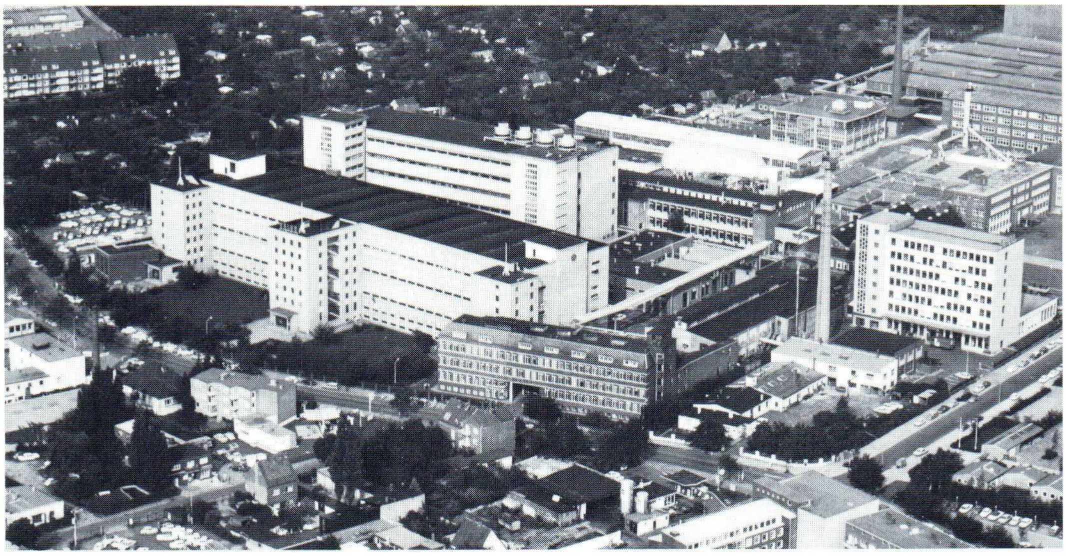
Klystrons
Microwave Sub-Assemblies
Power Tubes
Circulators

This brochure describes components and materials for television transmitters and related applications, including full details about our klystrons and news of the latest developments in microwave activity.

January 1973

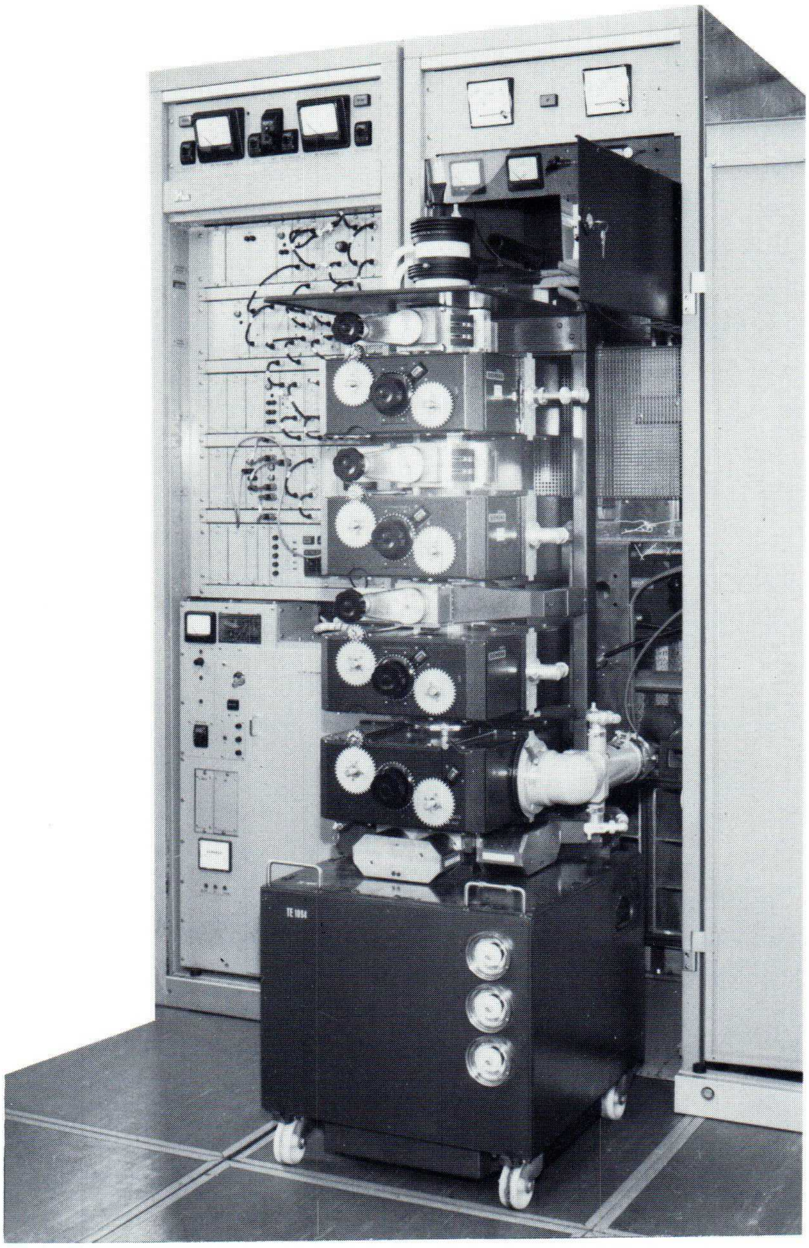
VALVO GmbH, Hamburg 1, Burchardstrasse 19



The VALVO GmbH plant in Hamburg-Lokstedt, which makes components and materials described in this brochure.

The VALVO electron tube and semi-conductor works in Hamburg-Lokstedt is one of the largest German producers of components and materials for the electronics industry. A member of the international Philips organisation, VALVO manufactures electron tubes, transistors and integrated circuits for a wide variety of applications. The total production area of the plant covers about 80000 m^2, and there are about 3500 employees.

Teams of highly specialised scientists and engineers are engaged in a continuous development programme in the fields of klystrons, microwave sub-assemblies, and power tubes to meet the needs of customers throughout the world. Basic research into special problems and choice of materials are carried out in modern well-equipped laboratories.



Klystron YK 1151 in a modern TV transmitter for the frequency bands IV and V.

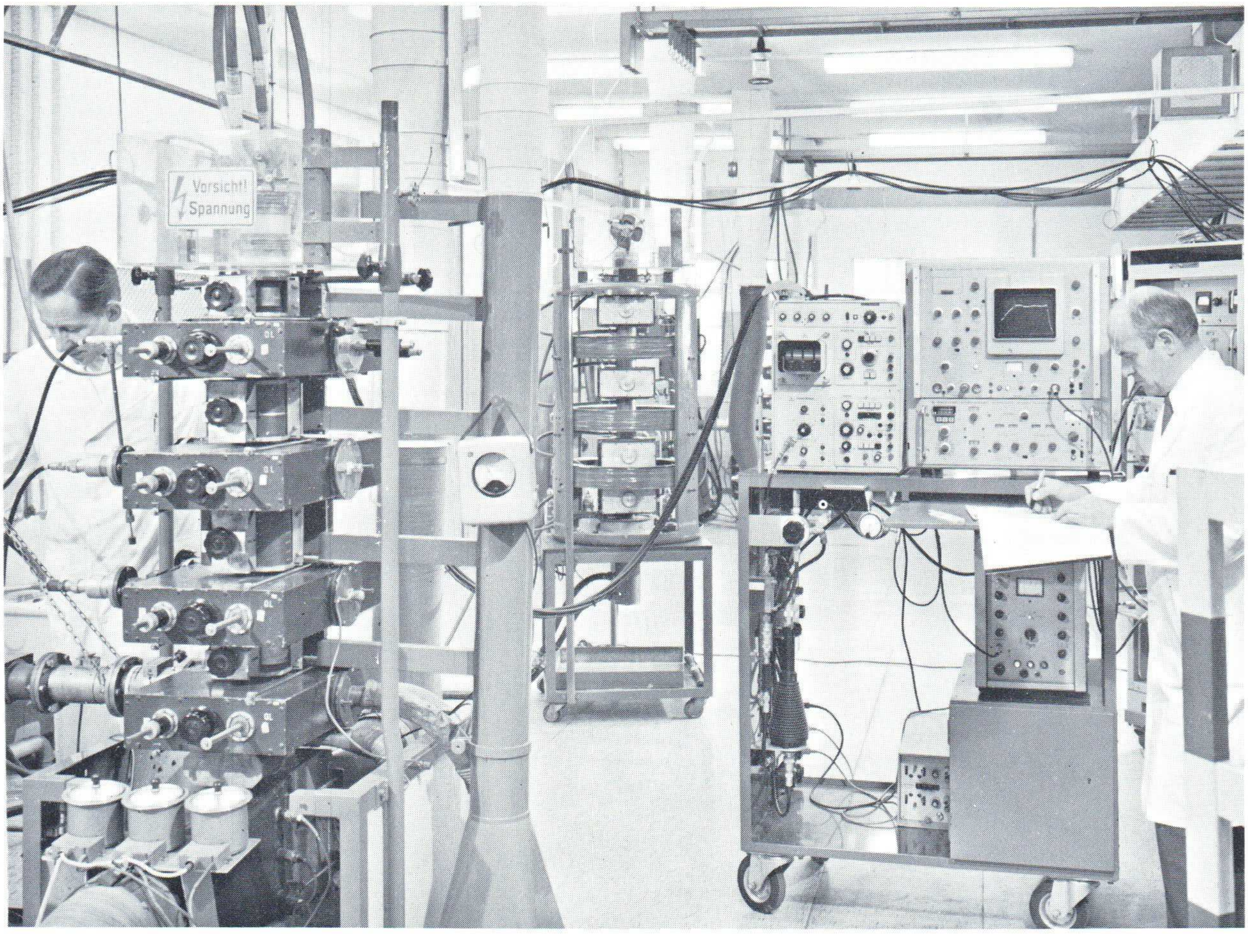
Some Aspects of the VALVO Klystrons

The early klystrons installed in the first German television transmitters of the fifties were imported and suffered from a number of disadvantages when used in television service, particularly their short working life.

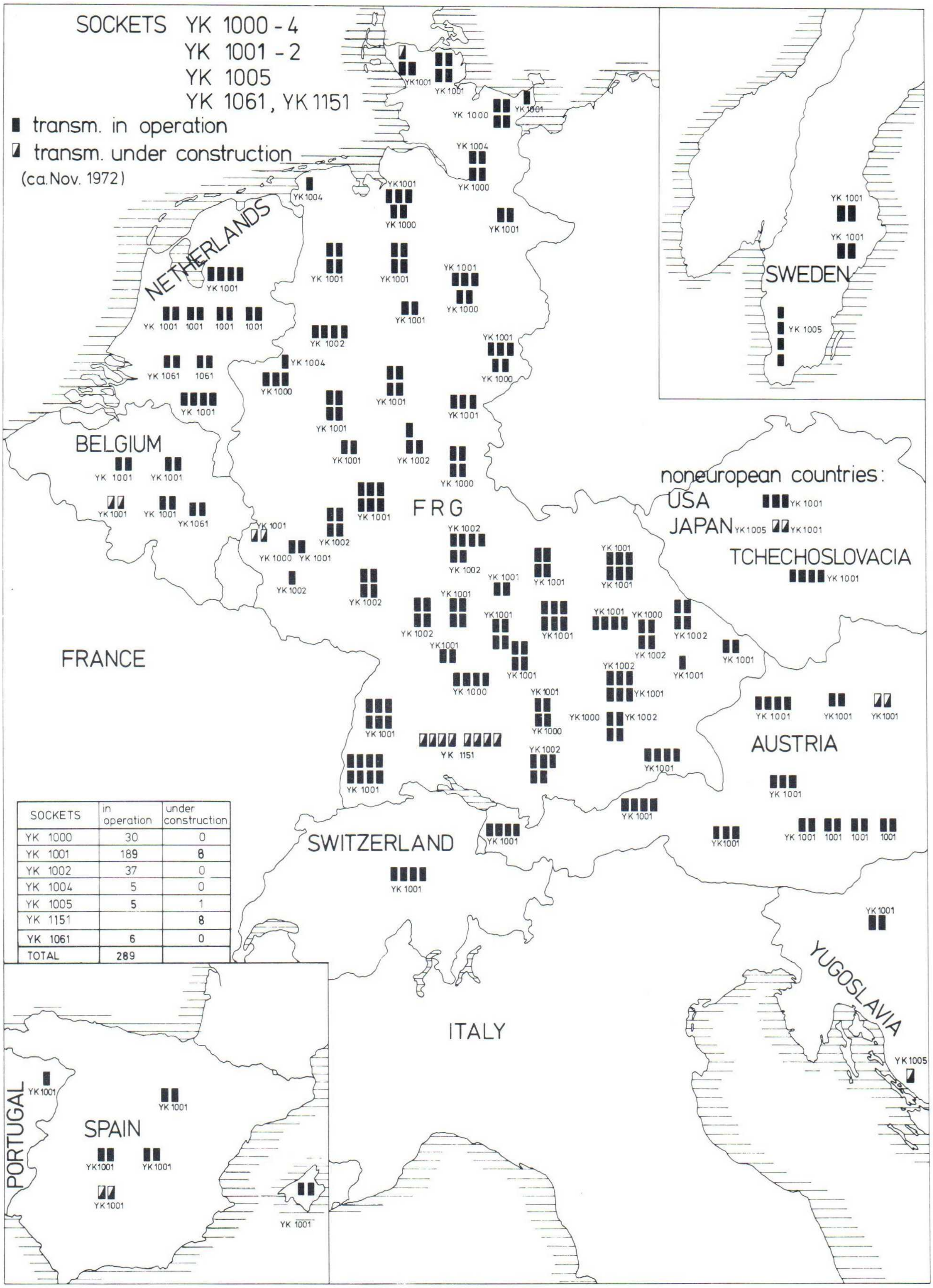
The first high power VALVO klystrons were a considerable improvement on the imported ones and offered the German customers greater life expectancy and higher performance.

Experience subsequently gained with these tubes, in close co-operation of both the set-makers and the German Federal Post Office, clearly demonstrated the need for further improvements. With the support of our customers and an enthusiastic team of scientists and engineers, we succeeded in developing and manufacturing new generations of high power klystrons specifically designed to meet the requirements of television transmitter operation. Features are long life, stability and higher power combined with long periods of service-free operation.

The success of our efforts is proved by our strong market position — clearly demonstrated by the map showing where VALVO TV klystrons are used.



A television klystron being carefully checked in the test department at our tube and semiconductor works (VALVO-RHW) in Hamburg. The test equipment includes a complete transmitter.



SOCKETS	in operation	under construction
YK 1000	30	0
YK 1001	189	8
YK 1002	37	0
YK 1004	5	0
YK 1005	5	1
YK 1151		8
YK 1061	6	0
TOTAL	289	

The map shows the location of klystrons installations.

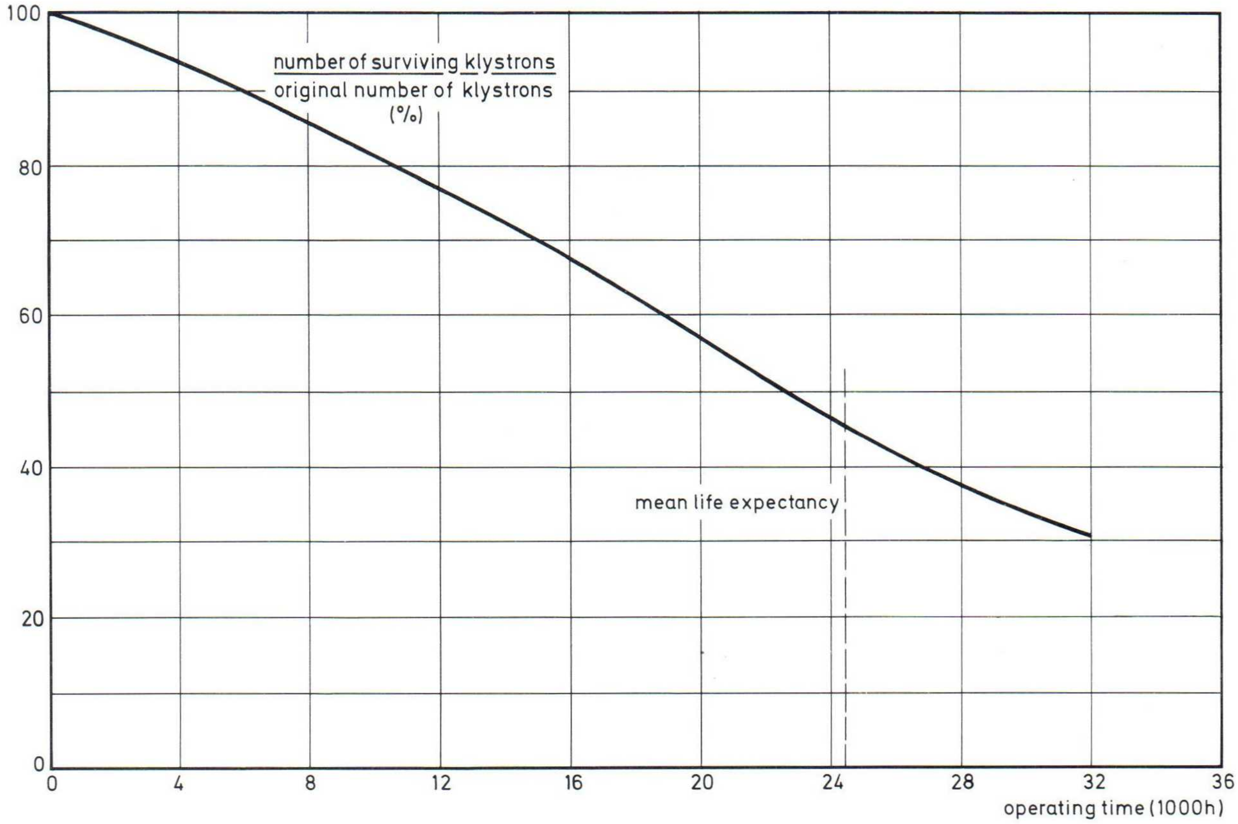
Life Expectancy of the 10 kW UHF Klystrons YK 1000/4 and YK 1001/2

VALVO gratefully acknowledges the information received from users of UHF klystrons, such as the German Federal Post Office, whose periodic reports have enabled an analysis of performance and life expectancy to be made.

So far, over 3 millions hours of operating time have been thoroughly analysed and a mean life expectancy of more than 20000 hours for the 10 kW klystrons YK 1000/4 and YK 1001/2 is clearly indicated by the graph below.

The slope of the curve is smooth and shows that there is no abrupt limitation to life expectancy.

The life of the dispenser cathode under operating conditions is up to 40000 hours.



Percentage of surviving tubes as a function of operating time.

VALVO

Brennstundenberichte und Garantieunterlagen für Hochleistungsklystrons im UHF-Bereich

~~31. März/~~
30. Sept.

Absender: Fernmeldeamt
FuÜ
83 Landshut
Postplatz 395
F: 0871 / 85 521
(Telefon-Vorwahl/-R

An die
VALVO GmbH
Röhren- und Halbleiterwerk
Qualitätslabor Prof. Röhre

2000 Hamburg 54
Stresemannallee 101

Brennstundenbericht für Hochlei

Röhrentyp: YK 1001

Röhren-Nr.: 9120301

Röhre eingesetzt am: 26.11.1970
Sender: Landshut, Fernsehsender Bereich IV 210,2 kW
Brennplatz: BTE Sender 1
Senderfabrikat: Rohde und Schwarz
Kanal: 39

Betriebsstunden-Zählerstand: 9746
Brennstunden seit letztem Bericht: 563
Gesamt-Brennstunden: 9746
abgelesen am: 4.10.72

Periodic report-lists for UHF high power klystrons.
1st page of a YK 1101 report (as an example)

Technical Data of UHF Power Klystrons

Applications

The tubes are intended for use as UHF power amplifiers in the final stages of band IV and band V television transmitters and transposers. Most types can be operated with a depressed collector potential.

Construction

VALVO UHF power klystrons are of metal-ceramic construction. Four external cavities are employed and beam focusing is done either by periodic permanent magnets (PPM) or, for the types YK 1000, YK 1004 and YK 1190, YK 1191, by electromagnets.

Cathode and Heating

VALVO UHF power klystrons have tungsten cathodes of the dispenser type which should be indirectly heated by a d. c. voltage. The cathodes have been designed to maintain constant emission throughout their life.

The special properties of the beam-forming system ensures maintenance-free operation for at least 6 months.

The required heater voltage is 7.5 V, and the heater current is about 32 A. During the first 300 hours of operation, the heater voltage should be 8.0 V. Heater voltage variation should be limited to ± 3%. The heating time required before application of the h. t. is at least 3 minutes.

Getter Ion Pump Power Supply

The tubes contain a continuously-operating getter ion pump. The pump voltage under unloaded conditions should be 4.0 kV with an absolute max. of 4.5 kV. The internal resistance of the power supply source must be about 300 kΩ.

The pump current is an indication of the pressure inside the tube. The magnet unit TE 1053 and the connector 55351 for the ion pump are supplied separately.

Operating Conditions

The operating conditions given in the following table are in accordance with the C. C. I. R. system. The first line or group of lines for each type gives operating conditions as vision amplifier, a second group as sound amplifier and a third line as common vision and sound amplifier marked by V, S and V + S.

Operating Conditions (continued)

Under these conditions, and operating as a vision amplifier, each tube shows the following characteristics:

differential gain of about 80 % measured with a sawtooth voltage with an amplitude between 17 and 65 % of the peak sync value, on which is superimposed a 4.43 MHz sine wave with a 10 % peak-to-peak value,

sync compression of max. 45/25, i. e. a picture/sync ratio of 75/25, for the outgoing signal requires a ratio of max. 55/45 for the incoming signal,

V. S. B. suppression allows V. S. B. filtering before the klystron input,

noise distance with reference to black level is better than – 46 dB produced by the klystron itself, without hum from power supplies.

Mounting

Normally a klystron should be mounted with its cathode at the top, except for the specially designed vapour cooled type YK 1190/YK 1191 which has to be mounted with its cathode at the botton.

To prevent distortion of the magnetic focusing field, ferromagnetic material should not be used within a radius of 350 mm from the tube axis.

All connections should be free of strain.

Operating Conditions

No. of operating condition	Cathode to collector voltage kV	Collector voltage kV	Accelerating electrode voltage kV	typ. negative focusing electrode voltage V	Cathode current A	Application V=vision, S=sound	Driving power (sync level) W	Frequency range MHz	Output power (sync level) kW	Type (collector cooling)
1	19	0		300	1.9	V	<15	400–620	11	YK 1000 (water)
2	14.5	4.0	0	400	2.6	V	<2	590–680	11	
2	18	0.5	0	400	1.9	V	<17	470–790 (860)	11	YK 1001 (air)
2	13.5	5.0								
3	14.5	4.0	7.5	400	0.7	S	<0.5	590–680	2.2	YK 1002 (water)
3	18	0.5	7.5	400	0.7	S	<0.5	470–790 (860)	2.2	
4			5.5		1.0				4.4	
3	13.5	5.0	7.5	400	0.7		<0.5	470–790 (860)	2.2	YK 1003 (vapour)
4			5.5		1.0				4.4	
5	15	5.0	0	400	2.2	V+S	<6	470–790	2.1	
1	19	0		300	1.9	V	<15	610–790	11	YK 1004 (water)
6	14	4	≈0	300	2.1	V	≈2.5	470–550	11	YK 1005 (air)
6	16	4	≈2.5	300	1.95		≈2.0	551–741		
6	17	5	≈4.5	300	1.8		≈2.0	742–860		
7	14	4		100...600	0.6	S	≈0.5	470–550	1.1	
8					0.8				2.2	
7	16	4		100...600	0.6		≈0.5	551–741	1.1	
8					0.8				2.2	
7	17	5		100...600	0.6		≈0.5	742–860	1.1	
8					0.8				2.2	
9	13	5	0	300	2.1	V+S	0.3	470–550	1.05	
9	15	5	2.5	300	2.0		0.3	551–741		
9	17	5	4.5	300	1.8		0.3	742–860		

Operating Conditions

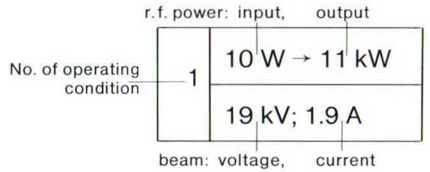
No. of operating condition	Cathode to collector voltage kV	Collector voltage kV	Accelerating electrode voltage kV	typ. negative focusing electrode voltage V	Cathode current A	Application V=vision, S=sound	Driving power (sync level) W	Frequency range MHz	Output power (sync level) kW	Type (collector cooling)
10	16.5	4	≈0	≈300	3.6	V	≦2.5	470–637	22 (25)	YK 1151 (air)
10	17.5		≈1.0		3.6					
10	20.0		≈6.0		3.0					
10	20	4	≈6.0	≈300	3.0		≦1.7	638–790	22 (25)	
10	20	4.5	≈6.0	≈300	3.1		≦1.7	790–860	22 (25)	
11	16.5	4	12.5	100...600	0.9	S	≦0.5	470–637	4.4	
12			14.5		0.6				2.2	
11	20	4	16.5	100...600	0.8		≦0.5	470–637	4.4	
12			18.5		0.5				2.2	
11	20	4	16.5	100...600	0.8		≦0.5	638–790	4.4	
12			18.5		0.5				2.2	
11	20	4.5	17.0	100...600	0.8		≦0.5	790–860	4.4	
12			19.0		0.5				2.2	
13	13.5	4	≈2	≈300	2.4	V	<2.5	470–637	11 (12.5)	
13	16.0		≈5.5		2.1					
13	16.0	4	≈5.5	≈300	2.1		<1.7	638–790	11 (12.5)	
13	16.0	4.5	≈6.0	≈300	2.2		<1.7	790–860	11 (12.5)	
14	13.5	4.0	11.5	100...600	0.6	S	≦0.5	470–637	2.2	
15			13.0		0.4				1.1	
14	16.0		14.5		0.5				2.2	
15			16.0		0.3				1.1	
14	16.0	4	14.5	100...600	0.5		≦0.5	638–790	2.2	
15			16.0		0.3				1.1	
14	16.0	4.5	15.0	100...600	0.5		≦0.5	790–860	2.2	
15			16.5		0.3				1.1	

Operating Conditions

No. of operating condition	Cathode to collector voltage kV	Collector voltage kV	Accelerating electrode voltage kV	typ. negative focusing electrode voltage V	Cathode current A	Application V=vision, S=sound	Driving power (sync level) W	Frequency range MHz	Output power (sync level) kW	Type (collector cooling)
16 16	22	0		0	6.2	V	4	470–610 590–720 700–860	45	YK 1190 (vapour) YK 1191 YK 1192
	10.5 8.0	0 2.5			0.4 0.4	V		11.8–12.2 GHz	1.15	YK 1210 (air)
	10.5 8.0	0 2.5			0.4 0.4	S		11.8–12.2 GHz	1.05	
	10.5 8.0	0 2.5			0.4 0.4	V+S		11.8–12.2	0.105	
	12.0 9.0	0 3			0.5 0.5	V+S		11.8–12.2	0.210	in preparation

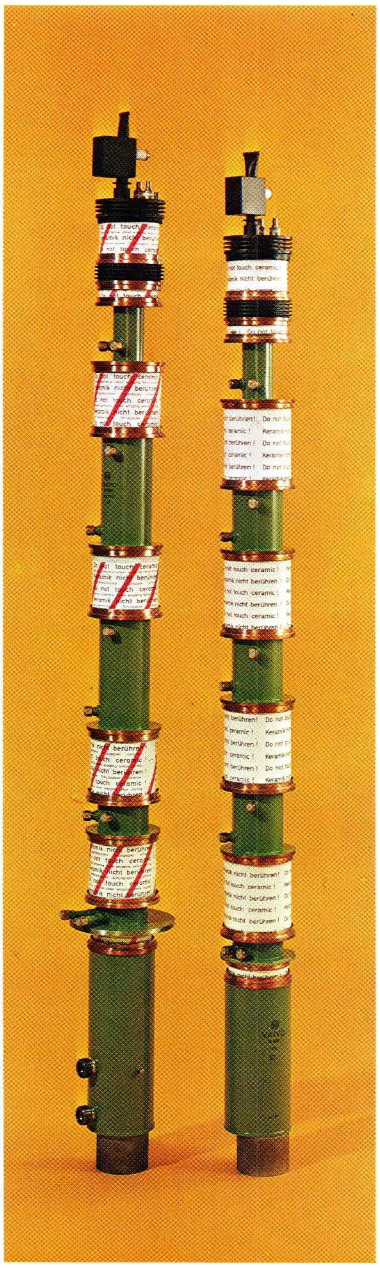
Concepts of TV Transmitters

In the following table the operating conditions are given for various TV transmitters.



Klystron		YK 1000/4	YK 1001/2/3	YK 1005	YK 1151	YK 1190/1/2
Vision Transmitter	10 kW	1: 10 W → 11 kW 19 kV; 1.9 A	2: 15 W → 11 kW 13.5 kV; 1.9 A	6: 2.5 W → 11 kW 14 kV; 2.1 A	13: 2.5 W → 11 kW 13.5 kV; 2.4 A	
	20 kW	2 tubes in parallel	2 tubes in parallel	—	10: 2.5 W → 22 kW 16.5 kV; 3.6 A	2 W → 25 kW 18 kV; 4.6 A
	40 kW				2 tubes in parallel	16: 4 W → 45 kW 22 kV; 6.2 A
Sound Transmitter	1 kW			7: 0.5 W → 1.1 kW 14 kV; 0.6 A	15: 0.5 W → 1.1 kW 13.5 kV; 0.4 A	
	2 kW		3: 0.5 W → 2.2 kW 13.5 kV; 0.7 A	8: 0.5 W → 2.2 kW 14 kV; 0.8 A	14 (12): 0.5 W → 2.2 kW 13.5 kV; 0.6 A	
	4 kW		4: 0.5 W → 4.4 kW 13.5 kV; 1.0 A		11: 0.5 W → 4.4 kW 16.5 kV; 0.9 A	
Vision + Sound Transmitter	1 kW			9: 0.3 W → 1.05 kW 13 kV; 2.1 A		
	2 kW		5: 6 W → 2.1 kW 15 kV; 2.2 A			

10 kW
E-MAGNET



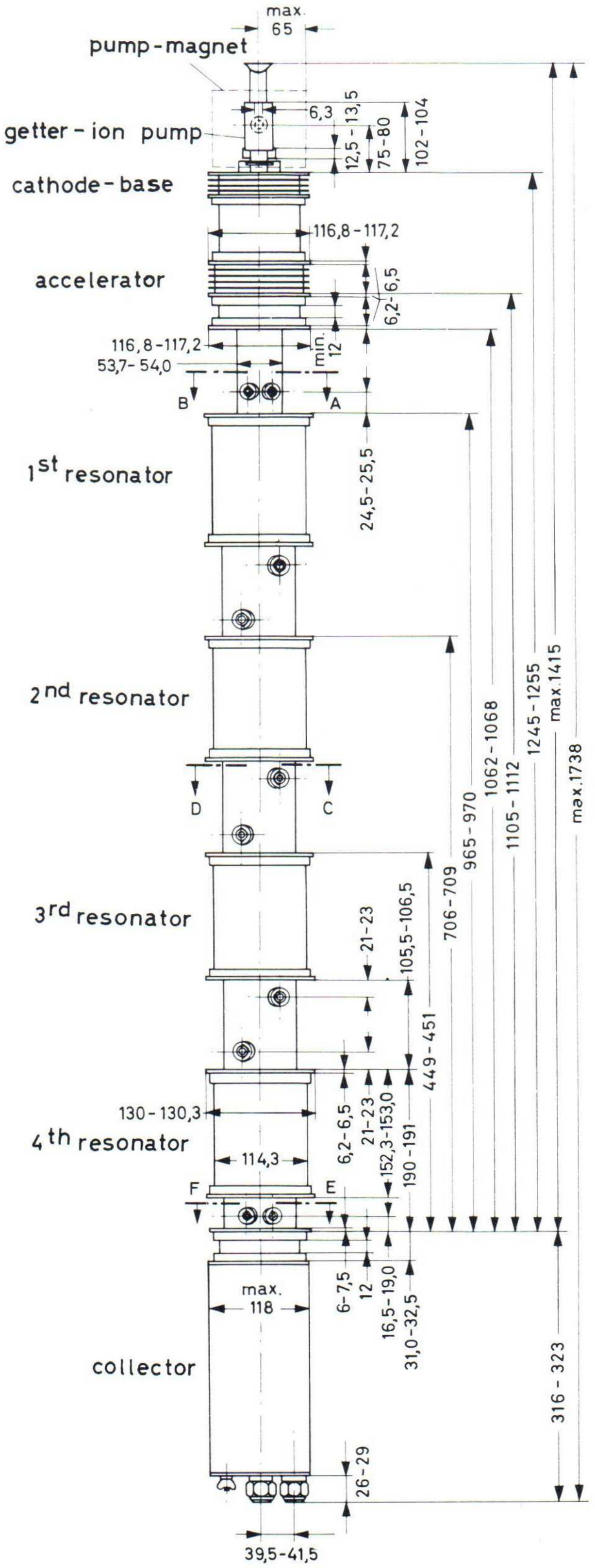
The first two types of high power klystrons specially developed by VALVO to give higher performance in television service than could be obtained hitherto with imported types. The YK 1004 shown on the left covers a frequency range from 610 to 790 MHz, while the YK 1000 on the right covers the range 400 to 620 MHz. The YK 1000/4 types which use electromagnetic focusing have a proven long life expectancy.

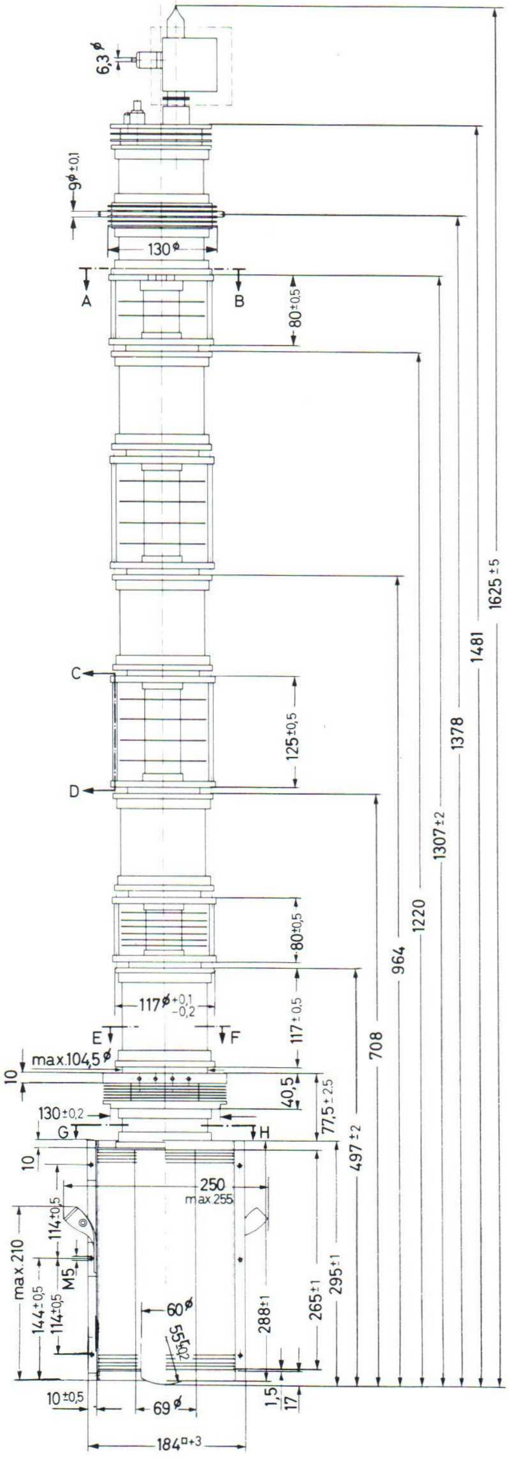
YK 1000

YK 1001

(Collector drawn rotated for 90°)

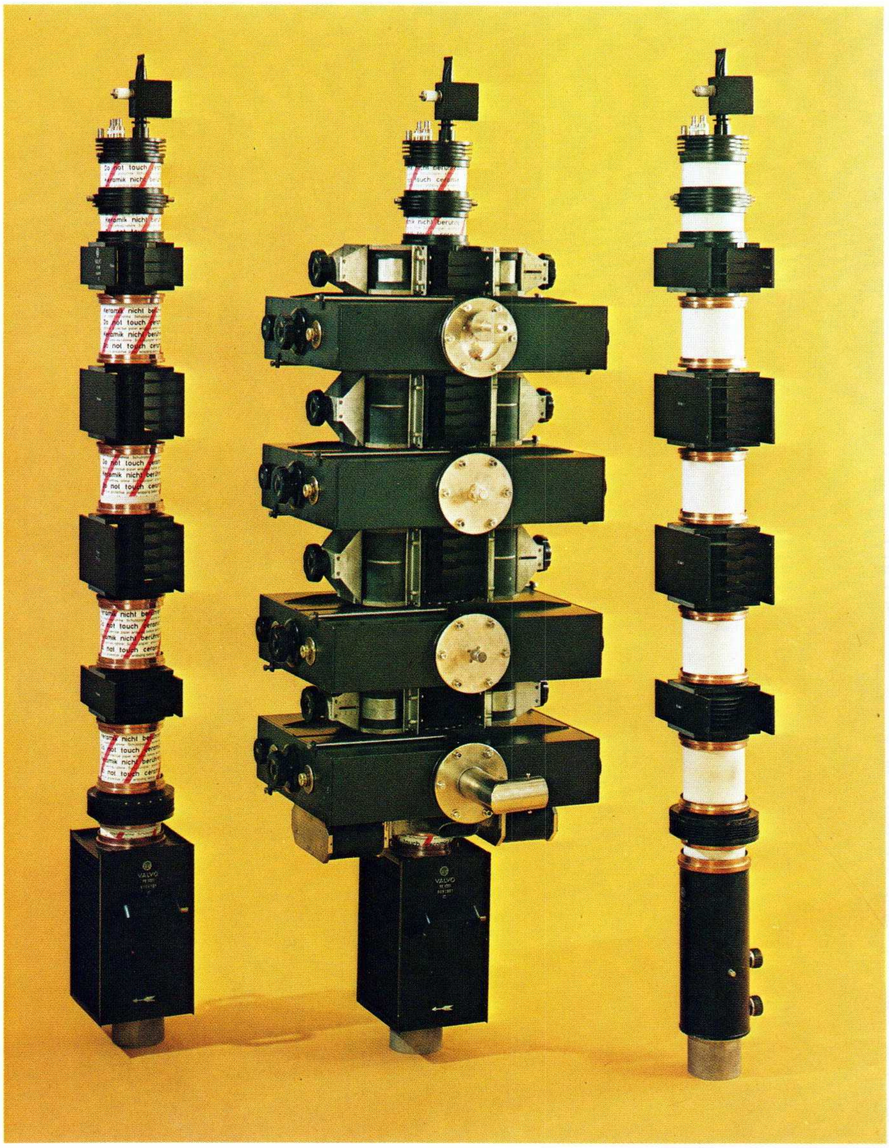
Outline drawings (Dimensions in mm)





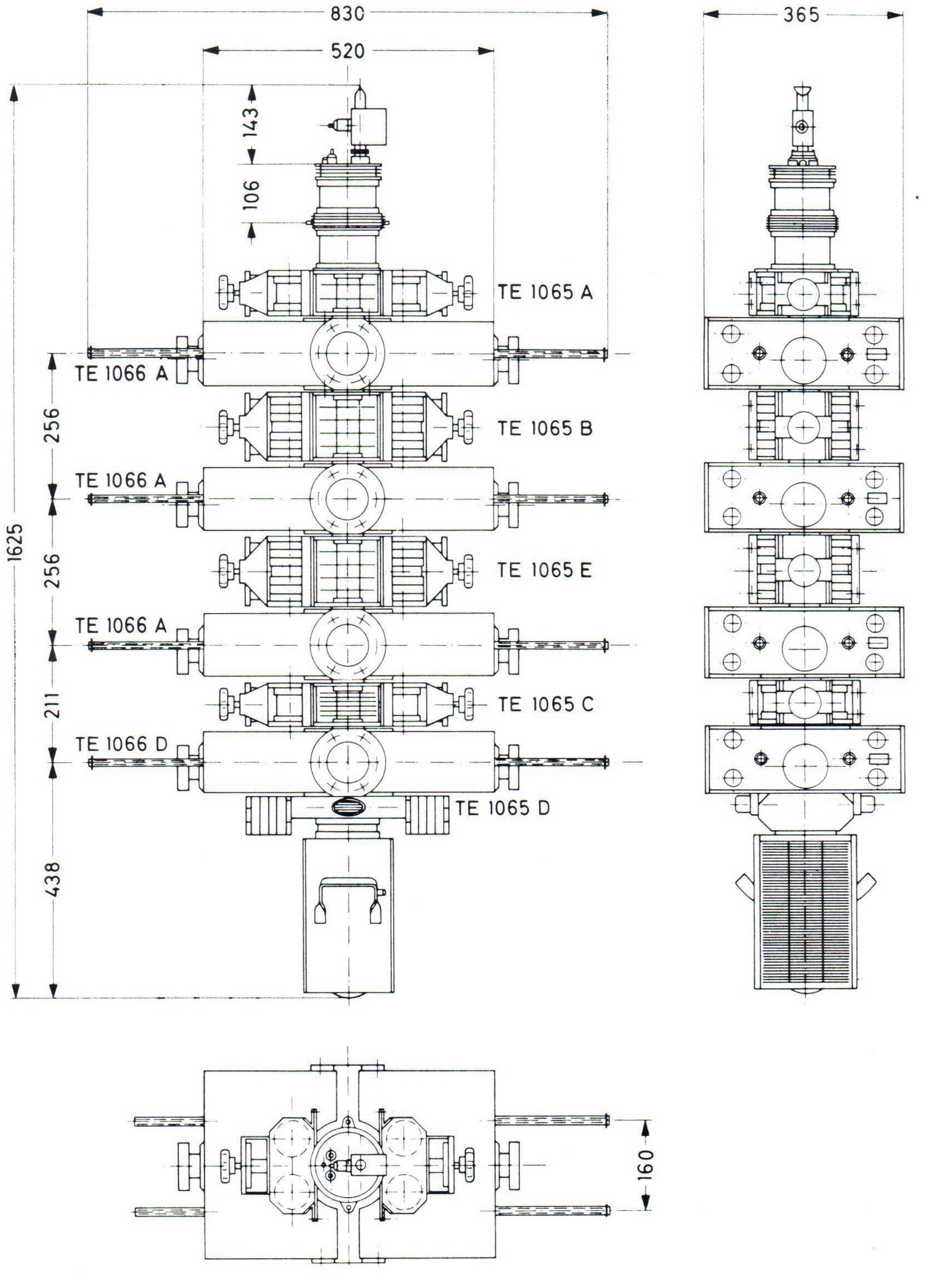
Klystrons

10 kW
PPM-FOCUSSED



The klystrons YK 1001 (air cooled, on the left) and YK 1002 (water cooled, on the right) represent the first generation of 10 kW high-power klystrons developed specially for TV operation (470–860 MHz). These very successful types are focused by permanent magnets. In the centre the klystron YK 1001 is shown fitted with cavities and magnet-sets.

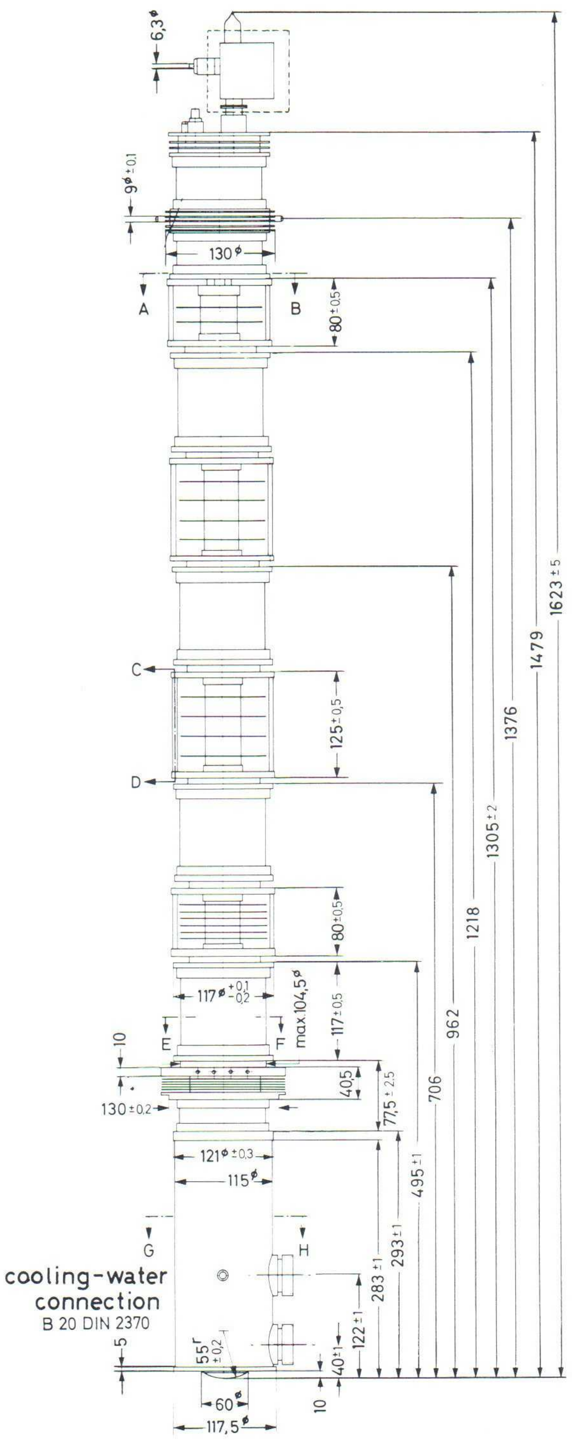
YK 1001

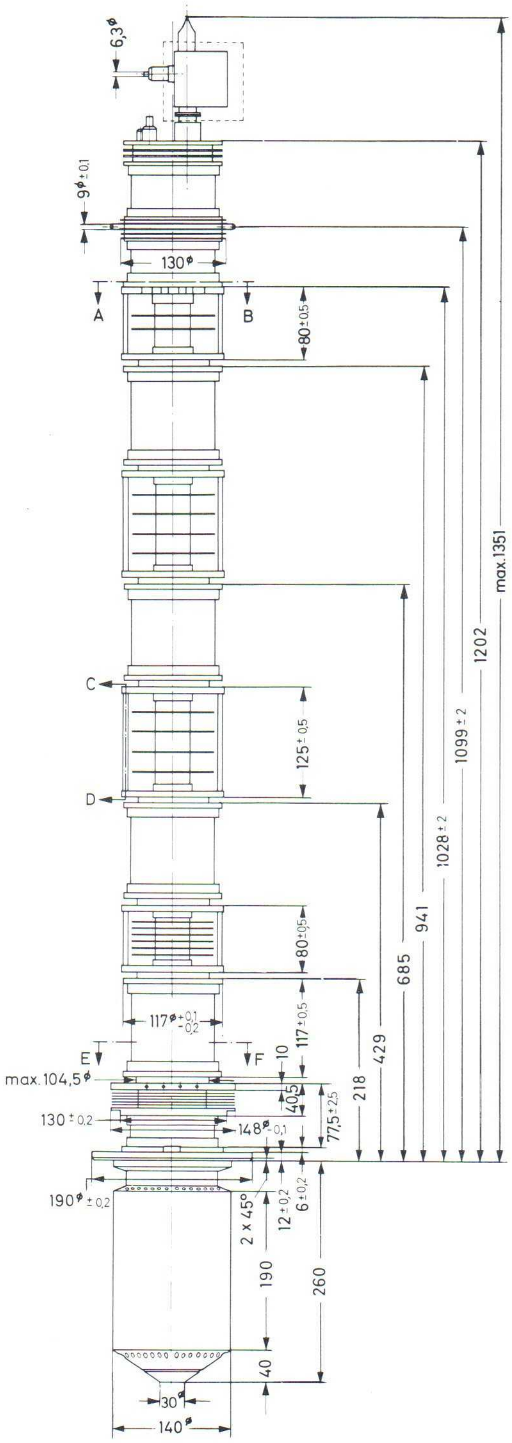

830
520
365
143
106
TE 1065 A
TE 1066 A
256
TE 1065 B
TE 1066 A
1625
256
TE 1065 E
TE 1066 A
211
TE 1065 C
TE 1066 D
TE 1065 D
438
160

YK 1002

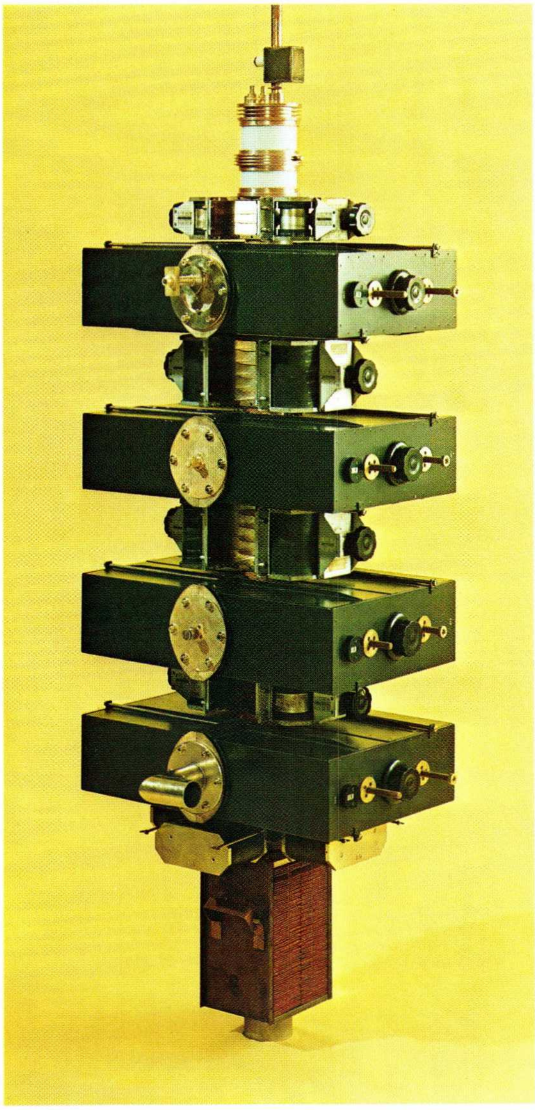
YK 1003

Outline drawings (Dimensions in mm)





10 kW
AIR COOLED
PPM-FOCUSSED
HIGH GAIN



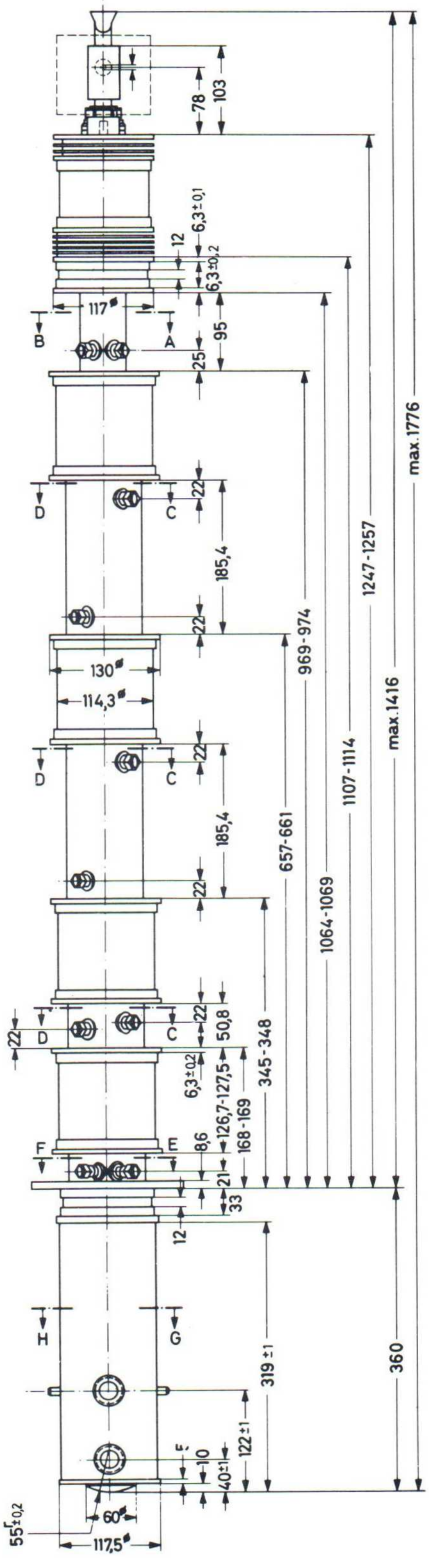
10 kW TV klystron YK 1005 (air cooled) fitted with its cavities and permanent magnet-sets. This type of klystron requires very low drive power, so that a solid-state drive unit may be employed over the entire frequency range of its operation from 470 to 860 MHz. Max. 2.5 W input drive power is needed for full output.

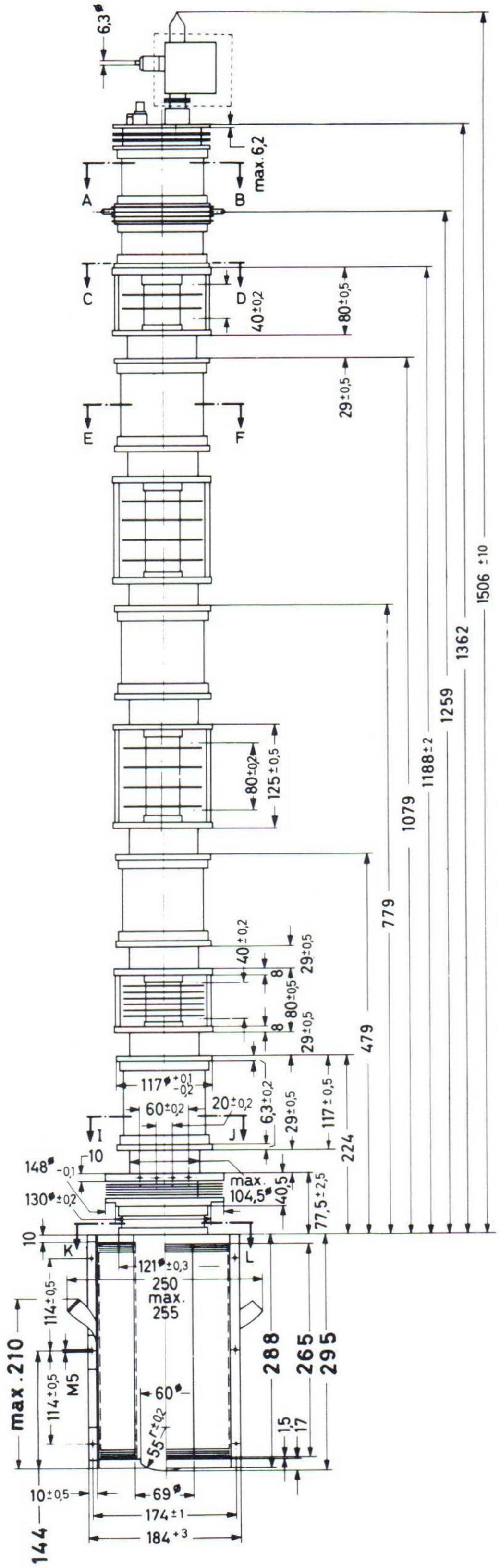
YK 1004

YK 1005

(Collector drawn rotated for 90°)

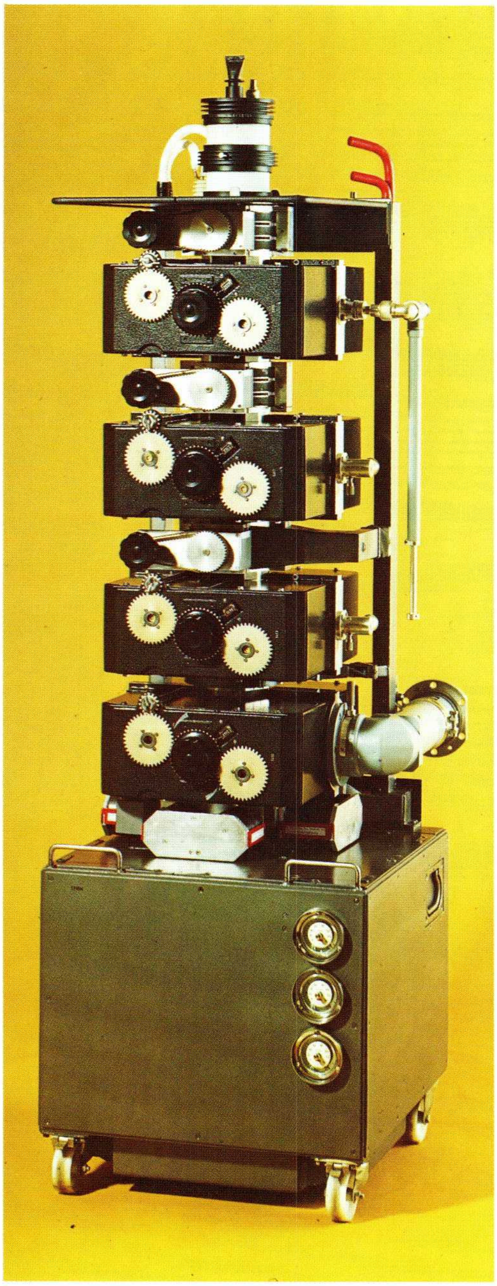
Outline drawings (Dimensions in mm)





Klystrons

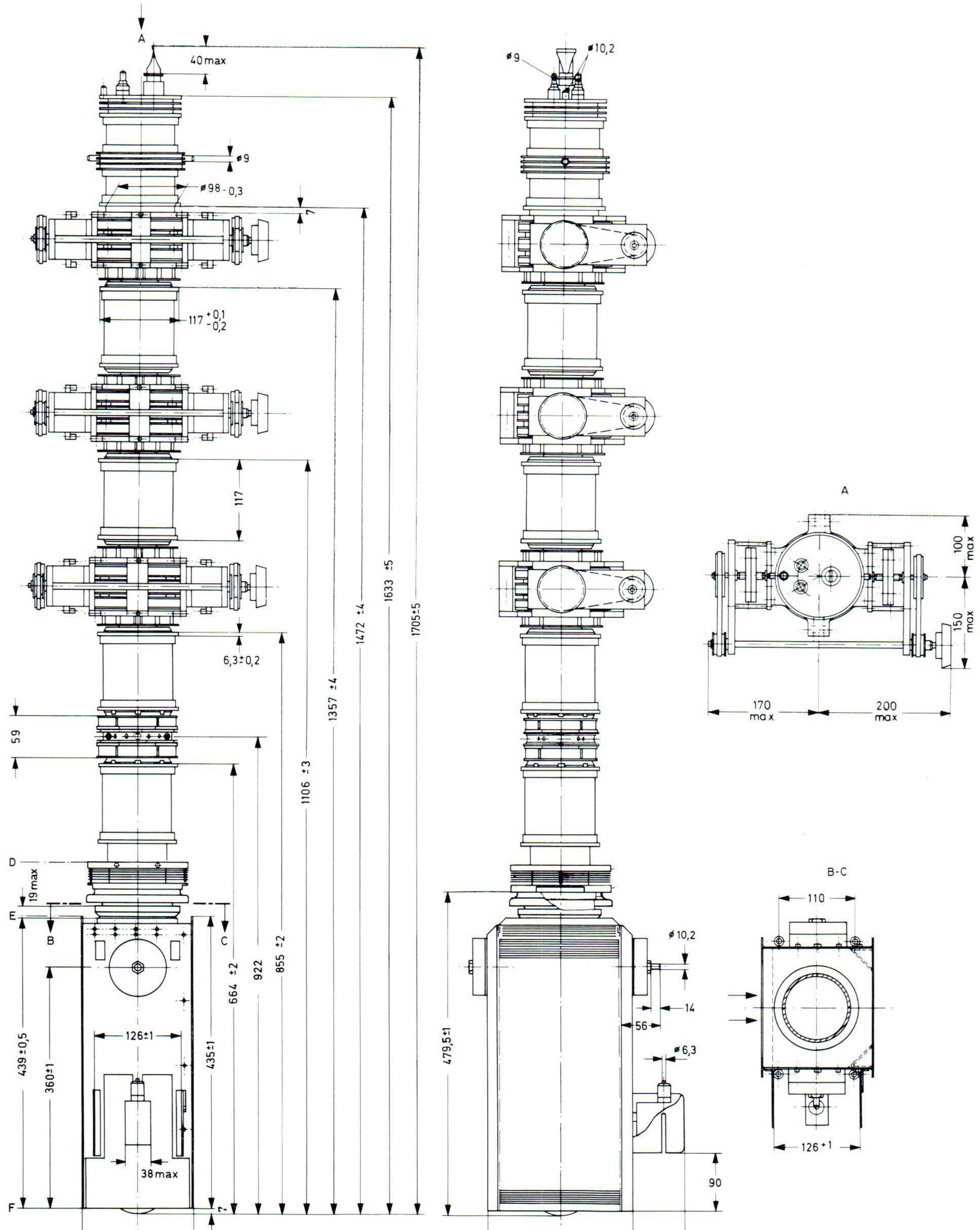
20 kW
AIR COOLED
PPM-FOCUSSED
HIGH GAIN



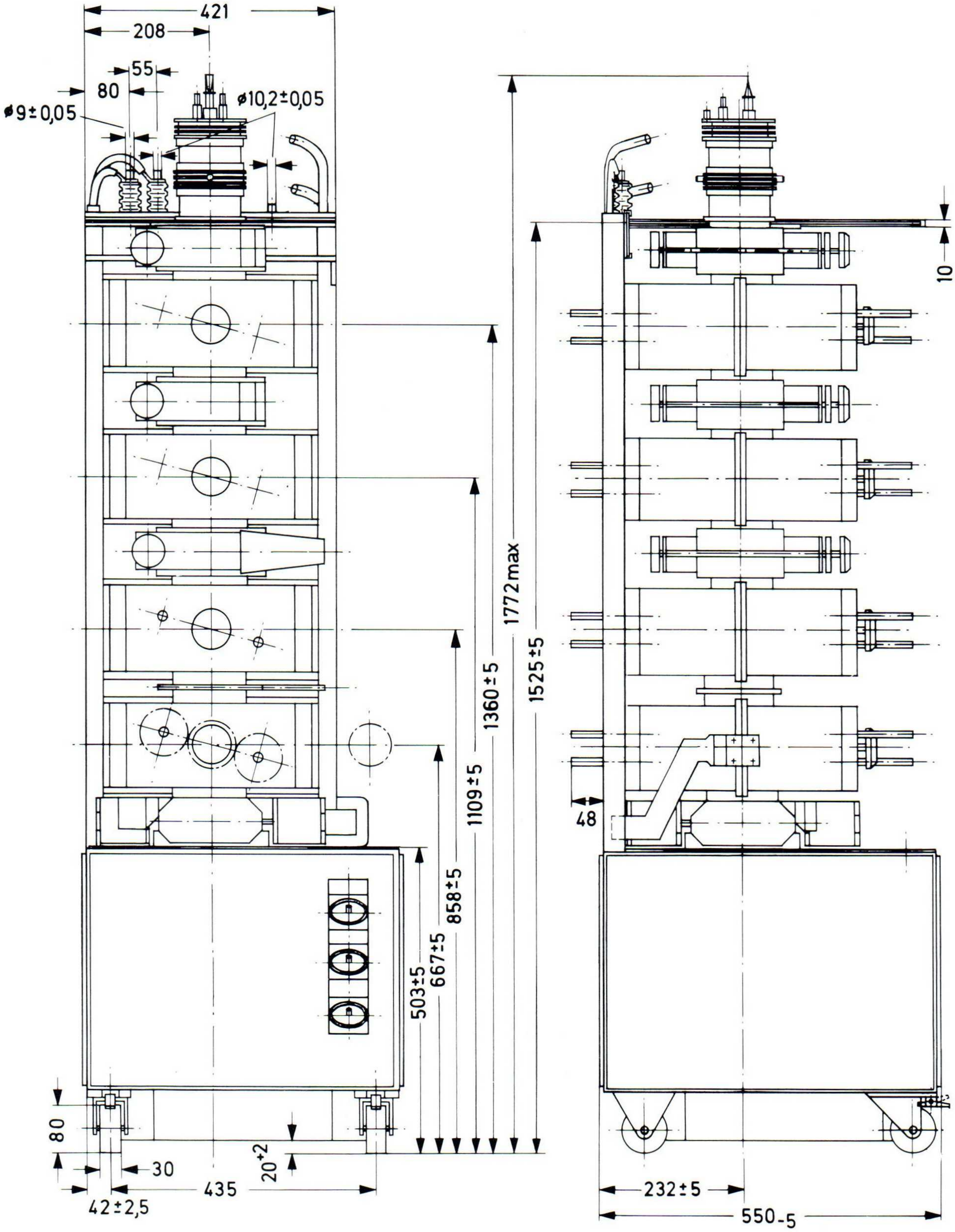
20 kW TV klystron YK 1151 installed in its trolley, with cavities in position. This klystron can be driven directly from a solid-state drive unit since it requires only max. 2.5 W input drive power for full output. The frequency range of the YK 1151 is from 470 to 860 MHz.

YK 1151

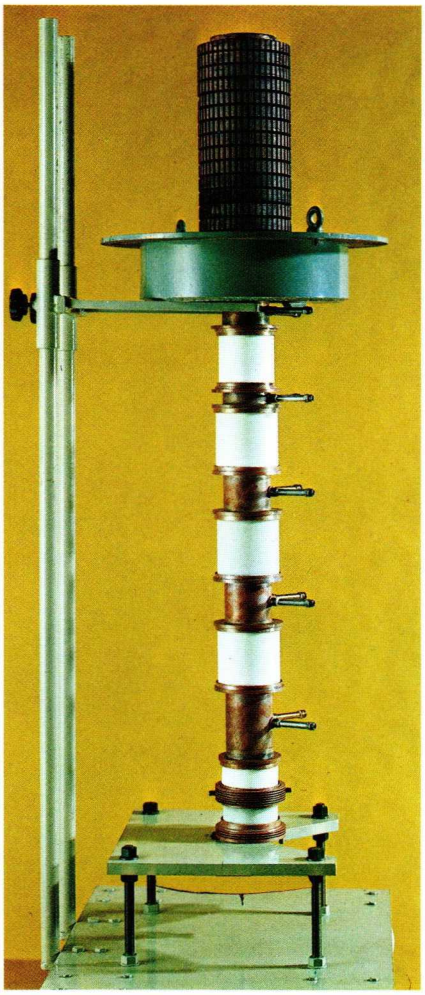
Outline drawing
(Dimensions in mm)

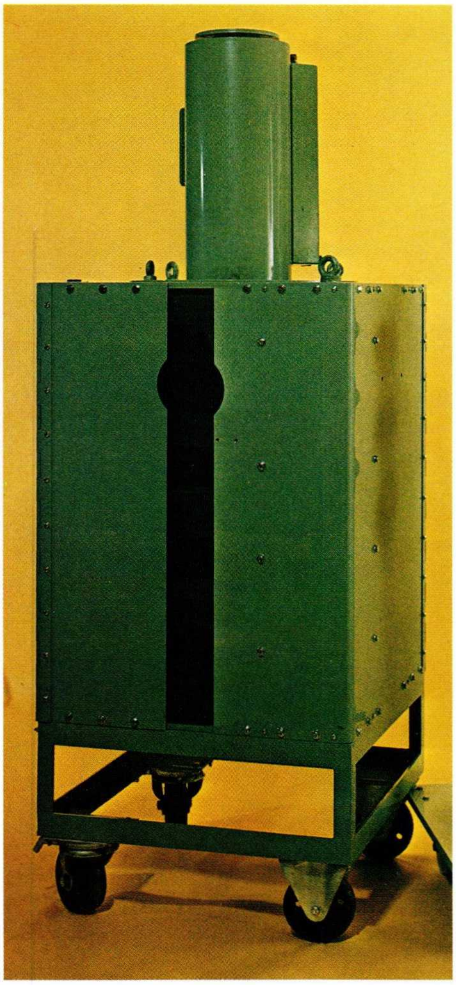


Klystrons


421
208
55
80
ø9±0,05
ø10,2±0,05
10
1772 max
1525±5
1360±5
1109±5
858±5
667±5
503±5
48
80
30
20+2
435
42±2,5
232±5
550-5

40 kW
E-MAGNET
VAPOUR COOLED
HIGH GAIN





The newly developed high gain 40 kW klystron, the YK 1190/YK 1191. On the left, the YK 1190/YK 1191 can be seen without cavities, ready for installation. On the right, the klystron has been fitted on its trolley, with its boiler position. The YK 1190/YK 1191 has been specially designed for television service over the frequency range 470—610 resp. 590 to 720 MHz.

Quick Reference Data of S-Band Power Klystrons for Use as Amplifier in Linear Accelerators and Similar Applications

5 MW Pulse Power Klystron YK 1110

metal-ceramic construction
water cooled
three fixed tuned internal cavities
electromagnetic focusing by integral coils
coaxial input connector
S-band rectangular output wave guide with round flange
continuously operating getter ion pump

Operating characteristics

Frequency	2998 ± 5	MHz 1)
Power output, peak	6	MW
Power gain	30	dB
Beam voltage, peak	210	kV
Beam current, peak	100	A
Pulse duration	2.2	µs
Pulse repetition rate	50	Hz 1)
Driving power	5	kW
Voltage } for electromagnetic	≈ 40	V
Current } focusing coils	≈ 29	A
Heater voltage	3 . . . 4.6	V
Heater current	70 . . . 82	A

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1) Other frequencies and data for operation at higher pulse repetition rate on request.

25 MW Pulse Power Klystron YK 1200

metal-ceramic construction
water cooled
five fixed tuned internal cavities
electromagnetic focusing
coaxial input connector
two S-band rectangular output wave guides
continuously operating getter ion pump

Operating characteristics

Frequency	2998 ± 5	MHz 2)
Power output, peak	25	MW
Power gain	50	dB
Efficiency	40	%
Beam voltage, peak	280	kV
Beam current, peak	250	A
Pulse duration	6	µs
Pulse repetition rate	50	Hz 1)
Driving power	200	W
Current for electromagnetic focusing coils	≈ 15	A
Heater voltage	17 . . . 24	V
Heater current	14.5 . . . 18.5	A

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2) Other frequencies on request.

1 kW Amplifier Klystron V 37 SK

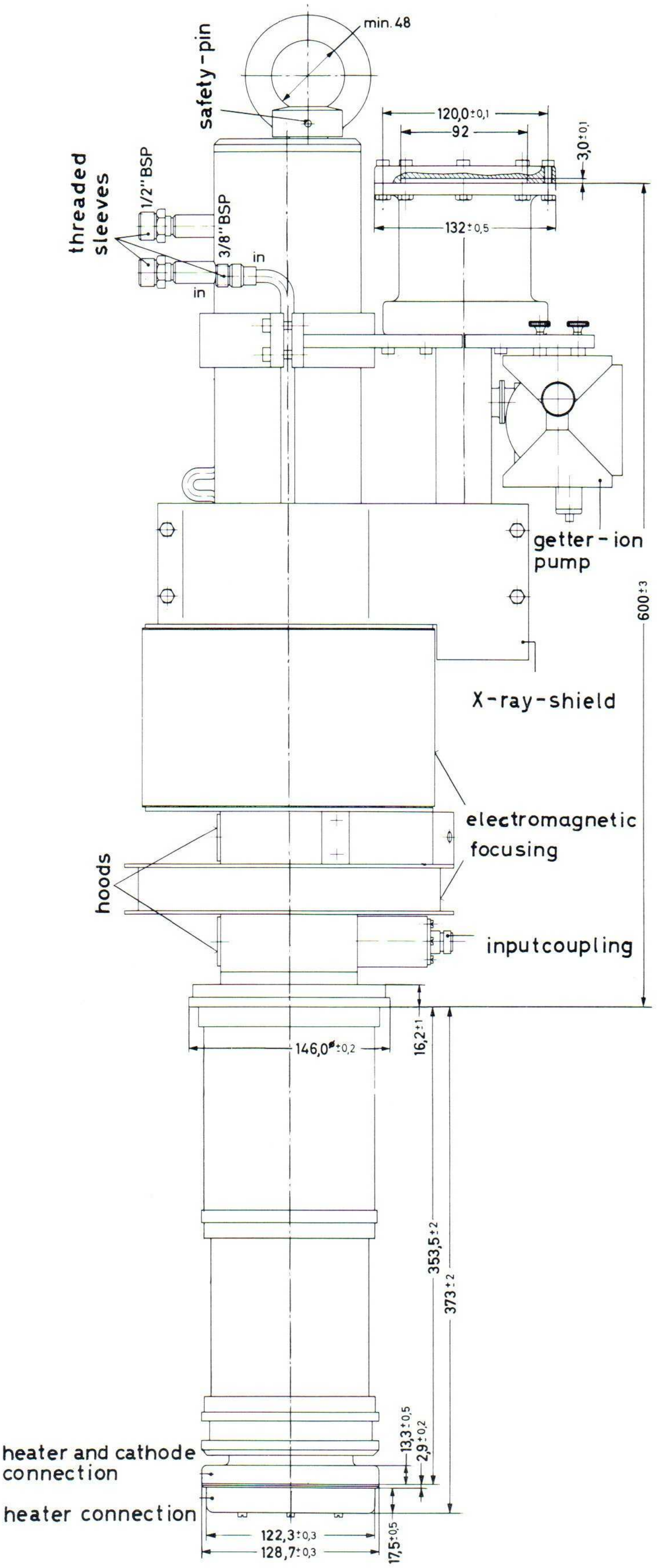
metal-ceramic construction
water cooled
five fixed tuned internal cavities
electromagnetic focusing
S-band rectangular output wave guide
continuously operating getter ion pump

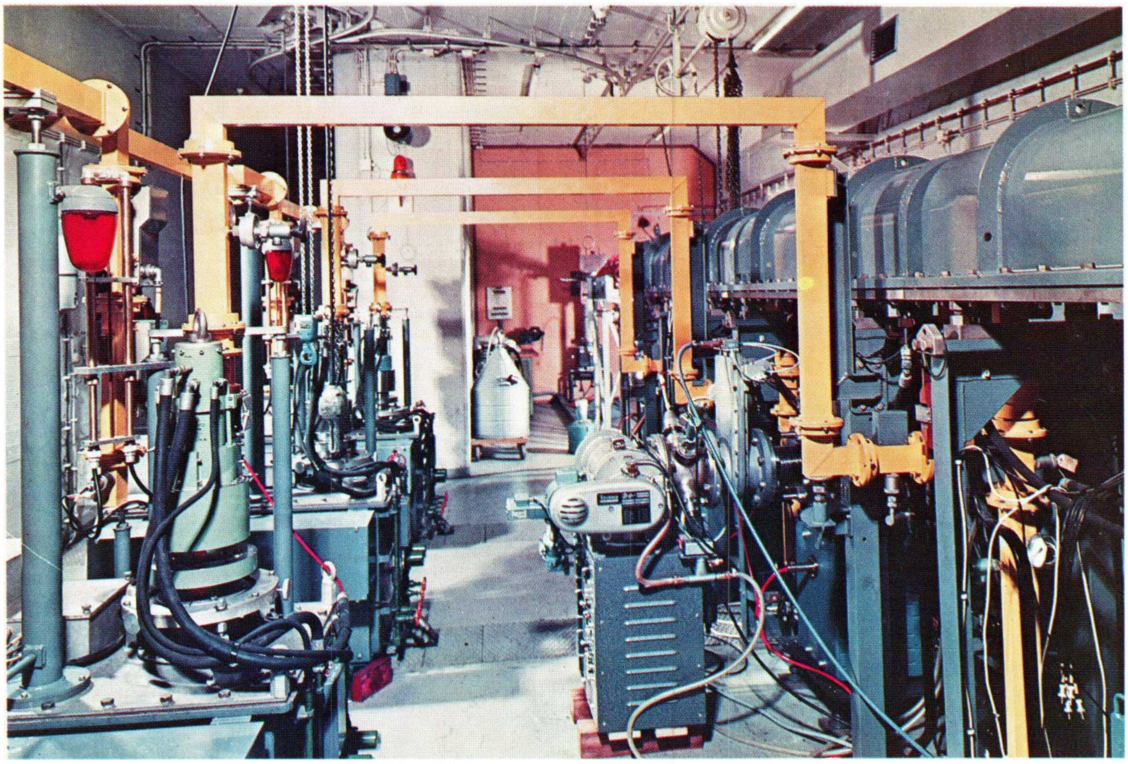
Operating characteristics

Frequency	2856	MHz
Bandwidth (−2 dB)	15	MHz
Output power	> 1	kW
Power gain	> 40	dB
Beam voltage	10.3	kV
Beam current	630	mA
Focusing electrode voltage	300	V
Voltage } for electromagnetic	≈ 65	V
Current } focusing coils	≈ 6.8	A
Heater voltage	7.2	V
Heater current	≈ 32	A

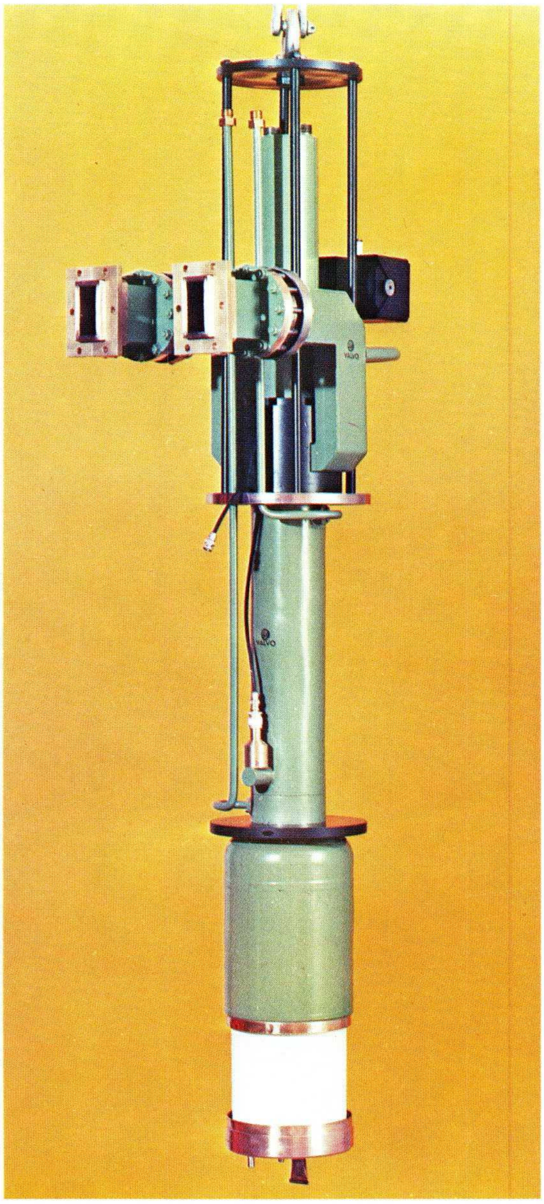
YK 1110

Outline drawing
(Dimensions in mm)



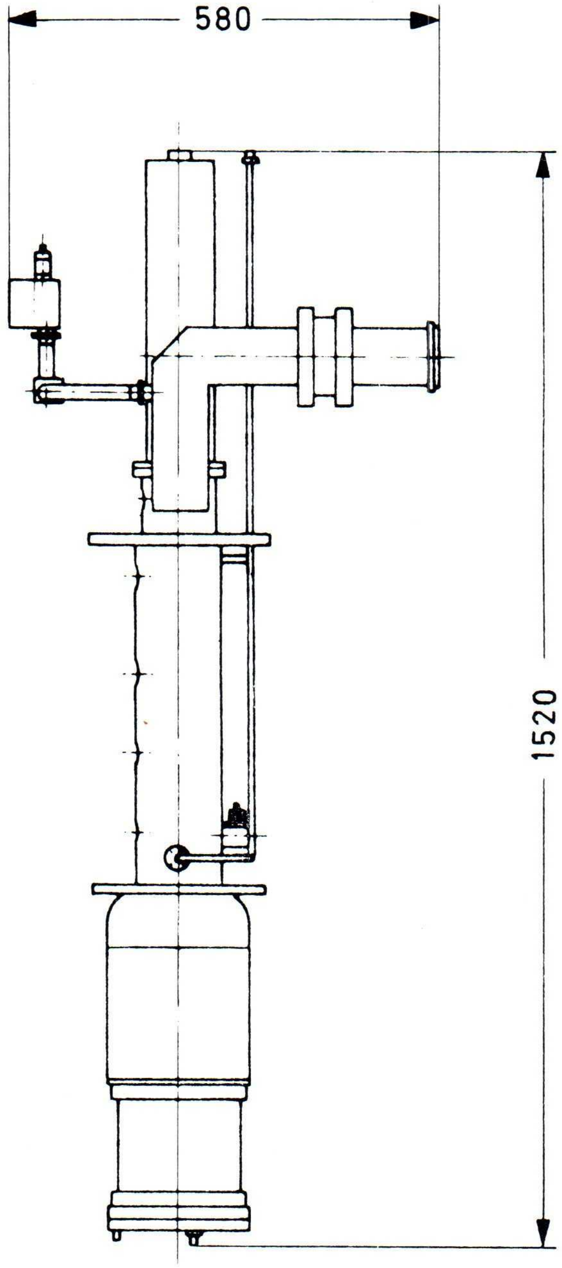


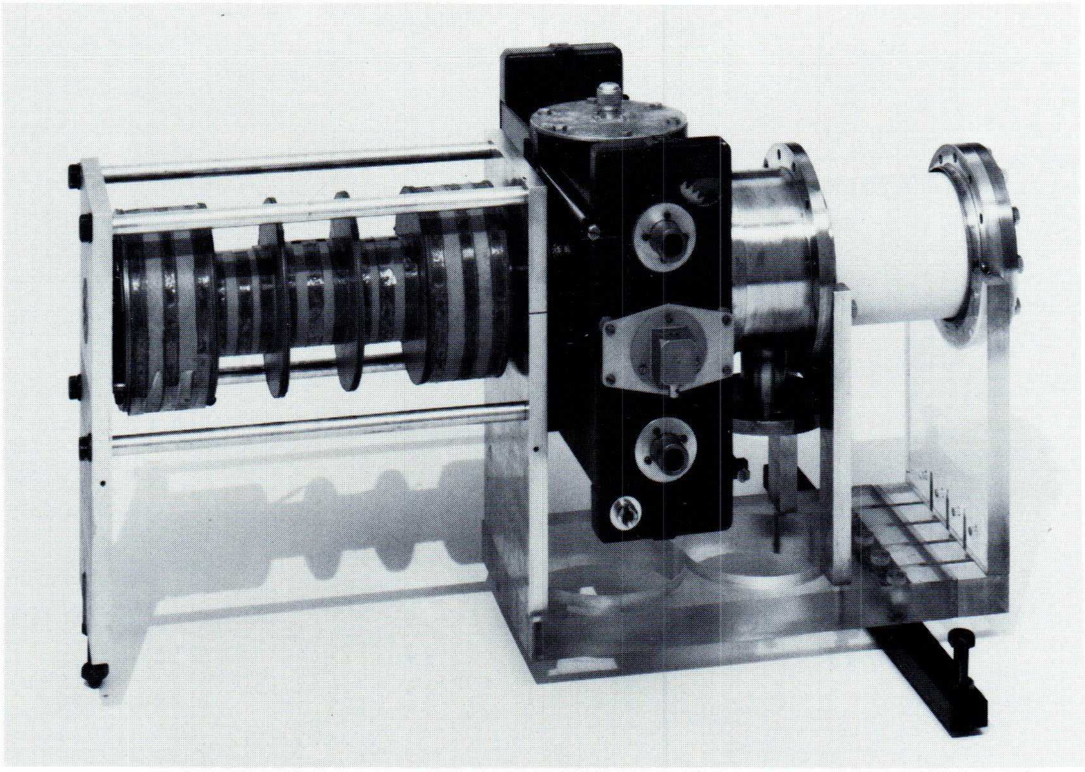
The DESY linear accelerator, Hamburg, equipped with VALVO high-power pulse klystrons YK 1110 (left side of the picture); r.f. energy is fed to the accelerator by the yellow waveguides.



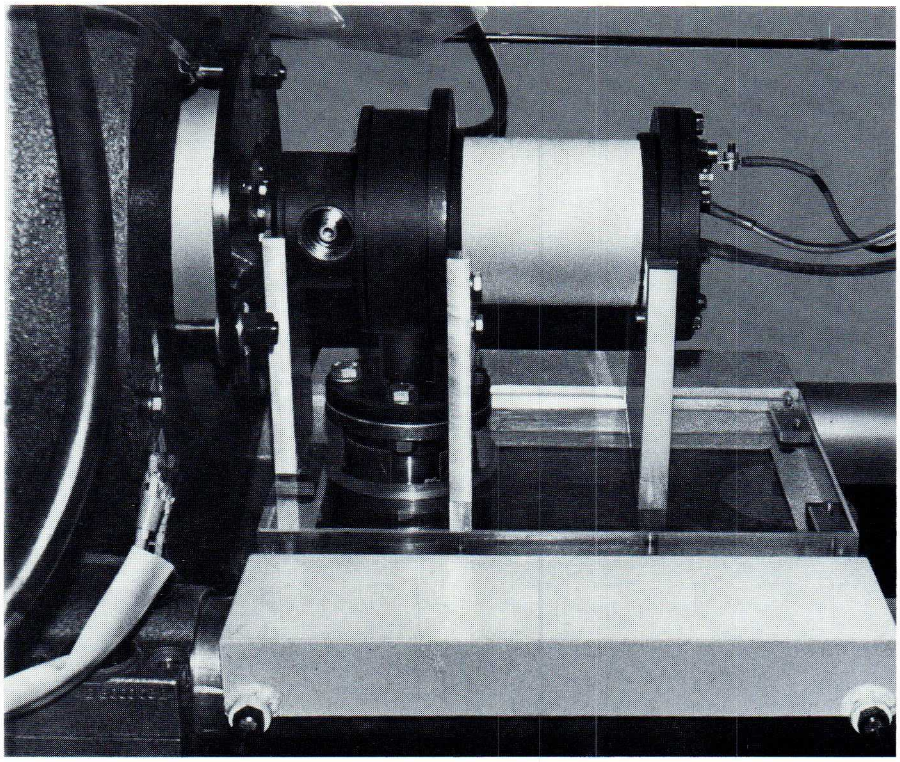
25 MW pulse klystron YK 1200 for r. f. power generation in linear accelerators.
(Frequency: 2998 MHz)

Outline drawing
(Dimensions in mm)

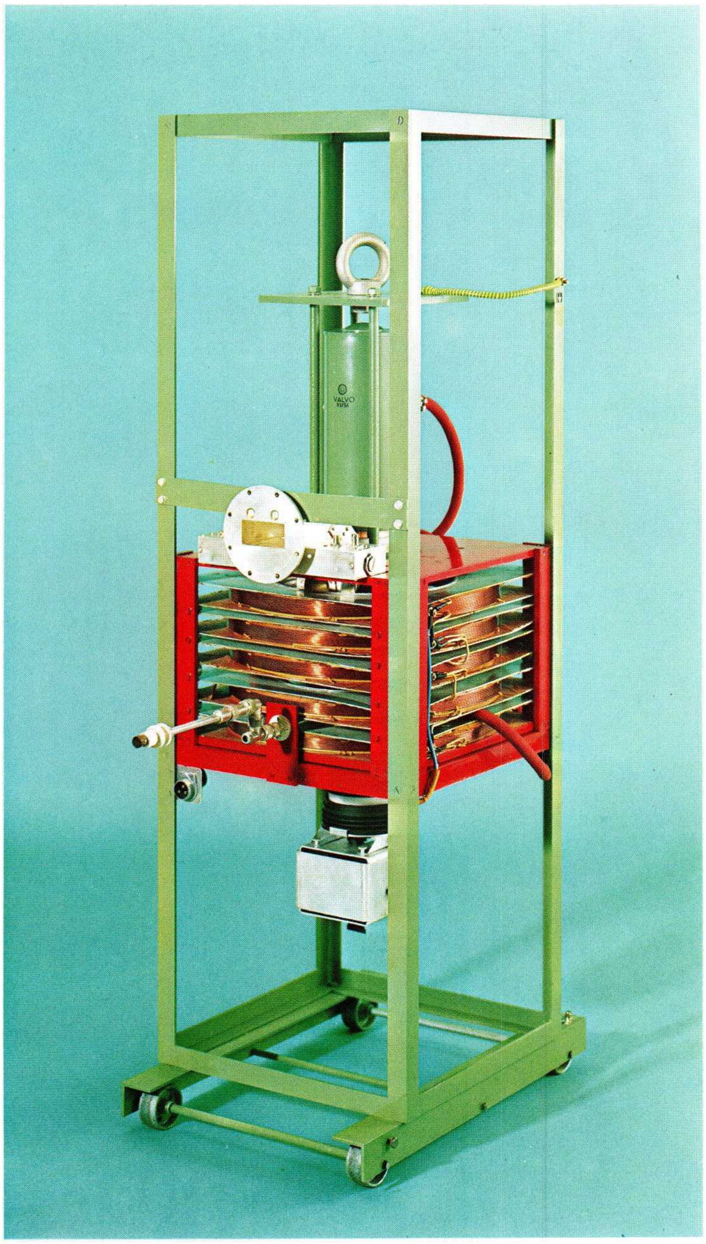




Electron injection system V 26 SK with cavity mounted (as installed at DESY, Hamburg in Linac I).



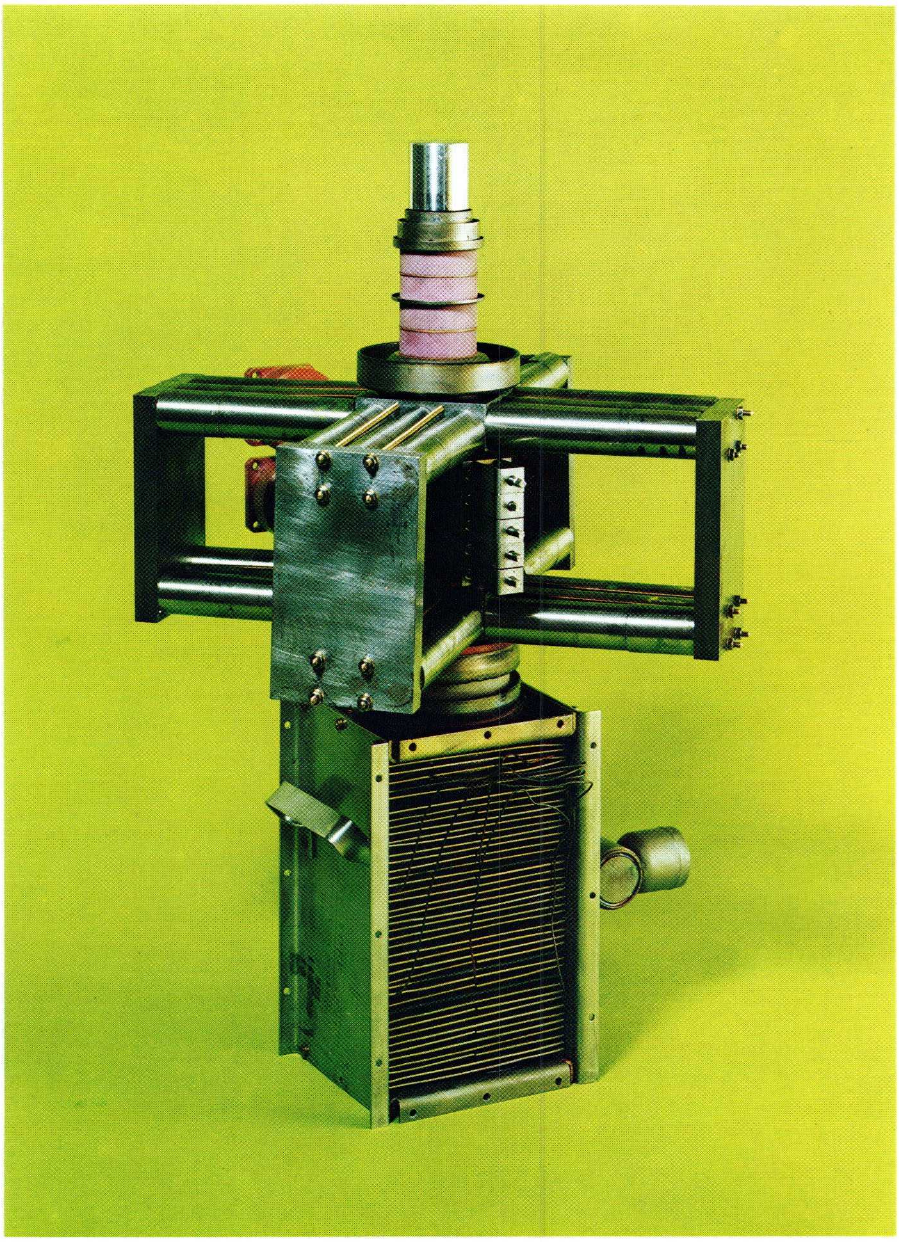
Electron injection system V 32 SK installed at the linear accelerator in the Institute for Nuclear Physics of the University of Mainz.



1 kW amplifier klystron V 37 SK for use in linear accelerators and similar applications. (Frequency: 2856 MHz)

Klystrons

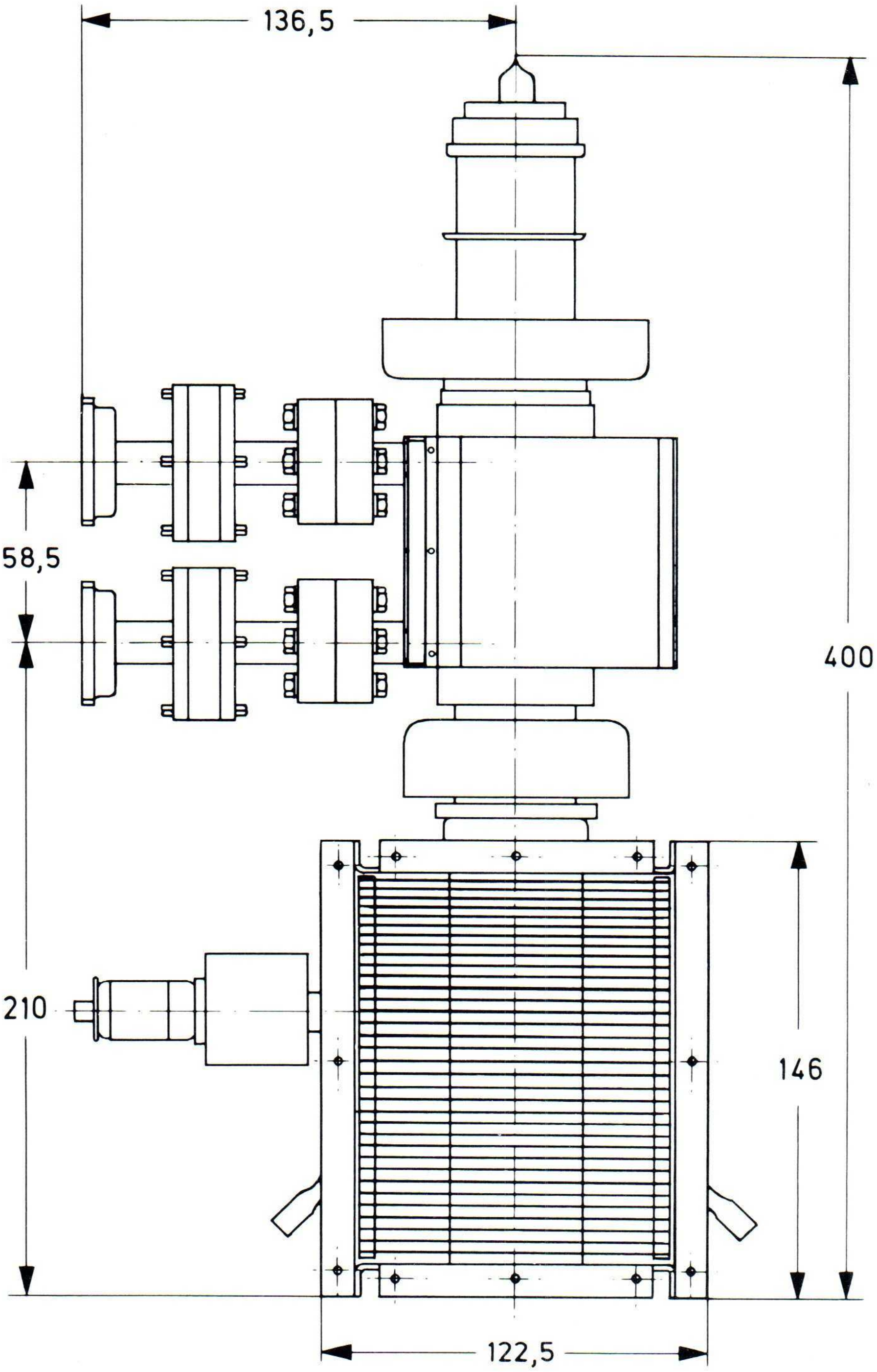
12 GHz Klystron YK 1210 for TV, Band VI



The new VALVO 12 GHz klystron YK 1210 has been specially developed for the planned commercial TV system on band VI. The YK 1210 has five cavities so that a high power gain of around 50 dB or higher can be achieved, with a power output of around 1 kW. Combined amplification of sound and vision signals yields an output power of 200 W with low intermodulation distortion.

YK 1210

Outline drawing
(Collector drawn rotated by 90°)



Klystrons

VALVO Triodes and Tetrodes for TV Transposers and Transmitters

A series of air cooled metal-ceramic triodes has been specially developed for TV transposer applications. Featuring high linearity and high gain, these tubes are particularly suitable where long life and high performance are required, as with unattended stations.

These requirements are met with generous margins by VALVO tubes incorporating the latest technological developments. Subject to stringent quality control at all stages of manufacture, the tubes feature low cathode temperatures to minimize evaporation of cathode material and consequent variation in performance characteristics.

Operating either in final power amplifier stages, or as drivers, the tubes can provide sufficient overall gain to enable them to be driven by solid-state driver stages. A combination of the types YD 1300 und YD 1330 will produce an overall gain of > 30 dB.

Triodes for TV Transposer Driver and Output Stages

Tube Type	Freq. (MHz)	V_a (V)	I_a (mA)	P_o (W)	Gain (dB)	Intermod. Products (dB)
YD 1300	860	1700	170	35	20	< −52
YD 1301/2	780	1700	185	50	18	< −52
YD 1330[1]) (family)	860	2500	500	220	16	< −54

---

[1]) For more data of the YD 1330 and its derivatives see following pages

200 W triode YD 1330 in metal ceramic construction, developed for TV transposer applications. When common transmission of vision and sound signal is used the power gain is 18 dB (bandwidth 9 MHz, suppression of intermodulation distortion 56 dB). This tube is also suitable for 500 W vision transmitters using negative or positive modulation.

300 W triode YD 1331 for broadband and sound transmitters up to 1000 MHz or 100 W TV transposers. The tube data correspond to type YD 1330.

200 W triode YD 1332 is another version of the YD 1330. Its cooling system (radiator) is dimensioned for a very small pressure drop.

100 W triode YD 1333 for TV transposers with high stability. The electrical data and the characteristics correspond to the tube type TH 308.

Power Tubes

Operating Conditions of VALVO Coaxial Tetrodes

YL 1230

R.F. Linear Amplifier Single Side Band

Operating Conditions

Frequency	1 to 30	MHz
Anode voltage	3.0	kV
Grid No. 2 voltage	560	V
Grid No. 1 voltage	—65 (50...80)	V

		zero signal	single tone signal	double tone signal	
Peak driving voltage	≦	0	50	50	V
Anode current	=	380	710	550	mA
Grid No. 2 current	≈	—5	—20	—15	mA
Grid No. 1 current	≈	0	0	0	mA
Grid No. 1 resistor (R.F.)		10	10	10	kΩ
Driver output power	<	0	5	5	W
Anode dissipation	≈	1140	1080	1100	W
Output power in load		0	1050	––	W
PEP output power in load		0		> 1000	W
Intermodulation distortion					
of the 3rd order	≧			40	dB
of the 5th order	≧			40	dB

YL 1110

R.F. Amplifier (grounded grid circuit)

YL 1111

TV Transposer

Operating Conditions

Frequency	=	920	790	500	≦ 960	MHz
Anode voltage	=	2500	2500	2500	1500	V
Anode current	=	500	500	500	380 . . . 420	mA
Grid No. 2 voltage	=	400	400	400	600	V
Grid No. 2 current	≈	6	7	8	4	mA
Grid No. 1 voltage	≈	—60	—45	—35	—40 (30 . . . 70)	V
Grid No. 1 current	≈	10	11	12	1	mA
Driver output power	=	55	35	40	5 . . . 10	W
Output power	≈	530	≈ 600	≧ 680	50 . . . 100	W

The power output tetrode YL 1110/1 (7650) for applications up to 1 GHz is shown on the left. On the right the 1.1 kW tetrode YL 1231 can be seen which is specially suitable for r.f. stages up to a frequency of 220 MHz.

Operating Conditions of the TV Transposer Triodes YD 1330 and its Derivatives

Application			YD 1330 TV Transposer [1] (sound and vision)		YD 1331 sound transmitter	YD 1332 TV transposer [1] (sound and vision)		YD 1333 TV transposer [1] (sound and vision)		YD 1334 TV transposer [1] (sound and vision)
Frequency	MHz	=	470 . . . 860	470 . . . 860	174 . . . 237	470 . . . 860	470 . . . 860	470 . . . 860	470 . . . 860	470 . . . 860
Anode voltage	V	=	3000	2500	2700	3000	2500	2000	1800	2500
Anode current (quiescent)	mA	=	420	350	200	420	350	250	200	200 . . . 300
Anode current (0 dB)	mA	≈	650	550	350	650	550	410	370	420 (≦ 500)
Grid voltage	V	=	15 . . . 30	10 . . . 25	15 . . . 40	15 . . . 30	10 . . . 25	10 . . . 30	10 . . . 30	15 . . . 35
Grid current	mA	≈	0	0 . . . 10	0	0	0 . . . 10	0	0	0
Power gain	dB	≈	17.5	16.5	16	17.5	16.5	16	16	17.5
Driving power (sync.)	W	≦	7	8	9	7	8	2.5	2.5	4
Output power (sync.)	W	=	220	220	300	220	220	100	100	110
I. M. distortion	dB	≧	56	56		56	56	56	54	58
Cooling			forced air $q = 2\ \mathrm{m^3/min}$ ($P_A = 1.8$ kW, $\Delta p = 1500$ Pa)		forced air $q = 1.5\ \mathrm{m^3/min}$ ($P_A = 900$ W, $\Delta p = 500$ Pa)	forced air $q = 2\ \mathrm{m^3/min}$ ($P_A = 1.8$ kW, $\Delta p = 200$ Pa)		forced air $q = 1.5\ \mathrm{m^3/min}$ ($P_A = 900$ W, $\Delta p = 500$ Pa)		forced air $q = 2.0\ \mathrm{m^2/min}$ ($P_A = 1.8$ kW, $\Delta p = 200$ Pa)

YD 1335

Picture transmitter (CCiR-G or CCiR-L)

frequency = 470 . . . 860 MHz
Anode voltage = 3500 V
Anode current (quiescent) = 250 mA
Anode current (grey) ≈ 550 mA
Grid voltage = 20 . . . 40 V
Grid current ≈ 0 mA

Power gain ≈ 15 dB
Driving power
(sync. G or white L) ≦ 25 W
Output power (sync.) (G) or white (L) = 650 W
Linearity ≧ 95 %

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[1] Test in accordance to ARD/DBP standard specification

Microwave Sub-Systems

Ever since their inception, microwave systems have been characterised by relatively large tubes, and bulky components such as waveguides.

As a result of fundamental research during the last ten years, several semiconductor devices for microwave applications have been developed by Philips Research Laboratories, including small free-running sources such as Gunn elements and avalanche diodes, mixer and detector diodes like the Schottky Barrier types, and switching and multiplying diodes such as the PIN and varactor diodes. These components are in current production.

Simultaneously with this development of components, a programme of research has been carried out to find a suitable material for use as a substrate for low power integrated microwave systems. Small metallic strips on a special substrate provided an answer to integrated transmission lines. Today microstrip, microslot and triplate structures are employed.

The new integrated microstripline technique offers important advantages for low power microwave applications:

substrates are suitable for mass production;
smaller and lighter components;
less expensive than conventional techniques.

These important advantages represent a great step forward in the use of microwaves for low power applications where hitherto conventional techniques have proved too expensive.

In addition to conventional telecommunications and radar systems, a number of interesting new applications appear feasible and are now under development:

small 12 GHz down-converters for the reception of
band VI television (including direct satellite TV broadcasts)
small X-band Doppler radars for detecting moving objects (burglar alarm)
as for traffic control (speed and distance monitoring) and
industrial applications (distance speed and level control, counting etc.).

The development of every new technique calls for new components. Integrated microwave circuits are no exception and development work is in progress on X-, K_u- and higher frequency bands:

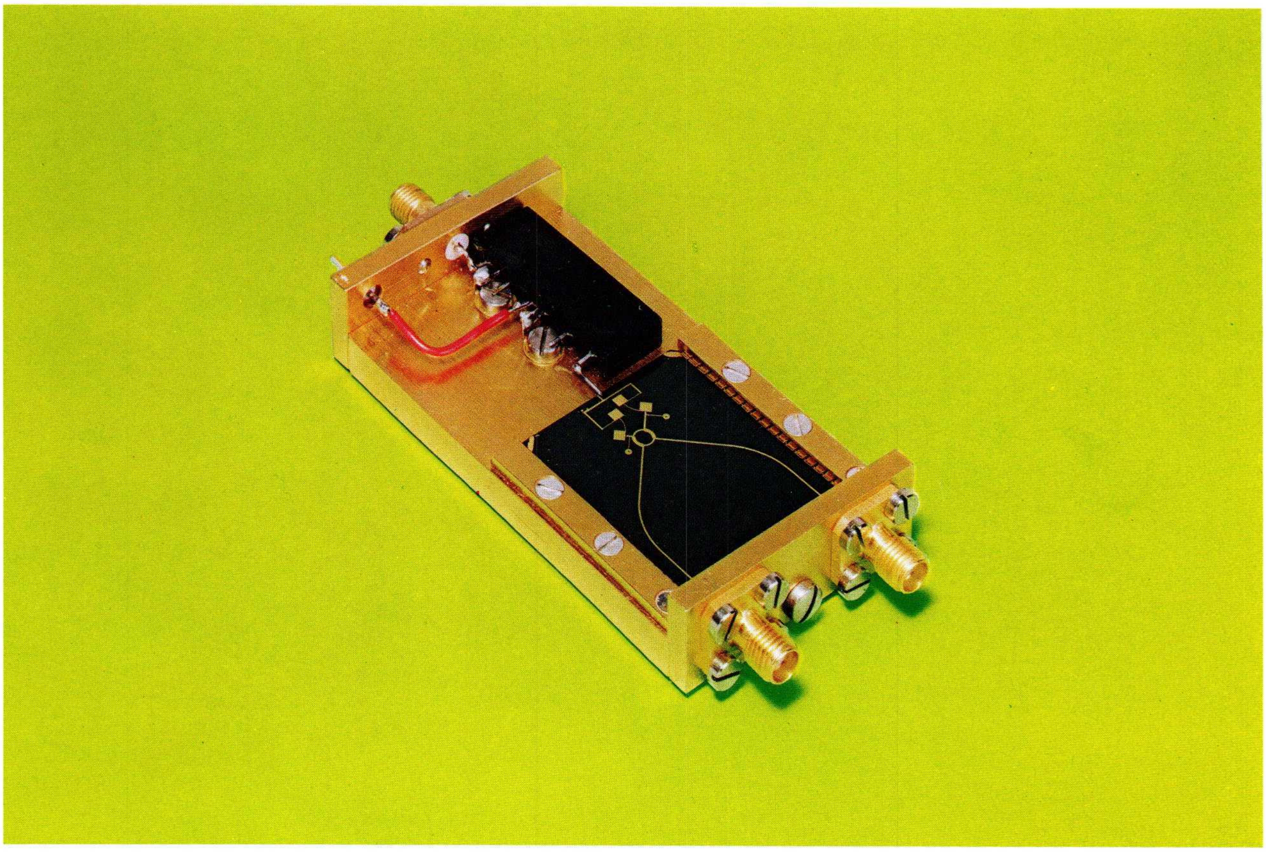
passive components such as resonators, couplers, 3 dB hybrids,
filters, circulators and phase-shifters;
modules such as X-band receiver front-ends with local oscillators,
balanced mixer stages with AFC loops, and low power X-band
transceivers with self-oscillating mixers;
complex sub-systems for X-band and K_u-band.

Microwave oscillators very often must fulfill stringent requirements with respect to frequency stability in order to stay within the allocated narrow frequency band. This problem was solved by combining specially developed small waveguide resonators with microstrip circuits.

VALVO and the Philips Research Laboratories, Hamburg, are engaged in several feasibility studies, including small converters for the planned commercial band VI television transmissions and sub-systems for the 16—18 GHz frequency band.

On the following pages, some laboratory models of X-band and K_u-band units are shown as examples of our activities in the field of integrated microwave systems.

Sub-Assembly for 12 GHz TV Converter



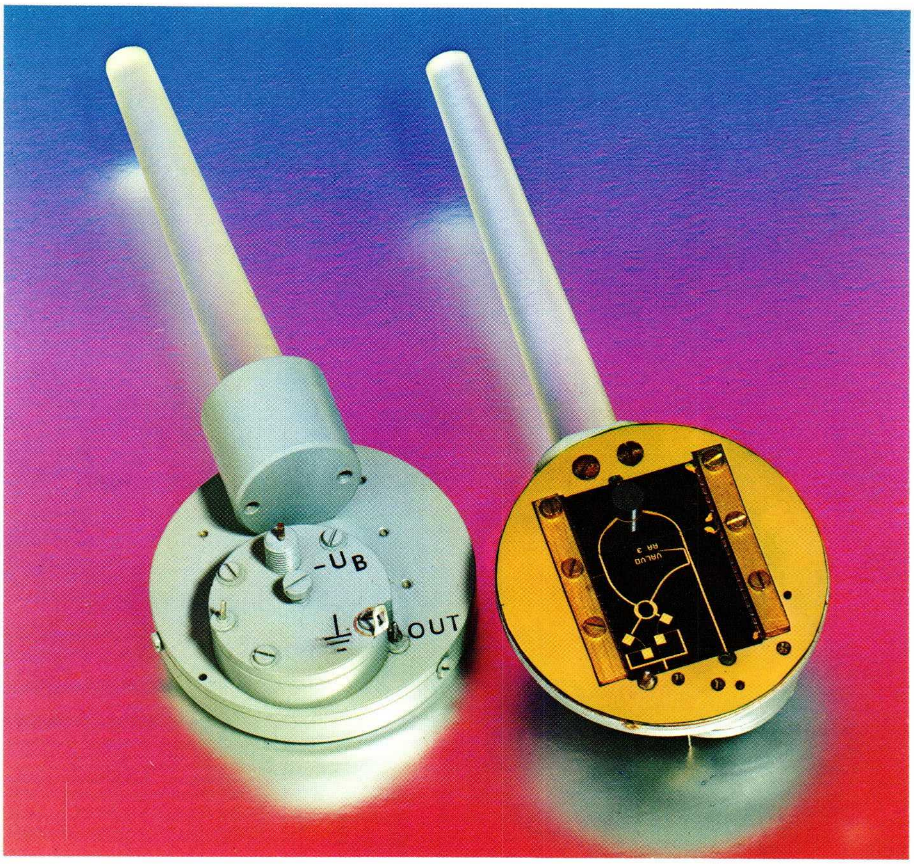
Balanced mixer (prototype, provisional type number V4SB) in microstrip technology for 12 GHz TV converters with included i. f. pre-amplifier module OM 185. The i. f. output is in bands IV and V or in VHF.

Converting from	SHF to UHF (band VI to IV/V)	SHF to VHF (band VI to I)
Operating frequency	11.8 . . . 12.2	11.8 . . . 12.2 GHz
Local oscillator frequency	11.33 . . . 11.41	GHz
Local oscillator power	8	8 mW
Noise figure (SSB)	< 12*	< 12 dB*
Conversion loss	< 8	< 8 dB
Isolation		
l. o. to signal input terminal	> 25	15 dB
l. o. input to i. f. output terminal	> 25	15 dB
Signal input		
characteristic impedance	50	50 Ω
v. s. w. r.	< 4	< 4
Local oscillator input		
characteristic impedance	50	50 Ω
v. s. w. r.	approx. 4	approx. 4

---

* Measured with an UHF resp. VHF broad-band amplifier with a noise figure of 3.5 dB. The noise figure of the OM 185 exceeds the value of 3.5 dB. Therefore the final noise figure of the complete unit will be slightly higher.

Doppler-Radar Units (provisional type number V9SB)



The Doppler-radar unit is equipped with a Gunn oscillator (on the unit at the right marked by the symbols ⏚ and U_B) with a flat cylindrical resonator operating in the TM 010 mode. By means of this construction high frequency stability of the oscillator is achieved. The oscillator signal is fed to the dielectric aerial via the circulator. Moving objects reflect the electromagnetic waves with a small shift of frequency depending on the velocity of the object relative to the aerial. The reflected signal is separated in the circulator and guided to the left hand side input of the hybrid ring. The oscillator signal is also fed via a directional coupler to be hybrid ring and the Schottky Barrier mixer diodes. The l. f. signal is available behind the low pass filter.

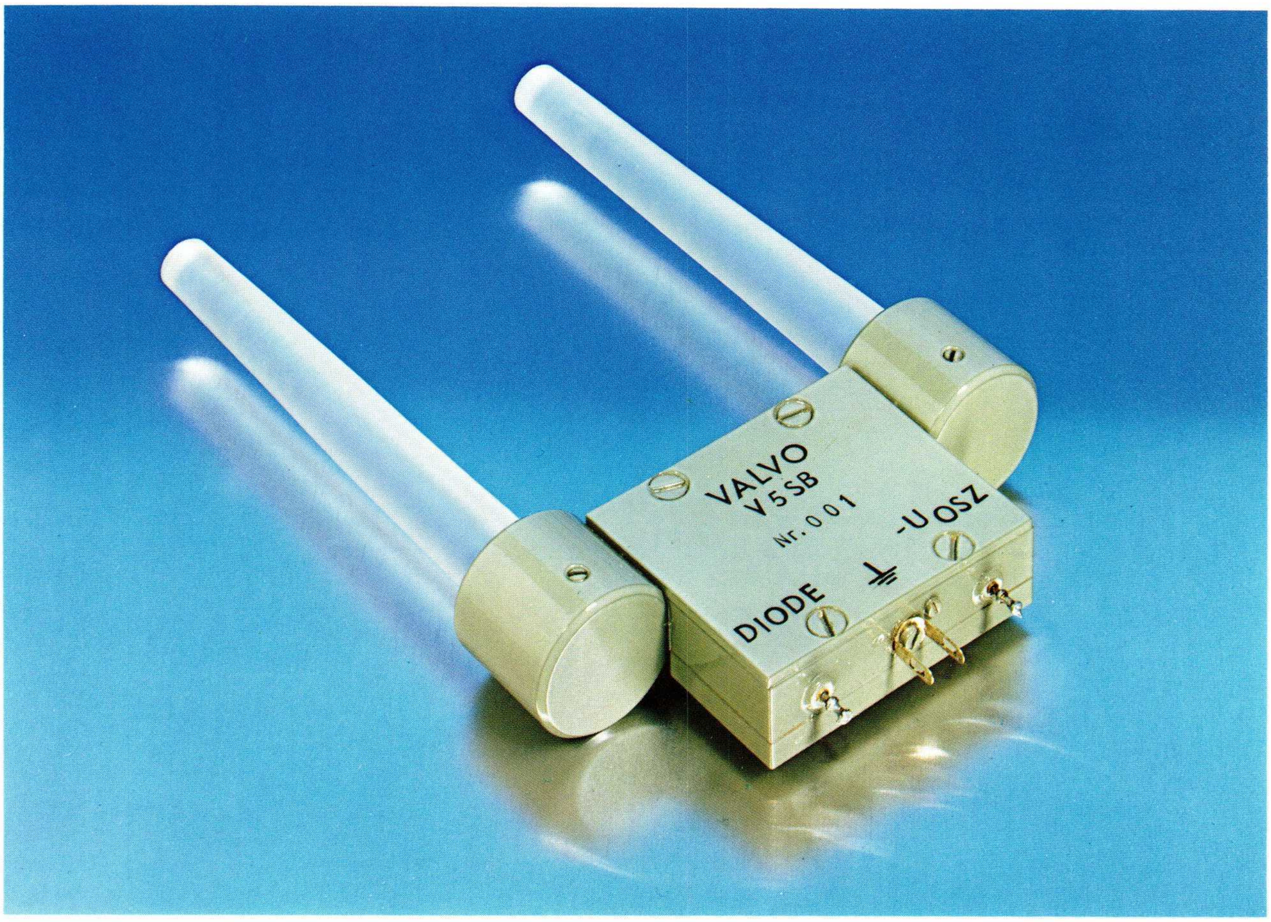
The substrate region on which the balanced mixer is assembled is made of nonmagnetic ferrite. The substrate region on which the circulator is situated is made of magnetically active ferrite.

The tangential sensitivity of the unit is high (typ. ≈85 dBm).

Typical data:

frequency 9350 ± 20 MHz or 9470 ± 20 MHz
power output ≈15 mW
frequency deviation as function of temperature
$-\triangle f/\triangle\vartheta < 1$ MHz/K
supply voltage 10 V (stabilized ± 1 %)
supply current ≈250 mA
range of temperature + 5 . . . + 45 °C

Microwave X-Band Transmitter-Receiver Unit for Presence Monitoring (prototype)

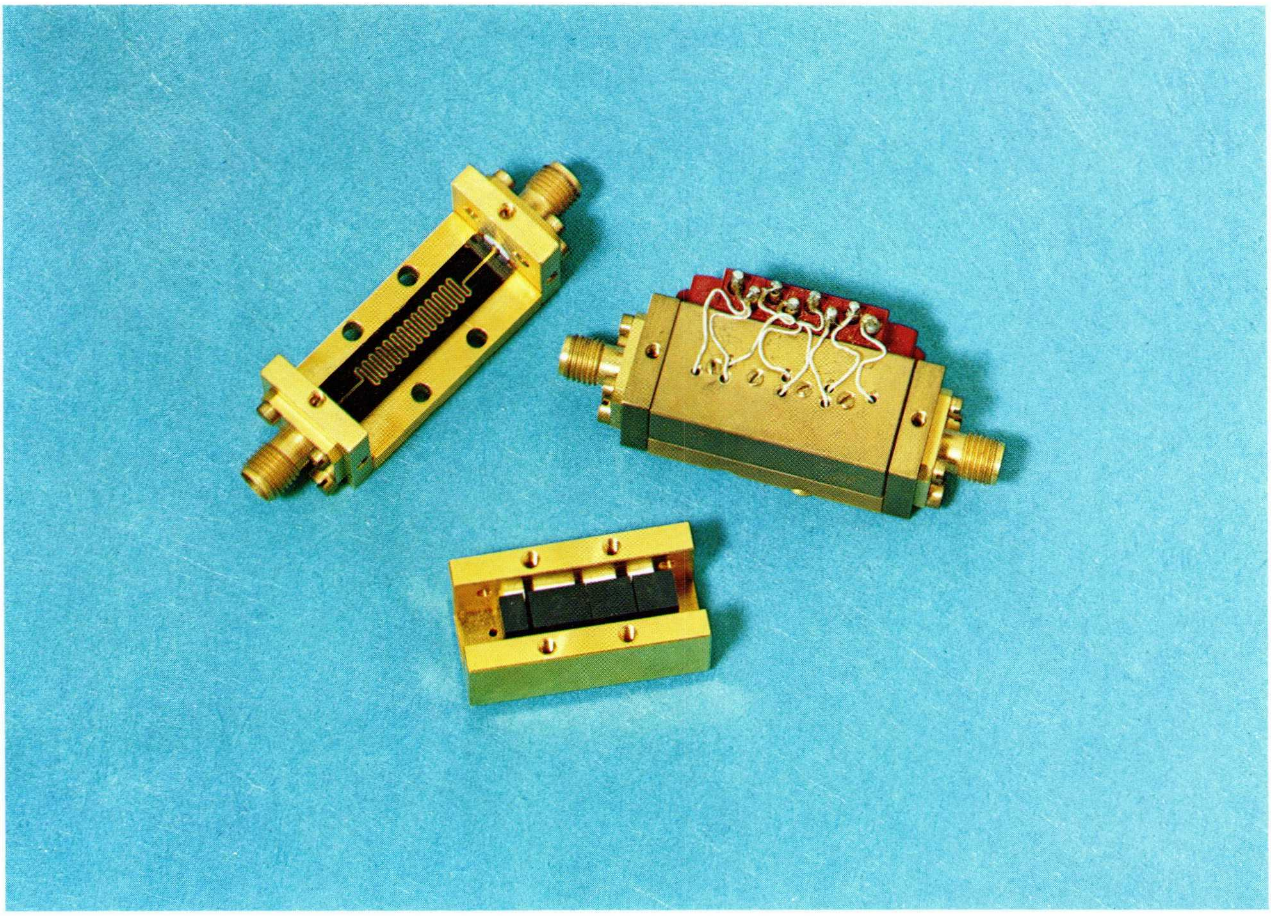


The microwave module (provisional type No. V 5 SB) contains a Gunn oscillator incorporating a flat cylindric resonator which acts in the TM 010 modus. This configuration gives on account of its high quality factor the demanded high frequency stability of <2 MHz/K. The frequency is 9350 ±20 MHz. The microwave energy of the transmitting circuit is fed into one of the two dielectric aerials.

The two aerials are de-coupled better than 40 dB. The electromagnetic waves reflected at an object which is situated in front of the unit are guided into the receiving part. This contains a Schottky Barrier diode detector and a low pass filter. The tangential sensitivity of the detector system is of about 38 dBm.

Digital X-Band Latching Phase Shifter (Four Bit)

Result of feasibility study, Philips Research Laboratory, Hamburg

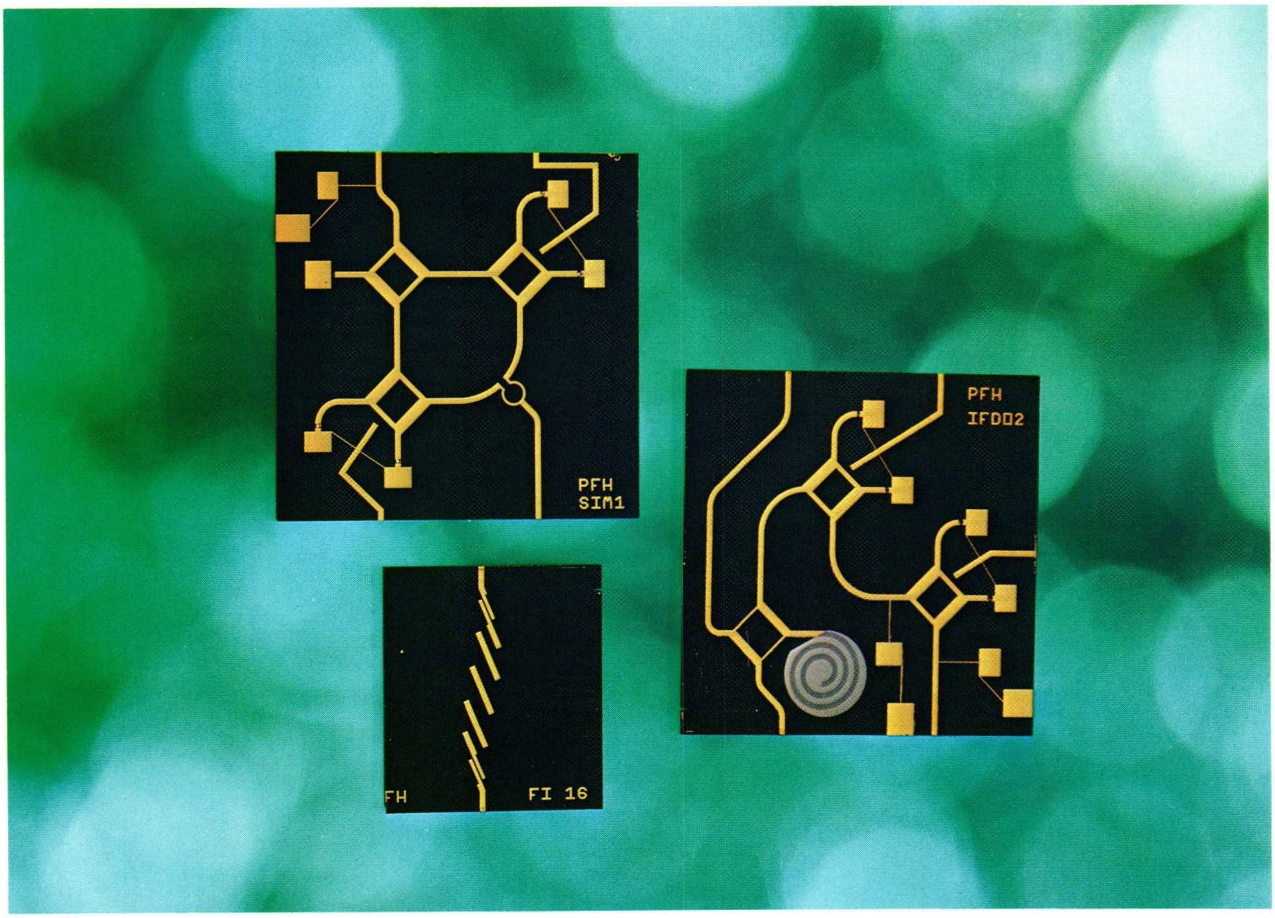


This four bit unit allows stepped phase shifts between 0° and 360°. The meanderline phase shifting structure is covered by four ferrite cores the remanent field of which can be switched individually. On the assembled unit (on the right) the switching wires can be seen.

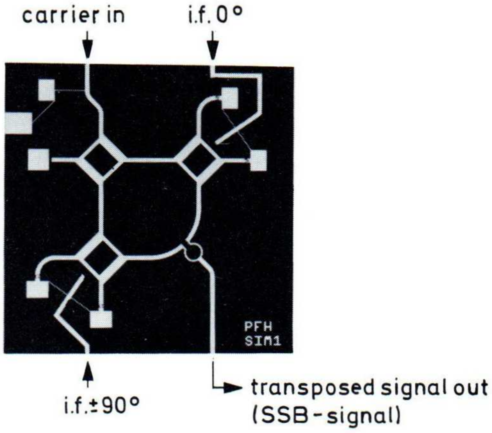
Microwave

X-Band Units (see next page)

Results of feasibility study, Philips Research Laboratory, Hamburg



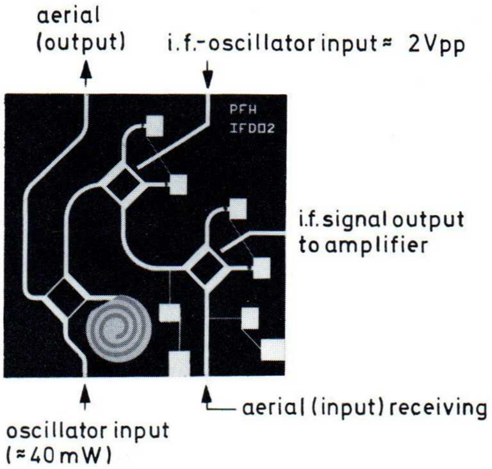
X-Band Single-Sideband-(SSB)Generator



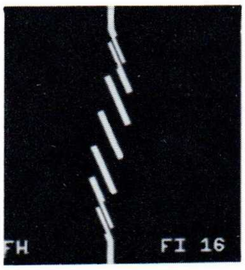
Two i. f. signals, 90° out of phase, are supplied to the two balanced mixers. The carrier signal is fed either to the 3 dB hybrid coupler or to the power splitter and the transposed SSB-signal is available at the other (opposite) port.

Performance: The image frequency suppression is better than 20 dB over a range of 2.5 GHz and better than 10 dB over the whole X-band. The carrier suppression relative to the wanted sideband is better than 20 dB over a range of 1.5 GHz. The conversion loss is typ. 8 . . . 9 dB. This unit can also be used as a SSB-receiver with similar performance.

I. F. Doppler-Radar Unit



An i. f. Doppler radar unit is about 25 dB better in sensitivity compared to a Doppler unit with direct detection for Doppler frequency shifts below 1 kHz. The local oscillator signal for the receiver is produced by a double sideband generator.

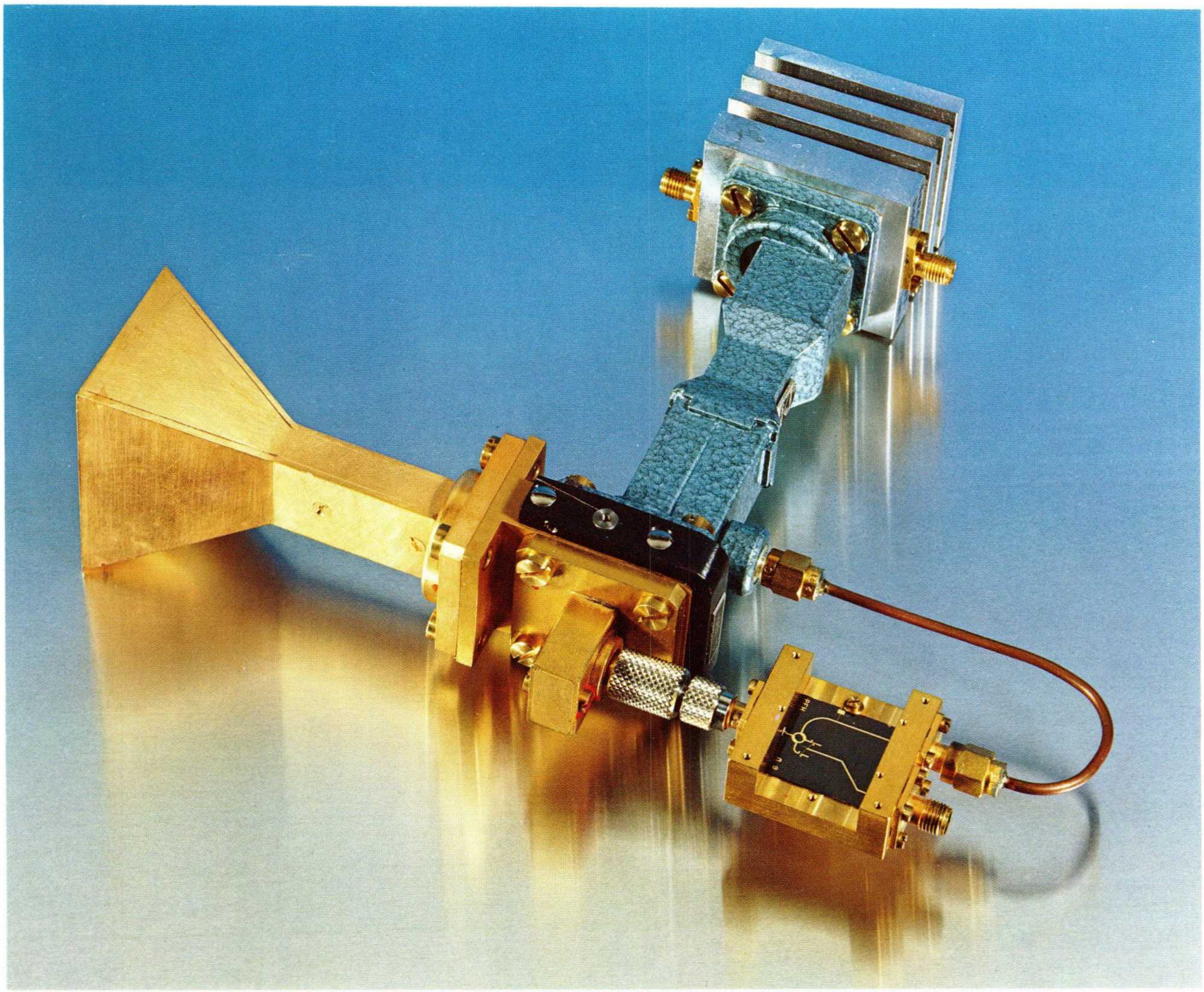


Parallel Coupled Bandpass-Filter

This parallel coupled five stage-bandpass filter has been developed for small integrated 12 GHz TV converters. It can be used for suppression of unwanted harmonics of the local oscillator.

Traffic-Radar System (Distance Monitor, 16 GHz Frequency Range)

Result of feasibility study, Philips Research Laboratory, Hamburg



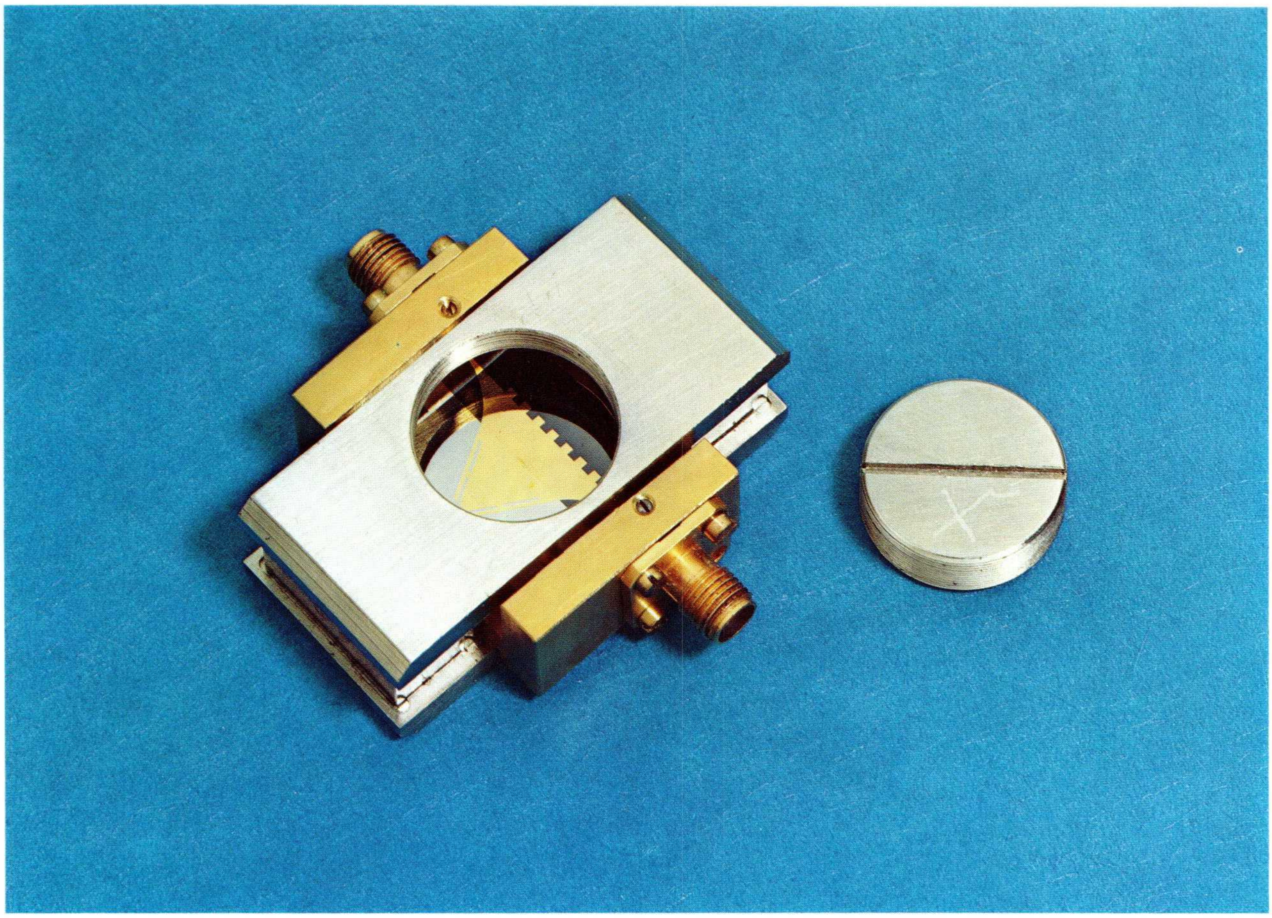
A Gunn oscillator giving 20 to 40 mW output (upper part of the picture, in aluminium) tuned in frequency with a varactor by means of a saw-tooth voltage. Max. Δf is 400 MHz. In addition, the unit contains a 3 dB waveguide coupler, a small-sized circulator, a horn antenna and an integrated balanced mixer.

An interesting application is distance and speed monitoring of vehicles.

Microwave

Peripheral Mode Isolator (Field Displacement Type) for the K_u-Band (12.4—18 GHz)

Result of feasibility study, Philips Research Laboratory, Hamburg

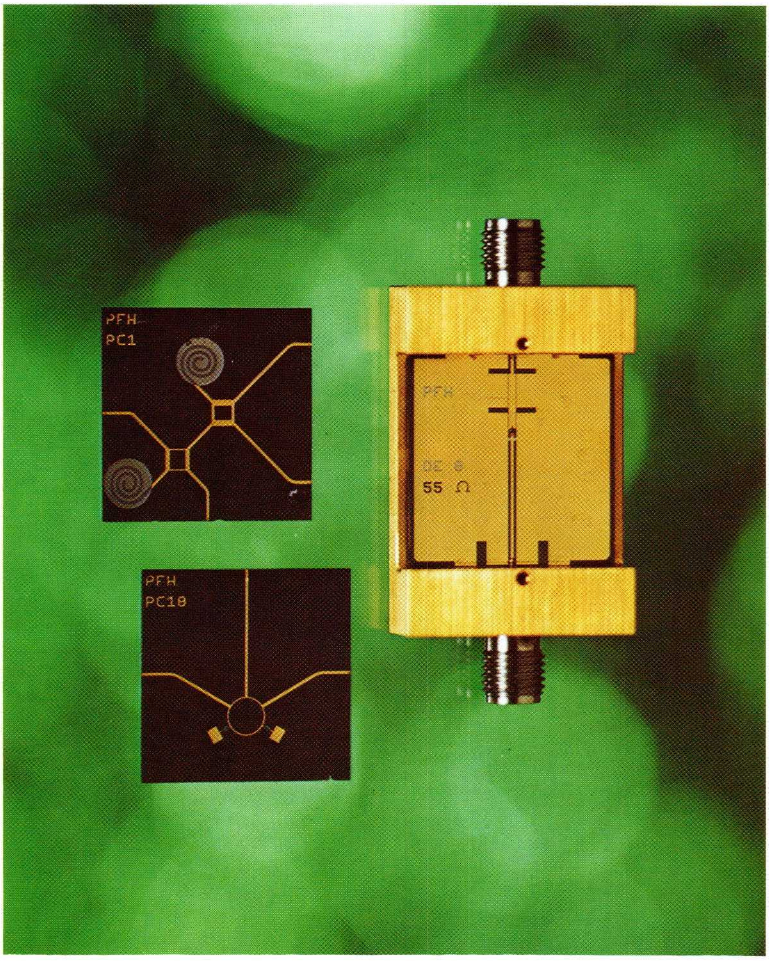


The unit includes a permanent magnet set, giving a field of $\approx 4 \cdot 10^5$ A/m. The upper pole piece has been removed for demonstration purposes. Isolation is better than 30 dB over the whole K_u-band. The insertion loss ($\leqq 2$ dB) and the low VSWR make this broadband device very suitable for swept frequency techniques.

Microwave

K_u-Band Units

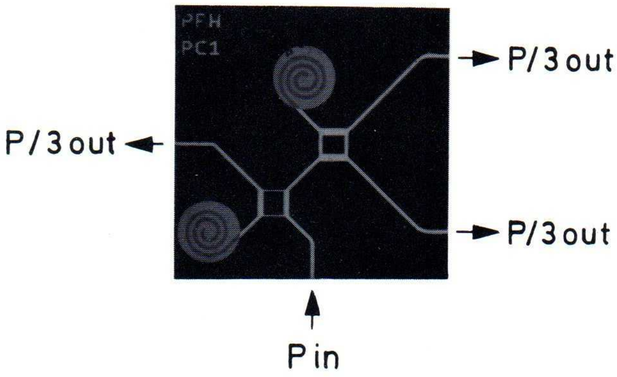
Result of feasibility study, Philips Research Laboratory, Hamburg



Broadband Detector in Coplanar Waveguide Technique for the K_u-Band (unit on the right)

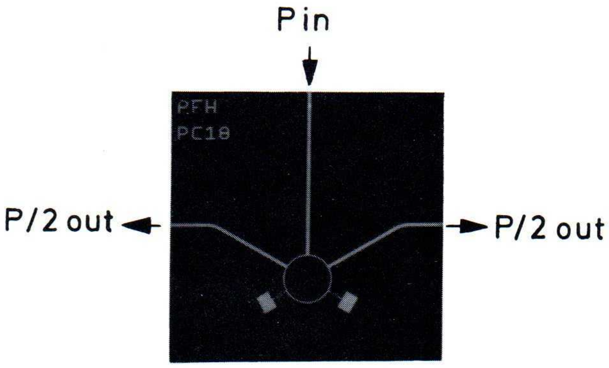
The microwave energy is fed via the lower OSM-connector to a beam lead backward diode which does not need additional bias for a low level of microwave energy. The l. f. signal is available at the upper OSM-connector after passing a low pass filter. Tangential sensitivity and flatness (K_u-band) are similar to the coaxial counterpart.

Power Splitting Network with De-coupled Output Ports for the K_u-Band



Over a bandwidth of 3 GHz the output signals are indentical within less than 0.5 dB. The conversion loss typ. is less than 1 dB. Isolation between any two output ports is better than 20 dB in the above mentioned 3 GHz range.

Power Splitting Network for the K_u-Band with De-coupled Output Ports



The performance is similar to the above mentioned unit. The two output signals are of indentical phase and the output power differs by less than 0.1 dB in magnitude. The isolation is given by two lumped 100-Ω resistors.

Circulators

Circulators offer advantages and remarkable simplifications for signal processing equipment. As the result of continuous basic research on ferrite materials in the Philips research laboratories, and development of special types for many applications, a large scale of circulator types is available for the different frequency regions including the important VHF and UHF ranges.

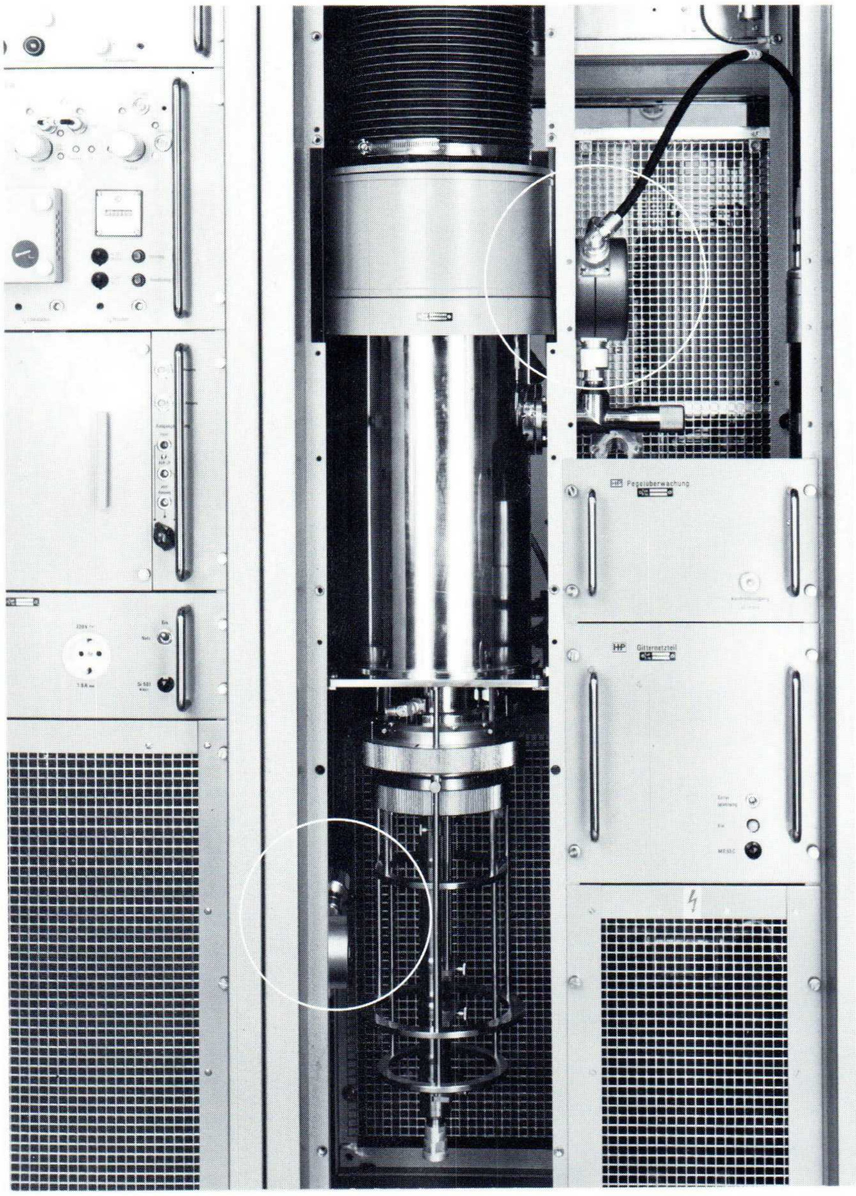
At present our efforts in development are directed at decreasing the size of existing VHF and UHF types and on realizing broadband VHF types for mobile radio applications. For the latter, a lumped-circuit construction with a sophisticated line crossing structure had to be developed.

The VALVO program concerns Y-junction circulators in stripline, waveguide – and microstrip technology and furthermore four-port devices. Some of the types can be delivered on request with different connectors and different values of characteristic impedance.

The use of circulators may be beneficial in the design of

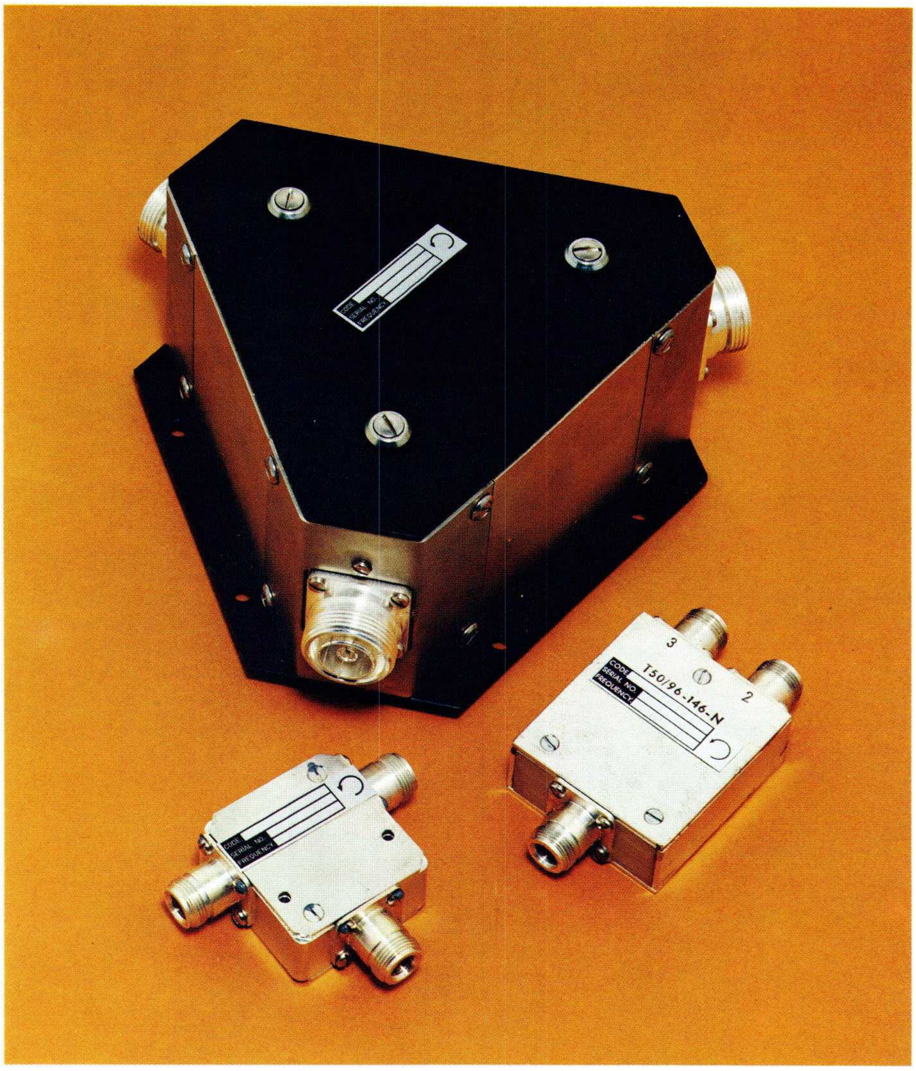
- amplifiers,
- branching and multiplexing devices,
- variable attenuators and phase shifters,
- modulators,
- measuring systems to get a higher precision,
- and will allow the protection of final stages.

The common viewpoint of all those applications is:
Higher quality of signals by feedback-free coupling of varying loads.

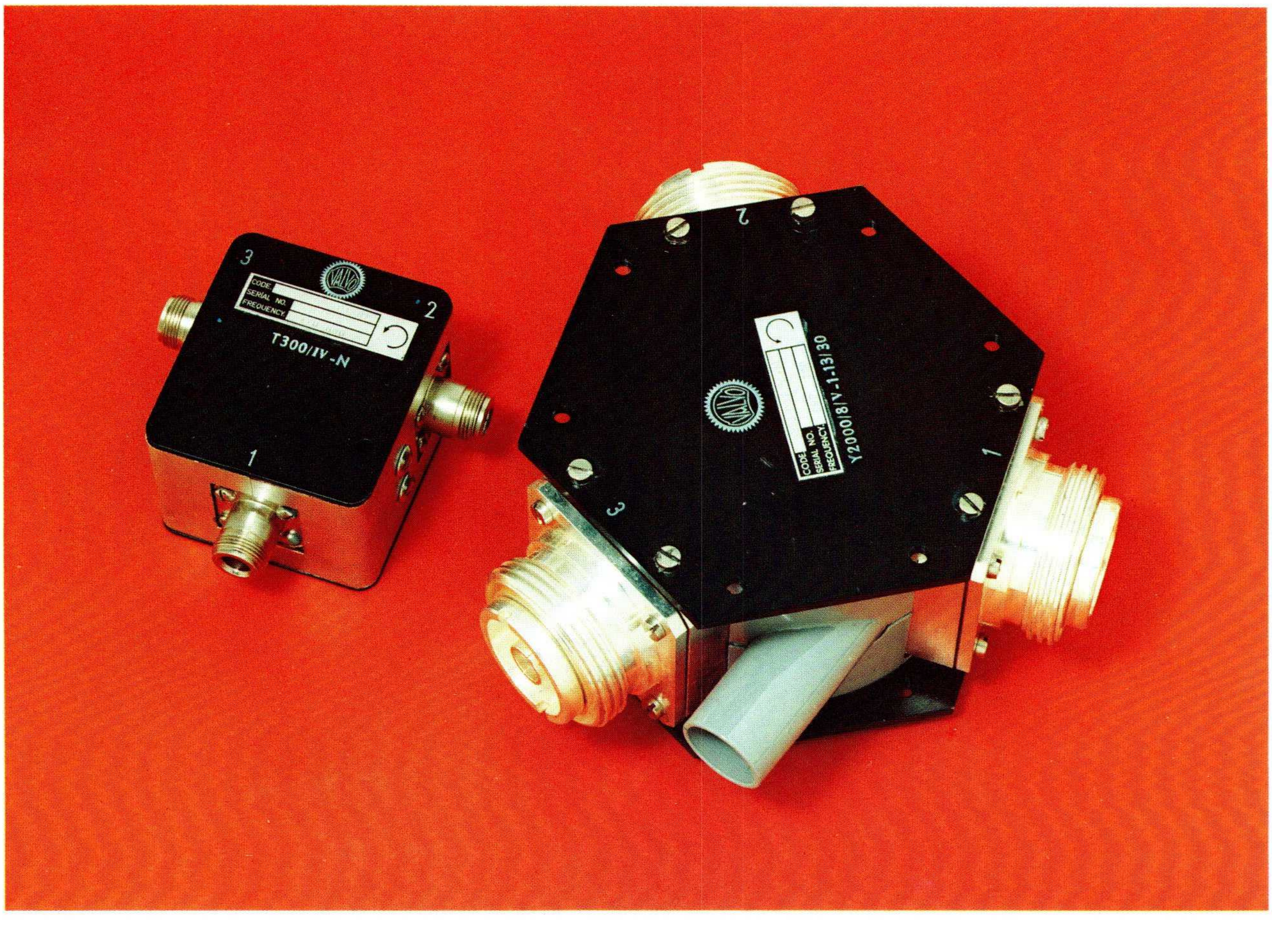


TV Transposer Type 1000 GDRP (Courtesy Hans H. Plisch, Viernheim).
In several stages the VALVO Circulators Y 100 and Y 2000 are installed as marked in the opened unit.

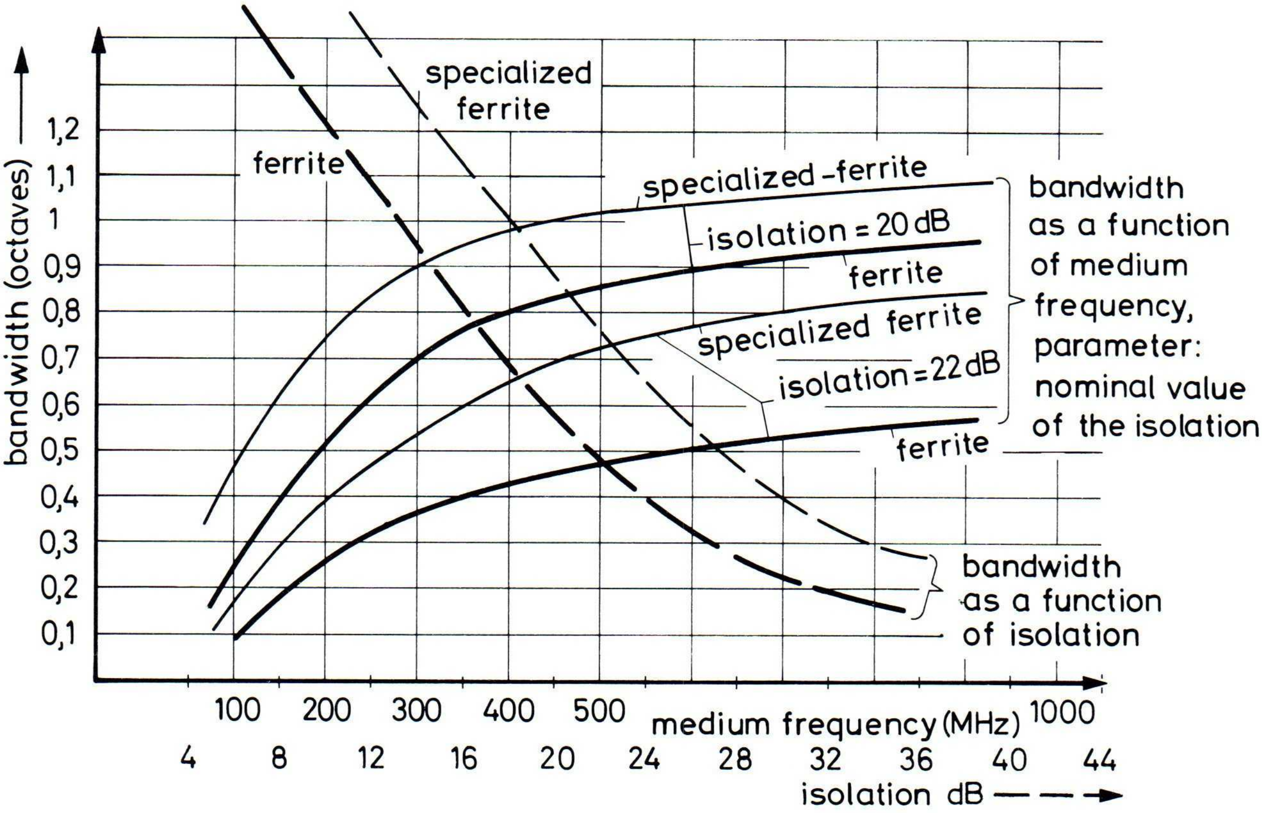
Three VALVO Circulators



400 W circulators Y 400/III in triangle version for the TV frequency region III (upper part of the figure).
Light weight small 100 W circulator T 100/IV-N for the frequency range IV equipped with N connectors (left hand, lower part of the picture).
Newly developed 50 W circulator for the frequency range 96–146 MHz (Prototype T 50/96-146-N).



Small high power circulator Y 2000/V-13/30 for 2000 W at UHF-TV band V
Circulator T 300/IV-N for 300 W at UHF-TV band IV



Performance of modern circulators. State of development, ca. end of 1972, for rough-orientation only.

The declining curves represent the bandwidth in octaves as a function of isolation for usual and highly specialized ferrites.

In the second field of curves the bandwidth (in octaves) as a function of medium frequency is drawn. Parameter: nominal value of isolation.

In this list the preferred types of our UHF, VHF circulators are mentioned. Further information is available from our data sheets.

On request, circulators can be manufactured for other temperature ranges and with other connectors.

Type	Frequency (MHz)	Power (W)	Preferred Type of Connector	Characteristic Impedance (Ω)
T 50/IV	470 . . . 600	50	N; 4.1/9.5 3.5/9.5	50 60
T 50/V	600 . . . 800	50	N; 4.1/9.5 3.5/9.5	50 60
T 50/V-3	800 . . . 960	50	N; 4.1/9.5 3.5/9.5	50 60
T 100/IV	470 . . . 600	100	N; 4.1/9.5 3.5/9.5	50 60
T 100/V	600 . . . 800	100	N; 4.1/9.5 3.5/9.5	50 60
T 100/V-3	800 . . . 960	100	N; 4.1/9.5 3.5/9.5	50 60
T 300/IV	470 . . . 600	300	N; 7/16	50
T 300/V	600 . . . 800	300	N; 7/16	50
T 300/V-3	800 . . . 960	300	N; 7/16	50
Y 400/IV	470 . . . 600	400	N; 7/16	50
Y 400/V	600 . . . 800	400	N; 7/16	50
Y 400/V-2	710 . . . 860	400	N; 7/16	50
Y 2000/IV	470 . . . 600	2000	7/16	50
Y 2000/V-1	590 . . . 720	2000	7/16	50
Y 2000/V-2	710 . . . 860	2000	7/16	50
T 50-120-N	96 . . . 146	50	N	50
T 100-120-N	96 . . . 146	100	N	50
T 50-300-N	225 . . . 400	50	N	50
T 100-300-N	225 . . . 400	100	N	50
Y 400/III-1	170 . . . 200	400	N	50
Y 400/III-2	195 . . . 230	400	N	50
T 2000/III-1	170 . . . 200	2000	N	50
T 2000/III-2	200 . . . 230	2000	N	50

SHF Broadband Circulators and Isolators

Several medium power broadband circulators with a bandwidth of ca. one octave had been developed. These building elements are of

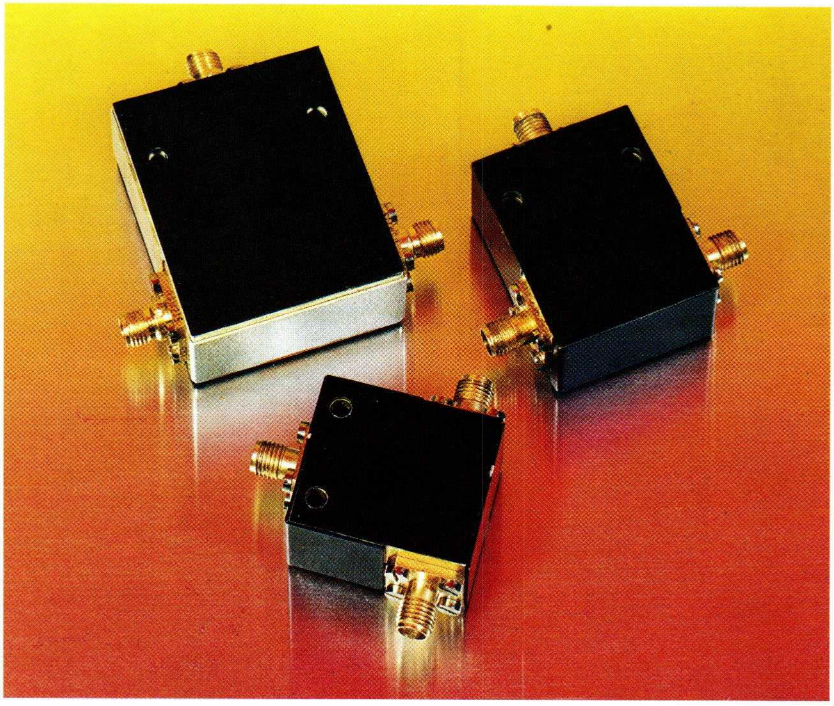
- optimum small size
- low price
- and in current production.

All types are equipped with SMA connectors and can be used in measuring and communication equipment.

Electrical data, typical values (at $\vartheta = 25\,^\circ C$)

Type No.	2722 162 01501	2722 162 01511	2722 162 01811	2722 162 01821
Frequency range	2 . . . 4 GHz	3 . . . 6 GHz	4 . . . 8 GHz	7 . . . 12.7 GHz
Isolation	24 dB	27 dB	23 dB	23 dB
Insertion loss	0.35 dB	0.3 dB	0.3 dB	0.4 dB
V. S. W. R.	1.15	1.1	1.15	1.15
Maximum power	50 W	20 W	10 W	10 W
Temperature range	–10 . . . +70 °C	–10 . . . +70 °C	–10 . . . +70 °C	–10 . . . +70 °C
Weight	≈300 g	≈120 g	≈100 g	≈60 g

The data of the familiar isolators correspond to those of the circulators.



SHF Broadband Circulators:
2722 162 01511, 2722 162 01811 (above)
2722 162 01821 (below)

SHF Broadband Isolators:
2722 162 02111, 2722 162 02071 (above)
2722 294 00811 (below)

Electron Tubes

Transmitting tubes (Triodes, Tetrodes, Pentodes)
Tubes for R. F. heating (Triodes)
Tubes for microwave equipment:
Klystrons, high power
Klystrons, medium and low power
Travelling-wave tubes
Communication magnetrons
Magnetrons for micro-wave heating
Miscellaneous devices
Special Quality tubes
Receiving tubes
TV picture tubes
Cathode-ray tubes
Photo tubes
Camera tubes
Photoconductive devices
Associated accessories
Photomultiplier tubes
Scintillators
Photoscintillators
Radiation counter tubes
Semiconductor radiation detectors
Neutron generator tubes
Voltage stabilizing and reference tubes
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

VALVO

Further information about the products described in this brochure may be obtained from the following companies:

Argentina
FAPESA I.y.C.
Av. Crovara 2550
Tel. 652-7438/7478
BUENOS AIRES

Australia
Philips Industries Ltd.
Elcoma Division
95-99 York Street
Tel. 20223
SYDNEY, N.S.W. 2000

Austria
Österreichische Philips
Bauelemente Industrie
G.m.b.H.
Zieglergasse 6
Tel. 93 26 22
A 1072 VIENNA

Belgium
M.B.L.E.
80, Rue des Deux Gares
Tel. 23 00 00
1070 BRUSSELS

Brazil
IBRAPE S.A.
Av. Paulista, 2073-S/Loja
Tel. 278-1111
SAO PAULO, SP.

Canada
Philips Electron Devices
116, Vanderhoof Ave.
Tel. 425-5161
TORONTO 17, Ontario

Chile
Philips Chilena S.A.
Av. Santa Maria 0760
Tel. 39-40 01
SANTIAGO

Colombia
SADAPE S.A.
Calle 19, No. 5-51
Tel. 422-175
BOGOTA D.E. 1

Denmark
Miniwatt A/S
Emdrupvej 115 A
Tel. (01) 69 16 22
DK-2400 KØBENHAVN NV

Finland
Oy Philips Ab
Elcoma Division
Kaivokatu 8
Tel. 65 80 33
SF-00100 HELSINKI 10

France
R.T.C.
La Radiotechnique-Compelec
130 Avenue Ledru Rollin
Tel. 357-69-30
PARIS 11

Germany
VALVO GmbH
Valvo Haus
Burchardstrasse 19
Tel. (0411) 32 96-1
2 HAMBURG 1

Greece
Philips S.A. Hellénique
Elcoma Division
52, Av. Syngrou
Tel. 915.311
ATHENS

Hong Kong
Philips Hong Kong Ltd.
Components Dept.
(Kowloon Branch)
7/F. Wai Yip Industrial
Building
41 Tsun Yip St. Kwuntong
Tel. K-42 82 05-8
HONG KONG

India
INBELEC Div. of
Philips India Ltd.
Band Box House
254-D, Dr. Annie Besant Road
Tel. 457 311 to 15
Prabhadevi, BOMBAY -25- DD

Indonesia
P.T. Philips-Ralin Electronics
Elcoma Division
Djalan Gadjah Mada 18
Tel. 44 163
DJAKARTA

Ireland
Philips Electrical (Ireland) Ltd.
Newstead, Clonskeagh
Tel. 69 33 55
DUBLIN 14

Italy
Philips S.p.A.
Sezione Elcoma
Piazza IV Novembre 3
Tel. 69 94
MILANO

Japan
NIHON PHILIPS
32nd Fl., World Trade
Center Bldg.
5, 3-chome, Shiba
Hamamatsu-cho Minato-ku,
Tel. (435) 5204-5
TOKYO

Mexico
Electrónica S.A. de C.V.
Varsovia No. 36
Tel. 5-33-11-80
MEXICO 6, D.F.

Netherlands
Philips Nederland N.V.
Afd. Elonco
Boschdijk, VB
Tel. (040) 79 33 33
EINDHOVEN

New Zealand
EDAC Ltd.
70-72 Kingsford Smith Street
Tel. 873 159
WELLINGTON

Norway
Electronica A.S
Middelthunsgate 27
Tel. 46 39 70
OSLO 3

Peru
CADESA
Jr. Ilo, No. 216
Appartado 10132
Tel. 27 73 17
LIMA

Philippines
EDAC
Philips Industrial Dev. Inc.
2246 Pasong Tamo
Tel. 88-94-53 (to 56)
MAKATI-RIZAL

Portugal
Philips Portuguesa S.A.R.L.
Av. Eng. Duharte Pacheco 6
Tel. 68 31 21
LISBOA 1

Singapore
Philips Singapore Private Ltd.
8th Floor, International
Building
360 Orchard Road
Tel. 37 22 11 (10 lines)
SINGAPORE-9

South Africa
EDAC (Pty.) Ltd.
South Park Lane
New Doornfontein
Tel. 24/6701-2
JOHANNESBURG

Spain
COPRESA S.A.
Balmes 22
Tel. 2 32 66 80
BARCELONA 7

Sweden
ELCOMA A.B.
Lidingövägen 50
Tel. 08/67 97 80
10250 STOCKHOLM 27

Switzerland
Philips A.G.
Edenstrasse 20
Tel. 01/44 22 11
CH-8027 ZUERICH

Taiwan
Philips Taiwan Ltd.
San Min Building, 3rd Fl.
57-1, Chung Shan N. Road
Section 2
Tel. 553 101-5
TAIPEI

Turkey
Turk Philips Ticaret A.S.
EMET Department
Gümüssuyu Cad. 78-80
Tel. 45.32.50
Beyoglü, ISTANBUL

United Kingdom
Mullard Ltd.
Mullard House
Torrington Place
Tel. 01-580 6633
LONDON WC 1 7 HD

United States
North American Philips
Electronic Component Corp.
230, Duffy Avenue
Tel. (516) 931-6200
HICKSVILLE, N.Y. 11802

Uruguay
Luzilectron S.A.
Rondeau 1567, pisto 5
Tel. 9 43 21
MONTEVIDEO

Venezuela
C.A. Philips Venezolana
Elcoma Department
Colinas de Bello Monte
Tel. 72.01.51
CARACAS

1. 73

P. Durh

YK 1195
YK 1196

U.H.F. POWER KLYSTRONS

for 55 kW vision transmitters and
sound transmitters in the U.H.F. bands IV/V

vapour cooled, electromagnetic focused,
four external cavities, high stability dispenser-type
cathode, metal ceramic construction

Frequency range:

YK 1195	470...610 MHz
YK 1196	590...720 MHz

Cathode heating: indirect by d.c.

Heater voltage	V_f = 8.5 V ± 3 %
Heater current	$I_f \approx$ 22...27 A 1)
Cold heater resistance	$R_{fo} \approx$ 30 mΩ
Preheating time 2)	
at V_f = 8.5 V	$t_{h\ min}$ = 300 s
at "stand-by"-heating V_f = 6 V	$t_{h\ min}$ = 0 s

Focusing:

Focusing coil current	9...12 A
Resistance of coils	
cold (20 °C)	7.2...9.5 Ω
opering at t_{amb} = 20 °C	$\leqq$ 11 Ω

Beam control:

The accelerator electrode voltage allows to adjust the beam current between 0 and 100 %.

Operating of ion getter appendix pump: 3)

Open circuit voltage with respect to cathode	3...4 kV
Internal resistance of power supply	300 kΩ

Notes see page 5

Cooling:

Cathode socket and accelerator electrode	air $q \approx 0.15\ m^3/min$, t_i max. 45 °C
Collector	vapour $^{4)}$ volume of water converted to steam 27 cm^3/min per kW collector dissipation resulting in 43 l/min steam per kW collector dissipation
Drift tubes	water inlet flow to drift tubes and collector connected in series $q = 9$ l/min, t_i max. 80 °C, $p_i = 200$ kPa (= 2 atm)
Cavities 3 und 4	forced air each: $q = 1.5\ m^3/min$, t_i max. 45 °C, $p_i = 250$ Pa

Weight:

Net weight YK 1195/96	approx. 80 kg
Cavities	approx. 45 kg
Magnet frame with coils and boiler	approx. 855 kg

Mounting:

Mounting position	vertical, collector up

To remove the tube from the magnet frame a total free height of 3.5 m exclusive hoist is required.

Limiting Values: (absolute max. ratings)

Heater voltage	max. 9.5 V
Cathode voltage	max. -24 kV ×
Cold cathode voltage	max. -27 kV –
Cathode current	max. 7 A
Drift tube current	max. 150 mA
Accelerator electrode current	max. 6 mA $^{5)}$
Collector dissipation	max. 150 kW
Load v.s.w.r.	max. 1.5 : 1
Temperature of tube envelope	max. 175 °C

Notes see page 5

Typical operating conditions:

55 kW vision transmitter (standards CCIR-G, RTMA-M and RTMA-M*)

Output power, peak sync.	58 kW	
Cathode voltage	-22.5 kV	
Cathode current	6.4 A	6)
Drift tube current		
without drive	15 mA	
at 58 kW peak sync., black level	40 mA	
Focusing coil current	10.5 A	
Drive power, peak sync.		
YK 1195 - channel 21	10 W	7)
channel 38	7 W	7)
YK 1196 - channel 37	7 W	7)
channel 51	5 W	7)
Bandwidth at -1 dB points	8 MHz	8)
Differential gain	75 %	9)
Differential phase	6 deg	9)
Linearity	65 %	10)
Operating efficiency (Sync)	40 %	
Saturation output power	63 kW	
Saturation efficiency	44 %	

11 kW FM sound transmitter

Output power	12 kW	
Cathode voltage	-22.5 kV	
Accelerator electrode voltage	-14 kV	11)
Cathode current	1.5 A	
Focusing coil current	9 A	
Drive power	1.5 W	7)
Bandwidth at -1 dB points	1 MHz	

Notes see page 5

Accessories: 12)	YK 1195	YK 1196
A. Supplied with each tube		
set of sealing rings	TE 1147	TE 1147
B. Accessories required for each tube:		
Collector radiation suppressor (factory fitted to the tube)	TE 1111	TE 1132
Accelerator electrode ring (factory fitted to the tube)	TE 1141	TE 1141
Cathode ring (factory fitted to the tube)	TE 1142	TE 1142
Water inter-connecting pipes between drift tubes T_1-T_2:	TE 1134 A	TE 1135 A
T_2-T_3:	TE 1134 B	TE 1135 B
T_3-T_4:	TE 1134 C	TE 1135 C
T_4-T_5:	TE 1134 D	TE 1135 D
Extension pipes for drift tubes	6x TE 1133 A 2x TE 1133 B	6x TE 1133 A 2x TE 1133 B
Flexible water pipes		
between tube and boiler	TE 1145 A	TE 1145 A
between frame and tube	TE 1145 B	TE 1145 B
C. Accessories required in addition to pos. B for adaptation of sockets for replacement by the klystron YK 1195/96		
Magnet flux ring	TE 1138	TE 1138
Water protection shield	TE 1139	TE 1139
Spark gap	TE 1140	TE 1140
Heater/cathode connection cable (red)	TE 1146 A	TE 1146 A
Heater connection cable (blue)	TE 1146 B	TE 1146 B
Accelerator electrode connection cable (yellow)	TE 1146 C	TE 1146 C
D. Accessories required in addition to pos. B and C for first equipment		
Cavities	3x TE 1121 A 1x TE 1121 D	3x TE 1098 A 1x TE 1098 D
Input coupler	TE 1122 A	TE 1102
Load coupler for cavities 2 and 3	2x TE 1122 B	2x TE 1102
Output coupler for cavity 4	TE 1123	TE 1105
Arc detector	TE 1107	TE 1107
Magnet frame with coils	TE 1108	TE 1108
Boiler	TE 1110	TE 1110
Tool set	TE 1137	TE 1137
Recommended circulator	2722 162 01551 (T 100/IV-N)	2722 162 01561 (T 100/V-N)

Notes see page 5

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[1] Switching on the heater voltage the heater current must never exceed a peak value of 65 A.

[2] In case of a mains failure an interruption up to 30 s can be tolerated without new preheating.
After min. 10 minutes of stand-by heating time at 6.0 V, the beam current may be switched on, the heater voltage must be increased to its nominal value of 8.5 V simultaneously. Operation under stand-by condition is restricted to continuous periods of 2 weeks at a time. Stand-by periods should be separated by similar periods of rest or full operation.

[3] During storage to ensure that the klystron is ready for immediate operation the ion getter pump should be operated at least every 6 months, 3 months being recommended. For details see klystron instruction handbook.

[4] In order to avoid corrosion of the cooling system, pure deionised water must be used as the coolant. (Resistivity min. 10 kΩ · cm).

[5] The accelerator electrode voltage must not be positive with respect to the body (ground).

[6] If the accelerator electrode is connected to the body (ground) via a 10 kΩ resistor, the cathode current is within ± 5 % of the value given in the graph on page 8.

[7] The drive power is defined as the power delivered to a matched load.

[8] Varying the input level between black and white at any sideband frequency within this bandwidth will not cause a variation of the peak sync. output power exceeding 0.5 dB.

[9] measured with a sawtooth signal from black level to peak white occurring at each line and superimposed colour subcarrier with a 10 % peak to peak amplitude

[10] measured with a ten steps staircase signal from black level to peak white occurring at each line

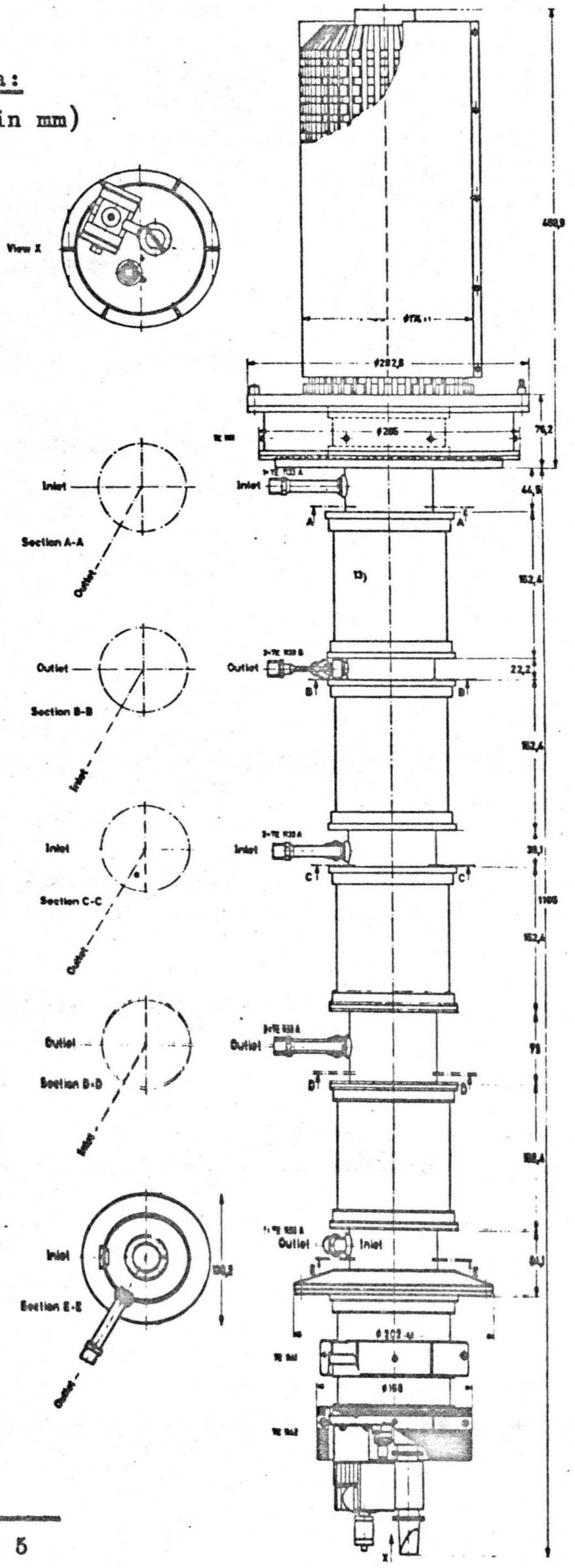
[11] For adjusting the cathode current in sound operation a voltage divider should be demensioned according to an accelerator electrode current of max. 1.5 mA.

[12] 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 admissable, non-dangerous level the tube must be shielded and any possible radiation path must be blocked by at least 1 mm of brass or an equivalent portion of non-magnetic X-ray absorbing material. The proper use of Valvo accessory parts will provide the necessary shielding.

[13] The ceramic of the output section is beryllium oxide the dust of which is toxic. For the disposal of burnt-out tubes observe government regulations.

Mechanical data:
(dimensions in mm)

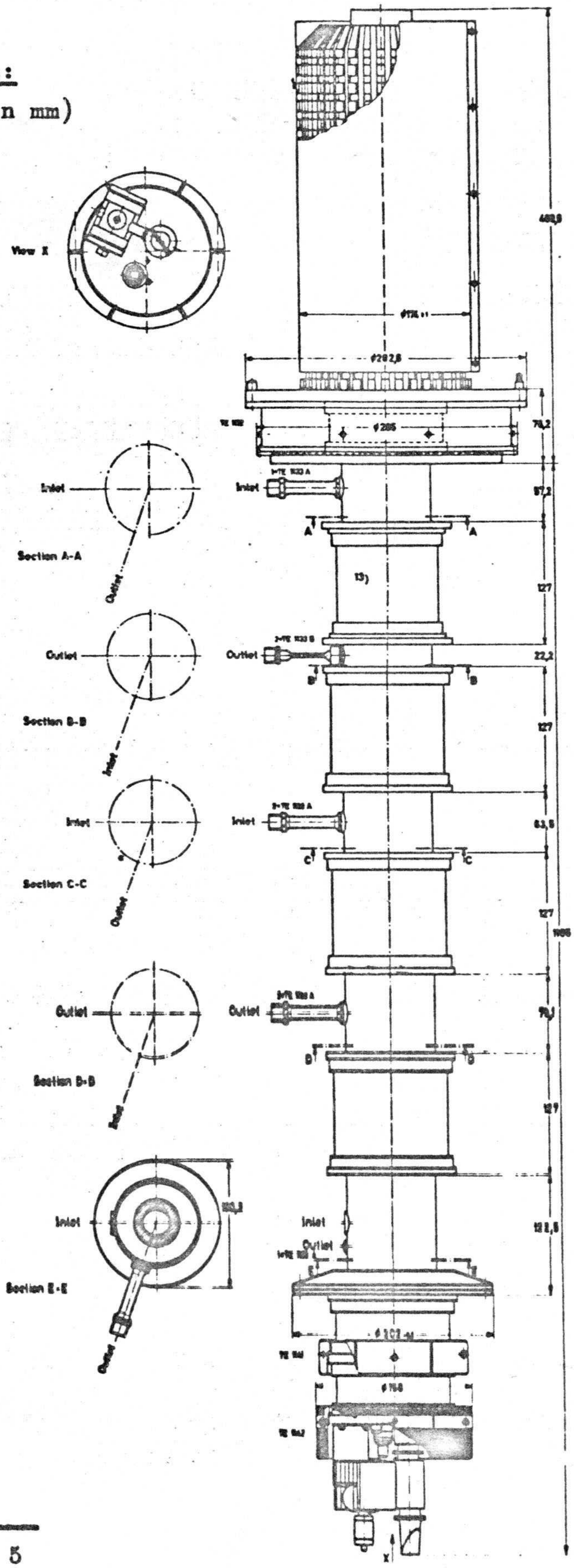
YK 1195



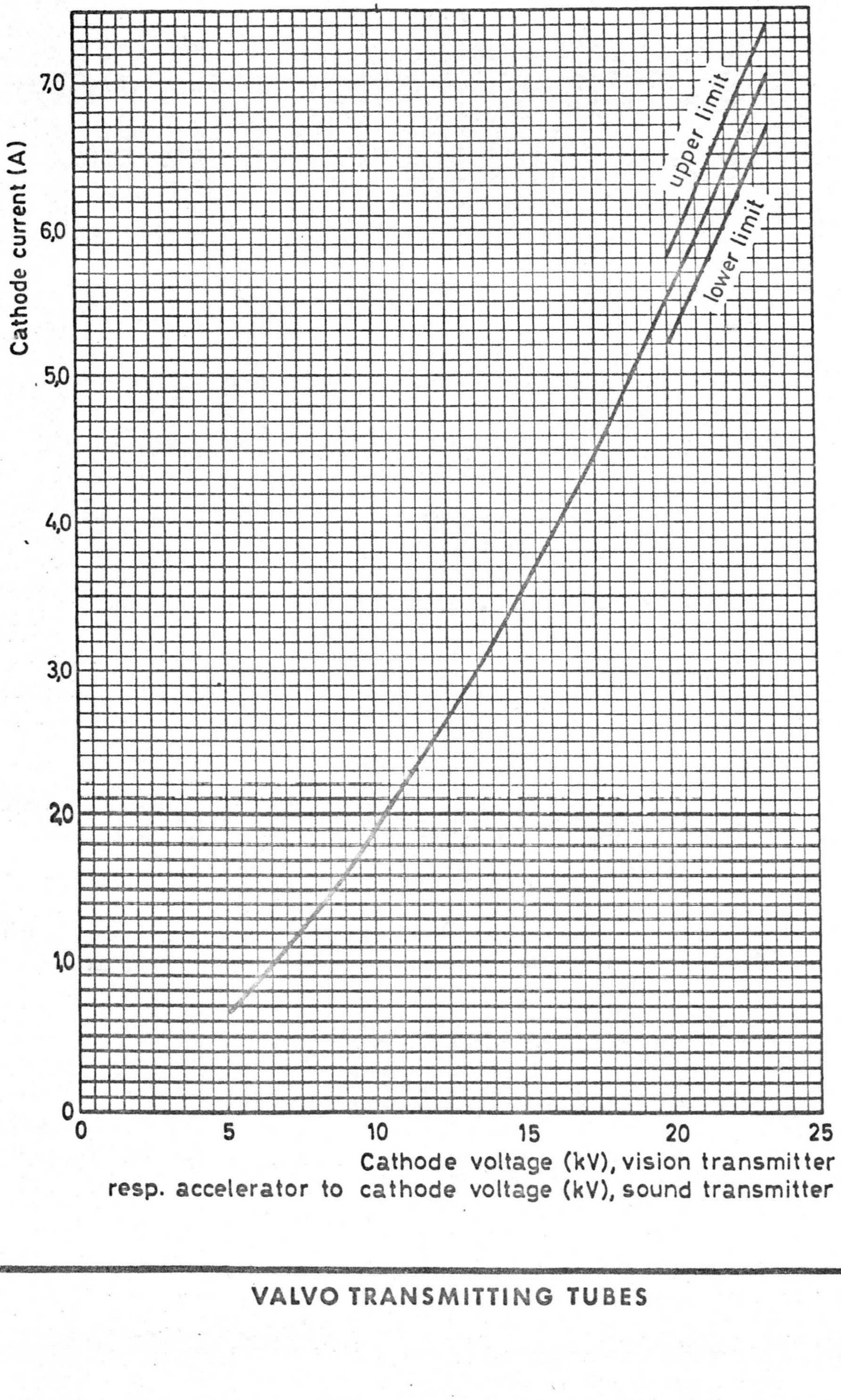
Notes see page 5

Mechanical data:
(dimensions in mm)

YK 1196



Notes see page 5


Cathode current (A)
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0
0
5
10
15
20
25
upper limit
lower limit
Cathode voltage (kV), vision transmitter
resp. accelerator to cathode voltage (kV), sound transmitter