

10/95-Sf-

Instruction Sheet

544 23

Demountable Capacitor

This equipment set is used for the assembly of plate capacitors where it is possible to vary the plate spacings and to select different plate areas and dielectrics.

Examples of Experiments:

- Electrostatic investigations in the electric field
- Interrelationship between charge, voltage and capacitance
- Capacitance as a function of plate spacing, plate area and dielectric
- Permittivity of vacuum ϵ_0 , dielectric constant ϵ
- Parallel and series connection of capacitors

Bibliography:

Central Card Index 'Electrostatics' (598 661), in German
 New Physics Leaflets for Colleges and Universities, Volume 1
 (599 952), Experiment 3.1.5-2
 Physics Experiments, Volume 2, Electricity — Electronics
 (599 932), Experiment 3.1.5-2

1 Safety Notes

- Connection of capacitor plates to voltage source should only be made via protective resistor.
- Do not touch the charged capacitor plates.
- Maximum permissible voltage: 5 kV.

2 Standard Equipment, Description, Technical Data

- ① to ④ Capacitor plates on riders
- ① 2 pairs of plates
 Areas: 283 mm x 283 mm
 200 mm x 200 mm
 Area ratio $A_1 : A_2 = 2 : 1$
- ② Rider of highly-insulated plastic material to be clamped onto rail ⑥
- ③ 4-mm socket for voltage connection
- ④ Pointers for adjusting and reading the plate spacings on the scale of rail ⑥
 Spacing between the pointers when the plates are completely pushed together (plate spacing $d = 0$): 10 cm
- ⑤ 20 spacers of highly-insulating plastic material, pluggable to the corners of capacitor plates ①; asymmetric, with side walls of different thickness (1 mm, 3 mm), for the adjustment of defined plate spacings d (e. g. 1 mm to 6 mm in steps of 1 mm)
- ⑥ Precision metal rail, 25 cm long, for clamping-on of ②; with mm scale
- ⑦ 1 glass plate and 1 polystyrene plate, 30 cm x 30 cm x 0.4 cm, as dielectric

Not shown: Storage tray (86 mm x 86 mm) for spacers ⑤

Total weight: 2.9 kg

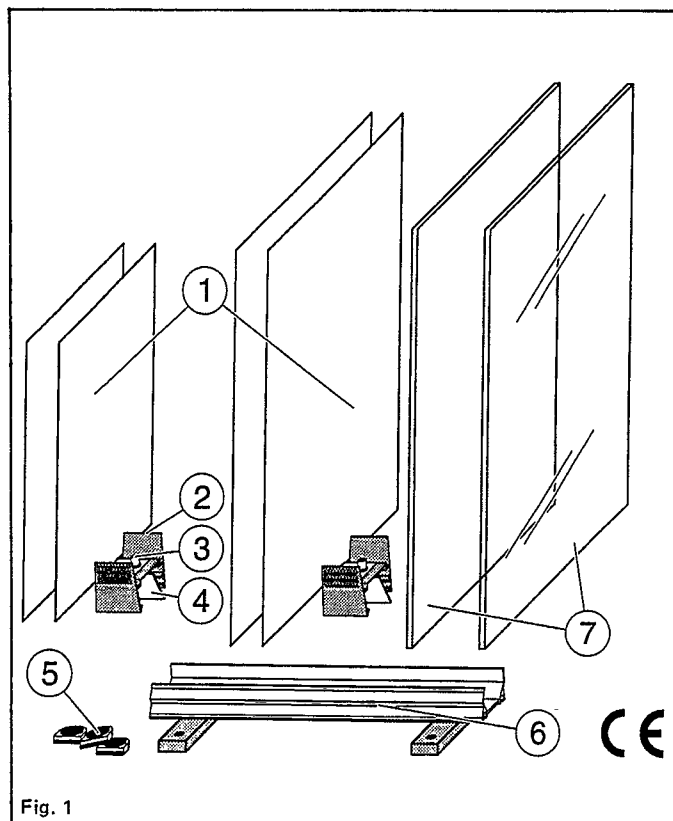


Fig. 1

3 Use

Additionally required:

For voltage supply and charge production:

Regulated power supply unit, 0 to 300 V with protective resistor 1 M Ω	522 35 e. g. 536 20
High-voltage power supply unit, 10 kV	522 37
Plastic rod	541 04
Glass tube	541 01
Rubbing material (wool, cotton, dry newspaper)	

For voltage indication:

Electroscope	e. g. 540 09
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For voltage measurement (high-resistance or electrostatic), e. g.

Demonstration multimeter	531 91
Electrostatic voltmeter, 0 to 1.5 kV	540 38

For charge measurement (range 10⁻⁶ As to 10⁻⁸ As):

Current measuring amplifier D with meter (range between 0.3 d. c. and 3 V d. c., $R_i > 3$ k Ω), e. g.	532 00
Moving-coil instrument D or P	531 781 or 791

For interrupting voltage supply and charge circuit:

Cut-out switch (2 x)	504 45
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For removing humidity:

Fan	545 20
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Important:

Do not apply voltage before the assembly has been completed. Do not touch the charged capacitor.

Before changing the spacer positions, interrupt connection to voltage source (switch) and discharge the capacitor.

Prior to use, wipe the capacitor-plate insides, the dielectrics and the spacers with a non-fibrous piece of cloth wetted with antistatic solution. Then dry the apparatus with hot air (using the fan 545 20).

In quantitative experiments, particularly when making series of measurements and comparative measurements, use the spacers and small plate spacings — max. 6 mm — (reproducible spacings; no excessive impairment by the inhomogeneity at the plate edges which increases with increased plate spacing).

Plug spacers to all four corners of one plate (for $d = 1$ mm or 3 mm respectively) or two plates (for $d = 2$ mm, 4 mm, 6 mm) (see Fig. 2). Push the plates together up to the stop, but do not press them together (deformation of the plates will falsify the spacing).

Adjust, on the rail scale, plate spacings $d > 6$ mm above tip positions of pointer ④. It is advisable to adjust the left pointer tip to "0" (or "10 cm") so that the scale value for the right pointer tip, reduced by 10 cm (or 20 cm) gives the plate spacing d .

Remove any humidity in the vicinity of the capacitor plates using a hot-air fan (e. g. 545 20) to avoid uncontrolled discharge.

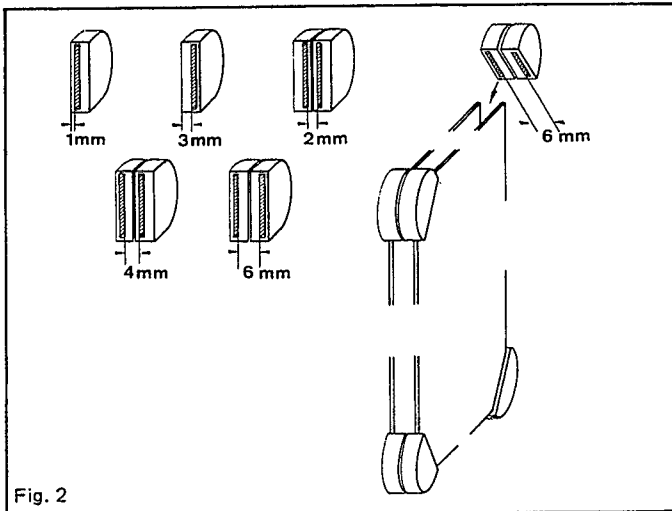


Fig. 2

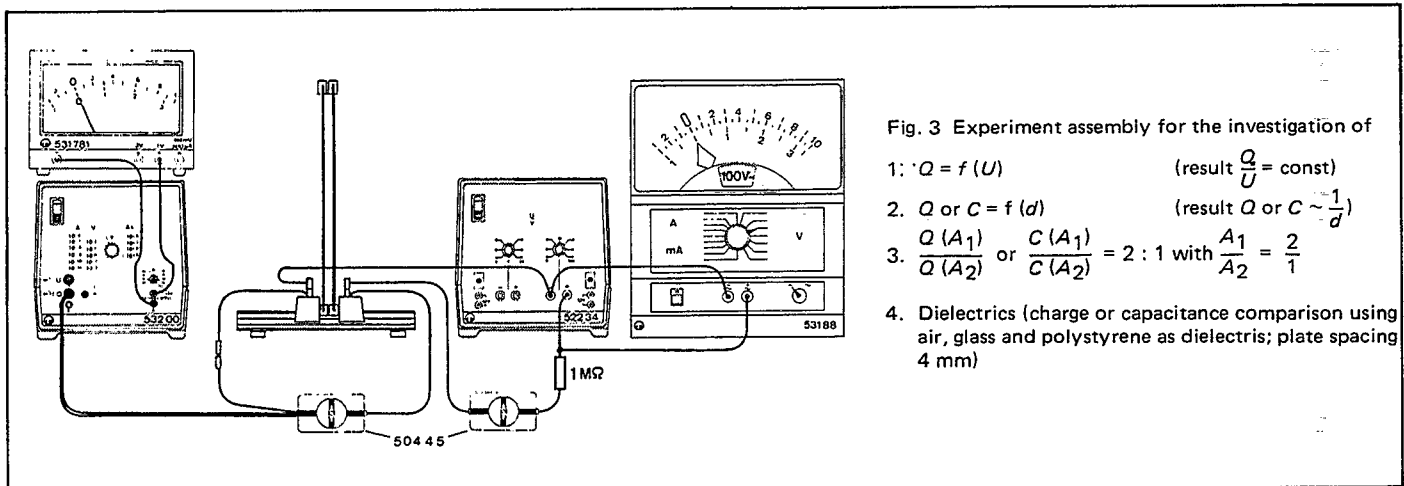


Fig. 3 Experiment assembly for the investigation of

1. $Q = f(U)$ (result $\frac{Q}{U} = \text{const}$)
2. Q or $C = f(d)$ (result Q or $C \sim \frac{1}{d}$)
3. $\frac{Q(A_1)}{Q(A_2)}$ or $\frac{C(A_1)}{C(A_2)} = 2 : 1$ with $\frac{A_1}{A_2} = \frac{2}{1}$
4. Dielectrics (charge or capacitance comparison using air, glass and polystyrene as dielectris; plate spacing 4 mm)

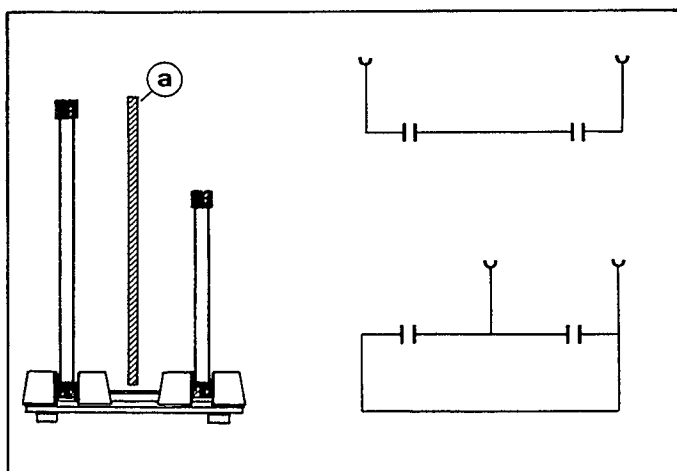


Fig. 4 Parallel and series connection of capacitors. Select spacing between the two capacitors as large as possible and place polystyrene plate ③ between the inner plates. For connections of voltage supply and measuring instruments refer to Fig. 3.

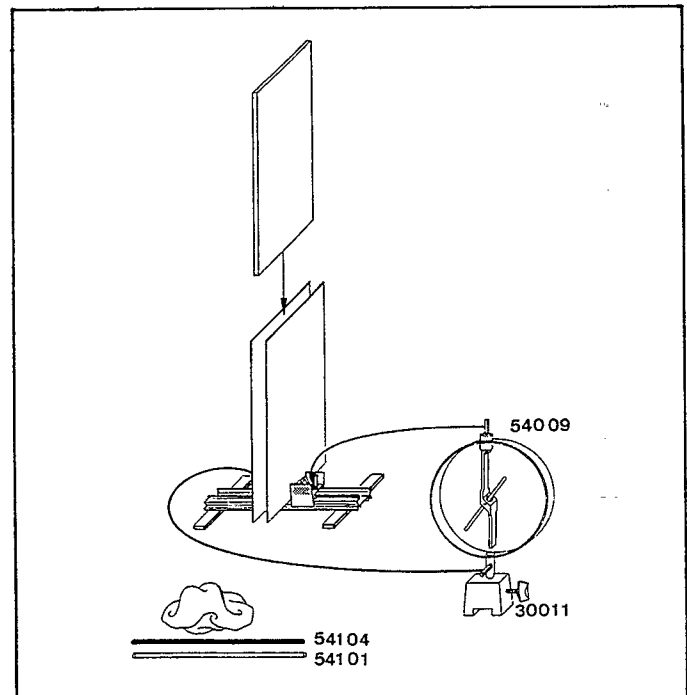


Fig. 5 Voltage between the capacitor plates as a function of their spacing; influence of the dielectrics (qualitative)