1/92 - Sf —

**Instruction Sheet** **522 37**

# High-Voltage Power Supply Unit, 10 kV

The unit supplies a continuously variable direct voltage of up to 10 kV which, as a result of current limiting, is not dangerous even in the event of accidental contact. At voltages above 5 kV, the current output is less than 100 μA.*)

The voltage is set either on the integral potentiometer or externally via a low-voltage control input.

An integral voltmeter allows a digital display of the output voltage.

*Possible applications:*

- Experiments in electrostatics
- Experiments in radioactivity (operation of Geiger counter, 546 28, and the ionization chamber, 546 25)
- Operation of electron beam and gas discharge tubes*) (e. g. electron beam tubes 555 10/11/12/17; Field emission microscope, 554 60; Spectral tubes, 467 64 – 69; Discharge tubes, open type, 554 16; Hittorf's tube, 554 36; Demountable gas discharge tube, 555 14).

## 1 Safety Notes

**Please read these Operating Instructions thoroughly before using this unit!**

**If used in accordance with the information given in these Operating Instructions, experiments with the high voltages produced by this unit are quite safe!**

- **Never connect several power supply units in series.**
- **Set potentiometer ② to the left-hand stop (output voltage 0) before activating ON/OFF switch**
- **Always switch off the unit before making any alterations to the experiment configuration.**
- **Always ensure that the high-voltage circuit is correctly earthed.**
- **At voltages of 10 kV, always maintain a minimum distance of 4 cm between all experiment cables**) and conducting surfaces (tabletop, experimental equipment, etc.) in order to prevent high-voltage spark-over; with lower voltages, the minimum distance may be correspondingly smaller.**
- **Set up the experiment so that non-insulated components (e. g. capacitor plates) or cables and plugs cannot be inadvertently touched.**
- **Connect no capacitors with a capacitance of greater than 2.5 nF (at 10 kV) since at 10 kV, according to VDE 0411, an inadvertent contact can be dangerous from 4.5 nF upwards (approx. 2 nF already installed in the unit).**
- **For mains voltages other than 220 V, convert the unit as described in Section 4.2.**
- **Only connect resistors in plastic case (e. g. 536 25) suitable for high-voltage, do not use resistors in metal case (old construction series) – danger of spark-over.**

*) Beam voltages of greater than 5 kV in evacuated tubes generate measureable X-rays. These must not be allowed to exceed the maximum legally permitted values. The internal current limitation to max. 100 μA for voltages above 5 kV is an effective contribution to preventing unacceptable X-ray radiation.

## 2 Description, Technical Data

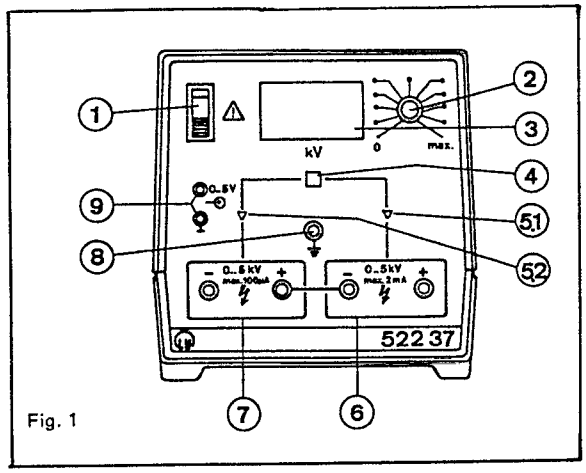


Fig. 1

① On/off switch with pilot lamp

② Potentiometer for direct continuous adjustment of the output voltage or to set an upper limit value. External control of the output voltage via input ⑨

③ 3-position digital display of the output voltage; overflow display (e. g. at $U < 0$ or $U > 10$ kV) indicated by "⊏"; accuracy of the voltmeter: 3 % of final value.

④ Selector push-button to activate output sockets ⑥ or ⑦ or ⑥ + ⑦ (in series)

⑤ LED's to indicate the activated output socket ⑥, ⑦ or ⑥ + ⑦ (in series)

⑥, ⑦ Output sockets (1 pair of 4 mm safety sockets each) to take off the voltage set on the potentiometer ② or controlled externally via input ⑨;
Two output sockets, connected internally in series;
Activation of the output sockets via selector push-button ④; Indication of the activated output socket via LED 5.1 or 5.2;
Output voltage has current limitation and is earth-free.
After switching off the unit, the voltage at the output sockets drops to zero in max. 30 seconds.

Output ⑥ : 0 to approx. 5 kV
max. 2 mA (short-circuit current)
(Output ⑦ has approx. same potential as minus (–) socket of output ⑥)

Output ⑦ : 0 to approx. 5 kV
max. 100 μA (short-circuit current)
(Output ⑥ has approx. same potential as plus (+) socket of output ⑦)

Output ⑥ + ⑦ connected in series:
0 to approx. 10 kV
max. 200 μA (short-circuit current)
At voltages > 5 kV, internally limited to < 100 μA;
With centre tap for output voltages –5 kV . . . 0 . . . +5 kV

⑧ Earth socket, galvanically connected to protective earth

**) Experiment cables and sockets whose insulation is sufficient for low voltages are not always capable of withstanding high voltages.

⑨ Control input (4 mm socket) for external control of the output voltage below an upper limit value set on potentiometer ② (see Section 3.2), lower socket to ground;
control of output voltage via external resistor or external low-voltage;

Control voltage: 0 to 5 V d.c.
0 to 5 $V_p$, max. 1 Hz.

Corresponding output voltage:
0 to approx. 5 kV (output ⑥ or ⑦)
0 to approx. 10 kV (outputs ⑥ and ⑦ in series)

On the rear of the unit: Plug socket with integral holder for primary and spare fuse; T 0.135 fuses (Spare Part No. 668 10) for 220 V/240 V installed on delivery.

In the base of the unit: Two hinged legs for inclining the unit.

Included in the scope of delivery: Mains connection lead with T 0.63 safety fuse (Spare Part No. 668 13) for 110 V/130 V.

| | |
|---|---|
| Mains voltage: | 220 V a. c., 50/60 Hz;<br>switch-over for 110/130/240 V d. c. |
| Power rating: | 35 VA |
| Dimensions: | W 20 cm x H 21 cm x D 23 cm |
| Weight: | 2.5 kg |

## 3 Operation

*Important:* Observe Safety Notes (Section 1)

### 3.1 General Instructions

Set up experiment with power supply unit switched off and potentiometer ② against left-hand stop (output voltage 0);

Earth high-voltage circuit at a suitable point; avoid earth circuits.

When connecting to a gas-discharge tube (in particular spectral tubes, 467 64 – 69), connect a 100 kΩ resistor (536 25) in series, in order to prevent vibrations due to the ignition processes in the tubes.

Select output appropriate to the experiment configuration, e. g.:

*Electrostatic experiments:*

Output ⑦ (0 to approx. 5 kV, 100 μA) or outputs ⑥ + ⑦ in series (0 to approx. 10 kV)

*Operation of ionization chambers and gas-discharge tubes:*

Output ⑥ (0 to approx. 5 kV, 2 mA);
or in exceptional cases, Outputs ⑥ + ⑦ in series (0 to approx. 10 kV), e. g. with the discharge tube (554 16) and the field emission microscope (554 60); see appropriate Operating Instructions (1985 edition).

*Activation of the outputs:*

Switch on the unit:

Output ⑥ active (indicated by LED (5.1))

Depress selector push-button ④ once:
Output ⑦ active (indicated by LED (5.2))

Depress selector push-button ④ again:
Outputs ⑥ and ⑦ active (indicated by LED's (5.1) and (5.2))

Depress selector push-button ④ again:
Output ⑥ active (see above)

Set output voltage either on potentiometer ② or externally via control input ⑨ below the maximum value set with ②.

To obtain a symmetrical voltage $-U \ldots 0 \ldots +U$, connect outputs ⑥ and ⑦ in series and earth with the "centre tap" (blue socket of output ⑥ or red socket of output ⑦; the two sockets are connected internally).

After completing the experiment, reset output voltage to zero with potentiometer ② and switch off the unit.

### 3.2 External Control of the Output Voltage

To be recommended, for example, for experiment configurations which

react sensitively to electrical fields set up by the experimenter ("Remote Control" of the high voltage; see Fig. 2, Fig. 3.1/2)
or
which require a fine adjustment to the high voltage (see Fig. 4)
or
whose high voltage is computer controlled via the Cap interface (533 00) – only for experiments without spark-gap.

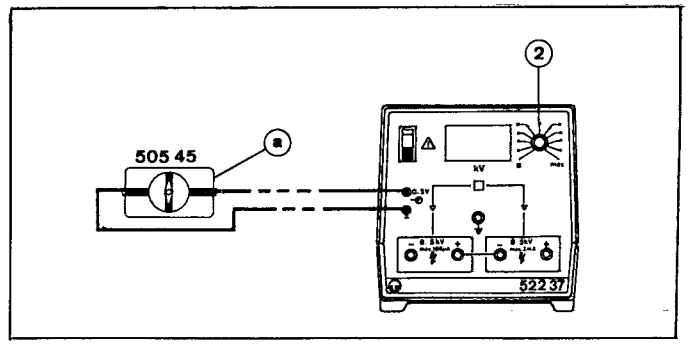


Fig. 2 Switching on and off the output voltage via external switches ("remote control"):
Connect switch ⓐ (e. g. 505 45) using long experimenting cables; with switch ⓐ open, preselect the required output voltage on potentiometer ②; switch output voltage off by closing and on by opening switch ⓐ

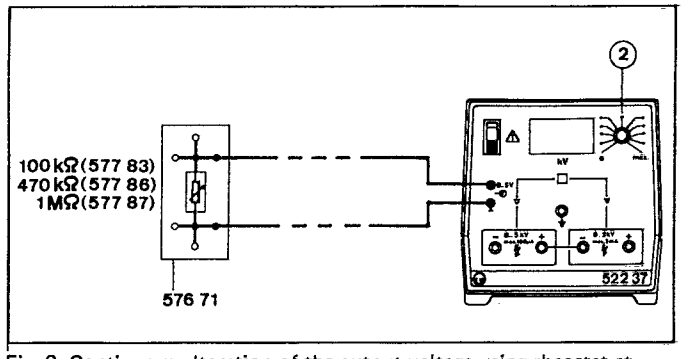


Fig. 3 Continuous alteration of the output voltage using rheostat at control input ⑨;
Set potentiometer ② to right-hand stop and, using long experimenting cables, connect input ⑨ to rheostat $R$ which is set for the maximum output voltage $U_{max}$:

$R$ = 1 MΩ for $U_{max} \approx$ 5 kV (or 10 kV)
$R$ = 470 kΩ for $U_{max} \approx$ 3.5 kV (or 7 kV)
$R$ = 100 kΩ for $U_{max} \approx$ 1 kV (or 2 kV)

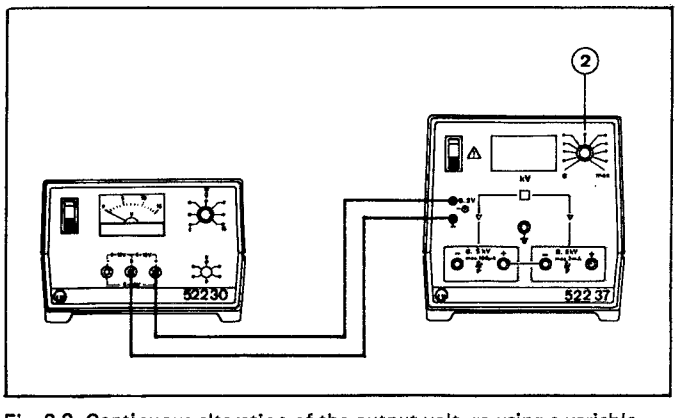


Fig. 3.2 Continuous alteration of the output voltage using a variable external control voltage (0 . . . 5 V) at input ⑨;
Set potentiometer ② either to the right-hand stop or – with input ⑨ open – to the desired upper output voltage limit.

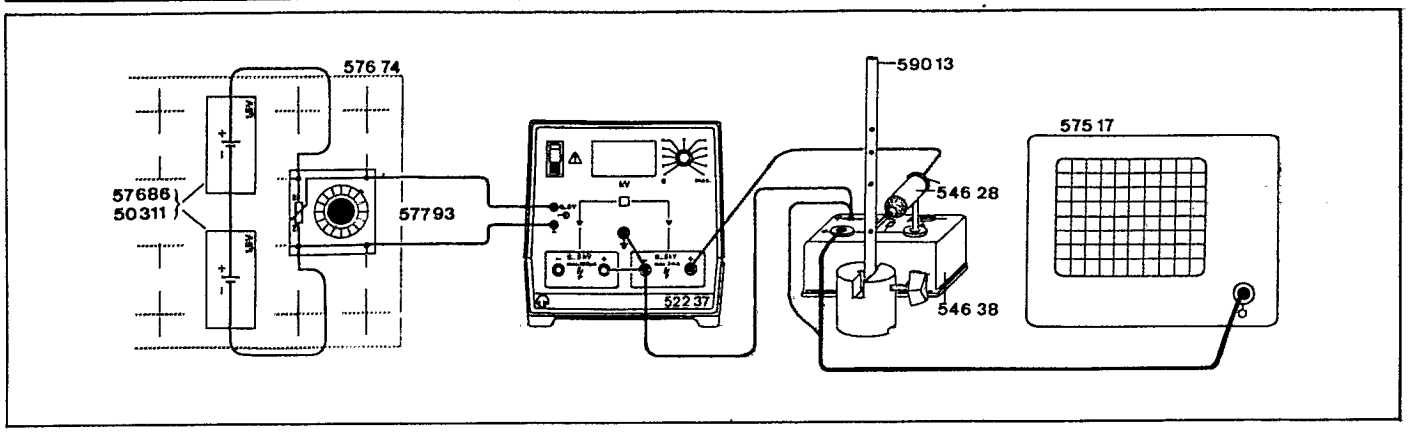


Fig. 4 Testing for $\alpha$ and $\beta$ radiation using the Geiger counter (546 28) and oscilloscope; differentiation of radiation types by impulse analysis;
Fine adjustment of the high voltage in a very small proportional range of the Geiger counter using the 10-turn potentiometer (577 93);
Set an upper limit for the output voltage of approx. 3 kV on potentiometer ② with input ⑨ open.

## 4 Replacing the Fuse, Adaptation to Mains Supply Voltages other than 220 V

### 4.1 Replacing the primary fuse

- Remove insert ⓐ (with socket for primary fuse ⓑ and spare fuse ⓒ) using a screw-driver or another suitable tool (Fig. 5.1).
- Replace defective fuse ⓑ by new fuse ⓒ after checking for correct fuse rating (Fig. 5.2).
- Insert spare fuse ⓒ and replace insert ⓐ.

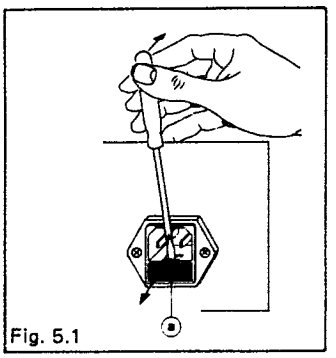

Fig. 5.1

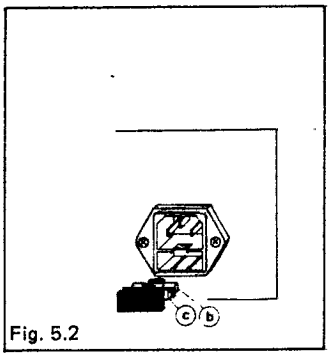

Fig. 5.2

### 4.2 Adaptation to mains supply voltages other than 220 V

*Note: First disconnect from mains and wait for voltage drop to zero (30 s).*

- Unscrew screws ⓓ on the bottom of the instrument using a cross-head screw-driver (size 2) (Fig. 6.1).
- Place the apparatus in the normal position and remove the upper part of the cabinet ⓔ (Fig. 6.2).
- Remove p. c. board ⓖ from the blue socket ⓕ (on the transformer), (Fig. 6.3).
- Position the p. c. board ⓖ so that the imprint of the intended mains voltage (e. g. 110 V a. c.) appears above the 1 on the plug-in socket ⓕ (Fig. 6.4).
- Insert p. c. board ⓖ and reassemble the casing.
- Change the primary fuse to adapt to the changed mains voltage (see Technical Data).

  For directions for replacing a fuse refer to 4.1 (Figs. 5.1 and 5.2).

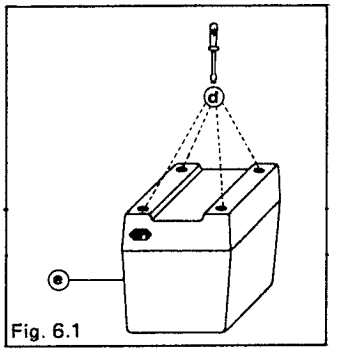

Fig. 6.1

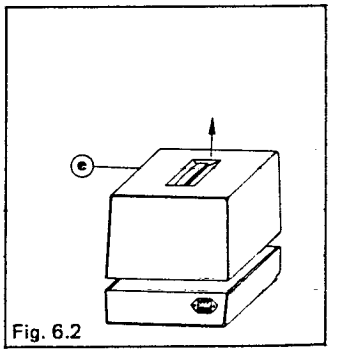

Fig. 6.2

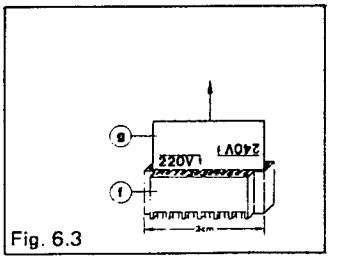

Fig. 6.3

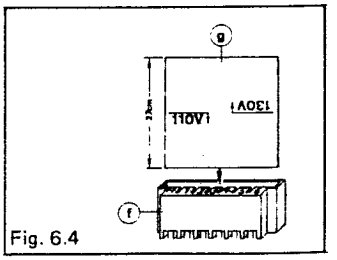

Fig. 6.4