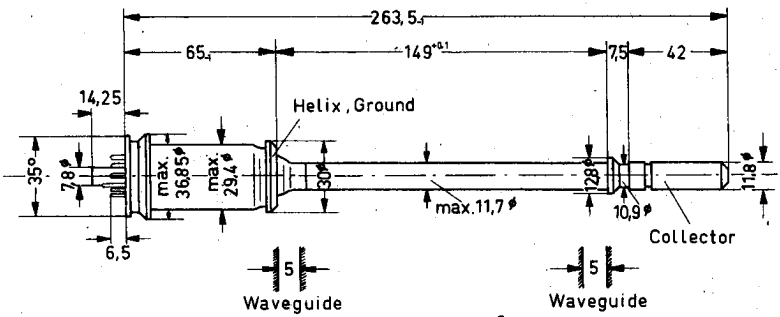
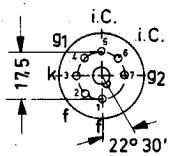
Design and Application

Preliminary Data

Power travelling wave tube specially designed for broadband radio relay systems with an average power output of 10 watts and an average gain of 39 db.
The RW 6 is a periodic, permanent magnet focused travelling wave tube and is replaceable within the magnet system. It is arranged to operate with depressed collector.
The rf power is coupled in and out by way of wave guides.





Dimensions in mm

Base:	special type, included in magnet system
Tube mount:	delivered with magnet system
Weight of tube:	approx. 100 gm net
Weight of magnet system:	approx. 7.5 kg
Dimensions of magnet system:	100 x 112 x 338 mm
Dimensions of tube packing:	175 x 190 x 445 mm
Waveguide:	F 70, DIN 47302, 34.85 x 5 mm (similar to WR 137)
Flange:	NF 70, DIN 47303
Mounting position:	see "Cooling"

Heating

Heater voltage	=	6.3 ± 2 %	V (1)
Heater current	≈	0.9	A
Cathode heating time	≥	2	min

indirect by AC, parallel supply

MK-dispenser cathode

Characteristics

Frequency range	=	5.8 to 7.3	kMc
Saturation power	=	18	W
Average gain (P_o=10 W)	≈	39	db
Small-signal gain (P_o = 1 W)	≈	40.5	db
Reflection factor	≤	15	% (2)
Reflection factor	≈	5	% (3)
Magnetic field strength	≈	800	Gauss (4)

(1) If the maximum variation of the heater voltage exceeds the absolute limits of ± 2 %, the operating performance of the tube will be impaired and its life shortened.

(2) At input and output of cold tube with optimum adjustment of rf matching elements to midband and a bandwidth of ± 100 Mc in the frequency range from 5.8 to 7.3 kMc.

(3) At input and output of cold tube with optimum adjustment of rf matching elements to midband and a bandwidth of ± 10 Mc in the frequency range from 5.8 to 7.3 kMc.

(4) Peak value of alternating magnetic field.

Typical Operation

Operating frequency	=	6.2	6.6	7.0	kMc
Power output	=	10	10	10	W (5)
Gain	=	39.5	38.5	37	db
Collector voltage	=	1300	1300	1300	Vdc (6)
Helix voltage	≈	2480	2460	2440	Vdc
Grid No. 2 voltage	≈	550	550	550	Vdc
Grid No. 1 voltage	=	-20	-20	-20	Vdc (6,7)
Helix current	≈	2	2	2	mAdc
Grid No. 2 current	≦	0.1	0.1	0.1	mAdc
Cathode current	=	45	45	45	mAdc (6,8)
Noise figure	≦	25	25	25	db
AM/PM conversion	≈	4.5			°/dB (9)
Phase shift	≈	1.7			°/V (10)

All voltages are referred to the cathode

Maximum Ratings (absolute values)

Collector voltage	min	1250	Vdc
Collector voltage	max	1500	Vdc
Collector dissipation	max	65	W
Helix voltage	max	2800	Vdc
Helix voltage	min	2100	Vdc
Helix current	max	3.5	mAdc (11)
Helix dissipation	max	9	W
Grid No. 2 voltage	max	650	Vdc
Grid No. 2 voltage	min	450	Vdc
Grid No. 2 dissipation	max	0.2	W
Negative grid No. 1 voltage	max	25	Vdc
Positive grid No. 1 voltage	max	0	Vdc
Cathode current	max	50	mAdc
Collector temperature	max	250	°C

(5) For smaller outputs, the cathode current may be decreased to 25 mAdc by varying the grid No. 2 voltage. It is necessary to consult the manufacturer in such instances.

(6) Adjusting values

(7) It is recommended to adjust the grid No. 1 voltage by means of the cathode resistor.

(8) Changing the cathode current by 1 mAdc in the range from 42 - 47 mAdc has the effect of changing the gain by about 1 db.

(9) AM-PM conversion is the phase shift of the rf-output signal when changing the input by 1 db.

(10) Phase shift of rf-output signal when changing the helix voltage by 1 volt.

(11) The helix current may rise momentarily to 5 mAdc due to power supply surges and during starting.

Operating Instructions

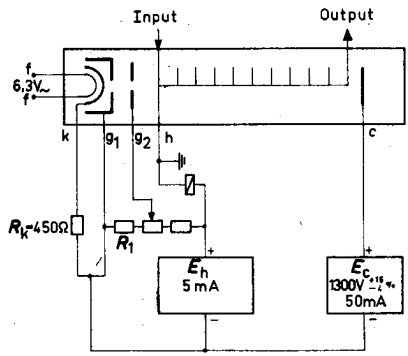
The travelling wave tube RW 6 may be operated only in conjunction with the associated magnet system MRW 6. The particular advantages of the periodic permanent-magnetic focussing of the RW 6 are the relatively small dimensions of the magnet system and the extremely small leakage field. Thus the magnetic field is largely neutral. The sensitivity to temperature changes is low.
With operation in radio link systems, isolators should be coupled to the tube input and output to avoid distortions due to multiple reflexions.

All tube voltages are referred to the cathode.

Grid No. 1 voltage is automatically generated by the cathode current at resistor R_k. Grid No. 2 voltage should be variable within a range of 450-650 volts. It can be tapped at a voltage divider R_1, the shunt resistance of which may not exceed 2.5 Meg.
The helix voltage should be variable between 2100 and 2800 volts. Consult the operating data and the curve on sheet K 5 for the filtering and stabilization necessary to meet the requirements of the respective system.
No stabilization is required for the collector voltage. The power dissipation involved must, however, be adhered to.

A protective relay must be inserted into the helix input circuit to disconnect the helix and grid No. 2 voltage when the maximum value for the helix current is exceeded.

When using an independant voltage source for grid No. 2, the immediate disconnection of grid No. 2 voltage in the case of an outage of the helix voltage must be ensured by an interlocking device. When the collector voltage is outed, the helix voltage and grid No. 2 voltage must be disconnected either by the overload relay in the helix input circuit or by a voltage interlocking system.



Designations of the grids: g_1 = focusing electrode (Wehnelt)
g_2 = acceleration electrode

Cooling

With ambient temperatures up to 40°C the RW 6 may be operated without special cooling if the tube is mounted in horizontal position and if a natural vertical air circulation is provided by the radiator.
With other mounting positions or with an excessive ambient temperature additional cooling by a low air flow (about 10 l/min) is required. In such a case it is important that the maximum admissible collector temperature of 250°C (absolute limit) is not exceeded.

Starting

For operation without danger, the magnet system must be properly grounded. For starting the tube, the preliminaries should be performed in the following order:

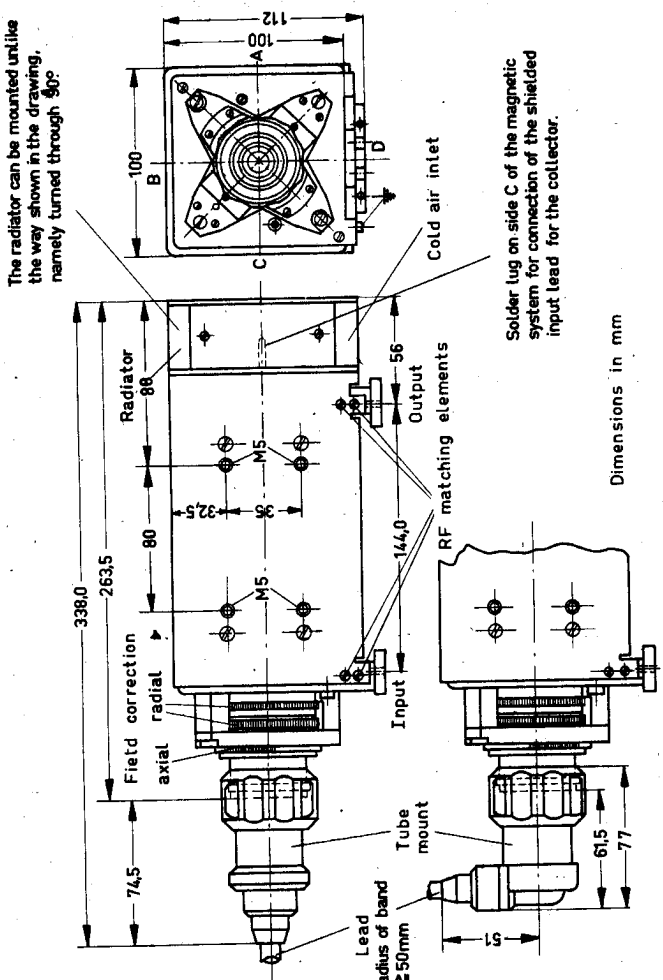
1. Connect up leads:

Filament	f,f	: brown
Cathode	k	: yellow
Grid No. 1	g_1	: green
Grid No. 2	g_2	: blue
Helix, Ground	h	: red

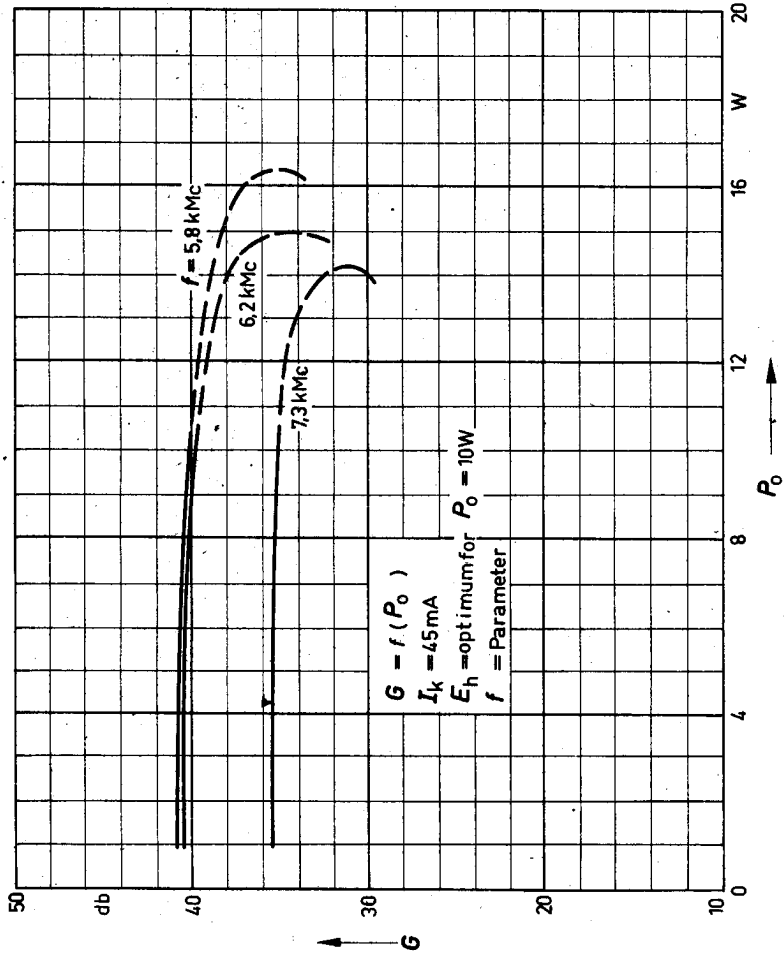
   Collector c: shielded lead must be soldered to the therminal on radiator of magnet system (see page 6)
2. Screw off sleeve .
3. Insert tube in magnet system.
4. Plug tube mount into tube and screw on sleeve until stop is reached. Check that threads are not binding.
5. Apply heater voltage and preheat tube for at least 2 min.
6. Apply collector voltage.
7. Switch on voltage supply for helix and grid No. 2. If separate power supplies are used, both must be switched on simultaneously. Make sure that full voltages are applied immediately and not increased gradually to full value.
8. Adjust cathode current by varying grid No. 2 voltage.
9. Adjust helix current to a minimum with the aid of radial field corrector (ring adjuster pair at cathode side of magnet system) and axial field corrector (cylindrical threaded ring adjustable along axis of tube).
10. Switch on rf-input signal and adjust to optimum gain with the helix voltage for the output required.
11. Correct field again as outlined under item 9.
12. Adjustment to minimum reflection factor is possible with the aid of the rf-matching elements at inlet and outlet.

Switching off

The voltages must be removed either in the reverse order to that in which they were applied, or simultaneously.

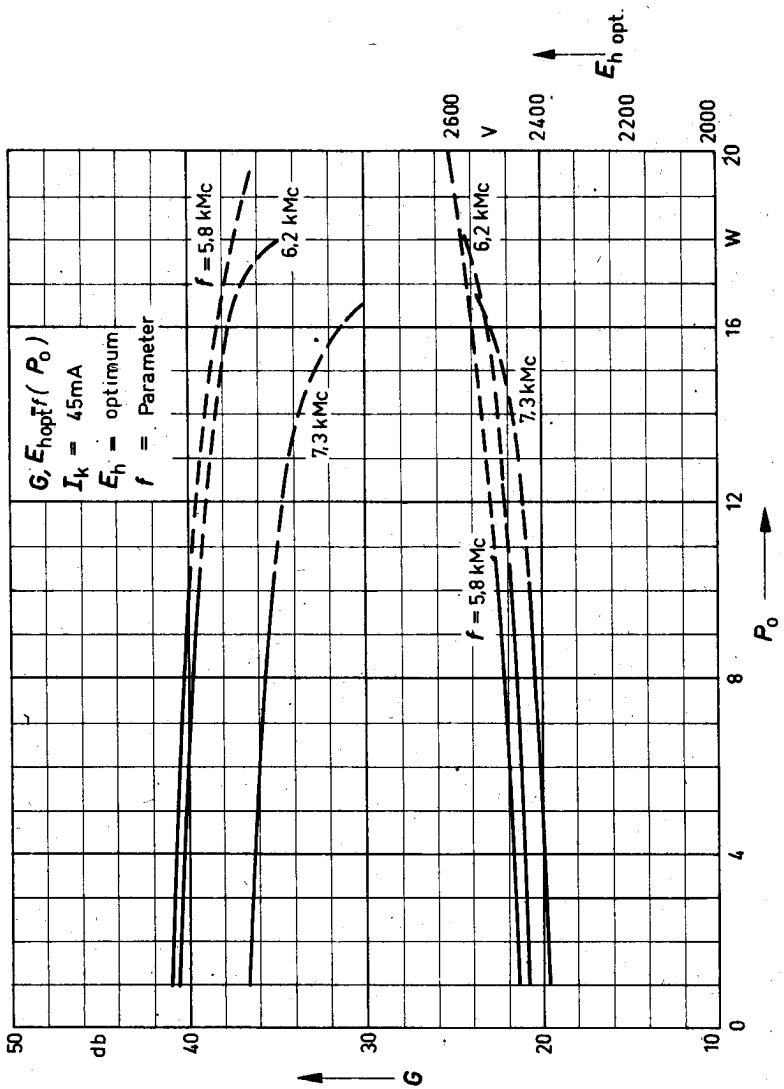


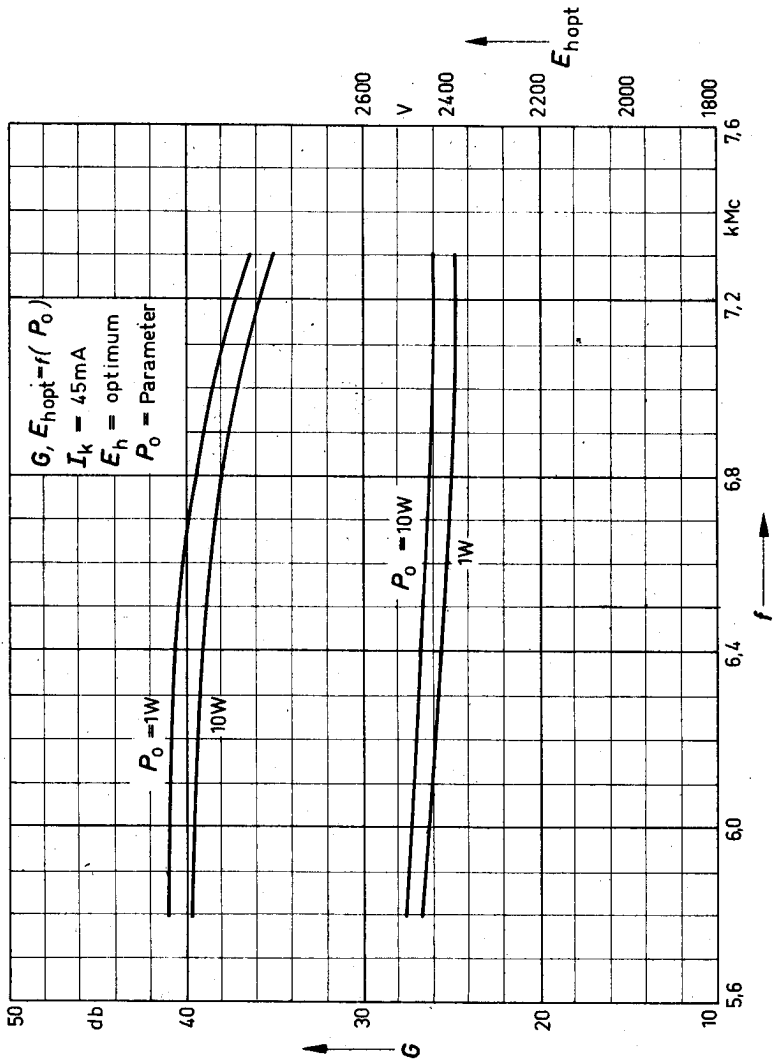
If the angled tube socket is used, the cable lead can come from sides A, B, C or D.
The magnetic system can be mounted on sides A, B or C with M5 screws (screwing depth 8mm) and it is magnetically neutral.


f = 5,8 kMc
6,2 kMc
7,3 kMc
G = f (Po)
Ik = 45mA
Eh = optimum for Po = 10W
f = Parameter
50
db
40
30
20
10
G
0
4
8
12
16
20
W
Po

Characteristics

Gain, $E_{hopt} = f(P_o)$




G, E_{hopt} = f(P_o)
I_k = 45mA
E_h = optimum
P_o = Parameter
P_o = 1W
10W
P_o = 10W
1W
50
db
40
30
20
10
G
2600
V
2400
2200
2000
1800
E_{hopt}
7,6
kMc
7,2
6,8
6,4
6,0
5,6
f

Characteristics

$P_o = f(P_i)$

Gain $= f(P_o, P_i)$

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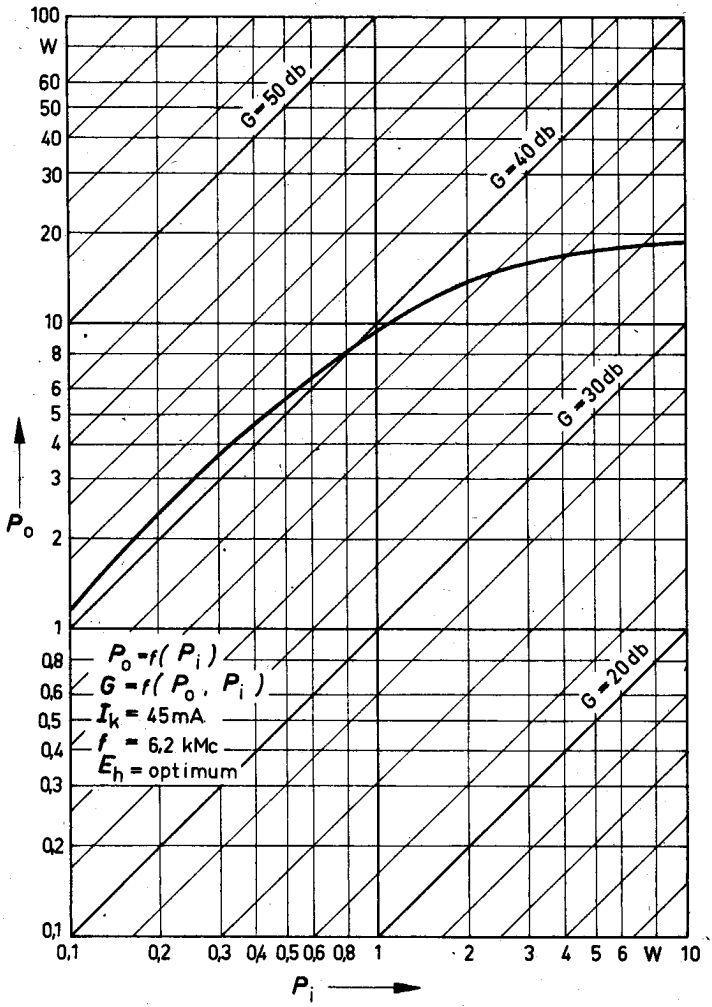
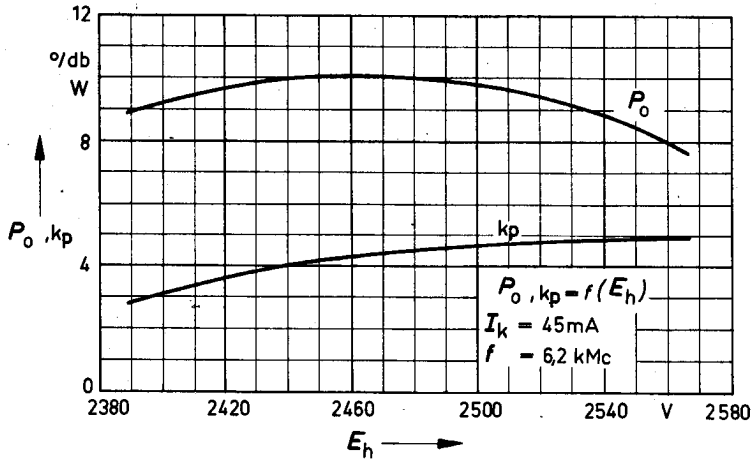
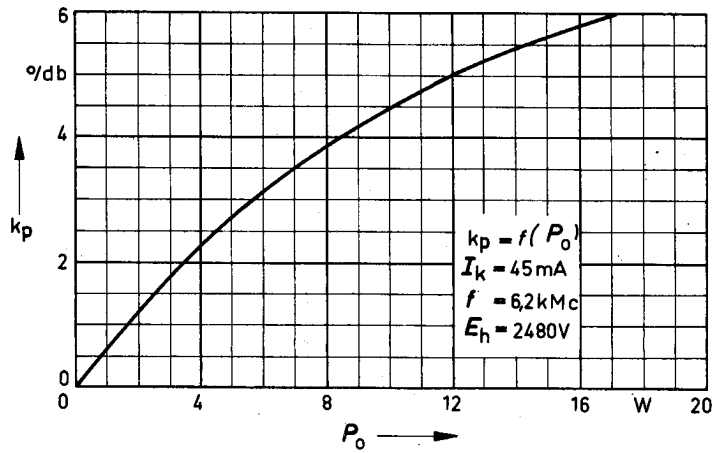


Characteristics

P_o, $k_p = f(E_h)$

$k_p = f(P_o)$





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