HIGH-VOLTAGE CAPACITIVE INSTRUMENT TRANSDUCER CHVT-500

User Manual

MC2.727.002-01 UM

2019

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This User Manual informs the user about important aspects concerning the operation, maintenance, storage, transportation, verification, and warranty conditions of the high-voltage capacitive instrument transducer CHVT-500 (the CHVT or the transducer below).

1. Safety requirements

1.1 When putting the transducer into operation and during operation, the “Interbranch rules for Labour Safety (Safety Rules) When Operating Electrical Systems” and local safety regulations in force applicable to electrical installations must be observed.

1.2 Regarding the protection against electric shock, the transducer relates to class I (protection is achieved through a combination of insulation and a protective earthing/ground).

1.3 The transducer relates to the electrical equipment with the following characteristics (according to Russian State Standard GOST 12.2.091 compliant with IEC 61010-1):

- Insulation category: basic
- Measuring category: III
- Degree of protection against pollution: 1.

1.4 The IEC 60529 protection code is IP40.

1.5 The electrical strength of insulation of the input electrode (conducting primary high voltage) complies with state standard GOST 1516.2 (“Electrical equipment and installations for AC voltages 3 kV and higher. General methods of dielectric tests”).

1.6 The transducer shall only be operated or tested by technical staff familiar with this manual and with all arrangements and operating techniques of every instrument, device, tool, accessory, or any other equipment involved in the test or operation as well as with local norms and safety regulations applicable to electrical installations rated over 1000 V.

1.7 The transducer-aided operations and measurements shall be conducted by operators qualified as at least Category IV personnel, according to local norms applicable to operations on electrical installations rated over 1000V. Other employees involved are permitted to have electrical safety qualification level III (but not less).

1.8 Some additional information is given in the User Guide for operation with SF6-filled equipment MC2.727.002-01 UG1.

2. Description and operation principle

2.1 Intended use

The CHVT is intended to transform high AC voltage on its input to low AC voltage on its output with a constant scaling factor.

The CHVT can be used:

- As a reference measuring instrument in the course of accuracy testing / calibration of working-class voltage measuring transformers of 0.2 accuracy class or less accurate
- For high-voltage measurements.

2.2 Modifications

The transducer comes in various options (modifications). The model name shown below contains information about the options as specified in the purchase order:

CHVT-500-xxx-yyyy,

where:

- 500 – high-voltage grade as stated in Russian State Standard GOST 1516.1
- xxx – accuracy class of the transducer (for an actual scaling factor)
- yyyy – rated secondary voltage in volts (may be represented as a fraction)

If multiple secondary voltages are ordered, their rated values are listed separated by semicolons.

Here is an example of the model name:

Transducer CHVT-500-0.05-100/√3; 110/3; 120

2.3 Design and operation

2.3.1 The block diagram of the transducer prepared for measuring phase voltage is shown in Fig. 2.1.

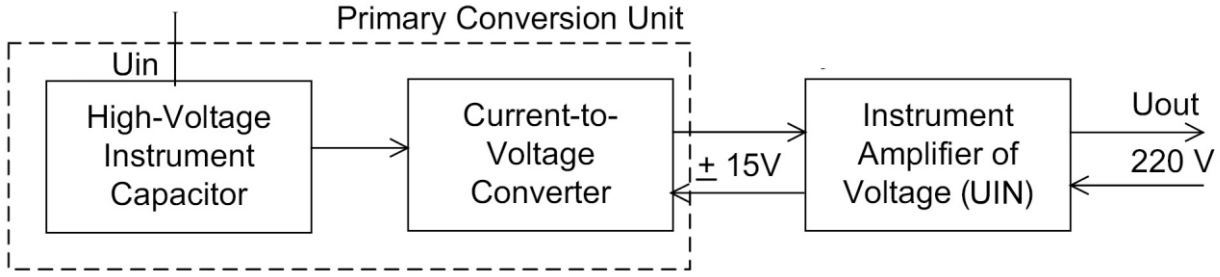


Fig. 2.1 Block diagram of the transducer

2.3.2 The transducer consists of 2 units:

- Primary Conversion Unit that includes a gas-filled capacitor (High-Voltage Instrument Capacitor – IHC) and Current-to-Voltage Converter
- Instrument Amplifier of Voltage (UIN).

The connection diagram is represented in Appendix A1.

High primary AC voltage is applied to the high-voltage input terminal of the HV Instrument

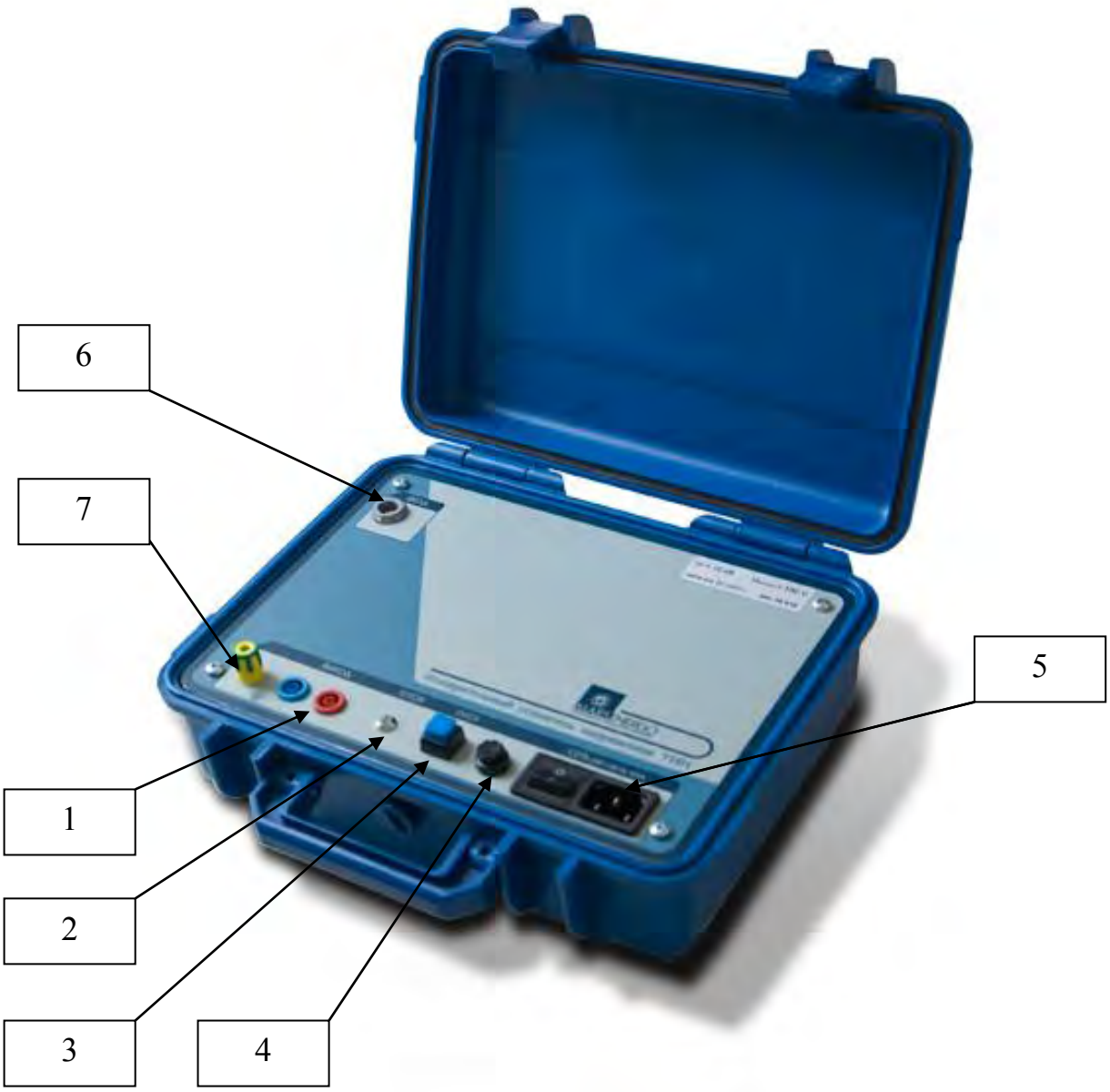
Capacitor IHC, while the output signal of the Capacitor (in the form of AC current) comes to the Current-to-Voltage Converter. The AC voltage from the output of the Current-to-Voltage Converter is applied to the amplifier of voltage (UIN) which puts the signal into correspondence with a given secondary voltage rating. The entire CHVT requires no configuration.

2.3.3 The voltage amplifier UIN is pictured in Fig. 2.3 and 2.4.

The controls and connectors on the front panel of the UIN (Fig. 2.4):

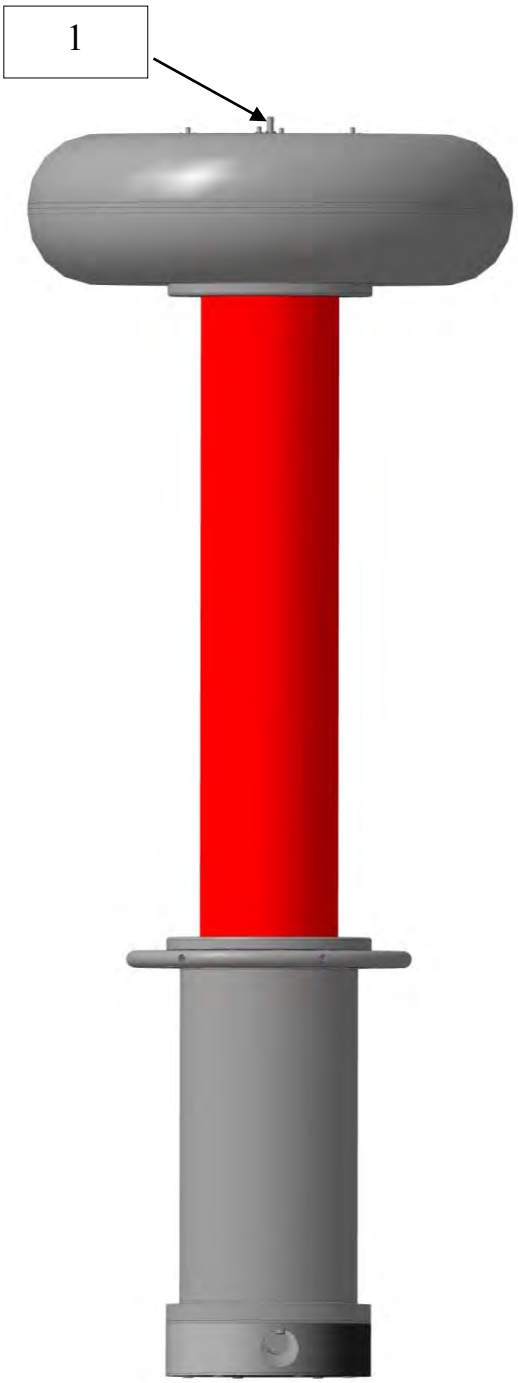
- 'INPUT' socket to which the cable C2 going from the Current-to-Voltage converter of the PCU is connected
- 'OUTPUT' connectors that accept the cables from a reference instrument (blue is neutral)
- READY' indicator (shows that the CHVT is ready to operate)
- 'START' button
- Fuse holder with a fuse connected to the input measuring circuit
- Mains switch and socket 220V (50Hz, 10VA) for connection of the power cable 230 V
- 'Earth' terminal.

Fig 2.3 Amplifier UIN



1 - ‘OUTPUT’ connectors (blue is neutral); 2 - ‘READY’ indicator; 3 – ‘START’ button; 4 – Fuse connected to the input measuring circuit; 5 - Mains switch and socket 230V (50Hz, 10VA) to connect power cable 230 V; 6 – ‘INPUT’ socket to connect measuring cable C2; 7 – ‘Earth’ terminal
Fig. 2.4 Front panel of the UIN

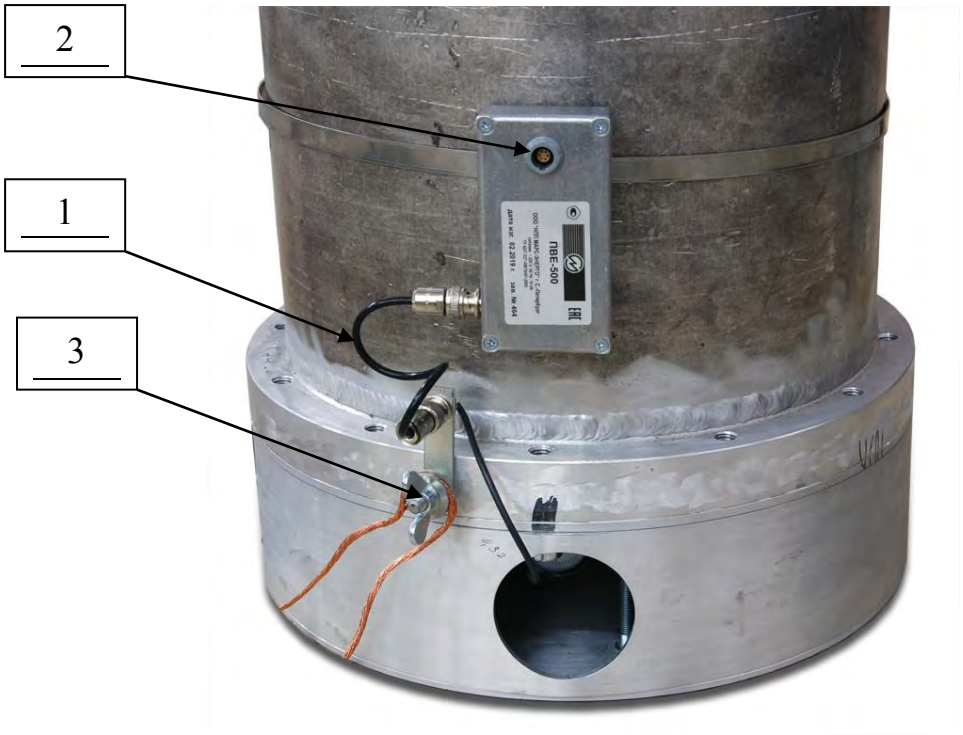
The general view of the Primary Conversion Unit (PCU) is shown in Fig. 2.5.



1 – Terminal of the High-Voltage electrode

Fig. 2.5 CHVT-500 – Primary Conversion Unit

The bottom part of the Primary Conversion Unit with the Current-to-Voltage Converter and manometer is shown in Fig. 2.6.



1 – Cable C1 to connect the output of HV Capacitor to the input of Current-to-Voltage Converter; 2 –Connector to connect the output of Current-to-Voltage Converter to the input of UIN amplifier via Cable C2; 3 – 'Earth' terminal

Fig. 2.6 Bottom part of the Primary Conversion Unit

Fig. 2.7 Manometer installed at the bottom of the Primary Conversion Unit

3. Preparing for operation

3.1 Operating restrictions

3.1.1 If the transducer has been moved from a cold environment (with ambient temperature below 0° C) into a warm one, it shall be left to stand for at least 4 hours at room temperature before applying power, to make sure that no condensation remains inside.

Warning! The transducer shall not be used under the ingress of moisture inside the body of the Current-to-Voltage Converter or UIN amplifier or in the presence of moisture on the insulator of the HV Capacitor.

3.1.2 Gas pressure inside the HV Capacitor shall be at least equal to the minimum value specified in Table 3.1 of the Equipment Certificate (see the Equipment Certificate MC2.727.002-01 EC). For information on how to fill the transducer with SF6 gas, see the User Guide for operation with SF6-filled equipment MC2.727.002-01 UG1.

3.1.3 The surface of the insulator of the HV Capacitor shall be clean. Use lint-free cloth moistened with ethyl alcohol to remove dirt or deposits, if there are any.

3.1.4 For the CHVT-500, a dent on a toroidal-shaped corona protection shield of the High-Voltage electrode is taken as acceptable if it has the characteristics as follows: 5 mm depth as a maximum and 50 mm diameter as a maximum, the dent shall be without sharp edges and damages to the paint and coating. No through holes in the corona protection shield are permitted (with the exception of mounting holes according to the specifications)

3.1.5 Operating conditions:

Ambient temperature	20 ±5 ºC
Relative humidity at 30ºC (no more than)	80%
Atmospheric pressure	84 – 106.7 kPa

3.1.6 To apply high voltage to the Primary Conversion Unit, use an external HV voltage source. The applied voltage must be raised smoothly from 0 up to the rated voltage during at least 30 seconds.

3.2 Unpacking

After the transducer is taken from its package, make sure that it has no mechanical damages, and all manufacturer's seals are intact. Check that all items specified in Table 4.1 of the Equipment Certificate MC2.727.002-01 EC are present.

3.3 Preparing for operation

3.3.1 Grounding

Before use of the transducer ensure that all measuring instruments to be grounded are provided with reliable linkage to protective ground loop. The ground linkages shall be secured before, but removed after all other connections.

Use manufacturer-supplied cables only. Inspect the cables. Ensure all joints are made properly to avoid overheating and excessively high resistance

3.3.2 Connecting the transducer to the measuring system

Warning! *The circuits to be measured shall be completely de-energized before connecting or disconnecting the CHVT to them. The connection and disconnection must be performed in accordance with all regulations in force applicable to electrical installations.*

Direct linkage between the ground terminal on the transformer under test and ground terminal on the CHVT shall be made with a copper conductor of at least 4 mm^2 cross-section which is connected in turn to the protective ground loop.

3.3.3 Applying high test voltage

Before applying high voltage (50 Hz) to the CHVT, take safety measures and make sure that **gas pressure** in the HV capacitor is at least equal to the minimum permissible value specified in Table 3.2 of the Equipment Certificate (MC2.727.002-01 EC), and the test voltage does not exceed **120%** of its rated value that equals 500/√3 kV.

Warning! The entire value of the rated input voltage shall in no way be applied to the transducer at once (as a "surge").

It is highly recommended that the HV electrode of the CHVT be connected to the HV terminal of the tested transformer with the corona-free high-voltage cable C4 included in the delivery package.

Special measures to be taken before applying voltage to the CHVT-500:

a) Put the transducer on a support of at least 400 mm height (e.g. on the transportation box).

b) Use the corona-free high-voltage cable C4 to link the high-voltage electrode of the transducer to the output conductor of a high-voltage electric installation. The cable shall approach the HV electrode vertically (at an angle of (90±10)° with respect to the horizon). The vertical part of the cable located immediately above the CHVT-500 shall be at least 1.5 meter long.

c) The unobstructed clearance between the transducer and high-voltage electric installation shall be at least twice of the required insulation distance attributable to either the installation or CHVT-500, whichever is greater.

d) The connection between the terminals of the high-voltage electrodes shall be of same topology, as the connection between the ground terminals.

A sample diagram of how to connect the transducer is given in Appendix A (Fig. A-1).

3.3.4 Training the transducer

After completing the actions described in sections 3.3.1-3.3.3, turn on the High-voltage Source in accordance with the instructions provided in its user manual.

Before starting work with the CHVT, the transducer must be trained. The training of the transducer is made in the following steps:

1. Ground the low-voltage terminal of the HV Capacitor with a short-circuiting cable.

2. Smoothly (during 30 s) increase the voltage on the high-voltage electrode of the transducer up to the following levels:

- 50% of the rated voltage (hold it during 1 min)
- 100% of the rated voltage (hold it during 2 min)
- 120% of the rated voltage (hold it during 3 min).

In the event of an insulation breakdown, repeat the training.

On successful completion of the training, smoothly reduce the voltage down to zero and turn the High-Voltage Source off (in conformity with its user manual). Connect the grounding device to the HV electrode of the transducer.

3.3.5 General guidelines for connecting the transducer

a) Connect low-voltage cables to the CHVT first, and then connect the high-voltage conductor to it.

b) Connect the CHVT to the test circuit as recommended in Appendix A (Fig. A.1).

c) Before connecting the transducer to its load (to measurement instruments as well) make sure that the value of the load does not exceed 120% of the rated load.

4. Operation

4.1 Disconnect the grounding device from the HV electrode of the transducer.

4.2 The transducer is turned on in the following steps:

- Apply power to the UIN amplifier by turning on the “MAINS” switch (the “MAINS” indicator will light up)
- Press the “START” button and hold it for up to 3 seconds
- Check to see that the “READY” indicator on the UIN front panel glows
- If it is, proceed to measurements after a lapse of 10 to 15 minutes.

NOTE: In case of a trouble in the measurement circuits, the “Ready” indicator won’t light up or it will go on and off. Check if the connections are made as instructed in section 3.3.5 of this manual, and the load of the UIN amplifier is within permissible limits specified in Table 3.2 of the Equipment Certificate (MC2.727.002-01 EC).

4.3 Next steps are performed in accordance with the test procedure.

5. User Maintenance

5.1 Maintenance is the care and servicing that the user provides for keeping his equipment operational over its life cycle.

5.2 Every maintenance operation shall meet the safety requirements described in sections 1 and 3.3.2 of this manual, as well as local technical norms and safety regulations in force. Damages to the equipment should be repaired by the manufacturer.

5.3 Routine maintenance includes minor operations, such as:

Operation	Interval
Strength test of electric insulation	Once a year
Cleaning the insulator surface with alcohol*	At least once a month
Cleaning BNC connectors (2 pcs) with alcohol **	At least once a month
Gas pressure check	At least once a month and prior to every test
Inspection of the connectors: checking the reliability of their fixing and cleaning the oxidized contacts, if any	Once a year

* The volume of alcohol needed to clean the insulator is 200 ml

** The volume of alcohol needed to clean 1 BNC connector is 10 ml

6. Troubleshooting

	Failure	Typical cause and remedy
1	Though the “Mains” switch is on, power is not supplied	Make sure the power cord is plugged into the operational mains socket.
2	Though the “Start” button is pressed, the “Ready” indicator either remains off or blinks.	The output circuit of the UIN amplifier is overloaded. Check the load of the UIN against Table 3.2 of the Equipment Certificate (MC2.727.002-01 EC).
3	Gas pressure in the PCU dropped below the specified minimum.	Pressure-tightness defect to be corrected by the manufacturer

7. Storage

7.1 On long storage the CHVT shall be stored indoor in a heated storeroom in the manufacturer’s package.

7.2 Storage conditions in the manufacturer’s package:

Ambient temperature ..... 0 to 40 °C

Relative humidity ..... 80 % at 35 °C

Storage conditions without the package:

Ambient temperature ..... 5 to 35 °C

Relative humidity ..... 80 % at 25 °

7.3 The storeroom should be free from current-conductive dust, acid or alkali fumes and other aggressive substances.

The content of dust, alkali fumes or acids, aggressive gases, and other corrosive agents in the storeroom air shall not exceed the limits specified for type 1 atmosphere in Russian State Standard (GOST) 15150-69.

8. Transportation

8.1 The transducer shall be transported packed in the manufacturer's package in heated and sealed cargo compartments of enclosed wagons or vehicles protected from atmospheric precipitation. The guidelines for preparing the transducer for transportation are given in the User Guide for operation with SF6-filled equipment (MC2.727.002-01 UG1).

Ambient conditions during transportation:

Ambient temperature: -20°C…+55°C

Relative Humidity: ≤ 90% at 25 °C

IT IS STRICTLY FORBIDDEN to transport the transducer by air.

9 Packaging

The transducer shall be packed in an appropriate transportation package.

The transportation package shall include a packing list with the following information:

- Model name and modification
- Scope of supply
- Date of manufacture
- Date of packing and signature of the responsible person
- Seal of the manufacturer's control department, date and signature of the responsible person.

10. Marking and sealing

10.1 The nameplate on the UIN (Instrument Amplifier of Voltage) unit bears:

- Model name of the UIN and model name of the CHVT
- Manufacturer's name and/or trade mark
- Power supply type and rated voltage
- Maximum output voltage
- Serial number of the UIN
- Date of manufacture

The nameplate on the PCU (Primary Conversion Unit) bears:

- Sign of National Registry of Measuring Instruments
- Manufacturer's name and/or trade mark
- Model name of the CHVT
- Serial number of the CHVT
- Date of manufacture.

10.2 Side and end faces of the shipping container bear the following handle-with-care symbols: "This side up", "Fragile", and "Shelter from humidity".

10.3 The seal is installed in the hole of an UIN unit fastening screw.

After opening the unit for repair, the seal should be reinstalled by an authorized Service Company.

11. Technical Support

If, while operating the test system or any of its units or software, you have faced some problems, try first of all to find the answers in the documentation available (help files or user manuals).

Should you still need help after reviewing all of the available materials, please contact our Technical Support group.

Manufacturer's address (for technical support and warranty claims):

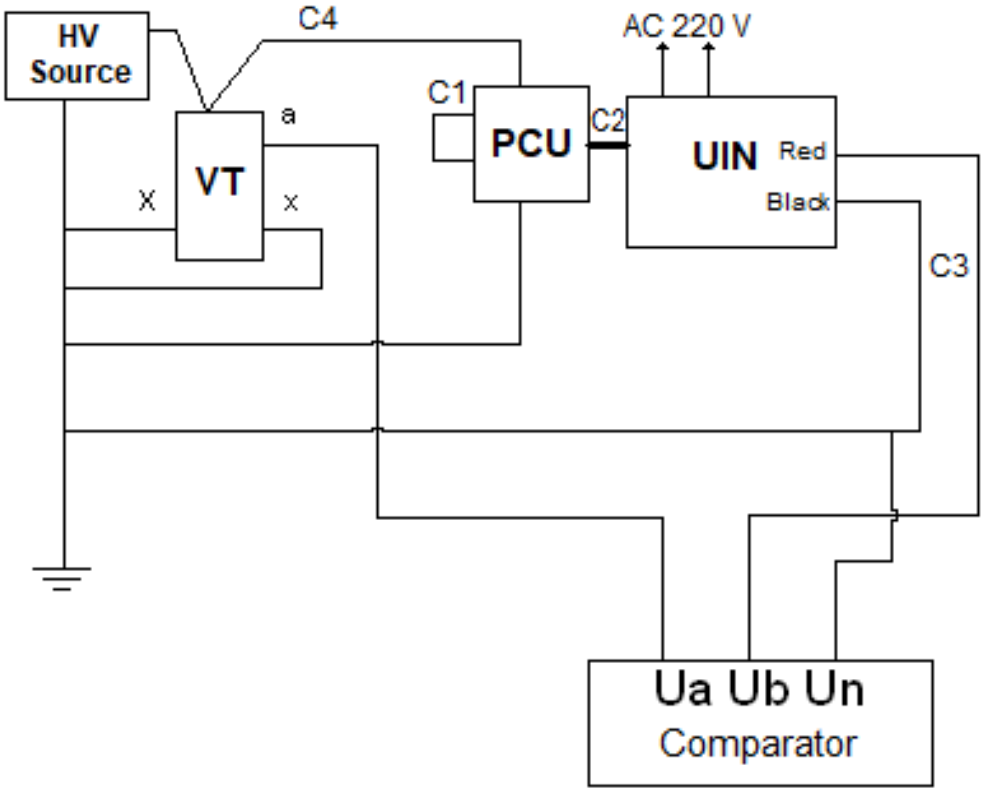
Mars-Energo
V.O. 13 Line, 6 - 8, office 40H, St. Petersburg, Russia
Tel/Fax: (812) 327-21-11, (812) 331-87-35 (812) 334-72-41
E-mail: mail@mars-energo.ru or mars@mars-energo.com
www.mars-energo.com

Please provide our Technical Support with the following information:

1. Contact information (your Company's name, e-mail address and the name and phone number of whom the reply may concern)
2. Software version number (see Help\About… from the menu)
3. Device info (model name, serial number and firmware version)
4. Hardware configuration of your PC (CPU, motherboard, RAM, Hard Disc Drive)
5. Software configuration and version of your operating system
6. Description of the problem, including the complete text of error message (if any)
7. Other information that you consider to be important.

Appendix A

Connection diagram (recommended)



HV Source – high-voltage source; VT – single-phase voltage transformer under test; PCU – Primary Conversion Unit of the CHVT-500; UIN – Voltage Amplifier of the CHVT-500; C1 – linkage cable between the HV Instrument Capacitor and Current-to-Voltage Converter of PCU (Primary Conversion Unit); C2 – measuring cable (PCU-UIN linkage cable); C3 – measuring cable of the Comparator; C4 – corona-free high-voltage connection cable

Fig. A1 – Connecting CHVT-500 to VT test system