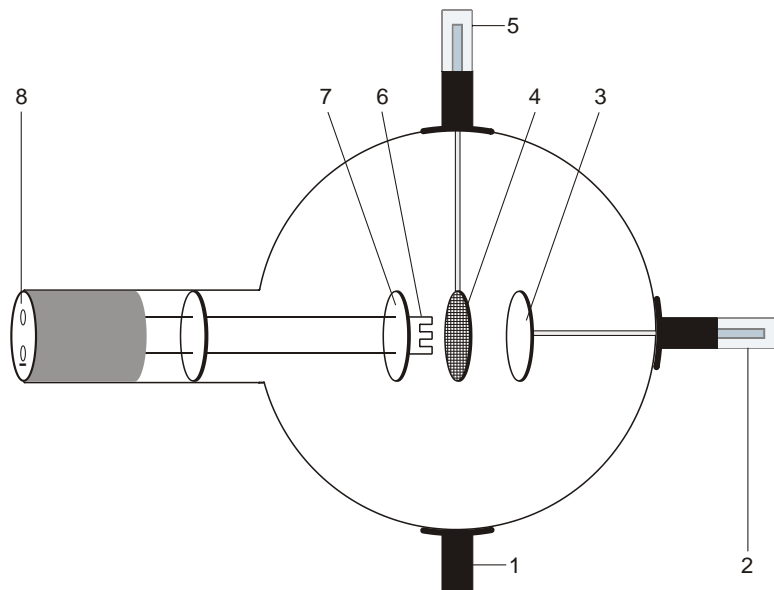


## Gas Triode D 1000653

### Instruction sheet

10/15 ALF



- 1 Boss
- 2 4-mm plug for connecting anode
- 3 Anode
- 4 Grid
- 5 Boss with 4-mm plug for connecting grid
- 6 Heater filament
- 7 Cathode plate
- 8 4-mm sockets for heater filament and cathode

### 1. Safety instructions

Hot cathode tubes are thin-walled, highly evacuated glass tubes. Treat them carefully as there is a risk of implosion.

- Do not subject the tube to mechanical stresses.
- Do not subject the connection leads to any tension.
- The tube may only be used with tube holder D (1008507).

If voltage or current is too high or the cathode is at the wrong temperature, it can lead to the tube becoming destroyed.

- Do not exceed the stated operating parameters.

When the tube is in operation, the terminals of the tube may be at high voltages with which it is dangerous to come into contact.

- Only change circuits with power supply equipment switched off.
- Only exchange tubes with power supply equipment switched off.

When the tube is in operation, the stock of the tube may get hot.

- Allow the tube to cool before dismantling.

Use of the equipment over long periods and involving hefty gas discharges can cause loss of material from the electrodes, which is deposited on the glass of the tube itself resulting in darkening of the surface.

The compliance with the EC directive on electromagnetic compatibility is only guaranteed when using the recommended power supplies.

### 2. Description

The gas triode allows recording of the  $I_A - U_A$  characteristic of a thyatron, observation of excited and non-excited discharge and of the discontinuous transfer of energy by helium atoms in inelastic collision with free electrons.

The gas triode is a helium-filled tube with a pure tungsten heater filament (cathode) and a round metal plate (anode) with a wire grid between them, all inside a clear glass bulb. The cathode, anode and grid are all aligned parallel to one another. This planar configuration corresponds to the conventional symbol for a triode. A circular metal plate attached as a backing to the filament ensures that the electric field between the anode and cathode is uniform.

### 3. Technical data

Gas filling:	Helium
Filament voltage:	$\leq \square 7.5$ V AC/DC
Anode voltage:	max. 500 V DC max.
Anode current:	10 mA typ. at $U_a = 300$ V
Grid voltage:	max. 30 V
Glass bulb:	130 mm diam. approx
Length of tube:	260 mm approx.

### 4. Operation

To perform experiments using the gas triode the following equipment is also required:

1 Tube holder D	1008507
1 DC Power supply 500 V (@115 V)	1003307
or	
1 DC Power supply 500 V (@230 V)	1003308
2 Analogue multimeter AM50	1003073

Additionally recommended:	
Protective Adapter, 2-Pole	1009961

#### 4.1 Setting up the tube in the tube holder

- The tube should not be mounted or removed unless all power supplies are disconnected.
- Push the jaw clamp sliders on the stanchion of the tube holder right back so that the jaws open.
- Push the bosses of the tube into the jaws.
- Push the jaw clamps forward on the stanchions to secure the tube within the jaws.
- If necessary plug the protective adapter onto the connector sockets for the tube.

#### 4.2 Removing the tube from the tube holder

- To remove the tube, push the jaw clamps right back again and take the tube out of the jaws.

### 5. Example experiments

#### 5.1 Discharge, evidence of positive charge carriers

- Set up the circuit as in fig. 1.
- To demonstrate the existence of positive charge carriers ( $\text{He}^+$  ions) for gas discharge at a maximum heater filament voltage  $U_F$ , measure the current  $I_G$  taking note of the sign.

#### 5.2 Non-self-sustaining discharge

- Set up the circuit as in fig. 2.
- Record a characteristic curve of  $I_A$  against  $U_A (= U_G)$  for various filament voltages  $U_F$  (5 V ...7.5 V).

At about 25 V the anode current  $I_A$  increases considerably in the gas triode. This increase is accompanied by the appearance of a blue luminescence. It is apparent that there are many more charge carriers transporting charge than in the vacuum triode (since there are  $\text{He}^+$  ions as well as thermal electrons).

#### 5.3 Self-sustaining discharge

- Set up the circuit as in fig. 3.
- Gradually increase the anode voltage  $U_A$  and determine the striking voltage  $U_S$  for the gas discharge.
- Reduce the anode voltage  $U_A$  again until the self-sustaining discharge ceases. Record this extinguishing voltage  $U_E$ .

#### 5.4 Simplified Franck-Hertz-set-up

Experiment for demonstrating discontinuous energy emission resulting from inelastic collisions between electrons and helium atoms. The electrons have to travel through a decelerating reverse-potential field between the grid and anode, so that they only arrive at the anode if they possess sufficient kinetic energy. Only then do they contribute to the current  $I_A$  between anode and ground.

- Set up the circuit as in fig. 4.
- For a reverse polarity  $U_R$  of 6 V, gradually raise the accelerating potential  $U_A$  from 0 V to 70 V and measure the anode current  $I_A$ .
- Plot a graph of the anode current as a function of the accelerating voltage.

Up to an accelerating potential of about 24 V, the anode current increases but then it drops suddenly. As the accelerating potential is further increased the current increases once again but after another 20 V or so it drops again.

A plot of the anode current should exhibit two clear maxima. If this is not perceptible, the filament voltage should be lowered somewhat.

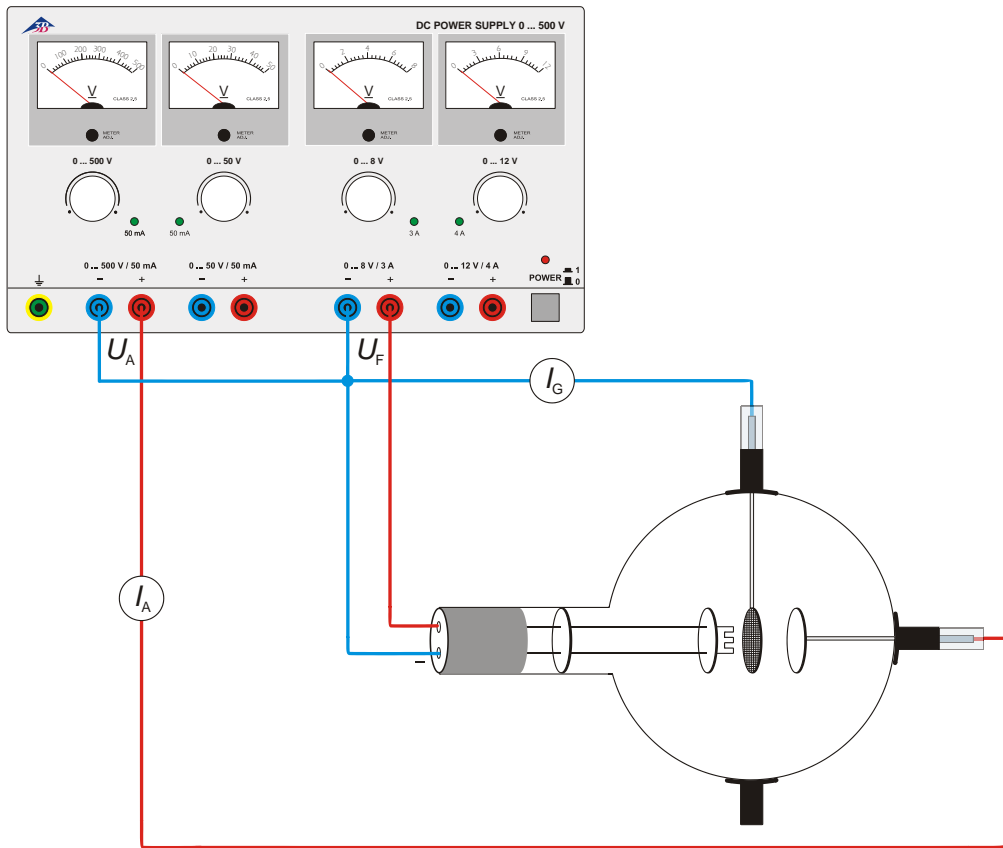


Fig. 1 Evidence of positive charge carriers

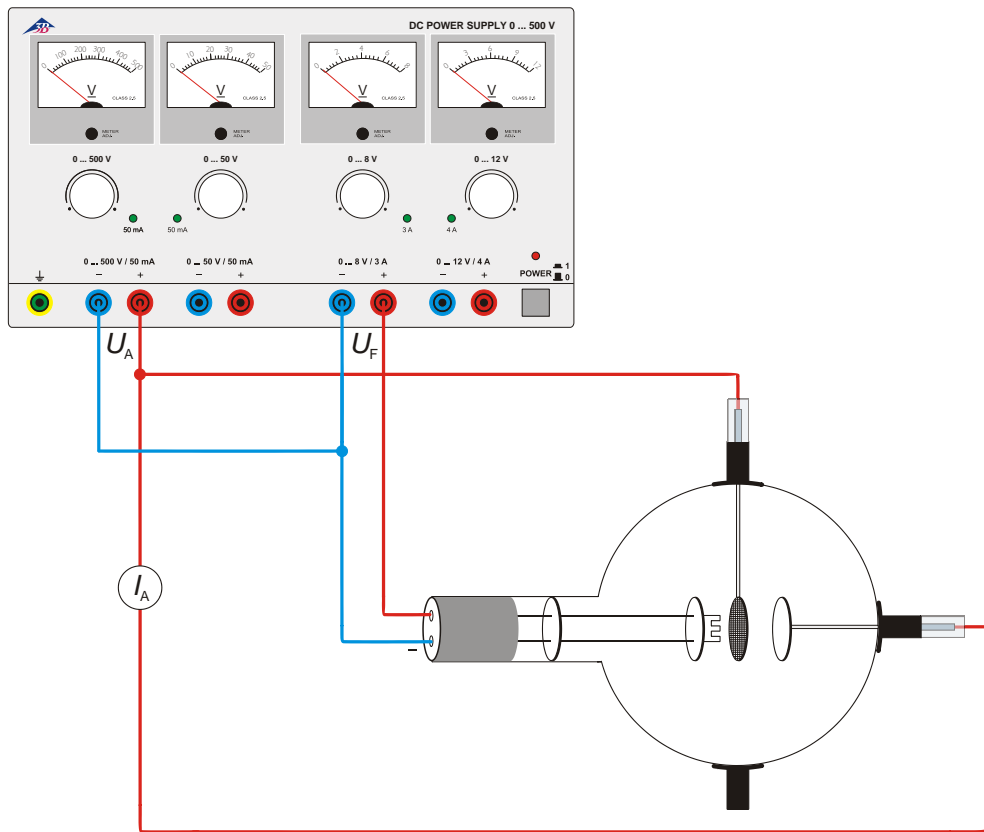


Fig. 2 Evidence for positive charge carriers

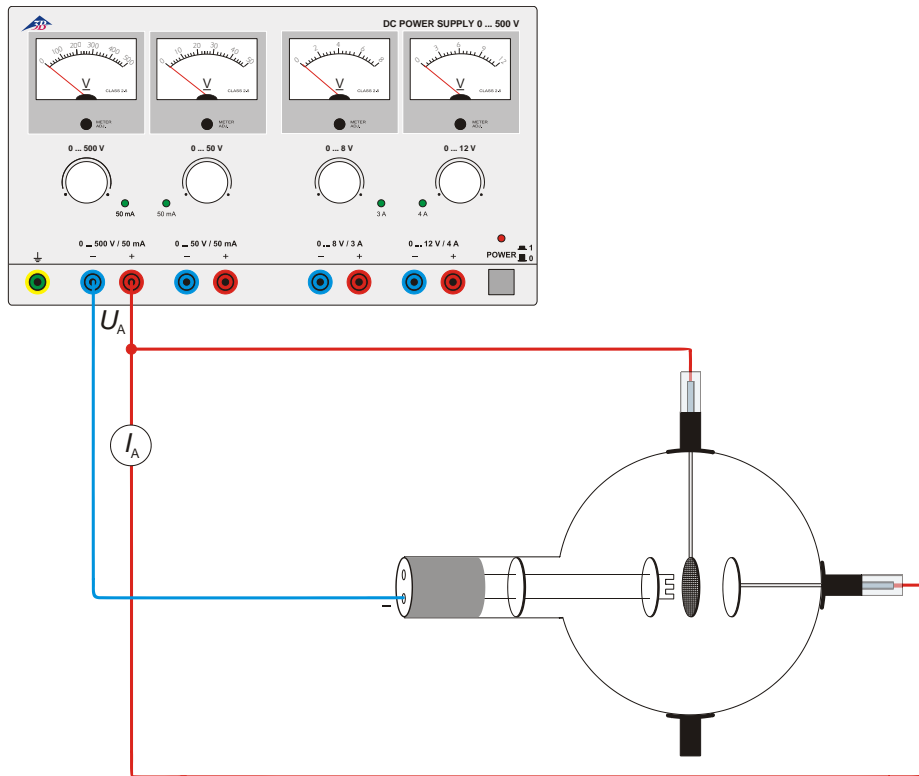


Fig.3 Self-sustaining discharge

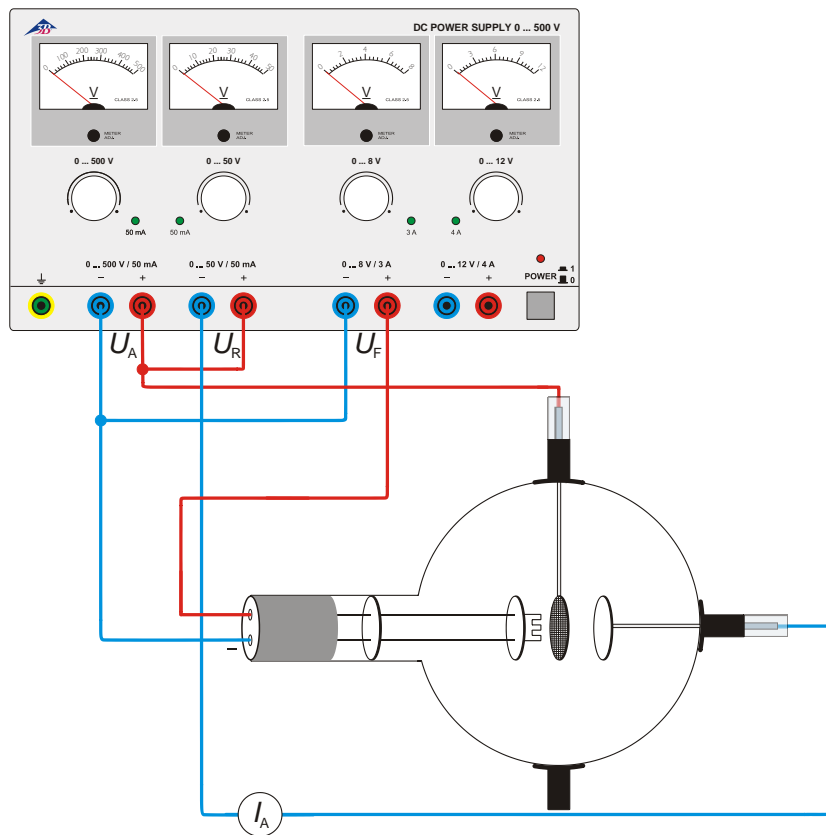


Fig. 4 Franck-Hertz set-up