

U.H.F. POWER KLYSTRONS

Power amplifier klystrons in metal-ceramic construction for the frequency band 470 MHz to 860 MHz designed for four external resonant cavities, beam focusing by means of permanent magnets, continuously operating getter-ion pump and operation with a depressed collector potential. These klystrons are intended for use as u.h.f. power amplifier in vision and/or sound transmitters for the TV bands IV and V.

QUICK REFERENCE DATA

Frequency range	470 to 860 MHz
Power output	11 kW
Power gain	30 dB
Cooling	
YK1001: air-cooled drift tubes and air-cooled collector	
YK1002: air-cooled drift tubes and water-cooled collector	

This data must be read in conjunction with GENERAL OPERATIONAL RECOMMENDATIONS for KLYSTRONS.

HEATING: indirect by a.c. or d.c.

Cathode	dispenser type
Heater voltage	V_f 7.5 to 8.0 V

During operation the applied heater voltage should not fluctuate more than $\pm 3\%$. It is advised to operate the klystron at 8 to 8.5 V (including mains fluctuations) during the first 300 hours. The heater voltage should then be reduced to 7.5 to 8.0 V.

Heater current	I_f 32 (< 36) A
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The heater current should never exceed a peak value of 80 A when applying an a.c. heater voltage or 65 A when applying a d.c. heater voltage.

Cold heater resistance	R_{fo} 28 m Ω
Waiting time	t_w min. 180 s

GETTER-ION PUMP POWER SUPPLY

Pump voltage, unloaded (cathode reference)	4.0 kV
Internal resistance	approx. 300 k Ω

MECHANICAL DATA

Dimensions in mm

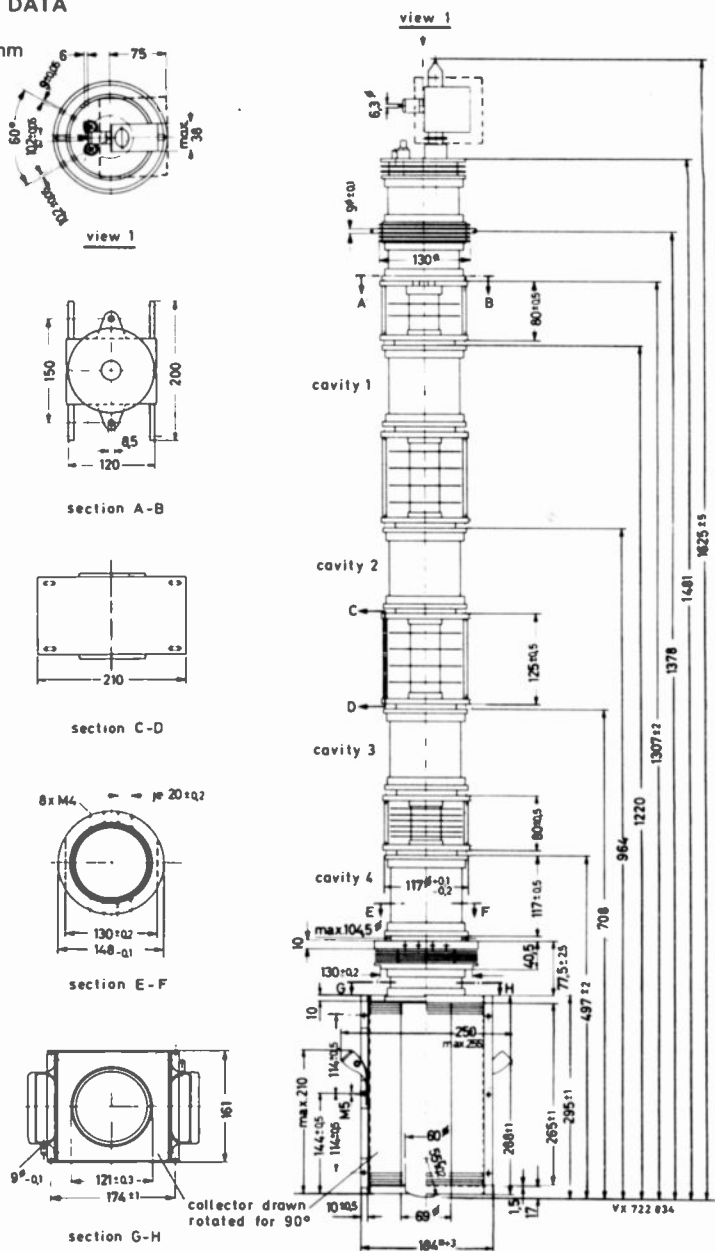


Fig. 1.

MECHANICAL DATA

Dimensions in mm

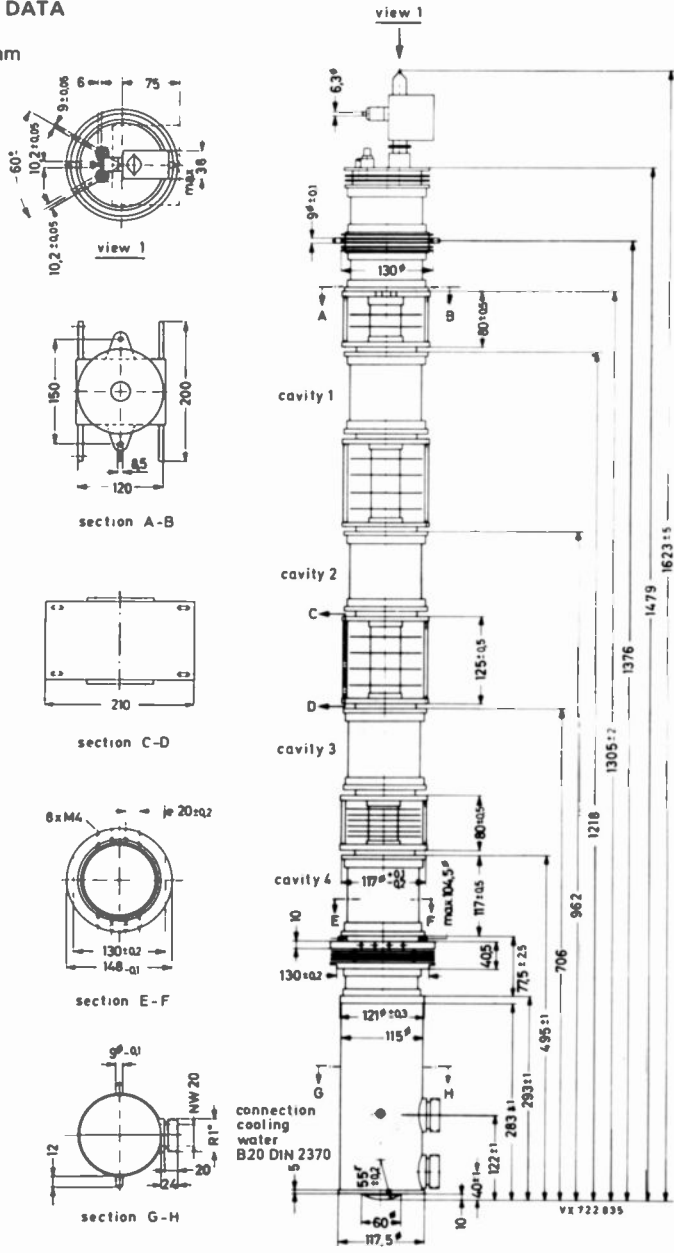


Fig. 2.

MECHANICAL DATA (continued)

Dimensions in mm

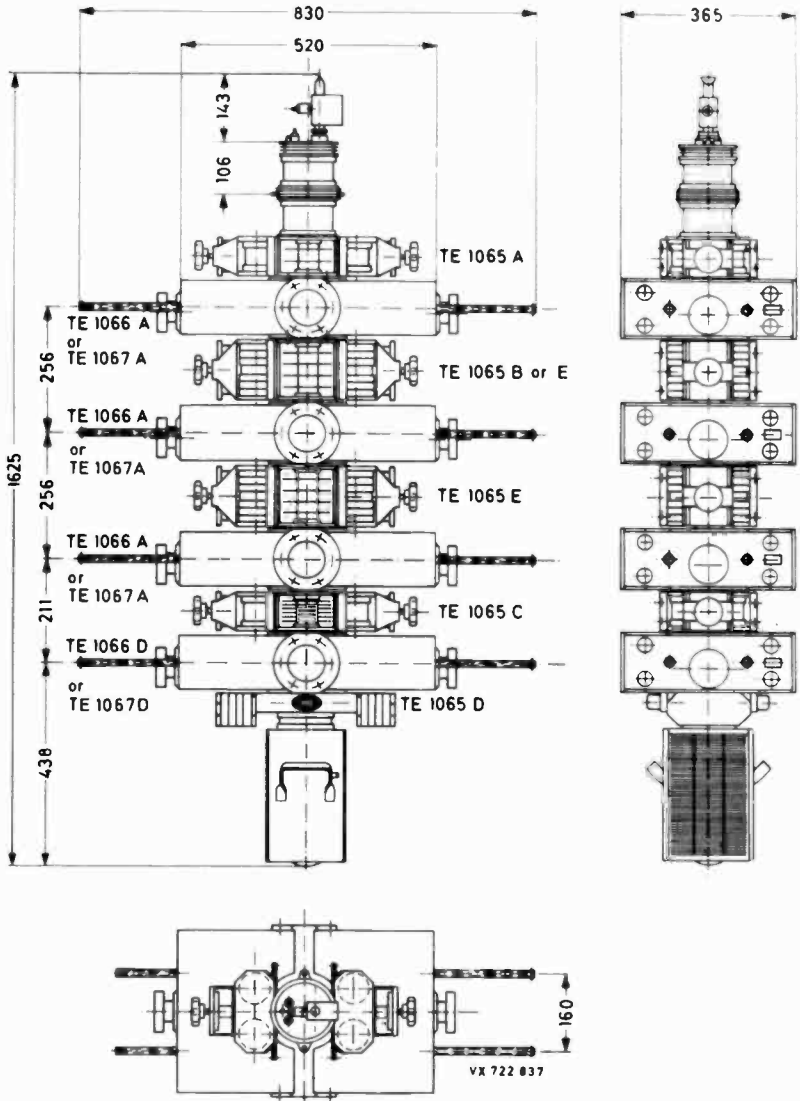


Fig. 3.

COOLING

Except collector, applicable up to an air-inlet temperature T_i of 40 °C and an altitude of 2500 m (values refer to air inlet).

Cathode base	air, $q = \text{approx. } 0.5 \text{ m}^3/\text{min}$
Accelerating electrode	air, $q = \text{approx. } 0.5 \text{ m}^3/\text{min}$
Drift tubes 1, 2 and 3	air, $q = \text{approx. } 1.0 \text{ m}^3/\text{min}$ each
Drift tube 4	air, $q = \text{approx. } 1.5 \text{ m}^3/\text{min}$
Drift tube 5	forced air, $q = \text{approx. } 1.5 \text{ m}^3/\text{min}$ ($\Delta p = 900 \text{ Pa} = 9 \text{ mbar}$)
Cavity TE1066D or TE1067D	forced air, $q = \text{approx. } 2.0 \text{ m}^3/\text{min}$ ($\Delta p = 900 \text{ Pa} = 9 \text{ mbar}$)
Collector YK1001	forced air, see cooling curves Figs 5, 6 and 7
Collector YK1002	water, see cooling curves Figs 9 and 10

MOUNTING

Vertical, cathode up. In order to prevent distortion of the magnetic focusing field ferromagnetic material should not be used within a radius of 35 cm from the tube axis. All connections should be free from strain.

MASS (net)

YK1001	approx. 55 kg
YK1002	approx. 45 kg
Total mass of accessories	approx. 125 kg

PRODUCT SAFETY*1. X-radiation*

Correct operation of the tube can be guaranteed only if a set of accessories, approved by the tube manufacturer, is used.

The operating tube generates X-rays which can penetrate the ceramic parts of the tube envelope. In order to reduce the radiation at any accessible points to an officially acceptable, non-dangerous level the tube must be shielded and any possible radiation path blocked by at least 1 mm of brass or an equivalent depth of non-magnetic X-ray absorbing material. The proper use of accessories will provide the necessary shielding.

2. R.F. radiation

R.F. power may be emitted through apertures other than the normal output coupling (for example r.f. leaks). This r.f. power may be sufficiently intense to cause danger to the human body, particularly to the eyes. Such radiation may be increased if the tube is functioning incorrectly.

ACCESSORIES

Heater connector	type 40649
Heater/cathode connector	type 40649
Focusing electrode connector	type 40634
Accelerating electrode connector	type 40634
Collector connector	type 40634
Getter ion pump connector	type 55351
Magnet unit for ion pump	type TE1053
Set of five pairs of focusing magnets	type TE1065 (2xA, 2xB, 2xC, 2xD, 2xE)*
Set of four cavities for 470 MHz to 790 MHz	type TE1066 (3xA, 1xD)
or	
Set of four cavities for 700 MHz to 860 MHz	type TE1067 (3xA, 1xD)
2 magnet field adaptor plates for collector (YK1001 only)**	type TE1073
Recommended circulators (optional)	
470 to 600 MHz	2722 162 01551 (T100/IV-N)
600 to 800 MHz	2722 162 01561 (T100/V-N)
790 to 1000 MHz	2722 162 03261 (T100/V-3-N)

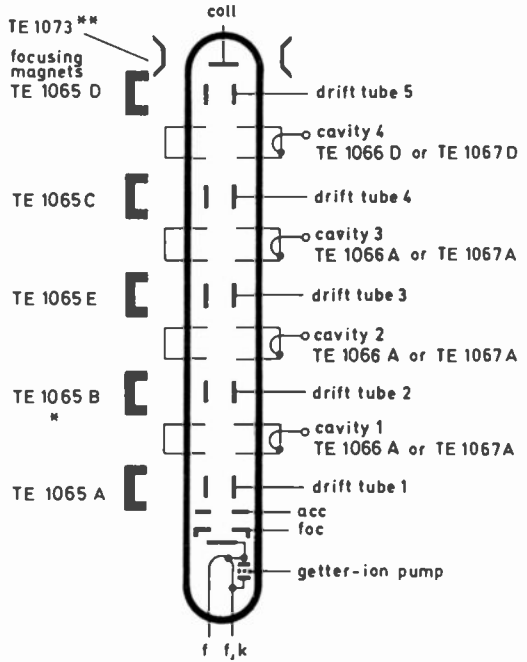


Fig. 4.

- * If the klystron is used under TV transposer conditions replace 2xB by 2xE.
- ** Operation for vision and sound transmitter without depressed collector voltage.

LIMITING VALUES (Absolute maximum rating system)

Heater voltage	max.	8.5	V
Cathode voltage	max.	-22	kV
Cathode voltage at zero current	max.	-25	kV
Depressed collector voltage	max.	7	kV
	min.	0.5	kV
Cathode current	max.	2.3	A
Accelerating electrode voltage	max.	-25	kV
Series resistance in accelerating electrode circuit	max.	20	k Ω
	min.	10	k Ω
Negative focusing electrode voltage*	max.	700	V
	min.	100	V
Drift tube current**			
Collector dissipation	max.	40	kW
Load VSWR	max.	1.5	(14 dB)
Pump voltage	max.	4.5	kV
Pump current (see Fig. 8.)	max.	15	mA
Temperature of			
cathode base and accelerating electrode	max.	125	$^{\circ}$ C
drift tubes 1, 2 and 3	max.	80	$^{\circ}$ C
drift tubes 4 and 5	max.	150	$^{\circ}$ C
resonator 4	max.	125	$^{\circ}$ C
collector seal YK1001	max.	200	$^{\circ}$ C
Collector body YK1001 [▲]	max.	300	$^{\circ}$ C
outlet cooling water YK1002	max.	75	$^{\circ}$ C
inlet cooling air	max.	40	$^{\circ}$ C

* The power supply must be preloaded with min. 10 mA at 500 V.

* For limiting values of various operating conditions see next page and Fig. 11.

▲ In safeguard this temperature limit the air outlet temperature should be measured in at least two places; one 50 mm and one 150 mm from the upper collector plate and 50 mm from the cooling fins; the cooling data of collector are minimum values.

MAXIMUM VALUES of drift tube current

For vision transmitter without level dependent cut-out threshold

without depressed collector voltage	max.	80 mA
with depressed collector voltage	max.	130 mA

For vision transmitter with level dependent cut-out threshold

without depressed collector voltage for 0 to 7 kW output power, peak sync.	max.	40 mA
with depressed collector voltage for 0 to 7 kW output power, peak sync.	max.	60 mA
without depressed collector voltage for full output power	max.	100 mA
with depressed collector voltage for full output power	max.	200 mA

For vision and sound transmitter fed from the same power supply and without level dependent cut-out threshold

without depressed collector voltage	max.	100 mA
with depressed collector voltage	max.	160 mA

For vision and sound transmitter fed from the same power supply and with level dependent cut-out threshold

without depressed collector voltage for 0 to 7 kW output power, peak sync.	max.	60 mA
with depressed collector voltage for 0 to 7 kW output power, peak sync.	max.	80 mA
without depressed collector voltage for full output power	max.	120 mA
with depressed collector voltage for full output power	max.	250 mA

TYPICAL OPERATING CONDITIONS

As 11 kW vision transmitter (CCIR-G standard)
in the frequency range 470 MHz to 790 MHznotes
1, 2

	without depressed collector voltage	with depressed collector voltage		
Cathode voltage	-18.0	-13.5	kV	3
Depressed collector voltage	-0.5	-5.0	kV	
Accelerating electrode voltage	0	0	V	4
Neg. focusing voltage	≈ 400	400	V	5
Drift tube current, static	≈ 25	30	mA	
black level	≈ 40	80	mA	6
Cathode current	1.9	1.9	A	
Output power, peak sync.	11	11	kW	
Drive power see Fig. 12.				
Linearity without compensation	≈ 80	80	%	7
Sync. compression	∧ 45/25	45/25		8
V.S.B. suppression	∧ -20	-20	dB	9
Noise with reference to black level	∧ -46	-46	dB	10
Differential gain	≈ 5	5	deg	11

As 2.2 kW and 4.4 kW TV sound amplifier

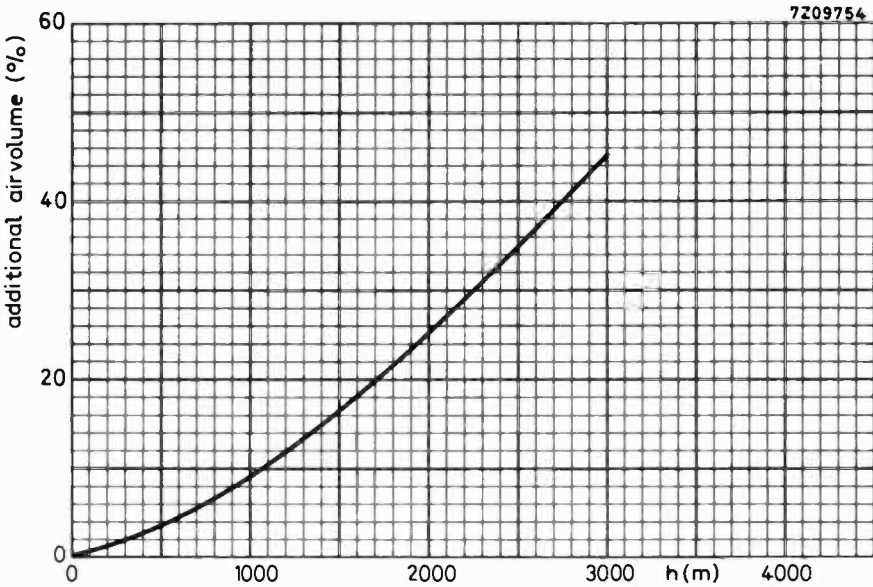
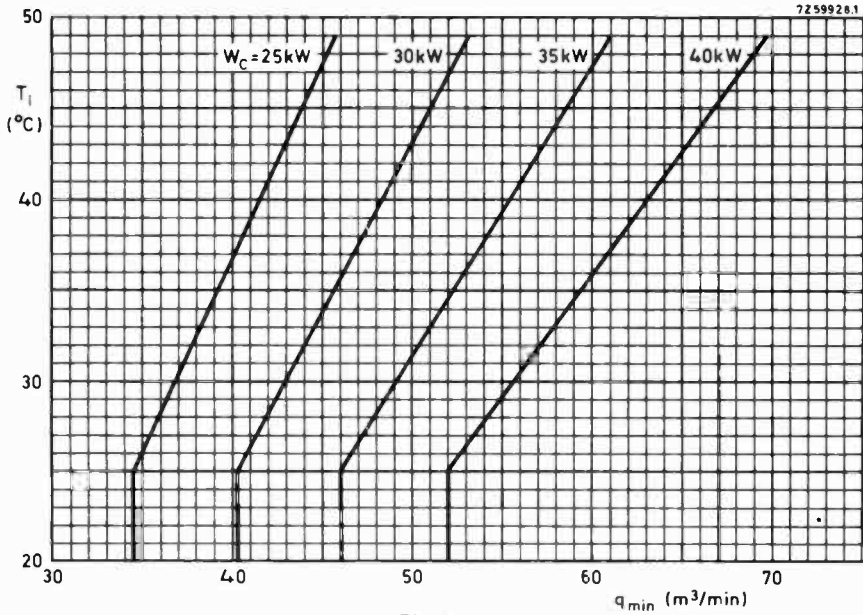
Cathode voltage	-18.0	-18.0	-13.5	-13.5	kV	3
Depressed collector voltage	-0.5	-0.5	-5.0	-5.0	kV	
Accelerating electrode voltage	-7.5	-5.5	-7.5	-5.5	kV	4
Neg. focusing voltage	≈ 400	400	400	400	V	5
Drift tube current	≈ 40	50	50	70	mA	6
Cathode current	0.7	1.0	0.7	1.0	A	
Output power	2.2	4.4	2.2	4.4	kW	
Drive power	∧ 0.5	0.5	0.5	0.5	W	

As 2.1 kW amplifier for television
transposer service

Cathode voltage			-15		kV	3
Depressed collector voltage			5.0		kV	
Neg. focusing voltage	≈		400		V	5
Drift tube current	≈		60		mA	6
Cathode current			2.2		A	
Output power, peak sync.			2.1		kW	
Drive power see Fig. 12						
Intermodulation products	∧		-51		dB	12

Notes

1. With the appropriate focusing magnets TE1065, cavities TE1066 and a circulator between the driver and input cavity.
A precorrection of the level dependent frequency response up to 2 dB must be provided.
2. In case of failure the beam voltage must be switched off and made to drop below 5% of its nominal value within 500 ms of the failure.
3. Fluctuations of the beam voltage up to $\pm 3\%$ will not damage the tube; to meet the signal-transfer quality requirements the nominal beam voltage should not vary more than $\pm 1\%$.
4. It is recommended that this voltage be obtained from a voltage divider between cathode and ground, which should carry a quiescent current of minimum 3 mA.
5. The focusing electrode voltage should be adjustable from 100 V to 500 V; a setting range from 100 V to 700 V is recommended.
6. At black level, to be focused for minimum drift tube current. If necessary to obtain the required signal-transfer quality, a deviation of maximum 10% from this minimum current is permitted. The limiting value, see Fig. 11, must however, not be exceeded.
7. Measured with a sawtooth voltage with amplitude between 17 and 75% of the peak sync value, on which is superimposed a 4.43 MHz sinewave with a 10% peak-to-peak value.
8. Calculated from $(1 - V_{\text{black}}/V_{\text{sync}})_{\text{in}} / (1 - V_{\text{black}}/V_{\text{sync}})_{\text{out}}$.
9. Measured with 10 to 75% modulation without compensation; V.S.B. filter between driving stage and klystron.
10. Produced by the klystron itself; without hum from power supplies.
11. Without compensation.
12. Without compensation, see German Bundespost 176 Pfl 2 or ARD-Pflichtenheft 5/2. Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB with respect to peak sync = 0 dB).



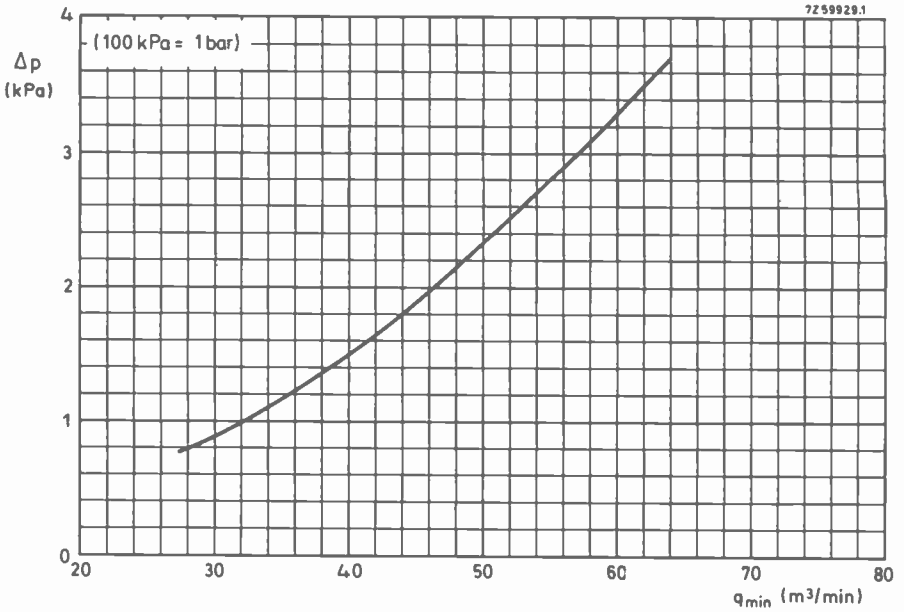


Fig. 7 Ratio of cooling air pressure to cooling air volume of YK1001.

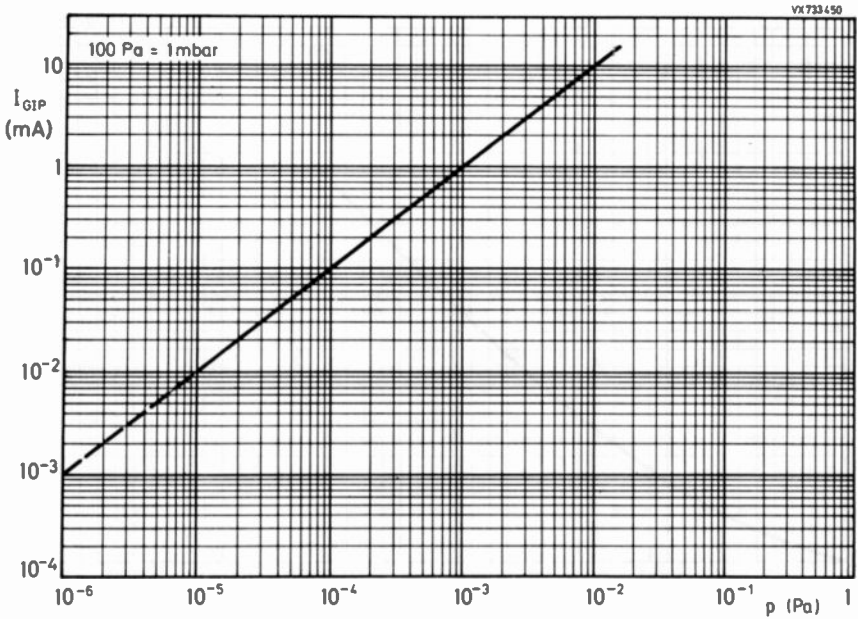


Fig. 8 Ratio of pump current to gas pressure in the klystron.

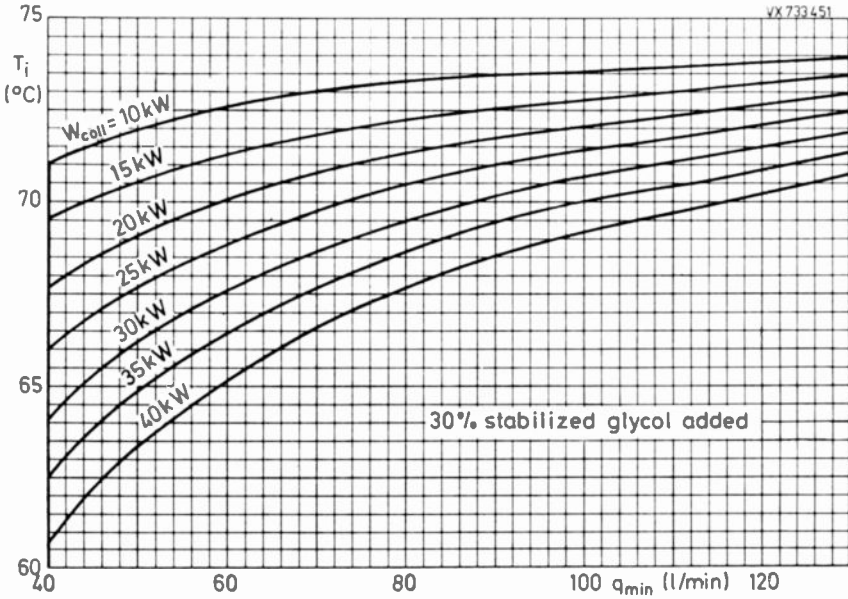


Fig. 9 Cooling curves for closed circuit cooling.

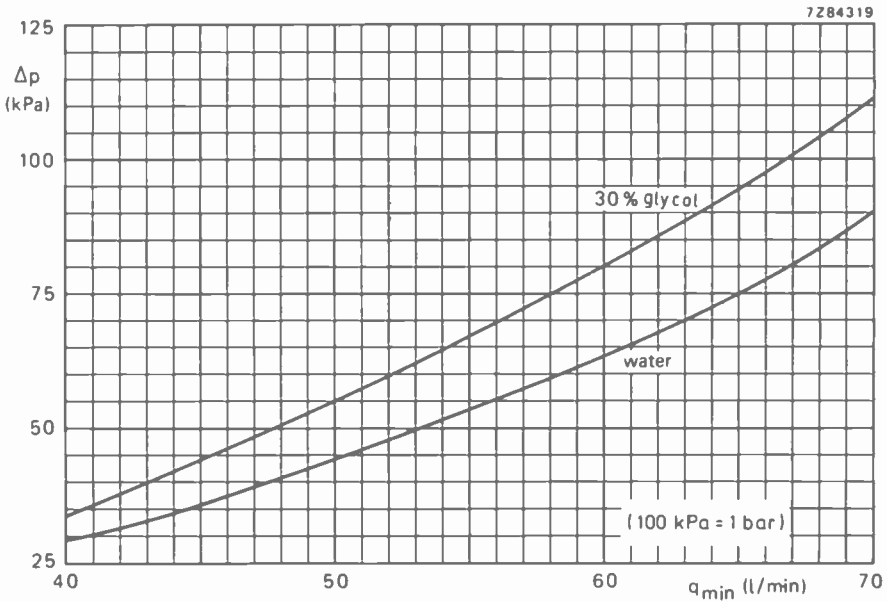


Fig. 10 Ratio of cooling water pressure to cooling water volume.

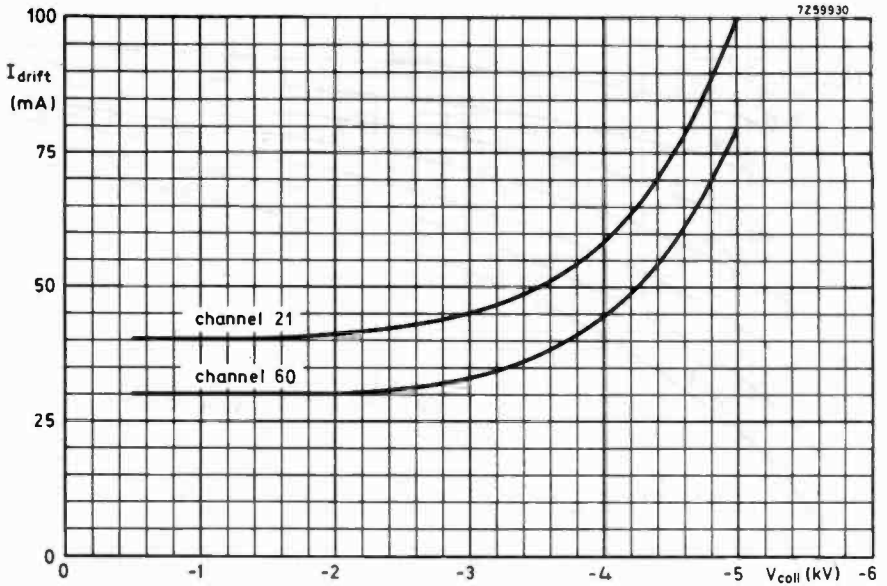


Fig. 11.

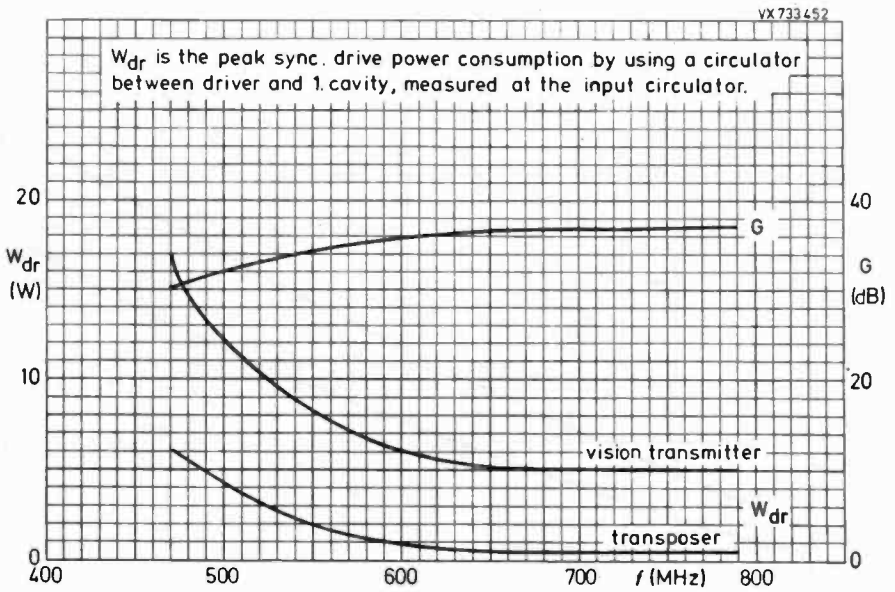


Fig. 12.