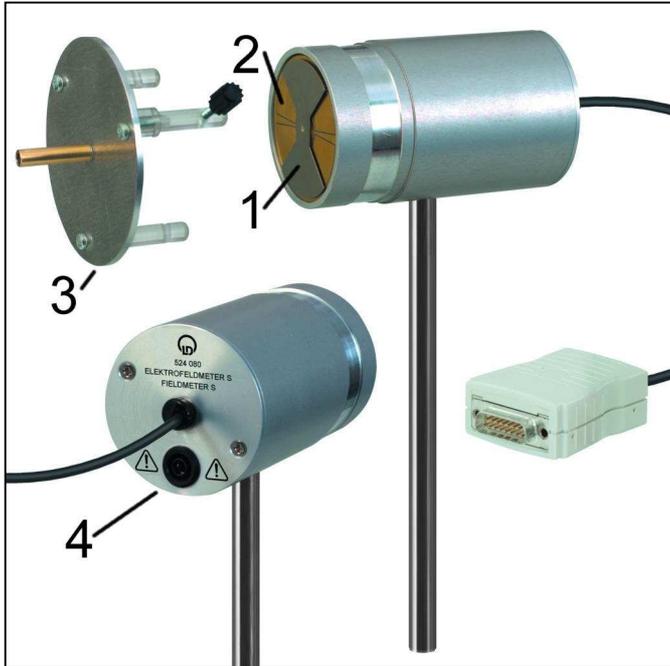


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Instruction sheet 524 080

Electric field meter S (524 080)

- 1 Grounded wing
- 2 Sensor fields
- 3 Voltage measuring plate
- 4 Grounding socket (on the back)

1 Description

The electric field meter S is used in conjunction with the CASSY[®] computer-assisted measurement system. It enables static electric fields and voltages to be measured.

Experiment examples are found on the CD of the CASSY Lab software (524 200) or in the download version of the software under <http://www.ld-didactic.com> or in the manual of the CASSY Lab software (524 201).

2 Measurement quantities

Meas. quantity	CASSY Lab ^{/1/} (524 200)	CASSY-Display ^{/2/} (524 020)	Mobile-CASSY (524 009)	Ranges
Field strength	E	✓	E	± 1 kV/m ± 10 kV/m ± 100 kV/m ± 1 MV/m
Voltage	U	✓	U	± 10 V ± 100 V ± 1 kV ± 10 kV

^{/1/} for Sensor-CASSY (524 010), Pocket-CASSY (524 006) or Mobile-CASSY (524 009) at a PC

^{/2/} in conjunction with Sensor-CASSY (524 010)

3 Scope of supply

- 1 electric field meter S
- 1 stand rod with thread
- 1 voltage measuring plate, 1cm distance

4 Accessories

Accessory set for electric field meter	540 540
Clamp rider with clamp	460 311

5 Principle of operation

The electric field meter S measures a static electric field.

The sensor consists of a grounded rotating wing and four gold-plated measuring sensors behind it, each of which covers an area of approx. 80 angular degrees. The rotation leads to the measuring plates with the surface area A being alternately exposed to the external electric field E or screened by the grounded wing. Accordingly, the charge on the surface of the plates varies periodically between zero and

$$Q = \epsilon_0 \cdot E \cdot A$$

This periodic variation leads to a current

$$I = \dot{Q}$$

of the order of magnitude of 1 nA at 1 kV/m in the lines connected to the measuring plates. This current is measured and integrated. This way the charges currently on the measuring plates are determined. For each plate the maximum and mini-

imum values of the charge are measured, and from the difference and the known quantities ϵ_0 and A the field strength E is calculated.

Whereas the magnitude of the current depends on the instantaneous speed of the wing, the integrated charge does not. Therefore the measuring result does not change if the wing rotates at a higher or lower speed.

Because of the principle of measurement, the electric field meter S is suited for measuring static electric fields. Alternating electric fields such as the 50 Hz fields from high-voltage lines are considered to be noise and are averaged out.

On the front of the electric field sensor, four gold-plated measuring plates can be seen behind the wing. Each of them covers 80 angular degrees and they are connected diagonally in twos. The narrow segments between the measuring plates serve as shields and lightning dischargers on the one hand. On the other hand, the charge remains constant on the plates while the edges of the wings move over these portions. During this time, the measured value is determined. The measurement on two pairs of plates at the same time increases the measuring frequency and provides noise suppression.

Apart from the electric field strength, the electric field meter S can also be used to measure voltages. The voltage measurement is based on measuring the field strength in a known capacitor. The enclosed voltage measuring plate is mounted at a fixed distance of 1 cm. With an applied voltage of 1 kV, for example, this gives an electric field of $1 \text{ kV/cm} = 100 \text{ kV/m}$. The software displays, of course, the voltage directly.

The voltage measuring plate is only held by three pins and there is no other electrical connection. This provides a very high-resistance, low capacitance voltage measuring input.

For measuring electric potentials around charged bodies or, e.g., inside a plate capacitor, the flame probe from the accessory set 540 540 is used. In the metal tube, a flammable gas flows into the tip and there burns with small flame. The flame at the tip causes an ionisation current to flow until the potential of the surrounding area is reached. The resulting voltage is transferred to the voltage measuring plate at the electric field meter S via a connecting lead and measured there. As the ionisation current only flows through the flame at the tip, the potential takes the value present at the tip. However, since the flame probe is made of metal, its mere presence leads to a disturbance in the electric field around it. In the ideal case, the flame probe can be positioned in an equipotential surface. In measurements of the electric field around a charged sphere, this is only possible approximately by holding the flame probe perpendicularly to the line connecting the flame and the sphere.

For safety reasons the flame probe is constricted at the tip. If the gas flow becomes too strong, the flame is interrupted.

If the field mill is used outdoors, e.g. for measuring the electric field of a gathering thundercloud, the user should be cautious of lightning and keep the field mill dry.

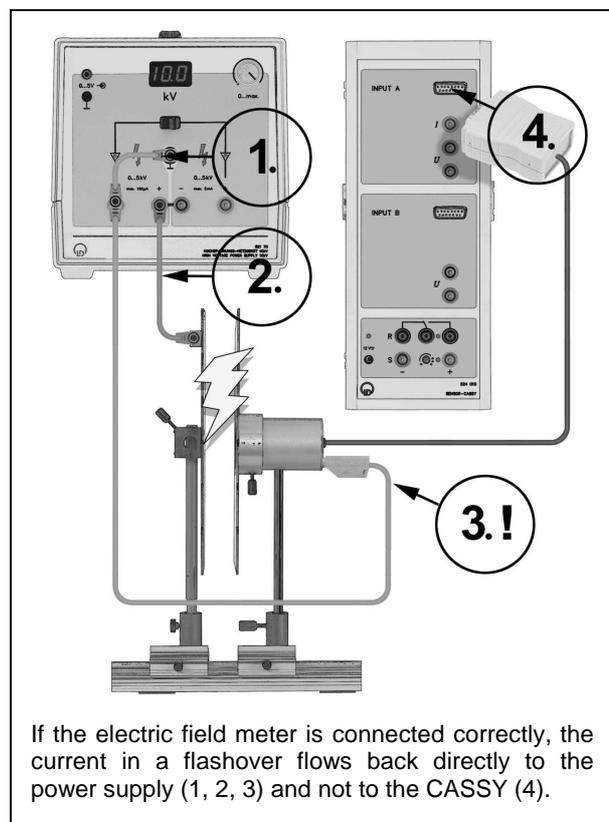
Practical remarks

The maximum voltage measuring range with the voltage measuring plate is 10 kV. Under normal conditions no flashovers are to be expected. If flashovers occur nevertheless along the pins of the voltage measuring plate, the pins should be cleaned and degreased.

Under extreme climatic conditions, such as high air humidity or low atmospheric pressure at higher altitudes, the input resistance for the voltage measurement and the electric strength cannot be guaranteed.

6 Operation

Correct grounding of the electric field meter S is indispensable. As measurements are typically carried out in connection with high voltages, the electric field meter S must never be used without connection of the 4 mm socket on the back to the ground of the experiment.



Please keep in mind that flashovers may always occur in experiments with high voltages. These overvoltages hit the housing of the electric field meter S. Although the electric field meter S is protected against overvoltage strikes, the energy has to be discharged somewhere, and this takes place via the 4 mm socket on the back.

If there is no correct grounding, the peripheral equipment of the electric field meter, including the CASSY and the computer, may be damaged.

6.1 Measuring the static electric field:

- Take the electric field meter S into the experimental setup and connect it.
- If desired, enlarge the surface around the electric field meter with the bored capacitor plate.
- Switch the high voltage on.
- Read the measured value or
- start the measurement with the  button or the F9 key.

6.2 Measuring the voltage:

- Put the voltage measuring plate onto the electric field meter. The wing should be at rest to avoid that it is damaged in an accidental contact with the legs of the voltage measuring plate.
- Connect the voltage source to the voltage measuring plate.
- Read the measured value or
- start the measurement with the  button or the F9 key.

7 Technical data

Voltage supply:	±12 V from CASSY
Limit frequency:	10 Hz
Voltage measurement:	
Electric strength:	10 kV with correct grounding
Input resistance:	10 ¹⁵ Ohm (under normal conditions)
Input capacitance:	4 pF
Diameter:	
Receptacle for capacitor:	58.3 mm
Back	60 mm
Length	96 mm
Length of the stand rod	190 mm without thread

8 Compatibility

The electric field meter S can be used in conjunction with the following CASSY modules:

	Sensor-CASSY (524 010)	Pocket-CASSY (524 006)	Mobile-CASSY (524 009)
with PC	CASSY Lab software 1.53 or higher version		
without PC	with CASSY-Display firmware 1.21 or higher version	—	Firmware 1.15 or higher ver- sion

As a member of the CASSY family the electric field meter has the following features:

- The device can be plugged in at any time.
- The connected device is recognized automatically.
- Measurement quantities and measuring ranges are set using the menu-driven software.

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