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Preliminary data

High power, metal ceramic, traveling-wave tube for satellite communications in the frequency band 14.0 to 14.5 GHz.

In single-carrier operation the tube delivers a CW output power of 2 kW at a minimum gain of 45 dB; in two-carrier operation the 3-tone intermodulation ratio has a minimum of 17 dB at an output power of 500 W per carrier.

The YH 1420 is ppm focussed with  $\text{SmCo}_5$  rings and runs with reduced collector voltage with regard to the delay line voltage.

The RF input and output are fitted out with waveguides.

The cooling of the collector is made by forced air, the delay line is water-cooled.

Dimensions	approx. 700 mm X 190 mm X 160 mm
Weight	approx. 15 kg
Waveguide	WR 62
Flange	UG-41S/U
Mounting position	Vertical, collector up

Operating data for multicarrier operation with two carriers of 500 W spaced 5 MHz apart.

Frequency	$f$	14 to 14.5	GHz
Power output	$P_2$	1000	W
Gain	$V_T$	$\geq 45$	dB
Gain variation (Load VSWR 1.15)	$V_o$	6	dB <sup>1)</sup>
Gain slope (VSWR 1.15)	$V_o/\Delta f$	$\leq 0.05$	dB/MHz
3 tone intermodulation ratio	d3 (2x500 W)	$\geq 17$	dB
	d3 (2x100 W)	$\geq 30$	dB
Collector voltage	$U_c$	9 to 12	kV
Delay line voltage	$U_H$	18 to 20	kV <sup>1)</sup>
Modulated anode voltage	$U_{G2}$	13 to 17	kV <sup>1)</sup>
Delay line current	$I_H$	$\leq 70$	mA
Modulated anode current	$I_{G2}$	-0.1 to +2	mA
Cathode current	$I_K$	0.7 to 0.85	A <sup>1)</sup>
Ion pump voltage	$U_{ip}$	3	kV
Ion pump current	$I_{ip}$	$\leq 100$	$\mu$ A

<sup>1)</sup> The exact setting value is stated on the tube card.

<sup>2)</sup> Without gain equalizer

### Pushing factors for output powers up to 2 kW

#### Heating:

$$\frac{\Delta V_p}{\Delta U_f} \approx 0,5 \text{ dB/V}$$

$$\frac{\Delta \eta}{\Delta U_f} \approx 10^\circ/\text{V}$$

#### Modulated anode:

$$\frac{\Delta V_p}{\Delta U_{G2}} \approx 0,01 \text{ dB/V}$$

$$\frac{\Delta \eta}{\Delta U_{G2}} \approx 0,2^\circ/\text{V}$$

#### Delay line

$$\frac{\Delta V_p}{\Delta U_H} \approx 0,02 \text{ dB/V}$$

$$\frac{\Delta \eta}{\Delta U_H} \approx 0,5^\circ/\text{V}$$

#### Collector

$$\frac{\Delta V_p}{\Delta U_c} \approx 2 \cdot 10^{-4} \text{ dB/V}$$

$$\frac{\Delta \eta}{\Delta U_c} \approx 0,02^\circ/\text{V}$$

#### Cooling

To dissipate the heat developed, the collector must be cooled with forced air and the delay line by cleaned water.

#### Collector

Air flow	9 m <sup>3</sup> /min
Pressure drop	16 mbar (160 mmWS)
Temperature at inlet	max. 55°C
Temperature at outlet	max. 150°C <sup>1)</sup>

#### Delay line

Water flow	3 l/min
Pressure drop	4 bar (4 at)
Temperature at inlet	max. 65°C
Temperature at outlet	max. 70°C

Details concerning the power supply such as electrical data, circuit and voltage control etc – and commissioning are described in separate operating instructions.

<sup>1)</sup> measured 5 cm (2") behind the collector

## Heating

Heater voltage	$U_h$	6.0 to 7.0	V <sup>1)</sup>
Preheating voltage	$U_p$	$0.85 U_h$	V
Heater current	$I_h$	3.2	A
Preheating time	$t_h$	$\leq 5$	min
Heating method	Indirect by ac or dc		
Cathode	Metal capillary dispenser cathode		

Characteristics ( $f = 14.0$  to  $14.5$  GHz,  $I_c = 0.7$  to  $0.85$  A)

		min	nom.	max	
Gain at $P_2 = 2$ kW	$V_p$	45			dB
VSWR	s		1.5	2.1	2)
Cold attenuation	$\alpha$		70		dB

## Typical Operation

## Single carrier operation

Frequency	$f$	14.0 to 14.5	GHz
Power output	$P_2$	2.0	kW
Gain	$V_p$	$\geq 45$	dB
Collector voltage	$U_c$	8 to 12	kV
Delay line voltage	$U_d$	18 to 20	kV <sup>3)</sup>
Modulating anode voltage	$U_{d2}$	13 to 17	kV <sup>3)</sup>
Delay line current	$I_d$	$\leq 70$	mA
Modulating anode current	$I_{d2}$	-0.1 to +2	mA
Cathode current	$I_c$	0.7 to 0.85	A <sup>3)</sup>
Ion-pump voltage	$U_p$	3	kV
Ion-pump current	$I_p$	$\leq 100$	$\mu$ A
AM/PM conversion	KP	$\leq 7$	%/dB

1) If the maximum variation of the heater voltage exceeds the absolute limits of  $\pm 1\%$  of the setting value, the operating performance and life of the tube will be impaired. For stand-by operation the tube can be operated at 95% of the nominal heater voltage without the other electrode voltages applied, it is fully serviceable at full power as soon as the heater voltage is increased to nominal and the other electrode voltages are applied.

2) Cold input and output values over the band 14 to 14.5 GHz.

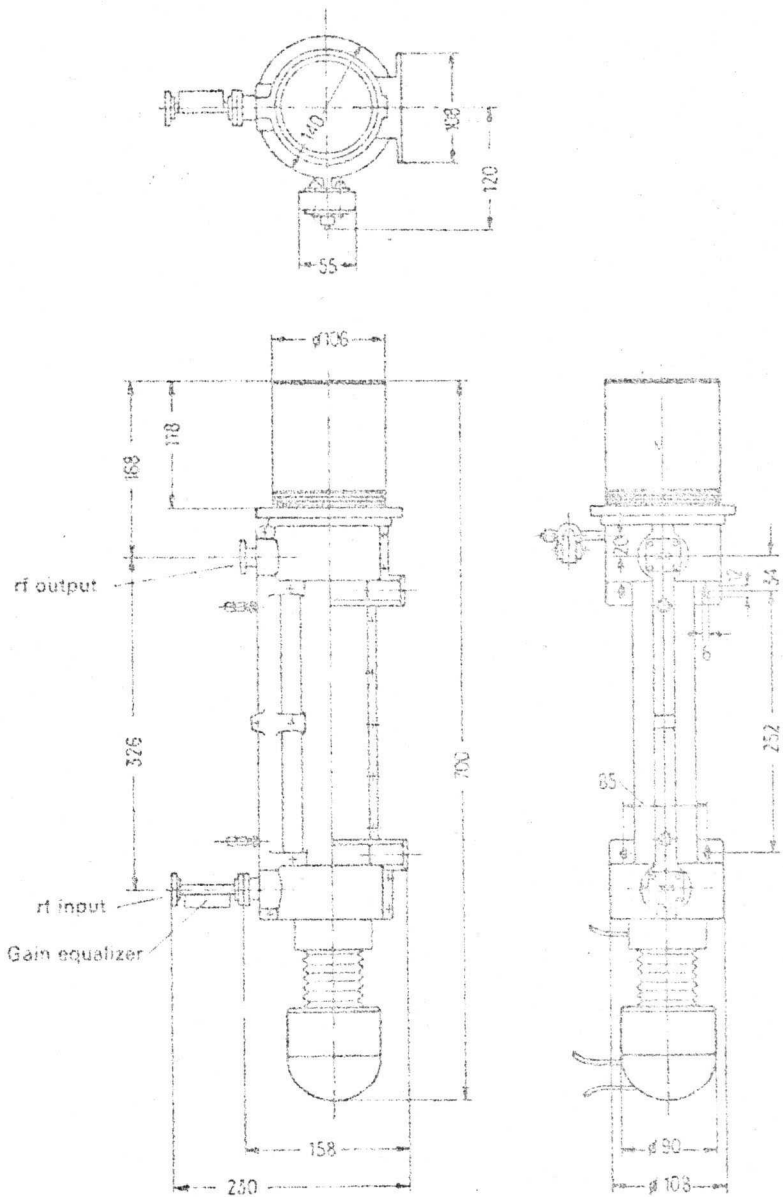
3) The exact value is stated on the tube card.

## Maximum ratings (absolute values)

Collector voltage	$U_c$	max	14	kV
Collector voltage	$U_{c0}$	min	7	kV
Collector current	$I_c$	max	0.9	A
Collector power dissipation	$P_c$	max	11	W
Delay line voltage	$U_{dl}$	max	21	kV
Delay line current	$I_{dl}$	max	80	mA
Modulated anode voltage	$U_{a2}$	max	18	kV
Modulated anode power	$P_{a2}$	max	36	W
Power output dissipation	$P_2$	max	2.2	kW
Power input	$P_1$	max	70	mW
Load VSWR	$S_L$	max	1.35	
Ambient temperature	$t_{amb}$	max	+55	°C
Ambient temperature	$t_{amb}$	min	+5	°C
Storage temperature	$t_{stor}$	min	-40	°C <sup>1)</sup>

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<sup>1)</sup> Cooling channels dehydrated



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