

USER'S MANUAL

ESC 2051



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1. INTRODUCTION

1.1. Safety



Read this instruction manual carefully and completely and follow all instructions contained therein. Otherwise using of the instrument may be dangerous for the operator, for equipment under test or for the instrument!

Observe the following safety precautions:

- Make sure that the instrument, measuring cables and all other accessories are in flawless condition, e.g. no damaged insulation, no broken cables or plugs etc.
- The instrument may be powered only from 230 V / 50 Hz grounded mains outlet, which is protected with a fuse or circuit breaker with a maximum rating of 16 A.
- Only a trained, skilled person, who is familiar with hazardous voltage operations, can handle the ESC 2051. Unexpected hazardous voltages can occur at appliance under test (dangerously charged capacitors etc.).
- It is necessary to respect all safety regulations applicable to particular measurement.
- Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance. It is intended for test purposes only; max. test duration is 30 min. @ 16A.
- Dangerous voltage or mains voltage may be present on Test Socket 1 during some tests.
- Appliance under test connected to Test Socket 1 of the ESC 2051 can be powered by mains voltage during some tests. The appliance can thus be activated.
- Use only standard or optional accessories supplied with the ESC 2051.



The ESC 2051 must not be used:

- If it no longer functions properly.
- If instrument, cables, connectors, plugs or other accessories is damaged.
- After extraordinary stresses (due to transport, unsuitable storage conditions etc.).

1.2. Explanation of symbols



Warning concerning a point of danger! Read User's Manual and observe all precautions!



Hint, notice.



Protection class (double insulation).

1.3. General description

The ESC 2051 is professional portable appliance tester with many features packed into very compact case. The ESC 2051 has extraordinary wide scope of use thanks to a lot of optional accessories, which enables to test practically any portable or hard-wired, one-phase or three-phase appliance.

FEATURES:

- Earth bond test 200 mA and 10 A AC and earth bond voltage drop at 10 A AC.
- Insulation resistance test 500 V / 250 V / 100 V DC.
- Measurement of substitute leakage current.
- Measurement of touch leakage current with 2 k Ω probe.
- Measurement of differential leakage current, possibility to exchange L/N in test socket.
- Measurement of PE current during operation, possibility to exchange L/N in test socket.
- Functional test – power consumption of tested appliance. Three-phase and hard-wired appliances functional test by means of optional clamp.
- Measurement of differential leakage current by means of optional clamp.
- Measurement of PE current during operation and differential leakage current of three-phase portable appliance by means of optional adapters - 16 A and 32 A socketed.
- Temperature – type K probe or infrared contact less probe with type K output signal.
- Rotation – contact less probe.
- Memory for results of about 900 measurements.
- RS 232 communication, PC software.
- Optional barcode reader.

The ESC 2051 has furthermore additional features, which improves the safety of both operator and the equipment under test:

- Automatic test of dangerous contact voltage on PE of power outlet, from which the ESC 2051 is powered.
- Automatic test, if PE of power outlet (from which the ESC 2051 is powered) is grounded.
- Automatic test of leakage current of equipment under test.
- The possibility to promptly test the basic functionality of the ESC 2051 (built-in normal)
- Only authorized person(s) can operate the ESC 2051, if PIN function is activated.

1.4. Applied standards

- * Safety EN 61010-1 + A2
- * EMC EN 55 022
EN 61000-4-2
EN 61000-4-3
EN 61000-4-4
EN 61000-4-5
EN 61000-4-6
EN 61000-4-11
- * Equipment for testing, measuring or monitoring of protective measures
EN 61557, part 2
EN 61557, part 4

2. DESCRIPTION OF THE INSTRUMENT

2.1. Front panel and rear panel

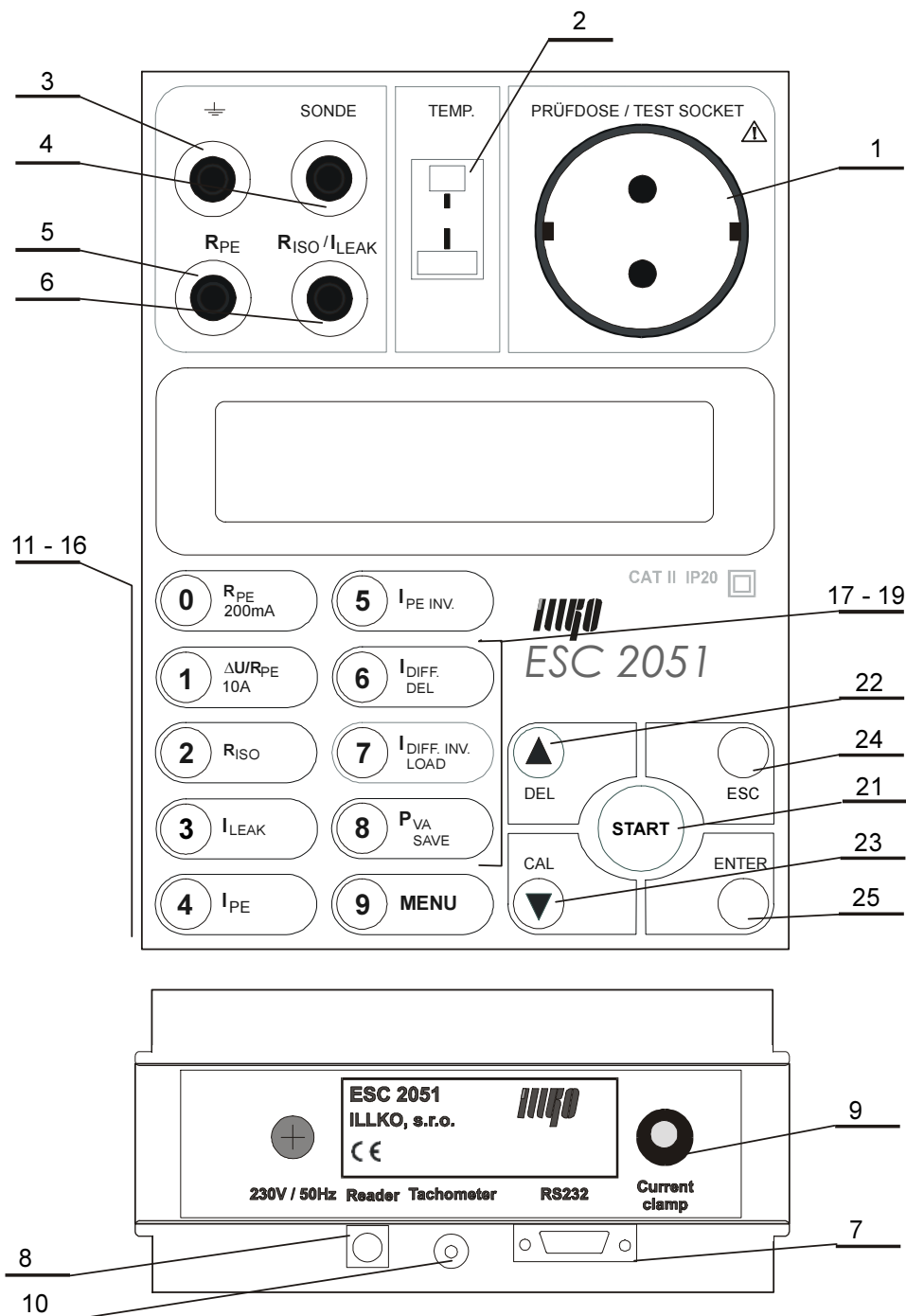



Fig. 1

2.2. Terminals



- Do not connect any external voltage to barcode reader, thermometer probe and R_{PE} connectors.
- Max. load on TEST SOCKET is 3600 W, max. test duration is 30 min.
- Use original accessories only.

Legend:

- 1 **Test socket 230V / 16A**
- 2 **TEMP.** – thermometer probe connector
- 3  – test terminal, which is connected to PE wire of test socket
- 4 **SONDE** – touch leakage current test terminal
- 5 **R_{PE}** – continuity / earth bond test terminal
- 6 **R_{ISO} / I_{LEAK}** – insulation resistance / substitute leakage current test terminal
- 7 RS 232 connector for PC connection
- 8 Barcode reader connector
- 9 Current clamp / three-phase adapter connector
- 10 Rotation sensor connector

2.3. Keyboard**Legend:****numerical / function:**

- 11 number **0** / Earth bond test 200 mA
- 12 number **1** / Earth bond test 10 A
- 13 number **2** / Insulation resistance test
- 14 number **3** / Substitute leakage current
- 15 number **4** / PE current, touch leakage current
- 16 number **5** / PE current, touch leakage current, L/N exchanged
- 17 number **6** / Differential leakage current, touch leakage current
- 18 number **7** / Differential leakage current, touch leakage current, L/N exchanged
- 19 number **8** / Power consumption
- 20 number **9** / Menu

memory:

- 17 **DEL** – to delete selected record from instrument's main memory
- 18 **LOAD** – to load selected record from instrument's main memory to the buffer
- 19 **SAVE** – to save the record from the buffer to instrument's main memory

other:

- 21 **START** – press it to start measurement. Release it to finish measurement.
(Locking of the **START** key - **DEL** key must be pressed simultaneously).
The ESC 2051 functionality test (**CAL** key must be pressed simultaneously).
- 22 **▲** - to select parameters upwardly / to erase character (**DEL**) / Locking of the **START** key - **DEL** key must be pressed simultaneously.
- 23 **▼** - to select parameters downwardly / to calibrate the resistance of the test leads (**CAL**) / **HOLD** (to “freeze” the result on display)
- 24 **ESC** - to escape some started procedure
- 25 **ENTER** - to confirm new setting

2.4. Included in the set

- **The ESC 2051**
- **P 2011** - Test lead, black, 2 m
- **P 4011** - Crocodile clip, black
- **P 3011** - Test tip, black
- Calibration certificate
- Instruction manual

2.5. Optional accessories

- **P 2012** - Test lead, blue, 2 m
- **P 4012** - Crocodile clip, blue
- **P 3012** - Test tip, blue
- **P 2021** - Extension lead, black, 5 m (for P 2011)
- **P 6061** - Carrying bag
- **P 7011** - Simple PC software RView for Windows 98SE / 2000 / XP
- **P 8015** - Three-phase adapter, 16 A socket, 5 contacts
- **P 8016** - Three-phase adapter, 16 A socket, 4 contacts
- **P 8017** - Three-phase adapter, 32 A socket, 5 contacts
- **P 8018** - Three-phase adapter, 32 A socket, 4 contacts
- **P 8010** - Clamp transformer
- **P 9030** - Temperature probe (K type)
- **P 9050** - Rotation sensor
- **P 9020** - Barcode reader
- **P 9070** - RS 232 cable
- **P 9060** - Barcode labels
- **PL 2051** - Option for measuring of leakage current of medical instruments

3. PERFORMING MEASUREMENTS

3.1. Connecting to mains outlet



Use grounded mains outlet only to supply the instrument!

If mains outlet, mains cable, instrument's case or accessories are damaged, do not connect the ESC 2051 to mains outlet!

The ESC 2051 can be powered only from 230 V / 50 Hz grounded mains, which is protected with a fuse or circuit breaker with a maximum rating of 16 A.

The instrument is automatically switched on after plugging in to the mains outlet.

Disconnect any equipment under test while connecting the ESC 2051 to the mains outlet!



The ESC 2051 automatically tests protective (ground) pin of mains outlet; the test is done always, when operator's finger touches button START. Make sure to stand on non-isolated floor, while carrying out the test, otherwise test result may be wrong. If the test result of ground pin is unsatisfactory, message „PE error !!!“ appears on the display and further measurement is not possible. In such case disconnect the ESC 2051 from faulty mains outlet and connect it to non-defective mains outlet.



If test result of ground pin of mains outlet is unsatisfactory, the wrong outlet must be repaired before you plug in the ESC 2051 to mentioned outlet again!

3.2. PIN code

Only authorized person(s) can operate the ESC 2051, if PIN code function is activated.

In such case operator must enter valid PIN code after the instrument powers up, otherwise instrument's keyboard is locked.

PIN code can consists of max four digits. Code 0000 deactivates PIN code function.

If PIN code function is activated, proceed as follows:

Step 1

- Connect mains cable of the ESC 2051 to grounded mains outlet 230 V / 50 Hz.
- Message „PIN:“ is displayed.

Step 2

- Enter valid PIN by means of numerical keyboard. Entered numbers are displayed as „*“.
- Press the **ENTER** key and release it to confirm entered PIN. The instrument is ready for use now.



If entered PIN is not valid, the keyboard stops to respond and message „Block...“ is displayed.

The ESC 2051 must be disconnected from mains outlet and plugged in again to continue.

Activation of PIN code function and entering of PIN code:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Change PIN**“ and press **ENTER**.
- Use **0 ÷ 9** keys to enter PIN code (max. four digits) and press **ENTER**. Even no digit can be set as PIN (it means only **ENTER** is to be pressed)!
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Deactivation of PIN code function:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Change PIN**“ and press **ENTER**.
- Use **0** key to enter **0000** and press **ENTER**.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.



*If you forget PIN, the instrument must be sent to service!
Therefore we advice you to notice your PIN carefully!*

3.3. Functionality test

It can be difficult to identify that the instrument is damaged, especially during leakage current measurement. The ESC 2051 has therefore built in the possibility to promptly test the basic functionality.

Functionality of following functions can be tested:

- Insulation resistance
- Measurement of substitute leakage current
- Measurement of differential leakage current
- Measurement of PE current during operation



Disconnect equipment under test before the ESC 2051 functionality test!

Functionality test procedure:

- Disconnect equipment under test.
- Use respective key to select the function you are going to test.
- Press and hold **▼** key and simultaneously press and release the **START** key. Then release **▼** key.
If the value $1.00 \text{ mA} \pm 10\%$ is displayed the leakage current measurement is correct*.
If the value $0.20 \text{ M}\Omega \div 0.26 \text{ M}\Omega$ is displayed, the insulation resistance measurement is correct.

*If you test PE current measurement functionality **I_{PE}** and displayed value is close to 0.00 mA , you must repeat the test with selected function **I_{PE INV}**. The same notice is valid for differential leakage current functionality test.

If the value $1.00 \text{ mA} \pm 10\%$ is displayed, the leakage current measurement is correct.

Contact service in case that the result(s) of the test differs from the results described above.

4. MEASUREMENTS

4.1. Earth bond 200 mA



- Make sure tested equipment is deenergized – its mains voltage must be disconnected before starting the measurement!
- If you are going to test equipment which can be charged to voltage > 25V (e.g. filter capacitors), discharge it before test!
- In case that external voltage is present at equipment under test, the measurement will not be carried out after pressing the START key and the message „Voltage on input“ will be displayed. Therefore it is important to connect test leads to equipment under test first and to press the START key afterwards; otherwise the function of protective circuitry in the ESC 2051 could be impaired!

4.1.1. Protective class I equipments equipped with mains plug

Step 1

- Press the **R_{PE} 200mA** key and release it to select 200mA earth bond function.
- Either result of last measurement or „---“ will be displayed.

RPE200mA

Step 2

- Connect test lead P 2011 with test tip P 3011 to **R_{PE}** terminal.
- Connect test tip of the test lead either to \perp terminal or press it against the ground pin of Test socket 1.
- Press the **START** key and release it. Test lead resistance is displayed.
- Press the **CAL** key and release it. The test lead resistance is memorized and it will be automatically subtracted from test results. „00.00 Ω “ and „C“ is displayed, indicating the compensation was accomplished. Test lead compensation is valid until the test lead is replaced or the ESC 2051 is switched off.

RPE200mA
00.00 Ω C

Step 3

- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 2).
- Press test tip against exposed metallic part of equipment under test. Press the **START** key to start measurement. Measurement starts to run and the results are currently displayed. Symbol „ “ indicates, that measurement is running.
- Release the **START** key again to stop the measurement. The lowest measured resistance will be displayed. This value is automatically written to the buffer, too.

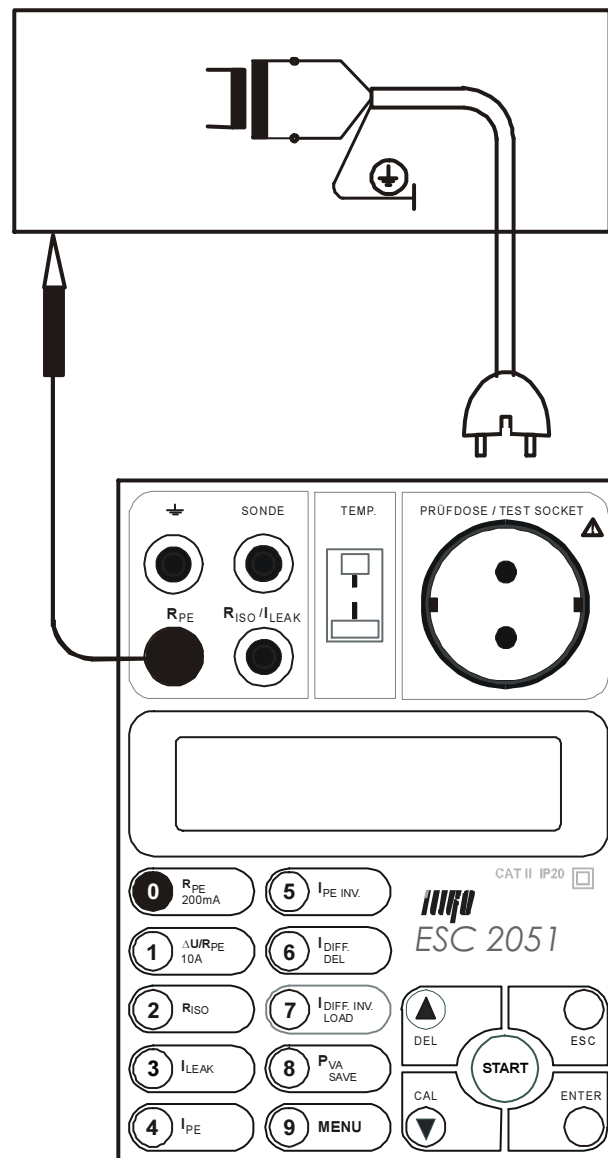


Fig. 2

4.1.2. Protective class I hard-wired and three-phase equipments

Step 1

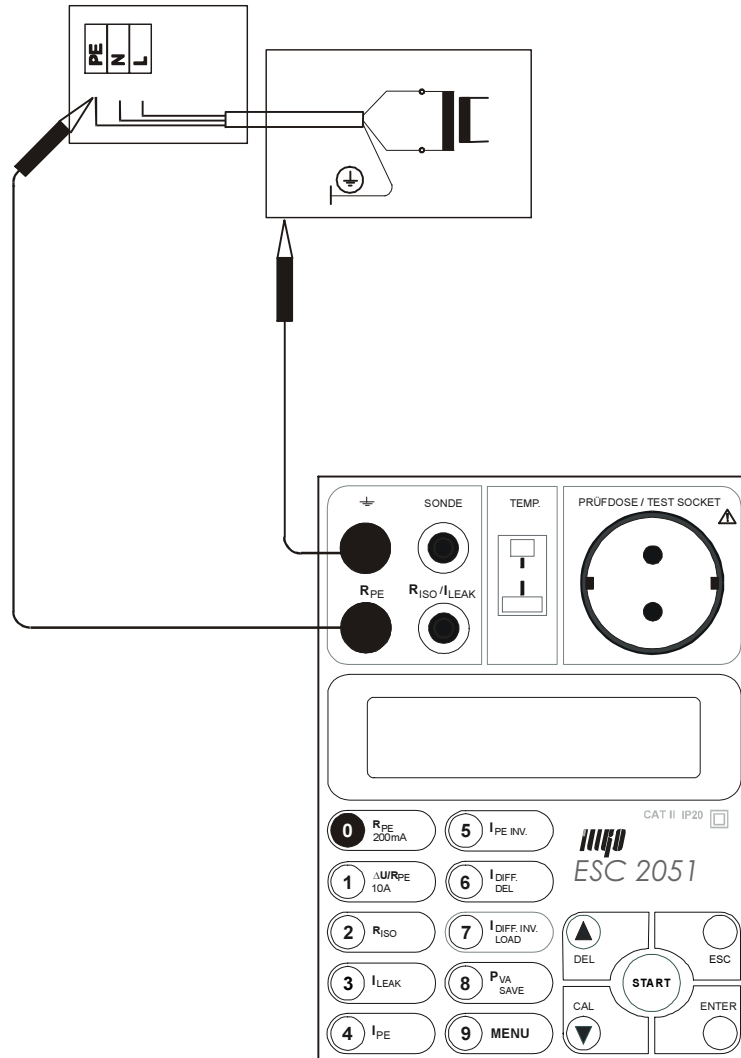
- Press the **R_{PE} 200mA** key and release it to select 200mA earth bond function.
- Either result of last measurement or „---“ will be displayed.

Step 2

- Connect test lead P 2011 with test tip P 3011 to **R_{PE}** terminal and test lead P 2012 with test tip P 3012 (or with crocodile clip P 4012) to **⏏** terminal.
- Short circuit both test tips in order to calibrate test leads resistance.
- Press the **START** key and release it. Test leads resistance is displayed.
- Press the **CAL** key and release it. The test leads resistance is memorized and it will be automatically subtracted from test results. „00.00 Ω“ and „C“ is displayed, indicating the compensation was accomplished. Test leads compensation is valid until the test leads are replaced or the ESC 2051 is switched off.

Step 3

- Disconnect equipment under test from mains!
- Press one test tip against earthing contact of equipment under test (or connect it to protective contact of three-phase plug). Press another test tip against exposed metallic part of equipment under test (Fig. 3).

**Fig. 3**

- Press the **START** key to start measurement. Measurement starts to run and the results are currently displayed. Symbol „□“ indicates, that measurement is running.
- Release the **START** key again to stop the measurement. The lowest measured resistance will be displayed. This value is automatically written to the buffer, too.

4.2. Voltage drop 10 A and earth bond 10 A

- **Make sure tested equipment is deenergized – its mains voltage must be disconnected before starting the measurement!**
- **If you are going to test equipment which can be charged to voltage > 25V (e.g. filter capacitors), discharge it before test!**

- In case that external voltage is present at equipment under test, the measurement will not be carried out after pressing the START key and the message „Voltage on input“ will be displayed. Therefore it is important to connect test leads to equipment under test first and to press the START key afterwards; otherwise the function of protective circuitry in the ESC 2051 could be impaired!



- In case of too hot internal circuitry of the ESC 2051 „Temp“ message will be displayed. Audible tone (beep) will be generated, too. In such case please wait, until internal temperature decreases. Other functions of the ESC 2051 are not affected.
- The ESC 2051 includes audible indication of test current amplitude. If test current falls under 10 A during measurement, the device will beep shortly after displaying result. If test current falls under 3 A, the measurement will be stopped.

4.2.1. Protective class I machines equipped with mains plug

Step 1

- Press the $\Delta U/R_{PE}$ 10A key and release it to select 10A voltage drop function (press and release it again to select 10A earth bond function).
- Either result of last measurement or „---“ will be displayed. The set value of cross-section of protective conductor will be displayed, too.

$\Delta U10A$ 1, 0mm²

Step 2

If you need to change timer setting, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „Set-up“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „Timer RPE 10A“ and press **ENTER**.
- Use **DEL** key to erase current setting.
- Use **0 ÷ 9** keys to enter required new setting (1 ÷ 15 s; if you set value to 0, the measurement will be running continually until you either disconnect test leads or internal circuitry overheats) and press **ENTER**. Once the value is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

If you need to change protective conductor cross-section setting, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „Set-up“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „PE cross-section“ and press **ENTER**.
- Press the **ENTER** key and release it repeatedly, until required value is displayed (if you set „Off“ instead of particular cross-section value, indication of threshold voltage drop is disabled). Once the value is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 4

- Connect test lead P 2011 with test tip P 3011 to **R_{PE}** terminal.
- Press the test tip of the test lead against the ground pin of Test socket **1**.
- Press the **START** key and release it. Voltage drop on test lead is displayed; test current is displayed during measurement, too.
- Press the **CAL** key and release it. The voltage drop on test leads is memorized and it will be automatically subtracted from test results. „**00.00 V**“ and „**C**“ is displayed, indicating the compensation was accomplished. Test lead compensation is valid until the test lead is replaced or the ESC 2051 is switched off.

ΔU10A	1,0mm2	
00.0 V		C

Step 5

- Connect mains plug of equipment under test to Test socket **1** (Fig.4).
- Press the test tip of the test lead against the tested section of machine under test.
- Press the **START** key and release it. Voltage drop, test current and timer information is displayed. Symbol „□“ indicates, that measurement is running. If threshold voltage drop (which depends on protective conductor cross-section, which was set in Step 3) is exceeded, audible signal is activated.
- If voltage drop is > about 4 V, measurement is stopped and „> **Max U**“ is displayed.
- Wait for timer to elapse to stop the measurement. Measurement is also stopped, if test current falls under 3 A (e.g. if you disconnect test lead from machine under test) or internal circuitry overheats.
- After the measurement is finished, minimal measured voltage drop will be displayed. This value is automatically written to the buffer, too. If threshold voltage drop is exceeded, symbol „!!!“ is displayed, too.

ΔU10A	1,0mm2	
03.6 V	!!!	C

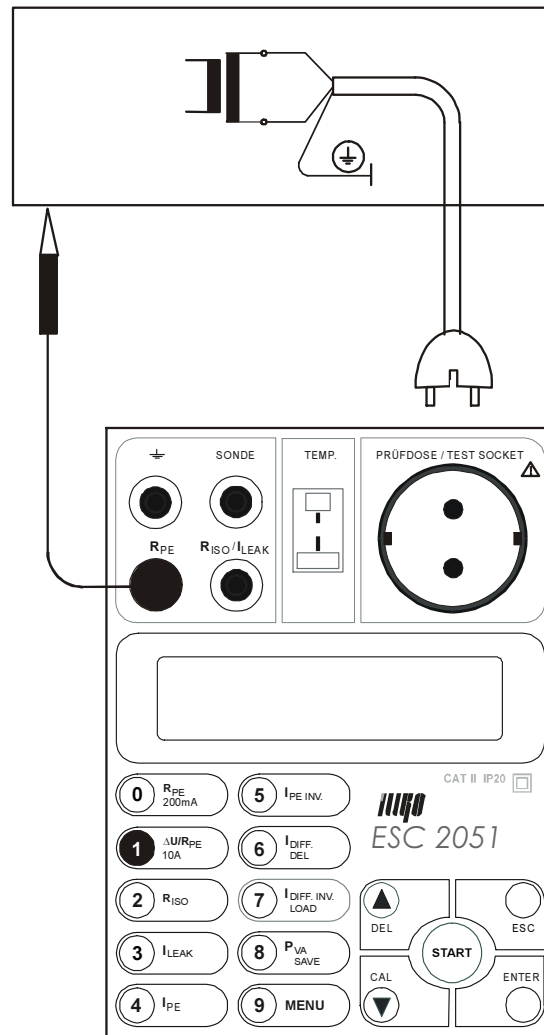


Fig. 4

4.2.2. Protective class I three-phase and hard-wired machines

Step 1

- Press the $\Delta U/R_{PE}$ 10A key and release it to select 10A voltage drop function (press and release it again to select 10A earth bond function).
- Either result of last measurement or „---“ will be displayed. The set value of cross-section of protective conductor will be displayed, too.

ΔU10A	1, 0mm²

Step 2

If you need to change timer setting, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Timer RPE 10A**“ and press **ENTER**.
- Use the **DEL** key to erase current setting.


- Use **0 ÷ 9** keys to enter required new setting (1 ÷ 15 s; if you set value to 0, the measurement will be running continually until you either disconnect test leads or internal circuitry overheats) and press **ENTER**. Once the value is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

If you need to change protective conductor cross-section setting, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**PE cross-section**“ and press **ENTER**.
- Press the **ENTER** key and release it repeatedly, until required value is displayed (if you set „**Off**“ item instead of particular cross-section value, indication of threshold voltage drop is disabled). Once the value is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 4

- Connect test lead P 2011 with crocodile clip P 4011 or with test tip P 3011 to **R_{PE}** terminal and test lead P 2012 with test tip P 3012 to  terminal.
- Short circuit both test tips in order to calibrate test leads resistance.
- Press the **START** key and release it. Voltage drop on test leads is displayed; test current is displayed during measurement, too.
- Press the **CAL** key and release it. The test leads voltage drop is memorized and it will be automatically subtracted from test results. „**00.00 Ω**“ and „**C**“ is displayed, indicating the compensation was accomplished. Test leads compensation is valid until the test lead will be replaced or the ESC 2051 will be switched off.
- Press the **CAL** key and release it. The voltage drop on test leads is memorized and it will be automatically subtracted from test results. „**00.00 V**“ and „**C**“ is displayed, indicating the compensation was accomplished. Test lead compensation is valid until the test leads are replaced or the ESC 2051 is switched off.

Step 5

- Disconnect machine under test from mains.
- Press one test tip against earthing contact of machine under test (or connect it to protective contact of three-phase plug). Press another test tip against exposed metallic part of machine under test (Fig. 5).
- Press the **START** key and release it. Voltage drop, test current and timer information is displayed. Symbol „**⏏**“ indicates, that measurement is running. If threshold voltage drop (which depends on protective conductor cross-section, which was set in Step 3) is exceeded, audible signal is activated.
- If voltage drop is > about 4 V, measurement is stopped and „**> Max U**“ is displayed.
- Wait for timer to elapse to stop the measurement. Measurement is also stopped, if test current falls under 3 A (e.g. if you disconnect test lead from machine under test).
- After the measurement is finished, minimal measured voltage drop will be displayed. This value is automatically written to the buffer, too. If threshold voltage drop is exceeded, symbol „**!!!**“ is displayed, too.

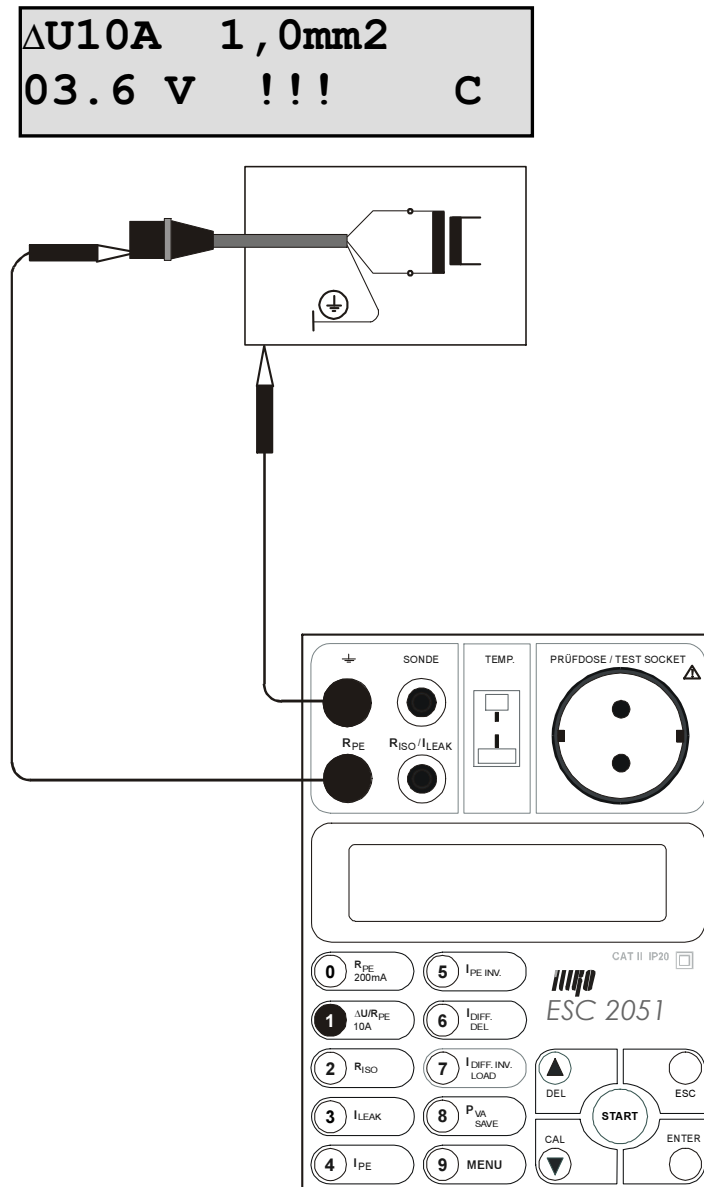


Fig. 5

4.2.3. Earth-bond

Step 1

- Press the $\Delta U/R_{PE}$ 10A key and release it to select 10 A earth bond function (press and release it again to select 10A voltage drop function).
- Either result of last measurement or „---“ will be displayed.



Step 2

If you need to change timer setting, proceed as follows:

- Press the **MENU** key; the main menu is opened.

- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Timer RPE 10A**“ and press **ENTER**.
- Use **DEL** key to erase current setting.
- Use **0 ÷ 9** keys to enter required new setting (1 ÷ 15 s; if you set value to 0, the measurement will be running continually until you either disconnect test leads or internal circuitry overheats) and press **ENTER**. Once the value is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

- Connect test lead P 2011 with crocodile clip P 4011 or with test tip P 3011 to **R_{PE}** terminal and test lead P 2012 with test tip P 3012 to **⏏** terminal.
- Short circuit both test tips in order to calibrate test leads resistance.
- Press the **START** key and release it. Resistance of test leads is displayed; test current is displayed during measurement, too.
- Press the **CAL** key and release it. The test leads resistance is memorized and it will be automatically subtracted from test results. „**00.00 Ω**“ and „**C**“ is displayed, indicating the compensation was accomplished. Test leads compensation is valid until the test leads are replaced or the ESC 2051 is switched off.

RPE10A 0.00 Ω	C
--------------------------------	----------

Step 4

- Disconnect machine under test from mains.
- Connect test tips to machine under test.
- Press the **START** key and release it. Resistance, test current and timer information is displayed. Symbol „**⏏**“ indicates, that measurement is running.
- If resistance is > about 1 Ω, measurement is stopped and „**>1.00 Ω**“ is displayed.
- Wait for timer to elapse to stop the measurement. Measurement is also stopped, if test current falls under 3 A (e.g. if you disconnect test lead from machine under test).
- After the measurement is finished, minimal measured resistance will be displayed. This value is automatically written to the buffer, too.

4.3. Insulation resistance



- **Make sure tested equipment is deenergized – its mains voltage must be disconnected before starting the measurement!**
- **Do not touch exposed conductive parts of tested object while measurement is in progress - risk of electric shock! Symbol „**⏏**“ is displayed on LCD if the measurement is in progress!**
- **Do not disconnect test leads, if the measurement is in progress, or immediately after finishing the measurement. Capacitive component of tested equipment can be charged to high voltage; after the key START is released, this voltage is automatically discharged!**

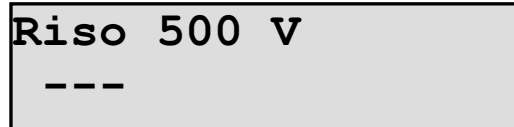


*In case that external voltage is present at equipment under test, the measurement will not be carried out after pressing the **START** key and the message „Voltage on input“ will be displayed. Therefore it is important to connect test leads to equipment under test first and to press the **START** key afterwards; otherwise the function of protective circuitry in the ESC 2051 could be impaired!*

4.3.1. Protective class I equipments equipped with mains plug

Step 1

- Press the **R_{ISO}** key and release it to select insulation resistance function.
- Either result of last measurement or „---“ and set test voltage will be displayed.



Step 2

If you need to change test voltage, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Nominal voltage**“ and press **ENTER**.
- Press the **ENTER** key and release it repetitively to select appropriate voltage (100 V, 250 V or 500 V).
Once the voltage is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

- Plug in the mains cable of equipment under test to Test socket **1** (Fig. 6) and switch on the tested equipment's mains switch.

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen“ on LCD (HOLD function), but the measurement is still running. Symbol „**H**“ is displayed when HOLD function is activated.

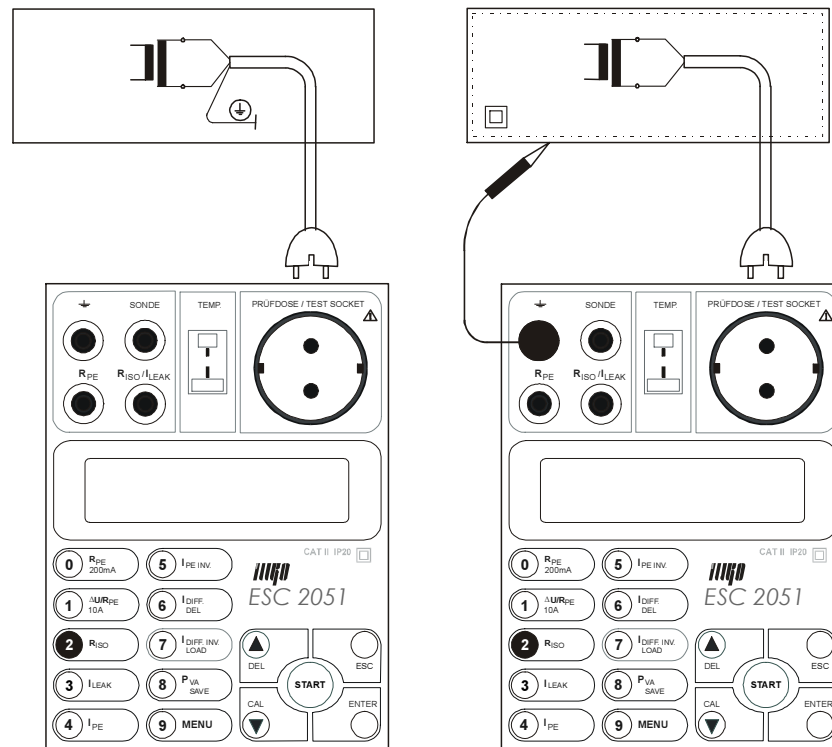


Fig. 6

4.3.2. Protective class II equipments equipped with mains plug



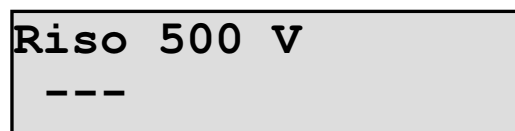
- Insulation resistance between mains part and exposed conductive part of the tested equipment should be tested.
- We advice to use aluminium foil about 200 mm x 100 mm for testing of insulation resistance on equipments, which have no exposed conductive part. In such case coat checked part with foil and connect it to one pole of test voltage.



- Take into consideration all safety warnings!
- Do not touch exposed conductive parts (including foil) while the measurement is running - risk of electric shock!

Step 1

- Press the **R_{ISO}** key and release it to select insulation resistance function.
- Either result of last measurement or „---“ and set test voltage will be displayed.



Step 2

If you need to change test voltage, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „Set-up“ and press **ENTER**.

- Use **▲** and **▼** keys to select item „**Nominal voltage**“ and press **ENTER**.
- Press the **ENTER** key and release it repetitively to select appropriate voltage (100 V, 250 V or 500 V).
Once the voltage is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

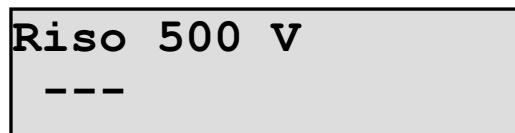
- Plug in the mains cable of equipment under test to Test socket **1** (Fig. 6) and switch on the tested equipment's mains switch.
- Connect test lead P 2011 with test tip P 3011 to \equiv terminal. Touch conductive part of equipment under test with test lead.

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen“ on LCD (HOLD function), but the measurement is still running. Symbol „H“ is displayed when HOLD function is activated.

4.3.3. Protective class I three-phase and hard-wired equipments**Step 1**

- Press the **R_{ISO}** key and release it to select insulation resistance function.
- Either result of last measurement or „---“ and set test voltage will be displayed.

**Step 2**

If you need to change test voltage, proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Nominal voltage**“ and press **ENTER**.
- Press the **ENTER** key and release it repetitively to select appropriate voltage (100 V, 250 V or 500 V).
Once the voltage is set it remains in instrument's memory even if it is disconnected from mains.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Step 3

- Connect test lead P 2011 with test tip P 3011 or with crocodile clip P 4011 to **R_{ISO}** / **I_{LEAK}** terminal and test lead P 2012 with test tip P 3012 to \equiv terminal (Fig. 7).

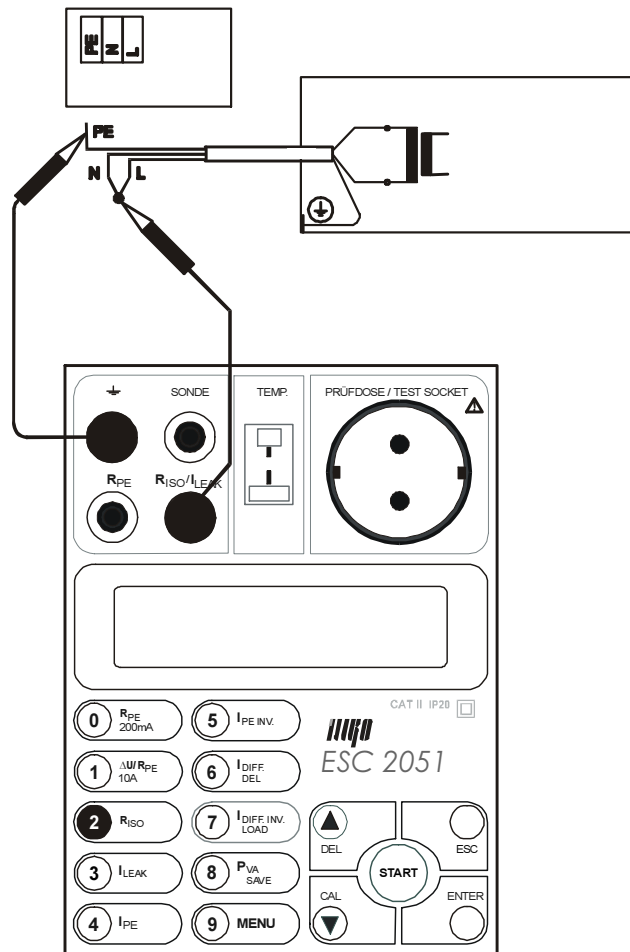


Fig. 7

- If equipment under test is hard-wired, disconnect live, neutral and protective conductor in its terminal board.
- Use test lead + test tip (or crocodile clip) to connect protective conductor of equipment under test with \equiv terminal or connect test tip to protective contact of three-phase plug of equipment under test.
- Connect live and neutral conductor of equipment under test. Use test lead + test tip (or crocodile clip) to connect it to **R_{ISO} / I_{LEAK}** terminal.
- Switch on the main switch of equipment under test.

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen“ on LCD (HOLD function), but the measurement is still running. Symbol „H“ is displayed when HOLD function is activated.

4.4. Substitute leakage current



Test voltage is 230 V / 50 Hz, short circuit current is about 3.5 mA.

4.4.1. Protective class I equipments equipped with mains plug



- Firstly test earth bond (chapter 4.1.) and insulation resistance (chapter 4.3.). Then you can execute substitute leakage current measurement!
- Take into consideration all safety warnings!
- Do not touch exposed conductive parts of tested object while measurement is in progress - risk of electric shock! Symbol „□“ is displayed on LCD if the measurement is in progress!

Step 1

- Press the **I_{LEAK}** key and release it to select substitute leakage current function.
- Either result of last measurement or „---“ will be displayed.

Step 2

- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 8).
- Switch on the main switch of equipment under test.

Step 3

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, minimal measured substitute leakage current will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen” on LCD (HOLD function), but the measurement is still running. Symbol „H“ is displayed when HOLD function is activated.

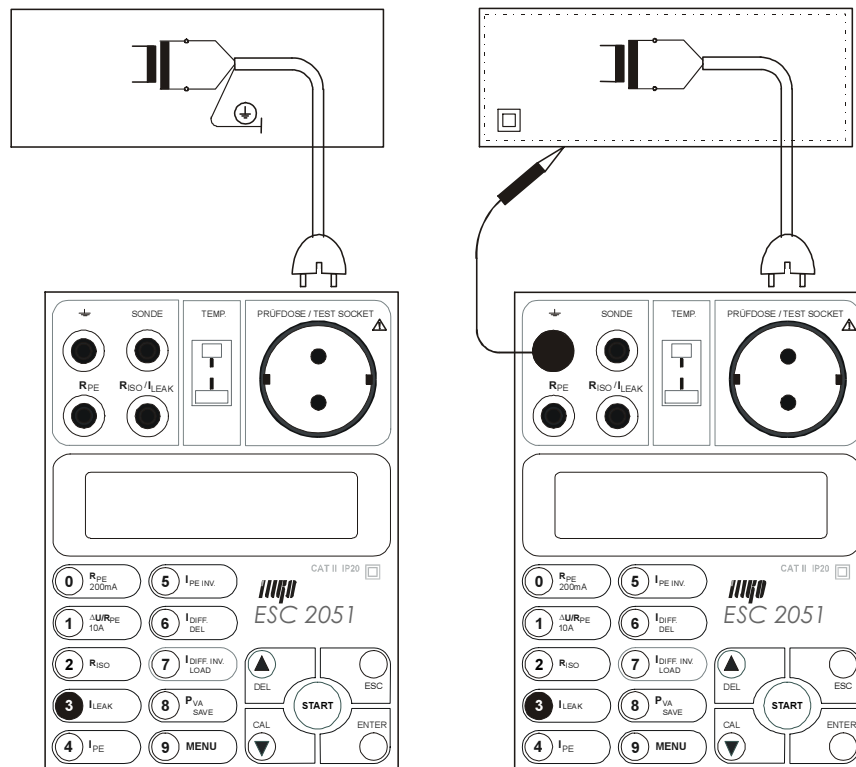


Fig. 8

4.4.2. Protective class II equipments equipped with mains plug



- Substitute leakage current between mains part and exposed conductive part of the tested equipment should be tested.
- We advice to use aluminium foil about 200 mm x 100 mm for testing of insulation resistance on equipments, which have no exposed conductive part. In such case coat checked part with foil and connect it to one pole of test voltage.



- Take into consideration all safety warnings!
- Do not touch exposed conductive parts of tested object (including foil) while measurement is in progress - risk of electric shock! Symbol „□“ is displayed on LCD if the measurement is in progress!

Step 1

- Press the **I_{LEAK}** key and release it to select substitute leakage current function.
- Either result of last measurement or „---“ will be displayed.

Step 2

- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 8).
- Switch on the main switch of equipment under test.
- Connect test lead P 2011 with test tip P 3011 to $\overline{\text{=}}$ terminal. Touch conductive part of equipment under test with test lead.

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.

- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen” on LCD (HOLD function), but the measurement is still running. Symbol „H” is displayed when HOLD function is activated.

4.4.3. Protective class I three-phase and hard-wired equipments



- **Take into consideration all safety warnings!**
- **Do not touch exposed conductive parts of tested object (including foil) while measurement is in progress - risk of electric shock! Symbol „□” is displayed on LCD if the measurement is in progress!**

Step 1

- Press the **I_{LEAK}** key and release it to select substitute leakage current function.
- Either result of last measurement or „---” will be displayed.

Step 2

- Connect test lead P 2011 with test tip P 3011 or with crocodile clip P 4011 to **R_{ISO} / I_{LEAK}** terminal and test lead P 2012 with test tip P 3012 to $\overline{\text{PE}}$ terminal (Fig. 9).
- If equipment under test is hard-wired, disconnect live, neutral and protective conductor in its terminal board.
- Use test lead + test tip (or crocodile clip) to connect protective conductor of equipment under test with $\overline{\text{PE}}$ terminal or connect test tip to protective contact of three-phase plug of equipment under test.
- Connect live and neutral conductor of equipment under test. Use test lead + test tip (or crocodile clip) to connect it to **R_{ISO} / I_{LEAK}** terminal.
- Switch on the main switch of equipment under test.

Step 3

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□” indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- If you press the **CAL** key while the **START** key is pressed, the displayed value is „frozen” on LCD (HOLD function), but the measurement is still running. Symbol „H” is displayed when HOLD function is activated.

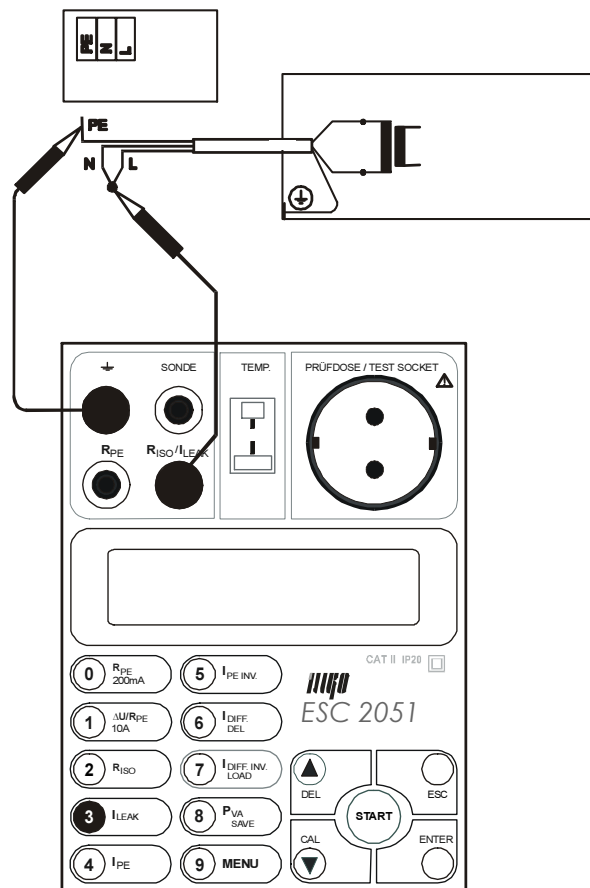


Fig. 9

4.5. PE current during operation and touch leakage current



The ESC 2051 is equipped with electronic checking of excessive leakage current. Test of leakage current is done before start of measurement. If leakage current should exceed appointed limit, the measurement will not start and message „>10 mA !!“ is displayed. Audible warning signal is generated, too.

The value of leakage current is also compared with appointed limit during measurement. If leakage current exceeds appointed limit (about 10 mA), the measurement is finished, message „>10 mA !!“ is displayed and audible warning signal is generated.

4.5.1. Protective class I equipments equipped with mains plug



- Firstly test earth bond (chapter 4.1.) and also insulation resistance (chapter 4.3.), if it is possible. Then you can execute PE current during operation measurement.
- Take into consideration all safety warnings!
- Equipment under test must be isolated from ground (from the earth potential) during measurement!

Step 1

- Press the **I_{PE}** key and release it to select PE current during operation function.
- Either result of last measurement or „---“ will be displayed.

**Step 2**

- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 10).
- Make sure, that equipment under test is not connected to potential of ground - for example with conductive water mine, metallic fixture etc. If equipment under test has electrical potential equalization connection, disconnect it.



Measurement result can be unfavourably affected by capacitance between equipment under test and conductive grounded base (e.g. other equipment or grounded fixture). If there is no possibility to insulate equipment under test (e.g. to place it to a bench made of insulating material), it is necessary to put at least 50 ÷ 100 mm thick insulating material under equipment under test to eliminate unwanted capacitance.

Step 3

- Press the **START** key and keep it pressed. Symbol „□“ indicates, that test voltage is present in Test socket 1.

If you need to lock the **START** key (it means that test voltage will be present steadily in Test socket 1), proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbol „A“ indicates, that test voltage is present in Test socket 1.



*Locking of the START key can be cancelled by pressing of any numerical key (11 - 20) or **▲** key.*



Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 30 min. @ 16A.

**WARNING - DANGER!**

- If test voltage is present in Test socket 1 (symbol „□“ or „A“ is displayed), then tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after main switch is switched on!

Step 4

- Switch on main switch of equipment under test.

Step 5


- If locking of the **START** key is activated: press the **START** key and keep it pressed until displayed result is stabilized. Symbol „□“ indicates, that measurement is running. If locking of the **START** key is not activated: measurement starts immediately after main switch of tested equipment is switched on.
- If locking of the **START** key is activated: last measured value is displayed after the **START** key is released. This value is automatically written to the buffer, too. If locking of the **START** key is not activated: press **▼** key and release it in order to save measured value to buffer **before** you release the **START** key. When measured value is saved to buffer, **H** („HOLD“) symbol is displayed.

Step 6

- Switch off main switch of equipment under test.
- Release the **START** key in order to disconnect test voltage from Test socket **1**, or cancel locking of the **START** key (if it was activated) by means of **▲** or **I_{PE INV.}** key.

Step 7

- Press the **I_{PE INV.}** key (if you didn't press it already in Step 6) in order to select PE current during operation function with interchanged L-N. Either result of last measurement or „---“ will be displayed.



I PE inv.

- Repeat Steps 3 ÷ 6.



- *Take into consideration higher of both measured values when you evaluate the condition of tested equipment.*
- *If you test protective class I equipment with exposed conductive parts, which are not connected with protective conductor, you must test touch leakage on mentioned conductive parts, as described for protective class II equipments (see below), too. In such case leakage current of tested equipment consists of PE current during operation + touch leakage(s)!*

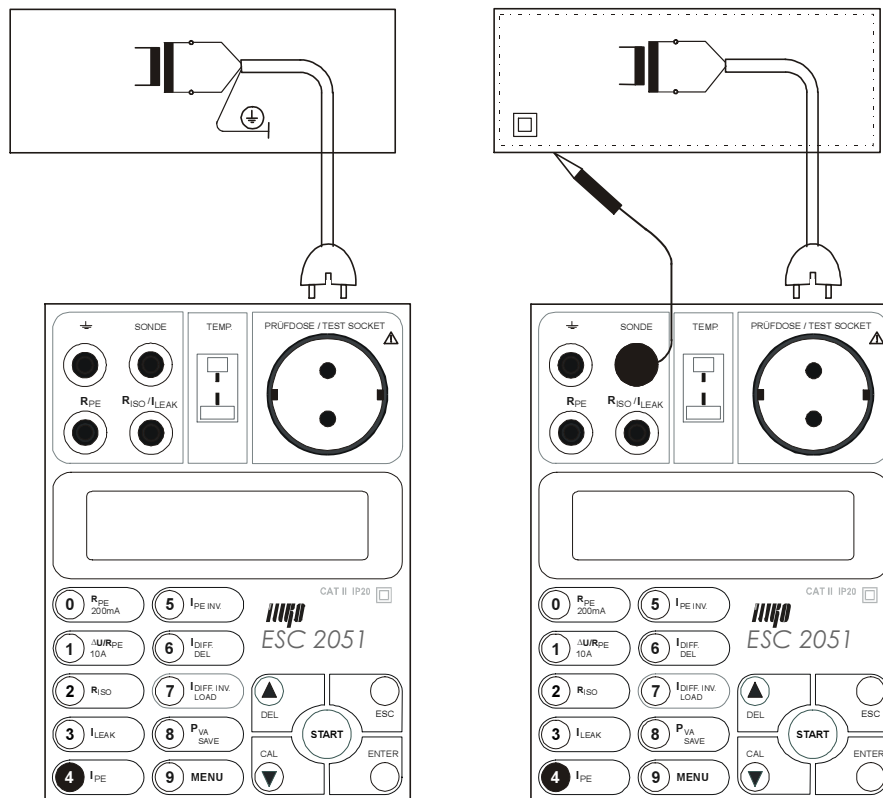


Fig. 10

4.5.2. Protective class II equipments equipped with mains plug



- Touch leakage current on exposed conductive parts of equipment under test should be tested.
- We advice to use aluminium foil about 200 mm x 100 mm for testing of touch leakage on equipments, which have no exposed conductive part. In such case coat checked part with foil and connect it to one test lead.



- **Firstly test insulation resistance (chapter 4.3.), if it is possible. Then you can execute touch leakage current measurement.**
- **Take into consideration all safety warnings!**
- **Exposed conductive parts of equipment under test must be isolated from ground (from the earth potential) during measurement!**

Step 1

- Press the **I_{PE}** key and release it to select touch leakage function.
- Either result of last measurement or „---“ will be displayed.

Step 2

- Connect test lead P 2011 with test tip P 3011 to **SONDE** terminal.
- Plug in the mains cable of equipment under test to Test socket **1** (Fig. 10).
- Make sure, that tested exposed conductive parts of equipment under test are not connected to potential of ground - for example with conductive water mine, metallic fixture etc. If equipment under test has electrical potential equalization connection, disconnect it.



Measurement result can be unfavourably affected by capacitance between equipment under test and conductive grounded base (e.g. other equipment or grounded fixture). If there is no possibility to insulate equipment under test (e.g. to place it to a bench made of insulating material), it is necessary to put at least 50 ÷ 100 mm thick insulating material under equipment under test to eliminate unwanted capacitance.

Step 3

- Press the **START** key and keep it pressed. Symbol „□“ indicates, that test voltage is present in Test socket 1.

If you need to lock the **START** key (it means that test voltage will be present steadily in Test socket 1), proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbol „A“ indicates, that test voltage is present in Test socket 1.



*Locking of the **START** key can be cancelled by pressing of any numerical key (11 - 20) or **▲** key.*



Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 30 min. @ 16A.



WARNING - DANGER!

- **If test voltage is present in Test socket 1 (symbol „□“ or „A“ is displayed), then tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!**
- **Do not touch exposed conductive parts of tested object after main switch is switched on!**

Step 4

- Switch on main switch of equipment under test.

Step 5

- Touch conductive part of equipment under test with test lead tip.
- If locking of the **START** key is activated: press the **START** key and keep it pressed until displayed result is stabilized. Symbol „□“ indicates, that measurement is running. If locking of the **START** key is not activated: measurement starts immediately after main switch of tested equipment is switched on and you touch conductive part of equipment under test with test lead tip.
- If locking of the **START** key is activated: last measured value is displayed after the **START** key is released. This value is automatically written to the buffer, too. If locking of the **START** key is not activated: press **▼** key and release it in order to save measured value to buffer **before** you release the **START** key. When measured value is saved to buffer, **H** („HOLD“) symbol is displayed.

Step 6

- Switch off main switch of equipment under test.
- Release the **START** key in order to disconnect test voltage from Test socket **1**, or cancel locking of the **START** key (if it was activated) by means of **▲** or **I_{PE} INV.** key.

Step 7

- Press the **I_{PE} INV.** key (if you didn't press it already in Step 6) in order to select touch leakage with interchanged L-N. Either result of last measurement or „---“ will be displayed.



I PE inv.

- Repeat Steps 3 ÷ 6.



- Take into consideration higher of both measured values when you evaluate the condition of tested equipment.

4.5.3. Protective class I three-phase and hard-wired equipments**WARNING - DANGER!!**

- It is strongly recommended to test PE current during operation on protective class I three-phase and hard wired equipments by means of optional clamp or three-phase adapter for safety reasons. Following procedure can be applied only in the case you have no mentioned optional accessories. Pay attention to all safety rules and wariness, because if insulation of tested equipment is damaged, dangerous voltage could occur on exposed conductive parts! Secure tested equipment in order other person could not touch it!
Equipment under test has **DISCONNECTED** protective conductor!
Higher possibility that the measurement instrument can be damaged!
- Firstly test earth bond (chapter 4.1.) and also insulation resistance (chapter 4.3.), if it is possible. Then you can execute PE current during operation measurement.
- Take into consideration all safety warnings!
Equipment under test must be isolated from ground (from the earth potential) during measurement!

Step 1

- Press the **I_{PE}** key and release it to select PE current during operation function.
- Either result of last measurement or „---“ will be displayed.



I PE

Step 2

- Disconnect protective conductor of tested equipment from its terminal board and connect it to \equiv terminal by means of test lead P 2011 with test tip P 3011 (Fig. 11).
- Make sure, that equipment under test is not connected to potential of ground - for example with conductive water mine, metallic fixture etc. If equipment under test has electrical potential equalization connection, disconnect it.



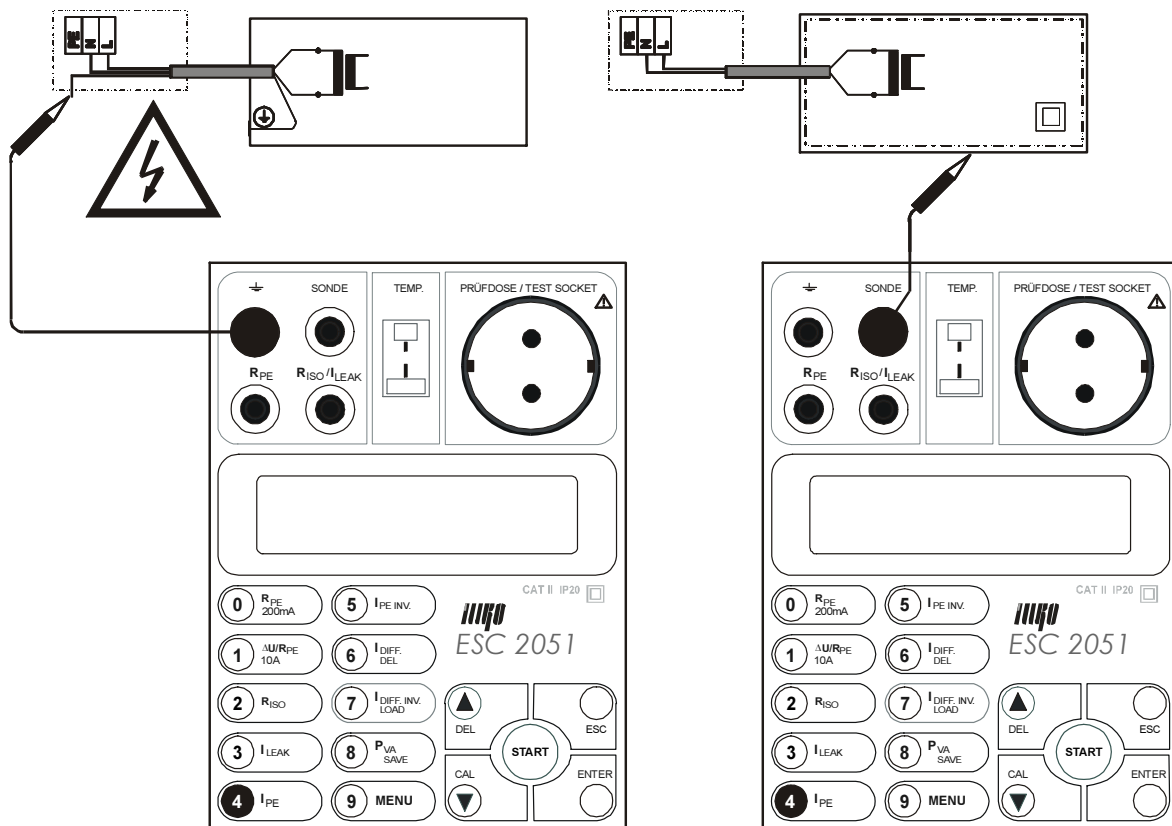
Measurement result can be unfavourably affected by capacitance between equipment under test and conductive grounded base (e.g. other equipment or grounded fixture). If there is no possibility to insulate equipment under test (e.g. to place it to a bench made of insulating material), it is necessary to put at least 50 ÷ 100 mm thick insulating material under equipment under test to eliminate unwanted capacitance.

**WARNING - DANGER!**

- Tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after main switch is switched on!

Step 3

- Switch on main switch of equipment under test.

**Fig. 11**

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.
- Switch off main switch of equipment under test.



- *If you test protective class I equipment with exposed conductive parts, which are not connected with protective conductor, you must test touch leakage on mentioned conductive parts, as described for protective class II equipments (see below), too. In such case leakage current of tested equipment consists of PE current during operation + touch leakage(s)!*

4.5.4. Protective class II hard-wired equipments

- *Touch leakage current on exposed conductive parts of equipment under test should be tested.*
- *We advice to use aluminium foil about 200 mm x 100 mm for testing of touch leakage on equipments, which have no exposed conductive part. In such case coat checked part with foil and connect it to test lead.*



- **Firstly test insulation resistance (chapter 4.3.), if it is possible. Then you can execute touch leakage current measurement.**
- **Take into consideration all safety warnings!**
- **Exposed conductive parts of equipment under test must be isolated from ground (from the earth potential) during measurement!**

Step 1

- Press the **I_{PE}** key and release it to select touch leakage current function.
- Either result of last measurement or „---“ will be displayed.

**Step 2**

- Connect test lead P 2011 with test tip P 3011 to **SONDE** terminal.
- Make sure, that tested exposed conductive parts of equipment under test are not connected to potential of ground - for example with conductive water mine, metallic fixture etc. If equipment under test has electrical potential equalization connection, disconnect it.



Measurement result can be unfavourably affected by capacitance between equipment under test and conductive grounded base (e.g. other equipment or grounded fixture). If there is no possibility to insulate equipment under test (e.g. to place it to a bench made of insulating material), it is necessary to put at least 50 ÷ 100 mm thick insulating material under equipment under test to eliminate unwanted capacitance.

**WARNING - DANGER!**

- Tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after main switch is switched on!

Step 3

- Switch on main switch of equipment under test.

Step 4

- Touch tested part of equipment under test with test lead (Fig. 11).
- Press the **START** key and keep it pressed, until displayed result is stabilized, then release the key. Symbol „□“ indicates, that measurement is running.
- After you release the **START** key, last measured result will be displayed. This value is automatically written to the buffer, too.

Step 5

- Switch off main switch of equipment under test.

4.6. Differential leakage current and touch leakage current

The ESC 2051 is equipped with electronic checking of excessive leakage current. Test of leakage current is done before start of measurement. If leakage current should exceed appointed limit, the measurement will not start and message „>10 mA !!“ is displayed. Audible warning signal is generated, too.

The value of leakage current is also compared with appointed limit during measurement. If leakage current exceeds appointed limit (about 10 mA), the measurement is finished, message „>10 mA !!“ is displayed and audible warning signal is generated.

4.6.1. Protective class I equipments equipped with mains plug

- Firstly test earth bond (chapter 4.1.) and also insulation resistance (chapter 4.3.), if it is possible. Then you can execute differential leakage current measurement.
- Take into consideration all safety warnings!

Step 1

- Press the **I_{DIFF}** key and release it to select differential leakage current function.
- Either result of last measurement or „---“ will be displayed.

Step 2

- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 12).

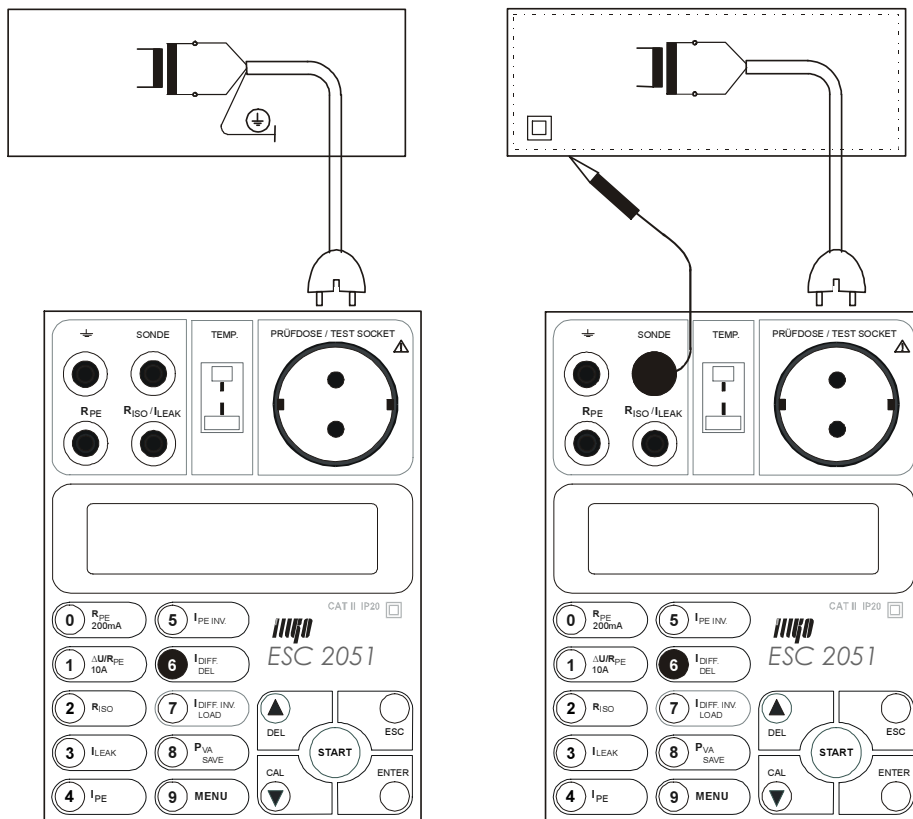


Fig. 12

Step 3

- Press the **START** key and keep it pressed. Symbol „□“ indicates, that test voltage is present in Test socket 1.

If you need to lock the **START** key (it means that test voltage will be present steadily in Test socket 1), proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbol „A“ indicates, that test voltage is present in Test socket 1.

I differential
 --- **A**



*Locking of the **START** key can be cancelled by pressing of any numerical key (11 - 20) or **▲** key.*



Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 30 min. @ 16A.

**WARNING - DANGER!**

- If test voltage is present in Test socket **1** (symbol „□“ or „A“ is displayed), then tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after main switch is switched on!

Step 4

- Switch on main switch of equipment under test.

Step 5

- If locking of the **START** key is activated: press the **START** key and keep it pressed until displayed result is stabilized. Symbol „□“ indicates, that measurement is running. If locking of the **START** key is not activated: measurement starts immediately after main switch of tested equipment is switched on.
- If locking of the **START** key is activated: last measured value is displayed after the **START** key is released. This value is automatically written to the buffer, too. If locking of the **START** key is not activated: press **▼** key and release it in order to save measured value to buffer **before** you release the **START** key. When measured value is saved to buffer, **H** („HOLD“) symbol is displayed.

Step 6

- Switch off main switch of equipment under test.
- Release the **START** key in order to disconnect test voltage from Test socket **1**, or cancel locking of the **START** key (if it was activated) by means of **▲** or **I_{DIFF. INV.}** key.

Step 7

- Press the **I_{DIFF. INV.}** key (if you didn't press it already in Step 6) in order to select differential leakage with interchanged L-N. Either result of last measurement or „---“ will be displayed.

I diff. inv.

- Repeat Steps 3 ÷ 6.



- Take into consideration higher of both measured values when you evaluate the condition of tested equipment.
- If you test protective class I equipment with exposed conductive parts, which are not connected with protective conductor, you must test touch leakage on mentioned conductive parts, as described for protective class II equipments (see below), too. In such case leakage current of tested equipment consists of PE current during operation + touch leakage(s)!

4.6.2. Protective class II equipments equipped with mains plug



- Touch leakage current on exposed conductive parts of equipment under test should be tested.
- We advice to use aluminium foil about 200 mm x 100 mm for testing of touch leakage on equipments, which have no exposed conductive part. In such case coat checked part with foil and connect it to test lead.



- **Firstly test insulation resistance (chapter 4.3.), if it is possible. Then you can execute touch leakage current measurement.**
- **Take into consideration all safety warnings!**

Step 1

- Press the **I_{DIFF}** key and release it to select differential leakage current function.
- Either result of last measurement or „---“ will be displayed.

I diff.

Step 2

- Connect test lead P 2011 with test tip P 3011 to **SONDE** terminal.
- Plug in the mains cable of equipment under test to Test socket 1 (Fig. 12)

Step 3

- Press the **START** key and keep it pressed. Symbol „□“ indicates, that test voltage is present in Test socket 1.

If you need to lock the **START** key (it means that test voltage will be present steadily in Test socket 1), proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbol „A“ indicates, that test voltage is present in Test socket 1.



*Locking of the START key can be cancelled by pressing of any numerical key (11 - 20) or **▲** key.*



Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 30 min. @ 16A.



WARNING - DANGER!

- **If test voltage is present in Test socket 1 (symbol „□“ or „A“ is displayed), then tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!**
- **Do not touch exposed conductive parts of tested object after main switch is switched on!**

Step 4

- Switch on main switch of equipment under test.

Step 5

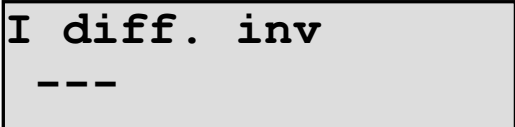
- Touch conductive part of equipment under test with test lead tip.
- If locking of the **START** key is activated: press the **START** key and keep it pressed until displayed result is stabilized. Symbol „□“ indicates, that measurement is running. If locking of the **START** key is not activated: measurement starts immediately after main switch of tested equipment is switched on and you touch conductive part of equipment under test with test lead tip.
- If locking of the **START** key is activated: last measured value is displayed after the **START** key is released. This value is automatically written to the buffer, too. If locking of the **START** key is not activated: press ▼ key and release it in order to save measured value to buffer **before** you release the **START** key. When measured value is saved to buffer, **H** („HOLD“) symbol is displayed.

Step 6

- Switch off main switch of equipment under test.
- Release the **START** key in order to disconnect test voltage from Test socket 1, or cancel locking of the **START** key (if it was activated) by means of ▲ or **IDIFF.INV.** key.

Step 7

- Press the **IDIFF. INV.** key (if you didn't press it already in Step 6) in order to select touch leakage with interchanged L-N. Either result of last measurement or „---“ will be displayed.



I diff. inv

- Repeat Steps 3 ÷ 6.



Take into consideration higher of both measured values when you evaluate the condition of tested equipment.

4.7. Leakage current by means of current clamp



Apply measurement of leakage current and touch leakage current by means of current clamp to hard-wired and three-phase equipments or in the case you can interchange L-N on tested equipment in order to accomplish measurement in both L-N polarities.

4.7.1. PE current during operation and differential leakage current



PE current during operation should be measured on protective class I equipments provided that it can be isolated from ground (from the earth potential).

See chapter 4.5. for details about insulating of tested equipments.

Step 1

- Connect optional clamp P 8010 to terminal **9**.

Step 2

Select the current clamp mode; proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**I external: No**“. Press the **ENTER** key and release it in order to select „**I external: Yes**“.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.
- Press the **I_{PE}** key in order to select PE current during operation function or press the **I_{DIFF}** key in order to select differential leakage current function.



- *Once the current clamp mode is set, it remains set even if the ESC 2051 is disconnected from mains.*
- *As long as the current clamp mode („**I external: Yes**“) is selected, „**X**“ symbol is displayed. There is no voltage present in Test socket **1** during measurement.*

Step 3

- Enclose either protective conductor (PE current during operation measurement) or L+N conductors (differential leakage current measurement) with current clamp (Fig. 13).
- Switch on the main switch of equipment under test; it starts to run.

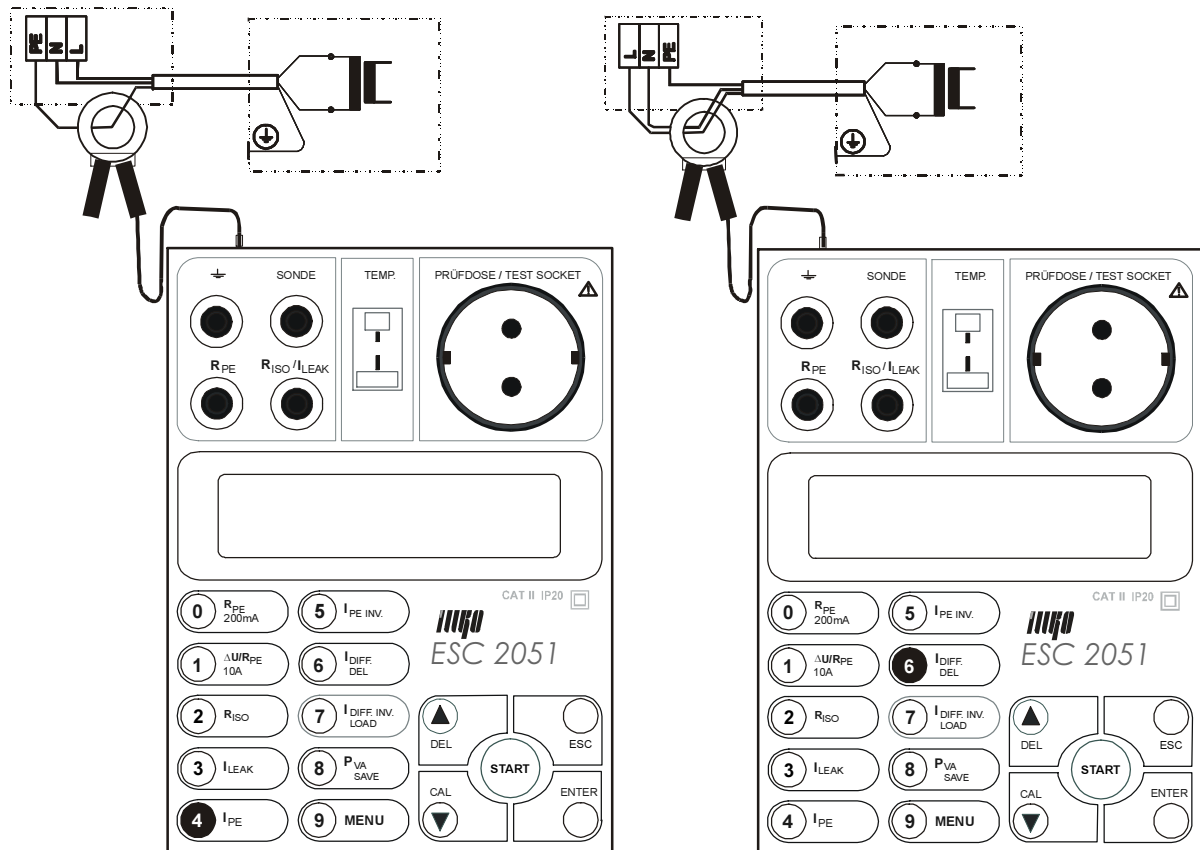


Fig. 13

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized. Symbol „□“ indicates, that measurement is running.

If you need to lock the **START** key, proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbols „A“ and „□“ are displayed, indicating that locking of the **START** key is activated and measurement is running.

I diff.	X
0.00 mA	A□

Step 5

- If locking of the **START** key is activated: measured value is automatically written to the buffer after you cancel locking of the **START** key by means of **▲** key.
If locking of the **START** key is not activated: last measured value is displayed and automatically written to the buffer after you release the **START** key.
- Switch off the main switch of equipment under test.

4.8. Leakage current by means of three-phase adapter

4.8.1. PE current during operation and differential leakage current



PE current during operation should be measured on protective class I equipments provided that it can be isolated from ground (from the earth potential).

See chapter 4.5. for details about insulating of tested equipments.

Step 1

- Connect tested equipment with three-phase mains outlet via optional three-phase adapter **P 801x**.
- Connect three-phase adapter to connector **2** by means of adapter's connection cable jack (Fig. 15).

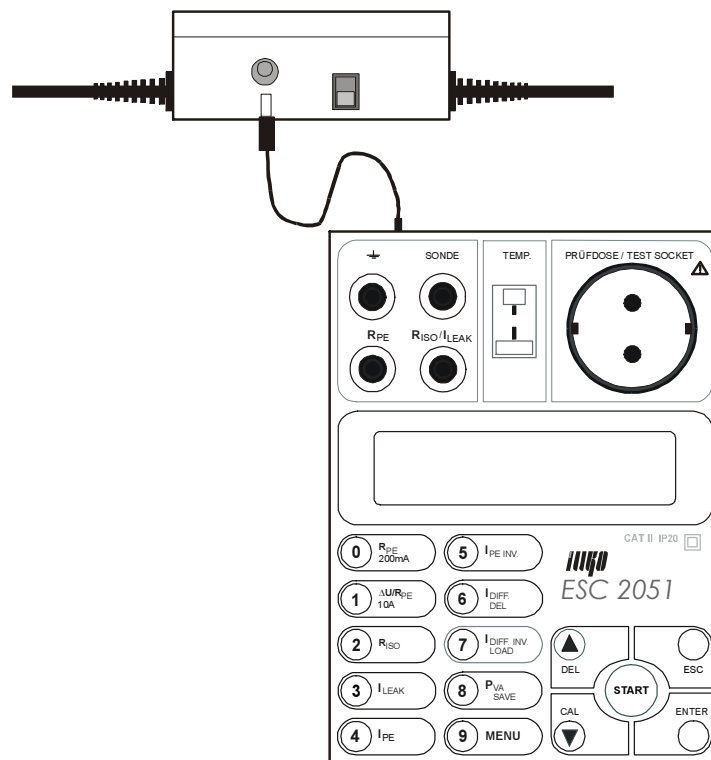


Fig. 15

Step 2

Select the three-phase adapter mode (identical with current clamp mode); proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**I external: No**“. Press the **ENTER** key and release it in order to select „**I external: Yes**“.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.
- Press the **IPE** key in order to select PE current during operation function or press the **IDIFF** key in order to select differential leakage current function.
Select the same function (either PE current during operation or differential leakage current) with function switch on three-phase adapter, too.



- *Once the three-phase adapter (current clamp) mode is set, it remains set even if the ESC 2051 is disconnected from mains.*
- *As long as the three-phase adapter (current clamp) mode is selected, „X“ symbol is displayed. There is no voltage present in Test socket 1 during measurement.*

Step 3

- Switch on the main switch of equipment under test; it starts to run.

Step 4

- Press the **START** key and keep it pressed, until displayed result is stabilized. Symbol „□“ indicates, that measurement is running.

If you need to lock the **START** key, proceed as follows:

- Press **▲** key and keep it pressed. Press the **START** key.
- Release both keys. Symbols „A“ and „□“ are displayed, indicating that locking of the **START** key is activated and measurement is running.

Step 5

- If locking of the **START** key is activated: measured value is automatically written to the buffer after you cancel the **START** key locking by means of **▲** key.
If locking of the **START** key is not activated: last measured value is displayed and automatically written to the buffer after you release the **START** key.
- Switch off the main switch of equipment under test.

4.9. Tested equipment power and current

4.9.1. Power measurement of equipments equipped with mains plug

Step 1

- Press the **P_{VA}** key and release it to select power measurement function.
- Either result of last measurement or „---“ will be displayed.

Device power

Step 2

- Plug in the mains cable of equipment under test to Test socket 1.
- Press the **START** key and keep it pressed. Symbol „□“ indicates, that measurement is running.



Test Socket 1 of the ESC 2051 must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 30 min. @ 16A.



WARNING - DANGER!

- If test voltage is present in Test socket 1 (symbol „□“ is displayed), then tested equipment starts to run after its main switch is switched on in following Step! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after main switch is switched on!

Step 3

- Switch on the main switch of equipment under test; its apparent power is displayed.



- Displayed value can be saved to buffer by means of ▼ key. Writing to the buffer is confirmed by H symbol displaying.

Step 4

- Switch off the main switch of equipment under test.
- Release the **START** key.

4.9.2. Current

Step 1

- Connect optional clamp P 8010 to terminal 9.

Step 2

Select the current clamp mode; proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use ▲ and ▼ keys to select submenu „**Set-up**“ and press **ENTER**.
- Use ▲ and ▼ keys to select item „**I external: No**“. Press the **ENTER** key and release it in order to select „**I external: Yes**“.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.
- Press the **P_{VA}** key in order to select clamp current measurement function. „**Device current**“ message is displayed.



- *Once the current clamp mode is set, it remains set even if the ESC 2051 is disconnected from mains.*
- *As long as the current clamp mode („**I external: Yes**“) is selected, „X“ symbol is displayed. There is no voltage present in Test socket 1 during measurement.*

Step 3

- Enclose L conductor with current clamp (Fig. 16).
- Switch on the main switch of equipment under test; it starts to run.

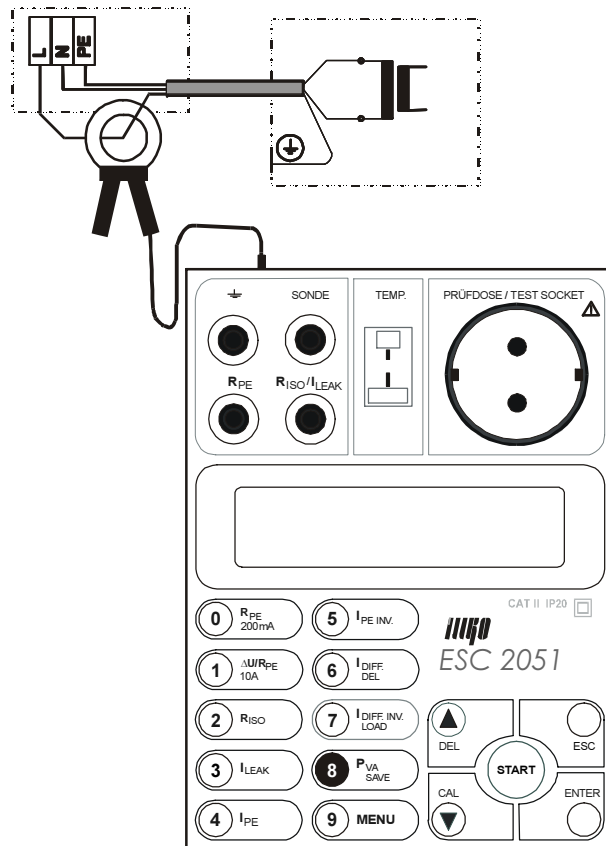


Fig. 16

Step 4

- Press the **START** key and keep it pressed. Symbol „□“ indicates, that measurement is running.

If you need to lock the **START** key, proceed as follows:

- Press ▲ key and keep it pressed. Press the **START** key.
- Release both keys. Symbols „A“ and „□“ are displayed, indicating that locking of the **START** key is activated and measurement is running.

Device current
000.0 A A□

Step 5

- If locking of the **START** key is activated: measured value is automatically written to the buffer after you cancel locking of the **START** key by means of ▲ key. Writing to the buffer is confirmed by H symbol displaying.
If locking of the **START** key is not activated: last measured value is displayed and automatically written to the buffer after you release the **START** key.
- Switch off the main switch of equipment under test.

4.10. Temperature

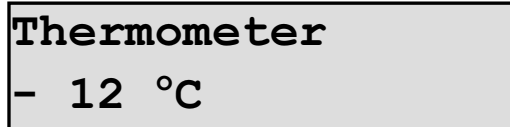
Step 1

- Connect optional K type temperature probe P 9030 to terminal 2.

Step 2

Select temperature measurement mode; proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select item „**Thermometer**“.
- Temperature is continuously displayed. Symbol „---“ is displayed, if temperature probe is not connected.



Thermometer
- 12 °C

- Measurement can be finished with the **ESC** key.



It is not possible to save temperature to memory.

4.11. Revolution

Step 1

- Connect optional revolution probe P 9050 to terminal 10.

Step 2

Select revolution measurement mode; proceed as follows:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select item „**RPM**“.
- Revolution is continuously displayed. „0000“ is displayed, if revolution probe is not connected.



RPM
02120

- Measurement can be finished by the **ESC** key.



- *It is not possible to save revolution to memory.*
- *You must scan part of rotating object on which lighter and darker surface are alternated during rotation. If it is not possible (or if measurement is erroneous), we advice to place reflective part to object rotation of which is to be measured. You can use paper sticker for example. Each interruption of luminous flow represents one pulse and thus one revolution. So if there are two reflective parts on rotating object, displayed result is two times higher in comparison with real rotation!*
- *Measurement can be unfavourably affected by artificial light (e.g. fluorescent lamp).*

5. MENU

You can set various parameters of the instrument, to utilize memory etc by means of **MENU**.

5.1. Utilization and structure of MENU

5.1.1. How to enter MENU and to move in MENU

Step 1

- Press the **MENU** key.
- Use **▲** and **▼** keys to select item (function) you need. Confirm with the **ENTER** key.
- Use **▲** and **▼** keys to select parameter you need in submenu.
- Set the parameter you selected. The way of setting will be described later.

Step 2

- Press the **ESC** key and release it (repeatedly) until you abandon all (sub)menus. The number of **ESC** key press/release repetition depends on how „deep” you are in MENU.



Once the function is set it remains in instrument's memory even if it is disconnected from mains.

5.1.2. The MENU structure

Items of submenus are indented.

```

Last values
  Ident. number
  Class
  RPE200mA
  U△10A (RPE10A)
  Riso 500 V
  I equivalent
  I PE
  I PE inv.
  I differential
  I diff.inv.
  Device power (Device current)
Memory
  ID: (identification number of equipment)
Set-up
  I external
  Timer RPE 10A
  Erase memory
  Nominal voltage
  PE cross-section
  Change PIN
Thermometer
RPM
```

5.2. Description of MENU items

„Last values“



The screenshot shows a rectangular box with a black border. Inside the box, the text "Last values" is displayed in a bold, black, monospaced font.

This item allows latest measured values examining and identification number and protection class of tested equipment examining and editing. The procedure of identification number and protection class entering/editing is described in chapter 5.3.1.

Browsing with ▲ and ▼ keys through submenu „**Last values**“ displays last measured values, which are saved in the buffer. „**Val**“ symbol is displayed, too.


„Memory“



The screenshot shows a rectangular box with a black border. Inside the box, the text "Memory" is displayed in a bold, black, monospaced font.

This item allows browsing through records saved in instrument's main memory. When you browse with ▲ and ▼ keys through records in memory, identification number of particular tested equipment is displayed. After you press the **ENTER** key and release it, you can browse through measured values of selected particular equipment. „**Mem**“ symbol is displayed, too. Selected record can be transferred to the buffer and then checked or edited. Detailed description of memory operation is described in chapter 5.3.2.

„Set-up“



The screenshot shows a rectangular box with a black border. Inside the box, the text "Set-up" is displayed in a bold, black, monospaced font.

This item allows changing of some system settings. Once it is set it remains in instrument's memory even if it is disconnected from mains.

„I external“



The screenshot shows a rectangular box with a black border. Inside the box, the text "I external" is displayed in a bold, black, monospaced font on the first line, and "Yes" is displayed on the second line.

This item allows switching the method of measurement of leakage currents, power and current. You can switch between „**Yes**“ and „**No**“ with the **ENTER** key. If „**Yes**“ is selected then „**Device current**“ message is displayed (clamp current measurement), if you press the **P_{VA}** key. Enabling of „**I external**“ is indicated by displaying „**X**“ symbol, too.



If „**I external**“ is enabled, it is not possible to carry out leakage current measurement by means of Test socket **1**.

„Timer RPE 10A“

Timer RPE 10A
15 sec

Duration of 10 A voltage drop and 10 A earth bond measurement can be set:

- Press the **MENU** key; the main menu is opened.
- Use **▲** and **▼** keys to select submenu „**Set-up**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Timer RPE 10A**“ and press **ENTER**.
- Use **DEL** key to erase current setting.
- Use **0 ÷ 9** keys to enter required new setting (1 ÷ 15 s; if you set value to 0, the measurement will be running continually until you either disconnect test leads or internal circuitry overheats). You can use the **DEL** key to erase incorrectly entered characters.
- Confirm with the **ENTER** key.

„Erase memory“

Erase memory

This item erases all measurement results stored in main instrument's memory! Data in the buffer are not erased.

Press the **ENTER** key and release it. Following menu is displayed: „**Enter=Yes Esc=No**“.

Erase memory?
Enter=Yes Esc=No

Confirm with the **ENTER** key. Abandon erasing procedure with the **ESC** key.

„Nominal voltage“

Nominal voltage
500 V

You can set insulation measurement voltage to 500V, 250V, 100V with the **ENTER** key.

„PE cross-section“

PE cross-section
1.0 mm²

You can set protective conductor cross-section if you want so that measured voltage drop will be automatically compared with threshold voltage drop allowed. If threshold voltage drop is exceeded, audible signal is activated. If you set „Off“ instead of particular cross-section value, the comparison is disabled.



Threshold values of voltage drop versus cross-section:

1.0 mm^2	3.3 V	4.0 mm^2	1.4 V
1.5 mm^2	2.6 V	$> 6.0 \text{ mm}^2$	1.0 V
2.5 mm^2	1.9 V	Off mm^2	off

„Change PIN“

Change PIN

Only particular person(s) can operate the ESC 2051, if PIN code function is activated. In such case operator must enter valid PIN code after the instrument powers up, otherwise instrument's keyboard is locked.

PIN code can consists of max four digits. Code 0000 deactivates PIN code function. Detailed description of PIN function - see chapter 3.2.

„Thermometer“

Thermometer
- 16 °C

Temperature can be measured with optional K type (NiCrNi) temperature probe. See details in chapter 4.10.

„RPM“

RPM
2120

Revolution can be measured with optional revolution probe. See details in chapter 4.11.

5.3. Memory

Memory operation and connecting of the ESC 2051 to PC

Equipment testing procedure with saving measured results to instrument's memory and with later transferring memorized results to PC can be following:

Step 1

- Measure all required parameters of tested equipment – see description of particular measurements in respective chapters.



Values you have just measured are automatically (in some instances after ▼ key pressing – such instances are described in respective chapters) stored to the buffer.

Step 2

- Add on identification number of tested equipment to the measured parameters, which were written to the buffer. You can edit protective class of tested equipment, too (see chapter 5.3.2. for details).



Identification number of tested equipment can be entered either from the keyboard of the ESC 2051 or you can use barcode reader.

Protective class is set automatically and you can edit it from instrument's keyboard.

Step 3

- Save entire record to instrument's main memory (see chapter 5.3.2. for details).
- Start with Step 1 again in order to measure next equipment.



Records stored in main memory can be browsed or edited so that you transfer it to the buffer, carry out required editing and save it to main memory again.

Step 4

- 1) Transfer data from main memory to PC.

Data transfer to PC:

- Connect the ESC 2051 to PC via RS 232 cable (option **P 9070**).
- Install (if you didn't install it formerly) PC software RView (option **P 7011**). Start PC software.
- Transfer data from the ESC 2051 to PC software. Save data in CSV format. Process it in appropriate SW which can import CSV format (Excel™ etc).



You can find details about installation of PC software in relevant documentation, e.g. in software manual or in readme.txt file.

Structure of the ESC 2051 memory

There are two parts of instrument's memory:

- 1) **Buffer** – measured values of currently tested equipment are saved here before you transfer it to main memory.
- 2) **Main memory** is intended for saving of measured values (records) before you transfer it to PC.

After you finish the measurement of particular equipment, you can edit measured values saved in buffer; add on identification number, edit protective class of tested equipment and such complete record save to main memory.

5.3.1. Buffer

Values you have just measured are automatically (in some instances after ▼ key pressing – such instances are described in respective chapters) stored to the buffer.

You can add on identification number (from keyboard or by means of optional barcode reader) to the data stored in buffer; you can edit protective class of tested equipment.

One record of particular equipment consists of:

1. Identification number (max. 10 digits)
2. Protective class (I, II, III)
3. Earth bond test 200 mA
4. Earth bond test 10 A AC and earth bond voltage drop at 10 A AC
5. Insulation resistance test 500 V / 250 V / 100 V DC
6. Substitute leakage current
7. PE current during operation
8. PE current during operation (interchanged L – N)
9. Differential leakage current
10. Differential leakage current (interchanged L – N)
11. Power consumption or current of tested appliance

If any item above was not measured (or entered) then during browsing of the record symbol „---“ is displayed.

How to enter identification number

You can enter identification number either by means of optional barcode reader or from keyboard.

Entering of identification number by means of barcode reader:

Step 1

- Connect optional barcode reader P 9020 to terminal **8**.



Connect barcode reader to the instrument before you plug in the ESC 2051!

Step 2

- Press the key on barcode reader to scan barcode label attached on tested equipment. After barcode is successfully scanned, the ESC 2051 beeps to confirm it. Identification number is displayed momentarily.



Entering of identification number of tested equipment can be accomplished before start of equipment measurement, between particular measurements or after all measurements are finished.

Entering of identification number from instrument's keyboard:

Step 1

- Press the **ENTER** key and release it.
- If identification number was not entered yet, call for its entering is displayed.

Ident. number ----- Val
--

- Press the **ENTER** key and release it.

Step 2

- Use instrument's numerical keyboard to enter identification number. You can use the **DEL** key to erase incorrectly entered characters.
- Use the **ENTER** key to store entered identification number or use the **ESC** key to cancel entering of identification number.

Editing of tested equipment's protective class

Protective class of tested equipment is set automatically. If **R_{PE}** was measured (either 200 mA or 10 A), protective class I is set, otherwise class II is set.

In order to change protective class proceed as follows:

Step 1

- After you have finished all measurements of particular equipment, press the **MENU** key and release it.
- Use **▲** and **▼** keys to select submenu „**Last values**“ and press **ENTER**.
- Use **▲** and **▼** keys to select item „**Class**“ and press **ENTER**.

Step 2

- Press the **ENTER** key and release it repetitively to select appropriate protective class I, II or III.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

Buffer erasing

- Measurement result must be displayed. Press the **DEL** key and keep it pressed. Press the **ENTER** key. Release both keys.

5.3.2. Main memory

Transferring buffer content to main memory

User can use two ways to transfer buffer content to main memory. It is possible to use either “quick storing” or “standard storing”.

All records are placed ascending in main memory in accordance with identification number, it means from the lowest to the highest identification number.

If you are storing record with the identification number, under which was former stored other record, the older record will be overwritten with the new one!

Quick storing

- Enter identification number – see chapter 5.3.1. for details.
- Measure all required parameters of tested equipment.
- After finishing of all required parameters measurement press the **ENTER** key and release it. Data from buffer will be transferred to main memory; the ESC 2051 generates long beep to confirm transfer.

If you didn't enter identification number before you start to transfer data from buffer to main memory, the transfer will not be completed. The call for identification number entering is displayed instead:

Ident. number
----- Val

- Enter identification number by means of barcode reader or numerical keyboard: press and release the **ENTER** key and enter identification number.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.
- Press the **ENTER** key and release it. Data from buffer will be transferred to main memory; the ESC 2051 generates long beep to confirm transfer.



We advise to use described quick storing procedure. Before you start storing, we advise to enter identification number of tested equipment.

Standard storing by means of MENU

- After finishing of all required measurements of tested equipment press the **MENU** key and release it. Select item „**Memory**“.
- Press the **ENTER** key and release it. You entered main memory. Either identification number of first record in main memory or identification number of last selected record (if you browsed through main memory former) is displayed.
- Press the key **SAVE** and release it. Data from buffer will be transferred to main memory; the ESC 2051 generates long beep to confirm transfer. Identification number of just stored record (equipment) is displayed. If no identification number was entered, the record will be transferred from buffer with no identification!




Buffer is erased automatically after its content is transferred to main memory.

Browsing through and editing of records which are stored in main memory

If you want to display particular record stored in main memory, proceed as follows:

Step 1

- Press the **MENU** key and release it. Select item „**Memory**“.
- Press the **ENTER** key and release it. You entered main memory. Either identification number of first record in main memory or identification number of last selected record (if you browsed through main memory former) is displayed.
- Use **▲** and **▼** keys to select required identification number.



Memory:
ID: 0000010285


Step 2

- Press the **ENTER** key and release it.
- Use **▲** and **▼** keys to browse through results saved in main memory under selected identification number. „**Mem**“ message is displayed, too.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

If you want to erase particular record stored in main memory, proceed as follows:

Step 1

- Press the **MENU** key and release it. Select item „**Memory**“.
- Press the **ENTER** key and release it. You entered main memory. Either identification number of first record in main memory or identification number of last selected record (if you browsed through main memory former) is displayed.
- Use **▲** and **▼** keys to select identification number of record you want to erase.



Memory:
ID: 0000010285

Step 2

- Press the **DEL** key and release it in order to erase selected record.
- Press the **ESC** key and release it (repeatedly) until you abandon (sub)menus.

If you want to edit particular record stored in main memory, proceed as follows:

Step 1

- Press the **MENU** key and release it. Select item „**Memory**“.
- Press the **ENTER** key and release it. You entered main memory. Either identification number of first record in main memory or identification number of last selected record (if you browsed through main memory former) is displayed.
- Use **▲** and **▼** keys to select identification number of record you want to edit.



Memory:
ID: 0000010285

Step 2

- Press the **LOAD** key and release it in order to transfer selected record to the buffer. Long beep is generated to confirm the transfer.
- If you want to change identification number, use the **ESC** key to return to the main menu and then use the procedure described in chapter 5.3.1. in order to change identification number.
- If you want to change any particular measured value, use the **ESC** key to abandon (sub)menus. Then carry out new measurement of value you need to change – see chapter 4. for details.

Step 3

- Transfer edited record to the main memory – press the key **ENTER** and release it.

6. ADDITIONAL INFORMATION

6.1. Displayed messages

Different messages can be displayed during operation of the ESC 2051. Explanation follows:

PE error !!!

A rectangular display box with a black border containing the text "PE error !!!" in a bold, black, monospaced font.

There is a problem in PE circuit of mains outlet, from which the ESC 2051 is powered: dangerous contact voltage or too high loop impedance (e.g. PE wire disconnected). Instrument's keyboard is locked. You must disconnect the instrument from mains and connect it to mains outlet, which is not faulty.



Before you connect the instrument to the faulty mains outlet again, it is necessary to determine and eliminate the reason of fault.

Block ...

A rectangular display box with a black border containing the text "PIN:" on the first line and "Block..." on the second line, both in a bold, black, monospaced font.

Operator entered invalid PIN code. He has to disconnect the instrument from mains and connect it to mains outlet again. Then he has to enter valid PIN.

Voltage on input

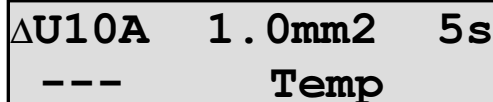
A rectangular display box with a black border containing the text "Voltage on input" in a bold, black, monospaced font.

There is external voltage (> about 20 V) present in Test socket **1** or in test terminals.



If higher external voltage is connected to the instrument, it is possible, that the ESC 2051 switches to another function itself instead of displaying warning message. External voltage must be disconnected in order to enable measurement.

Temp

A rectangular display box with a black border containing two lines of text in a bold, black, monospaced font. The first line is "ΔU10A 1.0mm2 5s" and the second line is "--- Temp".

Mentioned message is displayed in case of too hot internal circuitry of the ESC 2051. Audible tone (beep) is generated, too. In such case please wait, until internal temperature decreases - audible signal is generated again.



Other functions of the ESC 2051 are not affected.

Device insulated !!!

**Device
insulated !!!**

Equipment under test must be isolated from ground (from the earth potential) during measurement of PE current during operation. See chapter 4.5 for details.

> 10 mA !!

> 10 mA !!

Leakage current is too high. The measurement is stopped in order to avoid damage of the ESC 2051.

!!! (Threshold voltage drop is exceeded)

**UΔ10A 1.0 mm2
03.6 V !!! C**

6.2. Reset of the instrument

It is advised to execute instrument's RESET in case of any malfunction. All stored data and settings remain unchanged.

Disconnect the ESC 2051 from mains, wait 30 s and plug it in again in order to execute RESET.

6.3. Leakage current and touch leakage current measurement methods

Substitute leakage current

Test voltage 230 V / 50 Hz is connected to exposed part and to L+N terminals of tested equipment. Leakage current is measured on 2 kΩ shunt (Fig. 17). Leakage current consists of prospective damaged insulation current and capacitive current which flows via internal capacitances of tested equipment.

The main advantage of the method is accuracy of measurement and the possibility of testing such equipments, which are connected with ground not only by means of PE conductor.

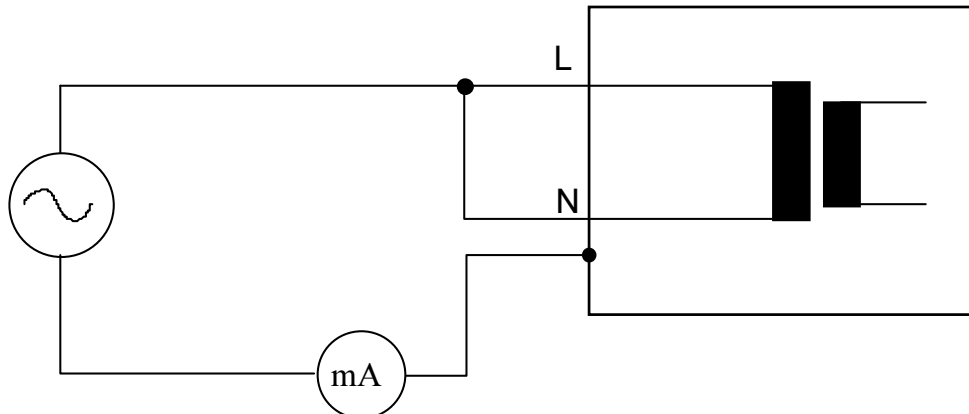


Fig. 17

The main disadvantage of the method is that test voltage is not present behind electrically/electronically controlled switching element (if such element is inside tested equipment – e.g. electromagnetic contactor, solid state relay etc.). In fact only circuits placed before such switching element are tested and only leakage current of circuits placed before such switching element is displayed.

If operator doesn't know the diagram of tested equipment's mains part, it is advised to use other measurement method.

PE current during operation, touch leakage current

This method simulates perfectly standard operating conditions of tested equipment. The equipment is powered; thus it runs. PE current is measured if you test protective class I equipment (Fig. 18).

If you test protective class I equipment with exposed conductive parts, which are not connected with protective conductor, or protective class II equipment, you can measure touch leakage current (Fig. 18). You touch exposed parts with test tip and current which flows via measuring instrument (with 2 k Ω shunt built in) is displayed.

Exposed conductive parts of equipment under test must not be connected to potential of ground; otherwise measurement results could be incorrect!

The ESC 2051 measures even DC component of leakage current, if PE current during operation function is used!

Measurement must be executed two times – with normal L-N connection and with interchanged L-N. The reason is that leakage current can “spread out” asymmetrically versus its power voltage.

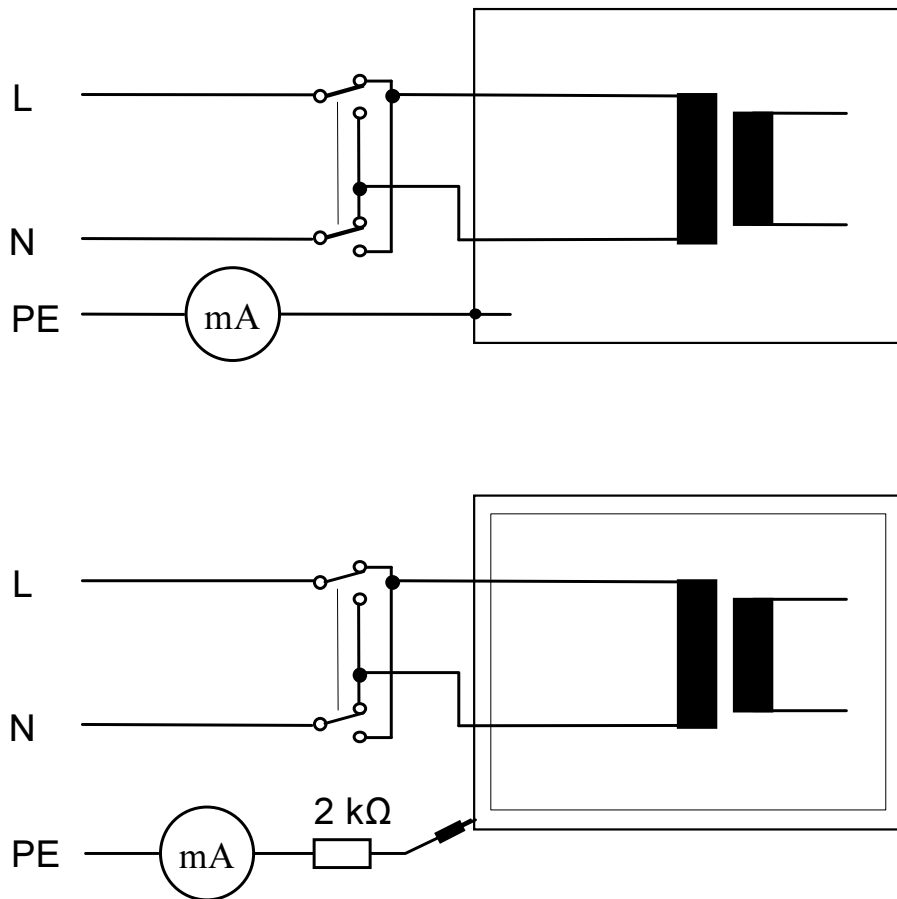


Fig. 18



It is advised to use this method in all cases, in which the possibility of isolating of tested equipment from ground exists.

Differential leakage current, touch leakage current

This method simulates perfectly standard operating conditions of tested equipment. The equipment is powered; thus it runs (Fig. 19). The method enables measurement of such equipments, which are connected with ground potential and which cannot be disconnected or insulated from ground thus leakage current can flows via separate conductive paths (Fig. 19 and Fig. 20).

Measurement must be executed two times – with normal L-N connection and with interchanged L-N. The reason is that leakage current can “spread out” asymmetrically versus the power voltage.

The method cannot measure DC part of leakage current.



It is advised to use this method in cases, in which there is no possibility of isolating of tested equipment from ground.

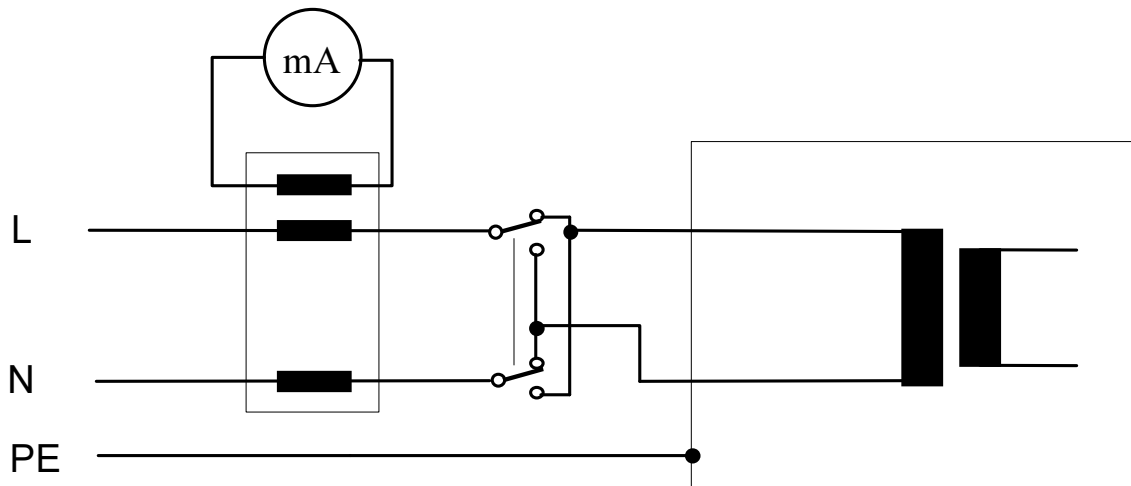


Fig. 19

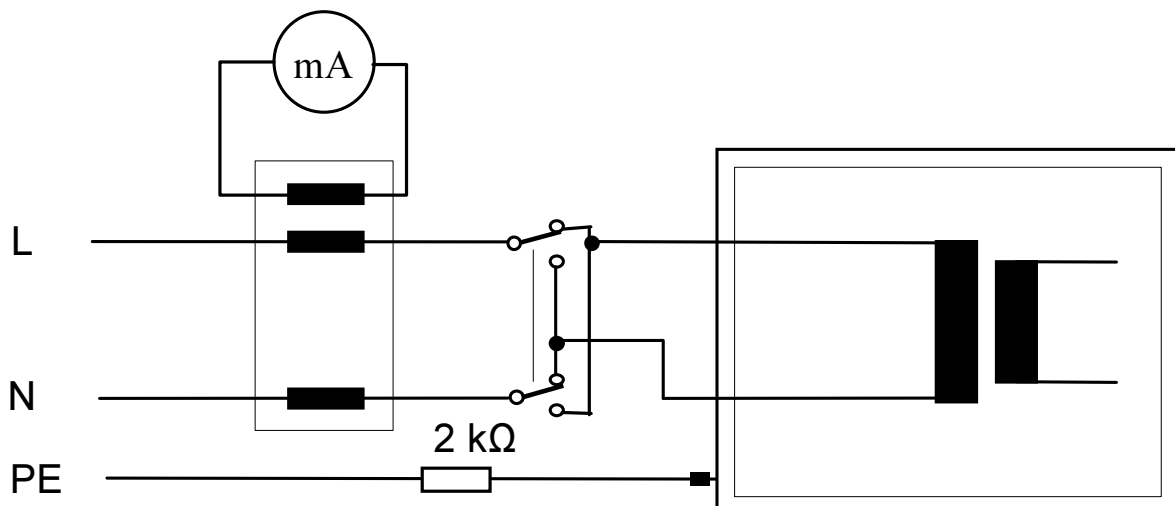


Fig. 20

Method used for measurement of any particular equipment must be selected individually with respect to specific condition.

6.4. Maintenance

Check regularly insulation of mains cable and the ESC 2051 plastic case. Plastic case should not be polluted with substances, which can noticeably degrade case's insulation quality. Use soft cloth, slightly moistened with lukewarm soap water for plastic case cleaning. Do not spill cleaning liquid over the instrument! Do not use cleaning liquids based on petrol, hydrocarbons etc! Wait until the instrument becomes totally dry before using it!



Do not expose the instrument to temperatures over 70 °C, otherwise the plastic case can be damaged!

6.5. Calibration

All measurement instruments should be regularly calibrated. We recommend interval of calibration 2 years.

Furthermore we recommend to carry out calibration after each repair.

6.6. Service

Contact your local distributor for further information.



Unauthorized persons are not allowed to open the ESC 2051! There are no replaceable components inside the instrument!

Producer:



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7. TECHNICAL SPECIFICATION

7.1. General data

Protective class II (double insulation)
Over voltage class CAT II
Pollution degree..... 2
Degree of protection IP 20
PC connection RS 232
Memory circa 1000 equipments
Reference conditions:
 line voltage 230 V \pm 1 % / 50 Hz
 ambient temperature (23 \pm 2) °C
 humidity 45 \div 55 % RH @ 23 °C
 position arbitrary
Operating condition:
 line voltage 230 V \pm 10 % / 50 Hz

ambient temperature 0 °C ÷ 40 °C
 humidity..... max. 75 % RH @ 23 °C
 (condensation not allowed)
 Max. current 16 A
 (it depends on tested equipment)
 Quiescent current..... circa 50 mA
 Dimensions (w x d x h) .155 x 195 x 85 mm
 Mass (without accessories)..... 1.9 kg
 Storage temperature/humidity range.....
 -10 ° ÷ 50 °C / max. 75 % RH
 Case resistance to temperature70 °C
 PE test..each time the **START** key is pressed

7.2. Functions

Earth bond 200 mA

Measuring range	0.00 ÷ 19.99 Ω
Operating range of use	0.10 ÷ 19.99 Ω
Resolution	0.01 Ω
Open-circuit voltage	4 ÷ 10 V
Test current (R < 1 Ω)	> 200 mA
Intrinsic (reference) error	±(2 % R + 2 D)
Operating error	±(3 % R + 2 D)
Test lead compensation	yes (up to 0.5 Ω)

Earth bond 10 A AC

Measuring range	0.00 ÷ 1.00 Ω
Operating range of use	0.10 ÷ 1.00 Ω
Resolution	0.01 Ω
Open-circuit voltage	4 ÷ 10 V
Test current (R < 0.35 Ω)	> 10 A AC
Intrinsic (reference) error	±(2 % R + 2 D)
Operating error	±(3 % R + 2 D)
Test lead compensation	yes (up to 0.5 Ω)
Timer	1 ÷ 15 s, off

Voltage drop 10 A AC

Measuring range	0.0 ÷ 3.5 V
Resolution	0.1 V
Open-circuit voltage	4 ÷ 10 V
Test current ($\Delta U < 3.5 \text{ V}$)	> 10 A AC
Intrinsic (reference) error	$\pm(2 \% R + 2 \text{ D})$
Operating error	$\pm(3 \% R + 2 \text{ D})$
Test lead compensation	yes
Timer	1 ÷ 15 s, off
Protective conductor cross-section setting	in accordance with EN 60204-1

Insulation resistance

Measuring range (500 V, 250 V)	0.10 ÷ 19.99 MΩ
Measuring range (100 V)	0.10 ÷ 10.00 MΩ
Operating range of use (500 V, 250 V)	0.20 ÷ 19.99 MΩ
Operating r. of use (100 V)	0.20 ÷ 10.00 MΩ
Resolution	0.01 MΩ
Nominal output voltage Un	100 V, 250 V, 500 V
Open-circuit voltage	(-0%, + 50%) Un
Nominal test current	1 mA
Short-circuit current	< 10 mA
Intrinsic (reference) error (500 V, 250V)	±(4 % R + 4 D)
Operating error (500 V, 250 V)	±(5 % R + 5 D)
Intrinsic (reference) error (100 V)	±(5 % R + 5 D)
Operating error (100 V)	±(6 % R + 10 D)
Functionality test	0.20 ÷ 0.26 MΩ

Substitute leakage current

Measuring range	0.00 ÷ 19.99 mA
Resolution	0.01 mA
Test voltage	230 V ± 15 % / 50 Hz
Short-circuit current	3.5 mA ± 10 %
Intrinsic (reference) error	±(2 % R + 3 D)
Operating error	±(3 % R + 4 D)
Functionality test	1.00 mA ± 10 %

PE current during operation

Measuring range	0.00 ÷ 10.00 mA (1)
Resolution	0.01 mA
Test voltage	line voltage
Intrinsic (reference) error	$\pm(2 \% R + 3 D)$
Operating error	$\pm(3 \% R + 4 D)$
The START key locking	yes
Functionality test	1.00 mA $\pm 10 \%$

Differential leakage current

Measuring range	0.00 ÷ 10.00 mA (1)
Resolution	0.01 mA
Test voltage	line voltage
Intrinsic (reference) error	$\pm(5 \% R + 5 D + X^*)$
Operating error	$\pm(6 \% R + 8 D + X^*)$
The START key locking	yes
Functionality test	1.00 mA $\pm 10 \%$

* $X = 0,005 D \times$ power consumption of tested equipment in VA

Leakage current - clamp measurement

Measuring range	0.0 ÷ 15.0 mA (2)
Resolution	0.1 mA
Intrinsic (reference) error	$\pm(5 \% R + 5 D)$
Operating error	$\pm(6 \% R + 5 D)$
The START key locking	yes

Leakage current – three-phase adapter

Measuring range	0.0 ÷ 15.0 mA (2)
Resolution	0.1 mA
Intrinsic (reference) error	$\pm(5 \% R + 5 D)$
Operating error	$\pm(6 \% R + 5 D)$
The START key locking	yes

(1) Range is restricted electronically to (10 ± 2) mA

(2) Clamp error has to be considered additionally

(3) Max current 16 A @ 30 min.

(4) Probe error has to be considered additionally;
range can be restricted with probe parameters

Tested equipment power

Measuring range	0 ÷ 3600 VA (3)
Resolution	1 VA
Intrinsic (reference) error $P \leq 500$ VA	$\pm(3 \% R + 15 D)$
Operating error $P \leq 500$ VA	$\pm(5 \% R + 20 D)$
Intrinsic (reference) error $P > 500$ VA	$\pm(3 \% R + 2 D)$
Operating error $P > 500$ VA	$\pm(5 \% R + 5 D)$

Tested equipment current - clamp meas.

Measuring range	0.0 ÷ 100.0 (2)
Resolution	0.1 A
Intrinsic (reference) error	$\pm(3 \% R + 5 D)$
Operating error	$\pm(5 \% R + 5 D)$
The START key locking	yes

Temperature (K type probe)

Measuring range	-40°C ÷ 350 °C (4)
Resolution	1 °C
Intrinsic (reference) error	$\pm(5 \% R + 3 D)$
Operating error	$\pm(6 \% R + 10 D)$

Revolution

Measuring range	0 ÷ 30 000 rpm
Resolution [rpm]	1 (range 0 ÷ 1024) 10 (range 1025 ÷ 30 000)
Intrinsic (reference) error (0 ÷ 1024 rpm)	$\pm(3 \% R + 5 D)$
Operating error (0 ÷ 1024 rpm)	$\pm(5 \% R + 10 D)$
Intrinsic (reference) error (1025 ÷ 30 000 rpm)	$\pm 3.5 \% R$
Operating error (1025 ÷ 30 000 rpm)	$\pm 6 \% R$

Note:

R - Reading

D - Digit

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