

# THREE-PHASE ELECTRONIC AMMETER FOR MAXIMUM VALUES

EGU



## TECHNICAL PARAMETERS

Measured quantities	3 alternating currents (mean values)
Rated values of currents $I_r$ <sup>1)</sup>	5 A 1 A special
Range of measurement of currents	3 % to 130 % of $I_r$
Accuracy of measurement	1 % + 1 digit in the range of 3 % to 120 % of $I_r$
Frequency of measured currents	50 Hz to 150 Hz
Rate of measurement	4-times per 1 minute
Reference temperature	23°C
Ambient temperature	0°C to 50°C – normal -20°C to + 60°C – extended <sup>2)</sup>
Relative humidity	40 % to 90 %
Operating position	optional, preferably vertical; TEAM1 is neither water-proof nor resistant against the running-down water
Power supply	at currents higher than 3 % of $I_r$ : from measured circuits at currents lower than 3 % of $I_r$ : from a stand-by battery, type CR 1/2 AA CD (3V) <sup>3)</sup>
Power input	3 × 2 VA at $I_r$
Time interval of storing the results	more than 5 years
Dimensions	91 × 91 × 80 mm
Dimensions of a square opening in the panel	92 × 92 mm
Weight	500 g

The circuits of TEAM1 and of series communication are galvanically separated from the measured currents. No current-carrying parts are on the surface of TEAM1.

### Notes:

- 1) Rated values of currents of individual inputs should be specified in the order.
- 2) The maximum ambient temperature +40°C is admitted for the measured currents higher than 110 % of  $I_r$
- 3) It is recommended to fit TEAM1 with two batteries when the visualization of the measured values below 5 % of  $I_r$  under negative temperatures is required.

## PRINCIPLE OF MEASUREMENT

The basis of TEAM1 (Fig. 1) is a four-bit one-chip low-power-demanding processor NEC with an internal crystal-controlled timer and a series bi-directional communication. The LCD-display and a keyboard are not necessary for the operation of TEAM1.

TEAM1 (developed according to Patent Nr. 2731-95) applies a modified method of a step-by-step approximation with an increased resistance against impulse interferences and measures the mean values of the currents. The input currents with rated values 5A and 1A or the secondary currents of special measuring transformers are transformed by input transformers onto voltages, they are rectified and filtered. In comparators K1, K2 and K3 these DC voltages are compared with the compensating voltage generated in the circuit of a D/A converter. The microprocessor generates the compensating voltage in the range of 3 %  $I_r$  to 130 %  $I_r$ . If the measured current is lower than 3 % of  $I_r$  it is marked by symbol Lo on the display. If it is higher than 130 % of  $I_r$  it is marked by symbol Hi. The measuring range with the width of 127 %  $I_r$  is divided into 256 levels and, therefore, one quantization step makes  $127 : 156 \cong 0.5$  % of  $I_r$ .

The measured three-phase currents are multiplied successively so that they may supply the circuits of TEAM1 when the current is not being measured. When the measured currents exceed 3 % of  $I_r$  they cover the whole consumption of TEAM1. When the currents drop down below 3 % of  $I_r$  the supply voltage of the input circuits becomes lower than that of the internal battery which takes over the power supply in this case. This is identified by the microprocessor via comparator K. Within the given one-minute interval the microprocessor passes into a low consumption state in which it does not measure the currents (as indicated by symbol Lo) but it only updates the time and counts statistical data. The speed of cycling the data on the display decreases from 2 s to 4 s at the same time.

## SIGNIFICANCE OF THE MEASURED DATA

In TEAM1 the maximum value of the current is determined as the highest value of the moving average of the last fifteen "one-minute" values. The time of reaching the maximum with the resolution of 1 min and/or the number of "one-minute" values overpassing the range of measurement is also recorded. If the moving average attains the value identical with the recorded maximum more times during the measurement, the appearance of another identical maximum will be registered in a special counter with the capacity of 256. The time of occurrence of another maximum is not stored.

The maximum of the sum of currents is established in the same way as that of a single current and the "one-minute" value is given by the sum of "one-minute" values of all the three currents.

The histogram of currents comprises 14 classes in total. The first class indicates the number of one-minute intervals during which the value of the current was in the range from 0 % to 10 % of  $I_r$ , i. e. including the number of one-minute intervals

marked by  $I_0$  when the measured value was lower than 3 % of  $I_r$ . The second till the thirteenth classes have also the width of 10 %  $I_r$  and indicate the number of minutes during which the value of the current ranked the corresponding interval in the range from 10 % of  $I_r$  to 130 % of  $I_r$ . The fourteenth class gives the total number of minutes in the course of which the range was overloaded.

The daily diagrams of individual currents represent the maximum values of one-minute currents at a given hour and on a chosen day. One single day of recording the daily diagrams of currents may be programmed for one measurement. Since the values measured by TEAM1 are assumed to be scanned twice a year the daily diagram of a day of winter and of summer measurement may be measured. The daily diagram of the sum of currents on the day when this sum reached its maximum is recorded on the first day when this maximum occurred. The internal timer (real time) shows always the “summer” time on the display of TEAM1. On PC the time indication is corrected with regard to the period of measurement.

### VIZUALIZATION OF DATA AND CONTROL

The basic version of TEAM1 has neither a keyboard nor a display. The scanning of data and the control of the ammeter can be performed either by means of PC and an interface cable using the protocol RS232c or by means of the reading unit with a special communication on the interface TEAM1 - reading unit.

In version with a display the ammeter TEAM1 visualizes the following data in a cyclic mode:

	SIGNALIZATION
instantaneous value of current $I_1$	1
instantaneous value of current $I_2$	2
instantaneous value of current $I_3$	3
maximum of current $I_1$ from the starting of measurement	–
maximum of current $I_2$ from the starting of measurement	=
maximum of current $I_3$ from the starting of measurement	≡
maximum of the sum of currents $I_1 + I_2 + I_3$	S
date: day, month	d
time: hour, minute	c
year	r

The time of visualization of one item is 2 s, when battery-powered 4 s.

TEAM1 in the version with a display and a keyboard enables the visualization to be carried out step-by-step by pressing the button **Step** or any other button of TEAM1. The item being visualized can be changed by means of buttons **Up** (arrow upwards) and **Down** (arrow downwards). The selected item is then visualized for 30 s and after this time, if no other button has been operated, the ammeter passes into the mode of a cyclic visualization.

The passing into the mode of setting internal parameters of TEAM1 is possible only from the step-by-step mode by pressing the button **SET**. However, the setting itself can be carried out only after the code H has been set. This code is a four digit number. The position of the digit being set is changed by means of the button **Step** and the magnitude of the digit by pressing the buttons **Up** and **Down**. Incrementation and decrementation are implemented into these buttons when being pressed for a longer time. The recording of the code, i. e. the access to the setting itself is provided by pressing the button **SET** again.

The internal parameters of TEAM1 are set step-by-step by operating the button **Step** or **Down** in the following order:

	<b>SIGNALIZATION</b>
date of internal timer	intermittently <i>d</i>
time of internal timer	intermittently <i>c</i>
year of internal timer	intermittently <i>r</i>
date of daily diagram	alternately <i>d</i> and $\equiv$
year of daily diagram	alternately <i>r</i> and $\equiv$
$I_p$ of the primary side of the measuring current transformer	intermittently <i>P</i>
change of code <b>ATTENTION!</b> - risky operation	intermittently <i>H</i>
reset (clearing the measured values to zero and setting new internal parameters of TEAM1)	intermittently <i>rESet</i>
error (cancelling of just set internal parameters and storing of initial parameters)	intermittently <i>cHYbA</i>

In the opposite order the internal parameters of TEAM1 can be set step-by-step by pressing the button **Up**. When the internal parameter to be selected has been set we press the button **SET** again until the character on the first position of the parameter lights up intermittently. If need be, its new value will be set by means of buttons **Up** or **Down** and by pressing the button **Step** we pass to setting the character on a further position of the selected parameter. Its setting will be ended by pressing the button **SET** and it is then possible to start the setting of a new value of another parameter.

By releasing the parameter **reset**, i. e. by pressing the button **SET** when the parameter **reset** is being visualized, the measured values stored in TEAM1 will be cleared to zero. By releasing the parameter **error**, i. e. by pressing the button **SET** when the parameter error is being visualized, all newly set parameters will be cancelled and initial parameters will be stored.

Note:

- 1) The correct significance of some characters is checked when setting the parameters and they are corrected if needed.
- 2) The mode "Measurement" is not in action when setting the parameters.
- 3) The delay of more than 60 s when setting the parameters initiates an automatic passing into the mode "Measurement" and "Cyclic visualization of data".

## MOUNTING AND INSTALLATION

Required ventilation:	free space 20 mm from all sides
Degree of contamination:	2
Overvoltage category:	III

First of all the ammeter TEAM1 shall be placed into a square opening 92 mm × 92 mm in the panel. The description must be in a horizontal position. Eccentrics shall then be inserted into four holes in the housing of TEAM1 and by rotating them the ammeter shall be fixed to the panel. The fixing of TEAM1 into a bigger opening in the panel shall be carried out by using reductions. The mounting of TEAM1 into the panel or on the wall is made by means of a clamp.

The conductors from the measuring current transformers with the diameter up to 2.5 mm shall be introduced from below and connected to the terminal box situated on the back side of TEAM1. The first current on the display corresponds to the current applied - as viewed from the back - to the first double terminal box from the left I1 (Fig. 3). The second current on the display corresponds to that applied to the second terminal box from the left I2 and the third one to that applied to the third terminal box from the left I3.

When the three-phase TEAM1 should be connected for the measurement of one current only all the three terminal boxes must be series-connected in order to reduce the power input from the internal battery. When the measurement of two currents is required two terminal boxes must be series-connected into the circuit of one current.

The internal terminal box, the reset button and one or two batteries become accessible after removing the back panel (two screws). The internal terminal box enables the switching of the input circuits from the mode "Measurement" into the mode "Checking". The manufacturer delivers TEAM1 with connections in the mode "Measurement". By pressing the reset button the measured data stored in TEAM1 will be cleared to zero and the code of TEAM1 will be set to a value pre-selected by the manufacturer. The replacement of the battery is assumed after six years of operation together with checking the accuracy of measurement.

If the visualization of the measured values below 5 %  $I_r$  under negative temperatures is required it is recommended to order TEAM1 provided with two batteries.

Except for the battery replacement (every 6 years) and the checking of the accuracy of measurement (intervals fixed in the metrological regulations of the utility) the ammeter TEAM1 requires no other maintenance. A many years' storage of TEAM1 is not recommended with regard to discharging of its internal battery.

## CHECKING THE ACCURACY OF MEASUREMENT

The accuracy of measurement may be checked only by a person trained by the manufacturer.

The switching of terminal boxes from the mode “Measurement” into the mode “Checking” and back is shown in Fig. 3 and on the rear panel of TEAM1.

The following procedure should be respected when switching the ammeter from the mode “Measurement” to that of “Checking”:

1. Connect connections B thus short-circuiting the secondary circuits of measuring current transformers.
2. Disconnect connections A thus disconnecting the input circuits of TEAM1 from the circuit of secondary windings of measuring current transformers.
3. Connect connections C thus connecting all the three input circuits of TEAM1 into series and enabling the accuracy of measurement to be checked in all three phases at once.

The switching of terminal boxes back from position Checking into position Measurement should proceed as follows:

1. Disconnect connections C.
2. Connect connections A.
3. Disconnect connections B.

## GUARANTEE

The manufacturer provides a guarantee for the product during 12 months following the date of sale if not otherwise stated in the contract. In case of a manufacturing defect the instrument will be repaired free of charge during this period.

When applying the requirement for a repair under the guarantee a letter of guarantee must be presented together with the instrument.

The following cases are excluded from the guarantee:

- defects caused by improper attendance
- defects caused by using the instrument for another purpose than for that given in the instruction
- instruments on which any intervention or mechanical adaptation had been made
- damages caused by transport.

## DELIVERY

The place of delivery is the seat of the manufacturer (supplier) if not otherwise specified. The electronic ammeter TEAM1 is delivered in a polystyrene packing for not more than 6 ammeters.

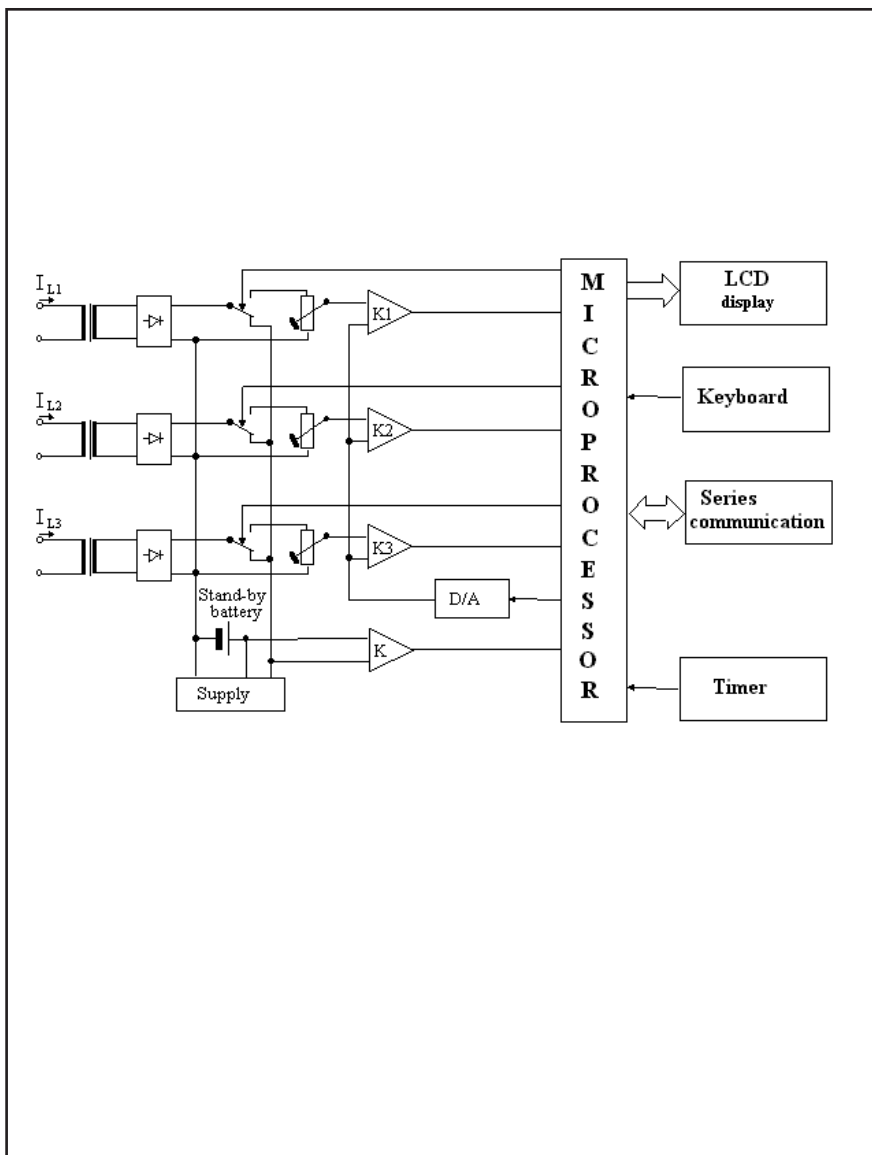
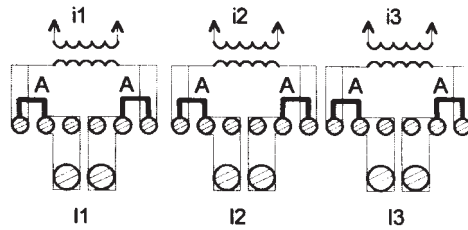


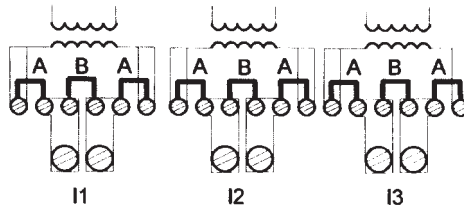
Fig. 1 Block diagram of ammeter TEAM



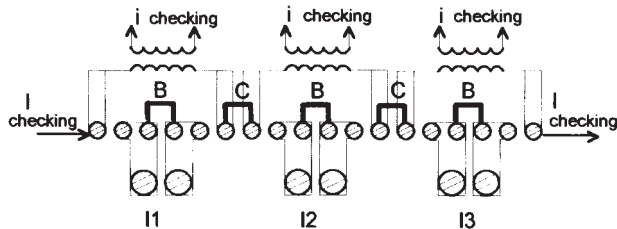
### Measurement



### Switching



### Checking



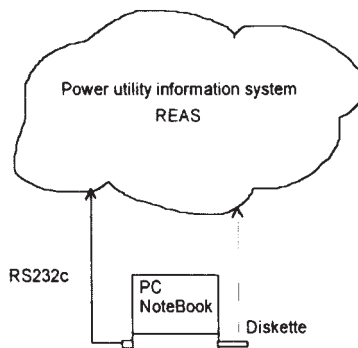
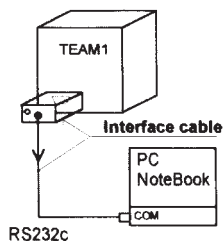
Note. The terminal boxes and connections are designed so as to enable the checking of the accuracy of measurement under respecting the given procedure without the necessity of disconnecting the secondary circuits of current transformers.

Fig. 2 Switching of connections

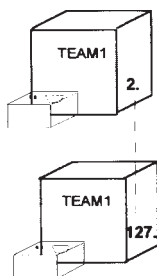
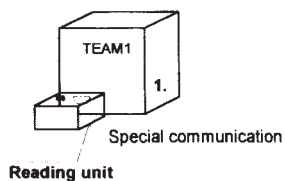
## SCANNING OF DATA FROM TEAM1

## TRANSMISSION OF DATA INTO THE INFORMATION SYSTEM

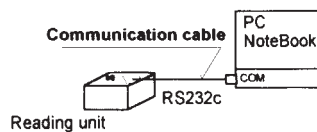
1) By means of the interface cable



2) By means of the reading unit



a)



b)

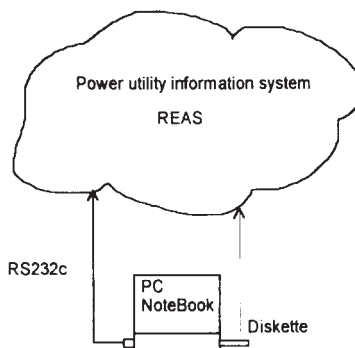


Fig. 3 Scanning of measured data and their transmission into the power utility information system

# READING UNIT OF AMMETER TEAM1

## APPLICATION GUIDE

### Main functions

The reading unit of ammeter TEAM1 enables:

1. Scanning the data measured by ammeter TEAM1 and their subsequent transmission into PC.
2. Resetting the indication of time, updating the date of scanning the daily diagram and resetting (clearing to zero) the data stored in the ammeter.
3. Special functions:
  - a) Resetting the indication of time, updating the date of scanning the daily diagram without resetting TEAM1,
  - b) Resetting the indication of time, updating the date of scanning the daily diagram and resetting TEAM1, changing the value of the primary current of the measuring current transformer.

### Connection

The reading unit is connected to TEAM1 by means of a 15-pin connector CANON. The connection to PC is carried out by using an interconnection cable (reduction of a 15-pin connector to a 9-pin one).

The scanning of data from TEAM1 into the reading unit is performed automatically after the reading unit has been connected to the ammeter. For the transmission of data into PC either the basic or a complete user program of ammeter TEAM1 can be used.

### Scanning the data from TEAM1 into the reading unit

1. Insert the connector of the reading unit into TEAM1. The correct insertion of the connector and a sufficient voltage of the main 9 V battery is signaled by the green LED lighting permanently.
2. The scanning of data and the resetting of TEAM1 takes up to 10 s. The typical time of scanning is 3 s. The reading unit signals the end of transmission by five pips.
3. The green LED stops lighting after further 2 s and the disconnection of the reading unit from TEAM1 is signaled by an intermittent audio signal (prevention against useless discharging of main battery of the reading unit). It is recommended to disconnect the reading unit from the ammeter immediately after the end of data transmission has been signaled.

Note:

Data files from up to 127 ammeters can be scanned into the reading unit. A corresponding part of the memory capacity is exhausted by each (even incorrect) connection of the reading unit to TEAM1.

## **Transmitting the data from the reading unit into PC**

1. Interconnect the reading unit with the series interface of PC by using the interconnecting cable.
2. If data from more ammeters are stored in the reading unit, the time of transmission between the reading unit and the PC is longer. It is therefore recommended to use an external 9 V power source.
3. Start the basic or the complete user program and transmit the data by selecting the menus "communication", "reading unit", "read up from the reading unit".

Errors and non-standard states, if any, are reported to PC.

The data transmitted into PC can be visualized as follows:

- a) in the basic program: by selecting the menus "database", "data", "read up from the reading unit";
- b) in the complete program: by selecting the menus "database", "data", "reading up according to the selected identification".

The data transmitted into PC can be erased in the non-destructive memory of the reading unit by a special command only. It is recommended to check the correctness of the data before erasing them.

## **Replacing the batteries and setting up the reading unit after its reset**

The reading unit of ammeter TEAM1 is provided with two batteries:

9V main battery, type 6F22 (6LR61), E-Block

3V stand-by battery, type CR 2032 - lithium battery

The discharged state of the main battery is signalized by the green LED lighting intermittently when the reading unit has been connected to the ammeter or when the interconnecting cable has been connected. In this case it is necessary to remove the cover of the battery and to replace the battery. The assumed interval between replacing the main battery depends on the number of scanned data and on the time when they are being scanned. It should be longer than one month and can be extended by using an external 9 V power source. When replacing the main battery the internal circuits of the reading unit are powered from the stand-by battery so that the reading unit stores the time and the date of scanning the daily diagram. The main battery cannot be replaced during the communication with the reading unit. The stand-by battery can be replaced only after unscrewing the connecting screw behind the main battery inside the case of the reading unit. The stand-by lithium battery is connected at the upper card of the reading unit. It is not permitted to use

a current-carrying tool when putting on a new battery so as to avoid the short-circuiting of battery poles. The manufacturer recommends to replace the stand-by battery after each two years of operation.

**The main battery must always be connected when replacing the stand-by battery in order to avoid the loss of time data! Both batteries must never be removed at the same time!!!**

The reading unit must be reset if the correct procedure of replacing the batteries was not respected or when the processor of the reading unit "has lost its way". The data recorded in the non-destructive memory of the reading unit are not lost when resetting the unit.

The reading unit of ammeter TEAM1 can be reset by initializing the reset button at the lower card through the hole in the card of the reading unit. The reset consists in setting the time of the reading unit on 0 hour 0 min. of the day 01.01.1995 (fixly programmed by the manufacturer).

The connection of the reset and not set up reading unit is signalized by four pips. The scanning of data into the reset and not set up reading unit is not possible. The reading unit must be set up after reset by applying the user program - by selecting the menus "communication", "reading unit", "parameters", "reset".

The reading unit is thus set up on the time of PC and on the date of the daily diagram which has been prepared in the program.

The measured data can be erased in the non-destructive memory of the reading unit only by a special command of the user program.

## **Table of states of signalling elements when scanning the data from the ammeter TEAM1 into the reading unit**

Phase of scanning the data	Reading unit			TEAM1
	Audio signal	Green LED	Red LED	Display
Reading unit connected:				
main battery discharged	no	intermittently lighting	not lighting	×
for the first not more than 10 s	no	permanently lighting	not lighting	PC
end of data transmission	5 pips	permanently lighting	not lighting	×
data scanned	intermittent	not lighting	not lighting	×
error in data transmission	permanent, two -state	lighting	intermittent lighting	×
full memory of the reading unit	permanent, two -state	intermittently lighting	permanent lighting	×
Reading unit after reset:				
phase of scanning the data	4 pips	lighting	4 pips	×

× Ammeter TEAM1 operates independently, it is not controlled by the reading unit.

## CI - COMMUNICATION INTERFACE OF TEAM1

The communication interface (CI) is used for interconnecting the electronic ammeter TEAM1 with the PC computer by using the series communication RS232C. CI comprises: matching circuits of the series interface, control logic, indication LED diode and batteries.

CI is provided with a 1.5 m long cable with a 9-pin connector for insertion into PC and with a 15-pin connector permanently connected with the cover of CI, for insertion into the electronic ammeter TEAM1.

### Application guide

1. Insert the 9-pin connector CI (free end of the CI cable) into the plug-in connector of the series interface (e. g. COM1).
2. Start the control program of electronic ammeters TEAM1 in PC.
3. Insert the 15-pin connector CI into the ammeter TEAM1.
4. The correct function of CI is signalized by the lighting LED diode. If the diode is not lighting, remove CI from the ammeter and replace the batteries. Then continue by step 3.
5. Carry out the required operations (e. g. reading the data from TEAM1 or reset of TEAM1) by applying the functions of the control program.
6. Remove CI from the ammeter TEAM1 (sparing of batteries).

### Replacement of batteries

- Unscrew the two side holding screws on the cover.
- Lift off the cover and remove the discharged batteries.
- Put on new batteries taking care of their correct polarity.
- Shut down the cover and screw the holding screws.

### Technical parameters

Power supply:	4 × mignon battery 1.5 V (AA-R6, MIGNON)
Dimensions:	67 × 82 × 31 mm (width - height - depth)
Weight:	0.25 kg including the batteries
Length of cable:	1.5 m
Number of conductors of the interface:	4 (TxD, RxD, DTR, SG)
Interface type:	communication interface and PC - PS232C communication interface and TEAM1 - special series one
Operating temperature:	0°C to +40°C

The communication interface TEAM1 must never be used with other instruments!

The delivery includes four supply batteries (mignon).

PARAMETERS SET BY THE MANUFACTURER

Date and time	summer time
Date of scanning the daily diagrams	01.01.1995
Code	1 2 3 4
Rated value of the primary current of the measuring current transformer	100 A (corresponds to the indication in % of I <sub>p</sub> ) if not otherwise specified in the order
State of the battery	100 %

DATA FOR THE ORDER

Number of pieces (TEAM1)		n
Version	display and keyboard	K
	display	D
	basic (without display and keyboard)	Z
Rated values of currents (input 1, input 2, input 3)	5A	5
	1A	1
	special transformer	S
Rated value of current on the display of TEAM1 (primary current)	100 %	100
	according to requirement	H

Example: 100/D/S-5-S/200  
100 pieces of TEAM1, version with a display, rated current ranges: input 1 = special, input 2 = 5A, input 3 = special, rated value of the visualized current = 200 A

Number of clamps (pieces)	p
Number of reductions (pieces)	r (outside dimensions in mm)
Number of cables for TEAM1 interface (pieces)	k
Number of reading units of TEAM1 (pieces)	c
Number of special measuring transformers (pieces)	s (rated value of the primary current)
User software	

## **RANGE OF USE**

The three-phase electronic ammeter for maximum values TEAM1 is an instrument intended to be used for recording the maximum values of the current, including the indication of time and other statistical data. It is suitable for the measurement of the alternating current, especially on transformers in distribution networks. The measured values can be transmitted into PC as to enable the reduction of losses in transformers and a better utilization of distribution networks.

## **MEASURED AND EVALUATED VALUES**

3 currents

Time of measurement

Maximum values of currents and the maximum of the sum of currents including the indication of time

Histograms of current for the period of measurement

Daily diagrams of currents on the defined day of measurement

Daily diagram of the sum of currents on the day of the maximum sum of currents

Daily diagram of the sum of currents on the last day of measurement

### **Manufacturer:**

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