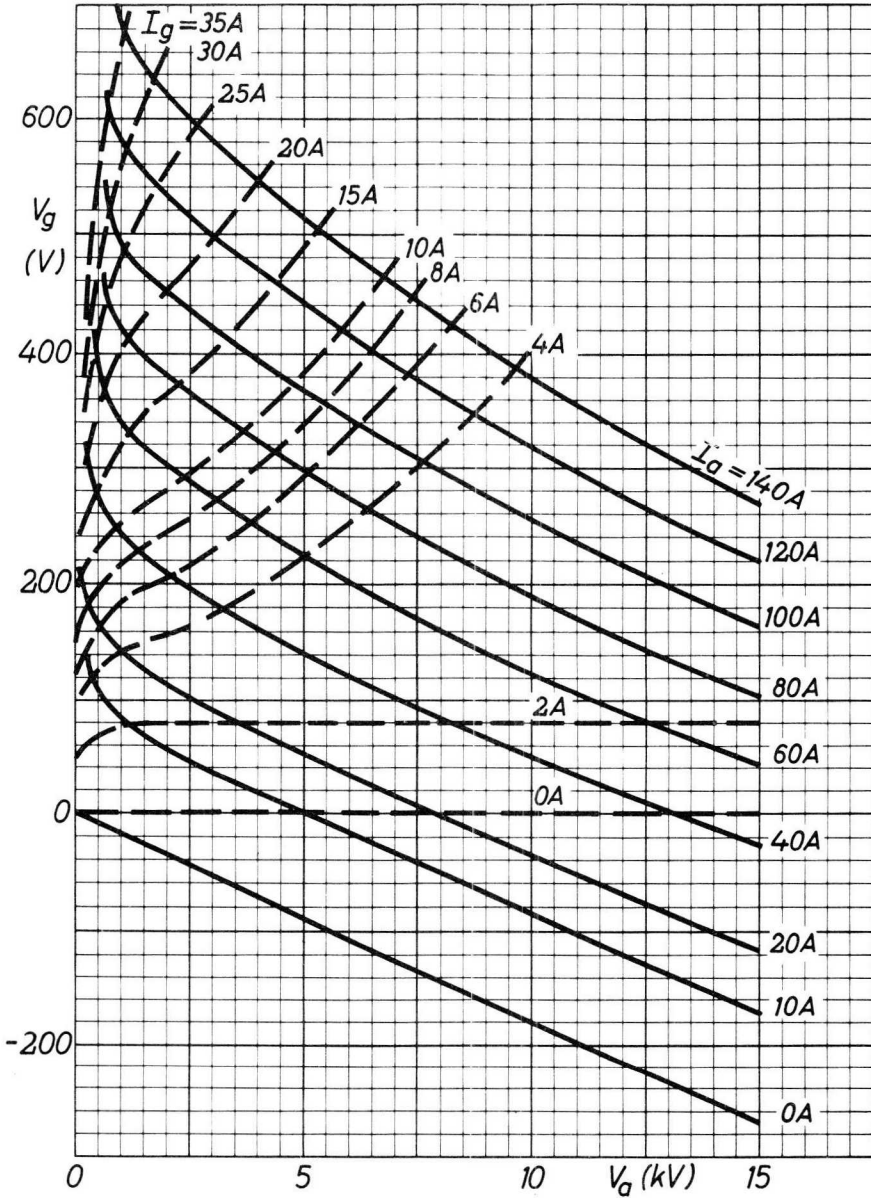
Anode voltage	$V_a$	=	8	6	kV
Grid voltage	$V_g$	=	-115	-82	V
Load resistance	$R_{aa\sim}$	=	338	268	$\Omega$
Peak driving voltage	$V_{ggp}$	=	0 1110	0 990	V
Anode current	$I_a$	=	2x1.6 2x27	2x1.4 2x25	A
Average grid current	$I_g$	=	0 2x5.0	0 2x4.9	A
Peak grid current	$I_{gp}$	=	0 2x24	0 2x22	A
Driving power	$W_{dr}$	=	0 2x2.5	0 2x2.2	kW
Anode input power	$W_{i_a}$	=	2x12.8 2x216	2x8.4 2x150	kW
Anode dissipation	$W_a$	=	2x12.8 2x66	2x8.4 2x50	kW
Output power	$W_o$	=	0 300	0 200	kW
Efficiency	$\eta$	=	- 69.5	- 67	%







7Z05640-25.4 ajaj





**AIR COOLED R.F. POWER TRIODE**

**QUICK REFERENCE DATA**

Frequency (MHz)	C telegraphy		C anode mod.		C television Two tubes		AF class B Two tubes	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	4	4.0					6	13.3
	5	5.6						
	6	6.9						
75			5	4.7				
110	5	4.8	4	2.8				
220	3	2.65						
48 to 75					5	9.5		



**HEATING:** direct; filament thoriated tungsten

Filament voltage  $V_f = 12.6 \text{ V}$

Filament current  $I_f = 33 \text{ A}$

The connection  $f_c$  is intended for use as cathode return. It is not an electrical centre tap and must not be used for filament current supply. At frequencies above 30 MHz the three filament leads should be interconnected by suitable capacitors.

**CAPACITANCES**

Anode to filament  $C_{af} = 0.3 \text{ pF}$

Grid to filament  $C_{gf} = 16 \text{ pF}$

Anode to grid  $C_{ag} = 11 \text{ pF}$

**TYPICAL CHARACTERISTICS**

Anode voltage  $V_a = 4.0 \text{ kV}$

Anode current  $I_a = 1.0 \text{ A}$

Amplification factor  $\mu = 32$

Mutual conductance  $S = 17 \text{ mA/V}$

**TEMPERATURE LIMITS (Absolute limits)**

Temperature of anode and grid seals	$t = \text{max. } 180 \text{ } ^\circ\text{C}$
Temperature of pin seals	$t = \text{max. } 220 \text{ } ^\circ\text{C}$
Air inlet temperature	$t_i = \text{max. } 45 \text{ } ^\circ\text{C}$

**AIR COOLING CHARACTERISTICS**

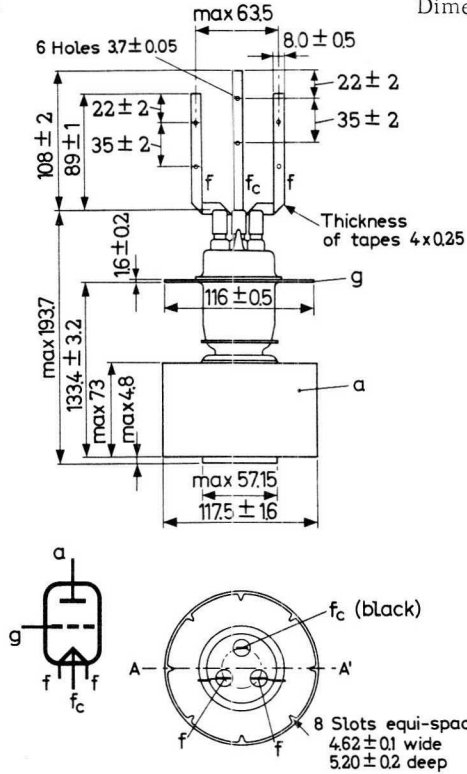
$W_a$ (kW)	h (m)	$t_i$ ( $^\circ\text{C}$ )	$q_{\text{min}}$ ( $\text{m}^3/\text{min}$ )	$P_i$ (mm $\text{H}_2\text{O}$ )
1	0	35	3.0	8
	0	45	3.1	8
	1500	35	3.7	9
	3000	25	4.1	10
3	0	35	5.2	23
	0	45	6.1	29
	1500	35	6.2	26
	3000	25	6.6	26
5	0	35	9.2	68
	0	45	10.7	90
	1500	35	11.2	81
	3000	25	11.6	79

It may be necessary to direct an air flow to the seals to keep them within the temperature limits.

MECHANICAL DATA

Net weight: 3.4 kg

Dimensions in mm



The plane of the filament is parallel to  $AA'$  to within  $3\frac{1}{2}^\circ$

Mounting position: vertical with base up or down

**R.F. CLASS C TELEGRAPHY or F.M. TELEPHONY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	75	110	220	MHz
Anode voltage	$V_a$	= max.	6.2	5.5	4.0	kV
Anode current	$I_a$	= max.	1.5	1.5	1.5	A
Anode input power	$W_{ia}$	= max.	9.3	8.2	6.0	kW
Anode dissipation	$W_a$	= max.	5.0	5.0	5.0	kW
Negative grid voltage	$-V_g$	= max.	1000	1000	1000	V
Grid current	$I_g$	= max.	350	350	350	mA

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30	110	220 <sup>1)</sup>	MHz
Anode voltage	$V_a$	=	6.0	5.0	4.0	5.0	3.0	kV
Grid voltage	$V_g$	=	-400	-300	-200	-300	-160	V
Anode current	$I_a$	=	1.5	1.5	1.37	1.25	1.25	A
Grid current	$I_g$	=	310	330	300	300	250	mA
Driver output power	$W_{dr}$	=	275	240	190	250	510	W
Anode input power	$W_{ia}$	=	9.0	7.5	5.5	6.25	3.75	kW
Anode dissipation	$W_a$	=	2.1	1.9	1.5	1.45	1.6	kW
Output power	$W_o$	=	6.9	5.6	4.0	4.8	2.65	kW
Tube efficiency	$\eta$	=	76.5	75	73	77	70	%
Output power in the load	$W_\ell$	=	5.5	4.5	3.2	3.9	2.15	kW

<sup>1)</sup> In grounded grid circuit



## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	75	110	220	MHz
Anode voltage	$V_a$	= max.	5.0	4.5	3.2	kV
Anode current	$I_a$	= max.	1.3	1.3	1.3	A
Anode input power	$W_{i_a}$	= max.	6.5	5.8	4.0	kW
Anode dissipation	$W_a$	= max.	3.4	3.4	3.4	kW
Negative grid voltage	$-V_g$	= max.	1000	1000	1000	V
Grid current	$I_g$	= max.	350	350	350	mA

## OPERATING CONDITIONS

Frequency	f	=	75	110	MHz
Anode voltage	$V_a$	=	5.0	4.0	kV
Grid voltage	$V_g$	=	-400	-350	V
Anode current	$I_a$	=	1.2	0.93	A
Grid current	$I_g$	=	300	240	mA
Driver output power	$W_{dr}$	=	205	130	W
Anode input power	$W_{i_a}$	=	6.0	3.72	kW
Anode dissipation	$W_a$	=	1.3	0.92	kW
Output power	$W_o$	=	4.7	2.8	kW
Tube efficiency	$\eta$	=	78.5	75	%
Output power in the load	$W_\ell$	=	3.75	2.25	kW
Modulation depth	m	=	100	100	%
Modulation power	$W_{mod}$	=	2.4	1.4	kW

**R.F. CLASS C AMPLIFIER FOR TELEVISION SERVICE** ; negative modulation, positive synchronisation

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 75	up to 220	MHz
Anode voltage	$V_a$	= max. 5.0	max. 4.0	kV
Anode current	$I_a$ sync	= max. 2.0	max. 1.6	A
Anode input power	$W_{i_a}$	= max. 10	max. 6.4	kW
Anode dissipation	$W_a$ sync	= max. 4.0	max. 4.0	kW
Negative grid voltage	$-V_g$ sync	= max. 1000	max. 1000	V
Grid dissipation	$W_g$ sync	= max. 120	max. 120	W

**OPERATING CONDITIONS** (Two tubes in push-pull, common cathode bias modulated)

Frequency	f	= 48 to 75	MHz
Bandwidth (- 3 dB)	B	= 8.0	MHz
Anode voltage	$V_a$	= 5.0	kV
Grid voltage	$V_g$ sync	= -200	V
	$V_g$ black	= -300	V
	$V_g$ white	= -550	V
Anode current	$I_a$ sync	= 2x1.9	A
	$I_a$ black	= 2x1.3	A
Grid current	$I_g$ sync	= 2x250	mA
	$I_g$ black	= 2x175	mA
Driver output power	$W_{dr}$ sync	= 250	W
Output power	$W_o$ sync	= 9.5	kW
Output power in the load	$W_l$ sync	= 6.3	kW

**A.F. CLASS B AMPLIFIER AND MODULATOR**

**LIMITING VALUES** (Absolute limits)

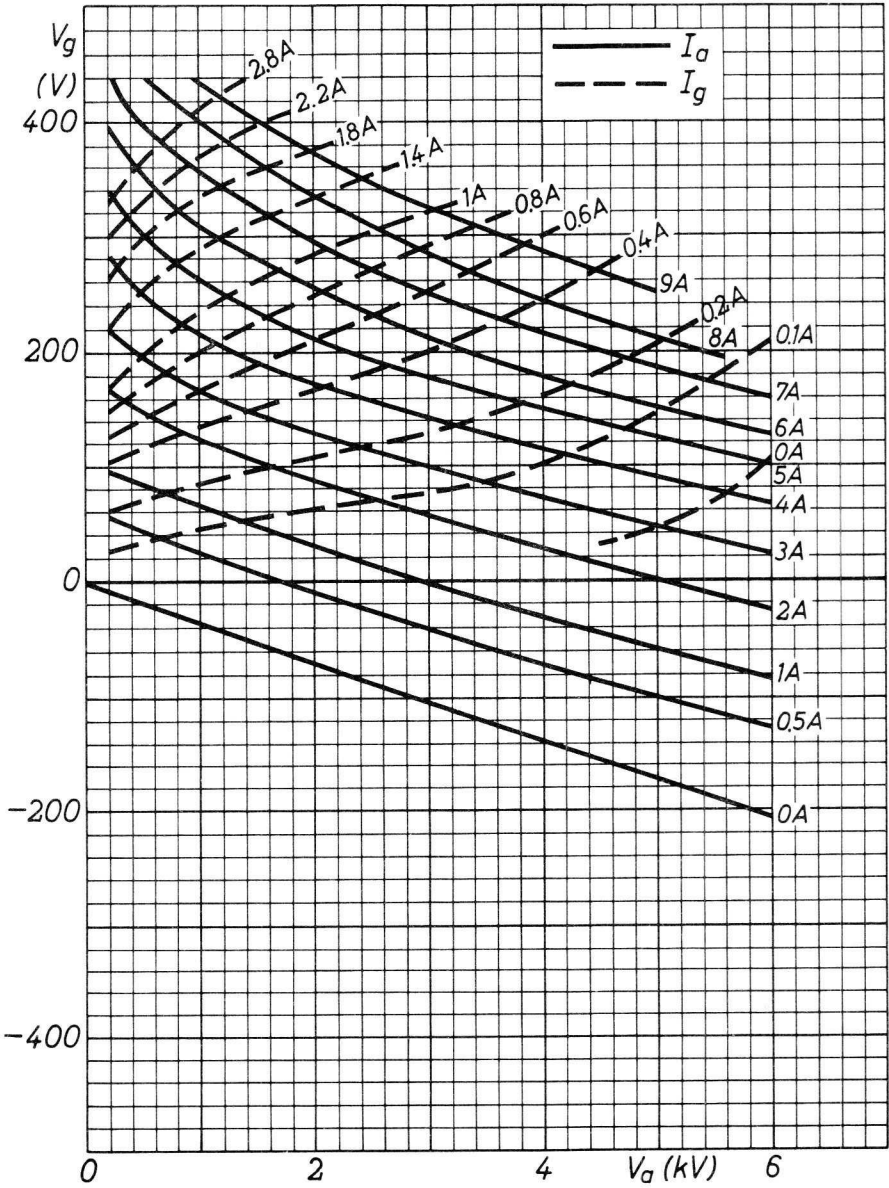
Anode voltage	$V_a$	=	max.	6.0	kV
Anode current	$I_a$	=	max.	1.8	A
Anode input power	$W_{i_a}$	=	max.	10.5	kW
Anode dissipation	$W_a$	=	max.	5.0	kW

**OPERATING CONDITIONS** (Two tubes in push-pull)

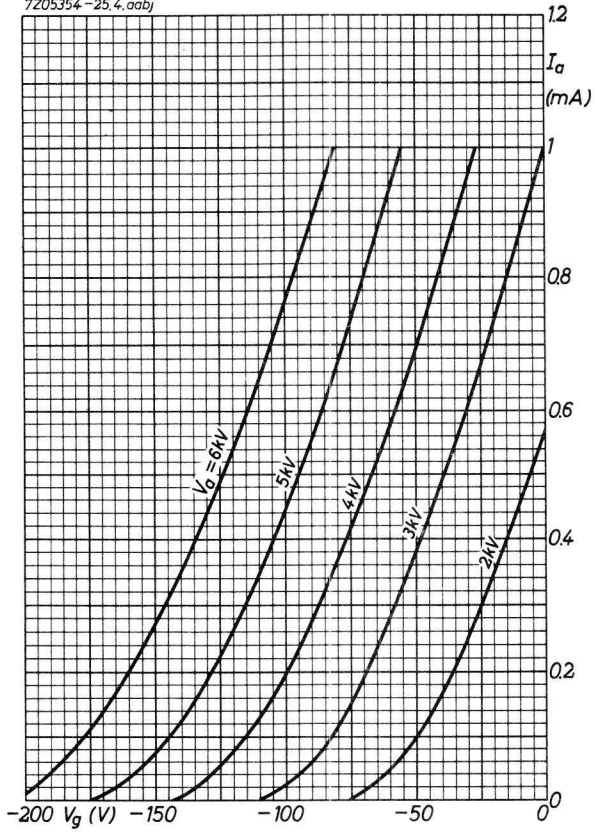
Anode voltage	$V_a$	=	6.0	kV
Grid voltage	$V_g$	=	-165	V <sup>1)</sup>
Load resistance	$R_{aa\sim}$	=	4.9	k $\Omega$
Grid driving voltage	$V_{gg}$	=	0	645 V(RMS)
Anode current	$I_a$	=	2x125	2x1500 mA
Grid current	$I_g$	=	0	2x280 mA
Driving power	$W_{dr}$	=	0	2x115 W
Anode input power	$W_{i_a}$	=	2x0.75	2x9.0 kW
Anode dissipation	$W_a$	=	2x0.75	2x2.35 kW
Output power	$W_o$	=	0	13.3 kW
Efficiency	$\eta$	=	-	74 %
Total harmonic distortion	$d_{tot}$	=	-	4.3 %



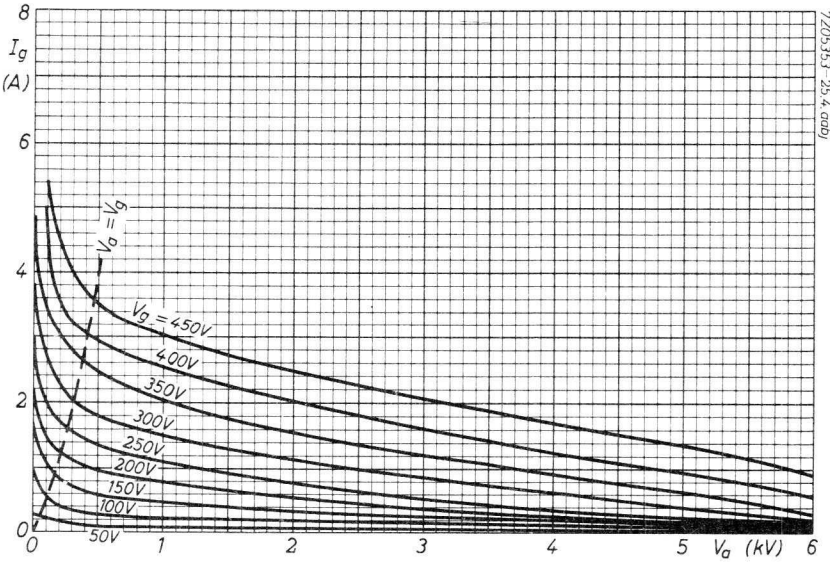
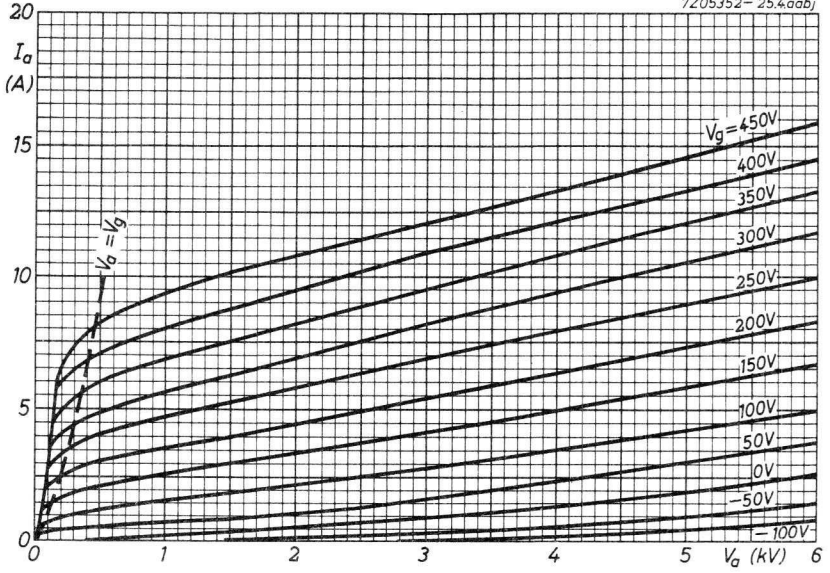
<sup>1)</sup> To be adjusted for zero signal anode current of 125 mA.



7Z05354 - 25.4, aabj



7Z05352-25.4aabj



## R.F. POWER TRIODE

R.F. zero bias power triode intended for use as linear S.S.B. amplifier and A.F. class B amplifier

QUICK REFERENCE DATA				
Class B SSB			B mod. Two tubes	
Frequency (MHz)	$V_a$ (V)	$W_{load}$ (PEP) (W)	$V_a$ (V)	$W_o$ (W)
30	2500	580	3000	1310

**HEATING:** direct by A.C. or D.C.; filament thoriated tungsten

Filament voltage  $V_f = 5.0$  V

Filament current  $I_f = 14.1$  A

### CAPACITANCES

Anode to filament  $C_{af} = 0.033$  pF

Grid to filament  $C_{gf} = 8.0$  pF

Anode to grid  $C_{ag} = 5.0$  pF

### TYPICAL CHARACTERISTICS

Anode voltage  $V_a = 5$  kV

Anode current  $I_a = 80$  mA

Mutual conductance  $S = 11$  mA/V

Amplification factor  $\mu = 350$

### TEMPERATURE LIMITS (Absolute limits)

Anode seal temperature  $t = \text{max. } 220$  °C

Pin seal temperature  $t = \text{max. } 180$  °C

Bulb temperature  $t = \text{max. } 350$  °C

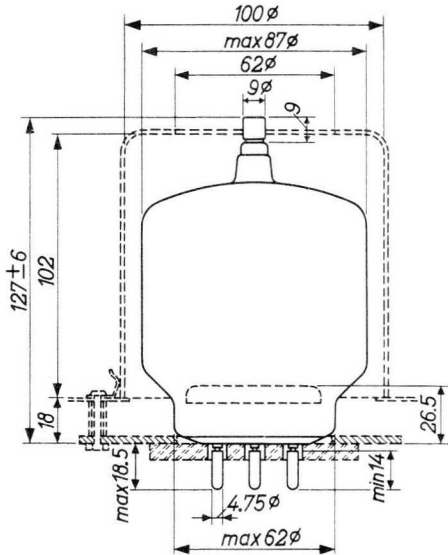
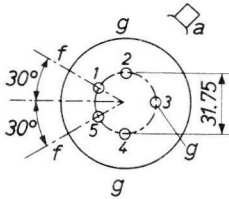
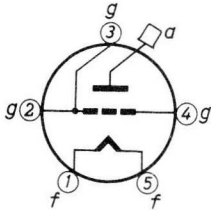
### COOLING

Radiation and low velocity air flow

**MECHANICAL DATA**

Net weight: 210 g

Base : Giant 5p.



Dimensions in mm

Mounting suggestion of  
tube with chimney

Mounting position: vertical with base up or down

In order to prevent overheating of the grid pins by high-frequency current it is recommended to include the three grid socket connections in the circuit.

**ACCESSORIES**

Anode connector	40624
Socket	2422 512 01001
Chimney	40666



**R. F. CLASS B LINEAR POWER AMPLIFIER SINGLE SIDE BAND**

suppressed carrier, zero bias, grounded grid

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to 110	MHz
Anode voltage	$V_a$	= max.	3000 V
Anode input power	$W_{i_a}$	= max.	1200 W
Anode dissipation	$W_a$	= max.	400 W
Anode current	$I_a$	= max.	400 mA
Grid dissipation	$W_g$	= max.	20 W

**OPERATING CHARACTERISTICS**

Frequency	f	=	30	MHz								
Anode voltage	$V_a$	=	2500	V								
Grid voltage	$V_g$	=	0	V								
			<table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">zero</td> <td style="text-align: center;">single tone</td> <td style="text-align: center;">double tone</td> <td></td> </tr> <tr> <td style="text-align: center;">signal</td> <td style="text-align: center;">signal</td> <td style="text-align: center;">signal</td> <td></td> </tr> </table>	zero	single tone	double tone		signal	signal	signal		
zero	single tone	double tone										
signal	signal	signal										
Peak cathode driving voltage	$V_{k_p}$	=	0	91	91	V						
Anode current	$I_a$	=	72	400	270	mA						
Grid current	$I_g$	=	-	140	80	mA						
Driver output power	$W_{dr}$	=	-	35	35 (PEP)	W						
Anode input power	$W_{i_a}$	=	180	1000	675	W						
Anode dissipation	$W_a$	=	180	385	368	W						
Output power	$W_o$	=	0	$640^1$ )	$640 (PEP)^2$ )	W						
Output power in load	$W_{load}$	=	0	580	$580 (PEP)$	$W^3$ )						
Overall efficiency	$\eta$	=	-	58	43	%						
Intermodulation distortion												
of the 3rd order	$d_3$	=	-	-	-29	$dB^4$ )						
of the 5th order	$d_5$	=	-	-	-34	$dB^4$ )						

1) Inclusive 25 W feedthrough power

2) Inclusive 25 W peak envelope feedthrough power

3) Measured in a circuit having an efficiency of 91 %

4) Maximum distortion level encountered at any driving level up to full drive, referred to the amplitude of either of the two tones in a double tone test signal at full drive.



**A.F. CLASS B AMPLIFIER AND MODULATOR**

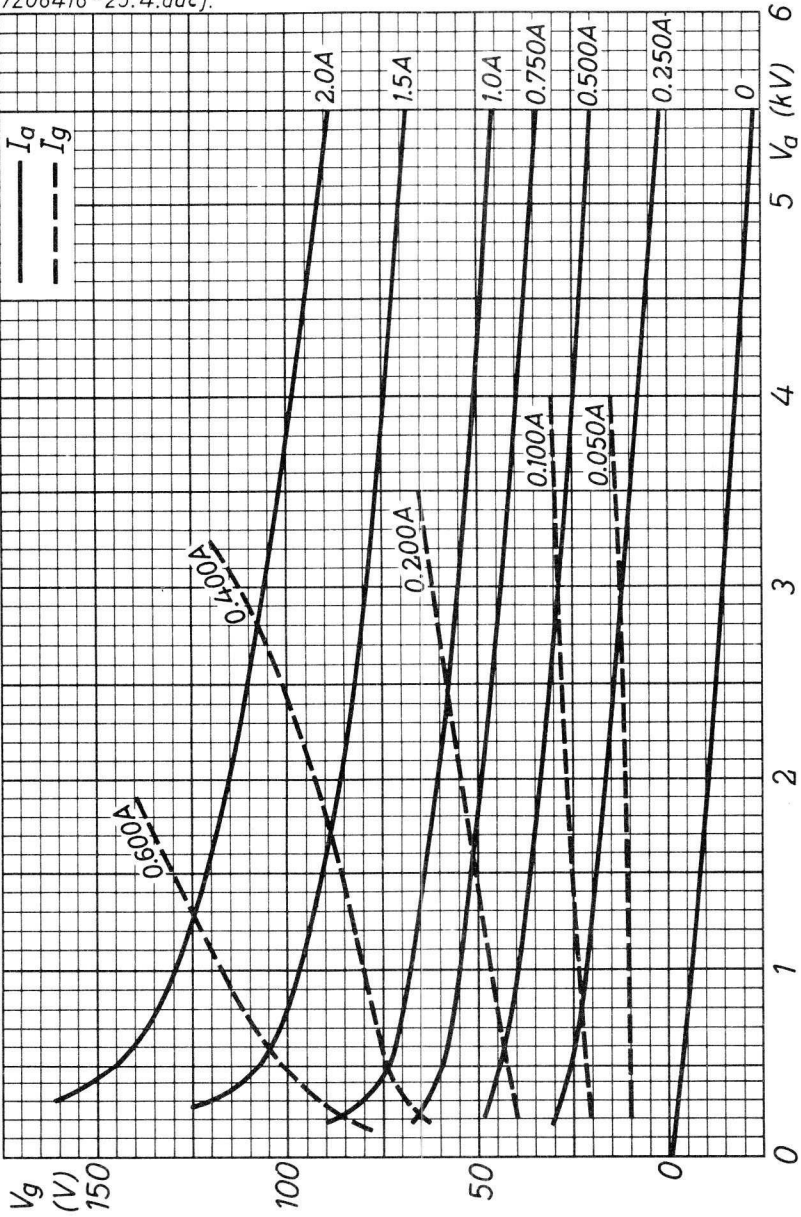
**LIMITING VALUES** (Absolute limits)

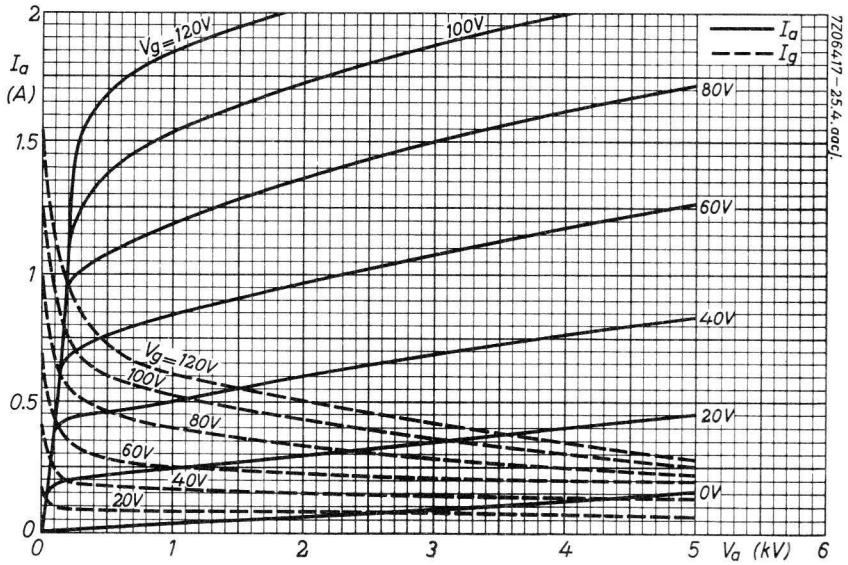
Anode voltage	$V_a$	=	max. 3000	V
Anode input power	$W_{i_a}$	=	max. 1200	W
Anode dissipation	$W_a$	=	max. 400	W
Anode current	$I_a$	=	max. 400	mA
Grid dissipation	$W_g$	=	max. 20	W

**OPERATING CONDITIONS** Class B, two tubes in push-pull

Anode voltage	$V_a$	=	3000	V
Load resistance	$R_{aa \sim}$	=	9500	$\Omega$
Peak grid driving voltage	$V_{ggp}$	=	0	176 V
Anode current	$I_a$	=	2x90	2x333 mA
Grid current	$I_g$	=	0	2x120 mA
Driving power	$W_{dr}$	=	0	26 W
Anode input power	$W_{i_a}$	=	2x270	2x1000 W
Anode dissipation	$W_a$	=	2x270	2x345 W
Output power	$W_o$	=	0	1310 W
Efficiency	$\eta$	=	-	65 %

7Z06416-25.4.aacj.





## WATER COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA								
Freq. (MHz)	C teleg. .		C an. mod. .		C industr. osc. .		B mod <sup>1)</sup>	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	108	10	83	12	124	10	106
	10	75	10	58	12	108	10	64
					10	75		

**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	17.5	V
Filament current	I <sub>f</sub>	=	196	A
Filament peak current	I <sub>fp</sub>	max.	420	A
Cold filament resistance	R <sub>fo</sub>	=	0.012	Ω

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	2.2	pF
Grid to all other elements except anode	C <sub>g</sub>	=	122	pF
Anode to grid	C <sub>ag</sub>	=	75	pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	3	10	kV
Anode current	I <sub>a</sub>	=	50	5	A
Amplification factor	μ	=	25	25	
Mutual conductance	S	=	140	60	mA/V

<sup>1)</sup> Two tubes

**TEMPERATURE LIMITS (Absolute limits)**

Water inlet temperature  $t_i$  = max. 50 °C  
 Temperature of seals = max. 180 °C

**WATER COOLING CHARACTERISTICS ; see also cooling curves**

$W_a$ (kW)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (atm)
30	20	25	0.15
	50	45	0.45
50	20	32	0.25
	50	65	0.85
100	20	55	0.6
	50	120	3.0

At water inlet temperatures between 20 and 50 °C the required quantity of water can be found by linear interpolation.

At frequencies below 6 MHz forced air cooling of the seals will, as a rule, not be necessary. Above 6 MHz air cooling must be used to keep the anode and grid seal temperatures below 180 °C. The seals can be cooled by connecting a blower of suitable size to the air inlet of the anti-corona ring, attached to the tube.

At maximum frequency (30 MHz) and published operating conditions an air flow of 2.5 m<sup>3</sup>/minute with a pressure loss of about 500 mm H<sub>2</sub>O will in general be sufficient. The air flow must be started upon or before the application of filament voltage.

When using the special filament connectors type No. 40628, together with connecting leads of adequate cross-section, additional air cooling of the filament terminals is, as a rule, not necessary.

Care should be taken to ensure firm contact of the filament terminals in order to obtain equal distribution of current over these terminals.

## MECHANICAL DATA

Dimensions in mm

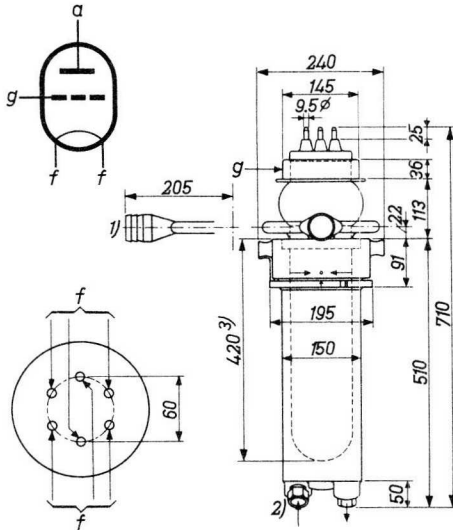
Water-jacket : K714

Net weight of tube : 14 kg

Filament connectors: 40628

Net weight of water-jacket: 20.5 kg

O-ring : 2622 080 30916



Mounting position: vertical with anode down

When connecting the filament the three pins of each group must be joined.

1) Use connecting hose with an inner diameter of  $1\frac{3}{4}$ ".

2) Coupling for metal tubing with an outer diameter of 28 mm.

3) For removing the tube from its water-jacket the free height above the tube must be at least 420 mm.

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	4	15	30	MHz
Anode voltage	$V_a$	= max.	15	13.5	12.5	kV
Anode current	$I_a$	= max.	12.5	12.5	12.5	A
Anode input power	$W_{ia}$	= max.	165	165	150	kW
Anode dissipation	$W_a$	= max.	100	100	100	kW
Negative grid voltage	$-V_g$	= max.	1200	1200	1200	V
Grid current	$I_g$	= max.	1.2	1.2	1.2	A

**OPERATING CONDITIONS**

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	12	10	kV
Grid voltage	$V_g$	=	-1000	-800	V
Grid driving voltage	$V_{gp}$	=	1500	1200	V
Anode current	$I_a$	=	12	10	A
Grid current	$I_g$	=	0.75	0.75	A
Anode input power	$W_{ia}$	=	144	100	kW
Anode dissipation	$W_a$	=	36	25	kW
Driving power	$W_{dr}$	=	1100	850	W
Output power	$W_o$	=	108	75	kW
Efficiency	$\eta$	=	75	75	%



**R.F. CLASS C ANODE MODULATION**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30 MHz
Anode voltage	$V_a$	= max.	10.5 kV
Anode current	$I_a$	= max.	10.5 A
Anode input power	$W_{i_a}$	= max.	110 kW
Anode dissipation	$W_a$	= max.	66 kW
Negative grid voltage	$-V_g$	= max.	1200 V
Grid current	$I_g$	= max.	1.3 A

**OPERATING CONDITIONS**

Frequency	f	=	30	30 MHz
Anode voltage	$V_a$	=	10	10 kV
Grid voltage	$V_g$	=	-1050	-1050 V <sup>1)</sup>
Grid driving voltage	$V_{gp}$	=	1550	1450 V
Anode current	$I_a$	=	10.5	7.4 A
Grid current	$I_g$	=	1.1	0.8 A
Anode input power	$W_{i_a}$	=	105	74 kW
Anode dissipation	$W_a$	=	22	16 kW
Driving power	$W_{dr}$	=	1650	1100 W
Output power	$W_o$	=	83	58 kW
Efficiency	$\eta$	=	79	79 %
Modulation depth	m	=	100	100 %
Modulation power	$W_{mod}$	=	53	37 kW

<sup>1)</sup> Grid bias partly obtained by a grid resistor

**R.F. CLASS C OSCILLATOR** for industrial use with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	15	A
Anode input power	$W_{i_a}$	= max.	180	kW
Anode dissipation	$W_a$	= max.	100	kW
Negative grid voltage	$-V_g$	= max.	1600	V
Grid current, loaded	$I_g$	= max.	1.0	A
Grid current, unloaded	$I_g$	= max.	1.4	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	12	12	10	kV
Anode current	$I_a$	=	14	12	10	A
Grid current	$I_g$	=	0.9	0.75	0.75	A
Grid circuit resistance	$R_g$	=	1100	1350	1100	$\Omega$
Feedback ratio	$V_{g\sim}/V_{a\sim}$	=	15	14	14	%
Anode input power	$W_{i_a}$	=	168	144	100	kW
Anode dissipation	$W_a$	=	44	36	25	kW
Output power	$W_o$	=	124	108	75	kW
Efficiency	$\eta$	=	74	75	75	%
Output power in the load	$W_l$	=	104	91	63	kW <sup>1)</sup>

1) Useful power in the load measured in a circuit having an efficiency of 85%.

A.F. CLASS B AMPLIFIER AND MODULATOR

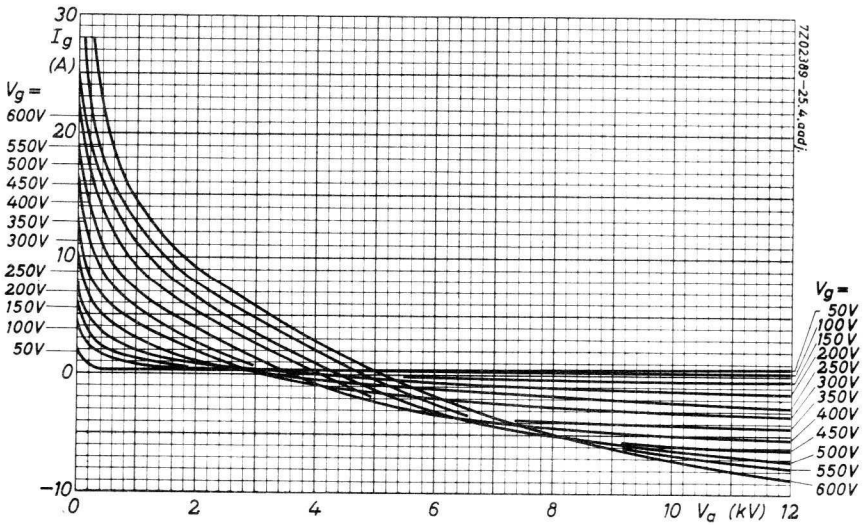
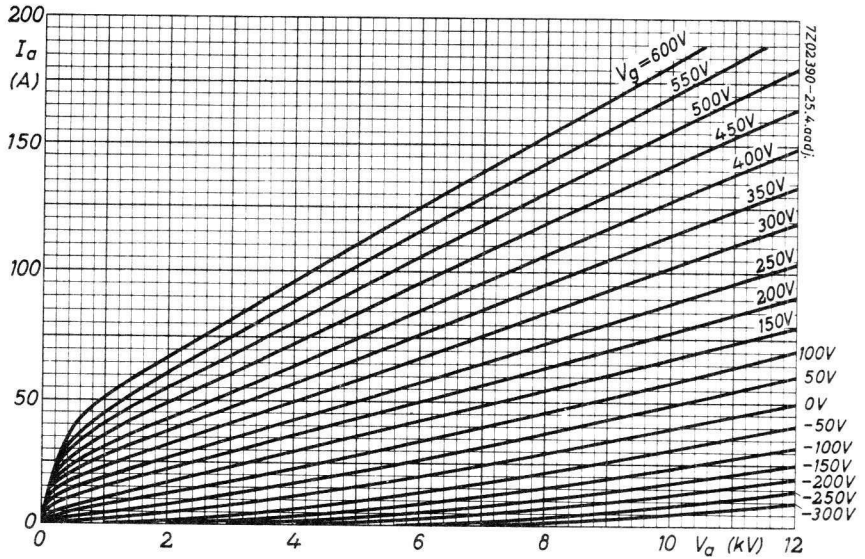
LIMITING VALUES (Absolute limits)

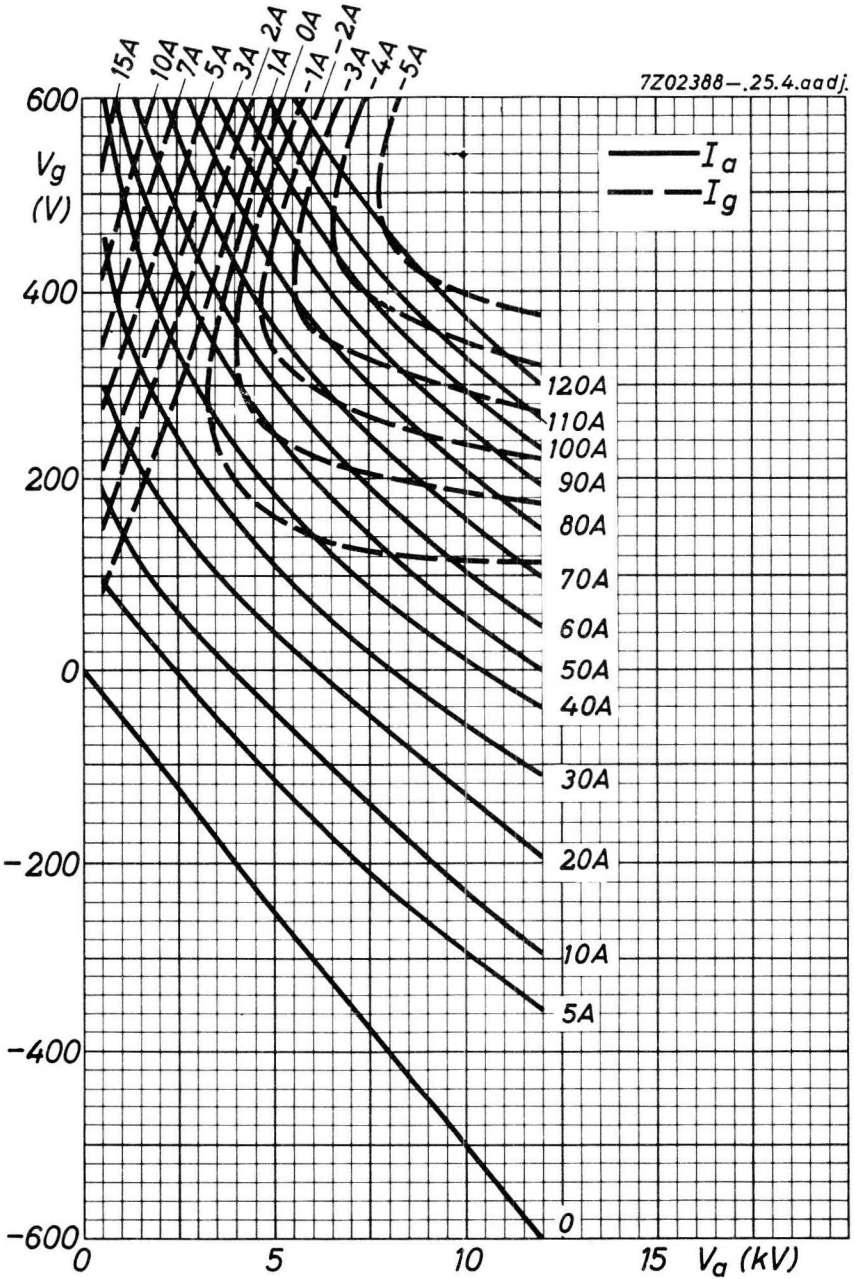
Anode voltage	$V_a$	= max.	15	kV
Anode current	$I_a$	= max.	12	A
Anode input power	$W_{i_a}$	= max.	162	kW
Anode dissipation	$W_a$	= max.	100	kW
Negative grid voltage	$-V_g$	= max.	1200	V
Grid current	$I_g$	= max.	1.2	A

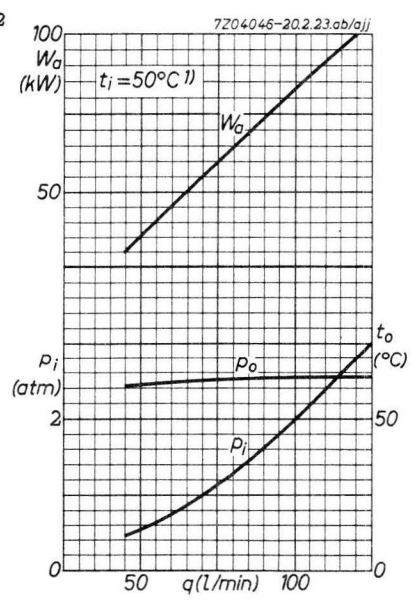
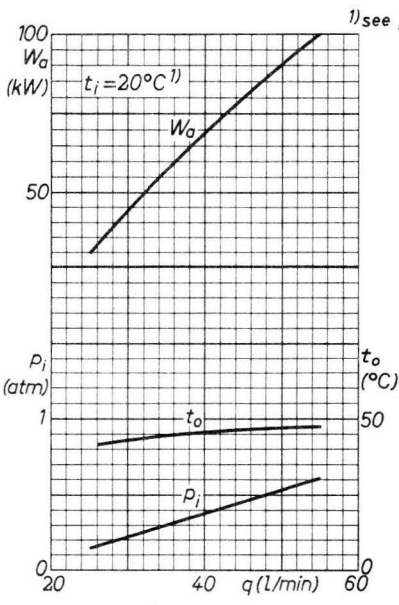
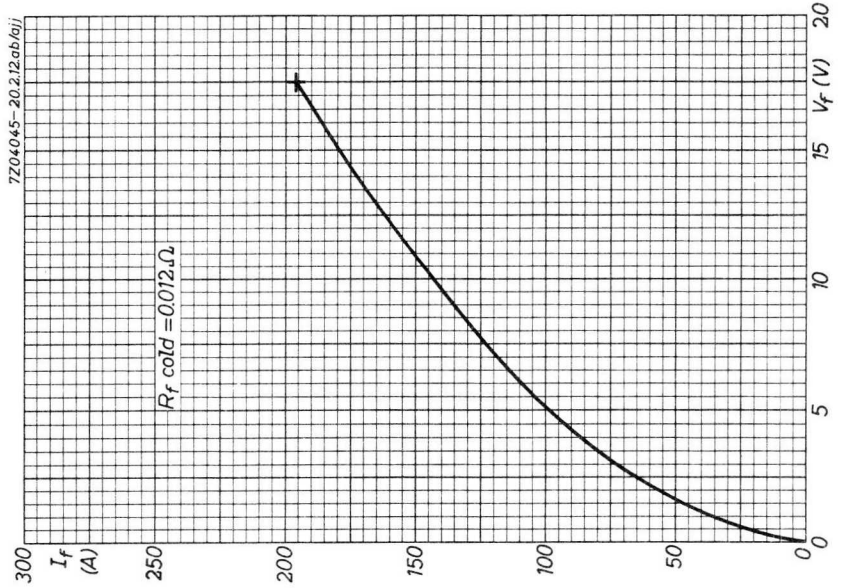
OPERATING CONDITIONS, two tubes in push-pull

Anode voltage	$V_a$	=	10	10	kV
Grid voltage	$V_g$	=	-540	-540	V <sup>1)</sup>
Load resistance	$R_{aa\sim}$	=	1360	1440	$\Omega$
Driving voltage	$V_{ggp}$	=	0 1550	0 1300	V
Anode current	$I_a$	=	2x0.3 2x8	2x0.3 2x5.8	A
Grid current	$I_g$	=	0 2x0.2	0 2x0.15	A
Anode input power	$W_{i_a}$	=	2x3 2x80	2x3 2x58	kW
Anode dissipation	$W_a$	=	2x3 2x27	2x3 2x26	kW
Driving power	$W_{dr}$	=	0 2x150	0 2x100	W
Output power	$W_o$	=	0 106	0 64	kW
Efficiency	$\eta$	=	- 67	- 56	%

1) To be adjusted for a zero signal anode current of 0.3 A







## AIR COOLED R.F. POWER TRIODE

QUICK REFERENCE DATA								
Freq. (MHz)	C telegr.		C an. mod.		C industr. osc.		B mod <sup>1)</sup>	
	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)	V <sub>a</sub> (kV)	W <sub>o</sub> (kW)
30	12	108	10	83	12	124	10	106
	10	75	10	58	12	108	10	64
					10	75		



**HEATING:** direct; filament thoriated tungsten

Filament voltage	V <sub>f</sub>	=	17.5	V
Filament current	I <sub>f</sub>	=	196	A
Filament peak current	I <sub>f</sub> p	max.	420	A
Cold filament resistance	R <sub>f0</sub>	=	0.012	Ω

### CAPACITANCES

Anode to all other elements except grid	C <sub>a</sub>	=	2.2	pF
Grid to all other elements except anode	C <sub>g</sub>	=	122	pF
Anode to grid	C <sub>ag</sub>	=	75	pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	=	3	10	kV
Anode current	I <sub>a</sub>	=	50	5	A
Amplification factor	μ	=	25	25	
Mutual conductance	S	=	140	60	mA/V

<sup>1)</sup> Two tubes

**TEMPERATURE LIMITS** (Absolute limits)

Temperature of all seals = max. 180 °C

**AIR COOLING CHARACTERISTICS** ; see also cooling curves

$W_a$ (kW)	$h$ (m)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mm H <sub>2</sub> O)
30	0	35	35	114
	0	45	40	143
	1500	35	42	136
	3000	25	44	132
45	0	35	54	275
	0	45	62.5	335
	1500	35	64.5	322
	3000	25	68	319

When the tube is used at frequencies above 6 MHz special attention must be paid to the anode and grid seal temperatures. For frequencies below 20 MHz cooling of these seals can be effected by air flowing through the slots at the top of the cooler. In certain cases, e.g. at low dissipation and cooling with the minimum quantity of air (according to the cooling curves), the air flow to the seals will not be sufficient to maintain the seal temperatures below 180 °C. In these cases and also if it is preferred to close the slots, cooling of the seals should be effected by a separate air flow to the seals.

When using the filament connectors type 40628, together with connecting leads of adequate cross-section, additional air cooling of the filament terminals is, as a rule, not necessary.

Care should be taken to ensure firm contact of the filament terminals in order to obtain equal distribution of current over these terminals.



**MECHANICAL DATA**

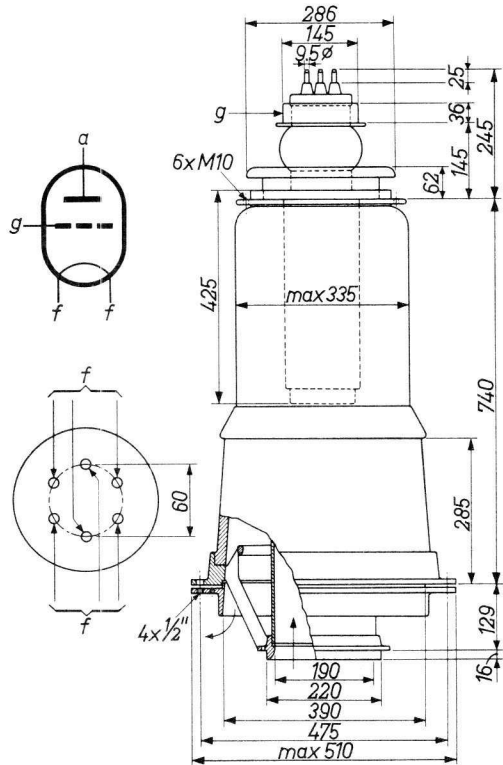
Dimensions in mm

Filament connectors: 40628

Cooler housing : K506

Net weight of tube : 28.5 kg

Net weight of K506 : 72 kg



Tube mounted in cooler housing type K 506

Mounting position: vertical with anode down

When connecting the filament the three pins of each group must be joined.

**R.F. CLASS C TELEGRAPHY**

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	4	15	30	MHz
Anode voltage	$V_a$	= max.	15	13.5	12.5	kV
Anode current	$I_a$	= max.	12.5	12.5	12.5	A
Anode input power	$W_{i_a}$	= max.	165	165	150	kW
Anode dissipation	$W_a$	= max.	45	45	45	kW
Negative grid voltage	$-V_g$	= max.	1200	1200	1200	V
Grid current	$I_g$	= max.	1.2	1.2	1.2	A

**OPERATING CONDITIONS**

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	12	10	kV
Grid voltage	$V_g$	=	-1000	-800	V
Grid driving voltage	$V_{g_p}$	=	1500	1200	V
Anode current	$I_a$	=	12	10	A
Grid current	$I_g$	=	0.75	0.75	A
Anode input power	$W_{i_a}$	=	144	100	kW
Anode dissipation	$W_a$	=	36	25	kW
Driving power	$W_{dr}$	=	1100	850	W
Output power	$W_o$	=	108	75	kW
Efficiency	$\eta$	=	75	75	%

## R.F. CLASS C ANODE MODULATION

## LIMITING VALUES (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	10.5	kV
Anode current	$I_a$	= max.	10.5	A
Anode input power	$W_{i_a}$	= max.	110	kW
Anode dissipation	$W_a$	= max.	30	kW
Negative grid voltage	$-V_g$	= max.	1200	V
Grid current	$I_g$	= max.	1.3	A

## OPERATING CONDITIONS

Frequency	f	=	30	30	MHz
Anode voltage	$V_a$	=	10	10	kV
Grid voltage	$V_g$	=	-1050	-1050	V <sup>1)</sup>
Grid driving voltage	$V_{g_p}$	=	1550	1450	V
Anode current	$I_a$	=	10.5	7.4	A
Grid current	$I_g$	=	1.1	0.8	A
Anode input power	$W_{i_a}$	=	105	74	kW
Anode dissipation	$W_a$	=	22	16	kW
Driving power	$W_{dr}$	=	1650	1100	W
Output power	$W_o$	=	83	58	kW
Efficiency	$\eta$	=	79	79	%
Modulation depth	m	=	100	100	%
Modulation power	$W_{mod}$	=	53	37	kW

<sup>1)</sup> Grid bias partly obtained by a grid resistor

**R.F. CLASS C OSCILLATOR** for industrial use with anode voltage from three-phase rectifier without filter

**LIMITING VALUES** (Absolute limits)

Frequency	f	up to	30	MHz
Anode voltage	$V_a$	= max.	13	kV
Anode current	$I_a$	= max.	15	A
Anode input power	$W_{i_a}$	= max.	180	kW
Anode dissipation	$W_a$	= max.	45	kW
Negative grid voltage	$-V_g$	= max.	1600	V
Grid current, loaded	$I_g$	= max.	1.0	A
Grid current, unloaded	$I_g$	= max.	1.4	A
Grid circuit resistance	$R_g$	= max.	10	k $\Omega$

**OPERATING CONDITIONS**

Frequency	f	=	30	30	30	MHz
Anode voltage	$V_a$	=	12	12	10	kV
Anode current	$I_a$	=	14	12	10	A
Grid current	$I_g$	=	0.9	0.75	0.75	A
Grid circuit resistance	$R_g$	=	1100	1350	1100	$\Omega$
Feedback ratio	$V_{g\sim}/V_{a\sim}$	=	15	14	14	%
Anode input power	$W_{i_a}$	=	168	144	100	kW
Anode dissipation	$W_a$	=	44	36	25	kW
Output power	$W_o$	=	124	108	75	kW
Efficiency	$\eta$	=	74	75	75	%
Output power in the load	$W_l$	=	104	91	63	kW <sup>1)</sup>

<sup>1)</sup> Useful power in the load measured in a circuit having an efficiency of 85%

## A.F. CLASS B AMPLIFIER AND MODULATOR

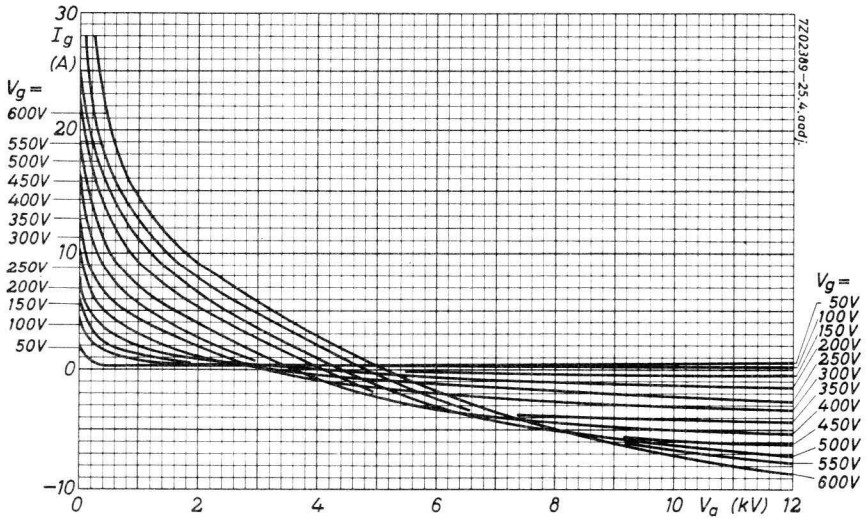
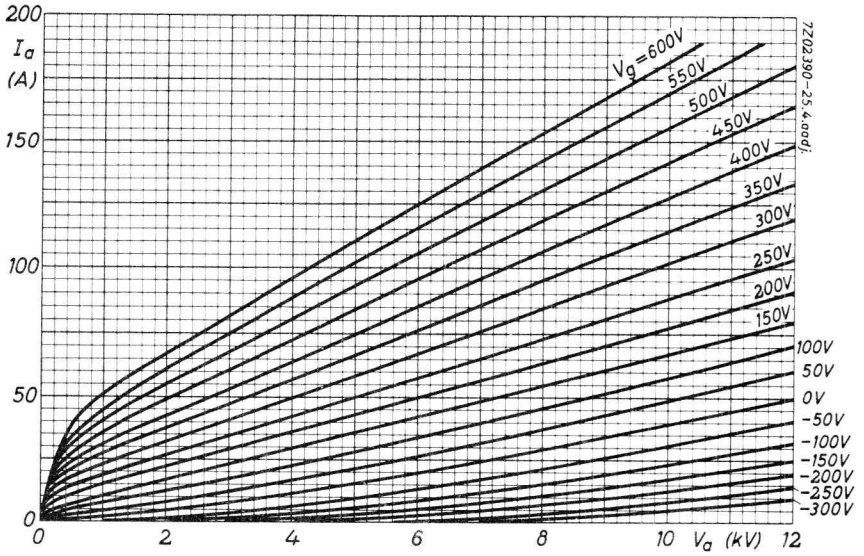
## LIMITING VALUES (Absolute limits)

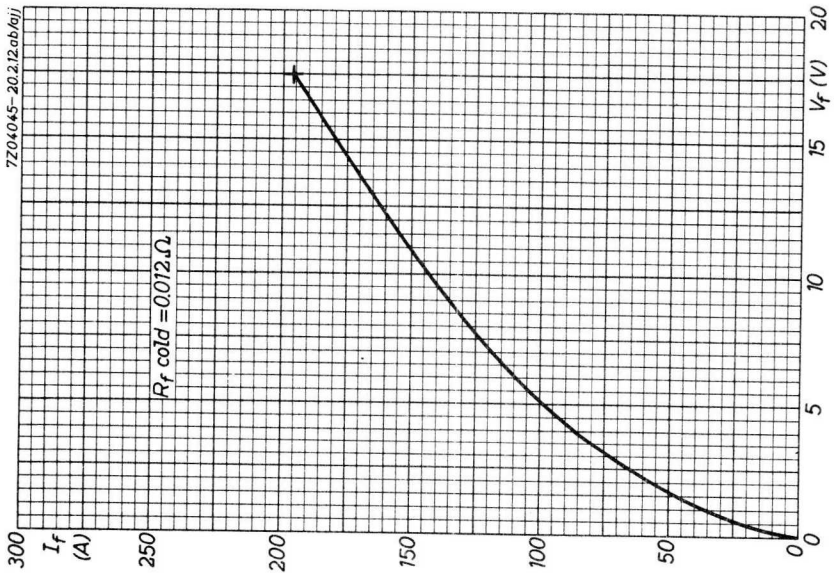
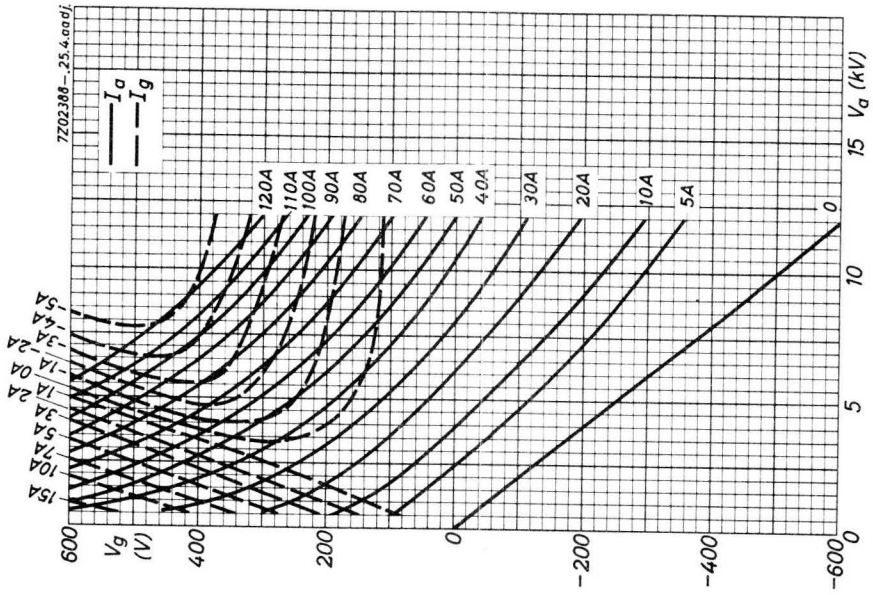
Anode voltage	$V_a$	= max.	15	kV
Anode current	$I_a$	= max.	12	A
Anode input power	$W_{i_a}$	= max.	162	kW
Anode dissipation	$W_a$	= max.	45	kW
Negative grid voltage	$-V_g$	= max.	1200	V
Grid current	$I_g$	= max.	1.2	A

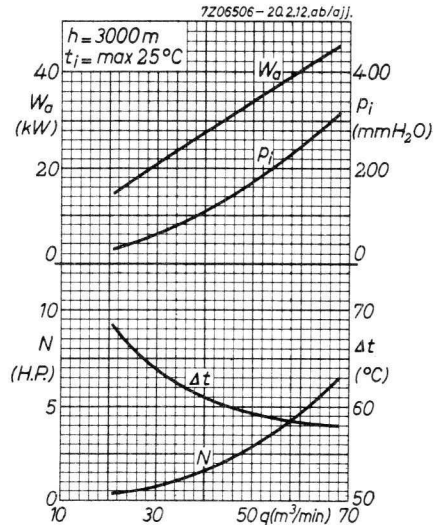
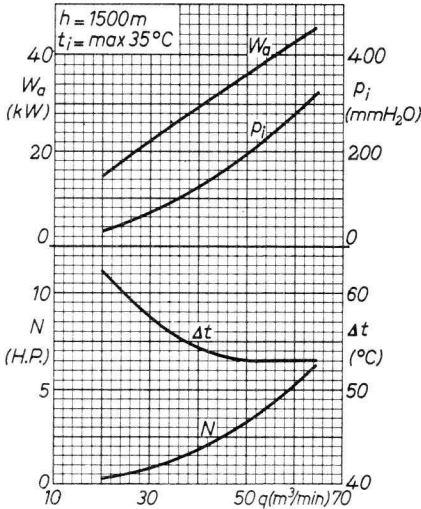
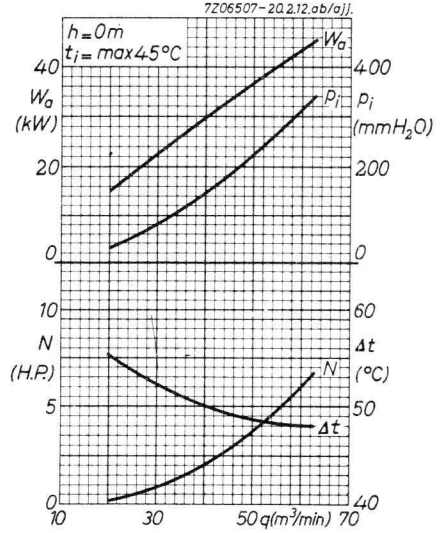
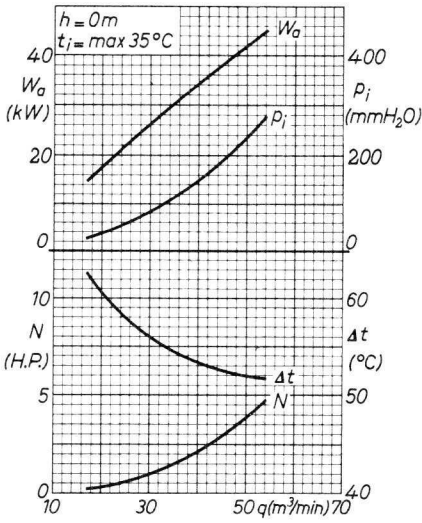
## OPERATING CONDITIONS, two tubes in push-pull

Anode voltage	$V_a$	=	10	10	kV
Grid voltage	$V_g$	=	-540	-540	V <sup>1)</sup>
Load resistance	$R_{aa\sim}$	=	1360	1440	$\Omega$
Driving voltage	$V_{ggp}$	=	0 1550	0 1300	V
Anode current	$I_a$	=	2x0.3 2x8	2x0.3 2x5.8	A
Grid current	$I_g$	=	0 2x0.2	0 2x0.15	A
Anode input power	$W_{i_a}$	=	2x3 2x80	2x3 2x58	kW
Anode dissipation	$W_a$	=	2x3 2x27	2x3 2x26	kW
Driving power	$W_{dr}$	=	0 2x150	0 2x100	W
Output power	$W_o$	=	0 106	0 64	kW
Efficiency	$\eta$	=	- 67	- 56	%

<sup>1)</sup> To be adjusted for a zero signal anode current of 0.3 A









## AIR COOLED R.F. INDUSTRIAL TRIODE

Forced air cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	4.75	kW
Frequency for full ratings	f	max. 85	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R. F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	160	27.12	27.12	MHz
Filament voltage	$V_f$	6.0	6.3	6.3	V
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	3.75	4.75	3.85	kW
Anode voltage	$V_a$	5.0	6.0	5.0	kV
Anode current	$I_a$	1.0	1.0	1.0	A
Anode input power	$W_{ia}$	5.0	6.0	5.0	kW
Anode dissipation	$W_a$	1.03	1.0	0.93	kW
Anode output power	$W_o$	3.97	5.0	4.07	kW
Anode efficiency	$\eta_a$	79.4	83.3	81.4	%
Oscillator efficiency	$\eta_{\text{osc}}$	75.0	79.1	77.0	%
Feedback ratio	$V_{gp}/V_{ap}$	17	17	17	%
Grid resistor	$R_g$	2.0	2.5	2.0	k $\Omega$
Grid current, on load	$I_g$	260	250	260	mA
Grid voltage, negative	$-V_g$	520	625	520	V
Grid dissipation	$W_g$	80	90	80	W
Grid resistor dissipation	$W_{Rg}$	135	156	135	W

**LIMITING VALUES** (Absolute max. rating system)

Frequency	f	up to	85	160	MHz
Anode voltage	$V_a$	max.	7.2	6.0	kV
Anode current	$I_a$	max.	1.1	1.1	A
Anode input power	$W_{ia}$	max.	6.5	6.0	kW
Anode dissipation	$W_a$	max.	2.5	2.5	kW
Grid voltage	$-V_g$	max.	1.0	1.0	kV
Grid current, on load	$I_g$	max.	280	280	mA
		off load	$I_g$	max.	400
Grid dissipation	$W_g$	max.	150	150	W
Grid circuit resistance	$R_g$	max.	20	20	k $\Omega$
Cathode current, mean	$I_k$	max.	1.4	1.4	A
		peak	$I_{kp}$	max.	7.5
Envelope temperature	$t_{env}$	max.	240		$^{\circ}\text{C}$

**HEATING:** direct; filament thoriated tungsten

Filament voltage (<120 MHz)	$V_f$	6.3	V
(>120 MHz)	$V_f$	6.0	V
Filament current at $V_f = 6.3$ V	$I_f$	33	A

The filament is designed to accept temporary fluctuations of +5% and -10%.

**CAPACITANCES**

Anode to filament	$C_{af}$	0.4	pF
Grid to filament	$C_{gf}$	17	pF
Anode to grid	$C_{ag}$	14	pF

**CHARACTERISTICS** measured at  $V_a = 2.0$  kV,  $I_a = 0.5$  A

Transconductance	S	10	mA/V
Amplification factor	$\mu$	20	

**COOLING**

With insulating pedestal type 40630

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude $h$ (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{min}$ (m <sup>3</sup> /min)	Pressure drop $P_i$ (mmH <sub>2</sub> O)	Outlet temperature $t_o$ (°C)
1	0	35	1.25	3.2	83
1	0	45	1.9	5.0	78
3	0	35	5.7	17	64
3	0	45	6.1	18.4	73

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

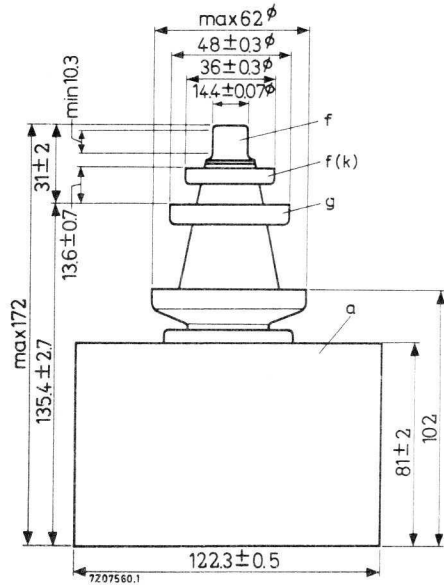
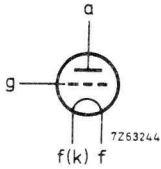
Filament connector		type 40688
Filament/cathode connector		type 40689
Grid connector	$f \leq 30$ MHz	type 40686
	$f > 30$ MHz	type 40687
Insulating pedestal		type 40630 net weight 2.1 kg

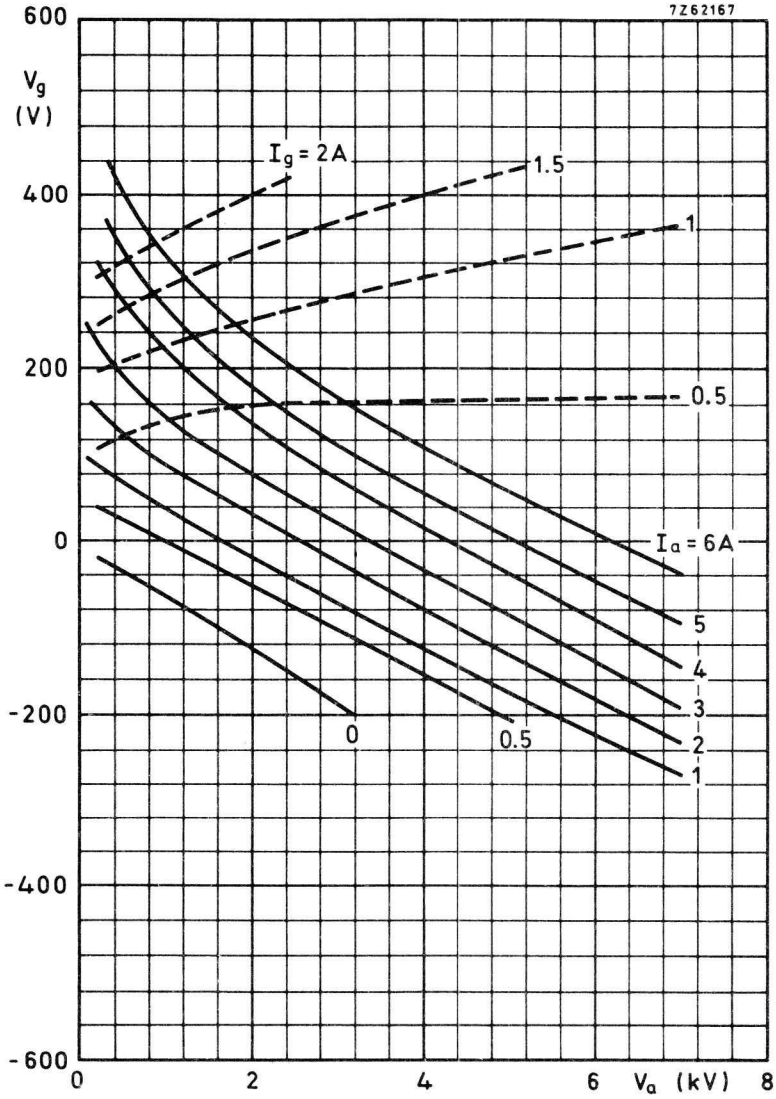
MECHANICAL DATA

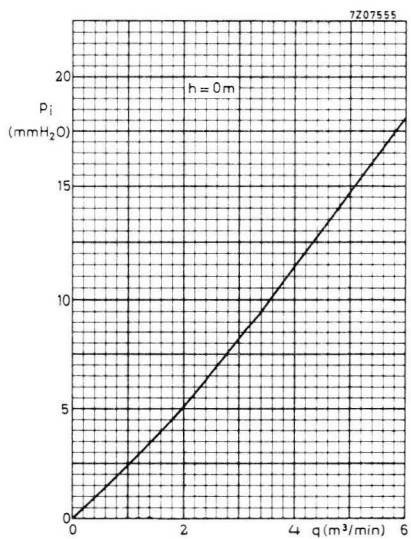
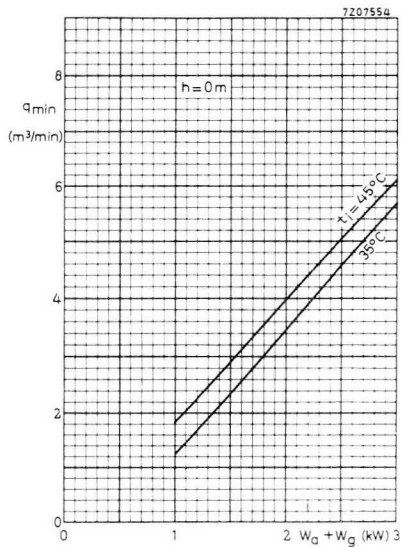
Dimensions in mm

Mounting position: vertical with anode up or down

Net weight: approx. 3.0 kg







## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction intended for use as an industrial oscillator. The tube is cooled by means of a separate jacket.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	4.75	kW
Frequency for full ratings	f	max.	85 MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R. F. heating."

### COOLING

See also cooling curves

With jacket K713

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (ℓ/min)	Pressure drop $p_i$ (atm)
1	20	2.5	0.11
	50	3.0	0.12
3	20	3.0	0.14
	50	6.8	0.38

Absolute max. water inlet temperature  $t_i$  max. 50 °C

A low velocity air flow may be required for cooling of the seals at frequencies above 4 MHz.

### ACCESSORIES

Filament connector	type	40688	
Filament/cathode connector	type	40689	
Grid connector	f ≤ 30 MHz	type	40686
	f > 30 MHz	type	40687
Water jacket	type	K713	net weight 0.52 kg
Gasket	code	3322 026 82801	

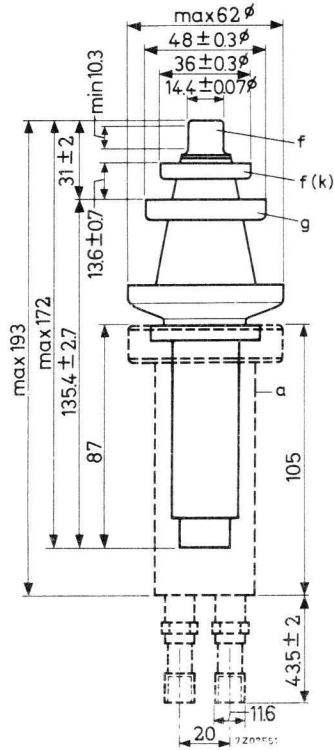
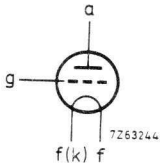
For further data and curves please refer to YD1150

MECHANICAL DATA

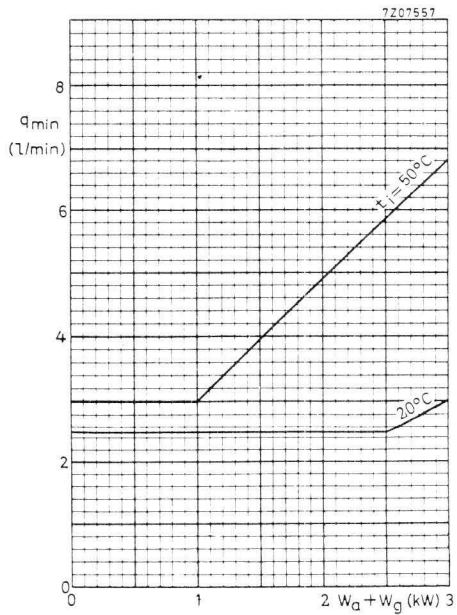
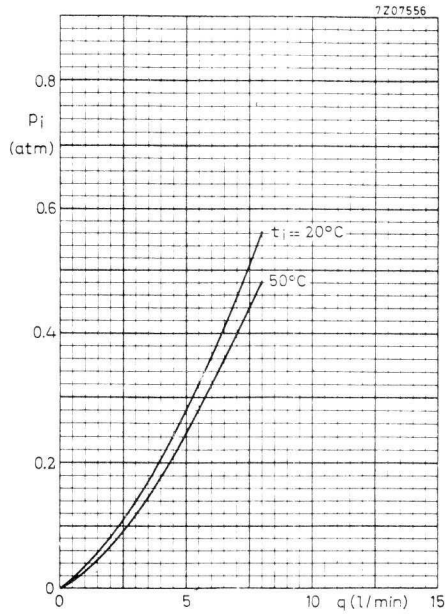
Dimensions in mm

Mounting position: vertical anode down

Net weight: approx. 0.65 kg









## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral helical cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	4.75	kW
Frequency for full ratings	f	max.	85 MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating".

### COOLING

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (ℓ/min)	Pressure drop $P_i$ (atm)
1	20	0.9	0.05
	50	1.4	0.06
3	20	2.2	0.14
	50	4.1	0.27

Absolute max. water inlet temperature  $t_i$  max. 50 °C

A low velocity air flow may be required for cooling of the seals at frequencies above 4 MHz.

### ACCESSORIES

Filament connector		type	40688
Filament/cathode connector		type	40789
Grid connector	$f \leq 30$ MHz	type	40686
	$f > 30$ MHz	type	40687

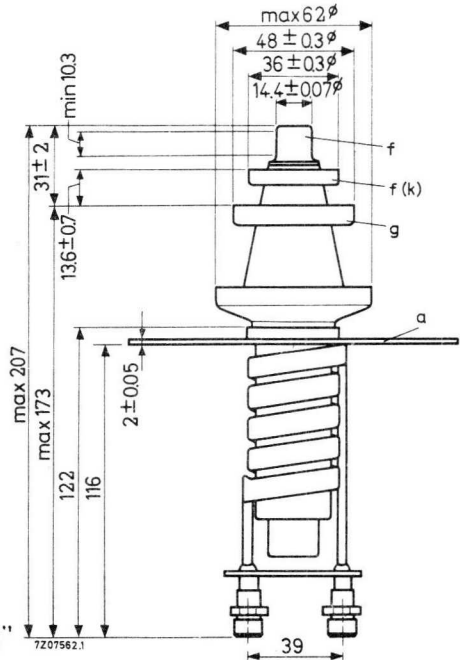
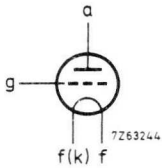
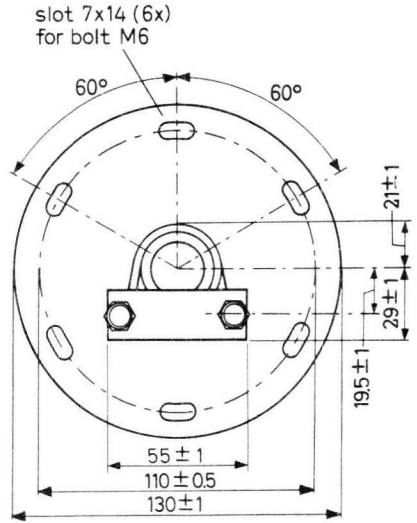
For further data and curves please refer to YD1150

MECHANICAL DATA

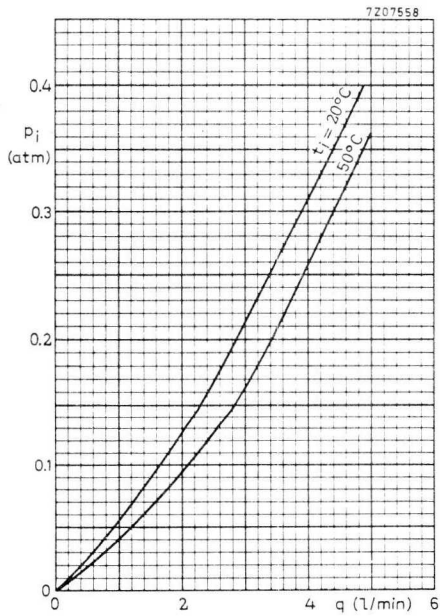
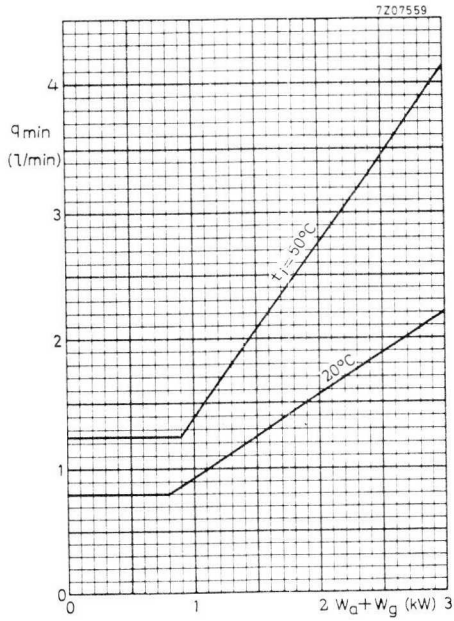
Dimensions in mm

Mounting position: vertical with anode down

Net weight: approx. 0.85 kg



Thread of water connections BSP  $\frac{1}{4}$ "





## AIR COOLED R.F. INDUSTRIAL TRIODE

Forced air cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	8.8	kW
Frequency for full ratings	f	max. 85	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	150	27.12	27.12	MHz
Filament voltage	$V_f$	5.8	6.3	6.3	V
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	7.15	8.8	7.5	kW
Anode voltage	$V_a$	5.0	6.5	6.0	kV
Anode current	$I_a$	2.0	1.8	1.6	A
Anode input power	$W_{ia}$	10.0	11.7	9.6	kW
Anode dissipation	$W_a$	2.45	2.5	1.7	kW
Anode output power	$W_o$	7.55	9.2	7.9	kW
Anode efficiency	$\eta_a$	75.5	78.6	82.3	%
Oscillator efficiency	$\eta_{\text{osc}}$	71.5	75.2	78.1	%
Feedback ratio	$V_{gp}/V_{ap}$	15	16	15	%
Grid resistor	$R_g$	1.0	1.6	1.3	$k\Omega$
Grid current, on load	$I_g$	480	430	480	mA
Grid voltage, negative	$-V_g$	480	688	624	V
Grid dissipation	$W_g$	100	110	120	W
Grid resistor dissipation	$WR_g$	230	296	300	W



## LIMITING VALUES (Absolute max. rating system)

Frequency	f	up to	85	150	MHz
Anode voltage	$V_a$	max.	7.2	6.0	kV
Anode current	$I_a$	max.	2.2	2.2	A
Anode input power	$W_{ia}$	max.	12.5	11	kW
Anode dissipation	$W_a$	max.	5.0	5.0	kW
Grid voltage	$-V_g$	max.	1.0	1.0	kV
Grid current, on load off load	$I_g$	max.	550	550	mA
	$I_g$	max.	750	750	mA
Grid dissipation	$W_g$	max.	250	250	W
Grid circuit resistance	$R_g$	max.	20	20	k $\Omega$
Cathode current, mean peak	$I_k$	max.	2.8	2.8	A
	$I_{kp}$	max.	15	15	A
Envelope temperature	$t_{env}$	max.	240	240	$^{\circ}\text{C}$

## HEATING : direct; filament thoriated tungsten

Filament voltage (f = 150 MHz) (f < 150 MHz)	$V_f$	5.8	V
	$V_f$	6.3	V
Filament current at $V_f = 6.3$ V	$I_f$	66	A

The filament is designed to accept temporary fluctuations of + 5% and - 10%.

## CAPACITANCES

Anode to filament	$C_{af}$	0.5	pF
Grid to filament	$C_{gf}$	16	pF
Anode to grid	$C_{ag}$	19	pF

## CHARACTERISTICS measured at $V_a = 2$ kV, $I_a = 1$ A.

Transconductance	S	22	mA/V
Amplification factor	$\mu$	20	



**COOLING**

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude h (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{min}$ (m <sup>3</sup> /min)	Pressure drop $p_i$ (mmH <sub>2</sub> O)	Outlet temperature $t_o$ (°C)
3	0	35	3,6	9	82
3	0	45	4,2	11	87

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

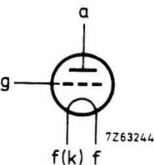
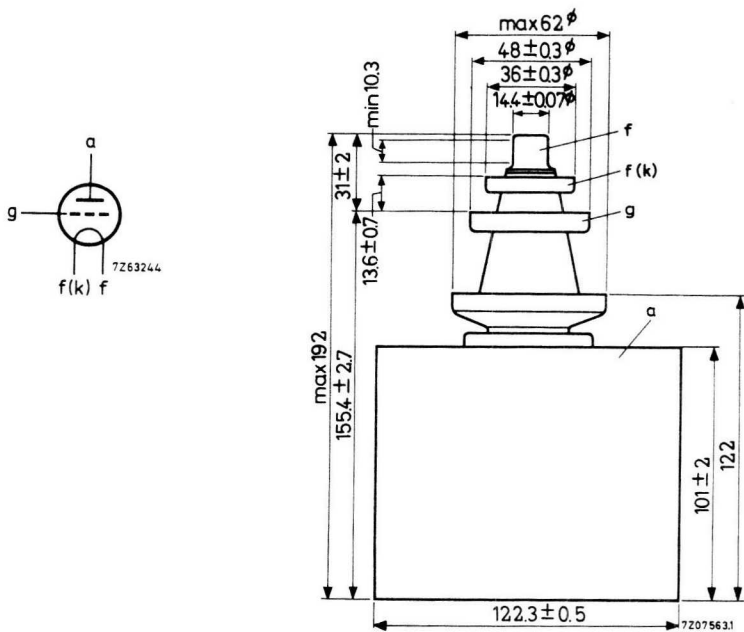
Filament connector	type	40688			
Filament/cathode connector	type	40689			
Grid connector $f \leq 30$ MHz	type	40686			
$f > 30$ MHz	type	40687			
Insulating pedestal	type	40630	net weight	2.1	kg

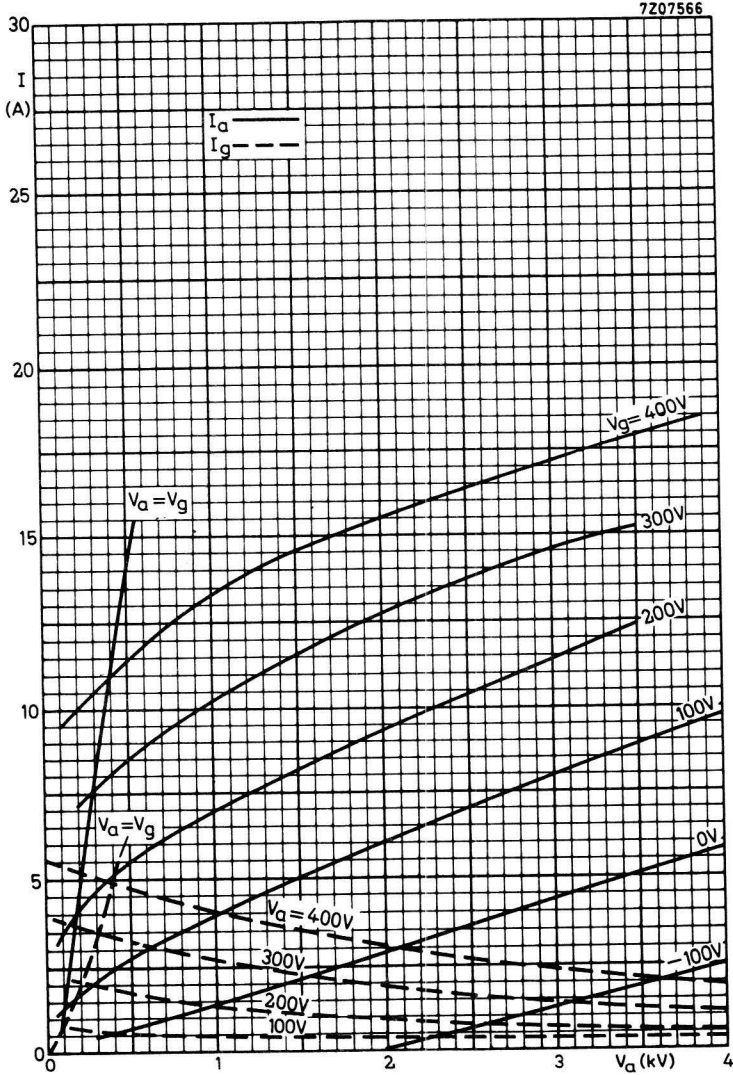
MECHANICAL DATA

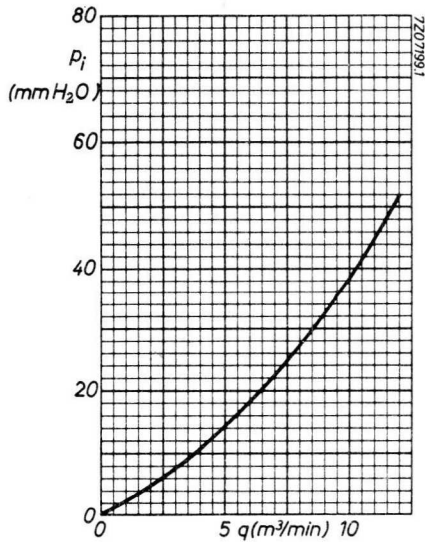
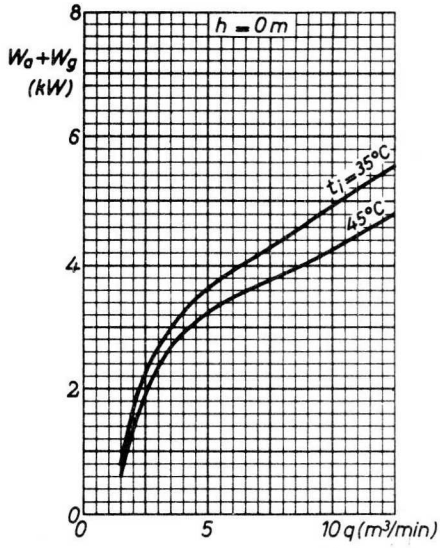
Dimensions in mm

Mounting position: vertical, with anode up or down

Net weight: approx. 3.9 kg







## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction intended for use as an industrial oscillator. The tube is cooled by means of a separate jacket.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	8.8	kW
Frequency for full ratings	f max.	85	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### COOLING

See also cooling curves

With jacket K726

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $Q_{\text{min}}$ (ℓ/min)	Pressure drop $P_i$ (atm)
3	20	3	0.16
	50	7	0.52
5	20	5	0.34
	50	11.5	1.4

Absolute max. water inlet temperature  $t_i$  max. 50 °C

A low velocity air flow may be required for cooling of the seals.

### ACCESSORIES

Filament connector	type	40688	
Filament/cathode connector ( $f \leq 30$ MHz)	type	40689	
Grid connector	$f \leq 30$ MHz	type	40686
	$f > 30$ MHz	type	40687
Water jacket	type	K726	net weight 0.73 kg
Gasket	code	3322 026 82801	

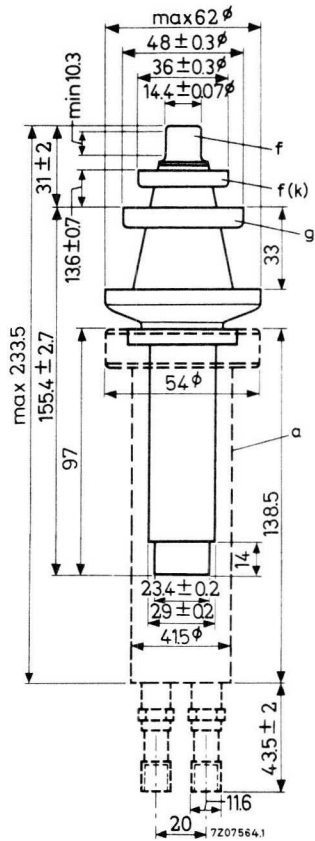
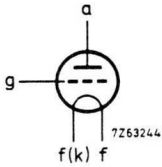
For further data and curves please refer to YD1160

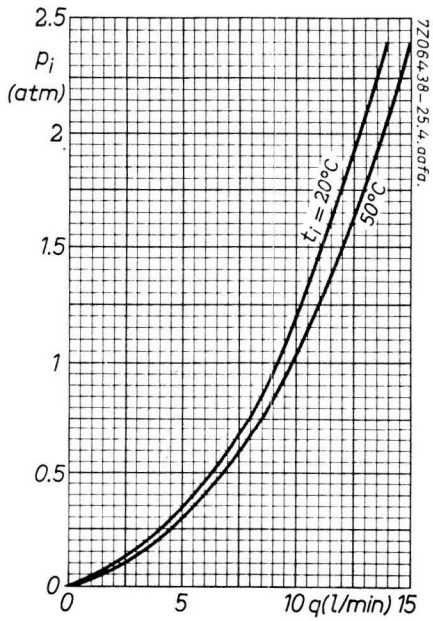
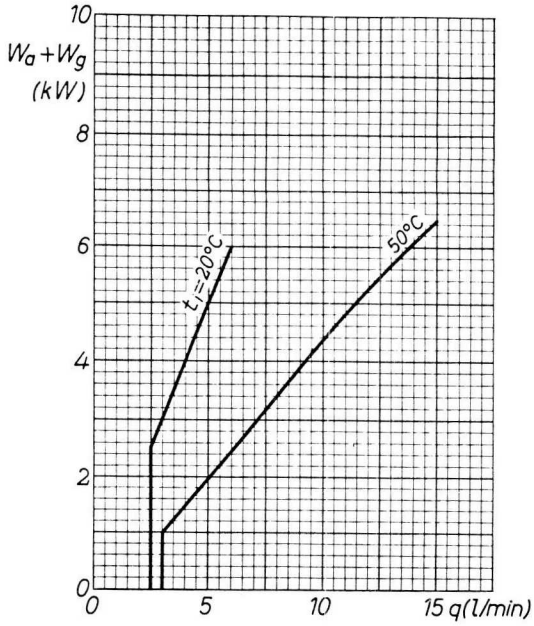
MECHANICAL DATA

Dimensions in mm

Mounting position: vertical with anode down

Net weight: approx. 0.66 kg









## WATER COOLED R.F INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral helical cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	8.8	kW
Frequency for full ratings	f	max. 85	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### COOLING

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (ℓ/min)	Pressure drop $P_i$ (atm)
3	20	2.2	0.18
	50	4.3	0.38
5	20	4.0	0.40
	50	8.0	1.4

Absolute max. water inlet temperature  $t_i$  max. 50 °C

A low velocity air flow may be required for cooling of the seals.

### ACCESSORIES

Filament connector	type	40688
Filament/cathode connector ( $f \leq 30$ MHz)	type	40689
Grid connector	$f \leq 30$ MHz	type 40686
	$f > 30$ MHz	type 40687

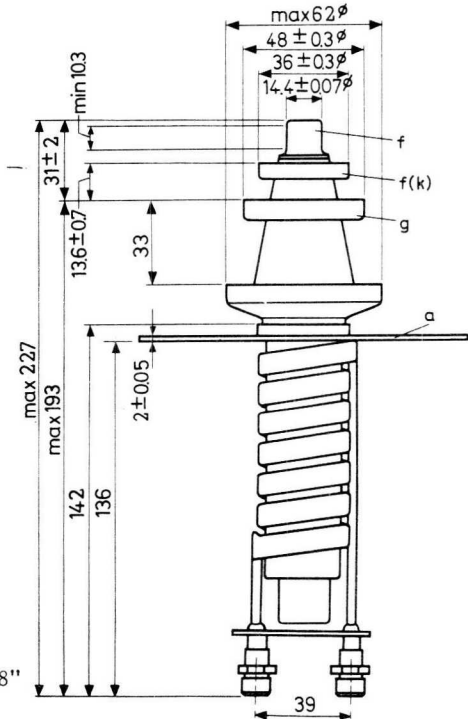
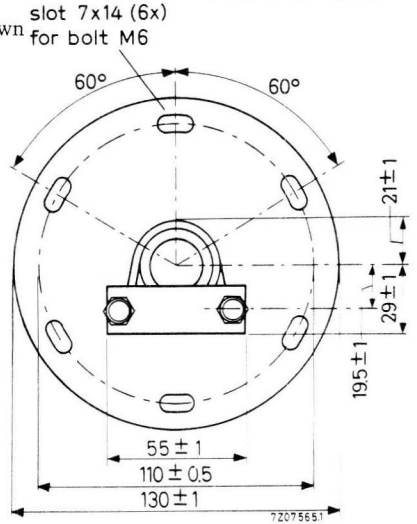
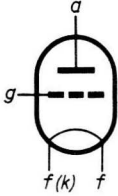
For further data and curves please refer to YD1160

**MECHANICAL DATA**

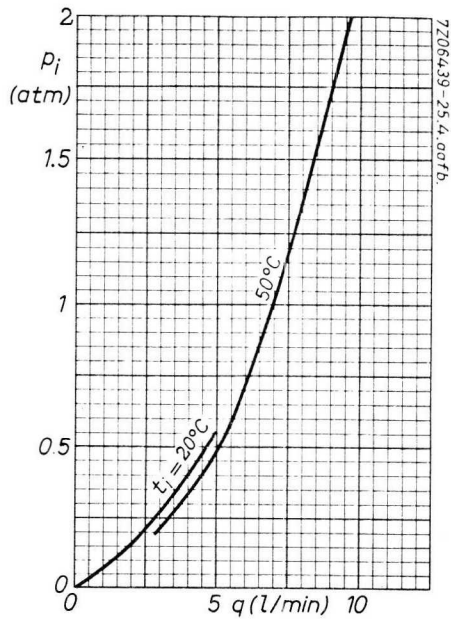
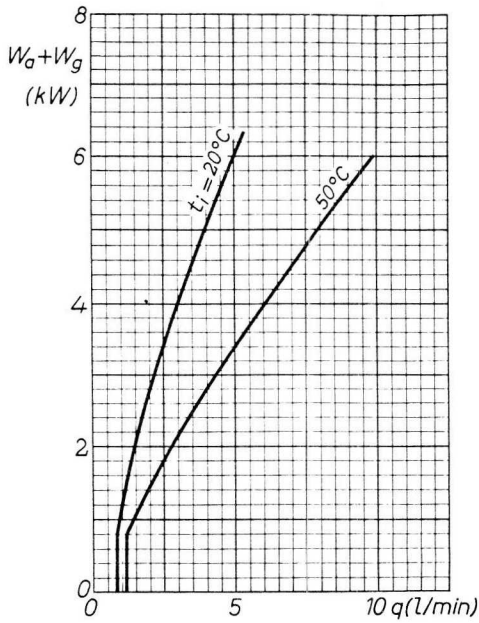
Mounting position: vertical with anode up or down  
 slot 7x14 (6x)  
 for bolt M6

Net weight: approx. 1.03 kg

Dimensions in mm



Thread of water connections BSP 3/8"





## AIR COOLED R.F. INDUSTRIAL TRIODE

Forced air-cooled triode of metal-ceramic construction intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	15.4	kW
Frequency for full ratings	f	max. 120	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	120	MHz
Filament voltage	f	See under "HEATING"	
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	15.4	kW
Anode voltage	$V_a$	6.0	kV
Anode current	$I_a$	3.4	A
Anode input power	$W_{ia}$	20.4	kW
Anode dissipation	$W_a$	4.3	kW
Anode output power	$W_o$	16.1	kW
Anode efficiency	$\eta_a$	78.9	%
Oscillator efficiency	$\eta_{\text{osc}}$	75.5	%
Feedback ratio	$V_{gp}/V_{ap}$	15.5	%
Grid resistor	$R_g$	500	$\Omega$
Grid current, on load	$I_g$	920	mA
Grid voltage, negative	$-V_g$	460	V
Grid dissipation	$W_g$	280	W
Grid resistor dissipation	$W_{Rg}$	423	W



**COOLING**

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude $h$ (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (m <sup>3</sup> /min)	Pressure drop $P_i$ (mmH <sub>2</sub> O)	Outlet temperature $t_o$ (°C)
10	0	35	9.5	55	94
8	0	35	6.5	28	105
6	0	35	4.5	15	113
4	0	35	3.0	8	117
10	0	45	11.0	69	98
8	0	45	7.6	35	108
6	0	45	5.2	19	115
4	0	45	3.5	10	119
10	1500	35	11.4	63	94
8	1500	35	7.8	32	105
6	1500	35	5.5	17	113
4	1500	35	3.6	9	117
10	3000	25	12.0	62	90
8	3000	25	8.2	32	102
6	3000	25	5.7	17	111
4	3000	25	3.8	9	116

Absolute max. air inlet temperature  $t_i$  max. 45 °C

At the lower values of anode dissipation and at the highest operating frequencies additional cooling of the seals is required.

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

Direction of airflow: arbitrary.

**ACCESSORIES**

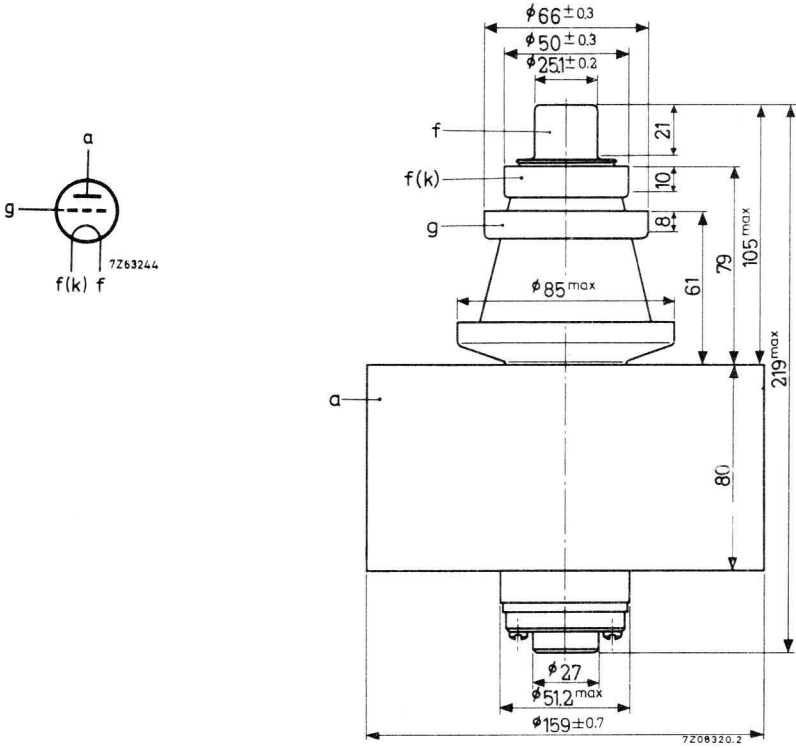
Filament connector	type	40692	net weight	140 g
Filament/cathode connector	type	40693	net weight	165 g
Filament cables (2 required)	type	40715	net weight	200 g
Grid connector	$f \leq 4$ MHz	type	40690	net weight 55 g
	$f > 4$ MHz	type	40691	net weight 240 g
Insulating pedestal	type	40654	net weight	4.25 kg

MECHANICAL DATA

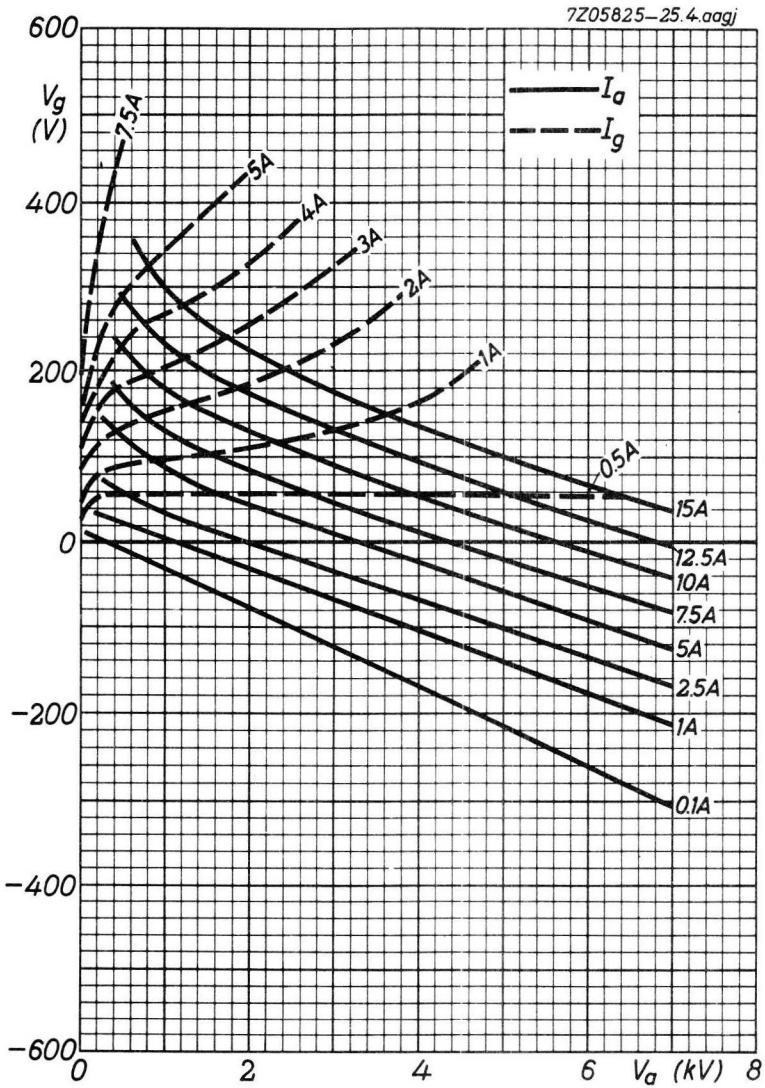
Dimensions in mm

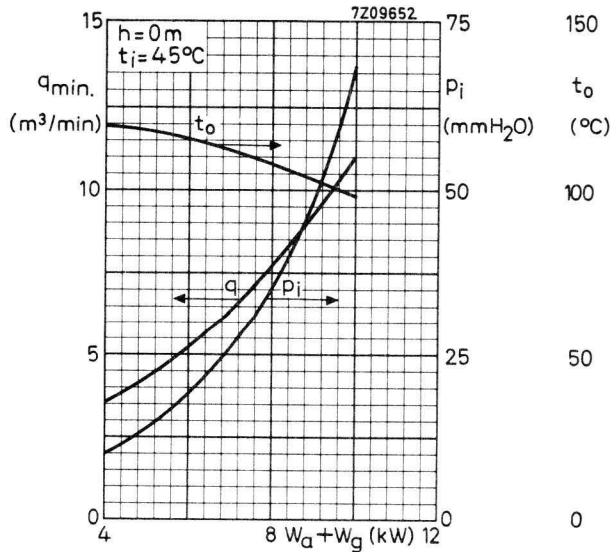
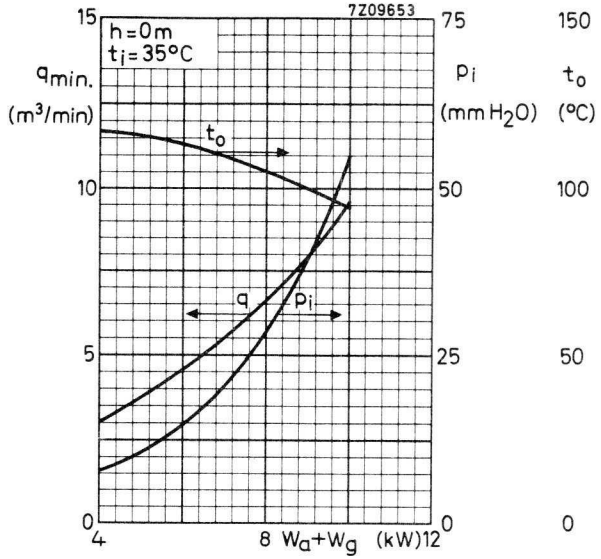
Mounting position: vertical with anode up or down

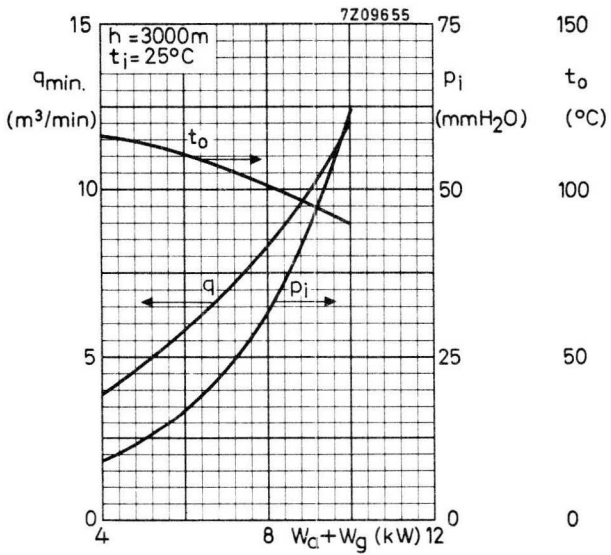
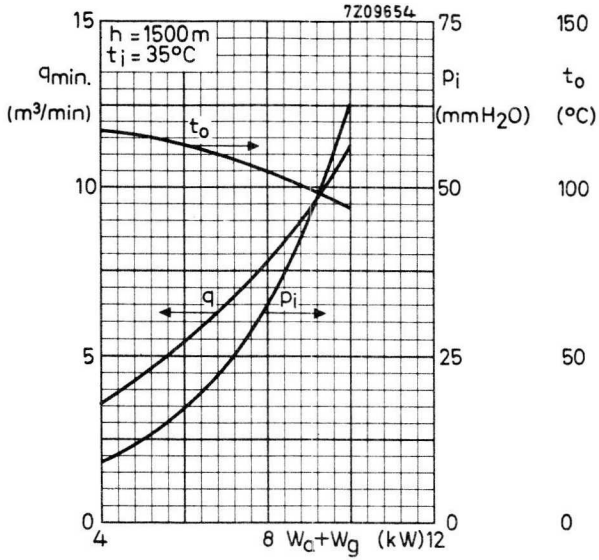
Net weight: approx 7.5 kg.













## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction intended for use as industrial oscillator. The tube is cooled by means of a separate jacket.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	15.4	kW
Frequency for full ratings	f max.	120	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### COOLING

See also cooling curves

With jacket K727

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (ℓ/min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
10	20	10.0	0.60	36
	50	15.0	1.25	61
8	20	7.8	0.38	37
	50	11.3	0.75	62
6	20	5.7	0.22	38
	50	8.2	0.42	62

Absolute max. water inlet temperature  $t_i$  max. 50 °C

Air cooling of the seals is required at frequencies above 4 MHz

### ACCESSORIES

Filament connector	type	40692	net weight	140	g	
Filament/cathode connector	type	40693	net weight	165	g	
Filament cables (two required)	type	40715	net weight	200	g	
Grid connector	type	$f \leq 4$ MHz	40690	net weight	55	g
		$f > 4$ MHz	40691	net weight	240	g
Water jacket	type	K727	net weight	2	kg	
Gasket (O-ring)	code		2622 080 30889			

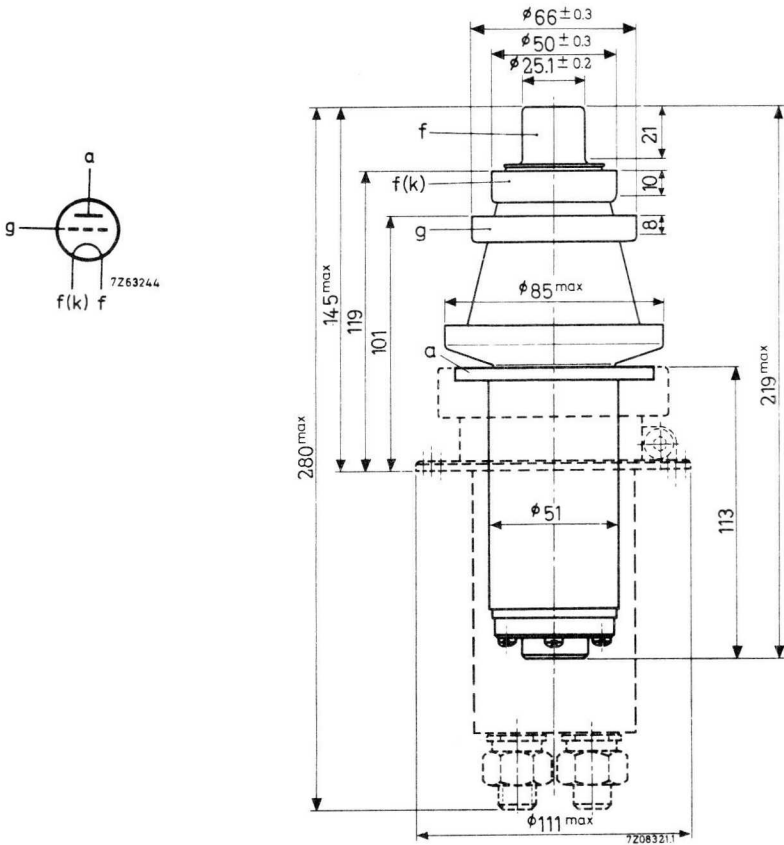
For further data and curves please refer to YD1170

MECHANICAL DATA

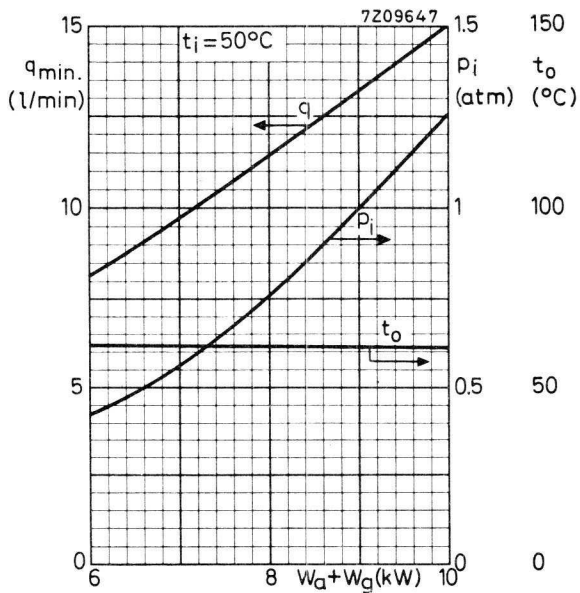
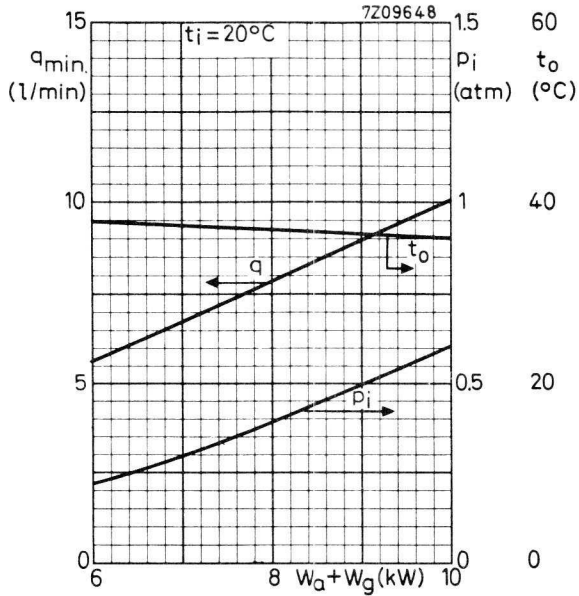
Dimensions in mm

Mounting position: vertical with anode down

Net weight: approx. 1.5 kg



Thread of water connections BSP 1/2"







## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral helical cooler intended for use as industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	15.4	kW
Frequency for full ratings	f	max. 120	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### COOLING

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{\text{min}}$ (ℓ/min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
10	20	6.0	0.25	46
	50	9.0	0.52	67
8	20	4.5	0.15	49
	50	6.7	0.31	69
6	20	3.0	0.07	53
	50	4.5	0.15	72

Absolute max. water inlet temperature  $t_i$  max. 50 °C

Air cooling of the seals is required at frequencies above 4 MHz.

### ACCESSORIES

Filament connector		type	40692	net weight	140	g
Filament/cathode connector		type	40693	net weight	165	g
Filament cables (two required)		type	40715	net weight	200	g
Grid connector	$f \leq 4$ MHz	type	40690	net weight	55	g
	$f > 4$ MHz	type	40691	net weight	240	g

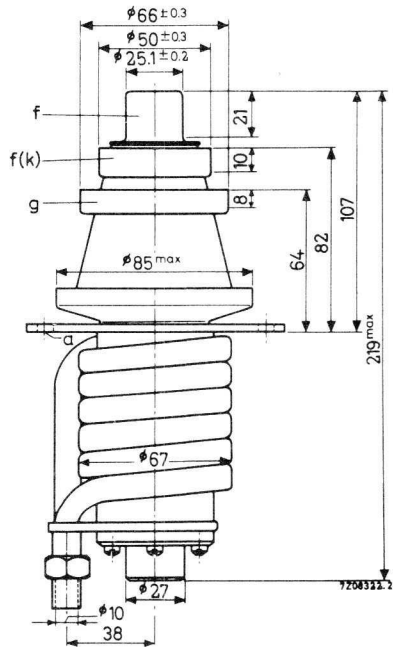
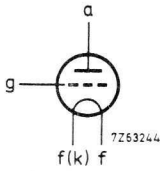
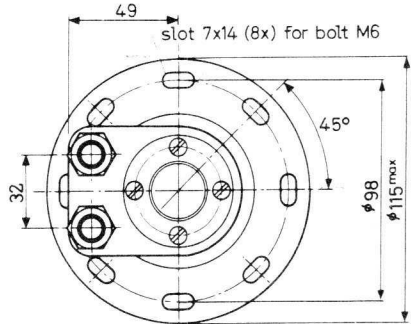
For further data please refer to YD1170

MECHANICAL DATA

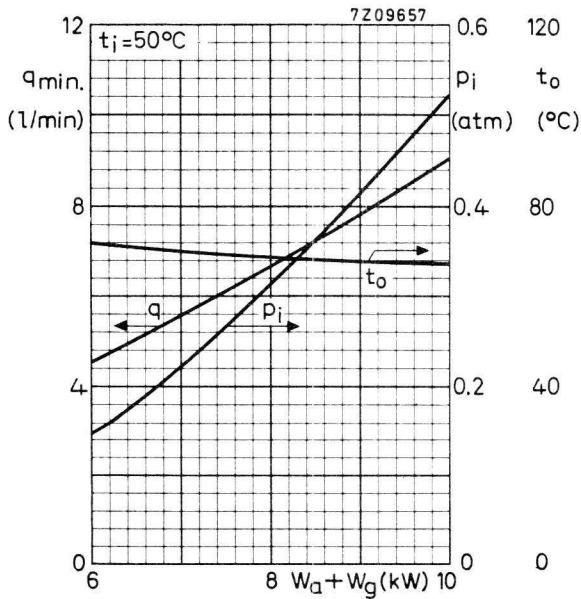
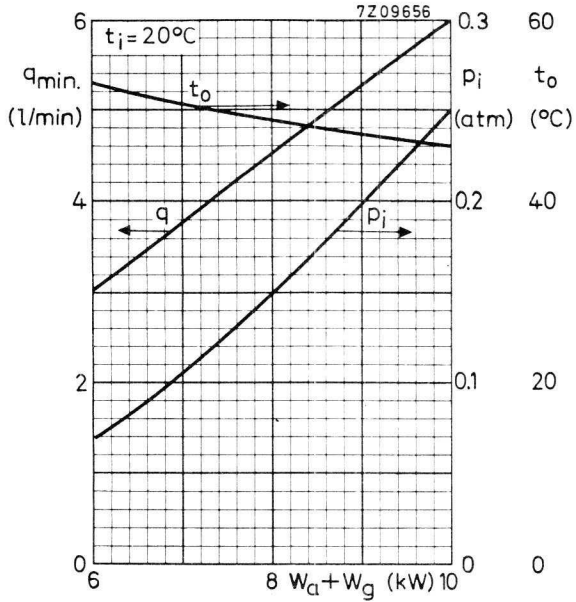
Dimensions in mm

Mounting position: vertical with anode up or down

Net weight: approx. 2 kg



Thread of water connections BSP 3/8"





## AIR COOLED R.F. INDUSTRIAL TRIODE

Forced air cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	13.22	kW
Frequency fur full ratings	f	max. 50	MHz

To be read in conjunction with "General Recommendations Transmitting tubes. Tubes for R.F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	50	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	13.22	kW
Anode voltage	$V_a$	10.0	kV
Anode current	$I_a$	1.75	A
Anode input power	$W_{ia}$	17.5	kW
Anode dissipation	$W_a$	3.8	kW
Anode output power	$W_o$	13.7	kW
Anode efficiency	$\eta_a$	78.3	%
Oscillator efficiency	$\eta_{\text{osc}}$	75.6	%
Feedback ratio	$V_{gp}/V_{ap}$	12.0	%
Grid resistor	$R_g$	1.5	$k\Omega$
Grid current, on load	$I_g$	450	mA
Grid voltage, negative	$-V_g$	675	V
Grid dissipation	$W_g$	180	W
Grid resistor dissipation	$W_{Rg}$	304	W



**COOLING**

See also cooling curves.

With insulating pedestal type 40654.

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude h (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{min}$ (m <sup>3</sup> /min)	Pressure drop $P_i$ (mmH <sub>2</sub> O)	Outlet temperature $t_o$ (°C)
10	0	35	9.5	55	94
8	0	35	6.5	28	105
6	0	35	4.5	15	113
4	0	35	3.0	8	117
10	0	45	11	69	98
8	0	45	7.6	35	108
6	0	45	5.2	19	115
4	0	45	3.5	10	119
10	1500	35	11.4	63	94
8	1500	35	7.8	32	105
6	1500	35	5.5	17	113
4	1500	35	3.6	9	117
10	3000	25	12	62	90
8	3000	25	8.2	32	102
6	3000	25	5.7	17	111
4	3000	25	3.8	9	116

To obtain optimum life, the seal/envelope temperature under continuous loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

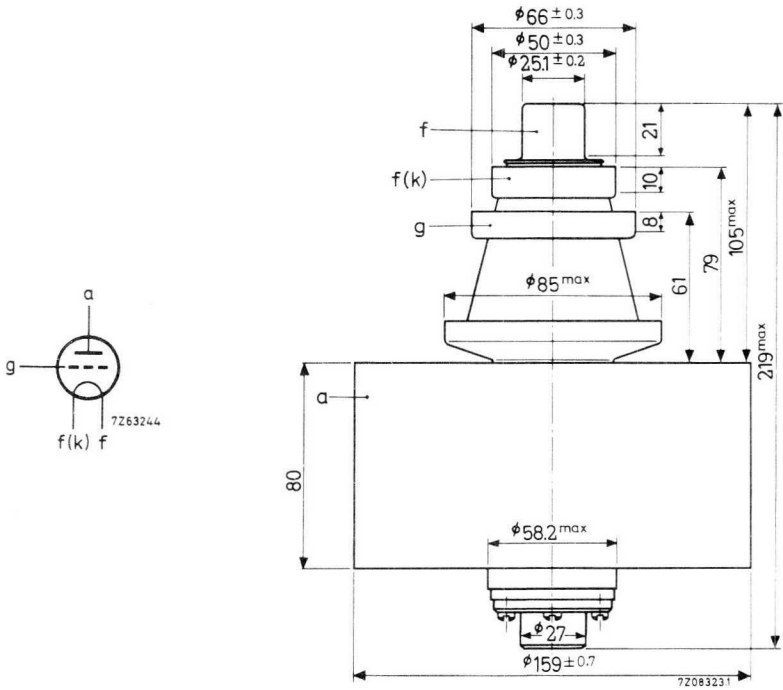
Filament connector		type 40692	net weight	140 g
Filament/cathode connector		type 40693	net weight	165 g
Filament cables (2 required)		type 40715	net weight	200 g
Grid connector	$f \leq 4$ MHz	type 40690	net weight	55 g
	$f > 4$ MHz	type 40691	net weight	240 g
Insulating pedestal		type 40654	net weight	4.25 kg

MECHANICAL DATA

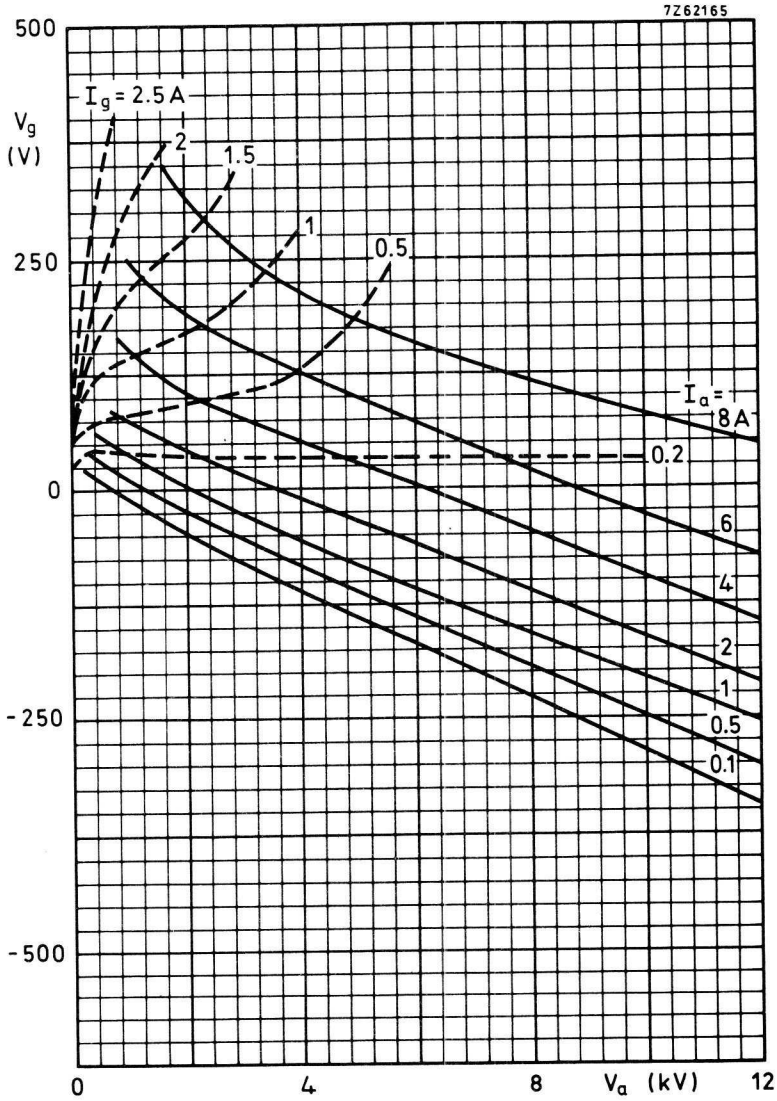
Dimensions in mm

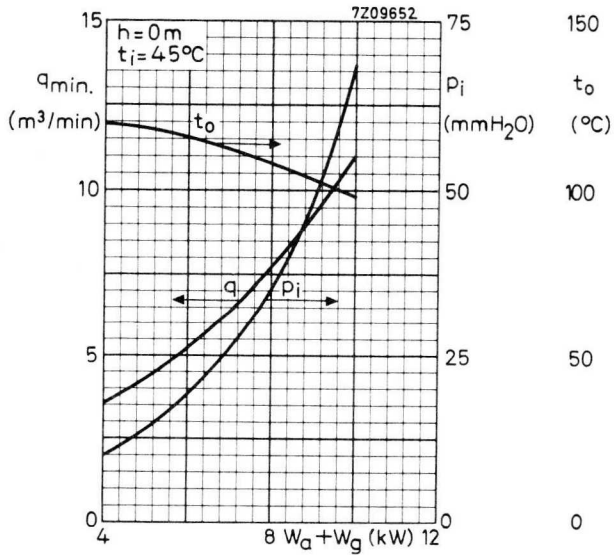
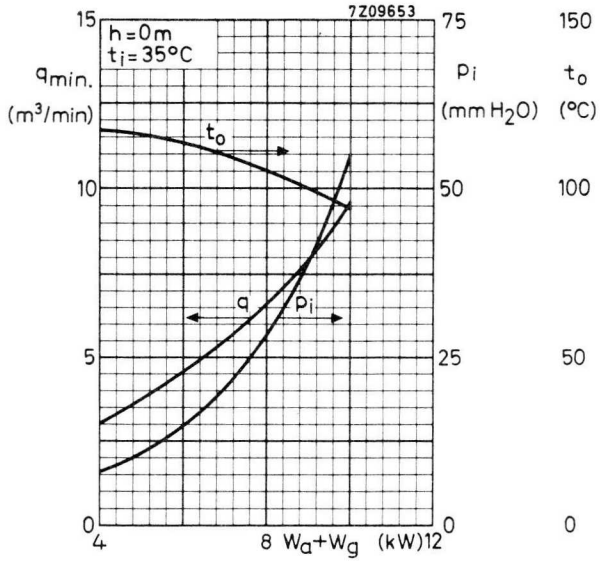
Mounting position: vertical with anode up or down

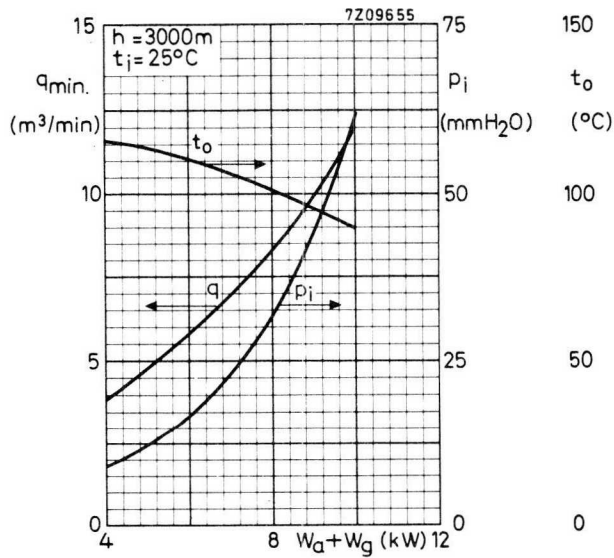
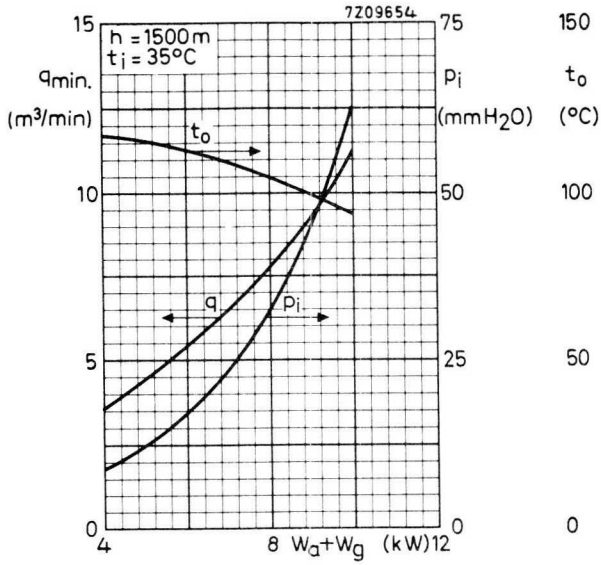
Net weight: approx. 7.5 kg













## AIR COOLED R.F. INDUSTRIAL TRIODE

Forced air cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	31.6	kW
Frequency for full ratings	f	max. 100	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R. F. heating"

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE



#### OPERATING CONDITIONS

Frequency	f	90	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	31.6	kW
Anode voltage	$V_a$	7.5	kV
Anode current	$I_a$	5.4	A
Anode input power	$W_{ia}$	40.5	kW
Anode dissipation	$W_a$	7.5	kW
Anode output power	$W_o$	33.0	kW
Anode efficiency	$\eta_a$	81.5	%
Oscillator efficiency	$\eta_{\text{osc}}$	78.0	%
Feedback ratio	$V_{gp}/V_{ap}$	14.8	%
Grid resistor	$R_g$	450	$\Omega$
Grid current, on load	$I_g$	1.45	A
Grid voltage, negative	$-V_g$	652	V
Grid dissipation	$W_g$	450	W
Grid resistor dissipation	$W_{Rg}$	946	W



## COOLING

See also cooling curves

With insulating pedestal type 40648

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude $h$ (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{\text{min}}$ (m <sup>3</sup> /min)	Pressure drop $P_i$ (mm H <sub>2</sub> O)	Outlet temperature $t_o$ (°C)
20	0	35	21	160	88
15	0	35	15	85	92
10	0	35	9.3	32	99
8	0	35	7	20	104
20	0	45	24.2	198	92
15	0	45	17.3	106	98
10	0	45	10.7	40	104
8	0	45	8.1	25	108
20	1500	35	25.2	182	86
15	1500	35	18	97	93
10	1500	35	11.2	46	100
8	1500	35	8.4	23	104
20	3000	25	26.8	178	84
15	3000	25	19	95	90
10	3000	25	11.8	45	95
8	3000	25	8.9	23	99

No additional cooling of the seals is required at frequencies < 4 MHz.

Preferred direction of air flow, especially at the higher operating frequencies: see outline drawing.

To obtain optimum life, the seal/envelope temperature under continuous loaded conditions should be kept at or below 200 °C.

## ACCESSORIES

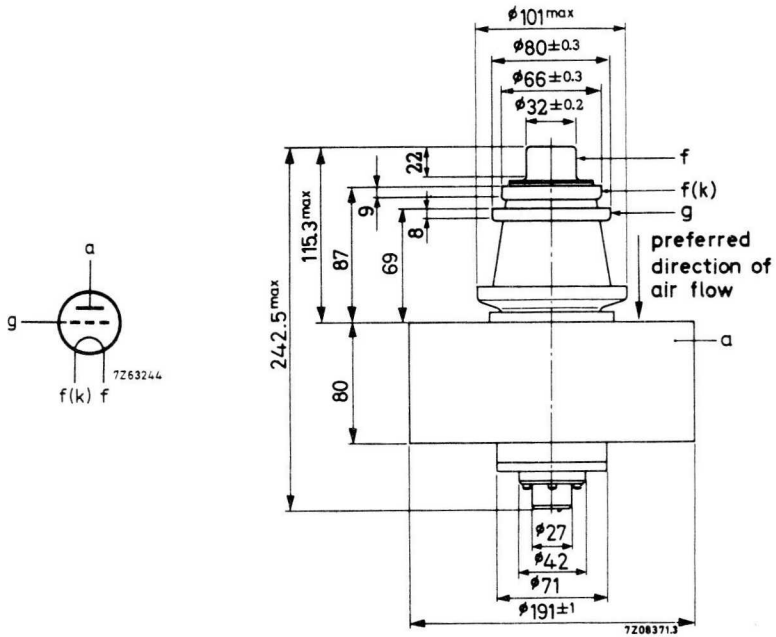
Filament connectors (both types required)	type 40708 net weight 230 g
	type 40709 net weight 265 g
Filament cables (2 required)	type 40720 net weight 215 g
Grid connector $f < 4$ MHz	type 40710 net weight 60 g
$f > 4$ MHz	type 40711 net weight 310 g
Insulating pedestal	type 40648 net weight 7.15 kg

MECHANICAL DATA

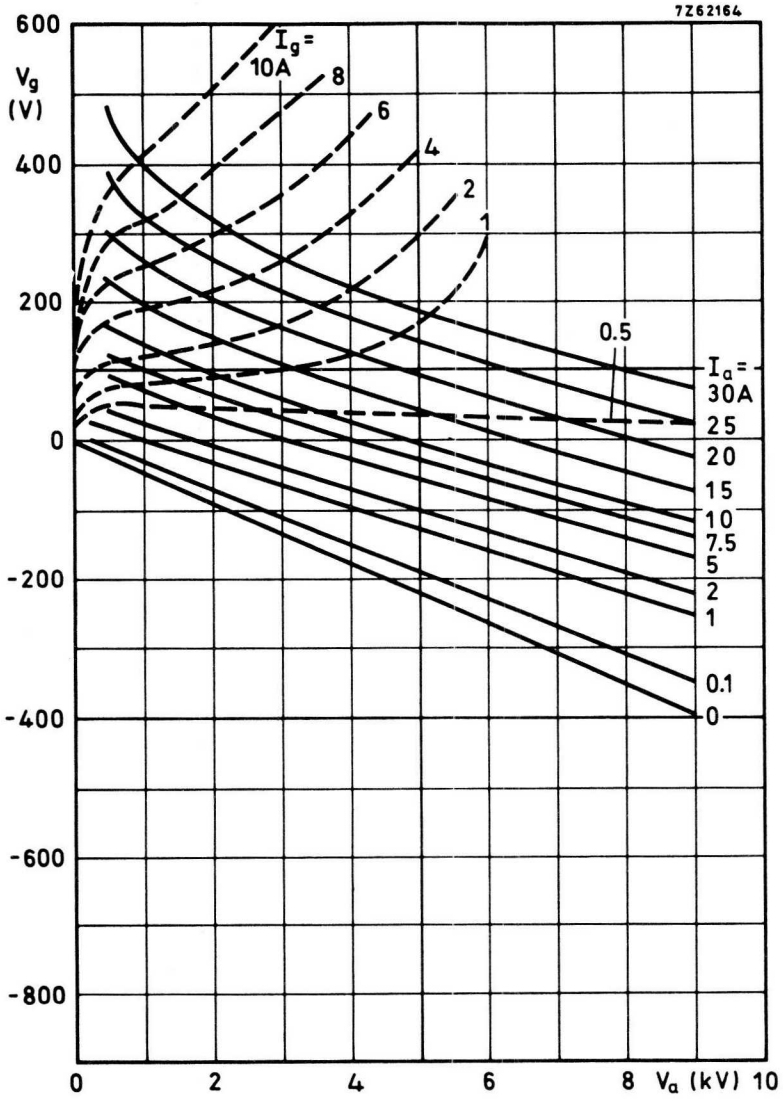
Dimensions in mm

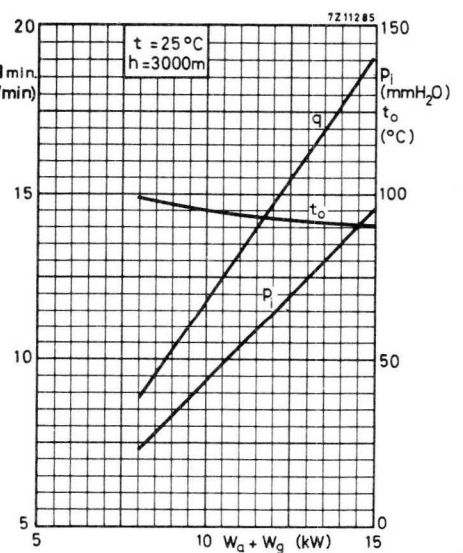
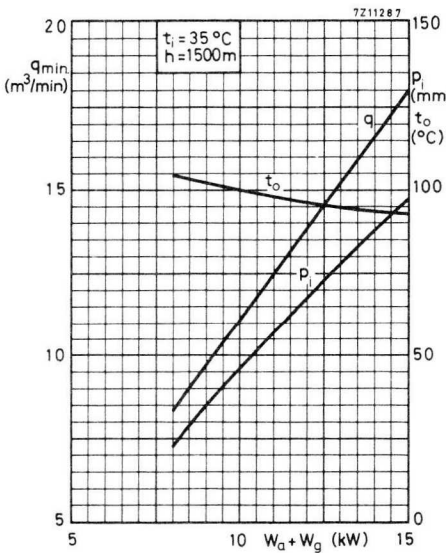
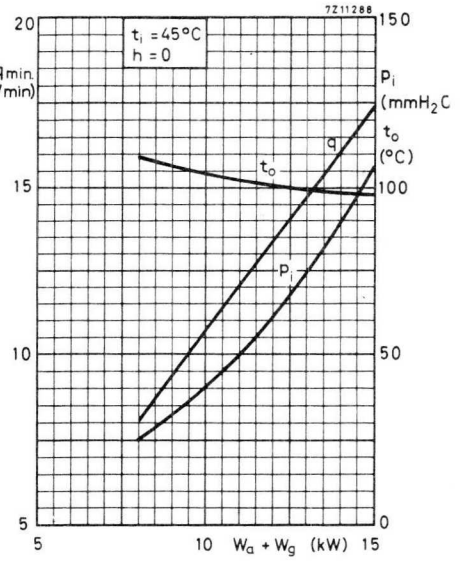
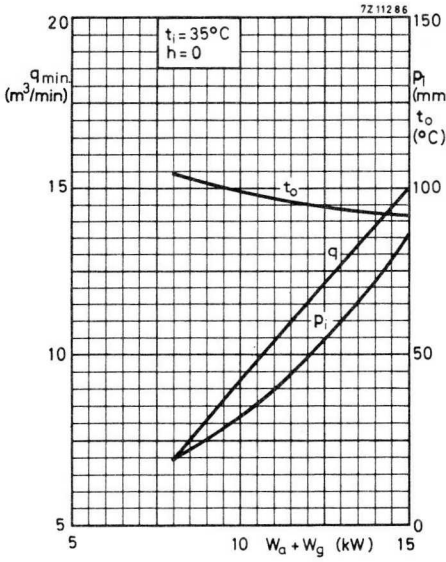
Mounting position: vertical with anode up or down

Net weight: approx. 12.1 kg









## WATER COOLED R.F. INDUSTRIAL TRIODE

Water cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	31.6 kW
Frequency for full ratings	f	max. 100 MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating.

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	90 MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	31.6 kW
Anode voltage	$V_a$	7.5 kV
Anode current	$I_a$	5.4 A
Anode input power	$W_{ia}$	40.5 kW
Anode dissipation	$W_a$	7.5 kW
Anode output power	$W_o$	33.0 kW
Anode efficiency	$\eta_a$	81.5 %
Oscillator efficiency	$\eta_{\text{osc}}$	78 %
Feedback ratio	$V_{gp}/V_{ap}$	14.8 %
Grid resistor	$R_g$	450 $\Omega$
Grid current, on load	$I_g$	1.45 A
Grid voltage, negative	$-V_g$	552 V
Grid dissipation	$W_g$	450 W
Grid resistor dissipation	$W_{Rg}$	946 W



**COOLING**

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{min}$ (ℓ/min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
20	20	10	0.7	51
	50	15	1.3	71
15	20	7.5	0.37	54
	50	10.5	0.7	73
10	20	4.5	0.17	58
	50	6.7	0.32	75

Maximum inlet water temperature  $t_i$  max. 50 °C.

No additional cooling of the seals is required at frequencies below 4 MHz. At frequencies > 4 MHz a low velocity airflow should be directed at the filament and grid seals.

To obtain optimum life, the seal/envelope temperature under continuous loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

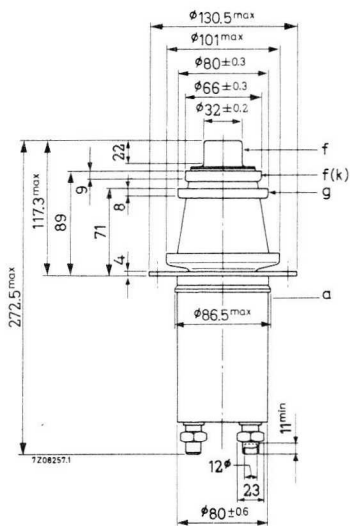
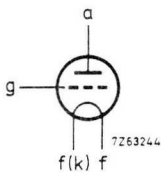
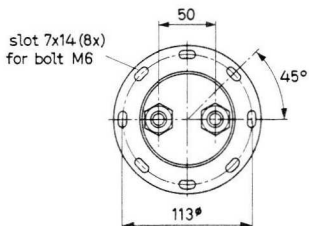
Filament connector	type	40708	net weight	230	g
Filament/cathode connector	type	40709	net weight	265	g
Filament cables ( 2 required)	type	40720	net weight	215	g
Grid connector $f \leq 4$ MHz	type	40710	net weight	60	g
	$f > 4$ MHz	type	40711	net weight	310

MECHANICAL DATA

Dimensions in mm

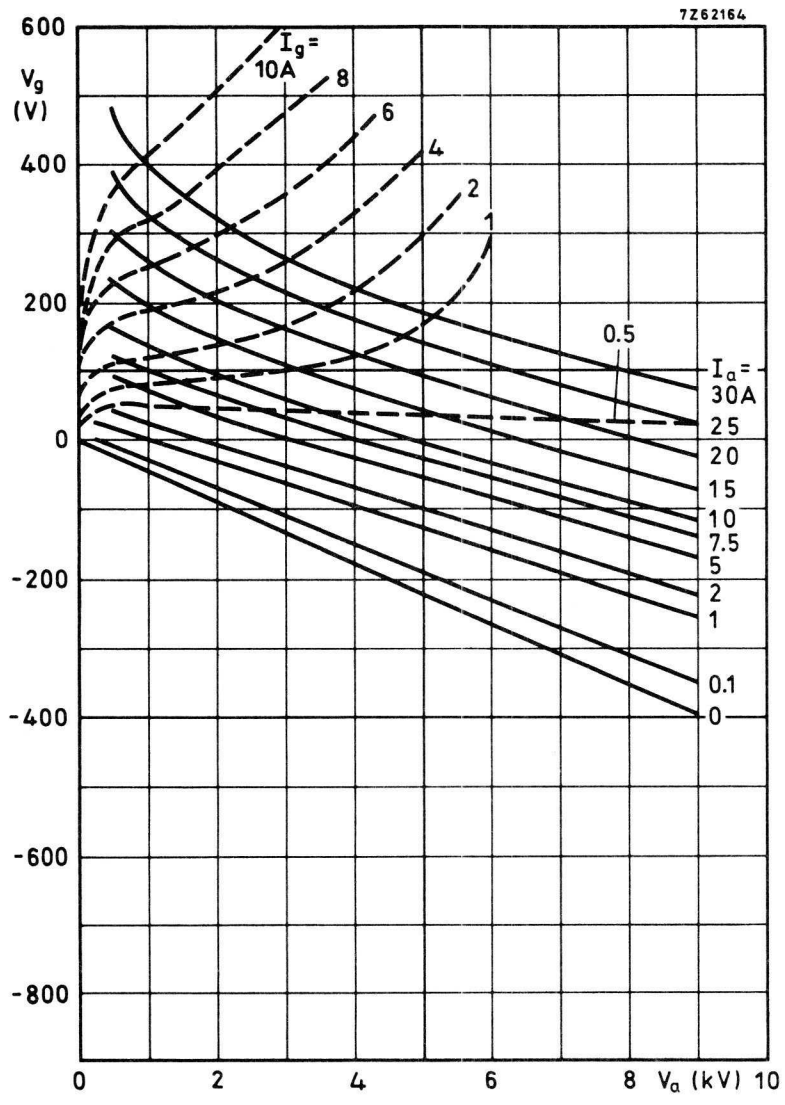
Mounting position: vertical, with anode up or down <sup>1)</sup>

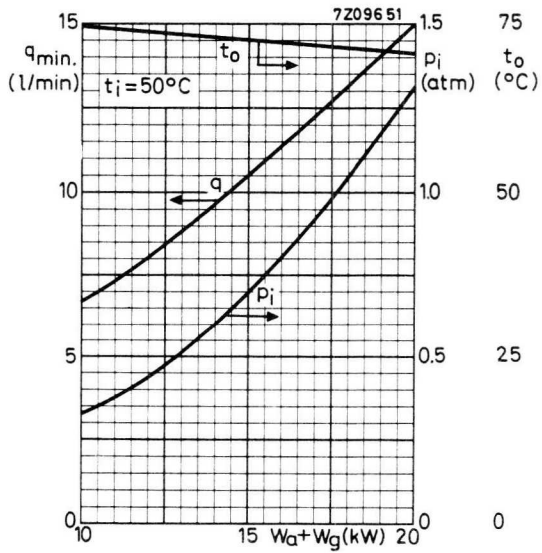
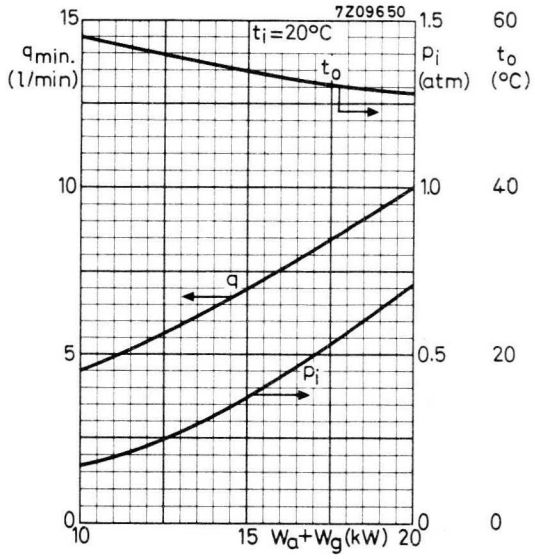
Net weight: approx. 3.0 kg.



Water inlet and outlet connections use British Standard Pipe  $\frac{1}{2}$  in thread.

<sup>1)</sup> When tube is used with anode up the water connections should be interchanged.







## AIR COOLED R.F. INDUSTRIAL TRIODE

Air-cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	62.7	kW
Frequency for full ratings	f	max.	100 MHz

To be read in conjunction with "General Recommendations Transmitting tubes, for R. F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{feedb}$ )	$W_{osc}$	62.7	kW
Anode voltage	$V_a$	8.0	kV
Anode current	$I_a$	10	A
Anode input power	$W_{ia}$	80.0	kW
Anode dissipation	$W_a$	15.0	kW
Anode output power	$W_o$	65.0	kW
Anode efficiency	$\eta_a$	81.2	%
Oscillator efficiency	$\eta_{osc}$	78.4	%
Feedback ratio	$V_{gp}/V_{ap}$	14.6	%
Grid resistor	$R_g$	300	$\Omega$
Grid current, on load	$I_g$	2.25	A
Grid voltage, negative	$-V_g$	675	V
Grid dissipation	$W_g$	750	W
Grid resistor dissipation	$W_{Rg}$	1.52	kW



**COOLING**

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Altitude h (m)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{\text{min}}$ (m <sup>3</sup> /min)	Pressure drop $P_i$ (mmH <sub>2</sub> O)
30	0	25	36	190
20	0	25	15	40
30	0	35	42	265
20	0	35	17	50

For frequencies > 4 MHz air cooling of the seals is required. Preferred direction of air flow: see outline drawing.

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

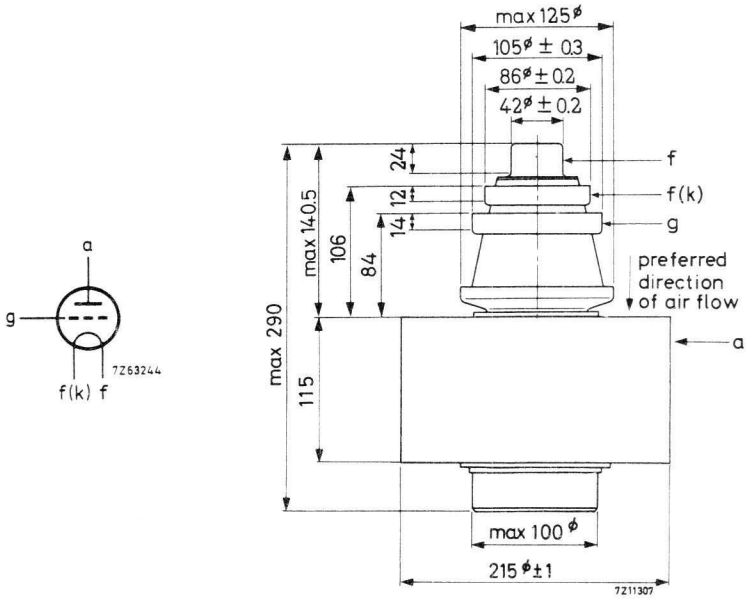
Filament connector		type	40705	net weight	330 g
Filament/cathode connector		type	40706	net weight	390 g
Filament cables (both required)		type	40718	net weight	460 g
		and			
		type	40719	net weight	475 g
Grid connector	$f \leq 4$ MHz	type	40707	net weight	75 g
	$f > 4$ MHz	type	40736	net weight	450 g
Insulating pedestal		type	40729	net weight	8.2 kg

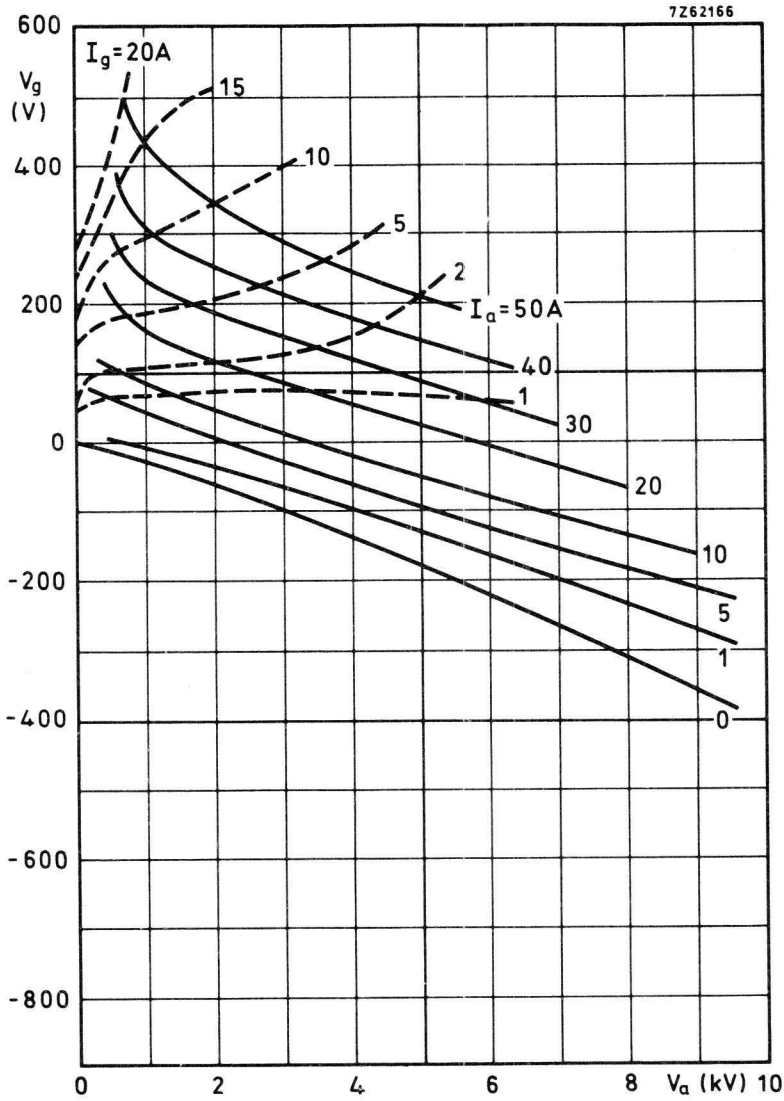
MECHANICAL DATA

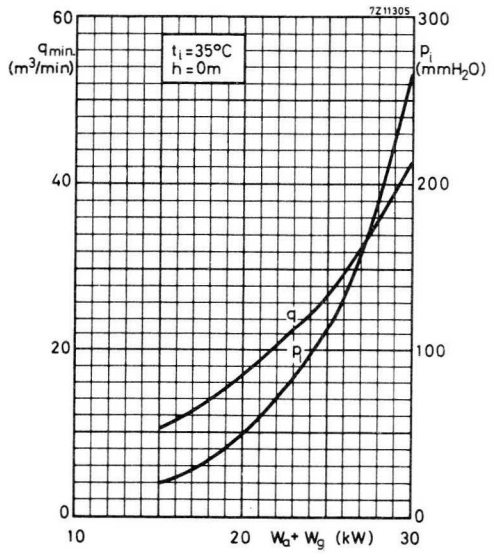
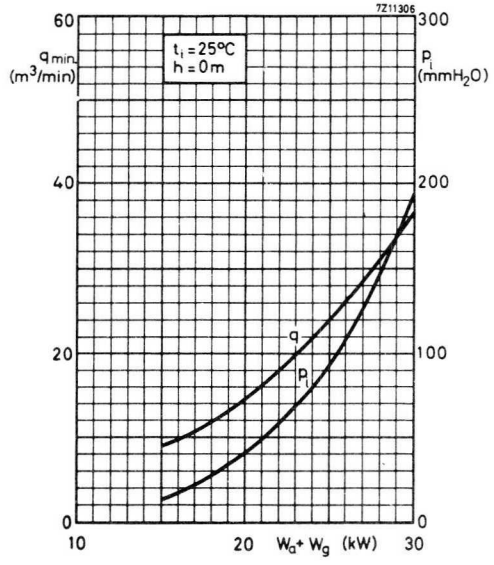
Dimensions in mm

Mounting position: vertical with anode up or down

Net weight: approx. 20 kg







## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	62.7 kW
Frequency for full ratings	f	max. 100 MHz

To be read in conjunction with "General Recommendations Transmitting tubes , Tubes for R.F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{feedb}$ )	$W_{osc}$	62.7	kW
Anode voltage	$V_a$	8.0	kV
Anode current	$I_a$	10	A
Anode input power	$W_{ia}$	80.0	kW
Anode dissipation	$W_a$	15.0	kW
Anode output power	$W_o$	65.0	kW
Anode efficiency	$\eta_a$	81.2	%
Oscillator efficiency	$\eta_{osc}$	78.4	%
Feedback ratio	$V_{gp}/V_{ap}$	14.6	%
Grid resistor	$R_g$	300	$\Omega$
Grid current, on load	$I_g$	2.25	A
Grid voltage, negative	$-V_g$	675	V
Grid dissipation	$W_g$	750	W
Grid resistor dissipation	$W_{Rg}$	1.52	kW





## COOLING

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	rate of flow $q$ min ( $l/min$ )	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
40	20	20	0.7	51
	50	30	1.3	70
30	20	14	0.37	53
	50	21	0.7	72
20	20	9	0.17	56
	50	13.5	0.32	74

Absolute max. water inlet temperature  $t_i$  max. 50 °C

For frequencies > 4 MHz air-cooling of the seals is required

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

## ACCESSORIES

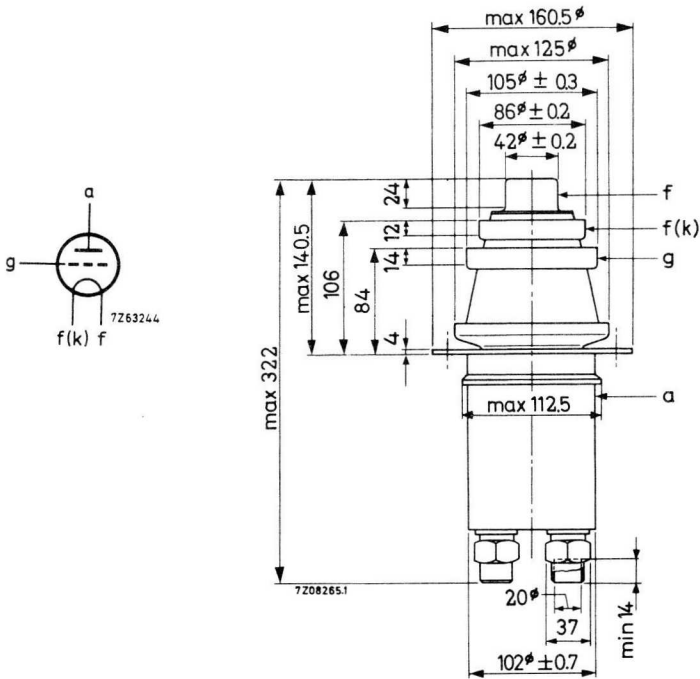
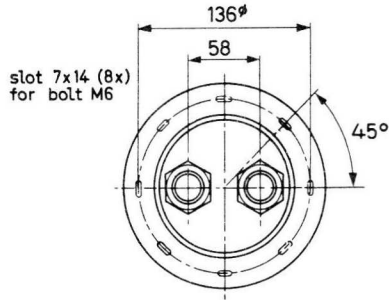
Filament connector	type	40705	net weight	330	g	
Filament/cathode connector	type	40706	net weight	390	g	
Filament cables (both required)	type	40718	net weight	460	g	
	and type	40719	net weight	475	g	
Grid connector	$f \leq 4$ MHz	type	40707	net weight	75	g
	$f > 4$ MHz	type	40736	net weight	450	g

MECHANICAL DATA

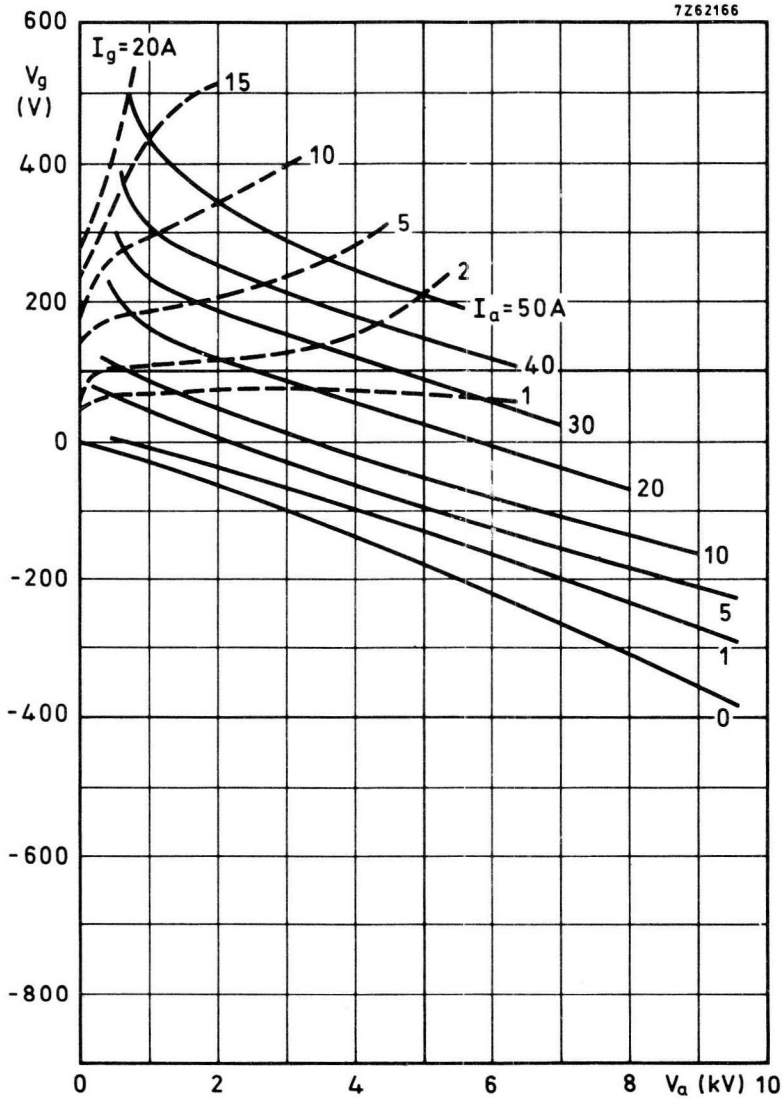
Dimensions in mm

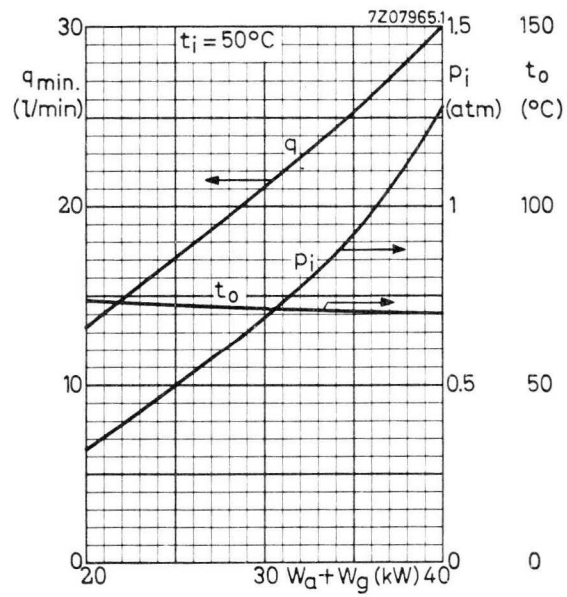
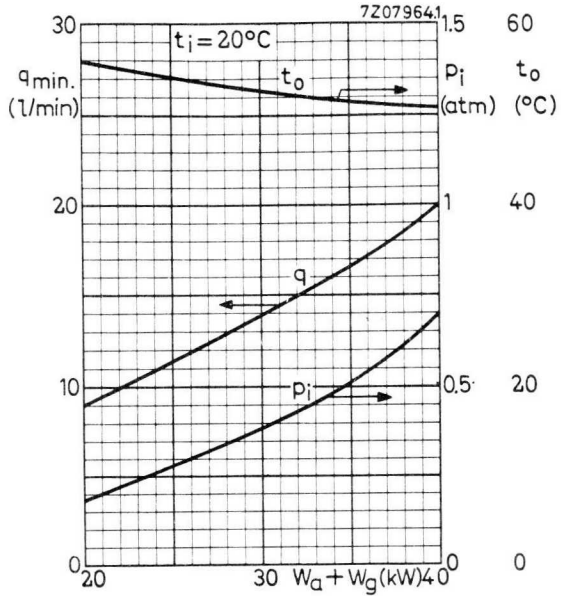
Mounting position: vertical with anode up or down

Net weight: approx 6 kg



With the anode up the water connections should be interchanged.





## VAPOUR COOLED R.F. INDUSTRIAL TRIODE

Vapourcooled triode of metal-ceramic construction intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	62.7	kW
Frequency for full ratings	f	max. 100	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	62.7	kW
Anode voltage	$V_a$	8.0	kV
Anode current	$I_a$	10	A
Anode input power	$W_{ia}$	80	kW
Anode dissipation	$W_a$	15	kW
Anode output power	$W_o$	65	kW
Anode efficiency	$\eta_a$	81.2	%
Oscillator efficiency	$\eta_{\text{osc}}$	78.4	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	14.6	%
Grid resistor	$R_g$	300	$\Omega$
Grid current, on load	$I_g$	2.25	A
Grid voltage, negative	$-V_g$	675	V
Grid dissipation	$W_g$	750	W
Grid resistor dissipation	$W_{Rg}$	1.52	kW



**COOLING**

See also cooling curves

With integrated boiler-condensor type K735.

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q_{min}$ (ℓ/min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
40	20	11	0.05	74
	35	15	0.07	74
	50	25	0.16	74
30	20	8	0.03	76
	35	11	0.05	76
	50	17	0.09	76
20	20	5	0.02	80
	35	6.7	0.03	80
	50	10	0.04	80

Air-cooling of seals is required.

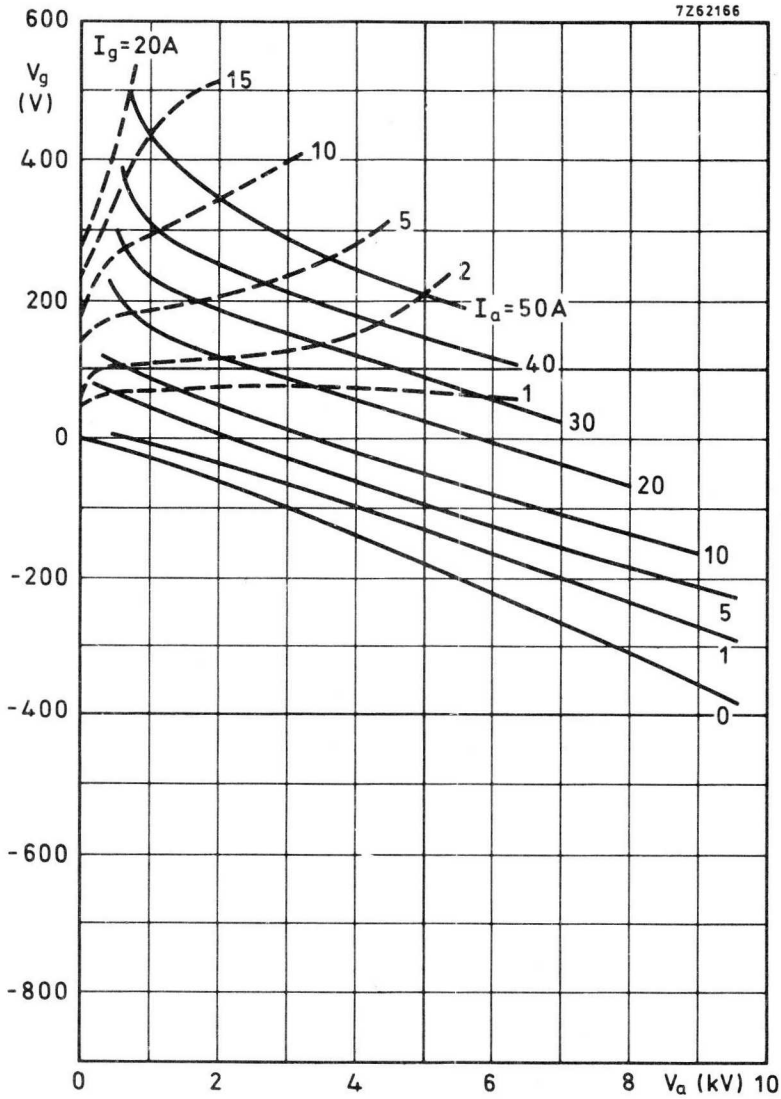
To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or lower than 200 °C.

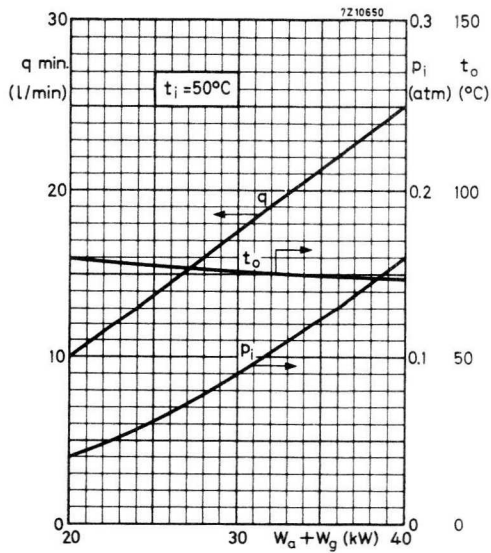
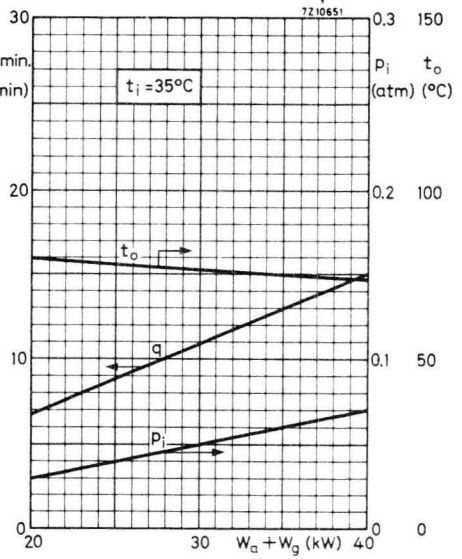
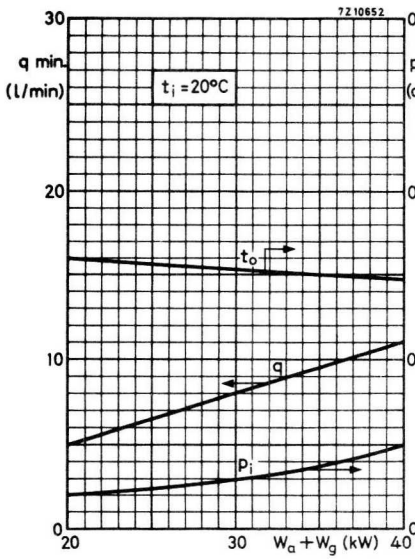
**ACCESSORIES**

Filament connector	type	40706	net weight	390 g
Filament/cathode connector	type	40705	net weight	330 g
Filament cables (both required)	type	40718	net weight	460 g
	and type	40719	net weight	475 g
Grid connector	type	40736	net weight	450 g
Boiler condenser	type	K735	net weight	70 kg









## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	120	kW
Frequency for full ratings	$f$	max.	100 MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	$f$	30	30	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	120	120	kW
Anode voltage	$V_a$	10.0	12.0	kV
Anode current	$I_a$	16.0	13.0	A
Anode input power	$W_{ia}$	160	156	kW
Anode dissipation	$W_a$	36.0	32.5	kW
Anode output power	$W_o$	124	123.5	kW
Anode efficiency	$\eta_a$	77.5	79.2	%
Oscillator efficiency	$\eta_{\text{osc}}$	75.0	77.0	%
Feedback ratio	$V_{gp}/V_{ap}$	12.8	11.6	%
Grid resistor	$R_g$	200	330	$\Omega$
Grid current, on load	$I_g$	3.5	2.7	A
Grid voltage, negative	$-V_g$	700	891	V
Grid dissipation	$W_g$	1.5	1.1	kW
Grid resistor dissipation	$W_{Rg}$	2.45	2.4	kW



**COOLING**

See also cooling curves.

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min ( $\ell$ /min)	Pressure drop $P_i$ (atm)	Outlet temperature to (°C)
80	20	40	0.35	50
	50	60	0.65	70
60	20	28	0.18	52
	50	42	0.32	72
40	20	18	0.08	54
	50	27	0.15	73

Absolute max. water inlet temperature  $t_i$  max. 50 °C

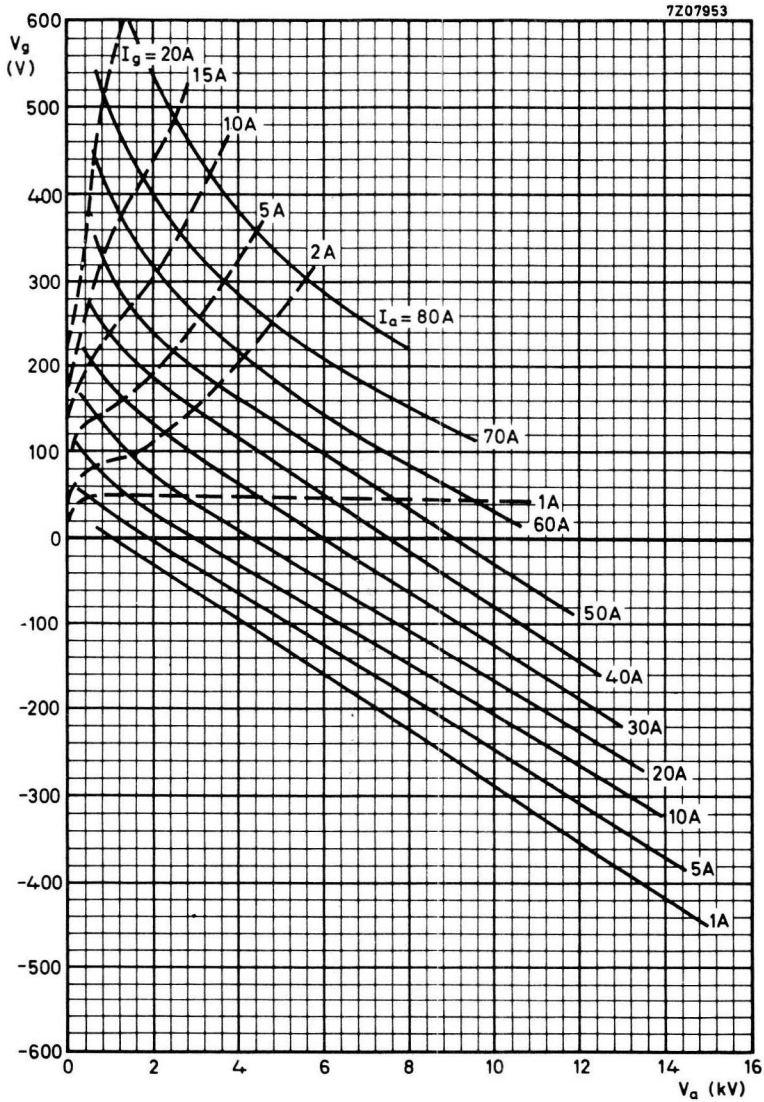
Cooling of the seals can be accomplished by a low velocity air flow, or by water cooling of the filament connectors. The cooling circuits of these accessories may be connected in series. A water flow of approximately 0.5 l/min. will be sufficient.

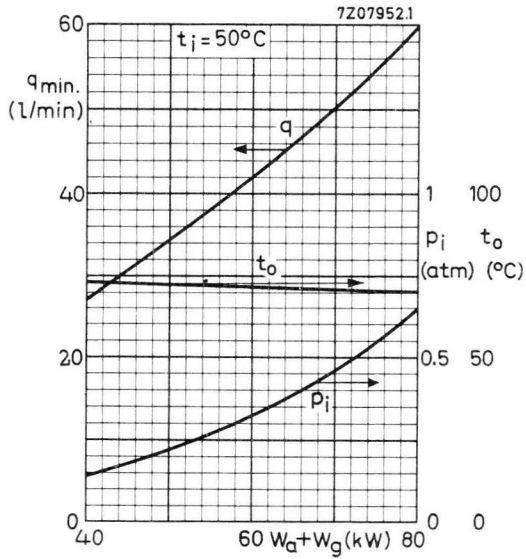
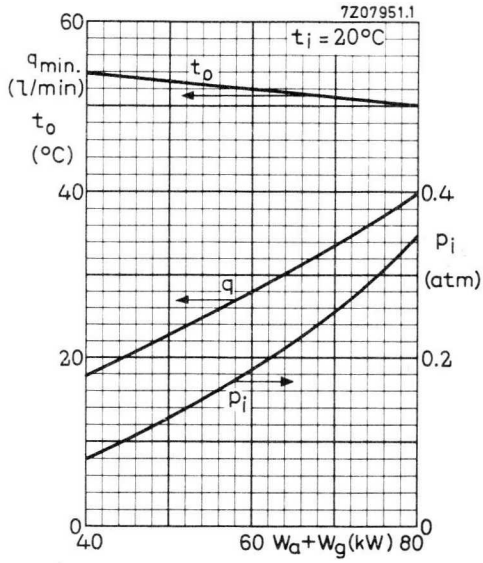
To obtain optimum life, the seal/anode temperature under continuously loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

Filament connector		type	40695	net weight	710 g
Filament/cathode connector		type	40696	net weight	860 g
Filament cables (both required)		type	40716	net weight	975 g
		and type	40717	net weight	980 g
Grid connector	$f \leq 4$ MHz	type	40694	net weight	270 g
	$f > 4$ MHz	type	40737	net weight	525 g









## VAPOUR COOLED R.F. INDUSTRIAL TRIODE

Vapour cooled triode of metal-ceramic construction intended for use as an industrial oscillator.

QUICK REFERENCE DATA			
Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	120	kW
Frequency for full ratings	f	max. 100	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	30	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	120	120	kW
Anode voltage	$V_a$	10	12	kV
Anode current	$I_a$	16.0	13.0	A
Anode input power	$W_{ia}$	160	156	kW
Anode dissipation	$W_a$	36.0	32.5	kW
Anode output power	$W_o$	124	123.5	kW
Anode efficiency	$\eta_a$	77.5	79.2	%
Oscillator efficiency	$\eta_{\text{osc}}$	75	77	%
Feedback ratio	$V_{gp}/V_{ap}$	12.8	11.6	%
Grid resistor	$R_g$	200	330	$\Omega$
Grid current, on load	$I_g$	3.5	2.7	A
Grid voltage, negative	$-V_g$	700	891	V
Grid dissipation	$W_g$	1.5	1.1	kW
Grid resistor dissipation	$W_{Rg}$	2.45	2.4	kW



**COOLING**

See also cooling curves

With integrated boiler condenser type K735

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min ( $\ell$ /min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
80	20	29	0.20	60
	35	48	0.51	59
60	20	16	0.08	75
	35	24	0.14	72
	50	45	0.45	70
40	20	10	0.04	80
	35	13.5	0.06	80
	50	20	0.10	80

Absolute max. water inlet temperature  $t_i$  max. 50 °C

Cooling of the seals can be accomplished by a low velocity air flow or by watercooling of the filament connectors. The cooling circuit of these accessories may be connected in series. A water flow of approximately 0.51/min. will be sufficient.

To obtain optimum life, the seal/anode temperature under continuously loaded conditions should be kept at or below 200°C.

**ACCESSORIES**

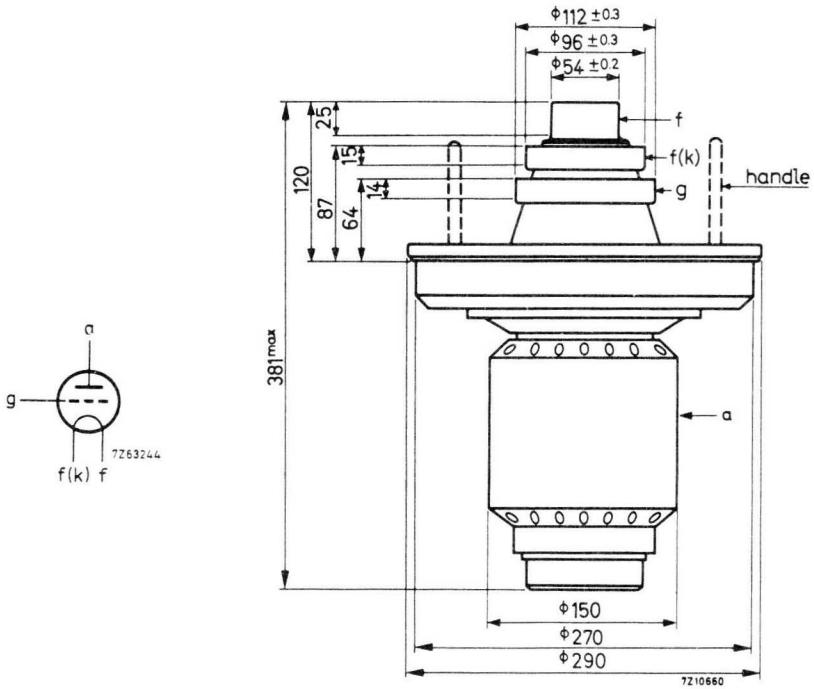
Filament connector	type	40695	net weight	710	g
Filament / cathode connector	type	40696	net weight	860	g
Filament cables (both required)	type	40716	net weight	975	g
	and type	40717	net weight	980	g
Grid connector	type	40694	net weight	270	g
Boiler condenser	type	K735	net weight	≈ 70	kg

MECHANICAL DATA

Dimensions in mm

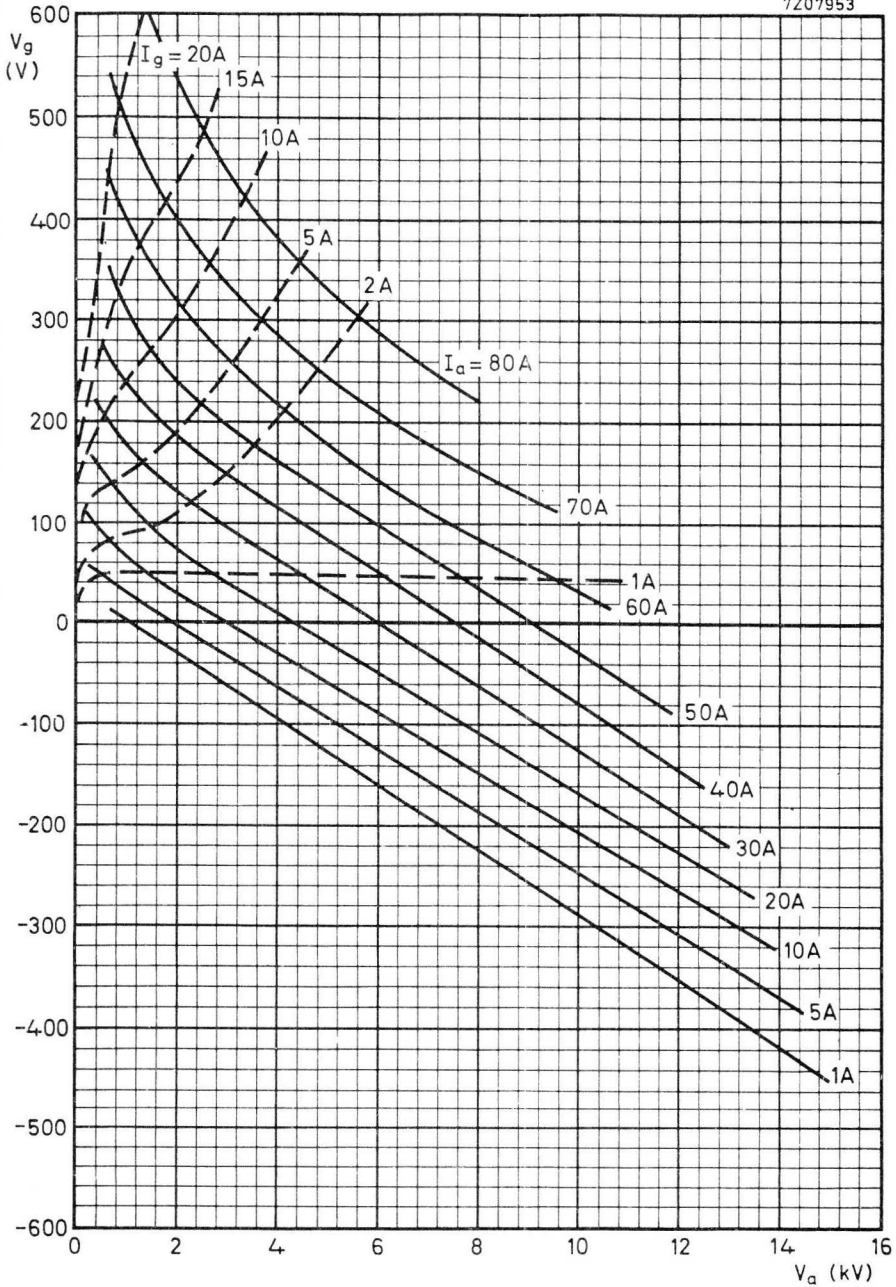
Mounting position: vertical with anode down

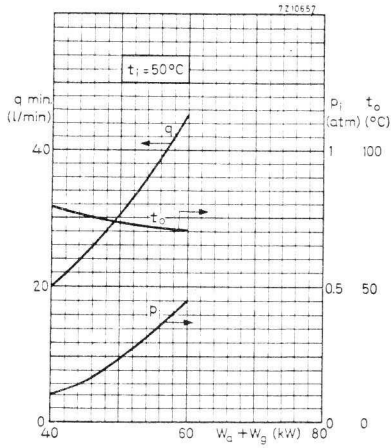
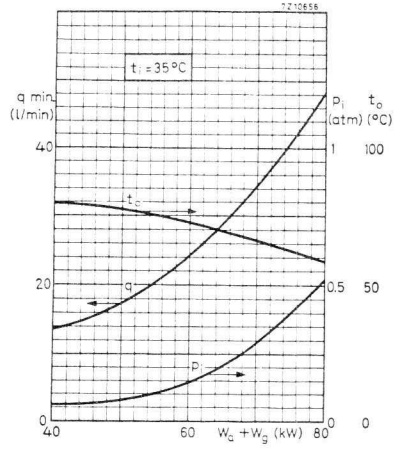
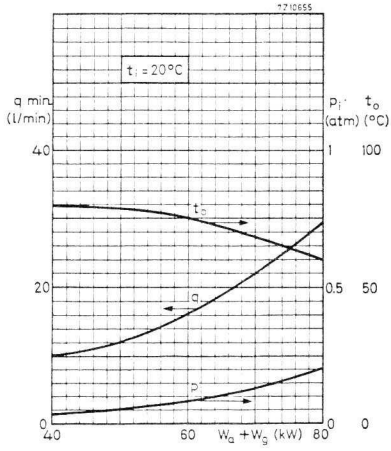
Net weight: approx. 16.7 kg



Note: The handles should be removed before switching on the tube.

7207953





## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	240	kW
Frequency for full ratings	f max.	100	MHz



To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	240	kW
Anode voltage	$V_a$	14	kV
Anode current	$I_a$	23.5	A
Anode input power	$W_{\text{ja}}$	329	kW
Anode dissipation	$W_a$	81.5	kW
Anode output power	$W_o$	247.5	kW
Anode efficiency	$\eta_a$	75.2	%
Oscillator efficiency	$\eta_{\text{osc}}$	73.0	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	10.4	%
Grid resistor	$R_g$	135	$\Omega$
Grid current, on load	$I_g$	6	A
Grid voltage, negative	$-V_g$	810	V
Grid dissipation	$W_g$	2.6	kW
Grid resistor dissipation	$W_{Rg}$	4.86	kW





## COOLING

See also cooling curves

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min (ℓ/min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
120	20	60	0.7	50
	50	90	1.3	77
80	20	34	0.3	54
	50	54	0.55	72
40	20	15	0.07	60
	50	24	0.13	70

Absolute max. water inlet temperature  $t_i$  max. 50 °C

At frequencies below 4 MHz cooling of the metal-ceramic seals can be accomplished by a low-velocity air flow, or by watercooling of the filament connectors. A water flow of approximately 0.5ℓ/min will be sufficient. At frequencies above 4 MHz it is recommended to cool the seals by means of an air flow of approximately 4 m<sup>3</sup>/min from a 50 mm diameter nozzle placed at a distance of 250 mm from the tube header.

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200°C.

## ACCESSORIES

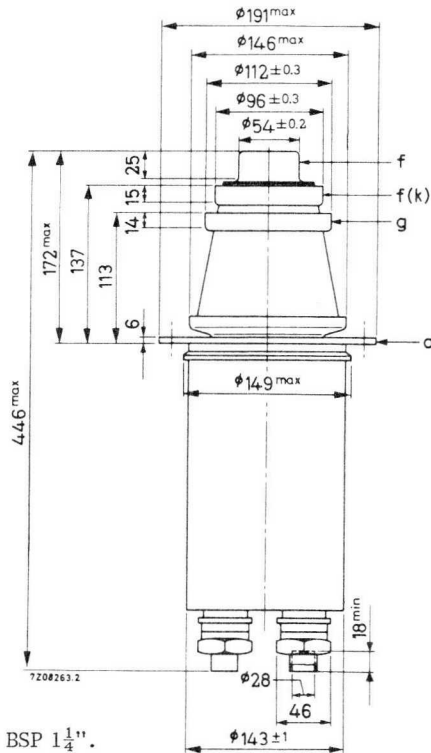
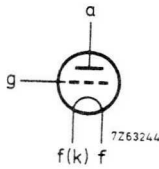
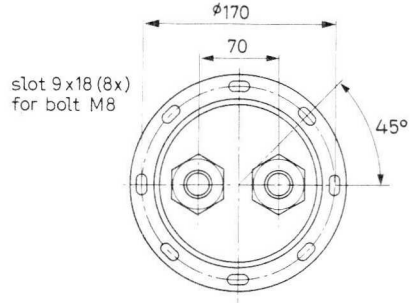
Filament connector		type 40695	net weight	710 g
Filament/cathode connector		type 40696	net weight	860 g
Filament cables (both required)		type 40716	net weight	975 g
		and type 40717	net weight	980 g
Grid connector	$f \leq 4$ MHz	type 40694	net weight	270 g
	$f \leq 4$ MHz	type 40737	net weight	525 g

MECHANICAL DATA

Dimensions in mm

Mounting position: vertical with anode up or down

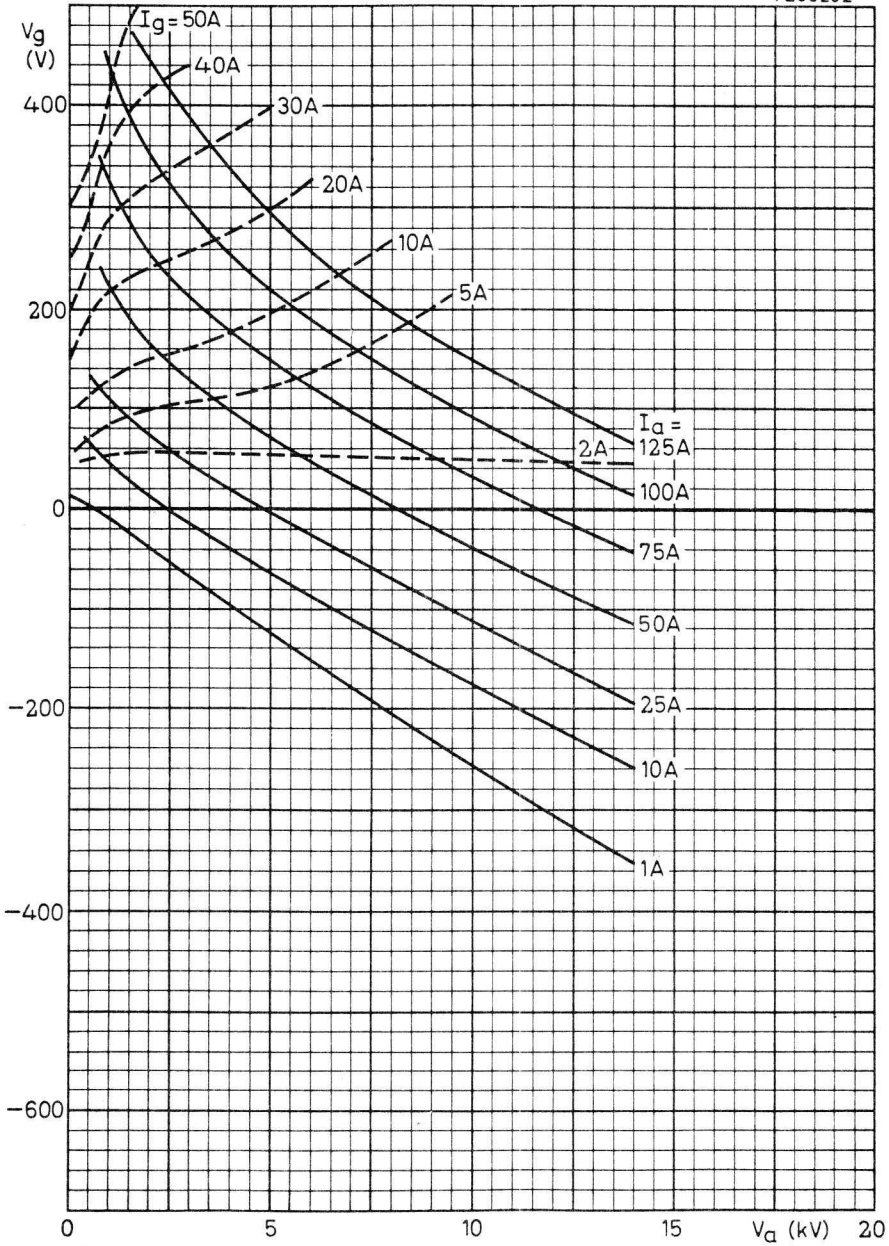
Net weight: approx. 15.6 kg

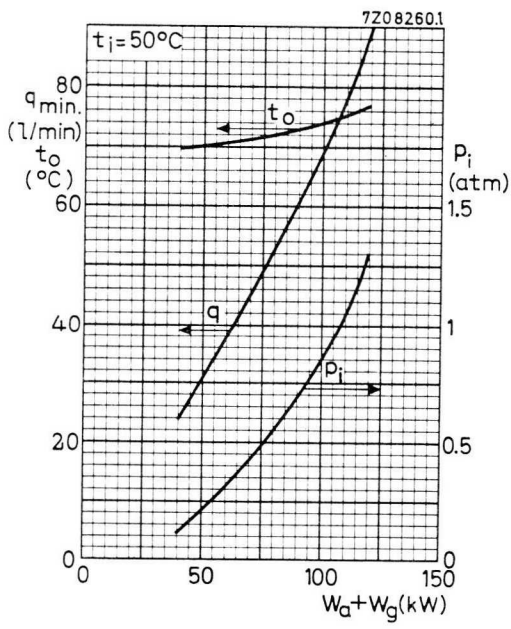
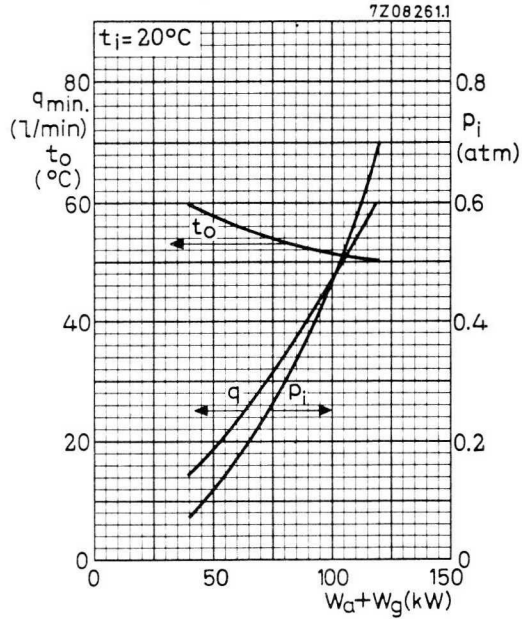


Thread of water connections BSP 1 1/4".

With anode up the water inlet and outlet connections should be interchanged.

7208262





## VAPOUR COOLED R.F. INDUSTRIAL TRIODE

Vapour cooled triode of metal-ceramic construction intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	240	kW
Frequency for full ratings	f max.	100	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	240	kW
Anode voltage	$V_a$	14	kV
Anode current	$I_a$	23.5	A
Anode input power	$W_{ia}$	329	kW
Anode dissipation	$W_a$	81.5	kW
Anode output power	$W_o$	247.5	kW
Anode efficiency	$\eta_a$	75.2	%
Oscillator efficiency	$\eta_{\text{osc}}$	73	%
Feedback ratio	$V_{gp}/V_{ap}$	10.4	%
Grid resistor	$R_g$	135	$\Omega$
Grid current, on load	$I_g$	6	A
Grid voltage, negative	$-V_g$	810	V
Grid dissipation	$W_g$	2.6	kW
Grid resistor dissipation	$W_{Rg}$	4.86	kW



## COOLING

See also cooling curves

With integrated boiler condenser type K733

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $Q$ min ( $\ell$ /min)	Pressure drop $p_i$ (atm)	Outlet temperature $t_o$ (°C)
120	20	59	0.84	50
80	20	29	0.20	61
	35	48	0.51	61
40	20	10	0.04	81
	35	13.5	0.06	81
	50	20	0.10	81

At frequencies below 4 MHz cooling of the metal-ceramic seals can be accomplished by a low-velocity air flow, or by watercooling of the filament connectors. A water flow of approximately 0.5 l/min will be sufficient. At frequencies above 4 MHz it is recommended to cool the seals by means of an air flow of approximately 4 m<sup>3</sup>/min from a 50 mm diameter nozzle placed at a distance of 250 mm from the tube header.

To obtain optimum life, the seal/envelope temperature under continuous loaded conditions should be kept at or below 200 °C.

## ACCESSORIES

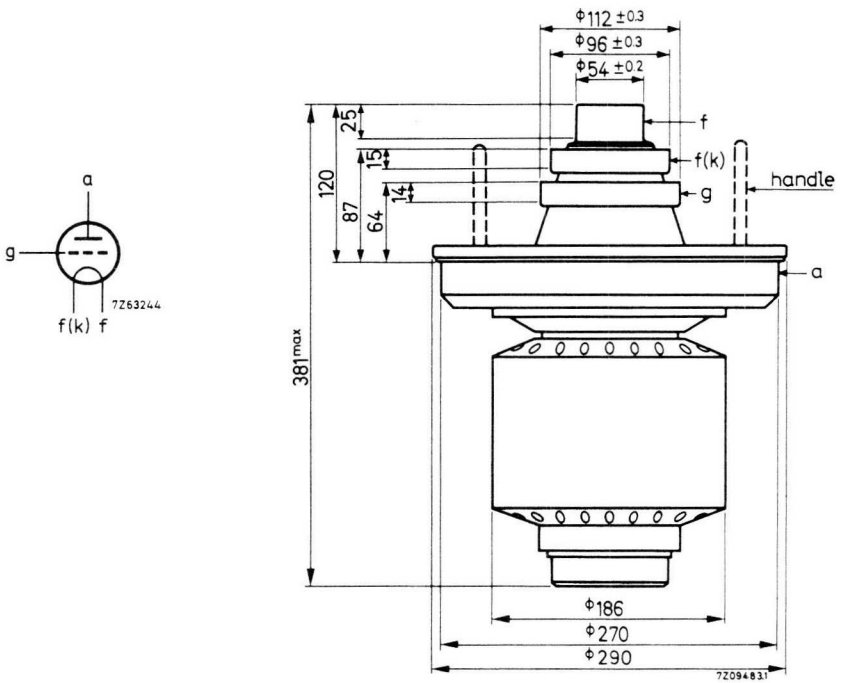
Filament connector	type	40695	net weight	710	g
Filament/cathode connector	type	40696	net weight	860	g
Filament cables (both required)	type	40716	net weight	975	g
	and type	40717	net weight	980	g
Grid connector	type	40694	net weight	270	g
Boiler condenser	type	K733	net weight $\approx$	70	kg

MECHANICAL DATA

Dimensions in mm

Mounting position: vertical with anode down

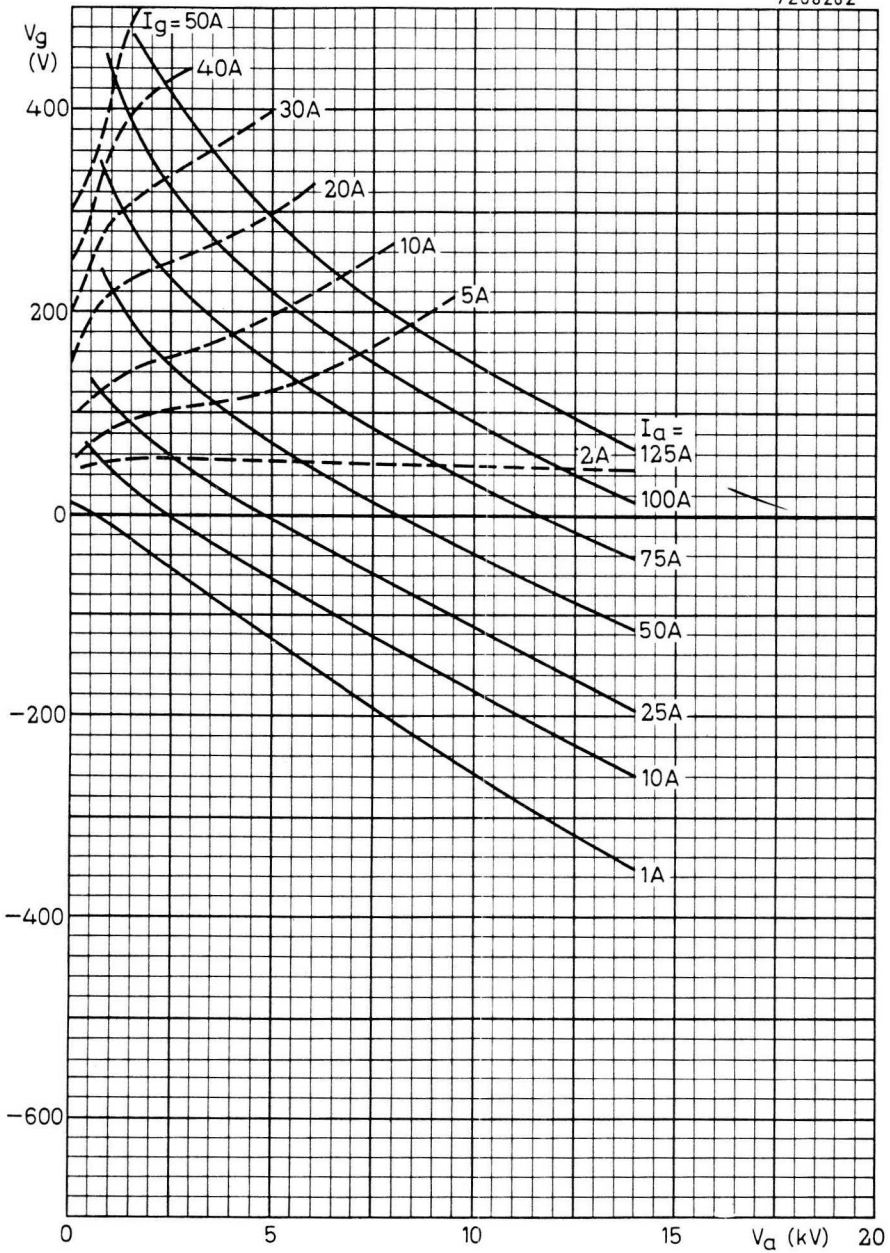
Net weight: approx. 27 kg

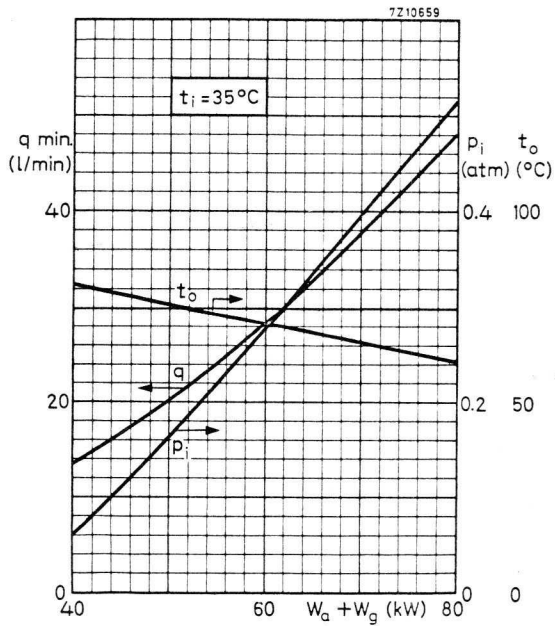
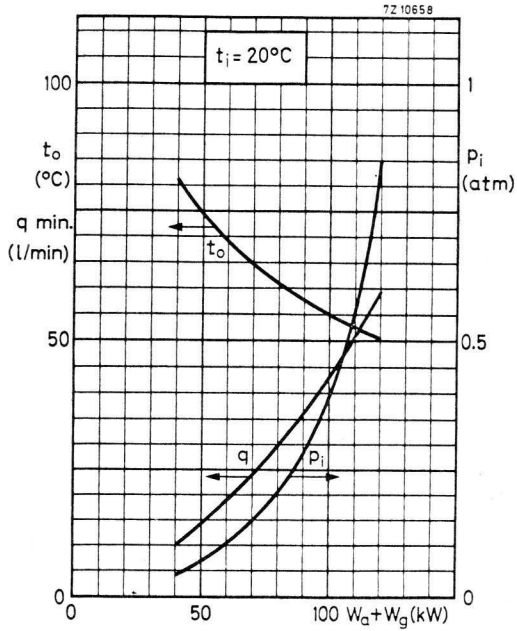


The handles should be removed before switching on the tube.



7208262





## AIR COOLED R.F. INDUSTRIAL TRIODE

Air-cooled triode of metal-ceramic construction with integral cooler intended for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	2.67	kW
Frequency for full ratings	f	max. 250	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating".

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	160	27.12	MHz
Filament voltage	$V_f$	6.0	6.3	V
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	2.22	2.67	kW
Anode voltage	$V_a$	4.5	5.0	kV
Anode current	$I_a$	700	750	mA
Anode input power	$W_{\text{ia}}$	3.15	3.75	kW
Anode dissipation	$W_a$	0.75	0.83	kW
Anode output power	$W_o$	2.4	2.9	kW
Anode efficiency	$\eta_a$	76	78	%
Oscillator efficiency	$\eta_{\text{osc}}$	71	71	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	17	17	%
Grid resistor	$R_g$	2.2	2.2	$k\Omega$
Grid current, on load	$I_g$	225	235	mA
Grid voltage, negative	$-V_g$	495	517	V
Grid dissipation	$W_g$	70	80	W
Grid resistor dissipation	$W_{Rg}$	111	121	W



**COOLING**

See cooling curves.

A low velocity air flow directed to the seals may be required,

To obtain optimum life, the seal/envelope temperature under continuously loaded conditions should be kept at or below 200 °C.

**ACCESSORIES**

Filament connector		type	40688
Filament/cathode connector		type	40689
Grid connector	$f \leq 30$ MHz	type	40686
	$f > 30$ MHz	type	40687

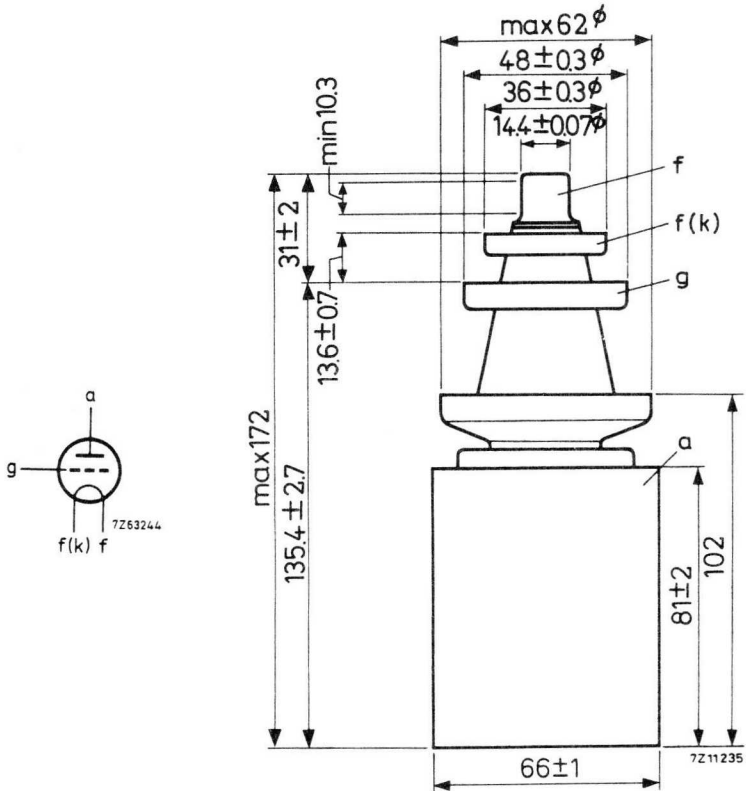


MECHANICAL DATA

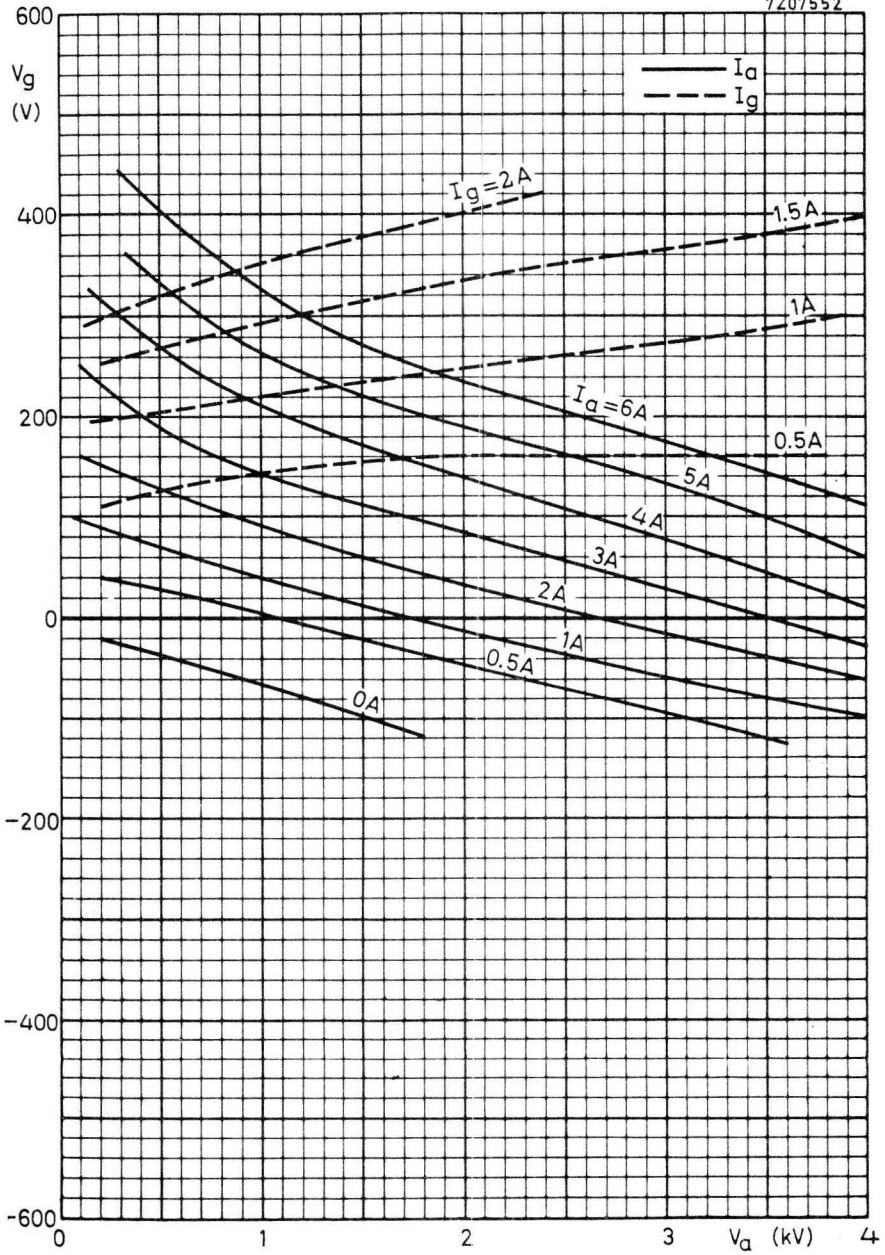
Dimensions in mm

Mounting position: vertical with anode up or down.

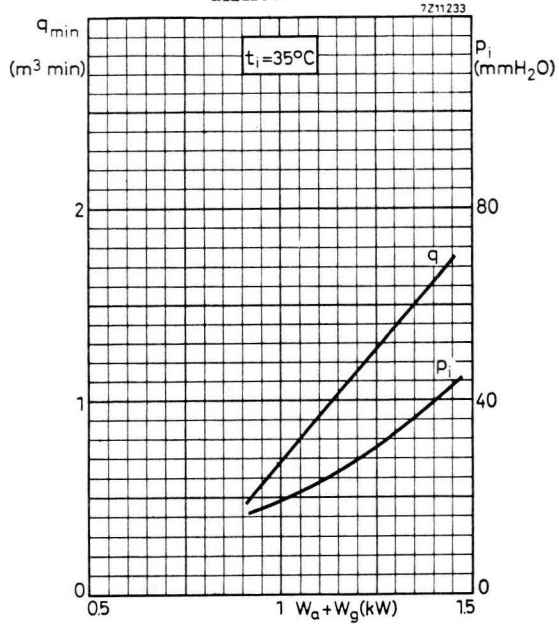
Net weight: approx. 1.13 kg



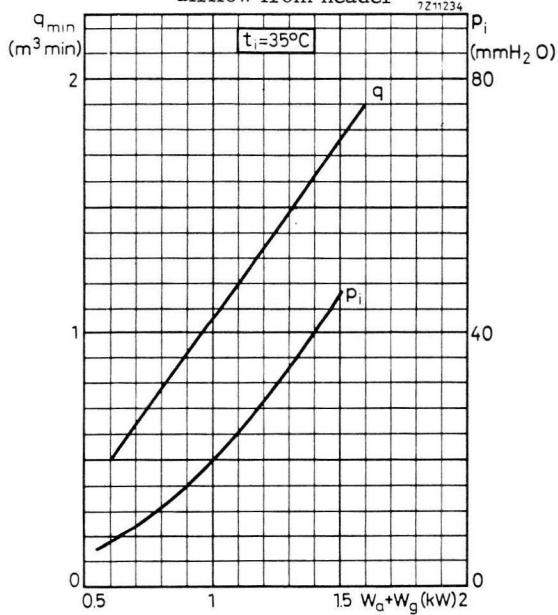
7207552



airflow to header



airflow from header





## AIR COOLED R.F. POWER TRIODE

Forced air cooled coaxial power triode in metal-ceramic construction primarily intended for use as a R. F. class AB linear broad-band amplifier in T. V. transposer service at frequencies up to 960 MHz.

QUICK REFERENCE DATA							
Frequency (MHz)	Transposer service (combined sound and vision)			Vision amplifier			
	V <sub>a</sub> (V)	W <sub>oℓ</sub> (W)	Power gain (dB)	V <sub>a</sub> (V)	W <sub>oℓ</sub> (W)	Power gain (dB)	
470 to 960	1700	35	20	1700	35	20	

**HEATING** : indirect; oxide coated cathode

Heater voltage	V <sub>f</sub>	5	V ± 5%
For transposer application a heater voltage deviation within ± 2% is recommended.			
Heater current	I <sub>f</sub>	2.1	A
Cathode heating time	T <sub>h</sub>	min. 120	s

### CAPACITANCES

Anode to grid	C <sub>ag</sub>	3.5	pF
Grid to cathode and heater	C <sub>g/kf</sub>	15	pF
Anode to cathode and heater	C <sub>a/kf</sub>	0.04	pF

### TYPICAL CHARACTERISTICS

Anode voltage	V <sub>a</sub>	1700	V
Anode current	I <sub>a</sub>	170	mA
Transconductance	S	50	mA/V
Amplification factor	μ	200	

### TEMPERATURE LIMITS

Absolute max. seal temperature	t	max. 225	°C
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Data based on pre-production tubes.



**R.F. CLASS AB AMPLIFIER FOR TELEVISION TRANSPOSER SERVICE**

Unless otherwise specified the voltages are given with respect to the cathode.

**LIMITING VALUES** (Absolute max. rating system)

Frequency	f	up to	1000	MHz
Anode voltage	$V_a$	max.	1800	V
Grid voltage	$-V_g$	max.	50	V
Anode current	$I_a$	max.	200	mA
Anode dissipation	$W_a$	max.	300	W

**OPERATING CONDITIONS** grounded grid

		CCIR	CCIR	
		standard L 1)	standard G 2)	
Frequency	f	780	780	MHz
Bandwidth (-1 dB)	B	8	8	MHz
Anode voltage	$V_a$	1700	1700	V
Grid voltage	$V_g$	-5	-5	V 3)
Grid current	$I_g$	0	0	mA
Anode current, no signal condition	$I_a$	120	120	mA
Anode current	$I_a$	170	170	mA 4)
Driving power (sync)	$W_{dr}$	0.35	0.35	W
Output power in load (sync)	$W_l$	35	35	W
Power gain	G	20	20	dB
Intermodulation products	d	-	-52	dB 5)
Differential phase		$\leq 2$	-	° 6)
Differential gain		$\geq 98$	-	% 6)

- 1) Positive modulation, negative synchronisation, sound and vision separate.
- 2) Negative modulation, positive synchronisation, combined sound and vision.
- 3) To be adjusted for the stated no-signal anode current.
- 4)  $I_a$  at C. W. output power = 35 W.
- 5) Three tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -17 dB with respect to the sum signal amplitude of the composite signal.
- 6) Measured with a saw tooth amplitude, running from 17% to 75% of the peak sync value, with superimposed a 4.43 MHz sine wave with a 10% peak to peak value.



## AIR COOLED R.F. POWER TRIODE

Forced air cooled coaxial power triode in metal-ceramic construction primarily intended for use as R.F. class AB linear broad-band amplifier in T.V. transposer service at frequencies up to 1000 MHz.

QUICK REFERENCE DATA			
Frequency  (MHz)	Transposer service (combined sound and vision)		
	$V_a$ (V)	$W_\ell$ (W)	Power gain (dB)
470 to 1000	1700	50	18

**HEATING** : indirect; oxide coated cathode

Heater voltage	$V_f$	5	$V \pm 2\%$
Heater current	$I_f$	2.1	A
Cathode heating time	$T_h$	min. 120	s

### CAPACITANCES

Anode to grid	$C_{ag}$	3.5	pF
Grid to cathode and heater	$C_{g/kf}$	15	pF
Anode to cathode and heater	$C_{a/kf}$	0.04	pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	1700	V
Anode current	$I_a$	170	mA
Transconductance	$S$	50	mA/V
Amplification factor	$\mu$	200	

### TEMPERATURE LIMITS

Absolute max. seal temperature	$t$	max. 225	$^{\circ}\text{C}$
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Data based on pre-production tubes.

## COOLING

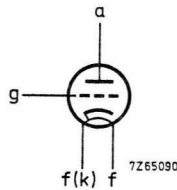
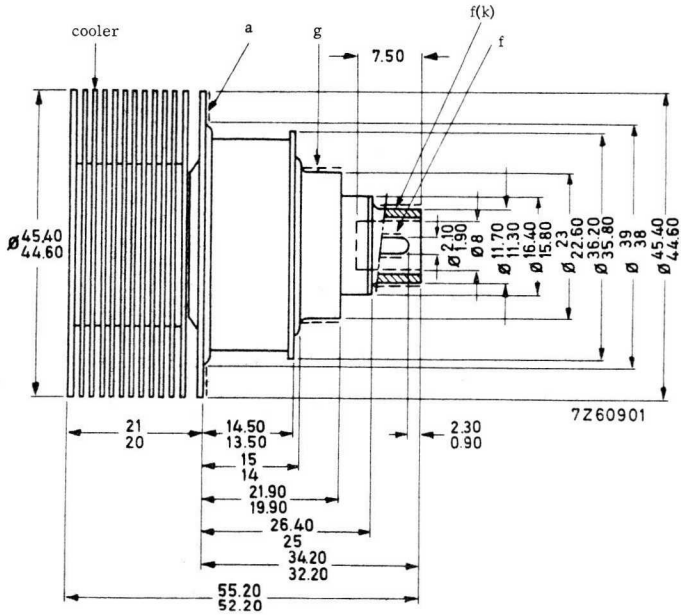
Forced air

$W_a$ (W)	$t_i$ (°C)	$q_{min}$ (l/min)	$P_i$ (mm H <sub>2</sub> O)
300	20	450	26

## MECHANICAL DATA

Dimensions in mm

Net weight: approx. 180 g



## R.F. CLASS AB AMPLIFIER FOR TELEVISION TRANSPOSER SERVICE

Unless otherwise specified the voltages are given with respect to cathode.

**LIMITING VALUES** (Absolute max. rating system)

Frequency	f	up to	1000	MHz
Anode voltage	$V_a$	max.	1800	V
Grid voltage	$-V_g$	max.	5 50	V
Anode current	$I_a$	max.	200	mA
Anode dissipation	$W_a$	max.	300	W

**OPERATING CONDITIONS**, grounded grid

CCIR Standard G 1)

Frequency	f	780	MHz
Bandwidth (0 dB)	B	8	MHz
(-1 dB)	B	11	MHz
Anode voltage	$V_a$	1700	V
Grid voltage	$V_g$	-5	V 2)
Anode current, no-signal condition	$I_a$	120	mA
Anode current	$I_a$	185	mA 3)
Driving power (sync)	$W_{dr}$	0.8	W
Output power in load (sync)	$W_f$	50	W
Power gain	G	18	dB
Intermodulation products	d	-52	dB 4)

- 1) Negative modulation, positive synchronisation, combined sound and vision.
- 2) To be adjusted for the stated no-signal anode current.
- 3)  $I_a$  at zero dB level = 50 W ( 0 dB level corresponding with peak sync ).
- 4) In-band intermodulation products with reference to peak sync level, measured with a three-tone test method ( vision carrier -8 dB, sound carrier -7 dB, side-band signal -17 dB with respect to the sum signal amplitude of the composite signal corresponding to zero dB level.).





# AIR COOLED R.F. POWER TRIODE

For data see type YD1332 except for the following:

## COOLING

Anode: forced air

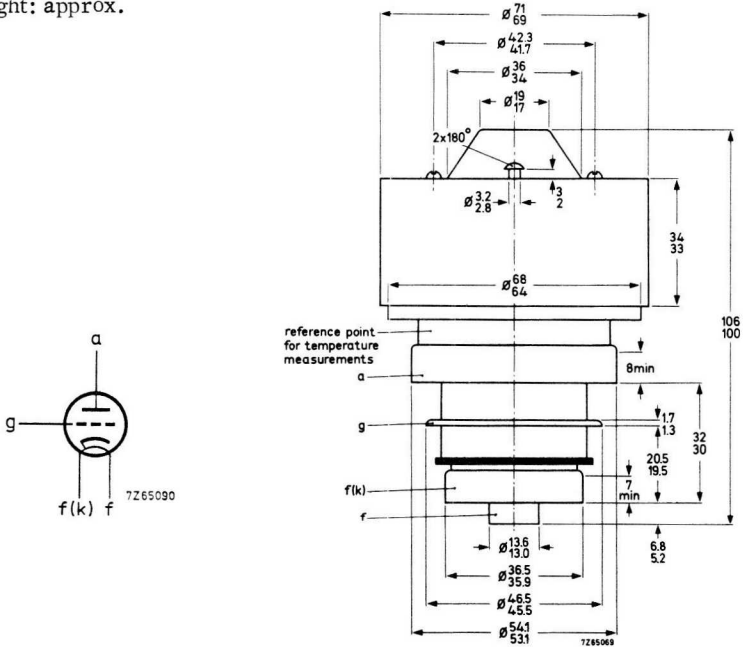
$W_a$ (W)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mmH <sub>2</sub> O)
1800	25	2	150



## MECHANICAL DATA

Dimensions in mm

Net weight: approx.





## AIR COOLED R.F. POWER TRIODE

Forced air cooled coaxial power triode in metal-ceramic construction primarily intended for use as R.F. class AB linear broad-band amplifier in T.V. transposer service at frequencies up to 960 MHz.

QUICK REFERENCE DATA						
Frequency  (MHz)	Transposer service (combined sound and vision)			Vision amplifier		
	V <sub>a</sub> (V)	W <sub>ℓ</sub> (sync) (W)	Power gain (dB)	V <sub>a</sub> (V)	W <sub>ℓ</sub> (sync) (W)	Power gain (dB)
470 to 860	3000	220	16	2500	250	15

**HEATING** indirect by A.C. (50 Hz to 400 Hz) or D.C.; oxide coated cathode.

Heater voltage  $V_f$  6.3 V ± 5%

For transposer application a heater voltage deviation within ± 2% is recommended.

Heater current  $I_f$  6.5 A

Cathode heating time  $T_h$  min. 120 s

### CAPACITANCES

Anode to grid  $C_{ag}$  8.5 pF

Grid to cathode and heater  $C_{g/kf}$  28 pF

Anode to cathode and heater  $C_{a/kf}$  0.15 pF

### TYPICAL CHARACTERISTICS

Anode voltage  $V_a$  2 kV

Anode current  $I_a$  400 mA

Transconductance  $S$  50 mA/V

Amplification factor  $\mu$  110

### TEMPERATURE LIMITS

Absolute max. temperature measured at reference point  $t$  max. 250 °C

Data based on pre-production tubes.

## COOLING

Anode: forced air

$W_a$ (W)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mmH <sub>2</sub> O)
1800	25	2	20

Other terminals: low velocity air flow.

When only the heater voltage is applied the heater and heater/cathode terminals should also be cooled.

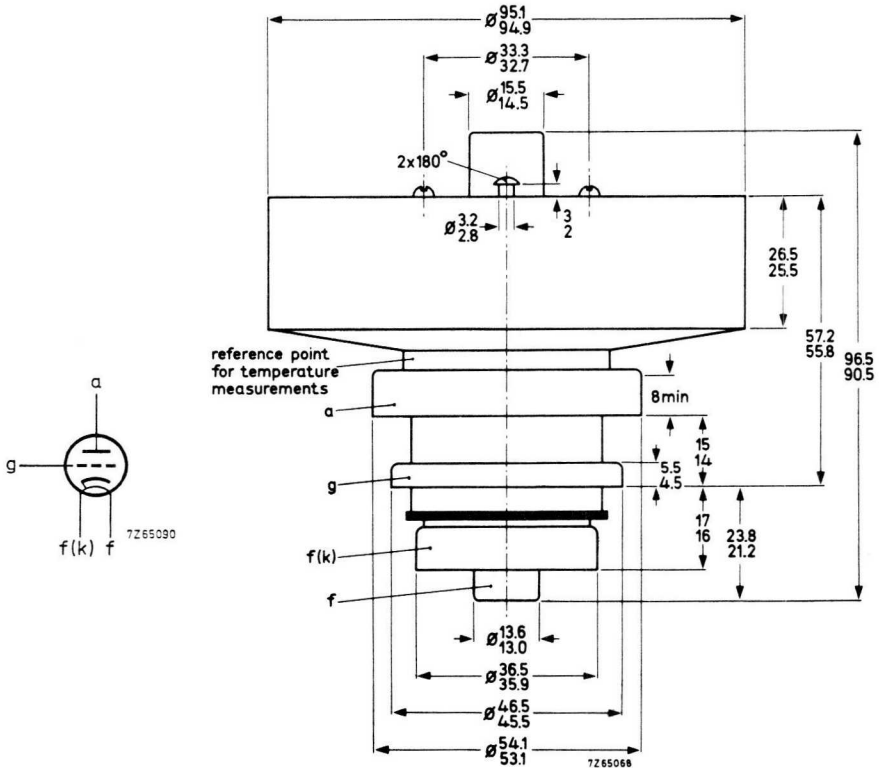
Cooling air and voltages may be switched off simultaneously.

## MECHANICAL DATA

Dimensions in mm

Net weight: approx.

Mounting position: any



R.F. CLASS AB AMPLIFIER FOR TELEVISION TRANSPOSER SERVICE , grounded grid.

**LIMITING VALUES** (Absolute max. rating System)

Frequency	f	up to	960	MHz
Anode voltage	$V_a$	max.	3500	V
Grid voltage	$-V_g$	max.	200	V
Anode dissipation	$W_a$	max.	1800	W
Grid dissipation	$W_g$	max.	0.5	W
Cathode current	$I_k$	max.	700	mA

**OPERATING CONDITIONS** , grounded grid

CCIR standard G<sup>1)</sup>

Frequency	f	470 to 860	MHz
Anode voltage	$V_a$	3000	V
Grid voltage <sup>2)</sup>	$V_g$	-19	V
Anode current, no signal condition	$I_a$	420	mA
Anode current <sup>3)</sup>	$I_a$	510	mA
Grid current	$I_g$	0 to -2	mA
Driving power (sync)	$W_{dr}$	5	W
Output power in load	$W_l$	220	W
Power gain	G	≈ 16	dB
Intermodulation products <sup>4)</sup>	d	≤ -52	dB

1) Negative modulation, positive synchronization, combined sound and vision.

2) To be adjusted for the stated no-signal anode current. Range values -15 V to -22 V

3) Average anode current measured with a three tone test signal (see 4).

4) Three tone test method ( vision carrier - 8 dB, sound carrier - 7 dB, sideband signal - 17 dB with respect to the sum signal amplitude of the composite signal).

## OPERATING CONDITIONS AS VISION AMPLIFIER ,grounded grid

Frequency	$f$	470 to 860	MHz
Anode voltage	$V_a$	2500	V
Grid voltage <sup>1)</sup>	$V_g$	-20	V
Anode current, no-signal condition	$I_a$	250	mA
Anode current <sup>2)</sup>	$I_a$	500	mA
Grid current	$I_g$	0	mA
Driving power (sync)	$W_{dr}$	8	W
Output power in load	$W_l$	250	W
Power gain	$G$	$\approx 15$	dB

1) To be adjusted for the stated no-signal anode current.

Range values: -10 V to -30 V.

2)  $I_a$  at C.W. output power = 250 W.

## AIR COOLED R.F. POWER TRIODE

Forced air cooled coaxial power triode in metal-ceramic construction primarily intended for use as R.F. class AB linear broad-band amplifier in T.V. transposer service at frequencies up to 960 MHz.

QUICK REFERENCE DATA			
Frequency  (MHz)	Transposer service (combined sound and vision)		
	$V_a$ (V)	$W_l$ (sync) (W)	Power gain (dB)
470 - 860	2000	100	16

**HEATING :** indirect by A. C. (50 Hz to 400 Hz) or D. C. ; oxide coated cathode.

Heater voltage	$V_f$	6.3	$V \pm 5\%$
For transposer application a heater voltage deviation within $\pm 2\%$ is recommended			
Heater current	$I_f$	5.4	A
Cathode heating time	$T_h$	min. 180	s

### CAPACITANCES

Anode to grid	$C_{ag}$	7.8	pF
Grid to cathode and heater	$C_{g/kf}$	27	pF
Anode to cathode and heater	$C_{a/kf}$	0.15	pF

### TYPICAL CHARACTERISTICS

Anode voltage	$V_a$	2	kV
Anode current	$I_a$	250	mA
Transconductance	S	70	mA/V
Amplification factor	$\mu$	80	

### TEMPERATURE LIMITS

Absolute max. temperature measured at reference point	t	250	$^{\circ}\text{C}$
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Data based on pre-production tubes.

## COOLING

Anode: forced air

$W_a$ (W)	$t_i$ (°C)	$q_{min}$ (m <sup>3</sup> /min)	$P_i$ (mmH <sub>2</sub> O)
900	25	1.5	50

Other terminals: low velocity air-flow.

When only the heater voltage is applied the heater and heater/cathode terminals should also be cooled.

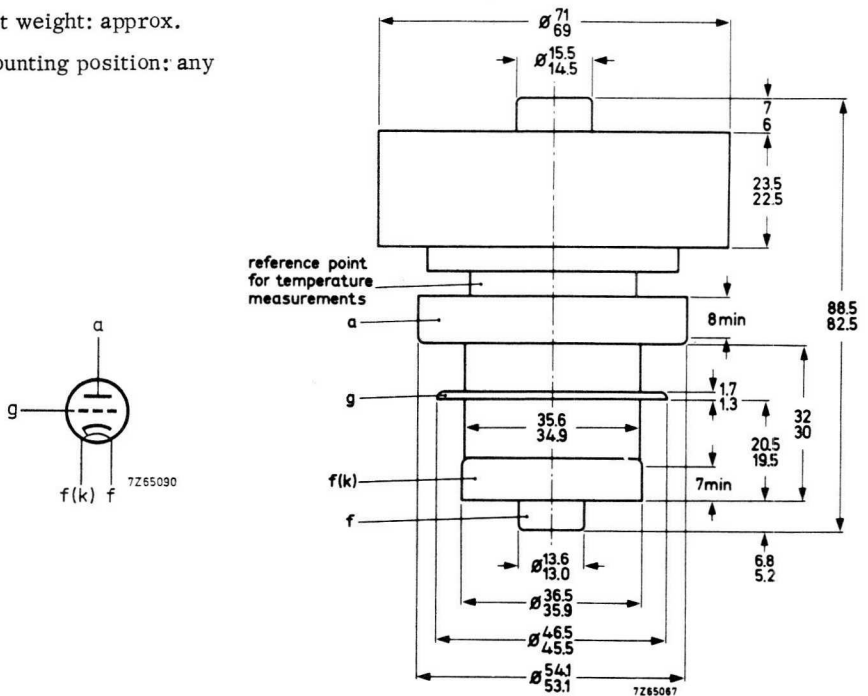
Cooling air and voltages may be switched of simultaneously.

## MECHANICAL DATA

Dimensions in mm

Net weight: approx.

Mounting position: any





R.F. CLASS AB AMPLIFIER FOR TELEVISION TRANSPOSER SERVICE grounded  
grid

LIMITING VALUES (Absolute max. rating system)

Frequency	f	up to	960	MHz
Anode voltage	$V_a$	max.	3500	V
Grid voltage	$-V_g$	max.	200	V
Anode dissipation	$W_a$	max.	900	W
Grid dissipation	$W_g$	max.	0.5	W
Cathode current	$I_k$	max.	550	mA

OPERATING CONDITIONS grounded grid CCIR Standard G 1)

Frequency	f	470	to	860	MHz
Anode voltage	$V_a$	2000			V
Grid voltage 2)	$V_g$	-20			V
Anode current, no-signal condition	$I_a$	250			mA
Anode current	$I_a$	410			mA
Grid current	$I_g$	0			mA
Driving power (sync)	$W_{dr}$	2.5			W
Output power in load (sync)	$W_l$	100			W
Power gain	G	16			dB
Intermodulation products 3)	d	$\leq 56$			dB

1) Negative modulation, positive synchronisation, combined sound and vision.

2) To be adjusted for the stated no-signal anode current.

Range values -10 V to -30 V.

3) Three tone test method (vision carrier -8 dB, sound carrier -10 dB, sideband signal -16 dB with respect to the sum signal amplitude of the composite signal).



## WATER COOLED R.F. INDUSTRIAL TRIODE

Water-cooled triode of metal-ceramic construction with integral cooler intended for tending for use as an industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{feedb}$ ), typical	$W_{osc}$	480	kW
Frequency for full ratings	f max.	30	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R.F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

#### OPERATING CONDITIONS

Frequency	f	30	MHz
Oscillator output power ( $W_o - W_{feedb}$ )	$W_{osc}$	480	kW
Anode voltage	$V_a$	16	kV
Anode current	$I_a$	42	A
Anode input power	$W_{ia}$	672	kW
Anode dissipation	$W_a$	183	kW
Anode output power	$W_o$	489	kW
Anode efficiency	$\eta_a$	73	%
Oscillator efficiency	$\eta_{osc}$	71.5	%
Feedback ratio	$V_{gp}/V_{ap}$	9.3	%
Grid resistor	$R_g$	100	$\Omega$
Grid current, on load	$I_g$	7.5	A
Grid voltage, negative	$-V_g$	750	V
Grid dissipation	$W_g$	3.4	kW
Grid resistor dissipation	$W_{Rg}$	5.6	kW

**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	$f$	up to	30	MHz
Anode voltage	$V_a$	max.	19.2	kV
Anode current	$I_a$	max.	45	A
Anode input power	$W_{i_a}$	max.	750	kW
Anode dissipation	$W_a$	max.	240	kW
Grid voltage	$-V_g$	max.	2.5	kV
Grid current, on load	$I_g$	max.	9	A
	$I_g$	max.	11	A
Grid dissipation	$W_g$	max.	6.0	kW
Grid circuit resistance	$R_g$	max.	10	k $\Omega$
Cathode current, mean	$I_k$	max.	55	A
	$I_{k_p}$	max.	250	A
Envelope temperature	$t_{env}$	max.	240	$^{\circ}C$

**HEATING** : direct; filament thoriated tungsten

Filament voltage	$V_f$		14	V
Filament current	$I_f$		555	A
Peak filament starting current	$I_{fp}$	max.	3500	A
Cold filament resistance	$R_{f_0}$		2.6	m $\Omega$

The filament is designed to accept temporary fluctuations of +5 % and -10 %.

**CAPACITANCES**

Anode to filament	$C_{af}$		3.9	pF
Grid to filament	$C_{gf}$		225	pF
Anode to grid	$C_{ag}$		70	pF

**CHARACTERISTICS** measured at  $V_a = 16$  kV,  $I_a = 15$  A

Transconductance	$S$		230	mA/V
Amplification factor	$\mu$		33	

## COOLING

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $q$ min ( $\ell$ /min)	Pressure drop $P_i$ (atm)	Outlet temperature $t_o$ (°C)
240	20	120	1	50
	50	180	1.8	70
200	20	95	0.65	52
	50	144	1.2	71
160	20	72	0.42	54
	50	110	0.75	72

Absolute max. water inlet temperature  $t_i$  max. 50 °C

At frequencies below 4 MHz cooling of the metal-ceramic seals can be accomplished by a low velocity air flow, or by water-cooling of the filament connectors. A water flow of approximately 1 l/min will be sufficient. At frequencies above 4 MHz it is recommended to cool the seals by means of an air flow of approximately 6 m<sup>3</sup>/min from a 60 mm diameter nozzle placed at a distance of 300 mm from the tube header.

To obtain optimum life, the seal/envelope temperature under continuous loaded conditions should be kept at of below 200°C.

## ACCESSORIES

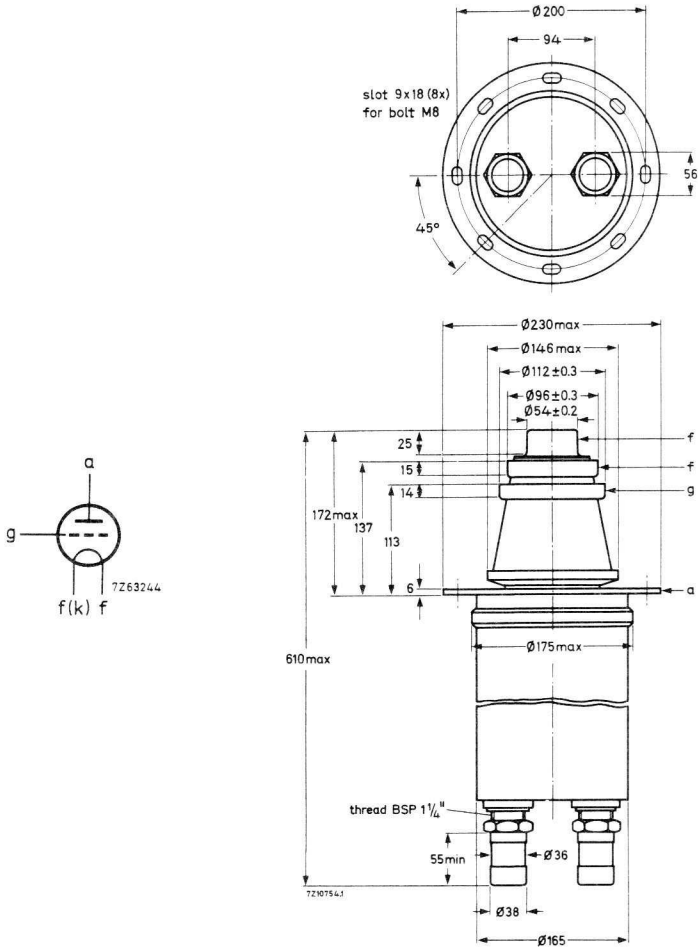
Filament connector		type	40695	net weight	710	g
Filament/cathode connector		type	40696	net weight	860	g
Filament cables (both required)		type	40716	net weight	975	g
		and type	40717	net weight	980	g
Grid connector	$f \leq 4$ MHz	type	40694	net weight	270	g
	$f > 4$ MHz	type	40737	net weight	525	g

## MECHANICAL DATA

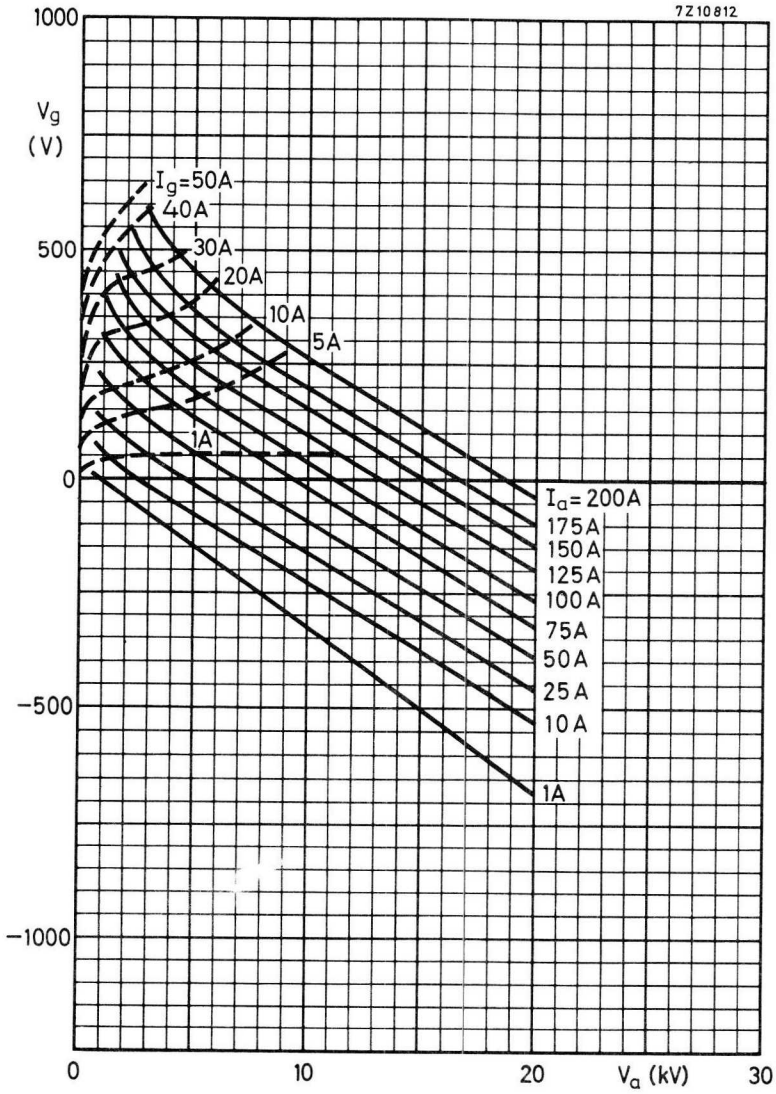
Dimensions in mm

Mounting position: vertical with anode up or down

Net weight: approx. 30 kg



When using the tube in the anode up position the input and output water connections should be reversed.







# WATER COOLED MAGNETICALLY BEAMED

## R.F. INDUSTRIAL TRIODE

Water-cooled magnetically focused triode of metal-ceramic construction with integral water jacket intended for use as industrial oscillator.

### QUICK REFERENCE DATA

Oscillator output power ( $W_o - W_{\text{feedb}}$ ), typical	$W_{\text{osc}}$	3	kW
Frequency for full ratings	f max.	5	MHz

To be read in conjunction with "General Recommendations Transmitting tubes, Tubes for R. F. heating."

### R.F. CLASS C OSCILLATOR FOR INDUSTRIAL USE

Anode voltage single phase, full-wave rectified, unfiltered

#### OPERATING CONDITIONS

Frequency	f	5	MHz
Oscillator output power ( $W_o - W_{\text{feedb}}$ )	$W_{\text{osc}}$	3094	W
Transformer voltage	$V_{\text{tr rms}}$	5000	V
Anode voltage, mean	$V_a$	4500	V
Anode current, mean	$I_a$	720	mA
Anode input power	$W_{\text{ia}}$	4000	W
Anode dissipation	$W_a$	900	W
Anode output power	$W_o$	3100	W
Anode efficiency	$\eta_a$	78	%
Oscillator efficiency	$\eta_{\text{osc}}$	77.4	%
Feedback ratio	$V_{\text{gp}}/V_{\text{ap}}$	33	%
Grid resistor	$R_g$	80	k $\Omega$
Grid current, on load	$I_g$	4.5	mA
off load	$I_g$	9.0	mA
Grid voltage, negative	$-V_g$	360	V <sup>1)</sup>
Grid dissipation	$W_g$	4.4	W
Grid resistor dissipation	$W_{Rg}$	1.6	W

1) Max. -565 V.

**LIMITING VALUES** (Absolute max. rating system)

Frequency for full ratings	f	max.	5	MHz
Anode voltage, mean	$V_a$	max.	4500	V
Anode current, mean	$I_a$	max.	725	mA
Anode input power	$W_{ia}$	max.	4	kW
Anode dissipation	$W_a$	max.	2	kW
Grid voltage	$V_g$	max.	2400	V
Grid current	$I_g$	max.		see 1)
Grid dissipation	$W_g$	max.	25	W
Grid circuit resistance	$R_g$	max.	88	k $\Omega$
Cathode current, mean	$I_k$	max.	730	mA
Seal temperature	t	max.	200	$^{\circ}$ C

**HEATING** : indirect; nickel-oxide cathode, dispenser type

Heater voltage	$V_f$		5	V
Heater current	$I_f$		6.1	A
Waiting time	$T_{wmin.}$		2	min.

The filament is designed to accept temporary fluctuations of +10 % and -10 %.

**CAPACITANCES**

Anode to cathode	$C_{ak}$		0.3	pF
Grid to cathode	$C_{gk}$		9.8	pF
Anode to grid	$C_{ag}$		11.5	pF

**CHARACTERISTICS** measured at  $V_a = 3$  kV,  $I_a = 500$  mA

Transconductance	S		4	mA/V
Amplification factor	$\mu$		25	
Magnetic flux density	B	min.	115	mT ( = 1150 Gs)

Care should be taken that the magnetic flux density is not influenced by external magnetic materials.

Data based on pre-production tubes.

1) Limited by  $W_g$  max. and  $I_k$  max.

**COOLING**

Anode + grid dissipation $W_a + W_g$ (kW)	Inlet temperature $t_i$ (°C)	Rate of flow $Q$ min (ℓ/min)	Pressure drop $P_i$ (atm)
2	20	3.8	0.31
	50	5.7	0.62

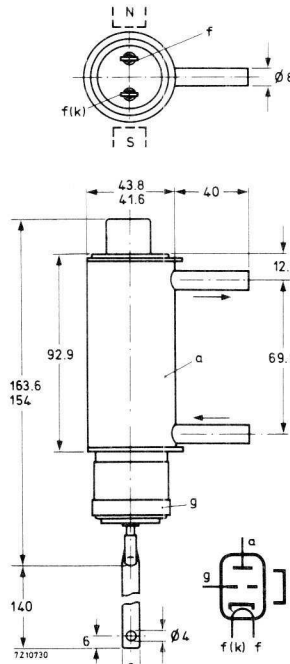
The waterflow must be maintained for at least 1 minute after anode power is removed. Additional air cooling of the seals may be necessary to keep the temperature below the limiting value. The direction of the water flow must be such that the inflow is below the outlet for either of the two vertical mounting positions.

**ACCESSORIES**

Magnet assembly (magnetic nest) type 40765 net weight 2.3 kg  
 Grid connector 40766

**MECHANICAL DATA**

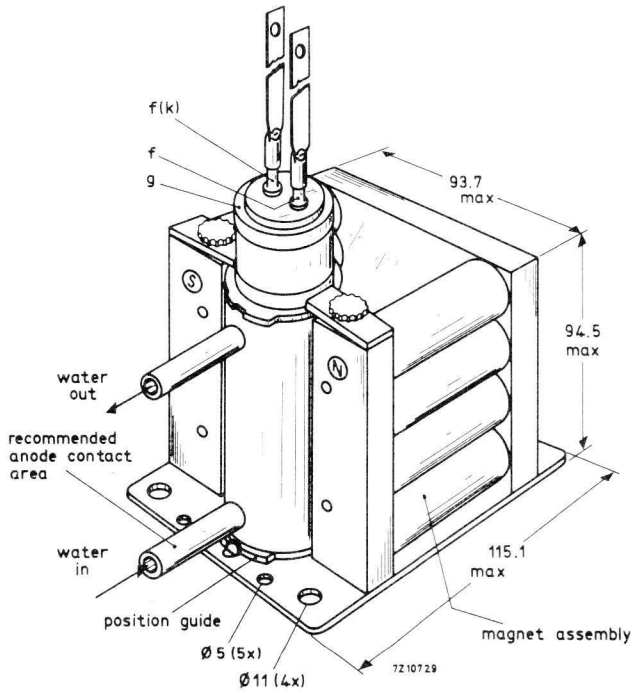
Net weight: approx. 0.45 kg



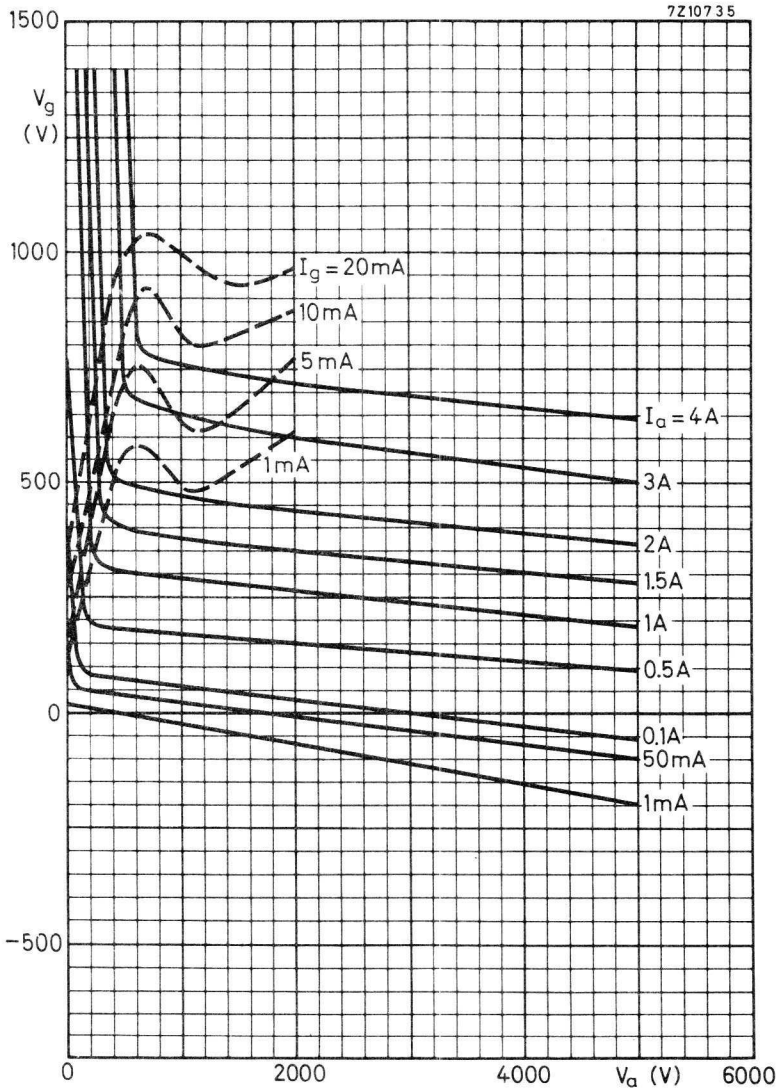
Dimensions in mm

Mounting position: vertical

Due to the very rugged construction of this type, generally it can be shipped mounted in the equipment



Tube mounted in magnet assembly





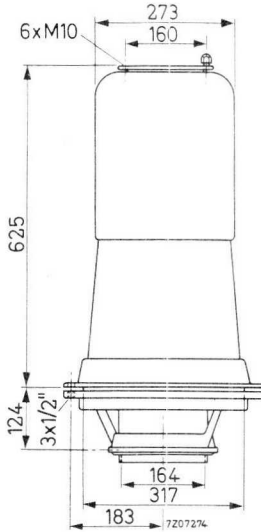
## Associated accessories



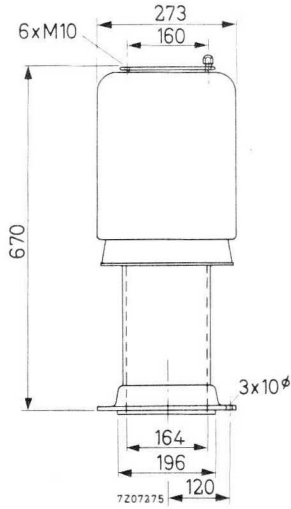




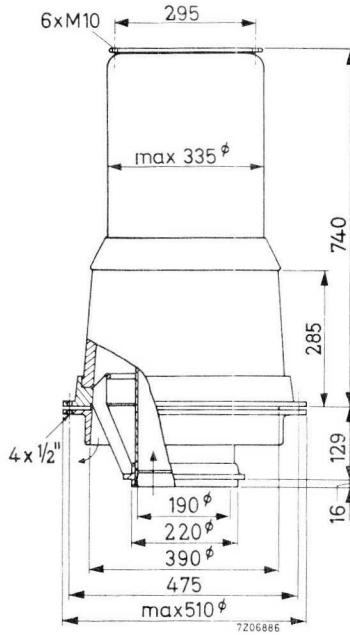
COOLER HOUSING FOR AIR COOLING



COOLER HOUSING FOR AIR COOLING

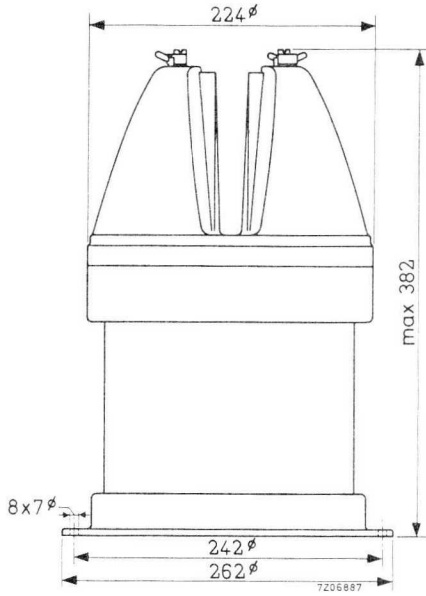


COOLER HOUSING FOR AIR COOLING



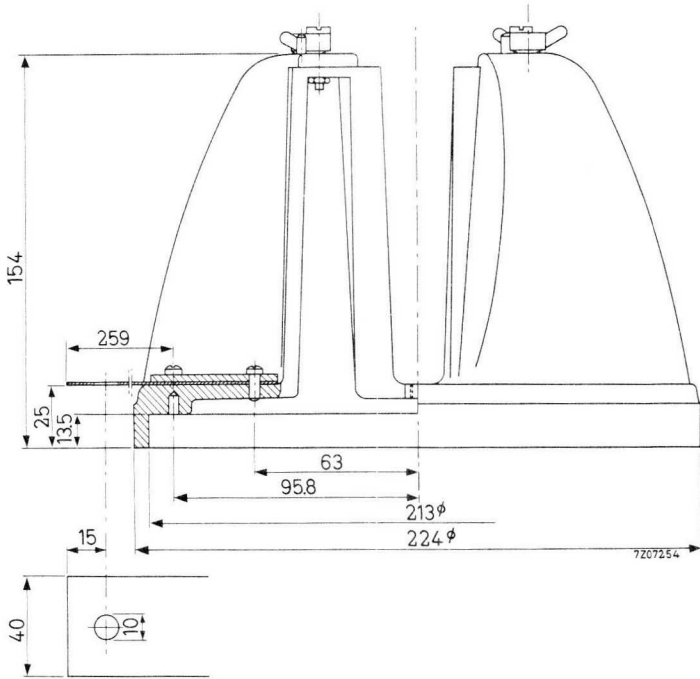
Net weight 72 kg

COOLER HOUSING FOR AIR COOLING

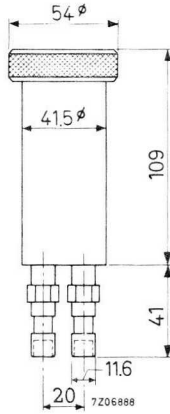


Net weight 7.4 kg

AIR DISTRIBUTOR  
UPPER PART OF K508

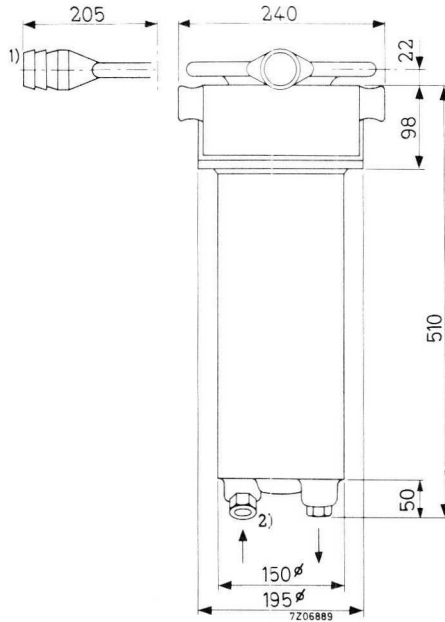


WATER JACKET



Net weight 0.52 kg

## WATER JACKET

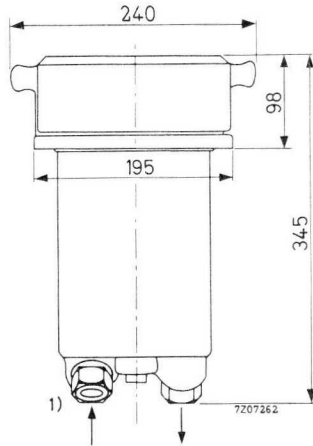


- 1) Use connecting hose with an inner diameter of  $1\frac{3}{4}$ "
- 2) Coupling for metal tubing with an outer diameter of 28mm

Net weight      20.5 kg



### WATER JACKET

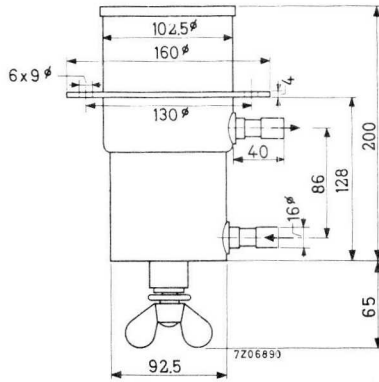


1) coupling for metal tubing with an outer diameter of 28mm

Net weight 16.7 kg

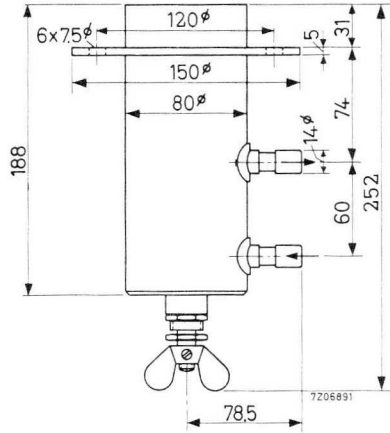


## WATER JACKET



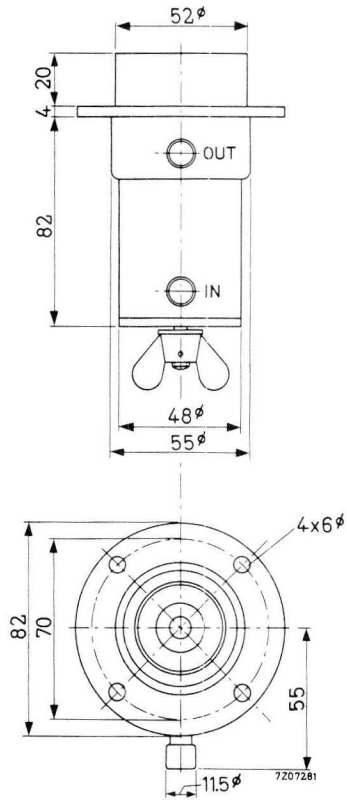
Net weight 2.1 kg

WATER JACKET



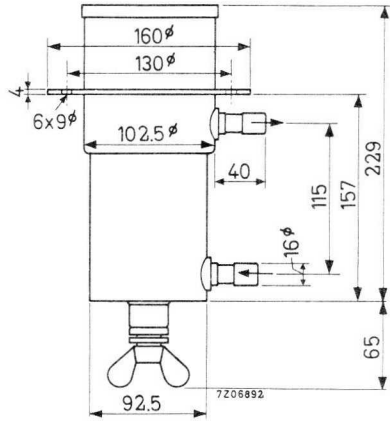
Net weight 2.2 kg

## WATER JACKET



Net weight 0.76 kg

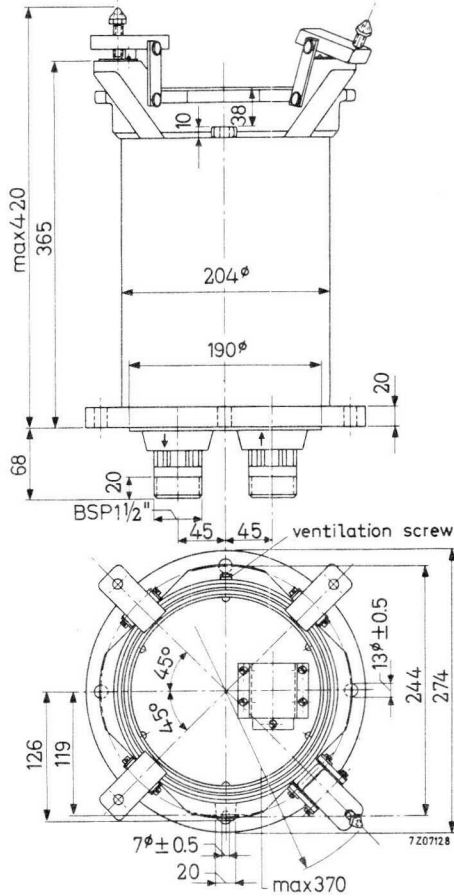
### WATER JACKET



Net weight 2.7 kg



WATER JACKET



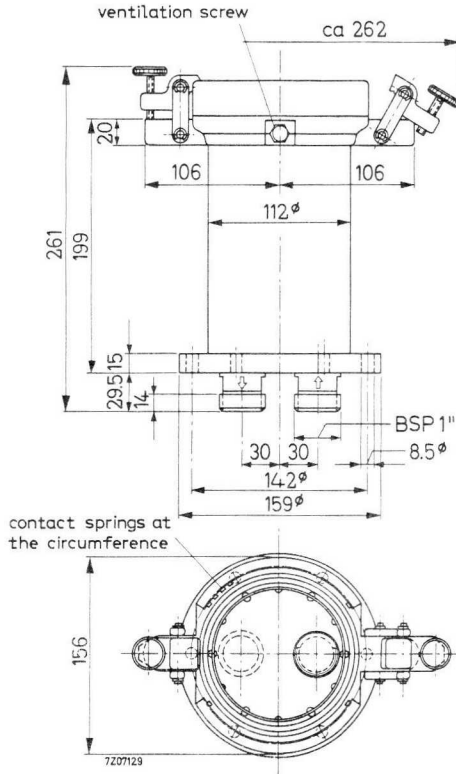
Water pressure

max. 5 ATO

Net weight

30.5 kg

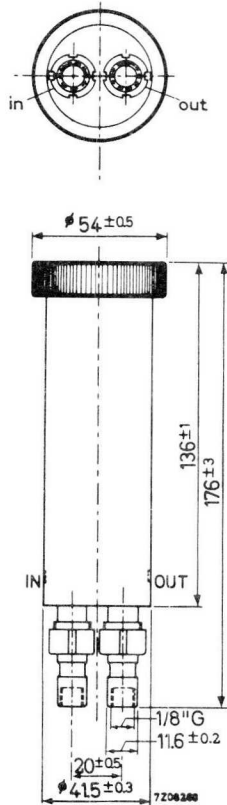
**WATER JACKET**



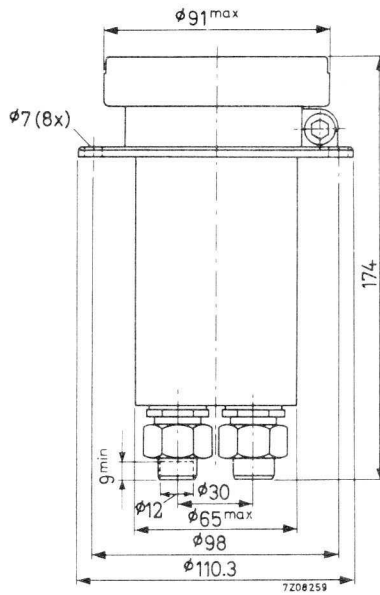
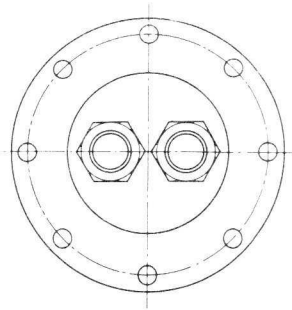
Water pressure max. 5 ATO

Net weight 5 kg

# WATER JACKET



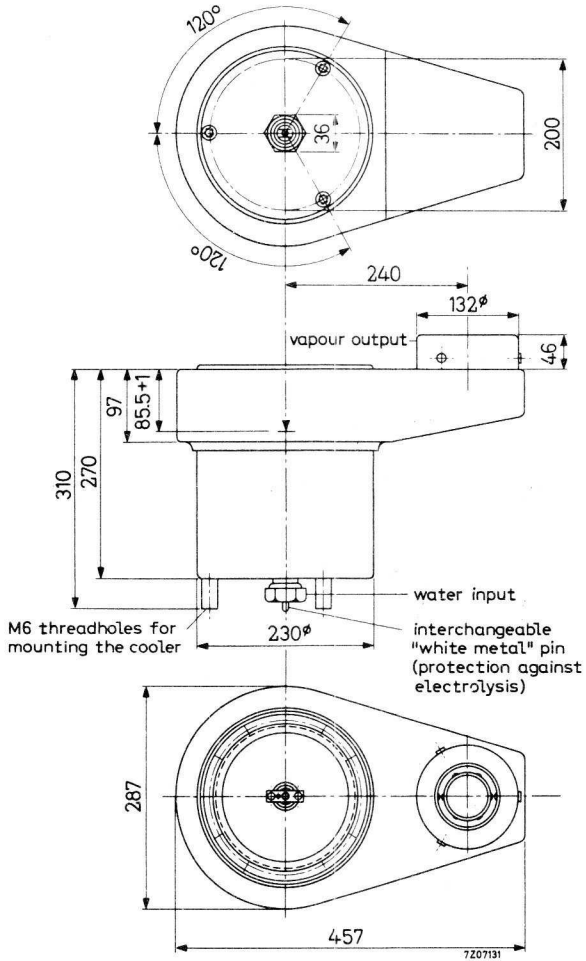
WATER JACKET



Net weight 2 kg

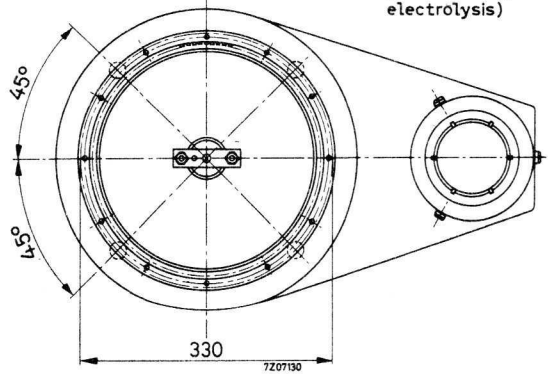
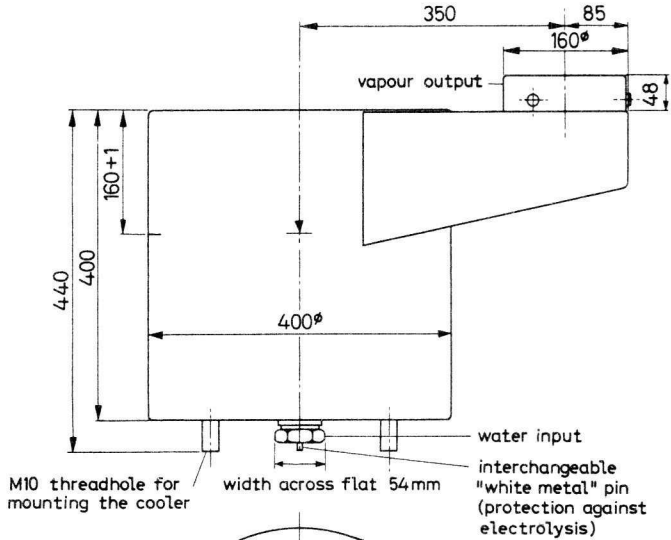


VAPOUR JACKET



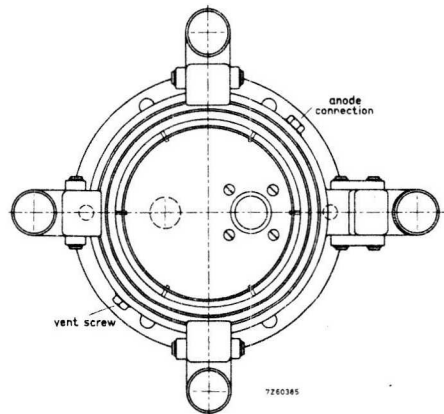
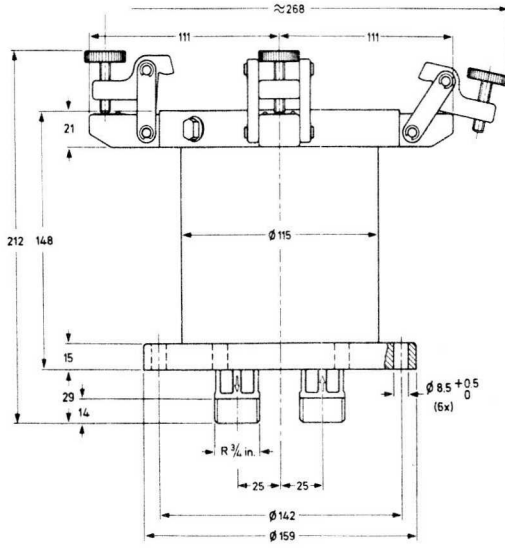
Net weight 8 kg

VAPOUR JACKET



Net weight 22 kg

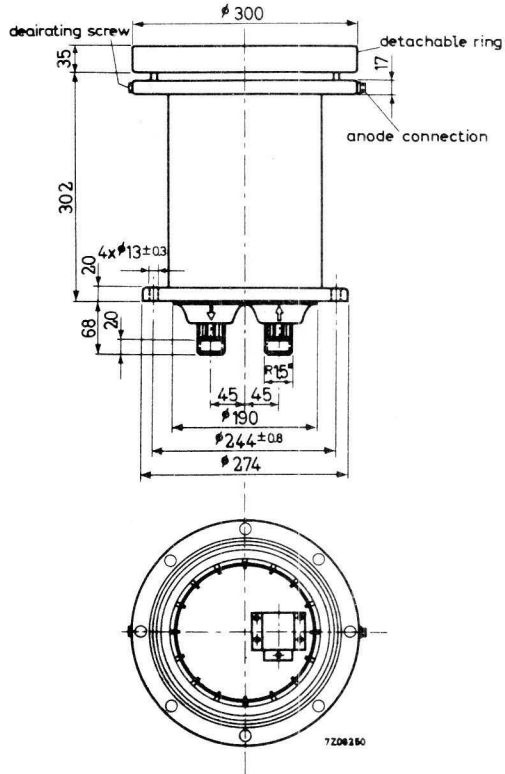
# WATER JACKET



Water pressure max. 10 ATO  
 Net weight approx. 6 kg.

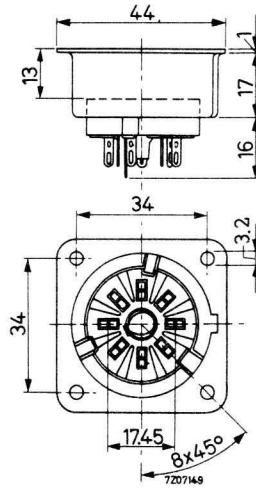


WATER JACKET



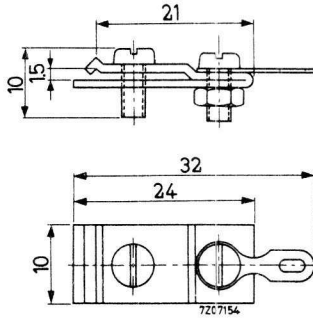
### TUBE SOCKET

WITH 8 SPRING CONTACTS AND CENTRAL LOCATING  
AND LOCKING DEVICE



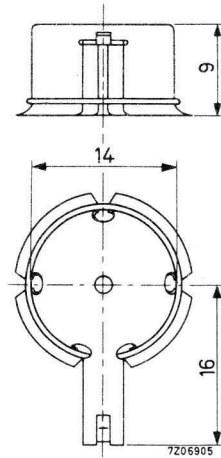
Chassis hole 42 mm

# ANODE CONNECTOR



# TOP CAP CONNECTOR

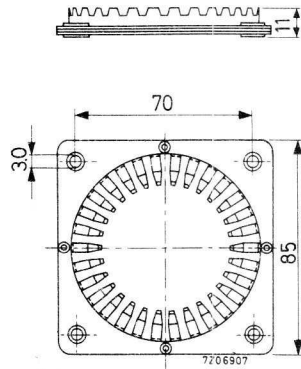
FOR TOP CAPS WITH 14.38 mm  $\phi$  (IEC 67-III-1b, type 3).



Material: brass, nickel plated

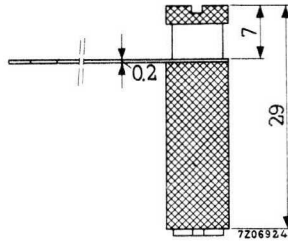
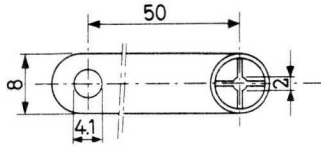


## GRID CONNECTOR



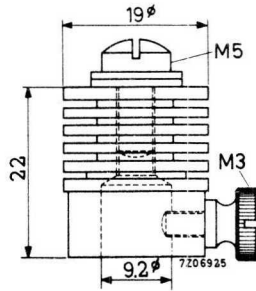
Material: brass, silver plated

ANODE CONNECTOR



Material: brass, silver plated

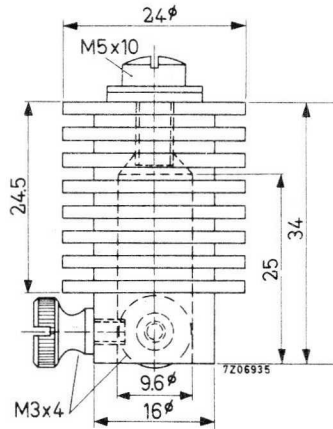
## ANODE CONNECTOR



Material: brass, nickel plated

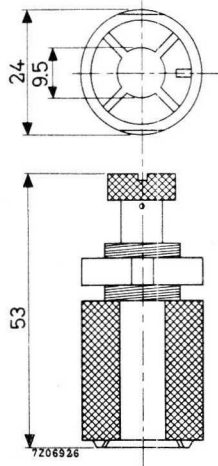


## ANODE CONNECTOR



Material: brass, nickel plated

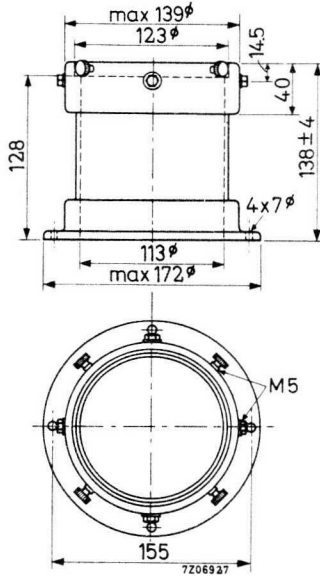
## FILAMENT CONNECTOR



Material: brass, silver plated

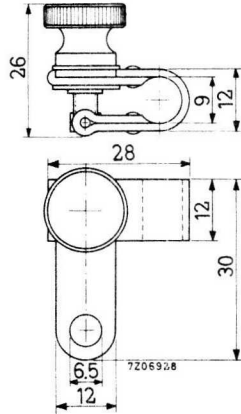


INSULATING PEDESTAL

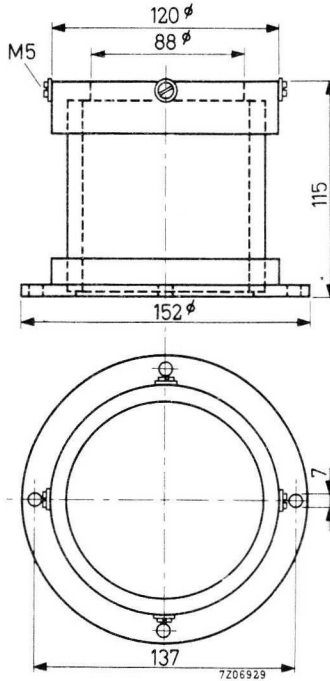


Material: ceramic  
 Net weight: 2.1 kg

# FILAMENT CONNECTOR



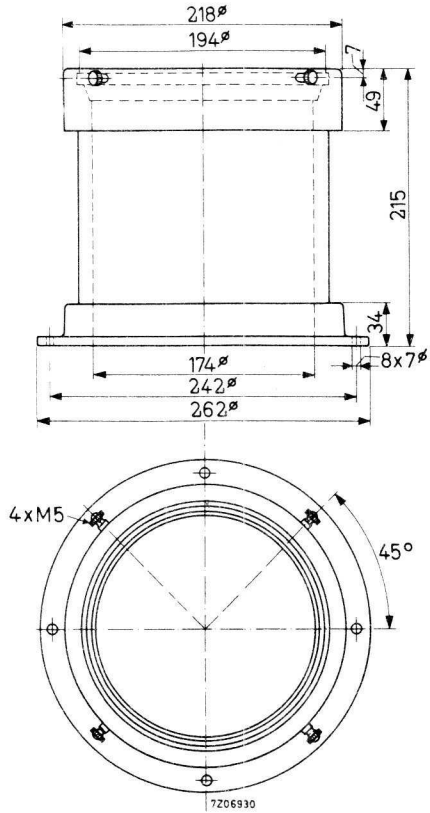
# INSULATING PEDESTAL



Material: ceramic  
Net weight: 1.6 kg

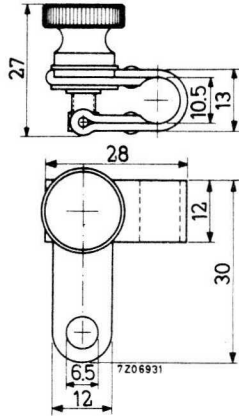


## INSULATING PEDESTAL



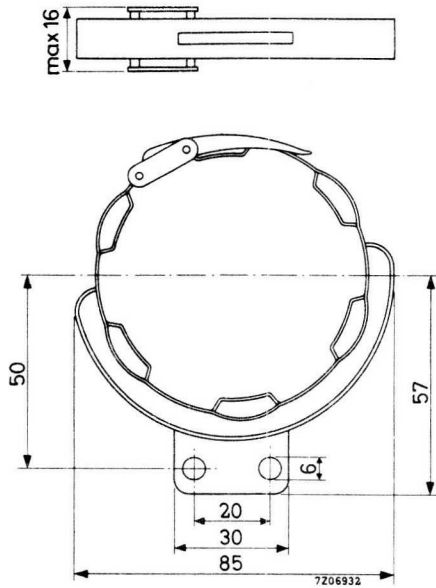
Material: ceramic

FILAMENT CONNECTOR



Material; brass, silver plated

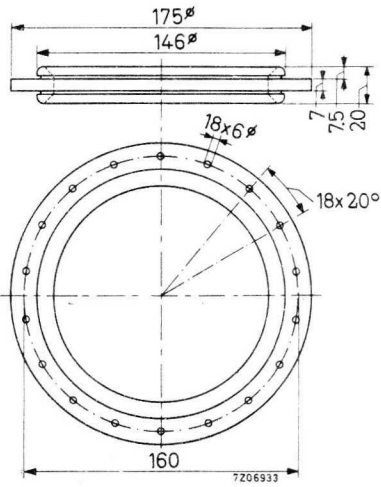
## GRID CONNECTOR



Material; brass, silver plated

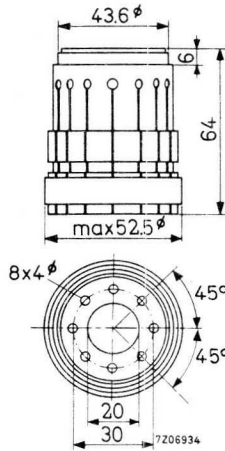


## GRID AND ANODE CONNECTOR



Material: brass, silver plated

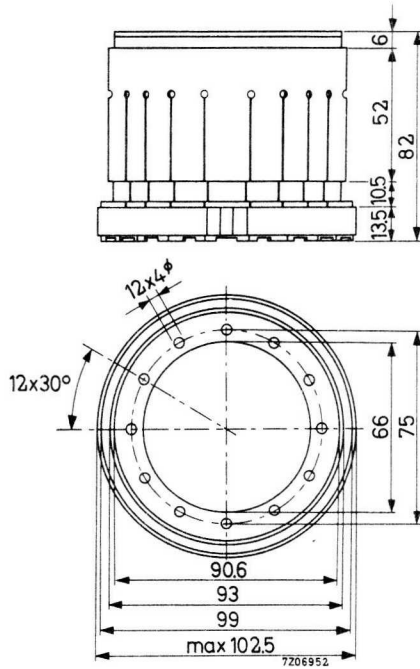
## FILAMENT CONNECTOR



Material: brass, silver plated

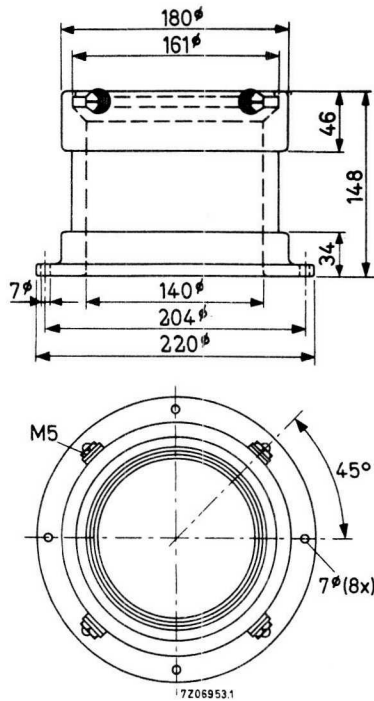


## FILAMENT CONNECTOR



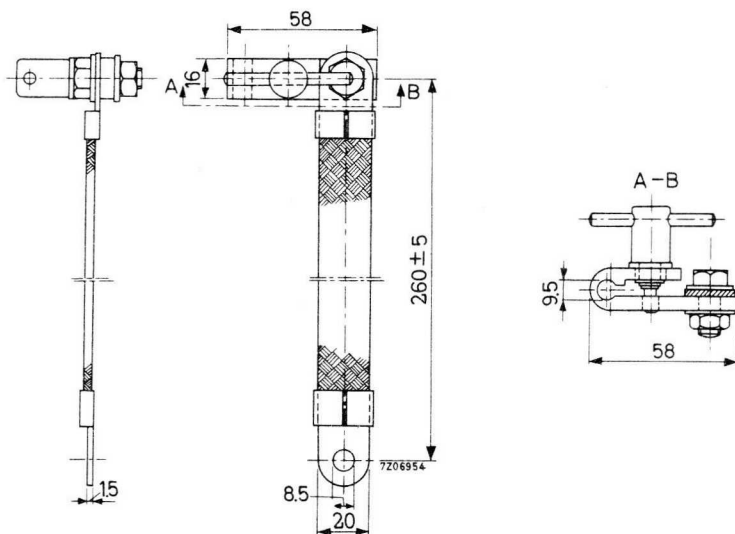
Material: brass, silver plated

## INSULATING PEDESTAL



Material: ceramic  
Net weight: 4.25 kg

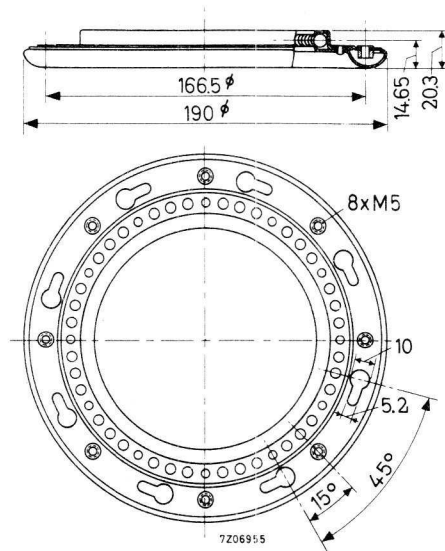
FILAMENT CONNECTOR WITH CABLE



Material: cable - twined copper  
 connector - brass, nickel plated

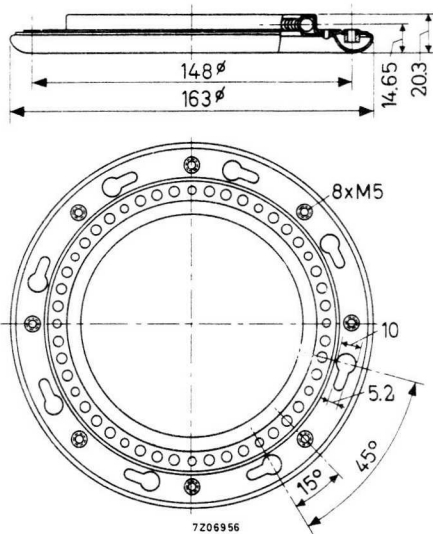


## GRID CONNECTOR

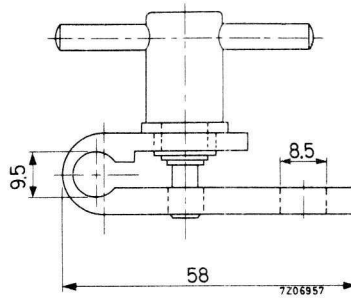


Material: brass, silver plated

## GRID CONNECTOR



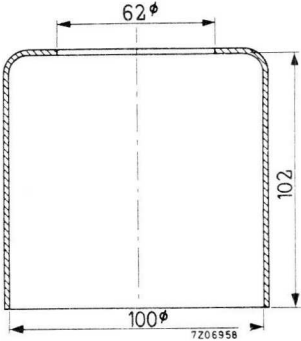
Material: brass, silver plated

**ANODE CONNECTOR**

Material: brass, nickel plated



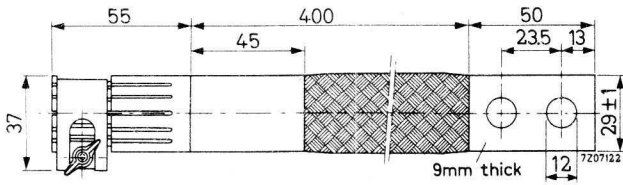
CHIMNEY



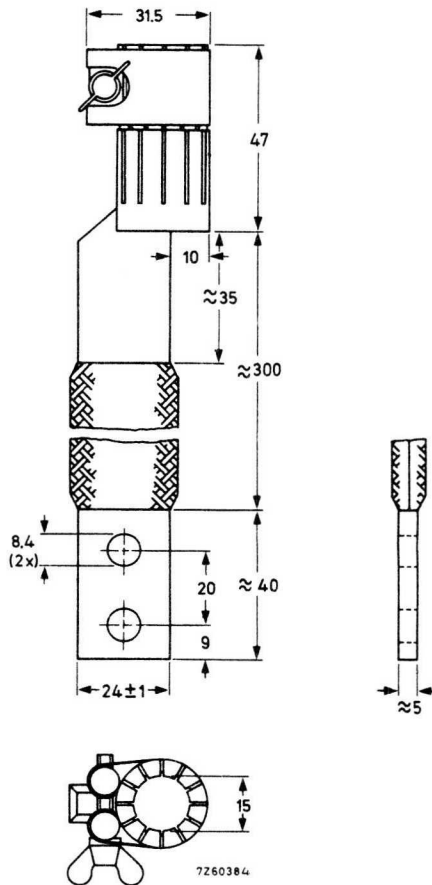
Material: glass



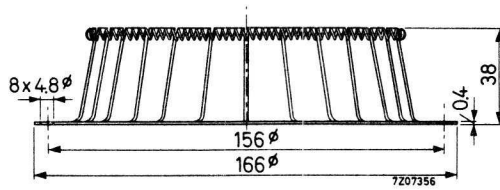
## FILAMENT CONNECTOR WITH CABLE



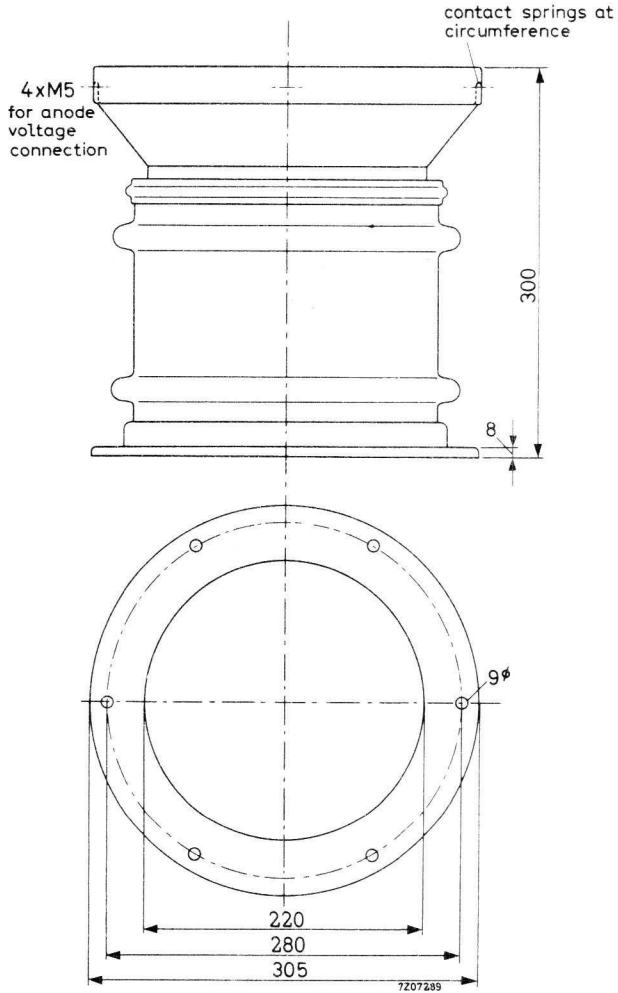
## FILAMENT CONNECTOR WITH CABLE



## GRID CONNECTOR



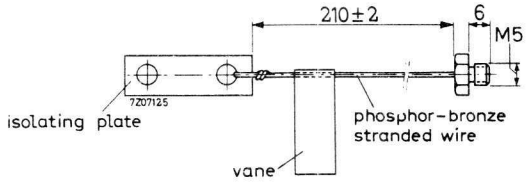
# INSULATING PEDESTAL



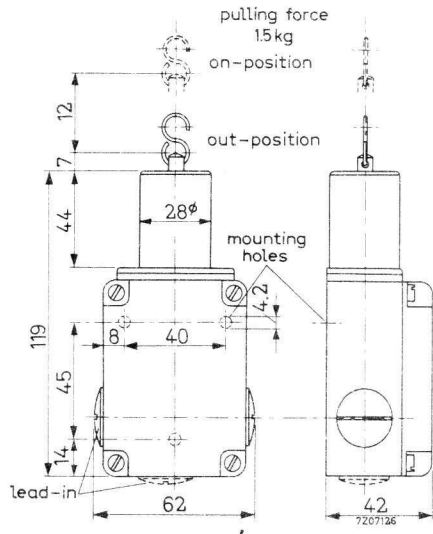
Net weight 9.2 kg

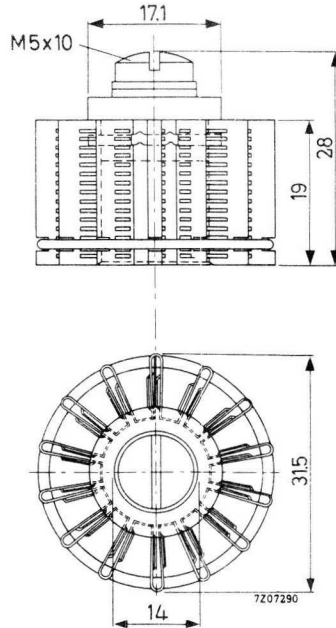


FUSE



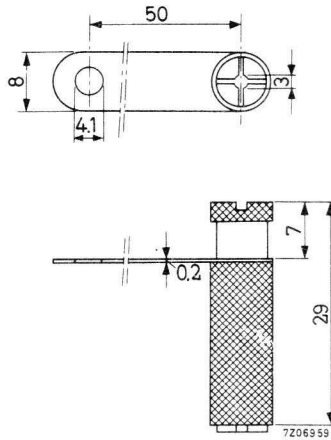
PULL SWITCH FOR TUBE CUT-OUT



**ANODE CONNECTOR**FOR TOP CAPS WITH 14.38 mm  $\phi$  (IEC67-III-1b, type 3)

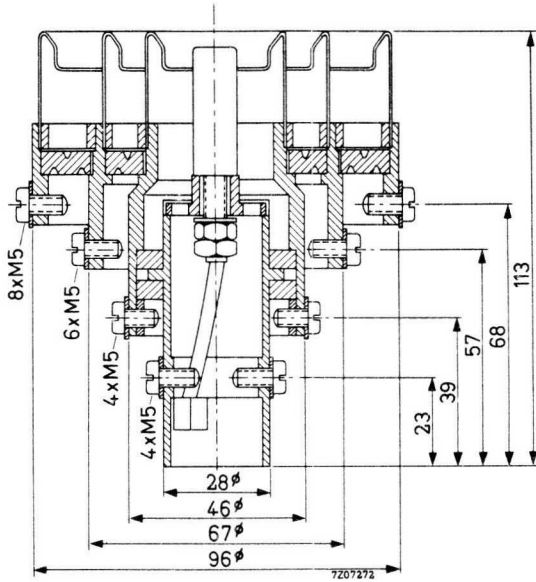
Material: brass, nickel plated

# ANODE CONNECTOR



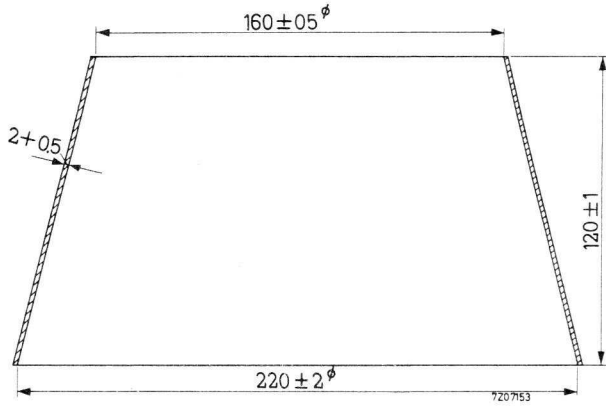
Material: brass, silver plated

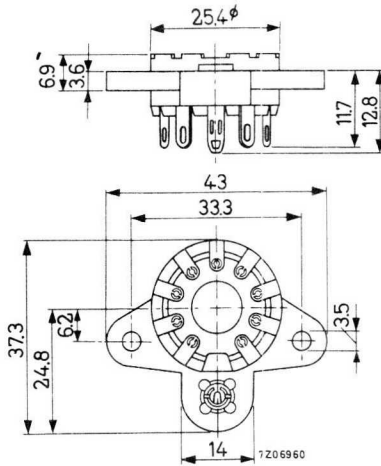
## TUBE SOCKET



Material: synthetic resin insulating material  
silver plated contacts

CHIMNEY



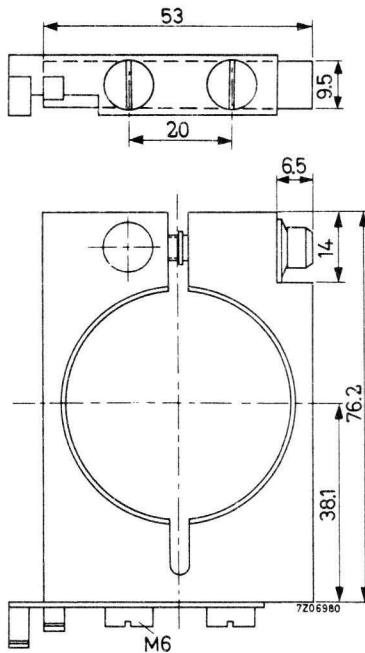
**TUBE SOCKET FOR MAGNOVAL BASES**

Material: synthetic resin insulating material  
9 silver plated cup-shaped contacts



# GRID CONNECTOR

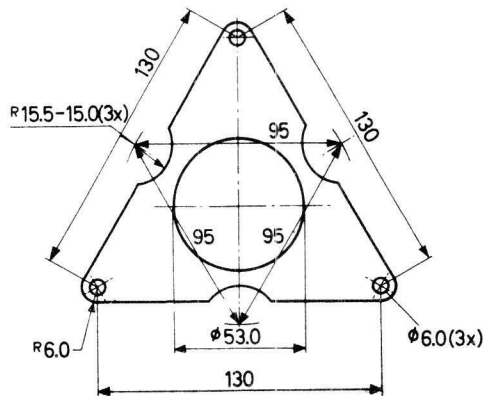
FOR 48 mm  $\phi$  TERMINALS



Material: brass, silver plated

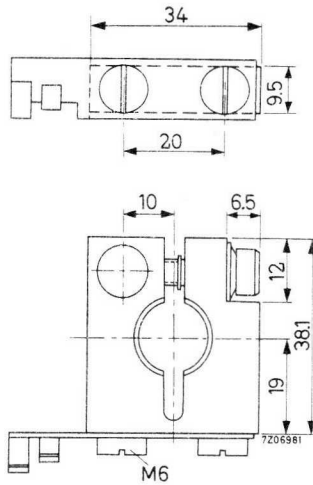


## GRID CONNECTOR

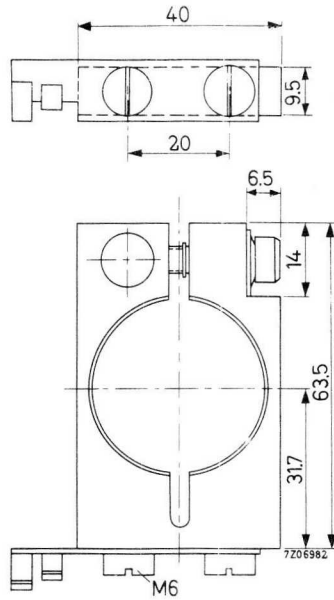


Material: Brass



**FILAMENT CONNECTOR**FOR 14.4 mm  $\phi$  TERMINALS

Material: brass, nickel plated

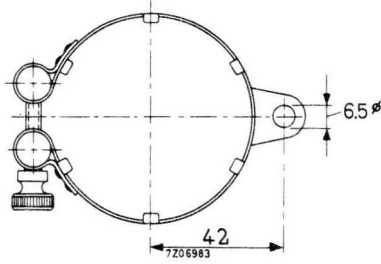
**FILAMENT CONNECTOR**FOR 36 mm  $\phi$  TERMINALS

Material: brass, nickel plated



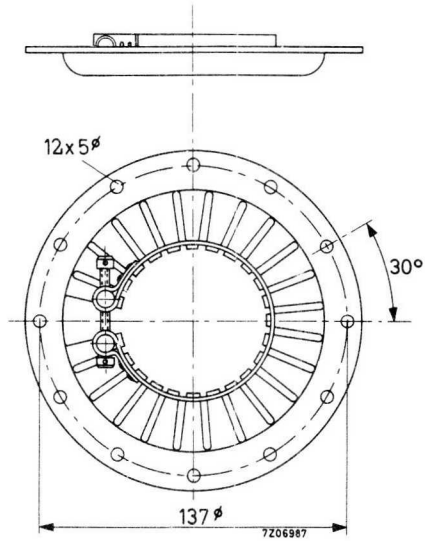
# GRID CONNECTOR

FOR 66 mm  $\phi$  TERMINALS



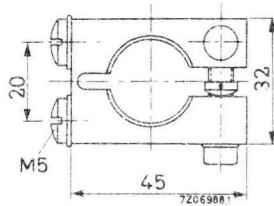
Material: brass, silver plated  
Net weight: 55 g



**GRID CONNECTOR**FOR 66 mm  $\phi$  TERMINALS

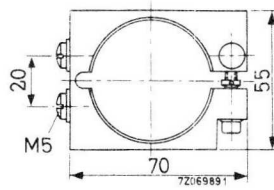
Material: brass, silver plated  
Net weight: 240 g



**FILAMENT CONNECTOR**FOR 25.1 mm  $\phi$  TERMINALS

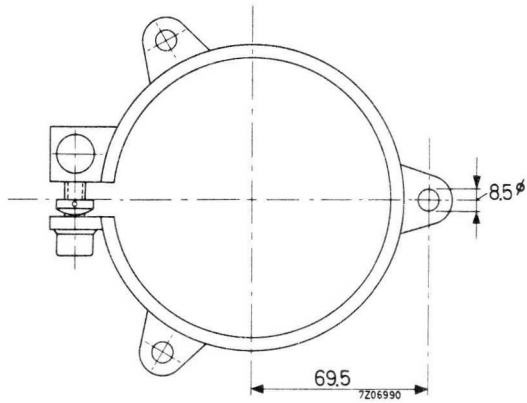
Material: brass, nickel plated

Net weight: 140 g

**FILAMENT CONNECTOR**FOR 50 mm  $\phi$  TERMINALS

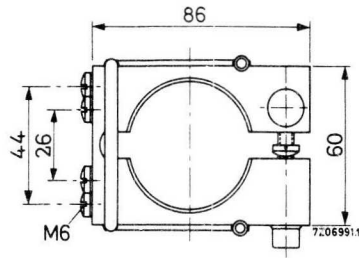
Material: brass, nickel plated  
Net weight: 165 g



**GRID CONNECTOR**FOR 112 mm  $\phi$  TERMINALS

Material: brass, silver plated  
Net weight: 270 g



**FILAMENT CONNECTOR**FOR 54 mm  $\phi$  TERMINALS

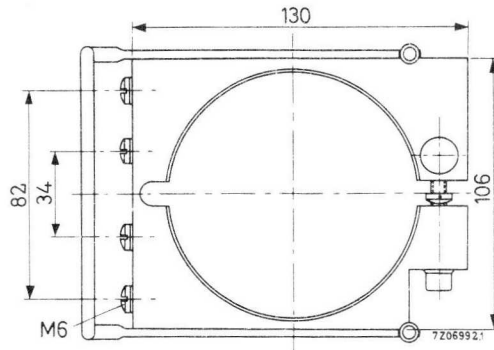
Material: brass, nickel plated  
Net weight: 710 g



40696

## FILAMENT CONNECTOR

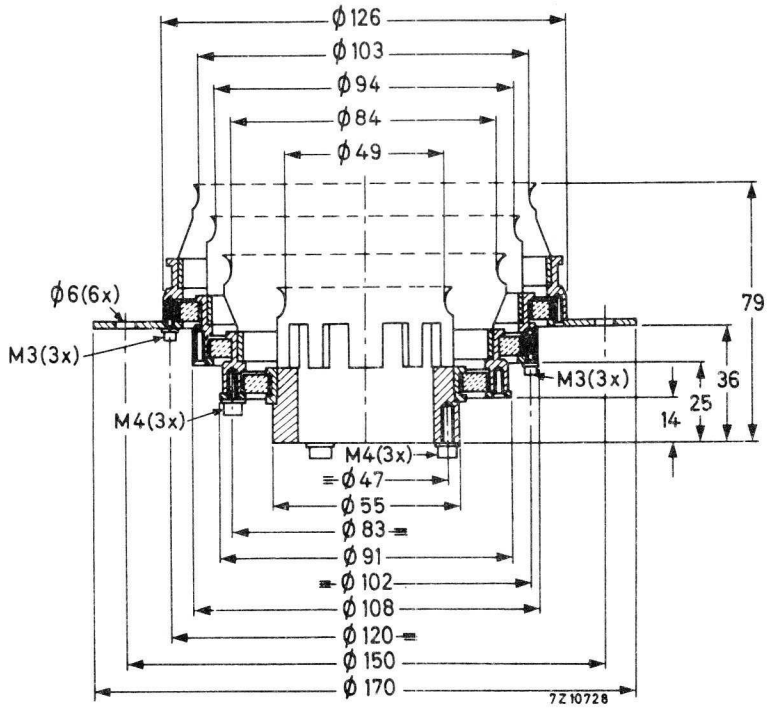
FOR 96 mm  $\phi$  TERMINALS



Material: brass, nickel plated

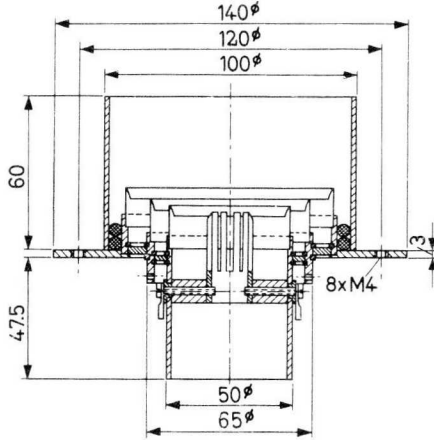
Net weight: 860 g

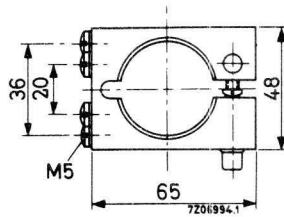
## TUBE SOCKET FOR COAXIAL TUBES



Material: teflon insulating material  
 silver plated contact springs

TUBE SOCKET FOR COAXIAL TETRODES



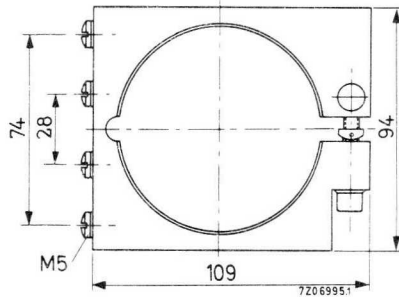
**FILAMENT CONNECTOR**FOR 42 mm  $\phi$  TERMINALS

Material: brass, nickel plated



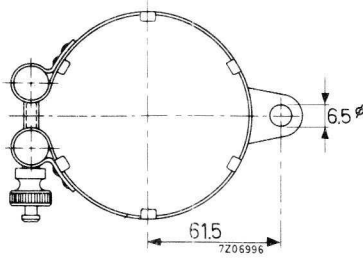
### FILAMENT CONNECTOR

FOR 86 mm  $\phi$  TERMINALS



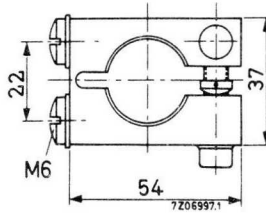
Material: brass, nickel plated



**GRID CONNECTOR**FOR 105 mm  $\phi$  TERMINALS

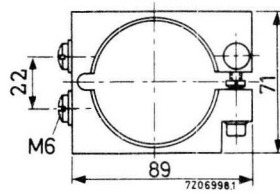
Material: brass, silver plated



**FILAMENT CONNECTOR**FOR 32 mm  $\phi$  TERMINALS

Material: brass, nickel plated  
Net weight: 230 g



**FILAMENT CONNECTOR**FOR 66 mm  $\phi$  TERMINALS

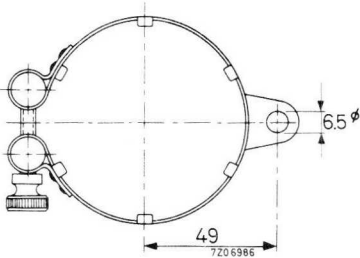
Material: brass, nickel plated  
Net weight: 265 g



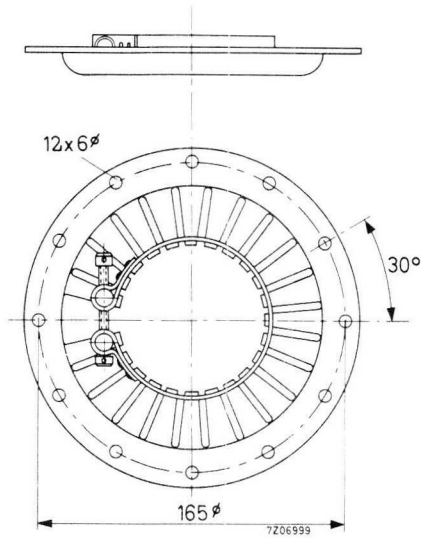
40710

## GRID CONNECTOR

FOR 80 mm  $\phi$  TERMINALS



Material: brass, silver plated  
Net weight: 60 g

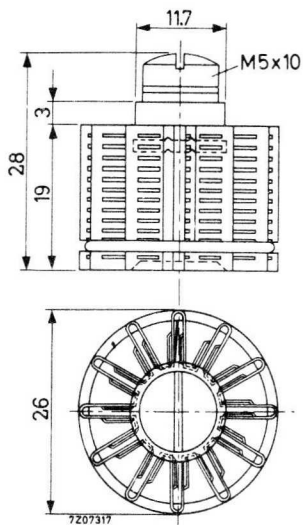
**GRID CONNECTOR**FOR 80 mm  $\phi$  TERMINALS

Material: brass, silver plated  
Net weight: 310 g

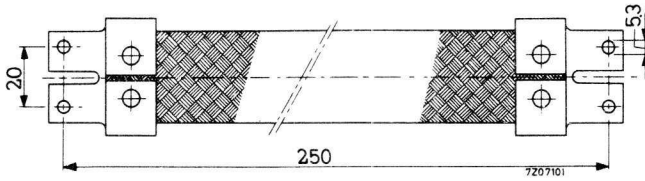


## ANODE CONNECTOR

FOR TOP CAPS WITH 9.14 mm  $\phi$  (IEC67-III-1b, type 2)



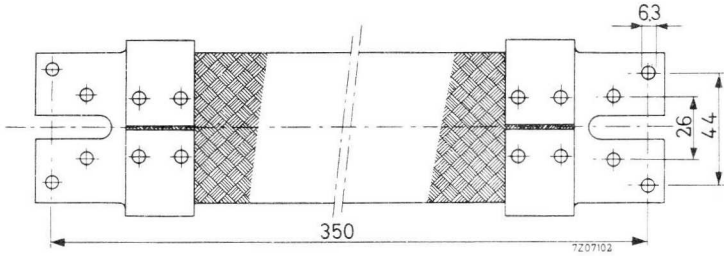
**FILAMENT CABLE  
TO BE USED WITH 40692 AND 40693**



Net weight: 200 g

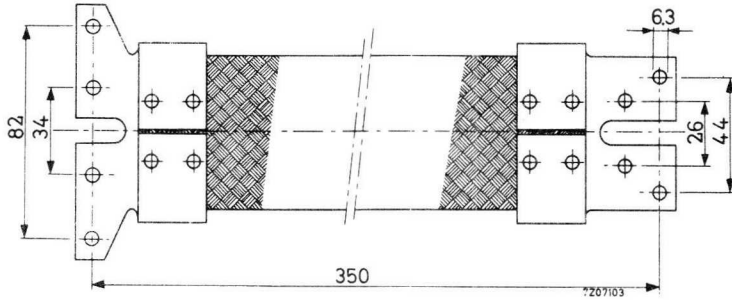


**FILAMENT CABLE  
TO BE USED WITH 40695**



Net weight: 975 g

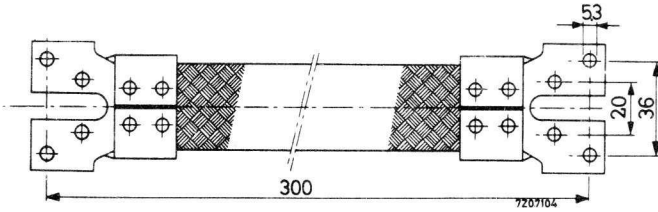
**FILAMENT CABLE  
TO BE USED WITH 40696**



Net weight: 980 g

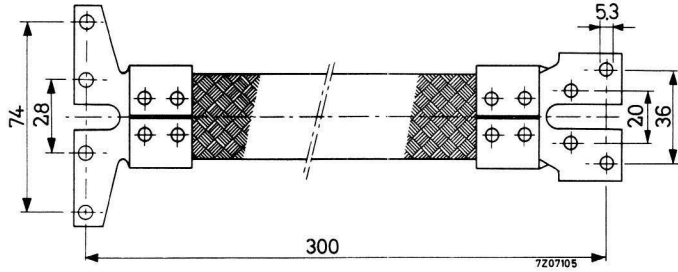


**FILAMENT CABLE  
TO BE USED WITH 40705**



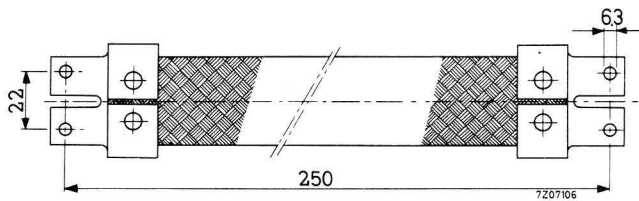


**FILAMENT CABLE  
TO BE USED WITH 40706**



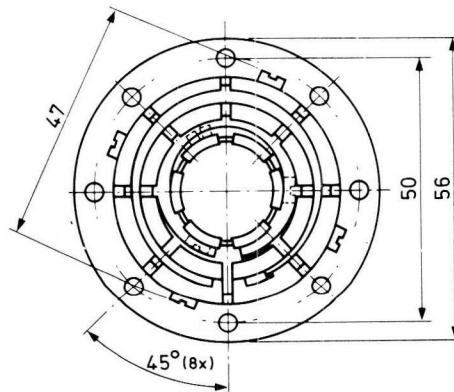
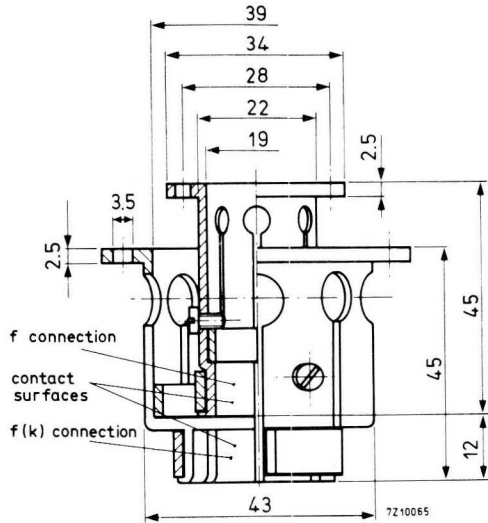
40720

**FILAMENT CABLE  
TO BE USED WITH 40708 AND 40709**



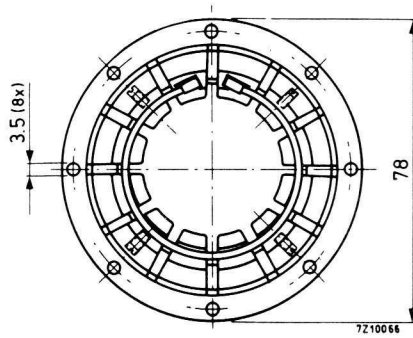
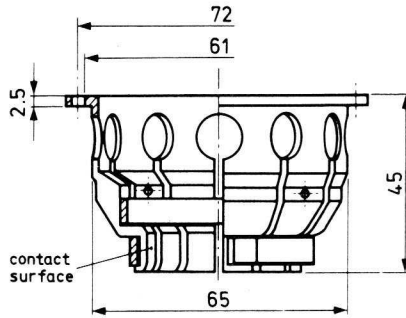
Net weight: 215 g

## FILAMENT CONNECTOR



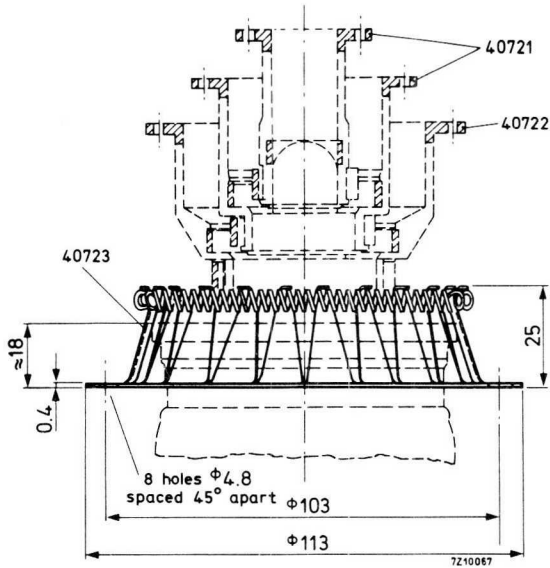
Net weight: approx. 0.2 kg

# GRID CONNECTOR



Net weight: approx. 0.2 kg

## SCREEN GRID CONNECTOR

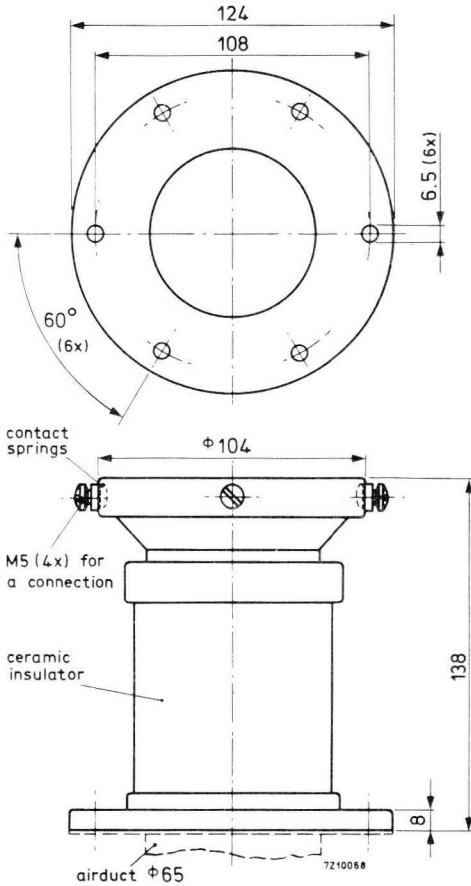


Net weight: approx. 0.1 kg

### Caution

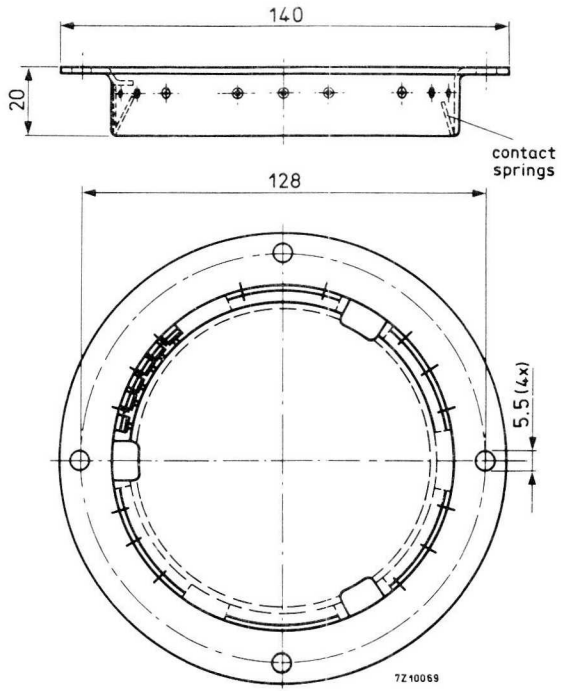
The tube must never be pulled through the spring ring. So, if it has to be inserted from above, this should be done first, before the screen grid connection is made. Similarly, the tube can only be taken out after the screen grid connector has been removed.

## INSULATING PEDESTAL



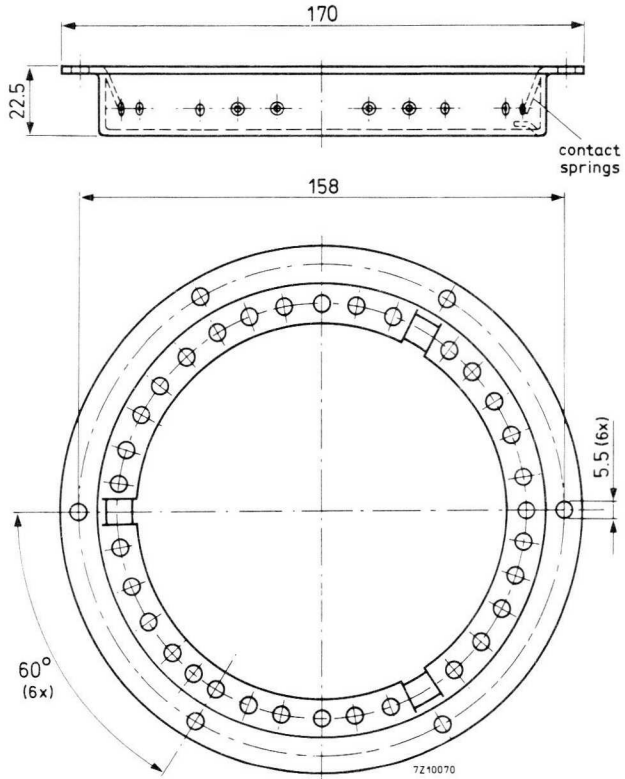
Net weight: approx. 1.3 kg

## GRID CONNECTOR



Net weight: approx. 0.14 kg

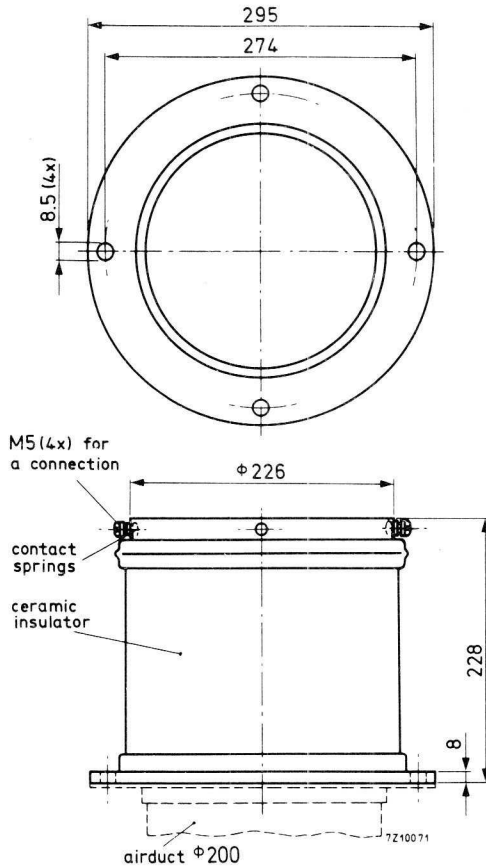
## SCREEN GRID CONNECTOR



Net weight: approx. 0.2 kg

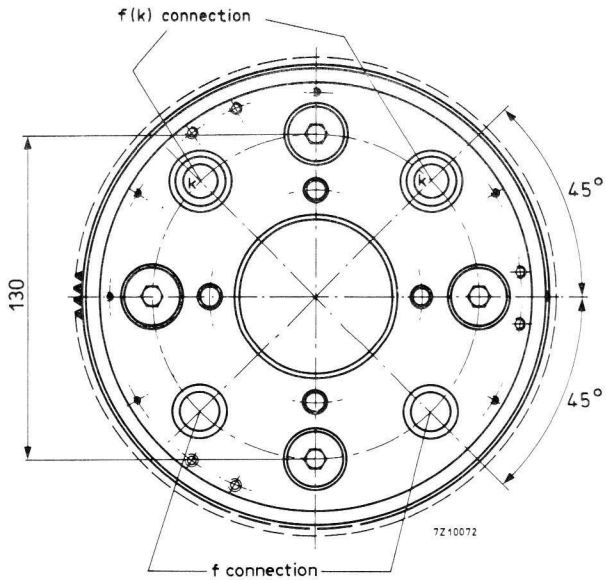
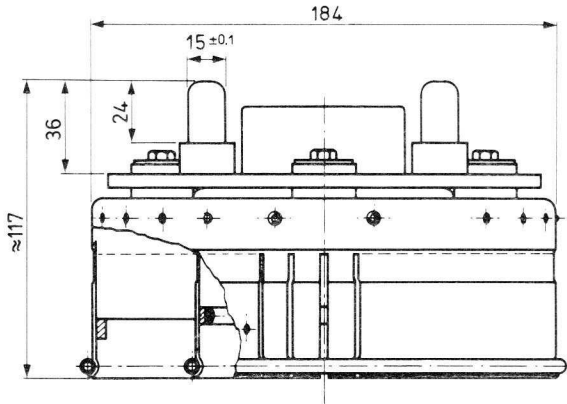


## INSULATING PEDESTAL



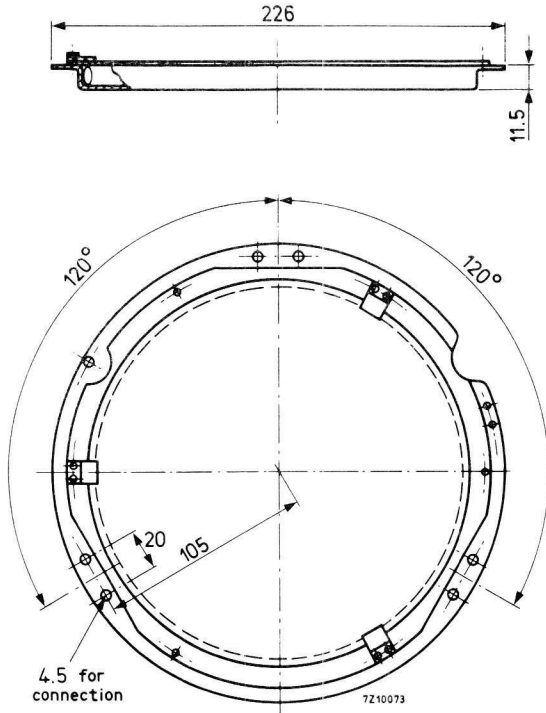
Net weight: approx. 8.2 kg

FILAMENT CONNECTOR



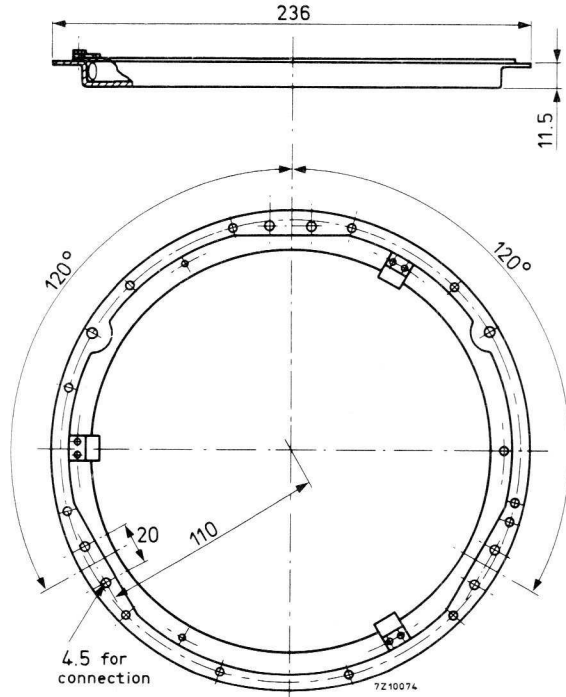
Net weight: approx. 2.5 kg

## GRID CONNECTOR



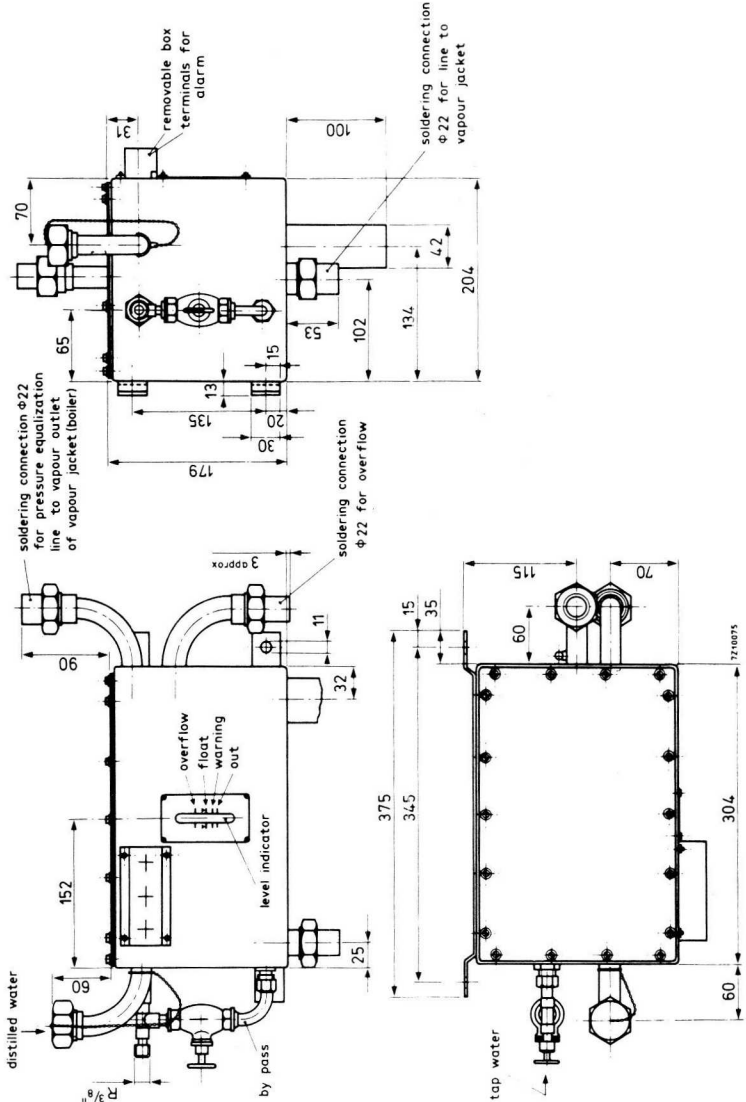
Net weight: approx. 0.35 kg

# SCREEN GRID CONNECTOR



Net weight: approx. 0.4 kg

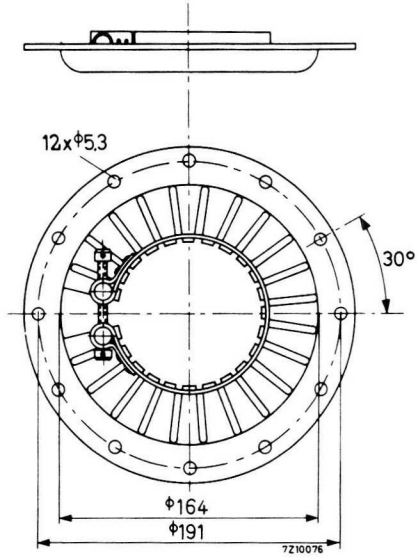
# WATER LEVEL CONTROL



Material: Copper  
 Net weight: approx. 8.5 kg

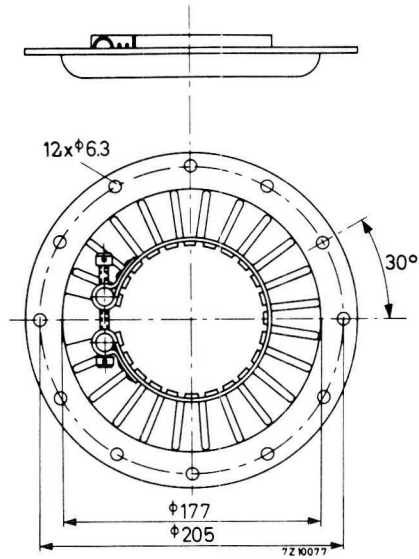
# GRID CONNECTOR

FOR 105 mm  $\phi$  TERMINALS



Material: brass, silver plated

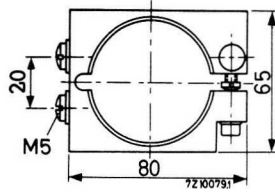
Net weight: 450 g

**GRID CONNECTOR**FOR 112 mm  $\phi$  TERMINALS

Material: brass, silver plated  
Net weight: 525 g

# GRID OR FILAMENT CONNECTOR

FOR 50 mm  $\phi$  TERMINALS

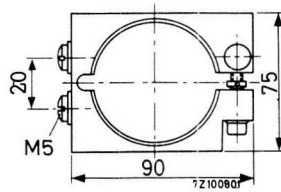


Material: brass, nickel plated



## SCREEN GRID CONNECTOR

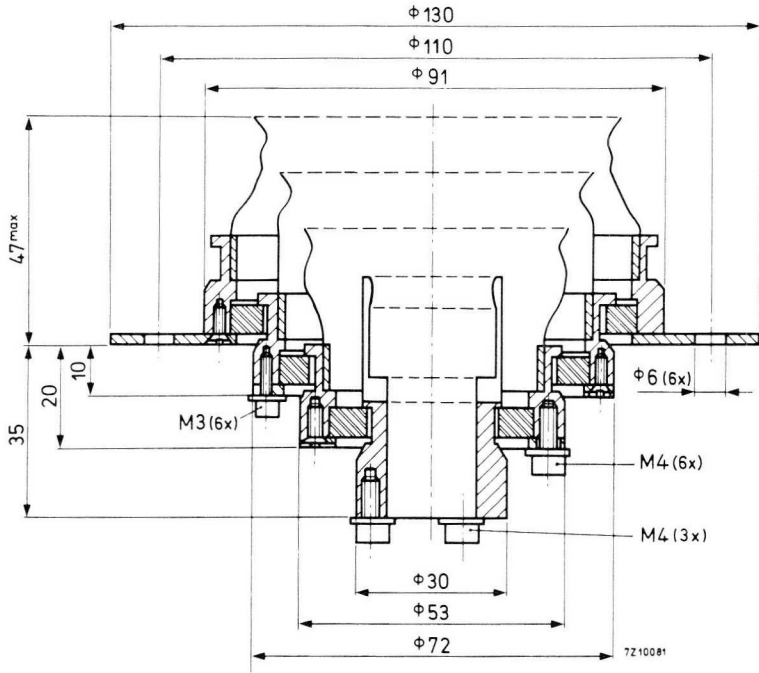
FOR 70.1 mm  $\phi$  TERMINALS



Material: brass, nickel plated

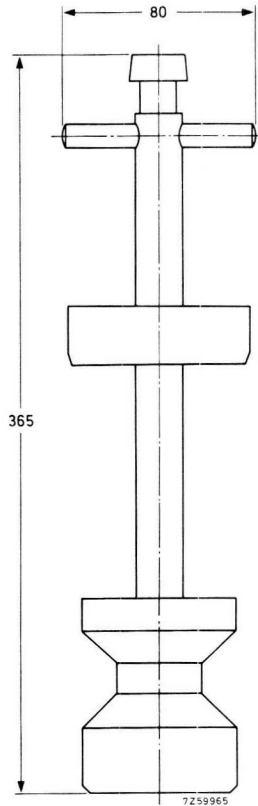


## SOCKET



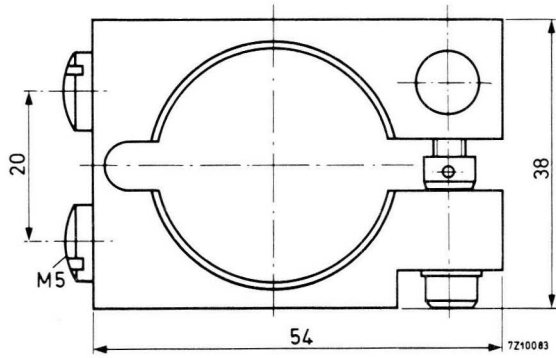
Material: brass and polytetra fluoroethylene

# TUBE EXTRACTOR

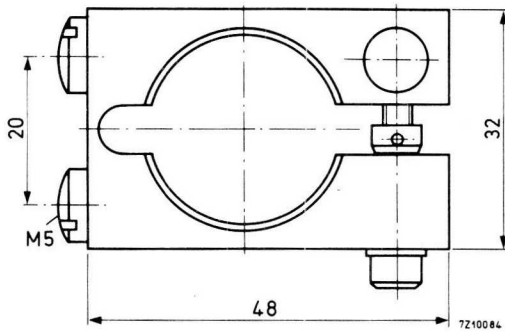


# GRID CONNECTOR

FOR 33.5 mm  $\phi$  TERMINALS



Material: brass

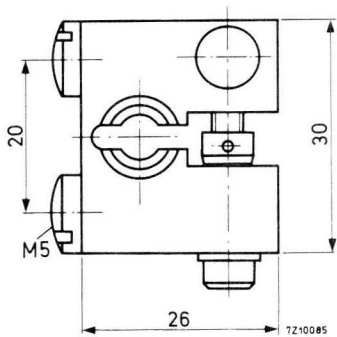
**FILAMENT/CATHODE CONNECTOR**FOR 27 mm  $\phi$  TERMINALS

Material: brass



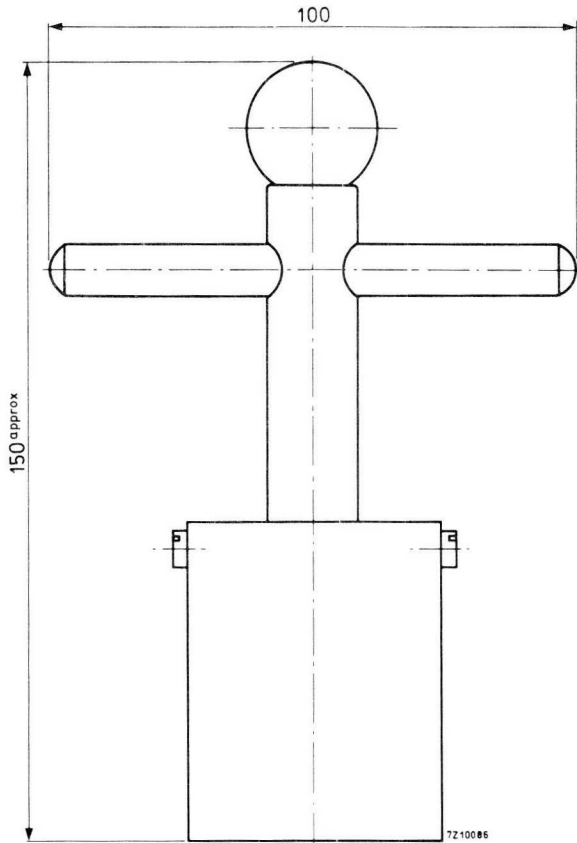
# GRID OR FILAMENT CONNECTOR

FOR 9 mm  $\phi$  TERMINALS



Material: brass

# TUBE EXTRACTOR







## INDEX OF TYPENUMBERS

Type No.	Section	Type No.	Section
K503	Acc.	TBH7/8000	Tr. T.
K504	Acc.	TBH7/9000	Tr. T.
K506	Acc.	TBH12/25	Tr. T.
K508	Acc.	TBH12/38	Tr. T.
K509	Acc.	TBL2/300	Tr. T.
K713	Acc.	TBL2/400	Tr. T.
K714	Acc.	TBL2/500	Tr. T.
K715	Acc.	TBL6/14	Tr. T.
K717	Acc.	TBL6/20	Tr. T.
K720	Acc.	TBL6/4000	Tr. T.
K721	Acc.	TBL6/6000	Tr. T.
K722	Acc.	TBL7/8000	Tr. T.
K723	Acc.	TBL7/9000	Tr. T.
K724	Acc.	TBL12/25	Tr. T.
K726	Acc.	TBL12/38	Tr. T.
K727	Acc.	TBL12/40	Tr. T.
K728	Acc.	TBL12/100	Tr. T.
K729	Acc.	TBL15/125	Tr. T.
K732	Acc.	TBW6/14	Tr. T.
K733	Acc.	TBW6/6000	Tr. T.
K734	Acc.	TBW7/8000	Tr. T.
K735	Acc.	TBW7/9000	Tr. T.
TAL12/10	Tr. T.	TBW12/25	Tr. T.
TAL12/20	Tr. T.	TBW12/38	Tr. T.
TAL12/35	Tr. T.	TBW12/100	Tr. T.
TAW12/10	Tr. T.	TBW15/125	Tr. T.
TAW12/20	Tr. T.	YD1000	Tr. T.
TAW12/35G	Tr. T.	YD1001	Tr. T.
TB2. 5/300	Tr. T.	YD1002	Tr. T.
TB2. 5/400	Tr. T.	YD1010	Tr. T.
TB3/750	Tr. T.	YD1012	Tr. T.
TB4/1250	Tr. T.	YD1120	Tr. T.
TB4/1500	Tr. T.	YD1130	Tr. T.
TB5/2500	Tr. T.	YD1140	Tr. T.
TBH6/14	Tr. T.	YD1141	Tr. T.
TBH6/6000	Tr. T.		

Acc. = Accessories

Tr. T. = Transmitting tubes, Triodes

Type No.	Section	Type No.	Section
YD1150	Tr. T.	7753	See TBL6/4000
YD1151	Tr. T.	7804	See TBL6/14
YD1152	Tr. T.	7805	See TBW6/14
YD1160	Tr. T.	7806	See TBL12/38
YD1161	Tr. T.	7807	See TBW12/38
YD1162	Tr. T.	7986	See TB2.5/400
YD1170	Tr. T.	8078	See TB4/1500
YD1171	Tr. T.	8119	See TBL2/400
YD1172	Tr. T.	8120	See TBL2/500
YD1173	Tr. T.	8163	See YD1130
YD1180	Tr. T.	8268	See TBW7/9000
YD1182	Tr. T.	8269	See TBL7/9000
YD1190	Tr. T.	8591	See TBH6/14
YD1192	Tr. T.	8592	See TBH7/8000
YD1193	Tr. T.	8593	See TBH7/9000
YD1202	Tr. T.	8594	See TBH12/38
YD1203	Tr. T.	8610	See TBH6/6000
YD1212	Tr. T.	8666	See YD1170
YD1213	Tr. T.	8667	See YD1171
YD1240	Tr. T.	8668	See YD1172
YD1300	Tr. T	8680	See YD1212
YD1301	Tr. T	8728	See YD1150
YD1330	Tr. T	8729	See YD1151
YD1332	Tr. T	8730	See YD1152
YD1333	Tr. T	8731	See YD1160
YD1342	Tr. T	8732	See YD1161
YD1352S	Tr. T	8733	See YD1162
5866	See TB2.5/300	8734	See YD1173
5867	See TB3/750	8735	See YD1182
5868	See TB4/1250	8736	See YD1192
5923	See TBW6/6000	8752	See YD1202
5924	See TBL6/6000	8801	See YD1180
6077	See TBW12/100	8867	See YD1352S
6078	See TBL12/100	40210/02	Acc.
6617	See TBW12/25	40615	Acc.
6618	See TBL12/25		
6960	See TBW7/8000		
6961	See TBL7/8000		
7004	See TBL2/300		
7092	See TB5/2500		

Acc. = Accessories

Tr. T. = Transmitting tubes, Triodes

Type No.	Section
40619	Acc.
40622	Acc.
40623	Acc.
40624	Acc.
40626	Acc.
40628	Acc.
40630	Acc.
40634	Acc.
40635	Acc.
40648	Acc.
40649	Acc.
40650	Acc.
40651	Acc.
40652	Acc.
40653	Acc.
40654	Acc.
40662	Acc.
40663	Acc.
40664	Acc.
40665	Acc.
40666	Acc.
40667	Acc.
40670	Acc.
40671	Acc.
40672	Acc.
40675	Acc.
40679	Acc.
40680	Acc.
40681	Acc.
40682	Acc.
40683	Acc.
40685	Acc.
40686	Acc.
40687	Acc.
40688	Acc.

Type No.	Section
40689	Acc.
40690	Acc.
40691	Acc.
40692	Acc.
40693	Acc.
40694	Acc.
40695	Acc.
40696	Acc.
40699	Acc.
40704	Acc.
40705	Acc.
40706	Acc.
40707	Acc.
40708	Acc.
40709	Acc.
40710	Acc.
40711	Acc.
40712	Acc.
40715	Acc.
40716	Acc.
40717	Acc.
40718	Acc.
40719	Acc.
40720	Acc.
40721	Acc.
40722	Acc.
40723	Acc.
40724	Acc.
40727	Acc.
40728	Acc.
40729	Acc.
40732	Acc.
40733	Acc.
40734	Acc.
40735	Acc.

Acc. = Accessories

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Type No.	Section
40736	Acc.
40737	Acc.
40740	Acc.
40741	Acc.
40742	Acc.
40750	Acc.
40751	Acc.
40752	Acc.
40753	Acc.
40754	Acc.

Type No.	Section
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Acc. = Accessories









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General section

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Transmitting tubes for communication  
and Tubes for R.F. heating

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TRIODES

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Associated accessories

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