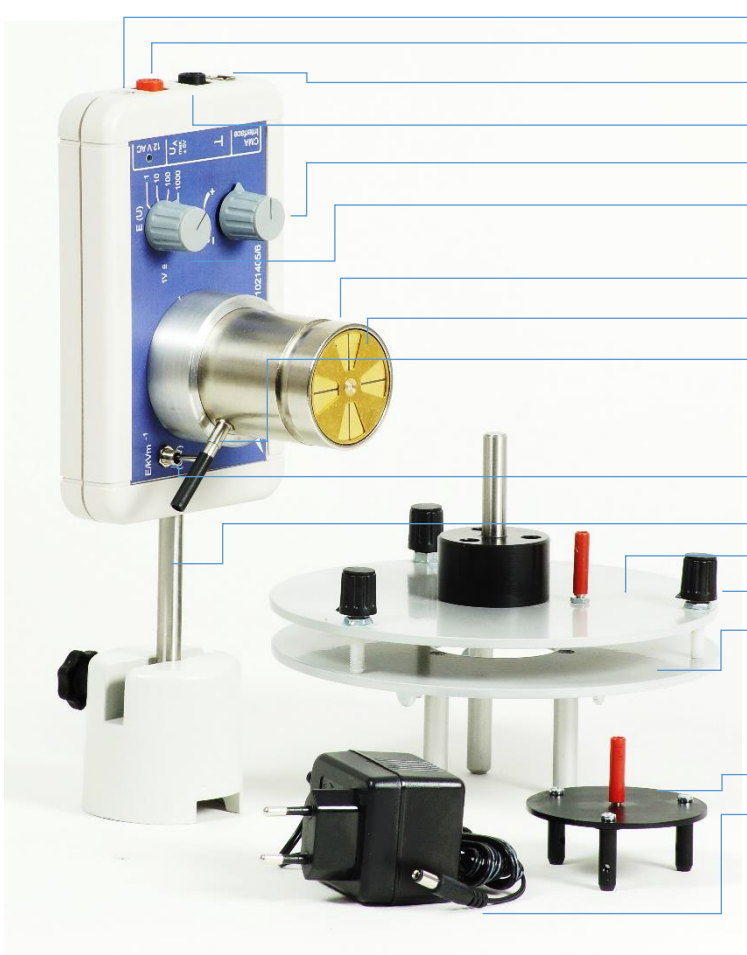
Electric field meter @115 V 1021406
Electric field meter @230 V 1021405

Instruction manual



1 Socket for plug-in power supply
2 Measurement voltage output
3 Socket for CMA interface
4 Ground socket
5 Offset (zero calibration)
6 Range selector switch
7 Field detector vanes
8 Rotor
10 Ground socket
11 E/V selector switch
12 Rod for vertical mounting
13 Capacitor plate, 250 cm²
14 Plate separation adjustment
15 Fixed capacitor plate
16 Voltage measurement plate 1x
17 Plug-in power supply

1. Safety instructions

The electric field meter complies with safety regulations for electric measuring, control and laboratory instruments in accordance with DIN EN 61010 part 1 and is designed to fulfil requirements for protection class III. It is intended for use in dry rooms suitable for electrical equipment. The electric field meter may only be used in conjunction with its own plug-in power supply.

Safety is guaranteed as long as the equipment is used as specified. No such guarantee can be made, however, if the plug-in power supply (17) should be damaged. If such damage occurs, the power supply must be replaced (P-1001014 230 VAC or P-1009545 115 VAC).

- Take care when positioning the voltage measurement plate (16) or the fixed capacitor plate (15) next to the field detection vanes (7).

  The equipment has to be turned off by disconnecting the plug-in power supply from the mains.
- Any discharges resulting in sparks could destroy the equipment and must be avoided at all costs.
- **Never touch the rotor while it is moving.**

- Do not allow the equipment to come into contact with any liquids or corrosive media. This applies in particular to the field detector vanes.
- In any experiments involving voltages in excess of 100 V it is essential that a 10 MΩ (e.g. 1022192) resistor be incorporated into the power supply circuit for protective purposes (see Fig. 2 and Fig. 3).
- Be careful when working at voltages with which it is dangerous to come into contact.
- In schools and training establishments, any experiments involving equipment exhibiting voltages with which it is dangerous to come into contact must be supervised by trained personnel.

2. Description

The electric field meter is intended to measure field strengths of static electric fields or electrical potentials. Using the voltage measurement attachment (16) it is possible to measure DC voltages between 1V and 1000V (a resistor must be included upstream in the circuit).

Measurement principle

A uniformly shaped screening plate (rotor (B)) rotates in front of the stator (C) of the induction electrode and continually interrupts the electrical flux acting on the induction electrode itself. This results in induced charging of the stator, amplified and rectified. The output voltage is therefore proportional to the inducing voltage and thus the electric field acting on the induction electrode.

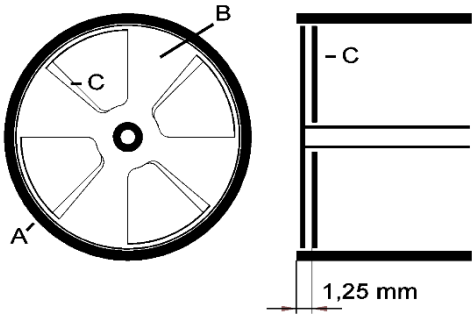


Fig. 1: Field detection vanes

A Screening cylinder, B Rotor, C Stator, Offset separation = 1.25 mm

Offset separation

To determine the electric field, it is essential to take into account the separation between the plates of the electrode and stator (C) (cf. Fig. 1). This means that an extra 1.25 mm needs to be added to the configured plate separation (distance between (13) and (15), the capacitor's measurement plate).

Measuring ranges for electric field measurement

1kV/m, 10kV/m, 100kV/m or 1000kV/m

Measuring ranges for voltage measurement

1V; 10V; 100V or 1000V

The selector switch (11) can be used to swap between measurements of electric field and voltage.

3. Zero-point calibration

Short the voltage measurement plate (16)) to the ground socket (4).

Use the offset adjustment knob (5) to calibrate the voltage between sockets (2) and (4) to zero.

When the capacitor measurement plate is used, zero calibration takes place with the measurement plate (13) attached and connected to the ground socket (4).

4. Technical data

Power supply:	Plug-in unit, 12 V AC
Output voltage:	max. ±5 V
Measuring ranges:	
1 V at the output corresponds to the following:	
(E/kVm^{-1}) or U/V	1, 10, 100, 1000
Dimensions:	
(L x W x H)	140 x 110 x 120 mm^3 approx.
Weight:	1 kg approx.

5. Equipment supplied

1 Basic electric field meter module
1 Voltage measurement plate, range 1x
1 Capacitor measurement plate, 250 cm^2
1 Fixed capacitor plate
1 Plug-in power supply, 12 V AV/700 mA

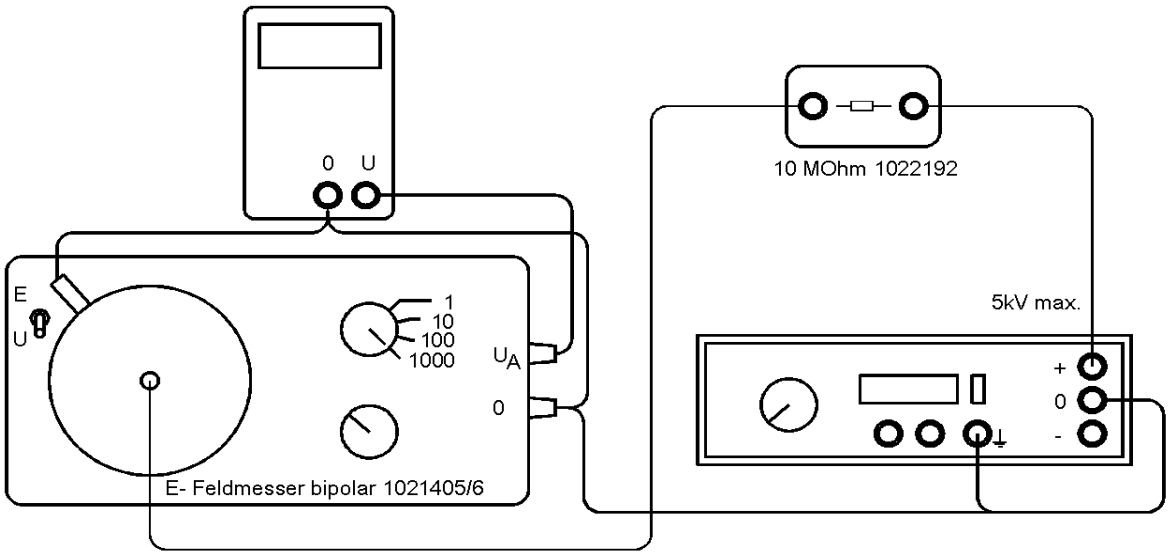


Fig. 1: Electric field meter used as induction electrometer

6.0 Experiments

6.1 Measurement of potential – Electric field meter used as static voltmeter

Additionally required:

1 High-voltage power supply 10 kV @115 V	1020138
or	
10 kV @230 V	1019243
1 Digital multimeter e.g.	1002784
1 Resistor, 10 MΩ	1022192

- Set up the experiment with the voltage measurement plate (16) as shown in Fig. 2.
- Connect the display instrument to the voltage output (2) and (4).
- Place the measurement plate (16) over the detection vanes (7) and gently(!) screw it into place by hand.
- Set the selector switch (11) to "(U/V)".
- Carry out zero calibration as in section 3.
- Connect the positive terminal of the high-voltage power supply with the voltage measurement plate via a protective 10 MΩ resistor. The negative terminal should be connected to the ground socket of the screening cylinder.
- Set the range selector switch (6) to 1000.

  Note: Voltage measurement puts no load on the voltage source, so no voltage drops across the large protective resistor.
- Turn on the high-voltage power supply.

In this example the high-voltage supply is set to 1500 V.

$U = U_A * MB = 1.5V * 1000 = 1500V$

MB = Measuring range

U = Voltage at measuring plate (16)

U_A = Measured voltage

1.5 V is measured at the output sockets.

6.2 Electric field measurement with 250 cm² capacitor measurement plate

The electric field strength E of a capacitor made up of a fixed plate (15) and measurement plate (13) is to be measured to see how it depends on plate separation and the applied voltage.

Additionally required:

1 High-voltage power supply DC 500 V @115 V 1003307

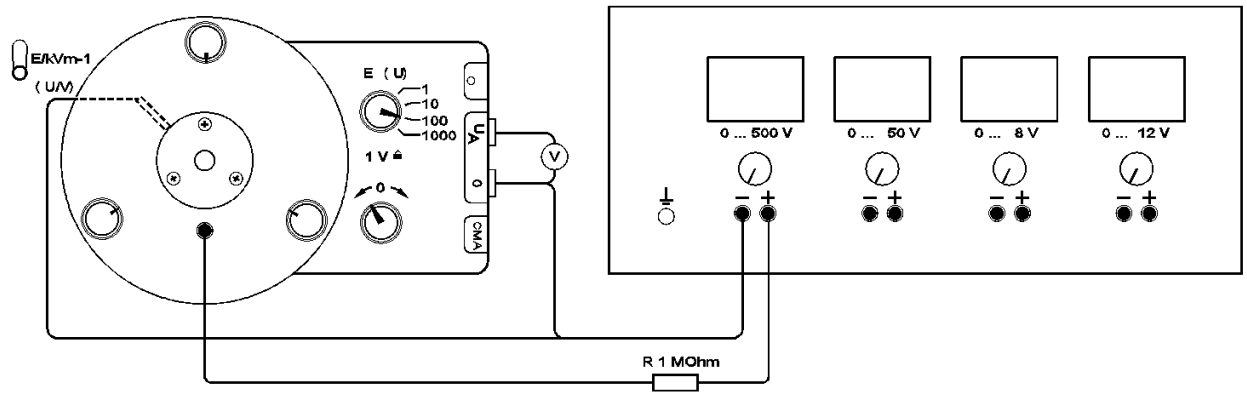
or

1 High-voltage power supply DC 500 V @230 V 1003308

1 Resistor, 10 MΩ 1022192

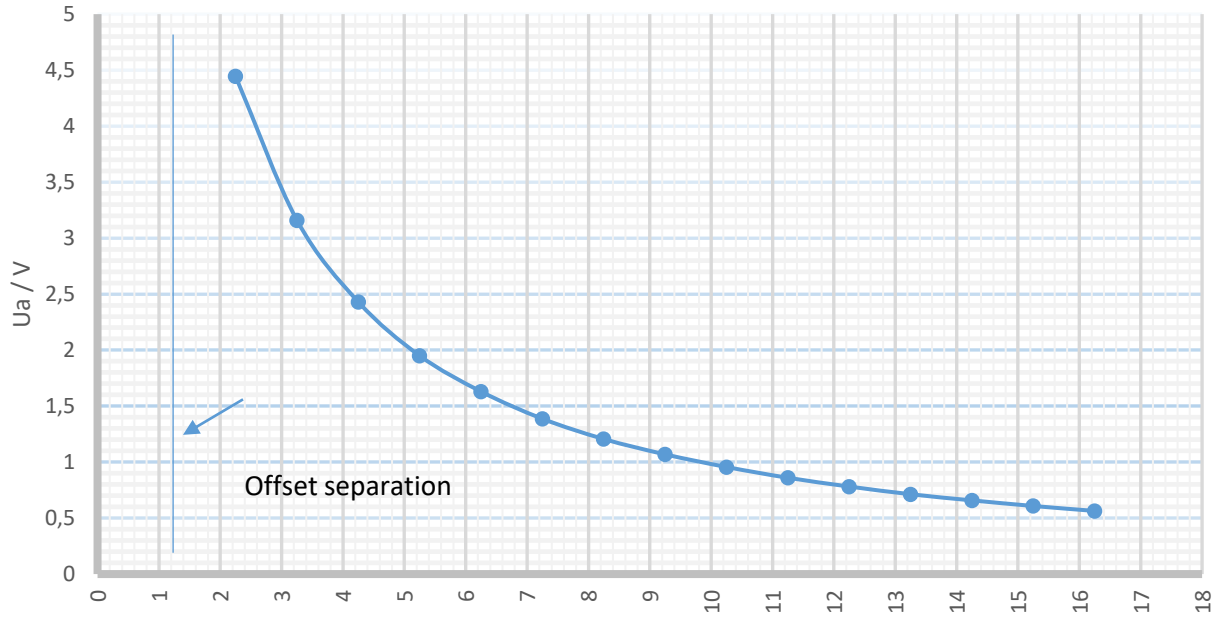
Set up the experiment as shown in Fig. 3.

- Position the fixed capacitor plate (15) next to the field detector vanes (7) while the equipment is switched off and gently tighten the screw under the fixed plate (15) by hand.
- Connect the measurement plate (13) to the ground socket (10).
- Set the spacing adjustment knob (14) to zero.

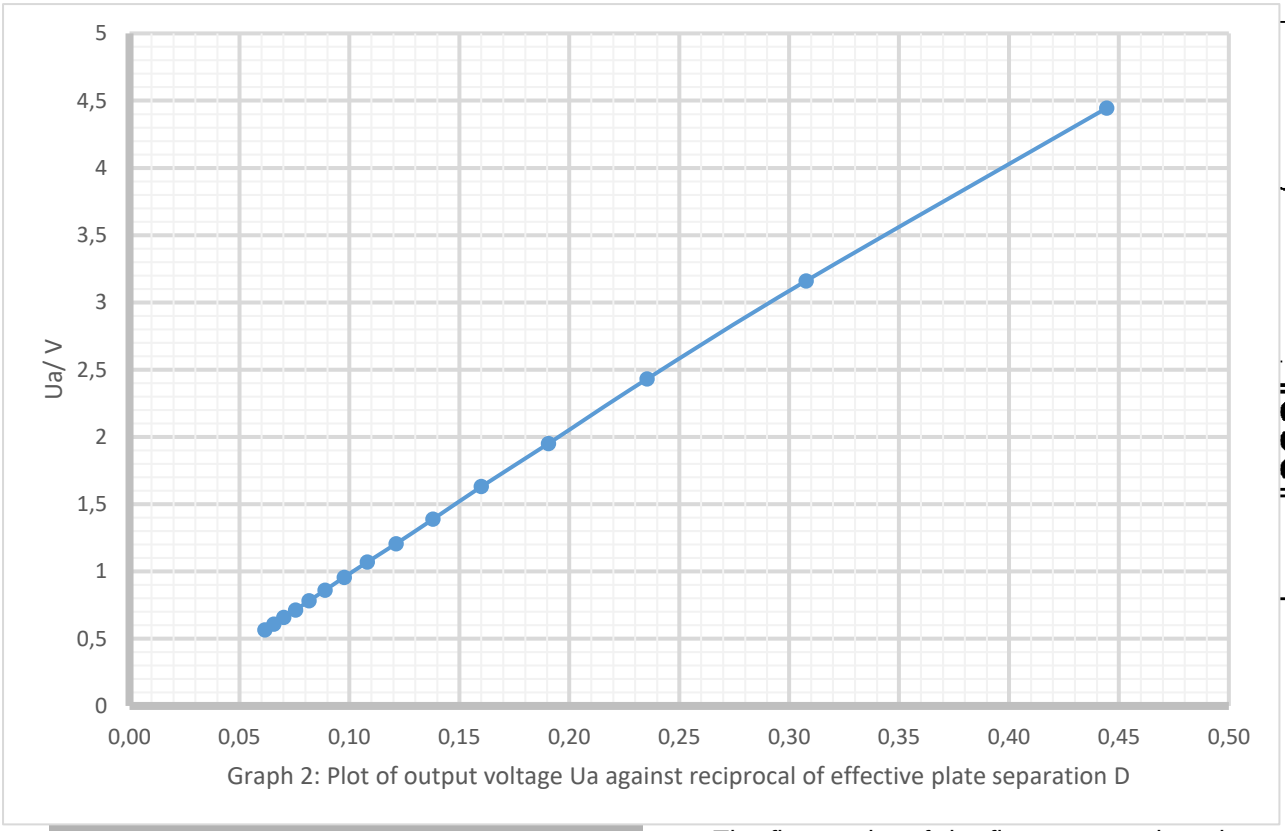


- Use the offset knob (5) to calibrate the voltage between sockets (2) and (4) to zero.
- Set up a separation of 1 mm.

  Note: Each clockwise turn of the spacing adjustment knob (14) increases the separation of the plates by 1 mm. Make a note of the zero position.
- Connect the positive terminal of the high-voltage power supply with the capacitor measurement plate via a protective 10 MΩ resistor (1022192) and the negative terminal to the ground socket for the detector vanes (4).
- Turn on the 500 V DC power supply.
- Set the DC power supply to 100 V.
- Measure voltages between sockets (2) and (4) for plate separations changing in steps of 1 mm (cf. graphs 1 and 2).



Graph 1: Plot of output voltage Ua against effective plate separation D/mm
(capacitor voltage U = 100 V, measuring range = 10 kV/m)



Graph 2: Plot of output voltage Ua against reciprocal of effective plate separation D

6.3 Measurement of potential using flame sensor 102199

The flame of the sensor produces ions, which means that charges migrate towards the flame sensor tube out of the region of the electric field and therefore towards the measuring equipment. The equalisation of charge by this process continues until the electric field is again formed without any disturbance and the probe has arrived at the same electric potential present at the point where the measurement is being made.
Due to the slight compensation currents and the unavoidable capacitances which result in the connecting leads and the voltage measurement plate, longer time constants (measurement times) may arise depending on the location of the measurement.

6.3.1 Measurement of potential in uniform field

Additionally required:

1 Flame sensor	1021799
1 High-voltage power supply 10 kV @115 V or 1 High-voltage power supply	1019238
10 kV @230 V	1019234
2 Resistors, 10 MΩ	1022192
1 Digital multimeter, e.g.	1002784

The flame tube of the flame sensor is to be set up on a rail such that it can be moved inside the uniform field between two capacitor plates (separation d = 10 cm) (cf. Fig. 4).

The electric field and a multimeter connected downstream from it act as a static voltmeter. After a certain delay, the flame tube of the sensor assumes the potential φ corresponding to the equipotential lines of the electric field.

$$\varphi = d/s * U = 0.5 * U$$

Alternatively, the experiment can be done with both positive and negative high voltages (bipolar). In that case, the left-hand capacitor plate should not be connected to “0” but to the negative voltage output of the high-voltage supply via a second large resistor (1022192).
At position s/2, the voltage at the electrometer output will then read “0”.

7. Storage, cleaning and disposal

- Store the equipment in a clean, dry and dust-free location.
- Disconnect the equipment from its power supply before cleaning.

Fig. 4: Flame sensor in uniform field of plate capacitor

- Do not use any aggressive cleaning agents or solvents to clean the equipment.
- Use a soft, moist cloth for cleaning.

- Packaging should be disposed of in local recycling depots.

- If the equipment itself should need to be scrapped, it should not be disposed of in normal household waste. Local regulations for the disposal of electrical waste are to be observed.