MEASURING INSTRUMENTS

CE

- Revision instruments
- Clamp instruments
- Accessories for instruments
- Non-electric quantities

METRA BLANSKO a.s.

INSTRUMENTS FOR MEASUREMENT OF INSULATION RESISTANCES

PU 182.1

The instrument is intended namely for insulation resistance measurements of electric objects and equipment in connection with the standard ČSN 331610 (for electric appliances) at the nominal dc voltage 100V, 250V and 500V. Furthermore, ac and dc voltage up to 550V can be measured as well.

- Easy attendance and minimal maintenance
- Blocking of measurement of the insulation resistance at presence of the strange voltage on the measured object
- Automatic discharging of contingent measured object capacitance component after finished measurement
- Automatic switch-over and indication of dc/ac at the strange voltage measure at dc voltage of the polarity indication
- Indication of insufficient voltage of the power supply elements
- The instrument and its accessories are manufactured with double insulation
- The instrument complies with the safety requirements acc. to the ČSN EN 61010-1, requirements of EMC acc. to the ČSN EN 50081-1, ČSN EN 50082-2, ČSN EN 61557 and fulfils requirements of the standard DIN 57 413/VDE 413, part 1

Insulation resistance	
Measurement ranges	0,10 ÷ 1,999 MΩ
	0,15 ÷ 19,99 MΩ
	5,0 ÷ 199,9 MΩ
	50 ÷ 1999 MΩ
Nominal measuring dc voltage	100 V, 250 V, 500 V
Nominal current	1,1 mA

Voltage	
Measurement ranges	20 ÷ 550V dc and ac /45 - 65 Hz

Measuring accuracy

±(2% of MH + 5D) for voltage and insulation resistance

MH – measured value, D - digit

Size	308 x 92 x 57 mm
Weight	≈ 500 g

Recharging source ZDA 31 upon an extra order

PU 186

The instrument serves for measurement of insulation resistances up to the value 20 GΩ and the resistance of the protecting leads up to 10Ω consequentially to the standard ČSN 331610 (for electrical appliances). Furthermore, the DC and AC voltages can be measured up to 1000 V. The nominal measuring voltages for measurements of insulation resistances are 500, 1000 and 2500 V. The measurement current at the measurement of the protecting lead resistance is min. 200 mA.

- Independent on the line voltage
- Indication of the supply source under-voltage
- Possibility of the battery recharging directly in the instrument
- Easy attendance and minimal maintenance
- The instrument complies with the ČSN 61010-1 and requirements EMC as per the ČSN EN 50081-1, ČSN EN 50082-2 and ČSN EN 61557

Measuring quantity	Measuring range	Measuring voltage	Current (I_K), I_N	Accuracy
dc voltage	(30 ÷ 1000) V			± (2% MH + 5D)
ac voltage	(30 ÷ 1000) V			± (2% MH + 5D)
insul. resistance	(0,1 ÷ 20) MΩ (5 ÷ 200) MΩ (50 ÷ 2000) MΩ (0,5 ÷ 20) GΩ	(500 + 20) V	(≤ 5mA) 1,1mA ± 0,1mA	± (2% MH + 5D)
	(0,2 ÷ 20) MΩ (10 ÷ 200) MΩ (100 ÷ 2000) MΩ (1 ÷ 20) GΩ	(1000 ÷ 100) V		
	(0,5 ÷ 20) MΩ (20 ÷ 200) MΩ (200 ÷ 2000) MΩ (2 ÷ 20) GΩ	(2500 ÷ 200) V		
resistance of protecting lead	10Ω	> 5 V	200 mA + 10 mA	± (2% MH + 5D)

Size	195 x 55 x 260 mm
Weight	approx 700 g without accumulators

Energy supply source ZDA 21 upon an extra order.

MH – measured value, D - digit

Current I_K short-circuit current at measurement of insulation resistances, measuring current at measurement of protecting lead

Current I_N nominal current at the nominal voltage (insulation resistances)

PU 187.2 Megmet 1000 D

The instrument PU 187.1 MEGNET 1000 D serves for measurements of insulation resistances up to their value 20 GΩ and the resistance of the protecting lead up to 2kΩ, or its length, also a check of over-voltage protections can be performed by it. Furthermore, DC and AC voltages can be measured up to 1000V and temperature within the range -20°C to 120°C, with connected external sensor within -50 to 850°C. The nominal measuring voltages for measurements of insulation resistances are 50, 100, 250, 500 and 1000V.

- The instrument MEGMET 1000 D fulfils requirements of standards :

DIN 57 413/VDE 0413, 1. part: Measuring instruments of insulation resistance, ČSN 33 1600 Revisions and inspections of electric hand-tools during use, ČSN 331610 Inspections and revisions of el. appliances during use, ČSN EN 61557, ČSN EN 61010-1 Safety requirements on electric measuring, controlling and laboratory equipment

The instrument complies with requirements of standards in the field of electro-magnetic compatibility.

- Micro-processor control of the instrument
- Digital display of the measured datum together with the analogical one (Bargraf)
- Calculation of cable length from the measured value of the resistance
- Measurement of dc, ac voltages of the over-voltage protections
- Measurement of insulation resistance up to 20 GΩ
- Measurement of small resistances (length of measured lead) with indication of disturbing voltages
- Memory of measured values with possibility of two-way transfer into the PC via the RS 232
- Display lighted from below
- Possibility of accumulator recharging in the instrument
- Low weight and small sizes
- Instrument assembled in the same casing as the Megmet PU 182.1
- Easy attendance and minimal maintenance

MH – measured value, D - digit

I_K short-circuit current at insulation resistance measurements
measuring current at measurements of the protection lead resistance

I_N nominal current at the nominal voltage (insulation resistances)

Size	308 x 92 x 57 mm
Weight	≈ 500 g

Measured quantity	Measuring range	Measuring voltage	Current (I_K), I_N	Accuracy
dc voltage	0 – 1000 V			± (2% MH + 2D)
ac voltage	0 – 1000 V			± (2% MH + 2D
over-voltage protections	0 - 1000 V			± (2% MH + 2D)
insulation resistance	0,1 MΩ - 20GΩ	(50+15) V	(≤ 4mA) 1,2 ± 0,2mA	± (2% MH + 5D)
	0,1 MΩ - 20GΩ	(100 + 20) V		± (2% MH + 5D)
R_{ISO}	0,1 MΩ - 20GΩ	(250 + 20) V		± (2% MH + 2D
	0,1 MΩ - 20GΩ	(500 + 50) V		± (2% MH + 5D)
	0,1 MΩ - 20GΩ	(1000 + 100) V		± (2% MH +5D)
protect. lead resistance R_{P-E}	20Ω	no-load	≥200 mA	± (2% MH+5D)
	200Ω	9 ± 0,5 V	≥20mA	
	2 kΩ		≥ 2mA	
temperature (int.sensor)	(-20 ÷ 120)°C		1 mA	± 3°C
Pt 100 (Pt 1000)	-50 ÷ 850 °C (-50 ÷ 250) °C		2 mA	(upon an extra order)
lead length Cu, Al	0 ÷ 20km	(9 ± 0,5) V no-load	≥ 2mA	Accuracy is given by the resistance measurement accuracy

PU 296 MEGMET 5000D

The instrument PU 296 is intended for measurements of voltages, insulation resistances and determination of coefficients PI, DD and DAR at revisions of the high-current equipment. It complies with the requirements of the standard ČSN EN 61557-2.

The instrument PU 296 is designed in the plastic suitcase PELI. The measured values can be read on the graphic display and saved into the instrument memory and consequently transferred through the USB port to the PC for consequent processing. One pair of special measuring cords is comprised into the delivery. All functions can be controlled from the membrane keyboard.
The power supply is carried out by the Pb accumulator, which can be recharged by the built-in charger.

Safety requirements
as per ČSN EN 61010-1 Equipment protection class II for the voltage 300 V against earth, CAT III/600V, degree of soiling 2.

Instrument size:	270 x 250 x 180 mm
Weight:	≈ 4 kg
Energy supply:	Pb accumulator 12V / 2,6Ah

Insulation quality	DAR	DD	PI
dangerous	< 1,25	> 7	< 1
bad		4 to 7	1 to 2
risk		2 to 4	
good	1,25 to 1,6	< 2	2 to 4
excellent	> 1,6	< 2	>4

The **Dielectric absorbing ratio** will be set as the rate of the insulation resistances measured after 1 min.
($\mathbf{R}_{ISO(1m)}$) and after 30s ($\mathbf{R}_{ISO(30s)}$) from putting the measuring voltage.

$$\mathbf{DAR = R_{ISO(1m)} / R_{ISO(30s)}}$$

The **Dielectric discharging index** will be calculated from the earth-leakage current ($\mathbf{I}_{S(1m)}$), which flows through the measured circuit after one minute from putting the measuring voltage (UISO) and capacity of the measured object (**C**).

$$\mathbf{DD = IS(1m) /(UISO \times C)}$$

The **Polarisation index** will be set as the rate of the insulation resistances measured after 10 minutes ($\mathbf{R}_{ISO(10m)}$) and after1 minute ($\mathbf{R}_{ISO(1m)}$) from putting the measuring voltage.

$$\mathbf{PI = R_{ISO(10m)} / R_{ISO(1m)}}$$

Technical parameters:

Measured quantity	Measuring voltage (DC)	Range	Accuracy reference terms	working terms
Voltage DC/AC	-	30 Vt to 1000 V		± 5% MH
Insulation resistance	250 V	<200 kΩ		undefined
		200 kΩ to 5 GΩ		± 5% MH
		5 GΩ to 50 GΩ		± 20% MH
		>50 GΩ		undefined
	500 V	<200 kΩ		undefined
		200 kΩ to 10 GΩ		± 5% MH
		10 GΩ to 100 GΩ		± 20% MH
		>100 GΩ		undefined
	1000 V	<200 kΩ		undefined
		200 kΩ to 20 GΩ		± 5% MH
		20 GΩ to 200 GΩ		± 20% MH
		>200 GΩ		undefined
	2500 V	<500 kΩ		undefined
		500 kΩ to 50 GΩ		± 5% MH
		50 GΩ to 500 GΩ		± 20% MH
		>500 GΩ		undefined
	5000 V	<500 kΩ		undefined
		500 kΩ to 100 GΩ		± 5% MH
		100 GΩ to 1 TΩ		± 20% MH
		>1 TΩ		undefined
Earth leakage current	-	1 nA to 3mA *)		± 5% MH
Capacity	-	0,01 μF to 10 μF *)		± 15% MH

MH measured value
***)** the values are applied for calculation of the dielectric discharging index DD

PU 580 INSULATION METER

The instrument PU 580 is intended namely for measurements on tele-communication cables, even in very disturbed environment.

By the instrument PU 580 following measurements can be performed:

- insulation resistance within the range from **100kΩ** to **20 GΩ** with the voltage **100 V,** or **500 V**, at disturbance max. 10 V and frequency > 1 Hz.
- resistance on the ranges **200Ω** and **2 000Ω**
- DC voltage on the ranges ± **200 V** and ± **600 V**
- AC voltage on the ranges **200 V** and **600 V**

The insulation resistance is displayed analogically, other measured quantities digitally. The power supply is performed from the internal battery with possiblity of recharging by an internal recharger, joinable to mains. The instrument has got simple attendance – measuring ranges can be switched-over by **one** reversing switch only, the voltage on the measured object at the insulation resistance measurement will be connected by the push-button **TEST**.
The instrument is protected against over-load from the strange source in all measuring ranges. If the instrument is out of operation, after several minutes it is automatically reversed into its stand-by state with minimal consumption.

INSTRUMENT DESIGN ENABLES:

- analogical display of the insulation resistance together with the display of the digital voltage on the measured object provides information about the size of the disturbing signal
- automatic discharging of the measured circuit at the insulation measurement after finished measurement
- number of measurements of the insulation resistance by the voltage 100 V within 30s with min. 1000 x after one charging
- simple attendance – at the insulation resistance measurement the object can be reversed by the push-button **TEST**
- digital display at the resistance and voltage measurements
- protection against an over-voltage from the strange source at all quantities measurements
- acoustic signalisation at the small resistance measurements (short-circuit)
- power supply from the internal battery
- voltage check of the power supply battery on the analogical instrument
- possibility of recharging from the internal recharger joinable to the source 230 V, 50Hz
- battery voltage at recharging is checked on the display
- automatic passing to the stand-by state, in case the instrument is out of operation
- the casing made of mechanically stable plastic matter
- accessories: network cord, two measuring cords ended by tips, two step-clamps

Measurement of insulation resistance

- range 100 kΩ to 20 G Ω
- measuring range 100 V for resistances over 100 kΩ (100 kΩ to 2 GΩ)
- measuring voltage 500 V for resistances over 10 MΩ (10 MΩ to 20 G Ω)
- nominal measuring voltage 1mA, short-circuit current max. 15 mA
- accuracy class 5 from the scale length
- admissible over-load by the strange voltage max. 600 V within max. 10 s

Measurement of resistance

- ranges 199,9 Ω resolution 0,1 Ω measuring current 10 mA
  1999 Ω 1 Ω 1 mA
- accuracy ±(1% of the measured value + 0,5% of the range)
- acoustic signalisation less than 100 Ω (indication of short-circuit)
- admissible over-load by the strange voltage max. 100 V within max. 10 s

Measurement of DC voltage

- ranges ± 199,9 V resolution 0,1 V
  ± 600 V 1 V
- accuracy ±(1% of the measured value + 0,5% of the range)
- inner resistance 1 MΩ
- over-load: permanent 1,2 x upper limit of the input electric quantity
  momentary 2 x upper limit of the input electric quantity within 10 s

Measurement of AC voltage

- ranges 199,9 V resolution 0,1 V
  600 V 1 V
- accuracy ±(1,5% of the measured value + 1% of the range)
- inner resistance 1 MΩ
- frequency range at the ac voltage measurement 40 Hz to 1 kHz
- over-load: permanent 1,2x upper limit of the electric input quantity
  momentary 2x upper limit of the electric input quantity within 10 s

Working conditions:

- working temperature range -10 °C to + 50 °C
- relative humidity max. 85% at 23 °C
- time of stabilisation:
  max. 20 s at the insulation resistance measurements at clean resistant load max. 5 s at other measurements

Power supply from the internal battery of 8 elements NiCd 9,6 V, 600 mAh, recharging time max. 12 hours.
Consumption from the battery

- at the resistance measurements max. 20 mA, at the voltage measurements max. 10 mA
- in the stand-by state with minimal consumption max. 50 μA

Instrument weight approx.. 1,8 kg incl. the power supply batteries
Dimensions 220 x 170 x 120 mm

ANALOGICAL INSULATION RESISTANCE METER FOR INSULATED NETWORKS IT

PU 590

Basic information:

The instrument PU 590 is intended for measurements of the insulation resistances and voltages in the insulation networks IT in the signalization and safeguarding systems, at presence of disturbing voltages. The PU 590 can be used even for current measurements of the insulation resistances. It complies with requirements of the standards ČSN EN 61557-2 ed. 2 and ČSN EN 61010-1ed.2.

Description of the instrument:

The instrument is located in the casing of the series PU500 with the analogical measuring system. For measurements of the insulation resistance and voltage independent pairs of sockets are applied. The measuring voltage for the insulation resistances and for the state measurements of the power supply elements are to be reversed by the sliding reversing switch. The instrument is equipped with the circuit for its automatic switching off. The instrument power supply is provided by four elements size AA (dry, or accumulators), accessible after removal of the instrument lower cover. The measuring mode is indicated by two-colour LED.

Safety requirements – as per CSN EN 61010-1
Equipment protection class II for the voltage 300 V to earth,
CAT III/600V, Degree of soiling 2.

Thermal resistance: -25°C to +55°C

Working terms:
ambient temperature: -15°C to +40°C
relative humidity: max 80% at 23°C
instrument position: horizontal

Power supply: 4 pc NiMh, or NiCd accumulators type AA, or dry elements

Technical parameters:

Measured quantity	Nominal measuring voltage (DC)	Range	Accuracy from the scale length	
			Reference terms	Working terms
Voltage DC/AC	-	5 V to 500 V	5%	
Insulation resistance	100 V	100 kΩ to 20 MΩ	5%	
	250 V	100 kΩ to 50 MΩ	5%	
	500 V	100 kΩ to 50 MΩ	5%	

*) Scale length is 80,5 mm

INSTRUMENT FOR GROUND RESISTANCE MEASUREMENTS

PU 183.1

The measuring instrument PU 183 is intended for measurements of the earthing conductors and systems, measurement of the soil resistivity and ohmic resistances.

- Independent on the network voltage
- Suppressed disturbing influence of the network frequency
- Possibility of the ohmic resistance measurements
- Protection of the inlet and outlet clamps
- Indication of the discharged battery
- Possibilityof the accumulator recharging inside the instrument
- Easy attendance and minimal maintenance
- The instrument corresponds with the safety requirements acc. to the standard ČSN EN 61010-1 and requirements of the EMC, acc. to ČSN EN 50082-2, ČSN EN 61557.
- Automatic switching off
- Indication of charging

Size	120 x 232 x 57 mm
Weight	approx. 500 g without batteries

Optional accessories: PD 183 (measuring cords on coils 3 m - 2 pc, 25 m - 2 pc, 40 m - 1 pc, measuring probes 450 mm - 4 pc, wrench, tool bag).

Measuring range	Output no-load voltage UL	Measuring short-circuit current IK
20Ω	max. 30 V_{ef}	10 mA_{ef}
200Ω	max. 30 V_{ef}	min. 1 mA_{ef}
2 kΩ	max. 30 V_{ef}	min. 100 $\propto A_{ef}$

Measuring frequency

128 Hz

Measuring accuracy

± (2% of MH +5D)

MH – measured value, D - digit

Accessories PD 183

- probes and measuring cables

ReviSoft 2®

The program ReviSoft2 is intended for data processing from the instruments brand METRA.
The program ReviSoft2 is a successor of the foregoing program ReviSoft, which has enlarged and completed acc. to cutomer requirements.

The Demo-version of the program can be obtained by the e-mail free of charge.

The program enables:

- **Design of the form templets and barcode labels**
- Data transfer from the instrument series PU. (At present the PU187.1, PU187.2, PU191, PU193, PU194, PU195)
- Setting of parameters of some instruments (time of the instrument switching off etc.).
- Processing of transferred data to the fashion of forms and their print.
- Global print of a greater quantity of forms.
- Print of barcode labels for identification of revised appliances.
- Creation of the well-arranged list of revisions.
- Monitoring of the validity times and planning of revisions.

PU 193

The instrument PU 193 is intended namely for measurements of the earthing elements and earthing systems. The instrument design complies with the **ČSN EN 61557** Earthing resistance.
The instrument complies with the requirements of the electro-magnetic compatibility acc. to the standard **ČSN EN 61326 – 1**.

Following measurements can be performed by the instrument:

- earth resistance up to 20 kΩ by the standard three-lead (four-lead) methods with possibility of the measuring signal change
- earthing resistance by means of the transmitting and measuring clamps, either simple, or continual measurements
- earthing resistance by means of the probes and measuring clamps – selective, single, or continual measurements
- soil resistivity up to 20 kΩ with the selectable distance of the measuring electrodes
  - resistance of the protective lead up to 20Ω by current min. 200 mA / DC (with the polarity changing)
  - current through the earthing element by means of the current clamps up to 20A / AC
  - voltage on the earthing element up to 250 V / AC, DC
- indication of serial disturbing voltage, great resistance of the probe and earthing element
- display lighted from below

The instrument is equipped with the memory capacity of 1999 measured values with possibility of transfer to the PC.

Electro-magnetic compatibility	the instrument PU193 complies with the requirements of the standard ČSN EN 61326-1 (change1)
Product safety	the instrument complies with the standard ČSN EN 61010-1: Equipment protection class I for the voltage 250 V to earth CAT II, Degree of soiling 2.

Power supply	built-in Pb accumulator 12V/1,3 Ah
Weight	approx. 2,3 kg
Size	170 x 220 x 120 mm
Temperature	-5 °C to 40 °C
Relative humidity	80 % at 23 °C

MEASURING RANGES AND ACCURACY

measured quantity	measuring range	measuring voltage UH	measuring current IH	measuring accuracy reference terms	measuring accuracy working terms
voltage U_N	(O - 250) V AC/DC			± (1% MH + 5 D)	± (1% MH + 10 D)
disturbing voltage U_s	8 V AC/DC			± (1% MH + 5 D) ± (1% MH + 10 D)	
earth resistance R_A clasically	(0 ÷ 19,99)Ω (20,0 ÷ 199,9)Ω (0,200 ÷ 1,999) kΩ (2,0 ÷19,99) kΩ * automatically reversed ranges	max. 40 V/ (59, 95, 128, 140) Hz	max. 40mA/ (59, 95, 128, 140) Hz	± (5% MH + 10 D) *) measurement on this range is informative only	
earth resistance R_A 2 x clamps	(0,10 ÷ 19,99)Ω (20,0 ÷ 199,9)Ω (0,200 ÷ 0,500) kΩ automatically reversed ranges			± (15% MH + 10 D)	
R_A select.	(0,10 ÷19,99)Ω (20,0 ÷ 199,9)Ω (0,200 ÷ 0,500) kΩ automatically reversed ranges	max. 40 V/ 2048 Hz	max. 40mA/ 2048 Hz	± (15% MH + 10 D)	
Resistance of Lprotecting lead R_{PE}	(0 ÷ 19.99) Ω	max. 12V/DC	± (200+10) MA	± (2% MH + 5 D) ± (5% MH + 5 D)	
earth specific resistance P	(0 ÷ 19,99)) kΩ m	max. 40 V/ (59, 95, 128, 140) Hz	max. 40mA/ (59, 95,128, 140) Hz	calculated value acuracy is given by the RA measurement accuracy and accuracy of the distance betweer	
current through the earthing element I_{AC}	(0 ÷ 199,9) mA (0 ÷ 1,999) A (0 ÷ 19,99) A			the measuring probes ± (10% MH + 15 D) ± (5% MH + 5 D)	

ACCESSORIES OF INSTRUMENTS PU193

PD 193 is a non-interchangeable accessories to the earthing resistance measuring instrument PU193 (optional)
PD 193.1- set of electrodes and leads
PD 193.2- set of clamps
PD 193.3- testing module

PD 193.1 – set of measuring electrodes and leads for measurements of the earth resistances and resistivity of soil

THE SET COMPRISES:

Measuring electrode	4 pc
coil with measuring cords 40m + 25 m	1 pc
coil with measuring cords 25 m	1 pc
3m blue	1 pc
3m red swith mark.	1 pc
wrench	1 pc
suitcase	1 pc

PD 193.3 – testing module for the functionality verification of the instrument PU193 and accessories PD 193.2

PD 193.2 – accessories to the PU193 for messurements of the earth resistances by the clamp and selective methods

The accessories comprises:

Transmitting clamp PKT193	1pc
measuring clamp PKM193	1pc

Technical data:

	PKM193	PKT193
Current measuring ranges:	0,2A	2A 20A
Max. measured lead size:	Ø 20 mm, or 35 x 20 mm	
Working temperature range:	-50°C to + 400°C	
Power supply:	from the instrument PU193	
Dimensions:	190 x 45 x 35 mm	
Weight:	approx. 250g	

PU 293

INSTRUMENT FOR MEASUREMENTS OF EARTH RESISTANCES AND IMPEDANCE OF THE PROTECTING LOOP

The instrument for measurements of the earth resistances and the protecting loop impedance, type PU293 is intended namely for measurements in energy industry, however, it can be also used even for current revisions of networks. It is intended for the earth resistance and the protective loop impedance measurements. The measured values are shown on the graphic display with possibility of its lighting from below.

The instrument enables following measurements:

- AC voltage U measurement up to 500V/50Hz
- impedance of the protecting loop ZS measurement up to 19,99Ω
- earth resistance RA measurement up to 1,999 kΩ by the three-lead, or four-lead method by AC current with possibility of the measuring frequency selection (no-load voltage less than 50V)
- soil resistivity measurements up to 20 kΩm with the optional distance of the measuring electrodes

In the casing lower part there is the terminal block assembled with 4 measuring clamps marked H, S, ES and E. The measured object should be connected to this clamps by means of the set of cables – i.e. the set PD193.1 for measurements of RA–optional accessories, for the voltage and Zs measurements use the measuring cords with guarded pin, which are comprised into the delivery.

TECHNICAL PARAMETERS OF THE INSTRUMENT PU293

Voltage				**Note**
Measured quantity	**Range**	**Basic error**	**Working error**	**effective AC voltage value**
voltage **U**	10 to 460 V	±(1%MH +2 D)	±(1%MH +3 D)	48 to 62 Hz
		Loop impedance Z		
Measured quantity	Range	Basic error	Working error	
Impedance of the protecting loop **ZS**	0,00 to 0,19Ω 1) 0,20 to 19,99Ω	± (5% MH + 4D)	± (5% MH + 5D)	U L-PE = 190V to 260V 49,5 to 50,5 Hz
Loop impedance **L1-L2**	0,00 to 0,19 Ω 1) 0,20 to 19,99Ω	± (5% MH + 4D)	± (5% MH + 5D)	U = 340V to 450V 49,5 to 50,5 Hz
Short-circuit current **IK**	10 A to 1999 A			Calculated value
		Measurement of earth resistances RA		
Measured quantity	Range	Basic error	Working error	
Resistance **RA**	0,00 to 0,19Ω 1) 0,20 to 19,99 Ω 20,0 to 199,9 Ω 200 to 1999) Ω	± (2% MH + 5D)	± (5% MH + 5D)	Reversible measuring frequencies 59Hz, 95Hz, 128Hz, 140Hz Max.measuring voltage 40V Max.measuring current 40mA
Soil resistivity P	0,00 to 19,99) kΩ	the calculated value the accuracy is given by the measurement accuracy RA and accuracy of distances between the measuring probes		
Disturbing voltage **Us**	0,00 to 9,99 V	± (1% MH + 5D)	± (1% MH + 10D)	
Indication of resistance **RS** Indication of resistance **RH**				Indication of exceeded admissible value (depending on the measured resistance RA size)

1) The measurement accuracy within this range does not fulfil the requirement of the standard ČSN EN 61557 – the measurement error is over 30% of the measured value

terms of application		
	Reference terms :	Working terms :
temperature	(23 ± 2) °C	-15°C to 40°C measurements of the ZS and U 5°C to 40°C measurements of the earth resistance RA
Dimensions	200mm x 120mm x 50mm	
Weight	approx. 1,5 kg including power supply batteries	
Product safety	The instrument complies with the ČSN EN 61010-1:Equipment of the protecting class II for voltage 600 V to earth, CAT III, Degree of soiling 2.	

Accessories for PU 293

PD 193.1 – set of measuring electrodes and leads for earth resistance and soil resistivity measurements

THE SET COMPRISES:

Measuring electrode		4 pc
coil with measuring cords 40m + 25 m		1 pc
coil with measuring cords	25 m	1 pc
	3m blue	1 pc
	3m red with marks	1 pc
wrench		1 pc
suitcase		1 pc

INSTRUMENT FOR REVISIONS OF ELECTRIC APPLIANCES

PU 184 DELTA

The measuring instrument PU 184 DELTA is intended for inspections and revisions of the electric objects acc. to ČSN 331600, ČSN 331610 (for el. appliances) and DIN VDE 0701, parts 1 and 240.

- Stabilised measuring voltage for the insulation resistance measurements
- Measurements of the actual effective values of the acquantities
- Protection of inlet clamps against an over-voltage
- Measurements of leakage currents of earthing appliances (differential method)
- Easy attendance and minimal maintenance
- The instrument complies with the safety requirements acc. to the ČSN EN 61010-1 and requirements EMC acc. to the ČSN EN 55011, ČSN EN 5082-2, ČSN EN 61557.

Dimensions	300 x 200 x 60 mm
Weight	approx. 2 kg

Measured quantity	Measuring range	No-load voltage	No-load current (I_K), I_N	Inner resistance	Accuracy
network voltage	187-253 V				±(1% of MH + 2D)
appliance current	0-16 A				±(2% of MH+ 5D)
contact current	0-2 mA			2 kΩ	±(2% of MH + 7D)
insulation resistance	20 MΩ	(510 V ± 10) dc	(<1,5 mA)		±(2% of MH + 5D)
	2 M Ω		1 mA		±(2% of MH + 5D)
resistance of	20Ω	max. 20 Vdc	200 mA + 10 mA dc		±(2% of MH + 5D)
protecting lead	2 Ω				±(2% of MH + 7D)
leakagae current	0-20 mA	(30 ± 10) V	(<8 mA)	2 kΩ	±(2% of MH + 7D)
	0-2 mA				±(2% of MH + 7D)
leakage current	0-20 mA	(differential method)			±(2% of MR)

MH – measured quantity, D - digit, MR – measuring range

Current I_K short-circuit current at the insulation resistance measurements, measuring current at the protecting lead resistance measurements

Current I_N nominal current at the nominal voltage (insulation resistances)

PU 194 DELTA

The measuring instrument PU 194 DELTA is intended for inspections and revisions of the electric appliances and portable hand tools with flexible, or firm inlets.
The instrument complies with the requirements of the standard ČSN 33 1600 ed. 2.

BY THE INSTRUMENTS PU 194 DELTA AND PU 194 DELTA 10 A FOLLOWING MEASUREMENTS ARE POSSIBLE:

- insulation resistance R_{ISO} up to **400 MΩ** measuring voltage **50, 100, 250 a 500 V**
- protecting lead resistance R_{PE} up to **20Ω** by the dc current min. **200 mA** (with the polarity reversing)
- leakage currents (current through the protecting lead I_{PE}, spare leakage current I_D, differential current **I**)
- contact current I_F
- network voltage U_N
- current consumed by the measured appliance I_N
- active input **P**, apparent input **S** and **cosφ** of the measured appliance
- temperature and speed

The instrument is equipped with the memory of its capacity 1000 measured values which can be transferred to the computer. Entering of the identification 8-figure code of the appliance is possible either from the keyboard, or by means of the barcode.

The instrument can be connected to the computer by means of the serial interface RS 232.

Maximal current consumption of the measured appliance – 16 A. The electro-magnetic compatibility – as per the ČSN EN 61326 –1, ČSN EN 61557

Safety – as per the ČSN EN 61010 –1: Equipment protection class I for the voltage 250 V to earth CAT II, Degree of soiling 2

THE INSTRUMENT UTILITY VALUE IS INCREASED BY THE OPTIONAL ACCESSORIES:

- **PD 194.1 – Testing module**
- **PD 194.2 – Testing module**
- **PD 194.4 – Temperature sensor (PT 100)**
- **PD 194.5 – Barcode reader**
- **PD 194.3 – Speedometer probe**

MEASURING RANGES AND MEASURING ACCURACY:

Measured quantity	Measuring range	Measuring voltage	Measuring accuracy	Note
Network voltage U_{LN}	(180 ÷ 253) V		± (1% MH+10 D)	
Insulation resistance R_{ISO}	(0,1 ÷ 3,999) MΩ (1,0 ÷ 39,99) MΩ (10 ÷ 399,9) MΩ	50 to 70 V, 100 to 130 V 250 to 300 V, 500 to 600 V	1) ± (5% MH+10 D)	IK ≤ 4 mA In = 1,0 to 1,5 mA
protecting lead resistance R_{PE}	(0,010 ÷ 3,999) Ω (0,01 ÷ 19,99) Ω	max. 20 V no-load	± (5% MH+10 D)	I = ± (200 to 210) mA
current I_F - contact current	(0 ÷ 3,999) mA		± (1% MR)	contact voltage, ΔDU_{max} = 8 V
current I_{PE} - current through the protecting lead	(0 ÷ 19,99) mA		± (2% MR)	
current I_D - spare leakage current	(0 ÷ 19,99) mA	max. 35 V / AC	± (2% MH+10 D)	
current I_D - differential current	(0 ÷ 19,99) mA		± (2% MR)	
current I_N - appliance current	(0 ÷ 16) A		± (2% MH+10 D)	Max. current 10A permanently 16A/5 min.
active input **P**	(0 ÷ 3700) W		± (5% MH+10 D)	
apparent input **S**	(0 ÷ 3700) VA		± (5% MH+10 D)	0,5A ≤ I_N ≤ 16A
power factor **cos** ϕ	0,50 ÷ 1,00		±10 D	
speed	(200 ÷ 9999) rpm		± (2% MH)	
temperature **t**	(-20 ÷ +350) °C		± 5 °C	

1) for the measuring voltage 50 V and 100 V the measurement accuracy is guaranteed up to the resistance value 200 M Ω

MH measured value

MR measuring range

D digit (digit of the lowest value place)

I_n measurer nominal current – (max. current supplied by the measurer at the nominal voltage at the resistance measurements)

I_K short-circuit current – the current flowing between the short-circuited measuring pins in the mode of the insulation resistance measurement

I_F contact current – the current which flows to earth through the person operating the appliance, comming from the electric appliances of the protection class II and from the conductive parts of the appliances of the protection class I, accessible for contact, which are not structurally connected to the protective lead (e.g. decorative parts).
(contact voltage $\Delta U = I_F \times 2\ k\Omega$)

I_M measuring current at the protecting lead resistance measurements

I_N current consumed by the appliance (power supply)

The values displayed on the bar indicator – on the bargraph in the display lower part – informative datum. At the double line indication the bargraph displays the lower line datum

Working temperature range: -5 °C to +40 °C

Accessories: network cord, measuring cords with connectors, measuring cord with the pin, step-clamps

Instrument weight PU 194 DELTA approx. 2,2 kg

Dimensions 170 x 220 x 120 mm

ACCESSORIES OF INSTRUMENTS PU 194 DELTA

PD 194.1 TESTING MODULE
PD 194.2 TESTING MODULE

The testing modules are intended for the quick orientational functionality verification of the instruments PU184 DELTA and following types. The modules can be used even for check of the instruments for revisions acc. to the standards ČSN 33 1600, ČSN 33 1610 from other manufacturers. The module connected to the revisioning instrument simulates the measured appliance. The testing modules PD 194.1 and PD 194.2 comply with the standard ČSN EN 61010 -1. At their proper exploitation as the operator safety, as the proper testing module safety are guaranteed. The modules comply with requirements of the electromagnetic compatibility acc. to the standard ČSN EN 61326 – the testing instrument functions are not influenced by them.

PD 194.1 - By this testing module the phase lead in the single-phase network socket can be indicated and the protecting lead state as well. By it the current measurements I_F, I_D, I , I_{PE} and the insulation resistance R_{ISO} measurements can be verified.

PD 194.2 - By this testing module the measurement R_{PE} can be verified.

PD 194.3 SPEEDOMETER PROBE

The speedometer probe is intended for scanning of the rotating parts speed (motor pulley, gearings)

Basic information:

- guaranteed measurement range: 200 - 9999 rpm
- measuring accuracy: 1% of the measured value
- distance from the measured object: approx.. 10 cm
- it operates in the invisible spectrum (IR) /scanning/
- the instrument aiming on the moving mark is performed by means of two yellow rays.

PD 194.4 TEMPERATURE SENSOR (Pt 100)

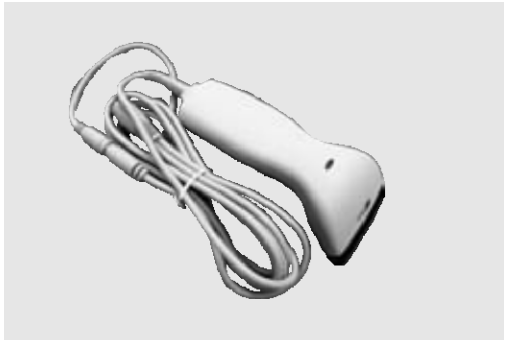
The temperature sensor Pt 100 serves for the temperature measurements at revisions of electric appliances and at various service activities. Regarding to the conductive material of the PD194.4, the temperature measurements can be performed on the parts without the voltage only. The testing voltage between the outlets and the conductible material of the probe casing is 500 V.

Technical paramaters:

Measuring range: **-25**°C to 350°C

Measuring accuracy ±5°C

Thermal resistance of instrument casing: max +370°C (measuring part with the inlet cord)



PD 194.5 BARCODE SCANNER

The barcode scanner type CCD 1000 is delivered as optional accessories. The manufacturer provides testing of each piece of the scanner together with the basic instrument PU 194 DELTA and guarantee such combination only.

The scanner is ended by the connector *DIN*, eventaually *MiniDIN*. At the execution equipped with the connector *miniDIN*, for the scanner connection to the panel PU 194 DELTA the reduction *miniDIN/DIN* must be used, which can be, in this case, delivered by the manufacturer to the customer. In general, any scanner can be used, with its corresponding connector, which has got its keyboard interface. The scanner will be connected (eventually through a proper reduction) to the connector **K2** of the instrument PU 194 DELTA. By this way the scanner power supply is provided, as well as the interconnection of the data routes with the processor in the PU 194 DELTA.

ACCESSORIES OF INSTRUMENTS

PD 191.1 ADAPTER FOR PU 191, PU 195 (two-lead type)

For measurements in three-phase networks.

QD 191 CABLE FOR DATA TRANSMISSION

The cable for the data transmission from the memory of the instrument PU 191 and instruments of the series PU187 to the computer.

USB-PU CABLE FOR DATA TRANSMISSION - series PU187, PU191, PU193, PU194

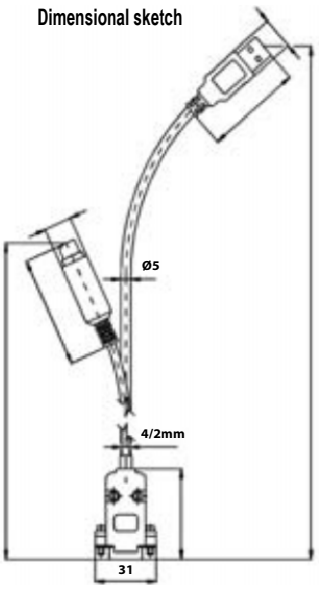
Only one instrument can be connected !

Area of application:

- The cable for the data transfer USB-PU (hereinafter the cable only) serves for connection of the revision instruments brand Metra Blansko a.s., equipped with the busbar RS232 (with the connectors CAN 9 and MINIDIN) with the USB busbar of the computer (PC).
- The cable can be used at the PC, which have not the busbar RS232, e.g. at notebooks.
- On one side the cable is terminated by the USB connector type A (plug) for connection to the PC. On the other side the connector CAN 9/F is assembled with the cover, in which the electronic system of the converter RS232/USB. From the connector cover the small cable with the connector MINIDIN 4/M is led out (plug).

The connectors CAN and MINIDIN are to be connected to the instruments which are intended for communication with the PC.

Dimensional sketch



Revisoft 2®

The program ReviSoft2 is intended for data processing from the instruments brand METRA.
The program ReviSoft2 is a successor of the foregoing program ReviSoft, which has enlarged and completed acc. to cutomer requirements.

The Demo-version of the program can be obtained by the e-mail free of charge.

The program enables:

- **Design of the form templets and barcode labels**
- Data transfer from the instrument series PU. (At present the PU187.1, PU187.2, PU191, PU193, PU194, PU195)
- Setting of parameters of some instruments (time of the instrument switching off etc.).
- Processing of transferred data to the fashion of forms and their print.
- Global print of a greater quantity of forms.
- Print of barcode labels for identification of revised appliances.
- Creation of the well-arranged list of revisions.
- Monitoring of the validity times and planning of revisions.

PU 294 DELTA

The instrument for revisions of electric appliances and medical electric equipment

BY THE INSTRUMENT PU 294 DELTA FOLLOWING CAN BE MEASURED:

- insulation resistances
- protecting lead resistance
- leakage currents incl. the leakage currents of the medical instruments
- contact current
- network voltage
- current consumed by the measured appliance
- active input, apparent input and cosφ of the measured appliance
- residual voltage on the plug pins after the appliance disconnection acc. to the ČSN EN61010-1 and ČSN EN 60204-1
- Possibility of connection of the temperature sensor, current clamp transformer, speedometer and the Busbar scanner
- Via the busbar USB the double-sided communication with the PC is possible

The instrument is equipped with the real time clock (RTC), memory up to 10000 measured values and the graphic LCD display, lighted from below.

The instrument PU 294 DELTA is intended for the measurement at the electric appliance revisions acc. to the standard ČSN 331600, ČSN 331610 and the medical electric instruments acc. to the standard ČSN EN 60601-1. It can be used at the new products revisions, continuous revisions and revisions of products after repairs. With the accessories PD 294 also three-phase appliances can be revised.

TECHNICAL PARAMETERS

Measured quantity	Measuring range	Measuring voltage	current 1) {I_k}, I_n I_M	Measuring accuracy Reference terms	Measuring accuracy Working terms
Network voltage U_{LN}	(180 ÷ 253) V	–	–	± (1% MH+10 D)	± (1% MH + 10 D)
Insulation resistance R_{ISO}	(0,1 ÷ 3,999) MΩ (1,0 ÷ 39,99) MΩ (10 ÷ 399,9) MΩ	50 to 70 V 100 to 130 V 250 to 300 V 500 to 600 V	(4 mA) (1 + 0,5) mA	± (3% MH + 10 D) 5)	± (5% MH + 10 D) 5)
Protecting lead resistance R_{PE}	(0,01 ÷ 19,99) Ω	max. 20 V / AC	-	± (3% MH + 5 D)	± (5% MH + 5D)
contact current I_F	(0 ÷ 3,999) mA	–	-	± (1% MR)	± (1% MR)
current I_{PE}	(0 ÷ 19,99) mA	–	-	± (2% MR)	± (2% MR)
current I_D	(0 ÷ 19,99) mA	max. 35 V / AC	-	± (2% MH + 5 D)	± (2% MH + 10 D)
differential current **I**	(0 ÷ 19,99) mA	–	-	± (2% MR)	± (2% MR)
consumed current I_N	(0 ÷ 10) A	–	-	± (2% MH + 5 D)	± (2% MH + 10 D)
Active input **P**	(0 ÷ 3700) W max. 2760 W	–	-	± (3% MH + 10 D)	± (5% MH + 10 D)
apparent input **S**	(0 ÷ 3700) VA max. 2760 VA	–	-	± (3% MH + 10 D)	± (5% MH + 10 D)
power factor **cos** ϕ	0,50 ÷ 1,00 2)	–	-	± 5 D	± 10 D
speed **n**	(200 ÷ 9999) rpm 3)	–	-	± (1% MH)	± (2% MH)
temperature **t**	(-20 ÷ + 350)°C 4)	–	-	± 3°C	± 5°C
residual voltage U_R	(20 ÷ 300) V	–	-	± (2% MR)	± (2% MR)
leakage current I_{M1} mains – contact part	(0 ÷ 3,999) mA	max. 250 V / AC	-	± (2% MH + 5 D)	± (5% MH + 5 D)
Leakage current I_{M2} mains.- contact part	(0 ÷ 3,999) mA	max. 250 V / AC	-		
leakage current I_{M3} mains- contact part	(0 ÷ 3,999) mA		-		
leakage current I_{M4} mains – contact part	(0 ÷ 3,999) mA	max. 250 V / AC	-		

MH measured value
MR measuring range
D digit (digit of the lowest place of the value)

1) {Ik} short-circuit current at the insulation resistance measurements
2) Consumed current IN must be min. 0,5A
3) Valid for the speedometer probe PD 294.3
4) Valid for the temperature sensors Pt 100, PD 294.4
5) For the measuring voltage 50 V and 100 V the measuring accuracy is guaranteed up to the resistance value 40 MΩ.

DIMENSIONS 270 x 240 x 130 mm
WEIGHT 4 kg

PD 294

The instrument for revisions of the three-phase electric appliances

By the instrument PD 294 connected to the PU 294 DELTA following can be measured:

- current through the protecting lead I_{PE}
- differential current I_{Δ}
- contact current I_F
- phase voltages of the separate phases
- currents of the separate phases consumed by the measured appliance
- active input P, apparent input S and the power factor cosφ of the measured appliance
- insulation resistances R_{ISO}
- protecting lead resistance R_{PE}
- spare leakage current I_D

Optional accessories

- adapter PD 294.6 for connection of the testing module PD 294.1 order No. 003-25286-0000
- testing module PD 294.1 (R_{ISO}, R_{PE}, I_D, I_F, I_{PE}, I_{Δ}) order No. 003-25262-0000

The instrument PD 294 is designed in its durable lock-up plastic suitcase. It is equipped with the firm supply cord with the three-phase 5-pin plug 32A. To the instrument PU 294 DELTA it is connected by the cable QD294. Furthermore, it has got its firm cable with the single-phase plug for connection to the measuring socket PU 294DELTA at the insulation resistance measurements RISO, protective lead RPE resistance and the spare leakage current ID. The single-phase socket is intended for the power supply of the instrument PU 294DELTA, but at the case only, if the instrument PD 294 is connected to the three-phase network with the central conductor.During the transport the plug and the cables are stored in the deposit space of the closed suitcase. The measured VALUES are displayed on the display PU 294DELTA.

TECHNICAL PARAMETERS

Measured quantity	Measuring range	Measuring accuracy Reference terms	Measuring accuracy Working terms
phase voltage U_{LN}	190 V to 255 V	± 2,0 V	± 3,0 V
consumed phase current I_L	0,5 to 24 A	± (3% MH + 2 A)	± (3% MH + 3 A)
active input **P** (1 phase) 1)	(200 to 6000) W	± (5% MH + 60 W)	± (5% MH + 100 W)
apparent input **S** (1 phase) 2)	(200 to 6000) VA	± (5% MH + 60 VA)	± (5% MH + 100 VA)
power factor **cos** ϕ 2)	(0,50 to 1,00)	± 0,06	± 0,10
current through the protecting lead I_{PE}	(0 ÷ 19,99) mA	± 0,40 mA	± 0,40 mA
differential current I_{Δ}	(0 ÷ 19,99) mA	± 0,40 mA	± 0,40 mA
contact current I_F	(0 ÷ 3,999) mA	± 0,040 mA	± 0,040 mA
spare leakage current I_D		3)	3)
insulation resistance R_{ISO}	20 MΩ / 500 V	3)	3)
resistance of protection lead R_{PE}		3)	3)

MH measured value

1) Consumed current in the measured phase IL must be min. 1,0 A

2) Consumed current IN must be min. 3,0 A

3) For measurements of RISO, RPE and ID the measuring and accuracy ranges are given by the parameters PU 294 DELTA.

Reference terms

power supply voltage:	3x230 V ± 2%
frequency:	50 Hz ± 0,1 Hz
temperature:	23 °C ± 2 °C
relative humidity:	(45 to 55)%
instrument position:	arbitrary
magnetic induction:	0,05 mT

Power supply line voltage in the range 340 V to 450 V / 50Hz

Electromagnetic compatibility - the instrument complies with the requirements of the EMC acc. to the standard ČSN EN 61326-1

(change1) :

- equipment class B
- intermittent operation
- basic operation (functional safety) - criterion A

Weight approx. 5 kg

Dimensions: 406 x 330 x 174 mm

ACCESSORIES OF THE INSTRUMENTS PU 294 DELTA

PD 294.1 TESTING MODULE

The testing module is intended for the quick orientation functionality verification of the instrument PU 294 DELTA and consequent types. The module can be used even for verification of the instruments acc. to the standard ČSN 33 1600, ČSN 33 1610 of other manufacturers. The module, connected to the revision instrument, simulates the measured appliance. The testing module PD 294.1 complies with the standard ČSN EN 61010 -1. If it is used duly, as the operator safety, as the safety of the proper testing module are guaranteed. The module complies with the requirements of the electromagnetic compatibility acc. to the standard ČSN EN 61326 – it has no influence on the testing instrument functions.

PD 294.1 - The testing module PD 294.1 is intended for the quick orientation verification of the proper function of the instrument PU 294 DELTA at the measurements of:

- contact current I_F
- spare leakage current I_D
- current through the protective lead IPE and the differential current I_Δ
- insulation resistance R_{ISO}
- protecting lead resistance R_{PE}
- leakage current at the medical equipment I_{M1}, I_{M2}, I_{M3} and I_{M4}
- residual voltage U_R

PD 294.2 CLAMPS FOR CURRENT MEASUREMENTS

The clamp A-meter enables measurements of the current on the ranges 20 A, 2 A and 200 mA. The measured values will be shown on the display PU 294 and saved into the memory of the PU 294.

Basic information:

Max. measured lead size :	Ø 20 mm, or 35x20 mm
Working temperature range :	-5 °C to + 40 °C
Power supply :	from the instrument PU 294
Dimensions :	190 x 45 x 35 mm
Weight :	approx.. 250g

PD 294.3 SPEEDOMETER PROBE

The speedometer probe is intended for the speed scanning of the rotating parts (motor pulleys, gearings)

Basic information:

guaranteed range of measurements:	200 - 9999 rpm
measuring accuracy:	1% of the measured value
distance from the measured object:	approx. 10 cm

- it operates in the invisible spectrum (IR) /scanning/
- aiming of the instrument to the moving mark is designed by means of two yellow rays.

PD 294.4 TEMPERATURE SENSOR (Pt 100)

The temperature sensor Pt 100 serves for the temperature measurements at revisions of the electric appliances and at the service activities. Regarding to the conductive material of the instrument PD 294.4, the temperature measurements can be performed on the dead parts only. The testing voltage between the outlets and the conductive casing of the probe is 500 V.

Technical parameters

Measuring range:	-25°C to + 350°C
Measuring accuracy:	± 5 °C
Thermal resistance of the instrument casing:	max. +370 °C (measuring part with the inlet cord)

PD 294.5 BARCODE SCANNER

The barcode scanner type CCD 1000 is delivered as an optional accessories. The manufacturer provides testing of each piece and guarantees the functionality of the scaner together with the basic instrument PU 294 DELTA.

The scanner is ended by the connector *DIN*, eventually *MiniDIN*. At the execution equipped with the connector *miniDIN*, for the scanner connection to the panel PU 294 DELTA the reduction *miniDIN/DIN* must be used, which can be, in this case delivered by the manufacturer to the customer. In general, any scanner can be used, with its corresponding connector, which has got its keyboard interface. The scanner will be connected (eventually through a proper reduction) to the connector **K2** of the instrument PU 294 DELTA. By this way the scanner power supply is provided, as well as the interconnection of the data routes with the processor PU 294 DELTA.

PD 294.6 ADAPTER FOR CONNECTION OF TESTING MODULE PD 294.1

The adapter PD294.6 is intended for connection of the testing module PD294.1 to the instrument for revision of three-phase devices PD294 . The module PD294.1 then will enable to verify functions of the instrument PD294.

PD 294.7 FIXTURE FOR REVISONS OF MEDICAL EQUIPMENT

The instrument PD294.7 serves for the leakage current measurements at the medical instruments. To its sockets up to 10 cables can be connected, used for connection of the applied parts. The cable PD294.7 is to be connected to the socke IF of the instrument PU294.

PD 294.8 ADAPTER FOR REVISIONS OF WELDING EQUIPMENT

The instrument PD 294.8 is optional accessories of the instrument PU294 DELTA. It is intended for inspections of the welding equipment acc. to the standard ČSN EN 60974-4.

Description of the instrument:
The PD294.8 is designed in its plastic suitcase. The electronic circuits are arranged on the printed circuit board. The instrument is to be connected by means of cables to the connector K1 MINIDIN and to the network socket PU294. The three-phase adapter PD294 is connected to the network socket and to the connector K1 of the instrument PD294.8. After connection to the measured object the measured data are shown on the display PU294.

Safety requirements:
as per the ČSN EN 61010-1 Equipment protection class I for the voltage 300 V to earth CAT III, Degree of soiling 2.

- Thermal resistance: -25°C to +55°C
- Instrument size: 235 x 200 x 120 mm
- Weight: approx. 1,9 kg
- Working terms:
  ambient temperature: -5°C to +40°C
  relative humidity: max 80% at 23°C
  instrument position: arbitrary
- Power supply: from the network socket PU294
- Range of delivery:

TECHNICAL PARAMETERS

Measured quantity	Symbol unit	Measuring range	Measuring accuracy	
			Reference terms	Working terms
Leakage current of the welding circuit	I_{WP} [mA]	(0 to 19,99)	±(2%MR)	
No-load voltage	U_{1M}, U_0 [V]	(0 to 149,9)		
	U_{0P} [V]	(0 to 212)		
Primary leakage current	I_{PE} [mA]	(0 to 19,99)	see the PD294	
	I_Δ [mA]	(0 to 19,99)		
Contact current	I_F [mA]	(0 to 3,999)		
Protecting lead resistance	R_{PE} [Ω]	(0,01 to 19,99)	see the PU294	
Insulation resistance	R_{ISO} [MΩ]	(0,1 to 399,9)		
Spare leakage current	I_D [mA]	(0 to 19,99)		

MR – measuring range

PU 298

Instrument for revisions of welding equipment
The instrument PU 298 is intended for checking of the welding equipment acc. to the ČSN EN 60974-4.

The instrument PU298 is designed in the plastic suitcase. To this instrument the three-phase adapter PD294 can be connected. From the instrument keyboard all measurements enabled by the PD294 can be switched on (phase voltages, currents, active and apparent powers, power factors, leaking currents IΔ, IPE and the contact current IF). The measured values shown on the display can be saved into the memory and transferred to the PC for consequent processing. For connection to the measured object there are two safety sockets available.

- **Safety requirements:** as per ČSN EN 61010-1
  Equipment protection class I for the voltage 300 V to earth CAT III
- **Degree of soiling** 2.
- **Thermal resistance:** -25°C to +55°C
- **Instrument size:** 235 x 200 x 120 mm
- **Weight:** approx. 1,9 kg
- **Working terms:**
  ambient temperature: -5°C to +40°C
  relative humidity: max 80% at 23°C
  instrument position: arbitrary
- **Power supply:** 195V to 253V/AC

TECHNICAL PARAMETERS				
Measured quantity	**Symbol unit**	**Measuring range**	**Measuring accuracy**	
			Reference terms	**Working terms**
Leakage current of the welding circuit	I_{WP} [mA]	(0 to 19,99)	±(2%MR)	
No-load voltage	U_{1M}, U_0 [V]	(0 to 149,9)		
	U_{0P} [V]	(0 to 212)		
Primary leakage current	I_{PE} [mA]	(0 to 19,99)	see the PD294	
	I_Δ [mA]	(0 to 19,99)		
Contact current	I_F [mA]	(0 to 3,999)		
Protection lead resistance	R_{PE} [Ω]	Acc. to the instrument for measurements of R_{PE} and R_{ISO}		
Insulation resistance	R_{ISO} [MΩ]			

MR – measuring range

CALIBRATION OF MEASURING INSTRUMENTS

METRA BLANSKO a.s. – Dept. of Metrology provides calibration of the working measuring instruments acc. to the Law on Metrology No. 505/1990 Coll. as ammended. The company METRA BLANSKO as a manufacturer and repairer of measuring instruments is registered at the Český metrologický institut in Brno, registration No. 620-60/96. The METRA BLANSKO a.s. has built its system of quality control acc. to the standard ČSN EN ISO 9001, the company is certified by the firm TÜ V Mnichov, certificate registration No. 12 100 9263

METRA BLANSKO a.s. provides calibration of working measuring instruments

A electric quantities

a) DC voltage in the range 1 mV to 30 kV, admissible accuracy error 0,001 % to 5 %
b) AC voltage in the range 10 mV to 10 kV, f = 40 Hz to 10 kHz, admissible accuracy error 0,1 % to 5 %
c) DC current in the range 10 μA to 50 A, clamp instruments up to 3000 A, admissible accuracy error 0,05 % to 2,5 %
d) AC current in the range 10 μA to 50 A f = 40 Hz to 1 kHz, clamp instruments up to 3000 A, f = 40 Hz to 100 Hz, admissible accuracy error 0,1 % to 2,5 %
e) electric resistance in the range 10-4Ω to 1010Ω, admissible accuracy error 0,01 % to 10 %
f) electric DC and AC power for the voltage range 10 to 750 V, current range 0,5 A to 10 A, admissible accuracy error 0,1 % to 1 %
g) phase in the range 0° to 360°, phase displacement cosφ 0 to 1, voltage range 10 V to 300 V and the current 0,5 A to 10 A, admissible accuracy error of the phase 0,2 % to 1 % of the phase displacement 0,5 % to 2,5 % of the scale length
h) measuring current transformers, in the range of the measured quantity 0,5 A to 1500 A, load less than 5 VA for the cosφ = 1; load 5 VA to 60 VA, cosφ = 0,8; admissible accuracy error of the current 0,5 % to 1 %, angle accuracy error 0,5
i) lighting 0 lx to 20 klx, accuracy 5 % to 10 %

B... other physical quantities

COMBINED REVISION INSTRUMENT

PU 195 COMBINED REVISION INSTRUMENT

The instrument is intended for fast measurements of high-tension installations, as the single-phase, as the three-phase, with the phase voltage 190 to 260 V and for testing of current protections of all types - unretarded (-), retarded (G) and selective (S), sensitive as to the AC current, as to the pulsing one (A).

Dimensions 200 mm x 120 mm x 50 mm

Weight max. 1,4 kg incl. supply batteries, without package

THE INSTRUMENT PU 195 ENABLES:

- voltage measurement between the phase and protecting leads U_{L-PE}
- voltage measurements between the phase and the neutral leads U_{L-N}
- voltage measurements between the neutral and the protecting leads U_{N-PE}
- informative measurements of the voltage frequency
- line voltage measurements up to 450 V and determination of the phase sequence (adapter PD195)
- measurement of the protecting loop impedance Z_S and the inner network impedance Z_i even between two phase leads
- measurement of the protecting loop impedance Z_S behind the current protection without its set-out
- measurement of the setting time of the current protections t_A by the differential AC current $I_{\Delta N}$, $5xI_{\Delta N}$ and the differential pulsating current
- testing of the protector by gradually increased current, measurement of the protector set-out current I_Δ and measurement of the contact voltage U_Δ at the set-out moment
- measurement of the contact voltage U_B without the protector set-out by the current 0,45 x $I_{\Delta N}$ (45% of the nominal set-out current and test of the protector unfurnishing
- measurement of small resistances R_{PE} by the DC current 200mA with changing of the current polarity
- measurement of the insulation resistances R_{ISO} by adjsustable voltage 50 V to 500 V
- test of the socket – verification of the proper connection of leads in the socket

The measured quantities and further data are displayed on the graphic display lighted from below. The measured values (up to 1000 measurements) are saved into the memory. They can be either displayed, or transferred into the computer for their consequent processing by means of the standard cable USB A-B.
The instrument fulfils requirements of the standard ČSN EN 61326-1 – Equipment class B, intermittent operation and ČSN EN 61557 – Equipment for testing, measurements, or monitoring of functions of the protecting means. It is supplied from 4 NiMh, or NiCd accumulators type AAA, which can be recharged inside the instrument. The two-lead measuring adapter PD191.1, and 2 step-clamps and the package are comprised into the delivery.

TECHNICAL PARAMETERS

Measured quantity	Range	Basic error	Working errorr	Note
Voltage				actual effective value of AC voltage TRMS 15 to 62 Hz
measurement in socket	10 V to 260 V	± (1% MH + 1 D)	± (1% MH + 2 D)	
measurement with adapter	10 V to 450 V	± (1% MH + 2 D)	± (1% MH + 3 D)	
Measured quantity	**Range**	**Basic error**	**Working error**	**Note**
Measurement of protecting elements				U_{L-PE} = 190 V to 260 V 49,5 to 50,5 Hz
contact voltage U_B	0,0 V to 99,9 V	+ 6% MH + 1 V	+ 8% MH + 1 V	
set-out time of protector t_A	type AC (alternate) 999 ms	± (1% MH + 2 ms)	± (1% MH + 3 ms)	
	typ A (pulsating) 999 ms	± (1% MH + 2 ms)	± (1% MH + 3 ms)	
	150 ms (5x $I_\Delta N$)	± (1% MH + 2 ms)	± (1% MH + 3 ms)	
actual set-out time of protector I_Δ	type AC 25 110% $I_\Delta N$	± 6% $I_\Delta N$	± 10% $I_\Delta N$	Error guaranteed for I_Δ= 50 to 110% $I_\Delta N$
	type A 25 to 140% $I_\Delta N$	± 6% $I_\Delta N$	± 10% $I_\Delta N$	
Measured quantity	**Quantity**	**Basic error**	**Working error**	**Note**
Impedance of protecting loop Z and inner impedance of the network Z				U_{L-PE} = 190 V to 260 V 49,5 to 50,5 Hz
Impedance of protecting loop Z_S	19,99 Ω	± (5% MH + 10 D)	± (5% MH + 12 D)	
Z_S behind the protector 300 mA	199,9 Ω	± (5% MH + 10 D)	± (6% MH + 12 D)	I_Δ < 150 mA
Z_S behind the protector 30 mA	1999 Ω	± (5% MH + 15 D)	± (6% MH + 15 D)	I_Δ < 15 mA
Impedance of the loop L-N	19,99 Ω	± (5% MH + 10 D)	± (5% MH + 12 D)	Range U_{L-N} 190 V to 260 V
Impedance of the loop L_1-L_2	19,99 Ω	± (5% MH + 12 D)	± (5% MH + 15 D)	Voltage range 340 V to 450 V
Measured quantity	**Range**	**Basic error**	**Working errorr**	**Note**
Measurement of small resistances R_{PE}				Measuring current I_M ≥ 200mA (measured resistance max. 6 to 12 Ω acc. to the battery state)
Resistance R_{PE}	0,00 Ω to 9,99 Ω	± (3% MH + 10 D)	± (4% MH + 10 D)	
	10,00 Ω to 19,99 Ω	± 5% MH	± 5% MH	
Measuring current I_M	Indication I_M > 200 mA at actual current value I_M ≥ 200 mA			
Measured quantity	**Range**	**Basic error**	**Working error**	**Note**
Measurement of insulation resistances R_{ISO}				Nominal measuring voltage U_M 500, 250, 100, 50 V / 1mA
Insulation resistance R_{ISO}	(0,100 to 9,999) MΩ	± (3% MH + 10 D)	± (5% MH + 10 D)	
	(10,00 to 99,99) MΩ	± (3% MH + 10 D)	± (5% MH + 10 D)	U_M = 500 V, 250 V
	(10,00 to 19,99) MΩ	± (3% MH + 10 D)	± (5% MH + 10 D)	t

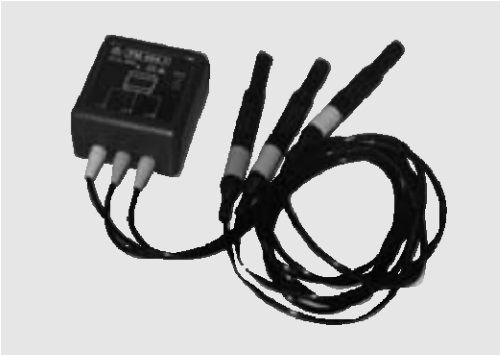
ACCESSORIES OF INSTRUMENT PU 195

PD 195 – the three-lead adaptor for measurements of the phase sequence in three-lead network with the instrument PU 195, incl. the step clamps with insulation PD 60.

Cable for data transmission from the memory of the instrument PU 195 to the computer

PHASE SEQUENCE INDICATOR

PM 454.1



The instrument PM 454.1 is intended for testing of three-phase network state :

- Detection of presence of voltage on connected phases
- Indication of proper sequence of connected phases

Technical parameters:

- input voltage U_{L-L}: 3 x 190 V to 3 x 690 V
- working temperature range: -5 °C to 45 °C
- safety acc. to the standard ČSN EN 61010-1
- protection class II
- max. voltage of any input against ground 600 V_{ef}
- coverage IP 40, over-voltage category III
- electromagnetic compatibility (EMC) ČSN EN 61326-1, ČSN EN 61557

Weight	approx. 250 g
Dimensions	68 x 75 x 40 mm

LUXMETER WITH DIGITAL INDICATION

PU 550

The instrument is intended for operational measurements of lighting in industrial shops and on workplaces for the maintenance purposes, or checks of the lighting intensity. By this instrument the lighting of communications and some laboratory measurements can be performed as well, within the range of its technical possibilities.

- The measuring probe is equipped with the cosine extension for correction of the directional error of the measured radiation
- The set of optic filters creates the part of the measuring sensor located in the measuring probe, providing the spectral sensitivity, which is close the sensitivity of the human eye.
- Function HOLD usable e.g. at measurements of small lighting intensities
- Possibility of external power supply
- Easy attendance and minimal maintenance

Measuring ranges

(20, 200, 2000) lx, (20, 100) klx

Accuracy

± (0,5% of measured value
± 0,5% of measuring range
+ total error of the photo-metric probe)

Dimensions	168 x 96 x 35 mm
Weight	approx.300 g (without probe)

CLAMP AMMETER-VOLTMETERS WITH ANALOGICAL DISPLAY

PK 410

TECHNICAL DATA	
Current AC	1,5 A, 3 A, 6 A,
	15 A, 30 A, 60 A
	150 A, 300 A
Voltage AC	150 V, 300 V, 600 V
Accuracy class	2,5
Max. size of measured lead	∅ 28 mm profile 30 x 20 mm
Working temperature range	-5°C to +40°C
Weight	≈ 0,5 kg

The instrument is energized from the measured circuit, it needs no battery.

PK 415

TECHNICAL DATA	
Current AC	15 A, 30 A, 60 A
	150 A, 300 A, 600 A
	1500 A, 3000 A
Voltage AC	150 V, 300 V, 600 V
Accuracy class	2,5
Max. size of measured lead	∅ 60 mm profile 70 x 30 mm
Working temperature range	-5°C to +40°C
Weight	≈ 0,9 kg

The instrument is energized from the measured circuit, it needs no battery.

COMBINED CLAMP INSTRUMENT WITH DIGITAL DISPLAY

PK 470

The clamp instrument PK 470 with digital display measures:

- actual effective value of current and voltage including the DC component – TRMS
- effective value of AC current and voltage
- DC current and voltage
- frequency of current, or voltage
- resistance (including the acoustic short-circuit tester)

TECHNICAL DATA	
Current AC, DC	399,9 A – *resolution 0,1 A*
	1000 A – *resolution 1 A*
Voltage AC, DC	399,9 V – *resolution 0,1 V*
	1000 V – *resolution 1 V*
Frequency (current and voltage)	399 Hz – *resolution 0,1 Hz*
Resistance	399,9 Ω – *resolution 0,1 Ω* 3,999 kΩ – *resolution 0,001 kΩ* 39,99 kΩ – *resolution 0,01 kΩ* 399,9 kΩ – *resolution 001 kΩ*
Measuring accuracy	current, voltage – 1% of MR frequency, resistance – 0,5% of MR
Max. size of measured lead	∅ 35 mm profile 50 x 10
Working temperature range	-5°C to +40°C
Power supply	battery IEC 6LR61, 9 V, resp.IEC 6F22
Weight	≈ 0,8 kg

MR … measuring range

ReviSoft 2®

The program ReviSoft2 is intended for processing of data from the instruments brand METRA.
The program ReviSoft2 is a successor of the foregoing program ReviSoft, which has enlarged and completed acc. to customer requirements.

The Demo-version of the program can be obtained by the e-mail free of charge.

The program enables:

- Design of the form templets and barcode labels
- Data transfer from the instrument series PU. (at present PU187.1, PU187.2, PU191, PU193, PU194, PU195)
- Setting of parameters of some instruments (time of the instrument switching off etc.).
- Processing of transferred data to the fashion of forms and their print.
- Global print of a greater quantity of forms.
- Print of barcode labels for identification of revised appliances.
- Creation of the well-arranged list of revisions.
- Monitoring of the validity times and planning of revisions.

CLAMP MULTIMETERS WITH DIGITAL DISPLAY

PK 430.1 PK 435.1

They are designed for the measurement of:

- actual effective current and voltage values including the DC component –TRMS
- effective values of the AC current and voltage
- DC current and voltage
- AC active and apparent power
- DC power
- four-quadrant value of the power factor
- current, or voltage frequency
- resistance (including acoustic short-circuit tester and measurement of semiconductor junction)
- temperature (probe SU 65)

The instruments enable (by means of the PM 45x accessories)**:**

- automated data collection controlled by the PC through the galvanically separated interface RS 485
- individual data collection of all measured quantities with the memory capacity 4032 measurements
- galvanically separated analogical output of all quantities

TECHNICAL DATA	
Inner resistance of the voltage input:	1 MΩ
Electric strength:	testing voltage 7,4 kV (50 Hz/1 min.)
Power supply battery:	9 V, alcaline IEC 6LR 61, or IEC 6F22
	service life min. 30 hours
Working temperature range:	-5°C to +40°C
Temperature resistance:	-25°C to +70 °C
Max. size of measured lead:	PK 430.1 – 35 mm, or profile 50 x10 mm
	PK 435.1 – 60 mm, or profile 70 x 30 mm

MEASURING RANGES	A	V	KW	KVA	cos φ	Hz	Ω	°C
PK 430.1	39,99	39,99	3,999	3,999	-1,0 to	min. 20	399,9	- 50°C to + 125 °C
	399,9	399,9	39,99	39,99	1,0 L	399,9	3,999 k	
	1000	1000	399,9	399,9	-1,0 to	3999	39,99 k	
			1000	1000	1,0 C		399,9 k	
PK 435.1	39,99	39,99	3,999	3,999	-1,0 to	min. 20	399,9	- 50°C to + 125 °C
	399,9	399,9	39,99	39,99	1,0 L	399,9	3,999 k	
	2000	1000	399,9	399,9	-1,0 to	3999	39,99 k	
			2000	2000	1,0 C		399,9 k	

The universal clamp multimeters series PK 430.1, PK 435.1 represent a top of the innovated series of the clamp measurement instruments brand Metra Blansko a.s. Thanks to their parameters these instruments are routed to fields of operational and service measurements in power engineering, machinery, transport and everywhere, where fast and operative measurements are required, without any intervention to electric installation of the measured object.

PM 454 – PHASE SEQUENCE INDICATOR

The phase sequence indicator PM 454 is, in connection with the universal clamp instruments PK 430.1, or PK 435.1, designed for testing of the 3-phase network state:

- it detects any voltage presence on connected phases
- it indicates the correct sequence of connected phases
- it enables the instruments PK 430.1 and PK 435.1 to measure power and phase displacement in three-phase networks without zero conductor

Technical data:

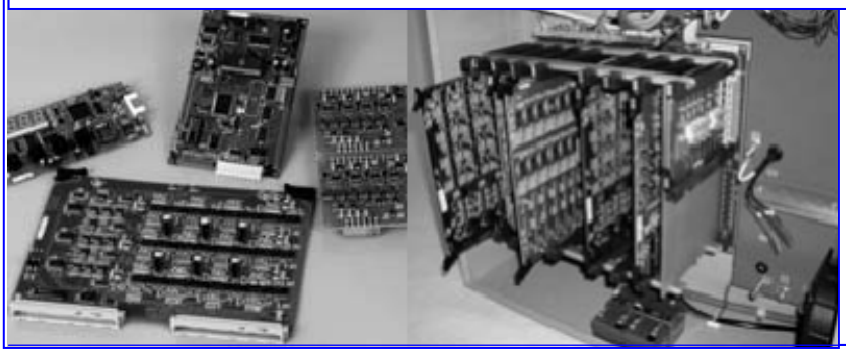
- input voltage U_{L-L}: 3 x 190 V to 3 x 690 V
- working temperature range: - 5°C to + 45°C
- safety: as per ČSN EN 61010-1
- protection class II
- max. voltage of any inlet to the earth 600 V_{ef}
- coverage IP 40, over-voltage category III

PD 10, PD10.1, PD 11, PD11.1 – FUSE HEADS

The Fuse heads PD 10, PD 11 and PD 10.1, PD 11.1 are a supplement to the clamp instruments. They enable measurement of current flowing through the fuse insert after the head screwing into the fuse bottom. The current flowing through the fuse insert is led into the loop of the fuse head. The current can be measured at the loop encircling by the clamp instrument. At the executions PD 10.1 and PD 11.1 a safety jack on the fuse head loop is prepared, to enable access to the voltage on the fuse for measurement by any suitable instrument.

PD 10, PD 10.1	E 27 - 25A / 500V
PD 11, PD 11.1	E 33 - 63A / 500V

SUB-DELIVERY ACTIVITIES IN ELECTRIC EQUIPMENT



Setting and testing of PCB

- complex design of PCB
- provision:
  - production of PCB
  - purchase of material
  - setting of PCB
  - testing

Switchboard measuring instruments

production:

- panel instruments
- switchboard instruments
- converters of el. quantities
- registration instruments
- shunts

CALIBRATION SERVICE

The company METRA BLANSKO a. s. provides calibration of working measuring instruments acc. to the Law on Metrology No.505/1990 Coll., Public Notice No. 69/1991 Coll., § 3, art. 12, by which the Law on Metrology is executed. METRA BLANSKO a. s., as a manufacturer and repairer of instruments is registered at the ČMI in Brno, registration No. 620-60/96.

Osvědčení nabylo právní moci dne:

.....
podpis

ČESKÝ METROLOGICKÝ INSTITUT

OSVĚDČENÍ O REGISTRACI

číslo 6000-OR-0011-06

Na základě žádosti č.j. --- ze dne 20.6.2006 a výsledku posouzení předpokladů stanovených § 19 zákona o metrologii č.505/1990 Sb. v platném znění a § 11 odst.1 vyhl. Ministerstva průmyslu a obchodu č. 262/2000 Sb. v platném znění je u Českého metrologického institutu - oblastního inspektorátu Brno registrován subjekt:

METRA BLANSKO a.s. IČ: **15546110**
Pražská 7, č.p. 1602
678 49 Blansko

Předmět registrace: výroba opravy

měřidla světelných veličin - luxmetry (stanovená měřidla)
měřidla elektrických veličin (pracovní měřidla)

Osvědčení o registraci je vykonatelné dnem jeho doručení žadateli – registrovanému subjektu; nabývá právní moci po uplynutí 15 dnů po jeho doručení, pokud nebylo proti němu podáno odvolání. Všechny skutečnosti rozhodné pro změnu nebo zrušení registrace, je registrovaný subjekt povinen bez zbytečného odkladu sdělit oblastnímu inspektorátu Českého metrologického institutu, u kterého je registrován.
Registrovaný subjekt je povinen plnit podmínky registrace, které jsou nedílnou součástí tohoto osvědčení o registraci a postupovat podle metrologického předpisu MP 001 - 02.

Za činnost v rozsahu registrace odpovídá: Ing. Richard Nikel
Přidělená značka: 6-06
11-MB

V Brně dne 3.7.2006

Ing. Radovan Wiecek
ředitel oblastního inspektorátu

Poučení o odvolání:
Proti tomuto osvědčení o registraci lze podat k Úřadu pro technickou normalizaci, metrologii a státní zkušebnictví odvolání do 15 dnů od jeho doručení registrovanému subjektu. Odvolání se podává ve dvou vyhotoveních prostřednictvím oblastního inspektorátu Českého metrologického institutu, který registraci provedl; postup řízení je upraven § 24 zákona č. 505/1990 Sb. v platném znění. Odvolání nemá odkladný účinek.

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Management Service

CERTIFIKÁT

Certifikační místo
TÜV SÜD Management Service GmbH
potvrzuje, že společnost

METRA BLANSKO a.s.
Prazská 7, c.p. 1602
CZ-678 49 Blansko

zavedla a používá
systém managementu jakosti v oboru

Vývoj, výroba, distribuce a servis elektrických přístrojů a systémů. Výroba plechových dílů a sestav, elektromechanických montáží.

Podle auditu, zpráva č. **70009486**
bylo prokázáno splnění
požadavků normy

ISO 9001:2008

Tento certifikát je platný do **2011-11-03**
Registrační číslo certifikátu **12 100 9263 TMS**

Mnichov, 2009-11-16

QMS-TGA-ZM-07-02

TÜV SÜD Management Service GmbH • Zertifizierstelle • Ridlerstraße 65 • 80339 München • Germany

Zlatý výrobek

Veletrhu Elektrotechnika 2008
Ostrava

udělený v oboru:
Měření a regulace

přihlášený výrobek:
Měřicí souprava PU 294 a PD 294

firmě:
METRA Blansko, a. s.

V Ostravě dne 11. 11. 2008

za firmu BAEL
Jindřich Babarik

za hodnotící komisi
Prof. Ing. Karel Sokanský, CSc.

ČESTNÉ UZNÁNÍ

Odborné hodnotitelské komise 16. mezinárodního veletrhu elektrotechniky a elektroniky

AMPER 2008

Název oceněného exponátu: **Přístroj pro revize - PU 294 DELTA**

Přihlašovatel exponátu: **METRA BLANSKO, a.s.**

Prof. Ing. Jiří Tůma, DrSc.
předseda komise / committee president

Praha, 2. 4. 2008

Ing. Jiří Čvrga
generální ředitel / managing director

From other production:

Panel and switchboard instruments, converters of electric quantities, revision instruments, shunts, printed circuit boards.












Contacts

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