SIEMENS

HIGH-POWER TRAVELING-WAVE TUBE YH 1010

$F = 470$ to 860 MHz

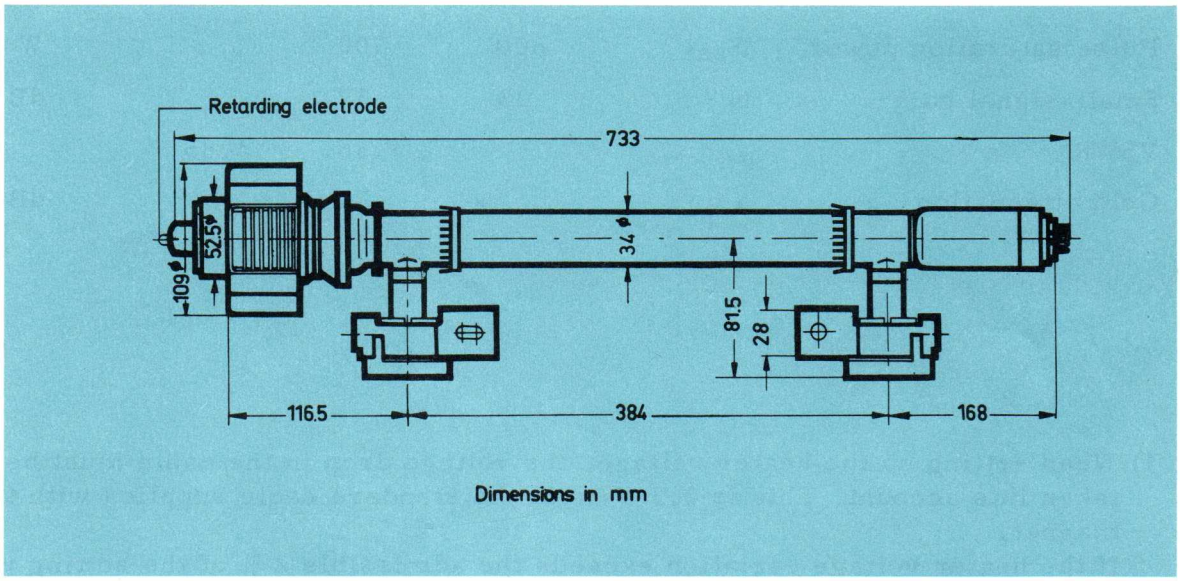
Order No.
Q42-X4610

Design and Application

Forced-air cooled high-power traveling-wave tube for the frequency range 470 to 860 MHz. The tube is intended for use in UHF TV transmitters or translators and delivers a video sync output power of 160 W in band IV and 200 W in band V.

It is focused by a permanent magnet and can be replaced in this magnet.

The r.f. input and output connectors are coaxial.



Base:	special 8-pin type (see also page 7) [1]
Tube weight:	3 kg (6.6 lbs)
Magnet weight:	40 kg (88 lbs)
Magnet dimensions:	approx. 200 mm x 220 mm x 750 mm (8" x 8 1/2" x 29 1/2")
R.f. connectors:	coaxial, 50 or 60 Ω, (various standardized connectors, see page 9)
Mounting position:	in stationary equipment optional. When mounted vertically, the best position in terms of cooling is with the collector uppermost.

1) The socket with cable is supplied as an accessory (see page 9).

Heating

Heater voltage	E_f	6.3	Vdc 1)
Heater current	I_f	≈ 2.6	Adc

indirect by dc, parallel supply, + pole connected to cathode

Metal capillary dispenser cathode

Characteristics

(F = 700 MHz, I_k = 1 A)

		min	nom	max	
Pulse saturation power	P_{sat}	600	700		W 2)
Small-signal gain	G	33	37		dB
VSWR			1.35	1.85	3)
Cold attenuation	a		70		dB

1) When setting up the heater voltage, the voltage drop in the cable must be taken into account. This is 0.3 V/m in the standard cable supplied with the magnet.
If the heater voltage variation exceeds the admissible 2 % of the setting value (absolute limits) the operational performance and life of the tube will be impaired. For standby operation, the heater voltage must be reduced to 5.6 V; the tube is then fully operational when the heater voltage is increased to its nominal value and the electrode voltages and r.f. drive applied simultaneously.

2) The saturation power way only be measured in pulsed operation.

3) Cold match at the tube input and output over the frequency band 470 to 860 MHz.

Typical operation

The collector, helix and grid No. 1 voltages and the cathode current are fixed setting up values which remain unchanged when tubes are replaced. The variation of helix voltage with frequency is shown in the graph on page 10.

Video carrier frequency	F	470 to 600	600 to 790	790 to 860	MHz	
Video: Audio ratio		5 : 1	5 : 1	5 : 1		
Video sync output power	P_{syn}	160	200	200	W	
Third order intermodulation	IM_3	$\geqq$ 54	$\geqq$ 54	$\geqq$ 54	dB	1) 2)
Gain	G	$\geqq$ 29	$\geqq$ 32	$\geqq$ 30	dB	3)
Collector voltage	E_b	E_h -300±70	E_h -300±70	E_h -300±70	V	
Helix voltage	E_h	3600	3400	3250	V	
Grid No. 2 voltage	E_{c2}	870	1050	1150	V	
Grid No. 1 voltage	E_{c1}	- 100	-100	- 100	V	
Retarding electrode voltage	E_{ret}	0	0	0	V	4)
Helix current	I_h	12	12	12	mA	
Grid No. 2 current	I_{c2}	± 0.5	± 0.5	± 0.5	V	
Cathode current	I_k	1	1	1	A	

1) With phase compensator. A suitable phase compensator type PK 200 is available for the frequency band 470 to 790 MHz.

2) Measured in accordance with the German Post Office specification FTZ Pfl 2, issue 2, October 1966, with undistorted input signal; carrier levels below reference (peak sync): F_{video} -8 dB, $F_{sideband}$ -16 dB, F_{audio} -7 dB.

It should be remembered that the intermodulation products of an amplifier are caused by each stage (see "Determination of Intermodulation products in TV translators").

3) When using the phase compensator PK 200, an additional gain loss of 2 dB in the compensator must be allowed for.

4) Connect retarding electrode to cathode.

Maximum Ratings (absolute values)

Collector voltage	E_b	max	3500	V	1)
Collector voltage at zero collector current	E_{bo}	max	4000	V	
Collector dissipation	P_p	max	3600	W	
Helix voltage	E_h	max	3800	V	
Helix voltage at zero helix current	E_{ho}	max	4000	V	
Helix current	I_h	max	30	mA	2)
Grid No. 2 voltage	E_{c2}	max	1700	V	
Grid No. 2 current	I_{c2}	max	$\pm$ 1	mA	
Grid No. 1 voltage neg.	$-E_{c1}$	min	- 200	V	
Grid No. 1 voltage pos.	$+E_{c1}$	max	- 50	V	
Retarding electrode voltage	E_r	max	0	V	3)
Cathode current	I_k	max	1100	mA	
Reflected CW power	P_{ref}	max	20	W	
Collector temperature	T_c	max	200	°C	4)
Ambient temperature	T_A	max	55	°C	
Ambient temperature	T_A	min	- 20	°C	
Storage temp. for tube and magnet	T_s	min	- 50	°C	
Storage temp. for tube and magnet	T_s	max	+ 65	°C	
CW output power (470-600 MHz)	P_o	max	400	W	
CW output power (600-860 MHz)	P_o	max	500	W	

1) The collector voltage must be 300 V $\pm$ 70 V lower than the helix voltage.

2) Trip level of the helix current overload relay (see "operating Instructions", page 5).

3) The retarding electrode is connected to the cathode.

4) Measured with a thermocouple at the periphery of the two outer and one of the center cooling fins on the outlet side (see "Cooling", page 6).

Operating Instructions

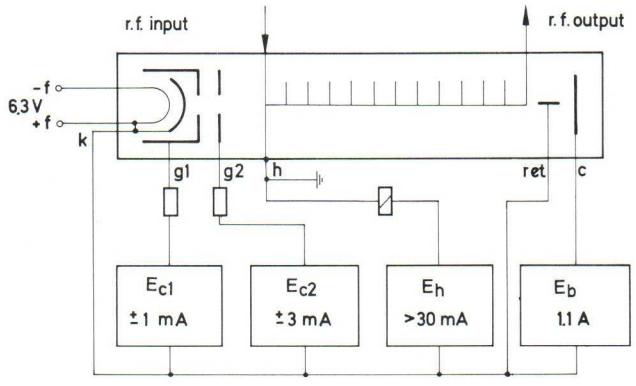
Installation

The traveling-wave tube YH 1010 can only be operated in its magnet system MYH 1010. The magnet system should be mounted at least 60 mm (2 1/2") from large ferromagnetic parts (such as mounting supports, and at least 30 mm (1 1/4") from small ferromagnetic parts (screws). The spacing between two magnets mounted adjacent must be at least 90 mm (3 5/8"). The tube can be removed by opening up the magnet system.

Power supply

All electrode voltages are referred to the cathode. It is recommended to obtain the grid No. 1 (E_{c1}), grid No. 2 (E_{c2}), helix (E_h) and collector (E_b) voltages from separate supplies. The following setting ranges are necessary:
E_{c1} = -100 $\pm$ 10 V, E_{c2} = 500 to 1500 V, E_h = 2800 to 3700 V, E_b = 2400 to 3500 V.

A protection relay in the helix supply should switch off all electrode voltages if the maximum admissible helix current is exceeded. An integration network should be incorporated to prevent short surges of up to 100 mA/sec from tripping the relay within the first two seconds after switch-on. The trip circuit must take off the helix voltage within 50 msec. If the electrode voltages fail or are switched off for longer than 5 minutes, the heater voltage should also be switched off or reduced to 5.6 V.
A series protection resistor of 10 kΩ must be inserted in the grid No. 1 and grid No. 2 supply leads.
Heater and cathode are at a potential of approximately 4000 V with respect to ground. The heater power supply must therefore be designed to withstand this potential difference. The positive pole of the heater is connected to the cathode.



In the interests of stable operation, particularly over longer periods, it is recommended that the cathode current be kept constant by automatically controlling the grid No. 2 voltage.
For TV translator operation with concurrent video and audio transmission the dynamic source impedance of the helix voltage supply at video frequencies should be less than 100 Ω, otherwise the variation of helix current in tact with the video signal will produce additional phase modulation of the output signal.
The phase compensator PK 200 available as an accessory must be connected to the input of the YH 1010 if the intermodulation performance stated under "typical operation" is to be met.
A power supply type YHN 1010 is available for the tube. It supplies all the necessary electrode voltages and contains suitable protection circuits (overcurrent trip etc.). The YH 1010 is also available in a rack type LVYH 1010, containing power supply, phase compensator, bandpass filter, directional coupler and blower, for use in power stages of TV transmitters or translators. Further information available on request.

Cooling

The required air flow for collector cooling is shown in the graph, page 11, for operation at sea level.
The magnet system is designed such that the air inlet is on side A (side on which magnet system is mounted) and the outlet on side C. If cooling in the opposite direction is required, the air ducts on both openings should be exchanged. If the cooling system fails, the tube supply voltages including heater voltage must be switched off automatically.
The cooling circuit must be designed such that the absolute maximum admissible collector temperature of 200 °C is not exceeded. The collector temperature is measured with a thermocouple at the periphery of the two outer and one of the center cooling fins on the outlet side.

Installation

For safety in operation the magnet system must be properly grounded at the terminal provided (see page 8).

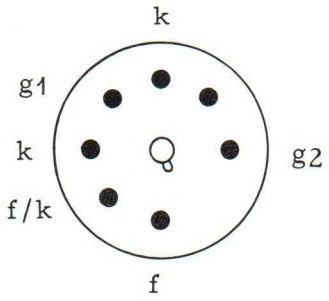
Insertion of tube into magnet system

1. Fit the coaxial connectors to the r.f. input and output ports.
2. Slide tube into field straightener and fix in position with the milled nut near the r.f. input port. The field straightener is matched to the magnet system.
3. Place tube with field straightener into the opened out magnet system and fix in position with the milled nuts near the r.f. input and output ports.
4. Close magnet system.
5. Push socket into tube base and screw up retaining ring to stop (connector socket must not be canted).

When mounting the magnet system and coaxial r.f. connectors and other connecting cables, any turning or bending moments on the tube input and output should be kept to a minimum.

Connection of supply voltage and setting-up procedure

1. Connect the individual leads (the first time the tube is fired up): The collector voltage is applied to the tube through the yellow high-voltage cable attached to the magnet system. The helix voltage lead is connected to the earthing plug socket on the earthing plug socket on the magnet system (see page 8).
   The remaining electrode voltages are applied to the tube via the supply cable screwed to the base of the tube. The individual leads in this cable are color-coded as follows:



heater		:	brown
heater/cathode	f/k	:	brown-yellow *)
cathode	k	:	yellow, red *)**)
grid No. 1	g_1	:	green
grid No. 2	g_2	:	blue
ground		:	black

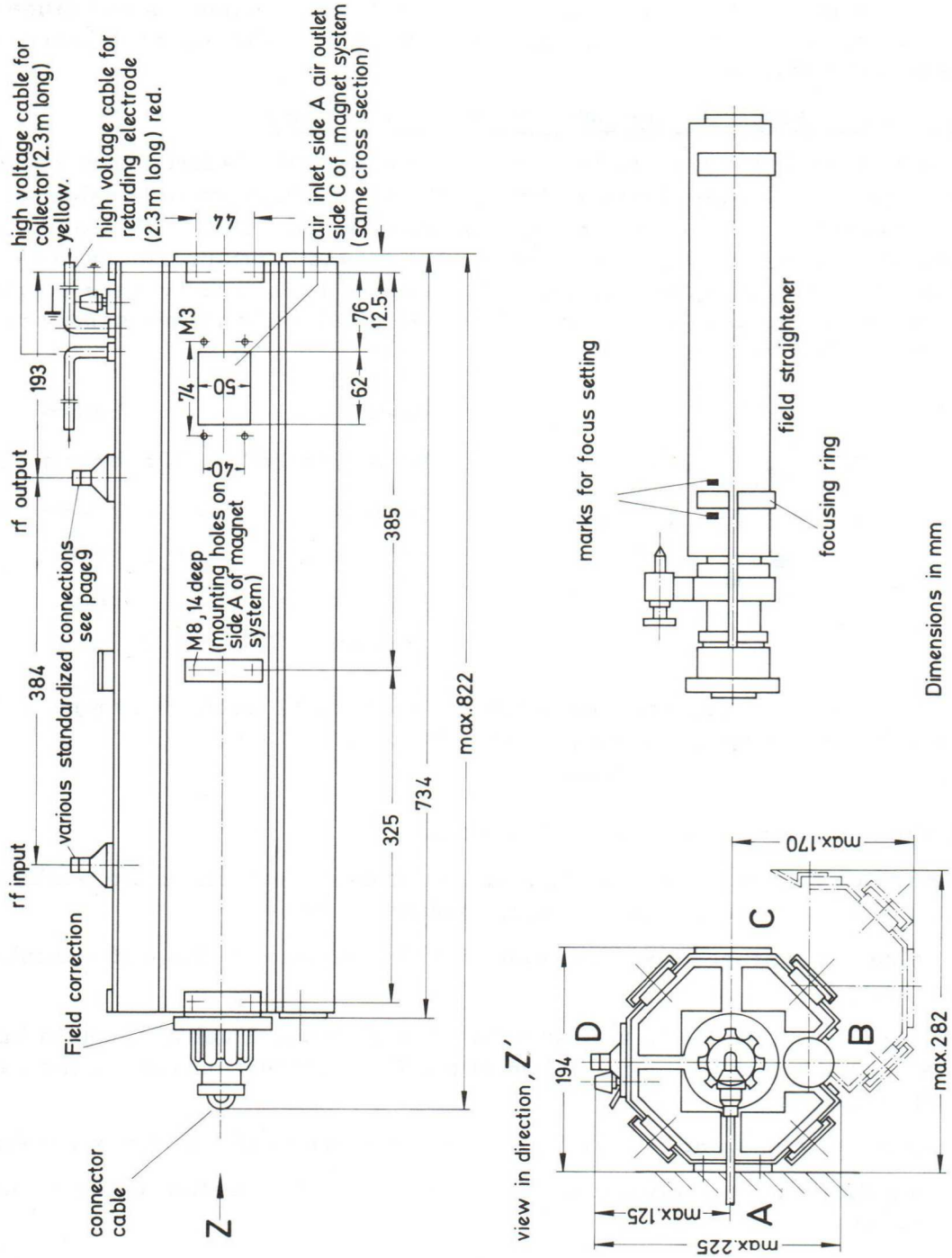
*) The cathode is internally connected to heater. To avoid heater hum, leads should be connected up exactly as indicated.
**) Join the red and yellow leads.

2. Switch on air blower (see also "Cooling").
3. Switch on the operating voltages in the following sequence: Collector voltage, grid No. 1 voltage, helix voltage, grid No. 2 voltage.

   The heater voltage is switched on with the collector voltage if the tube is not preheated.
4. Bring up the cathode (I_k) by adjusting the grid No. 2 voltage, and minimize the helix current (I_h) with the aid of the field correction ring at the cathode end of the magnet system.
5. Apply r.f. drive and repeat field correction for minimum helix current (I_h).
6. After obtaining operational status, switch over to constant cathode current regulation.

Switching on again

1. Switch on air blower.
2. Apply all electrode voltages and r.f. drive simultaneously or in the sequence stated above for firing up.
3. After 3 minutes switch over to constant cathode current regulation.


high voltage cable for collector (2.3 m long) yellow.
high voltage cable for retarding electrode (2.3 m long) red.
air inlet side A air outlet side C of magnet system (same cross section)
44
M3
74
50
76
12.5
62
193
rf output
384
various standardized connections see page 9
M8, 14 deep (mounting holes on side A of magnet system)
385
325
734
max. 822
rf input
Field correction
connector cable
Z
marks for focus setting
field straightener
focusing ring
Dimensions in mm
view in direction, Z'
max. 170
C
D
B
A
194
max. 282
max. 125
max. 225

Order Number for Traveling Wave Tube YH 1010 and Associated Elements

Designation	Design	Order Number	Fig.
Traveling wave tube YH 1010		Q42-X4610	
Magn.syst. MYH 1010 a		Q43-X2410	page 8
Coax. connector 1)	60 Ω, 3.5/9,5	Q81-X2401	
Coax. connector 1)	60 Ω, 6/16	Q81-X2402	
Coax. connector 1)	50 Ω, 4.1/9.5	Q81-X2403	
Coax. connector 1)	50 Ω, 7/16	Q81-X2404	
Coax. connector 1)	N-Connector	Q81-X2405	
Coax. connector 1)	C-Connector	Q81-X2406	
Coax. connector 1)	BNC-Connector	Q81-X2407	
Coax. connector 1)	50 Ω, Dezifix B	Q81-X2410	
Coax. connector 1)	60 Ω, Dezifix B	Q81-X2411	
Connector socket	bend in direction A standard cable length 1.2 m 2)4)	Q81-X2331	page 8
Connector socket	bend in direction A cable length as required 3)4)	Q81-X2341	page 8
Power supply YHN 1010		S65280-D1010-A1	
Complete rack LVYH 1010		S65392-J1010-A1	
Phase compensator PK 200	for Band IV V	S65107-D200-A1	

1) Rf connectors should be specified when ordered, and can be used again when the tube is replaced.

2) 0.1 m of this length as free leads.

3) When ordering please specify total length of cable and length of free leads.

4) The cable can also be supplied with a socket heaving a 90° bend in directions B, C or D.

Cooling diagram for operation at sea level

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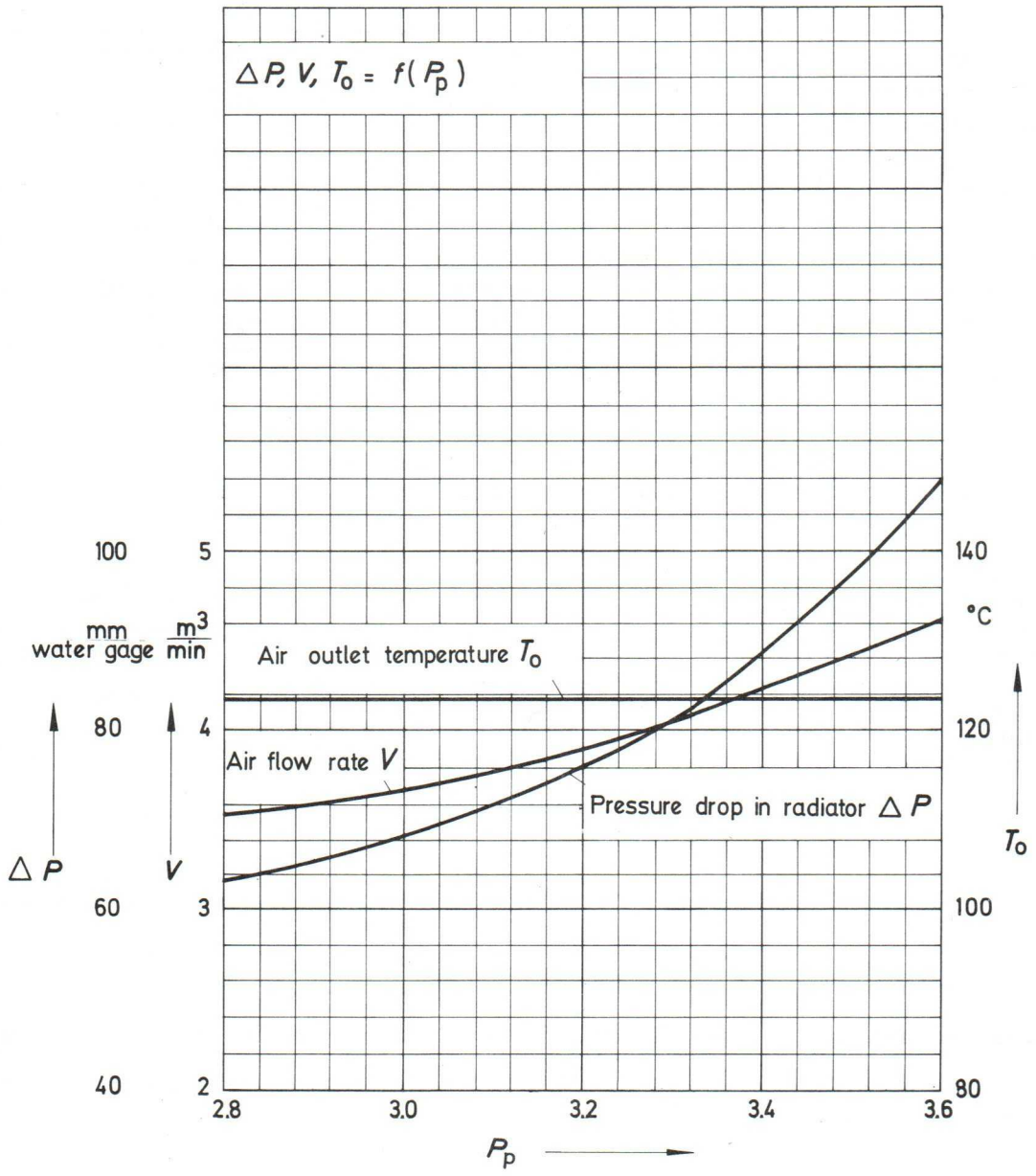
Air inlet temperature T_i = 25 °C
Barometric pressure = 760 mmHg
maximum radiator temperature = 170 °C



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Characteristics

$G, IM_3, E_h = f(F)$

YH 1010