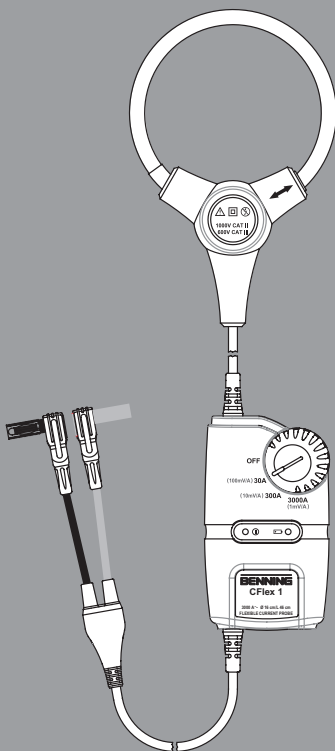


BENNING

GB

Operating manual



BENNING CFlex 1

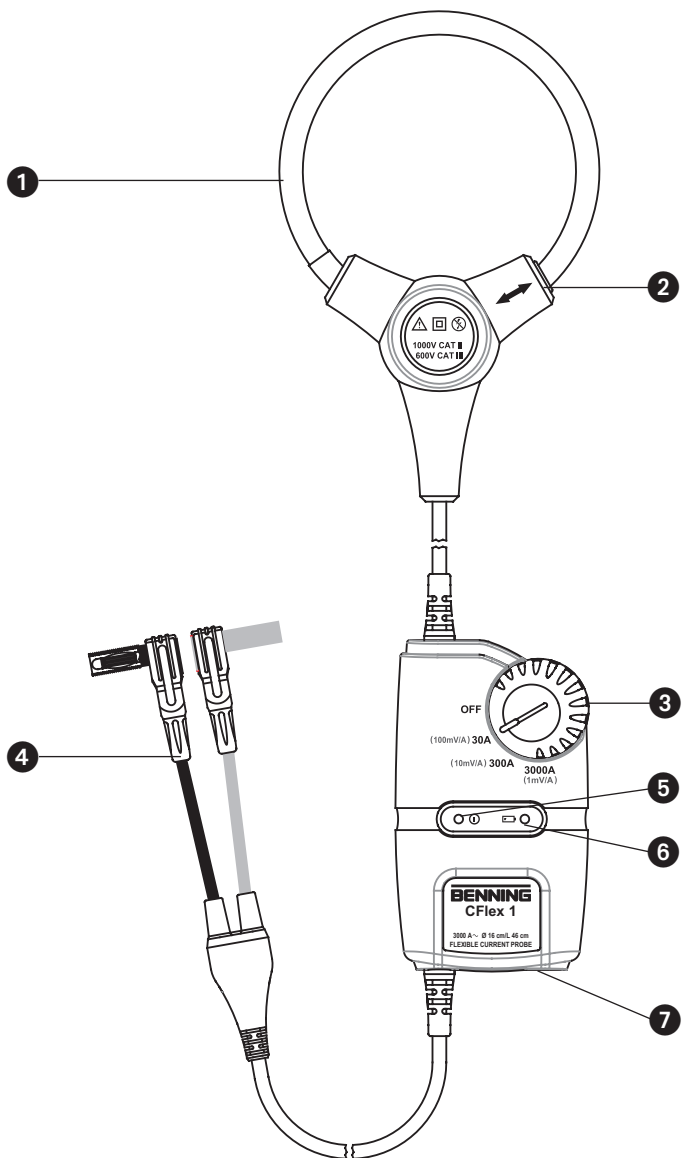


Bild 1: Gerätefrontseite
 Fig. 1: Appliance front face
 Fig. 1: Partie avant de l'appareil
 Fig. 1: Parte frontal del equipo
 Obr. 1: Přední strana přístroje
 Σκόνα 1: Μπροστινή όψη

Ill. 1: Lato anteriore apparecchio
 Fig. 1: Voorzijde van het apparaat
 Rys. 1: Panel przedni przyrządu
 Рис. 1: Вид спереди
 Resim 1: Cihaz önyüzü

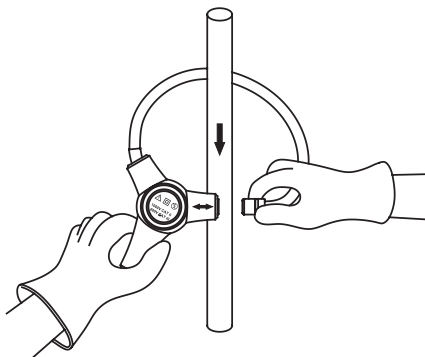
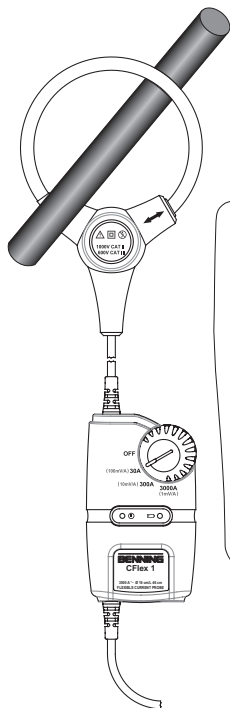


Bild 2 a: Wechselstrommessung
 Fig. 2 a: Alternating current measurement
 Fig. 2 a: Mesure de courant alternatif
 Fig. 2 a: Medición de corriente alterna
 obr. 2 a: Měření střídavého proudu
 Σικόνα 2 a: Μέτρηση εναλλασσόμενης έντασης ρεύματος

il. 2 a: Misura corrente alternata
 Fig. 2 a: Meten van wisselstroom
 Rys.2 a: Pomiar prądu przemiennego
 Рис. 2 a: Измерение величины переменного тока
 Resim 2 a: Alternatif akım ölçümü



$$\frac{3000 \text{ mV}}{10 \text{ mV/A}} = 300 \text{ A}$$

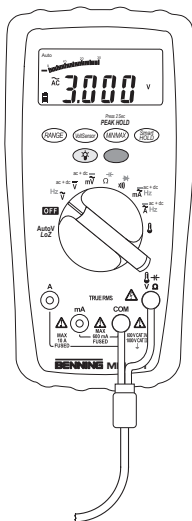


Bild 2 b: Wechselstrommessung
 Fig. 2 b: Alternating current measurement
 Fig. 2 b: Mesure de courant alternatif
 Fig. 2 b: Medición de corriente alterna
 obr. 2 b: Měření střídavého proudu
 Σικόνα 2 b: Μέτρηση εναλλασσόμενης έντασης ρεύματος

il. 2 b: Misura corrente alternata
 Fig. 2 b: Meten van wisselstroom
 Rys.2 b: Pomiar prądu przemiennego
 Рис. 2 b: Измерение величины переменного тока
 Resim 2 b: Alternatif akım ölçümü

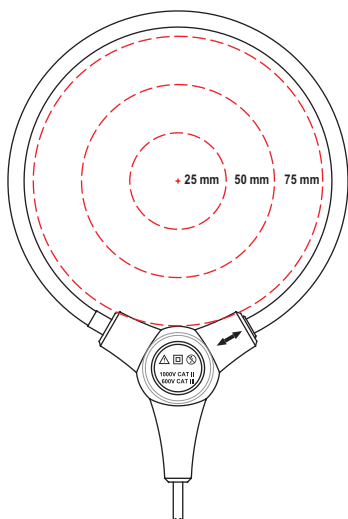


Bild 3: Positionierungsfehler
 Fig. 3: Positioning error
 Fig. 3: Erreur de positionnement
 Fig. 3: Error de posición
 Obr. 3: Pozíční chyba
 Σικόνα 3: Σφάλμα θέσης

Ill. 3: Errore di posizione
 Fig. 3: Positioning foutmarge
 Rys. 3: Błąd położenia
 Рис. 3: Погрешность позиционирования
 Resim 3: Pozisyon hatası

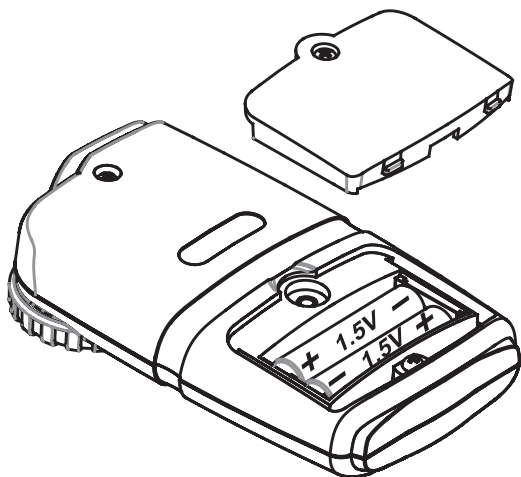


Bild 4: Batteriewechsel
 Fig. 4: Battery replacement
 Fig. 4: Remplacement de la pile
 Fig. 4: Cambio de pila
 Obr. 4: Výměna baterie
 Σικόνα 4: Αντικατάσταση μπαταριών

Ill. 4: Sostituzione batterie
 Fig. 4: Vervanging van de batterij
 Rys. 4: Wymiana baterii
 Рис. 4: Замена батареек
 Resim 4: Batarya değişimi

Operating Instructions

BENNING CFlex 1

Flexible AC current transformer for AC current measurement

Table of contents

1. User notes
2. Safety note
3. Scope of delivery
4. Unit description
5. General information
6. Ambient conditions
7. Electrical specifications
8. Measuring with the BENNING CFlex 1
9. Maintenance
10. Environmental note

1. User notes

These operating instructions are intended for

- qualified electricians and
- electrotechnically trained persons.

The BENNING CFlex 1 is intended for making measurements in dry environment. It must not be used in power circuits with a nominal voltage higher than 600 V AC CAT III/ 1000 V AC CAT II (More details in Section 6. "Ambient conditions").

The following symbols are used in these operating instructions and on the BENNING CFlex 1:



Application around and removal from NON-INSULATED HAZARDOUS LIVE conductors is NOT permitted.



Warning of electrical danger!
Indicates instructions which must be followed to avoid danger to persons.



Important, comply with the documentation!
The symbol indicates that the information provided in the operating instructions must be followed with in order to avoid risks.



This symbol on the BENNING CFlex 1 means that the BENNING CFlex 1 is totally insulated (protection class II).



This symbol on the BENNING CFlex 1 means that the BENNING CFlex 1 complies with the EU directives.



(AC) Alternating voltage or current.



Ground (Voltage against ground).

2. Safety note

The instrument is built and tested in accordance with
DIN VDE 0411 part 1/ EN 61010-1
DIN VDE 0411 part 2-032/ EN 61010-2-032
DIN VDE 0411 part 031/ EN 61010-031

and has left the factory in perfectly safe technical condition.

To maintain this condition and to ensure safe operation of the unit, the user must observe the notes and warnings given in these instructions at all times. Improper handling and non-observance of the warnings might involve severe **injuries** or **danger to life**.



WARNING! Be extremely careful when working with bare conductors or main line carrier! Contact with live conductors will cause an electric shock!



The **BENNING CFlex 1** may be used only in electrical circuits of over voltage category III with a maximum voltage of 600 V or of over voltage category II with a maximum voltage of 1000 V between the conductor and ground. Remember that work on electrical components of all kinds is dangerous. Even low-voltages of 30 V AC and 60 V DC may be dangerous to human life.



Before starting the unit, always check it as well as all measuring lead and wires for signs of damage.

Should it appear that safe operation of the unit is no longer possible, it should be shut down immediately and secured to prevent that it is switched on accidentally.

It may be assumed that safe operation is no longer possible:

- if the device or the measuring lead exhibit visible damages,
- if the unit no longer works,
- after long periods of storage under unfavourable conditions,
- after being subject to rough transportation, or
- if the device or the measuring lead are exposed to moisture.

3. Scope of delivery

The scope of delivery for the **BENNING CFlex 1** comprises:

- 3.1 One **BENNING CFlex 1** with one firmly connected safety measuring lead with 90° offset 4 mm safety plugs,
- 3.2 One compact protective pouch,
- 3.3 Two 1.5 V batteries of type AAA (IEC LR 03)
- 3.4 One operating manual

4. Description of AC current transformer

The flexible AC current transformer **BENNING CFlex 1** is a measuring adapter for analog and digital multimeters and is intended for AC current measurements up to 3000 A.

See figure 1: Appliance front face

The display and operator control elements specified in Fig. 1 are designated as follows:

- ① **Flexible measuring loop**, for clamping the single-wire AC current-carrying (live) conductor
- ② **Closing mechanism** of the measuring loop
- ③ **Rotary switch**, for selecting the measuring ranges
- ④ **Output with 4 mm safety plugs**, red, black, 90° offset
- ⑤ **Green LED** ("ON" LED), lights when the device is switched on
- ⑥ **Red LED** (battery indication), lights in case of discharged battery
- ⑦ **Battery compartment cover**

5. General information

5.1 General details on the AC current transformer

- 5.1.1 The rotary switch ③ is intended for selecting the measuring ranges of 30 A, 300 A and 3000 A AC.
- 5.1.2 The **BENNING CFlex 1** is supplied by means of two 1.5 V batteries of type AAA (IEC LR03).
- 5.1.3 If the battery voltage falls below the specified operating voltage of the **BENNING CFlex 1**, the red LED (battery indication) ⑥ lights.
- 5.1.4 The battery life is approx. 120 hours (alkaline battery).
- 5.1.5 Temperature coefficient of the measured value:
0.1 x (stated measuring accuracy)/ °C < 18 °C or > 28 °C, related to the value for the reference temperature of 23 °C

- 5.1.6 Length of the measuring loop: approx. 46 cm
- 5.1.7 Cable diameter of the measuring loop: approx. 8.5 mm
- 5.1.8 Cable length from measuring loop to housing: approx. 1.8 m
- 5.1.9 Cable length (housing to the 4 mm safety plugs): approx. 0.5 m
- 5.1.10 Housing dimensions: (L x W x H) = 120 x 70 x 26 mm
- 5.1.11 Weight of the device: 325 g

6. Ambient conditions

- The BENNING CFlex 1 is intended for making measurements in dry environment.
- Maximum barometric elevation for making measurements: 2000 m,
- Overvoltage category: IEC 60664/ IEC 61010 → 600 V category III, 1000 V category II
- Contamination class: 2 (EN 61010-1),
- Protection class: IP 30 (DIN VDE 0470-1, IEC/ EN 60529)
IP 30 means: Protection against access to dangerous parts and protection against solid impurities of a diameter > 2.5 mm, (3 - first index). No protection against water, (0 - second index).
- Operating temperature and relative humidity:
For operating temperatures from 0 °C to 50 °C: relative air humidity lower than 80 %, non-condensing
- Storage temperature: The BENNING CFlex 1 can be stored at temperatures between - 10 °C and + 60 °C, at a relative air humidity lower than 70 % without batteries.

7. Electrical specifications

Note: The measuring accuracy is specified as

- a relative part of the final measuring range value

This specified measuring precision is valid for temperature of 23 °C ± 5 °C and for a relative humidity lower than 80 %.

7.1 Alternating current ranges

Output voltage: 100 mV_{AC} / A_{AC} in the 30 A measuring range
10 mV_{AC} / A_{AC} in the 300 A measuring range
1 mV_{AC} / A_{AC} in the 3000 A measuring range

Measuring range	Measured value	Output	Measuring precision* within the frequency range 45 Hz - 65 Hz
30 A	0 ... 30 A	0 ... 3000 mV	± (3.0 % of the final measuring range value)
300 A	30 ... 300 A	300 ... 3000 mV	± (3.0 % of the final measuring range value)
3000 A	300 A ... 3000 A	300 ... 3000 mV	± (3.0 % of the final measuring range value)

- * The measuring accuracy is specified for a sinusoidal curve. The stated accuracy is specified for conductors that are centrally clamped by means of the measuring loop ① (see figure 3). For conductors that are not centrally clamped, an additional error has to be considered.

Distance from the middle	Positioning error
25 mm	± (1.0 % of the final measuring range value)
50 mm	± (2.0 % of the final measuring range value)
75 mm	± (3.0 % of the final measuring range value)

Load impedance: min. 10 kΩ (input resistance of the multimeter)

Noise: 0.03 A / 0.075 A / 0.5 A

Band width (-3 dB): 10 Hz to 10 kHz

Phase error: < ± 1°

8. Measuring with the BENNING CFlex 1

8.1 Preparing the measurement

Operate and store the BENNING CFlex 1 at the specified storage and operating temperatures only! Do not permanently expose the device to sunlight.

- Nominal voltage and nominal current of the enclosed safety measuring lead comply with the respective values of the BENNING CFlex 1. The safety measuring lead is firmly connected with the BENNING CFlex 1 and is not detachable.
- Check the insulation of the safety measuring lead. If the insulation is damaged, the BENNING CFlex 1 must be scrapped immediately.
- Do not clamp a live conductor with by means of the measuring loop before the BENNING CFlex 1 is connected with a multimeter.
- Strong sources of interference in the vicinity of the BENNING CFlex 1 might involve unsta-

ble readings and measuring errors.

- Do not apply any voltage to the output contacts of the BENNING CFlex 1.



**Do not exceed the maximum permitted voltage with respect to earth potential!
Electrical danger!**

The highest voltage that may be applied to the BENNING CFlex 1 with respect to earth potential is 600 V CAT III / 1000 V CAT II.

8.2 AC current measurement

- Select the measuring range (30 A, 300 A or 3000 A) by means of the rotary switch **3**.
- Set the multimeter to the AC current measuring function (V AC) and select a measuring range which can display voltages up to 3000 mV.
- Connect the black 4 mm safety plug of the safety measuring lead to the COM jack of the multimeter.
- Connect the red 4 mm safety plug of the safety measuring lead to the voltage input jack (V) of the multimeter.
- Clamp the single-wire live conductor centrally by means of the flexible measuring loop **1**.
- Read the voltage value on the multimeter and convert it to the respective current value considering the conversion factor.

Example 1: Measuring range: 30 A (100 mV / A)

Voltage value displayed on the multimeter: 2.500 V AC = 2500 mV AC, corresponds to a measured current value of 25 A AC.

Example 2: Measuring range: 300 A (10 mV / A)

Voltage value displayed on the multimeter: 2.500 V AC = 2500 mV AC, corresponds to a measured current value of 250 A AC.

Example 3: Measuring range: 3000 A (1 mV / A)

Voltage value displayed on the multimeter: 2.500 V AC = 2500 mV AC, corresponds to a measured current value of 2500 A AC.

See Figure 2 a: Alternating current measurement

See Figure 2 b: Alternating current measurement

9. Maintenance



**Before opening the BENNING CFlex 1, make sure that it is free of voltage!
Electrical danger!**

Work on the opened BENNING CFlex 1 under voltage may be carried out only **by skilled electricians with special precautions for the prevention of accidents.**

Make sure that the BENNING CFlex 1 is free of voltage as described below before opening the instrument:

- First, remove the BENNING CFlex 1 from the object to be measured.
- Then, remove both safety plugs of the safety measuring lead from the multimeter.

The BENNING CFlex 1 AC current transformer is not equipped with a fuse.

9.1 Securing the instrument

Under certain circumstances safe operation of the BENNING CFlex 1 is no longer ensured, for example in the case of:

- Visible damage of the casing.
- Incorrect measurement results.
- Recognisable consequences of prolonged storage under improper conditions.
- Recognisable consequences of extraordinary transportation stress.

In such cases, immediately disconnect the BENNING CFlex 1 from the measuring point and secure it against further use.

9.2 Cleaning

Clean the exterior of the housing with a clean dry cloth (exception: special cleaning wipers). Avoid using solvents and/ or scouring agents for cleaning the instrument. It is important to make sure that the battery compartment and battery contacts are not contaminated by leaking electrolyte.

If electrolyte contamination or white deposits occur in the area of the batteries or battery compartment, clean them too with a dry cloth.

9.3 Battery replacement



Before opening the BENNING CFlex 1, make sure that it is free of voltage! Electrical danger!

The BENNING CFlex 1 is supplied by means of two 1.5 V batteries of type AAA (IEC LR03). Battery replacement (see figure 4) is required, if the red LED (battery indication) ⑥ lights.

Proceed as follows to replace the batteries:

- Remove the BENNING CFlex 1 from the object to be measured.
- Disconnect both safety plugs of the safety measuring lead from the multimeter.
- Switch the rotary switch ③ to position "OFF".
- Put the BENNING CFlex 1 face down and unscrew the screw of the battery compartment cover ⑦.
- Lift off the battery compartment cover (in the area of the housing slots) at the bottom part of the battery compartment.
- Replace the exhausted batteries by two new ones of type AAA (LR03). Make sure that the new batteries are inserted with correct polarity!
- Place the battery compartment cover onto the bottom part and tighten the screw.

See figure 4: Battery replacement



**Make your contribution to environmental protection!
Do not dispose of discharged batteries in the household garbage. Instead, take them to a collecting point for discharged batteries and special waste material. Please inform yourself in your community.**

9.4 Calibration

To maintain the specified accuracy of the measurement results, the instrument must be recalibrated at regular intervals by our factory service. We recommend a recalibration interval of one year. Send the unit to the following address:

Benning Elektrotechnik & Elektronik GmbH & CO. KG
Service Centre
Robert-Bosch-Str. 20
D - 46397 Bocholt

10. Environmental note



At the end of the product's useful life, please dispose of the device at collection points provided in your community.

Benning Elektrotechnik & Elektronik GmbH & Co. KG
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