

**USER'S  
MANUAL**

***REVEXplus***  
***REVEXplus USB***

**ILLKO**  
ILLKO s.r.o.

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# 1. INTRODUCTION



*All information, instruction and warnings stated in this User's Manual are applicable both for REVEXplus and REVEXplus USB unless otherwise stated.*

## 1.1. Safety



**Read this User's Manual carefully and completely and follow all instructions contained therein. Otherwise using of the instrument may be dangerous for operator, for appliance 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 ÷ 60 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 REVEXplus. 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 REVEXplus must not be used for continuous power supply of appliance. It is intended for test purposes only; max. test duration is 60 s @ 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 REVEXplus can be powered by mains voltage during some tests. The appliance can thus be activated.
- The PE terminal is connected to PE terminal of Test Socket 1. Similarly, the I<sub>D</sub> terminal is electrically connected to PE terminal of Test Socket 1. When using the REVEXplus, do not connect any voltage to the terminals PE or I<sub>D</sub>. Otherwise there is a danger of electric shock or damage of the REVEXplus.
- Use only standard or optional accessories supplied with the REVEXplus by your distributor.



**If there is reason to believe that safe operation has become impossible, put the instrument out of operation and secure it against any unintended operation. Safe operation must be presumed to be no longer possible, if:**

- The instrument does not operate properly any longer.
- The instrument, cables, connectors, plugs or accessories exhibits visible damages.
- The instrument was stored under unfavourable conditions for a long period.
- The instrument was exposed to extraordinary stress caused by transport.

## 1.2. Explanation of symbols on instrument



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



Protection class (double insulation).

### 1.3. General description

The REVEXplus is professional portable appliance tester with many features packed into very compact case. The REVEXplus 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 AC.
- Insulation resistance test 500 V DC.
- Measurement of substitute leakage current and touch leakage current.
- Measurement of differential leakage current and touch leakage current, possibility of L-N reversal in test socket.
- Measurement of PE current during operation and touch leakage current, possibility of L-N reversal in test socket.
- Functional test of tested appliance: active power consumption (W), apparent power consumption (VA), current (A),  $\cos \varphi$ .
- Mains voltage.
- Measurement of PE current during operation by means of optional current clamp.
- Measurement of differential leakage current by means of optional current clamp.
- Measurement of current by means of optional current clamp.
- Functional test of tested appliance by means of optional current clamp: active power consumption (W), apparent power consumption (VA), and  $\cos \varphi$ .
- Measurement of PE current during operation and differential leakage current of three-phase portable appliance by means of optional adapters.
- USB communication (REVEXplus USB only).

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

- Automatic check of dangerous contact voltage on PE of power outlet, from which the REVEXplus is powered.
- Automatic check, if PE of power outlet (from which the REVEXplus is powered) is grounded.
- Automatic check of leakage current amplitude of equipment under test.
- Automatic check of external voltage absence during earth bond test.
- The possibility to promptly test the basic functionality of the REVEXplus (built-in normal).

## 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

## 1.5. Symbols used in this manual



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



Hint, notice.

[--]

Control key – meaning in the text is “Press the key”.

(--)

Indicator – it is turned on if particular function is activated.  
 The (START) indicator can blink or it can be turned on – it depends on selected measuring mode.



Press and release the relevant key.



Press and release the relevant key repetitively for the purpose of switching between its several functions.



Press the relevant key and hold it pressed.

## 2. DESCRIPTION OF THE INSTRUMENT

### 2.1. Front panel and rear panel

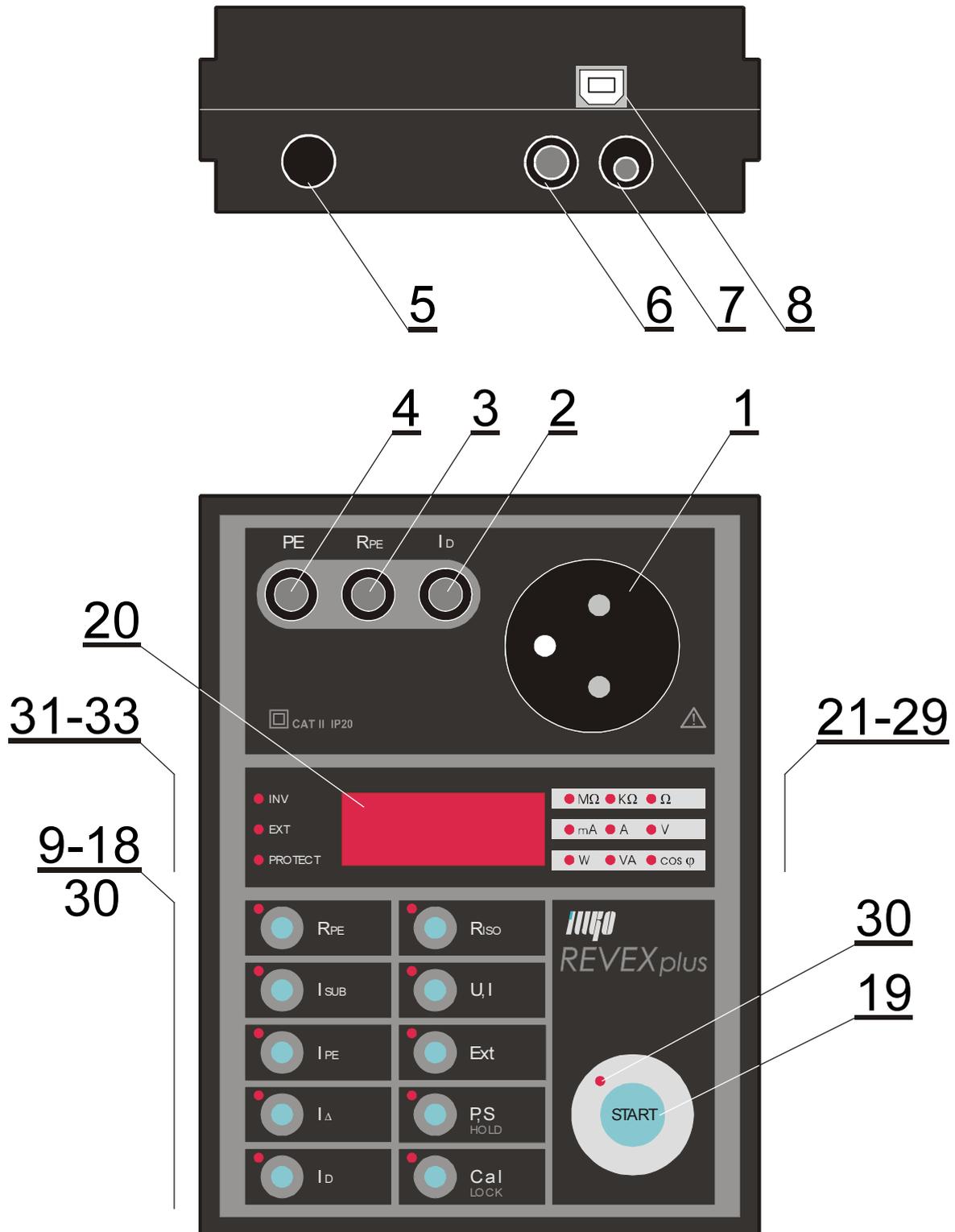


Fig. 1 – Front panel and rear panel

## 2.2. Terminals



- **Do not connect any external voltage to any terminal or connector. The only exception is power supply cord 5 which is intended for powering of the REVEXplus from 230 V / 50 ÷ 60 Hz mains outlet.**
- **Max. load on test socket 1 is 16 A, max test duration is 60 s.**
- **Use original accessories only.**

- 1 Test Socket for connection of tested appliance's power supply cord.
- 2 **I<sub>D</sub>** – touch leakage current test terminal.
- 3 **R<sub>PE</sub>** – earth bond test terminal.
- 4 **PE** – terminal for connecting of exposed conductive part of tested appliance (the terminal is connected to PE terminal of Test Socket 1).
- 5 Power supply cord.
- 6 **R<sub>ISO</sub>+I<sub>SUB</sub>** – insulation resistance / substitute leakage current test terminal.
- 7 **EXT INPUT** – current clamp / three-phase adapter / other adapters connector.
- 8 **USB** connector (REVEXplus USB only).

## 2.3. Keyboard and indicators

### *Keyboard – each key selects one or more functions*

- 9 **[R<sub>PE</sub>]** – Earth bond test.
- 10 **[I<sub>SUB</sub>]** – Substitute leakage current and touch leakage current.
- 11 **[I<sub>PE</sub>]** – PE current during operation and touch leakage current.
- 12 **[I<sub>Δ</sub>]** – Differential leakage current and touch leakage current.
- 13 **[I<sub>D</sub>]** – Touch leakage current on protective class I appliances.
- 14 **[R<sub>ISO</sub>]** – Insulation resistance.
- 15 **[U,I]** – Mains voltage and appliance's current.
- 16 **[EXT]** – EXT INPUT for current clamp / three-phase adapter activation.
- 17 **[P,S]** – Active power / apparent power / cos φ.  
**[HOLD]** – Holding of displayed data.
- 18 **[CAL]** – Test lead resistance compensation on **R<sub>PE</sub>** function / basic functionality test.  
**[LOCK]** - Locks the **[START]** key.
- 19 **[START]** – Starts measurement.

### *Indicators*

- 20 LED display.
- 21 **(MΩ)** – Insulation resistance in MΩ.
- 22 **(kΩ)** – Insulation resistance in kΩ.
- 23 **(Ω)** – Earth bond resistance in Ω.
- 24 **(mA)** – Leakage or touch current in mA.
- 25 **(A)** – Supply current of tested application in A.
- 26 **(V)** – Mains voltage in V.
- 27 **(W)** – Active power in W.
- 28 **(VA)** – Apparent power in VA.
- 29 **(cos φ)** – cos φ.

### **Status indicators**

- 30 Indicators of active status of the relevant key.
- 31 **(INV)** – indicator of L-N reversal in the test socket 1.
- 32 **(EXT)** – EXT INPUT is activated.
- 33 **(PROTECT)** – Protection (“electronic fuse”) is activated.

## **2.4. Included in the set**

The set includes all accessories necessary for testing of 230 V / 50 ÷ 60 Hz appliances equipped with movable power supply cord.

The set includes:

- REVEXplus or REVEXplus USB.
- **P 2011** – Test lead, black, 2 m.
- **P 3011** – Test tip, black.
- User's manual.
- Calibration certificate.
- USB cable A-B (REVEXplus USB only).
- CD with USB drivers (REVEXplus USB only).

## **2.5. Optional accessories**

### **Carrying bag**

- **P 6080** – bag for instrument and some accessories.  
It enables measurement with instrument hung around operator's neck.

### **Measuring cables and adapters**

- **P 2012** – Test lead, blue, 2 m.
- **P 4012** – Crocodile clip, blue.
- **P 4011** – Crocodile clip, black.
- **P 3012** – Test tip, blue.
- **P 2021** – Extension lead, black, 5 m (for P 2011).
- **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 8030** – Adapter for testing of extension power supply cords.

### **Special accessories**

- **P 8010** – Current clamp transformer.
- **WELDtest** – adapter, which enables measuring of arc welding equipments output voltage in accordance with EN 60974-4
- **PL 2051** – adapter, which enables measuring of medical instruments leakage current.
- **P 9080** – Stick-on label with appliance next test term marking.

***Special accessories for REVEXplus USB only***

- **P 9020** – Barcode reader with PS/2 connector; barcode reader connects to a PC (USB barcode reader is available, too).
- **P 9060** – Stick-on label with barcode.
- **P 9092** – Barcode printer PT-E300VP.
- **P 9100** – Cartridge TZ-241 for barcode printer; white, width 18 mm, length 8 m.
- **P 9101** – Cartridge TZ-231 for barcode printer; white, width 12 mm, length 8 m.
- **P 9102** – Cartridge TZ-221 for barcode printer; white, width 9 mm, length 8 m.

## 3. PUTTING INTO OPERATION

### 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 REVEXplus to mains outlet!**

The REVEXplus can be powered only from 230 V / 50 ÷ 60 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/disconnecting the REVEXplus to/from the mains outlet!



*The REVEXplus automatically tests protective PE (ground) pin of mains outlet:*

*1) If PE connection is inadequate, then the **(PROTECT)** indicator lights up after the REVEXplus is plugged in to mains outlet.*

*2) If dangerous contact voltage arises on PE, then the **(PROTECT)** indicator lights up when operator's finger touches the key **[START]**.*

*If operator presses the **[START]** key for all that, the measurement will not start and message „**Prot**“ appears on the display.*



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

### 3.2. Functionality test

It can be sometimes difficult to identify that the measuring instrument does not work properly, especially during leakage current measurement. The REVEXplus 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 (only one L-N polarity).
- Measurement of PE current during operation. (only one L-N polarity).



**Disconnect equipment under test before the REVEXplus functionality test!**

Functionality test procedure:

- Disconnect equipment under test.
- Use respective key to select the function you are going to test.
- Press the **[CAL]** key and release it. The **(CAL)** indicator lights up.
- Press the **[START]** key and release it. The test starts. After it is finished, the result is displayed and the **(CAL)** indicator turns off.

- If you test **I<sub>PE</sub>** or **I<sub>Δ</sub>** functions and displayed value is close to 0.000 mA, you must repeat the test once more after switching the L-N polarity by repetitive press and release of either the [**I<sub>PE</sub>**] or [**I<sub>Δ</sub>**] key. The (**INV**) indicator lights up in such case.

If the value 2.000 MΩ ÷ 2.600 MΩ is displayed, the insulation resistance measurement is correct.

If the value 0.090 mA ÷ 0.110 mA is displayed, the leakage current measurement is correct.

Contact service if the test results differ from the ones described above.

## 4. MEASUREMENTS

### 4.1. Measurement mode control - the [START] key

Beginning, process and ending of measurements is controlled by the [START] key.

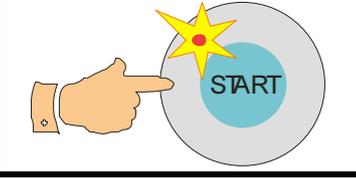
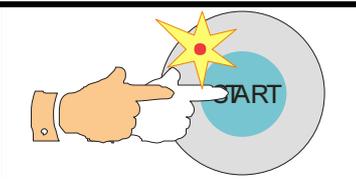
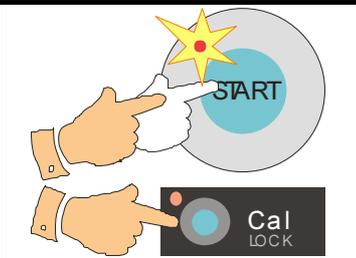
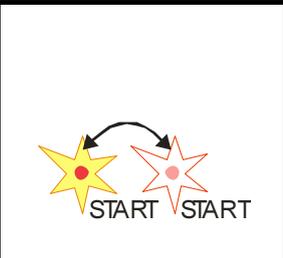
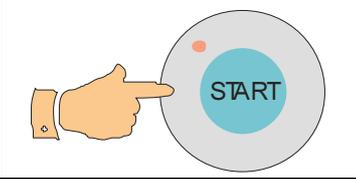
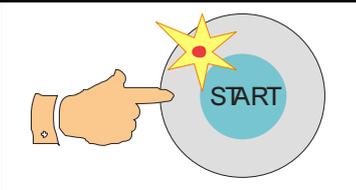
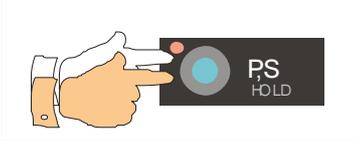
			<p><b>One measuring cycle</b></p> <p>One measuring cycle starts as it is completed.</p>
			<p><b>Continuous measurement</b></p> <p>Measurement is in progress until the [START] key is released.</p>
1			<p><b>Locking of measurement</b></p> <p>Measurement continues though both keys are released.</p>
2			Ending of measurement.
1			<p><b>Holding of displayed data</b></p> <p>Measurement is in progress and displayed result is periodically updated.</p>
2			<p>Measurement is in progress and last displayed result is displayed. To cancel the HOLD mode press and release the [HOLD] key again.</p>

Fig. 2 – Measurement mode control

#### 4.1.1. Measurement mode

The instrument enables to accomplish measurements in following three modes:

- One measuring cycle – after the [START] key is pressed and released, one measuring cycle starts and it is completed after few seconds. The result of measurement is displayed.
- Continuous measurement – press the [START] key; measurement is in progress and current measured values are displayed until the [START] key is released.

- Locking of measurement – press the [START] key and then press the [LOCK] key. Release both keys. Measurement is in progress and current measured values are displayed until the [START] key is again pressed and released.

Measuring process is indicated by (START) indicator.

#### 4.1.2. HOLD function

When measurement is in progress then current measured values are displayed. By press and release of the [HOLD] key the last measured result is displayed on display even if measurement either ended or continues. The HOLD function is indicated by such way that blinking of the (START) indicator changes to unremitting light.

HOLD function can be cancelled (measurement is still in progress) by press and release of the [HOLD] key. The (START) indicator then blinks again.

### 4.2. Earth bond 200 mA - [ $R_{PE}$ ]



- **Make sure that tested equipment is deenergized – its mains voltage must be disconnected before starting the measurement!**
- **Do not connect any external voltage between  $R_{PE}$  terminal 3 and either PE in test socket 1 or PE terminal 4.**
- **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 on appliance under test, the (PROTECT) indicator turns on and „Prot“ message is displayed. Such status is dangerous fault condition; disconnect equipment under test from the REVEXplus immediately to avoid its damage!**

#### 4.2.1. Test lead resistance compensation



*Compensation means that the test lead resistance is measured and then automatically memorized and subtracted from all  $R_{PE}$  measurements. The real earth bond resistance is thus displayed. The compensation constant remains in instrument's memory even if the instrument is switched off. And so the lead compensation is valid until new compensation is carried out.*

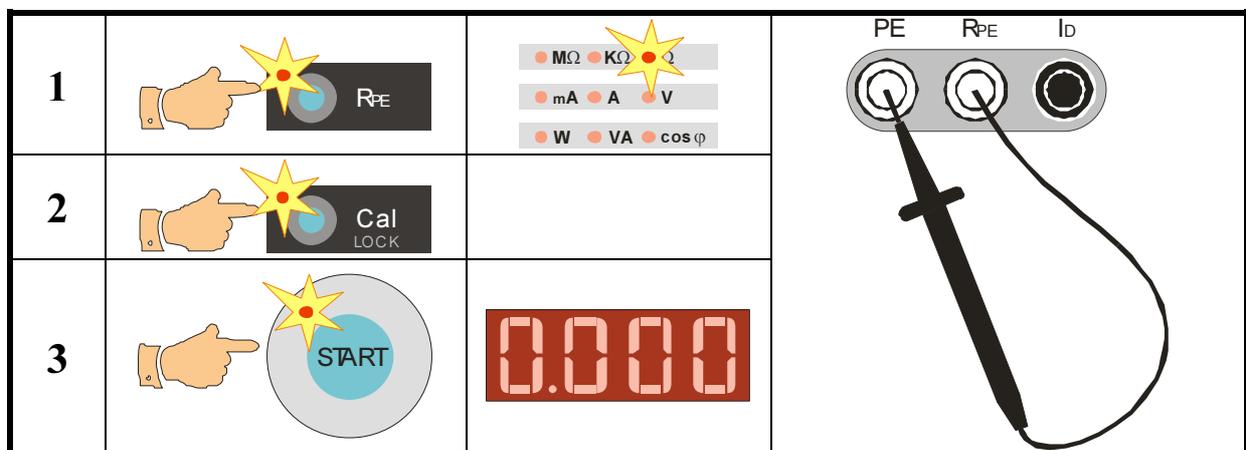


Fig. 3 – Test lead resistance compensation

- Press the [**R<sub>PE</sub>**] key and release it. Symbol „-“ is displayed and indicators (**R<sub>PE</sub>**) and (**Ω**) light up.
- Connect test lead P2011 with test tip P3011 to the **R<sub>PE</sub>** terminal.
- Connect test tip of the test lead either to the **PE** terminal or press it against the ground pin of the test socket **1**. If you use two test leads (which are connected to the **PE** terminal and the **R<sub>PE</sub>** terminal) then make short-circuit of their test tips.
- Press the [**CAL**] key and release it. Now the indicators (**CAL**), (**R<sub>PE</sub>**) and (**Ω**) shine.
- Press the [**START**] key and release it. Test lead resistance is shortly displayed, then the (**CAL**) indicator turns off and „0.000“ is displayed. Test lead resistance compensation is finished.

The compensation is effective for test lead resistance  $< 2 \Omega$ .

If test lead resistance is  $\geq 2 \Omega$  and compensation procedure is carried out, compensation is cancelled and all following displayed results are a sum of earth bond + test lead resistance. If compensation is active (it means that test lead resistance  $< 2 \Omega$  was memorized) then the (**CAL**) indicator lights up during **R<sub>PE</sub>** measurements.

#### 4.2.2. Earth bond measurement

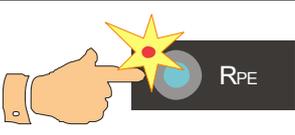
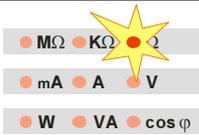
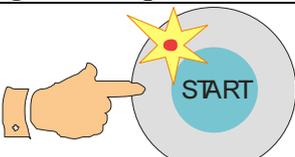
1			Function selection
2	Connect tested appliance		Appliance connecting
3	Press the test tip connected to the <b>R<sub>PE</sub></b> terminal against exposed conductive part of tested appliance		
4			Measurement

Fig. 4 – Earth bond measurement

##### Step 1 - preparation for measurement

- Select the **R<sub>PE</sub>** function: press the [**R<sub>PE</sub>**] key and release it. Symbol „-“ is displayed and indicators (**R<sub>PE</sub>**) and (**Ω**) light up.
- Connect test lead P2011 with test tip P3011 to the **R<sub>PE</sub>** terminal.
- If test lead compensation was not carried out yet, compensate it now – see details in chapter 4.2.1.
- Connect tested appliance:
  - One-phase appliance with movable power supply cord – plug in its mains plug to test socket **1**.
  - Three-phase appliance with movable power supply cord – connect PE pin of its plug to the instrument's **PE** terminal by means of optional test lead P2012 + crocodile clip P4012.
  - Hard-wired appliance – **firstly disconnect appliance from mains!** Connect its point of PE connection to the instrument's **PE** terminal by means of optional test lead P2012 + crocodile clip P4012.

## Step 2 - measurement

- Press test tip against exposed conductive part of tested appliance.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator. If the (CAL) indicator lights on during measurement, it means that test lead resistance is compensated (see chapter 4.2.1. for details).
- After finishing of measurement (the (START) indicator turns off) the **lowest** measured value of earth bond resistance is displayed. If only „1“ is displayed (see chapter 5.1 for details) it means that measured earth bond resistance is higher than maximal value which can be measured by the REVEXplus.

## 4.3. Insulation resistance - [R<sub>ISO</sub>]



- **Make sure tested appliance is deenergized – its mains voltage must be disconnected before starting of measurement!**
- **Do not touch exposed conductive parts of tested appliance while measurement is in progress – RISK OF ELECTRIC SHOCK! Measurement in progress is indicated by the (START) indicator.**
- **Do not disconnect test leads while measurement is in progress or immediately after finishing the measurement. Capacitive component of tested appliance can be charged to voltage up to 750 V; after the key [START] is released, this voltage is automatically discharged! If the capacitive component would be so extraordinary high that the discharging circuitry in the REVEXplus would not be able to discharge it to voltage < 50 V, the message „Prot“ would be displayed. Tested appliance must be disconnected from the instrument in this case and its capacitance must be discharged by another alternative safe method.**



In case that external voltage is present on tested appliance, measurement will not be carried out. Indicator (**PROTECT**) turns on and message „Prot“ is displayed.

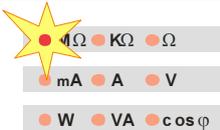
1			Function selection
2	Connect tested appliance; its mains switch must be switched on		Appliance connecting
3			Measurement

Fig. 5 – Insulation resistance measurement

### Step 1 - preparation for measurement

- Select the R<sub>ISO</sub> function: press the [R<sub>ISO</sub>] key and release it. Symbol „-“ is displayed and indicators (R<sub>ISO</sub>) and (MΩ) light up.
- Connect tested appliance:

- One-phase appliance with movable power supply cord – plug in its mains plug to test socket **1**.
- Three-phase appliance with movable power supply cord – connect PE pin of its plug to the instrument's **PE** terminal by means of optional test lead P2012 + crocodile clip P4012. Then connect remaining current-carrying conductors by means of test lead P2011 + test tip P3011 to the instrument's **R<sub>ISO</sub> + I<sub>SUB</sub>** terminal (placed on rear panel).
- Hard-wired appliance – **firstly disconnect appliance from mains!** Connect its point of PE connection to the instrument's **PE** terminal by means of optional test lead P2012 + crocodile clip P4012. Then connect remaining current-carrying conductors by means of test lead P2011 + test tip P3011 to the instrument's **R<sub>ISO</sub> + I<sub>SUB</sub>** terminal (placed on rear panel).

### Step 2 - measurement

- Switch on tested appliance's mains switch.
- Press the **[START]** key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the **(START)** indicator. It is recommended to hold the **[START]** key pressed 5-10 s (or even longer if displayed result is not stabilized) - the influence of tested appliance's internal capacitance can be eliminated by this method.
- After finishing of measurement (the **(START)** indicator turns off) the last measured value of insulation resistance is displayed. At the same time either indicator **(MΩ)** or **(kΩ)** lights up and so the unit of measured insulation resistance is determined. If only „1“ is displayed (see chapter 5.1 for details) it means that measured insulation resistance is higher than maximal value which can be measured by the REVEXplus.

## 4.4. Substitute leakage current - [I<sub>SUB</sub>]



- **Make sure tested appliance is deenergized – its mains voltage must be disconnected before starting of measurement!**
- **Firstly earth bond resistance (chapter 4.2.) must be tested; it is recommended to test insulation resistance, too (chapter 4.3.). Then you can execute substitute leakage current measurement!**
- **Do not touch exposed conductive parts of tested appliance while measurement is in progress – RISK OF ELECTRIC SHOCK! Measurement in progress is indicated by the (START) indicator.**



Test voltage is max. 230 V / 50 ÷ 60 Hz, short circuit current is about 3.5 mA.

### 4.4.1. Protective class I appliances

<b>1</b>			Function selection
<b>2</b>	Connect tested appliance; its mains switch must be switched on		Appliance connecting

3			Measurement
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Fig. 6 – Substitute leakage current measurement

### Step 1 - preparation for measurement

- Select the  $I_{SUB}$  function: pres the [ $I_{SUB}$ ] key and release it. Symbol „-“ is displayed and indicators ( $I_{SUB}$ ) and (mA) light up.
- Connect tested appliance:
  - One-phase appliance with movable power supply cord – plug in its mains plug to test socket 1.
  - Three-phase appliance with movable power supply cord – connect PE pin of its plug to the instrument's PE terminal by means of optional test lead P2012 + crocodile clip P4012. Then connect remaining current-carrying conductors by means of test lead P2011 + test tip P3011 to the instrument's  $R_{ISO} + I_{SUB}$  terminal (placed on rear panel).
  - Hard-wired appliance – **firstly disconnect appliance from mains!** Connect its point of PE connection to the instrument's PE terminal by means of optional test lead P2012 + crocodile clip P4012. Then connect remaining current-carrying conductors by means of test lead P2011 + test tip P3011 to the instrument's  $R_{ISO} + I_{SUB}$  terminal (placed on rear panel).

### Step 2 – measurement

- Switch on tested appliance's mains switch.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator.
- After finishing of measurement (the (START) indicator turns off) the last measured value of substitute leakage current is displayed.

#### 4.4.2. Protective class II appliances – substitute touch leakage current

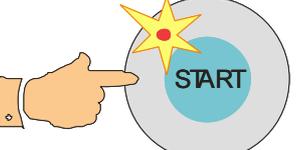
1			Function selection
2	Connect tested appliance; its mains switch must be switched on		Appliance connecting
3	Press the test tip connected to the $I_D$ terminal against exposed conductive part of tested appliance		
4			Measurement

Fig. 7 – Substitute touch leakage current measurement

**Step 1 - preparation for measurement**

- Select the  $I_{SUB}$  function: pres the [ $I_{SUB}$ ] key and release it. Symbol „-“ is displayed and indicators ( $I_{SUB}$ ) and (mA) light up.
- Connect tested appliance:
  - One-phase class II appliance with movable power supply cord – plug in its mains plug to test socket 1.
- Connect test lead P2011 + test tip P3011 to the instrument's ID terminal.
- Switch on tested appliance's mains switch.

**Step 2 – measurement**

- Press test tip against exposed conductive part of tested appliance.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator.
- After finishing of measurement (the (START) indicator turns off) the last measured value of substitute touch leakage current is displayed.

**4.5. PE current during operation - [ $I_{PE}$ ] and differential leakage current - [ $I_{\Delta}$ ]****4.5.1. Protective class I one-phase appliances****WARNING - DANGER!**

- If test voltage is present in Test socket 1 – it is indicated by the (START) indicator, then tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after mains switch is switched on!
- Firstly earth bond resistance (chapter 4.2.) must be tested; it is recommended to test insulation resistance if it is possible, too (chapter 4.3.). Then you can execute leakage current measurement!
- Equipment under test must be isolated from ground (from the earth potential) during measurement of  $I_{PE}$ !
- Test Socket 1 of the REVEXplus must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 60 s @ 16A.



The REVEXplus is equipped with electronic checking of excessive leakage current during measurement. If leakage current exceeds limit value about 12 mA, then mains voltage is disconnected from test socket 1. This status is indicated by displaying „Prot“ message; the indicator (PROTECT) turns on, too.

<b>1</b>		Function selection
<b>2</b>	Connect tested appliance	Connect tested appliance to test socket <u>1</u>

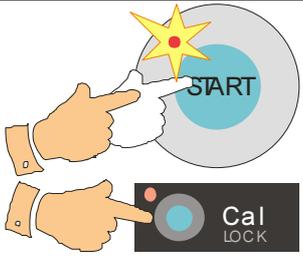
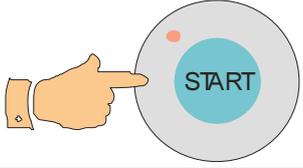
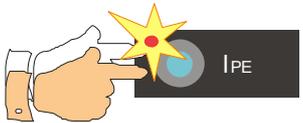
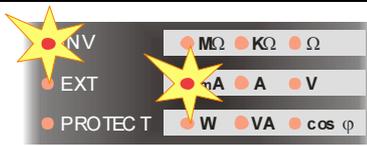
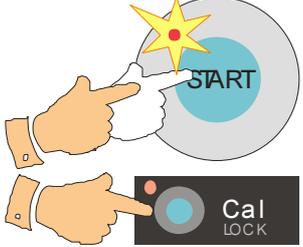
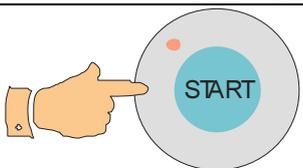
3			Test socket <u>1</u> energizing (Locking of the [START] key)
4	Switch on tested appliance		Measurement
5	Switch off tested appliance		End of measurement
6			Test socket <u>1</u> deenergizing (Unlocking of the [START] key)
7			L-N reversal in test socket <u>1</u>
8			Test socket <u>1</u> energizing (Locking of the [START] key)
9	Switch on tested appliance		Measurement
10	Switch off tested appliance		End of measurement
11			Test socket <u>1</u> deenergizing (Unlocking of the [START] key)

Fig. 8 – Leakage current measurement

**Step 1 - preparation for measurement**

- Select the  $I_{PE}$  function or the  $I_{\Delta}$  function: press either the [I<sub>PE</sub>] key or the [I<sub>Δ</sub>] key and release it. Symbol „-“ is displayed and indicators either (I<sub>PE</sub>) or (I<sub>Δ</sub>) and (mA) light up.
- Connect tested appliance: plug in its mains plug to test socket 1.

**Step 2 – measurement with L-N default**

- Press and release either the [I<sub>PE</sub>] or the [I<sub>Δ</sub>] key. If the indicator (INV) lights up, then press and release corresponding key once more in order to turn off the indicator (INV).
- Press the [START] key. It is recommended to lock the measurement - press the [START] key and then press the [LOCK] key. Release both keys. The presence of

voltage in test socket **1** and measurement in progress is indicated by the **(START)** indicator (see chapter 4.1. for measurement control details).

- Switch on tested appliance's mains switch and put it into operation.
- You can activate HOLD function by pressing and releasing of the **[HOLD]** key after stabilizing of displayed result (see chapter 4.1.2. for details).
- If it is necessary test touch leakage current – see chapter 4.6. for details.
- Switch off tested appliance by its mains switch.
- Disconnect voltage from test socket **1** by pressing and releasing of the **[START]** key. The indicator **(START)** turns off.

### Step 3 – measurement with L-N reversal

- Press and release either the **[I<sub>PE</sub>]** or the **[I<sub>Δ</sub>]** key. If the indicator **(INV)** does not light up, then press and release corresponding key once more in order to turn on the indicator **(INV)**.
- Proceed once more with above described procedure from Step 2, 2nd item.

### 4.5.2. Three-phase and hard-wired appliances - **[EXT]**

Optional accessories are intended for leakage current measurement of both three-phase and hard-wired appliances.

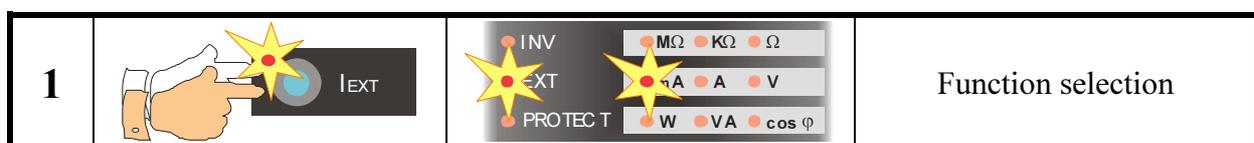
Three-phase adapter must be used for measurement of three-phase appliances with movable power supply cord. It is necessary to plug in tested appliance by means of three-phase adapter and to select required measuring method by means of three-phase adapter's function switch (see fig. 9) before measurement.

Current clamp must be used for measurement of hard-wired appliances.



*The **[EXT]** key activates external input **EXT INPUT**. If it is activated, the **(EXT)** indicator lights up and test socket **1** is not functional!*

- Connect either optional current clamp or three-phase adapter to the **EXT INPUT** terminal on the rear side of the REVEXplus.
- Press and release the **[EXT]** key, the **(mA)** indicator has to light up. The **(EXT)** indicator is turned on, too.
- Switch on tested appliance's mains switch and put it into operation.
- If you use current clamp then enclose with its jaws either protective conductor (PE current during operation measurement) or all current carrying (L+N) conductors (differential leakage current measurement) of tested appliance.
- Press the **[START]** key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the **(START)** indicator.
- Finish measurement after displayed result is stabilized (see chapter 4.1. for measurement control details).
- After finishing of measurement (the **(START)** indicator turns off) the last measured value of leakage current is displayed.
- Switch off tested appliance's mains switch.



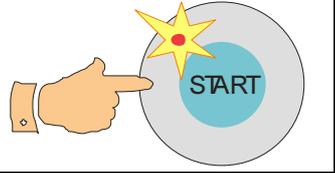
2	Connect optional accessories – either current clamp or three-phase adapter.	Appliance connecting	
3	Switch on tested appliance's mains switch and put it into operation.		
4			Measurement

Fig. 10 – Leakage current measurement by means of optional accessories

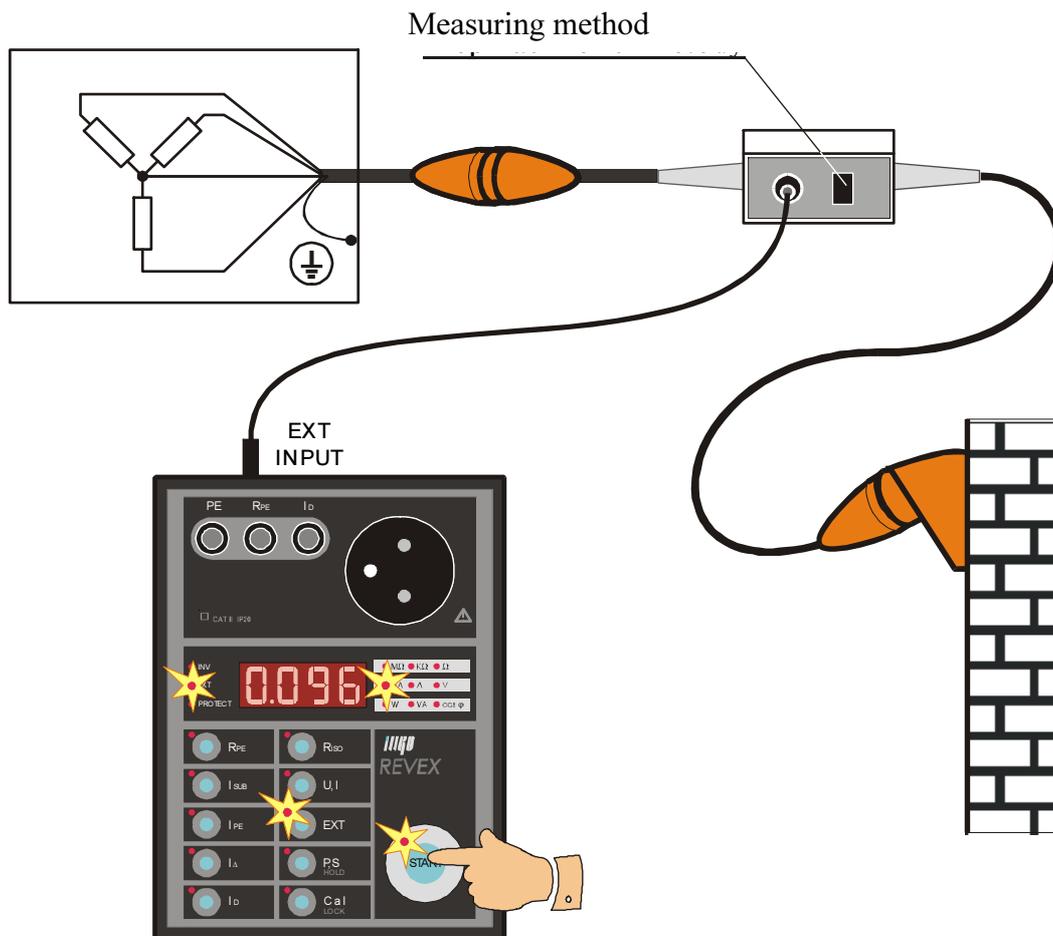


Fig. 9 – Three-phase adapter connection

#### 4.6. Touch leakage current - [I<sub>D</sub>]



**Touch leakage current measurements are performed with the same measuring methods like leakage current measurements.**

**Thus all safety and working warnings and instructions stated for leakage current measurements are valid for touch leakage current measurements, too!**



*Touch leakage current can be measured by methods described in chapters 4.4. and 4.5. The measurement of substitute touch leakage current is described in chapter 4.4.2.*

#### 4.6.1. Protective class II appliances

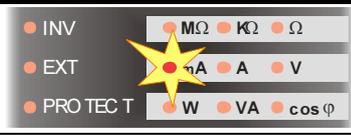
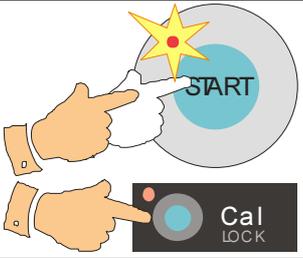
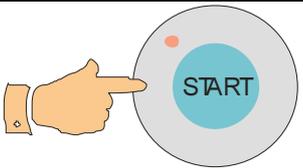
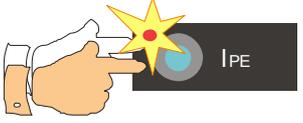
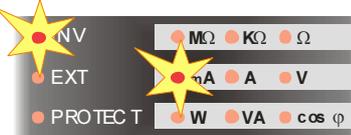
1			Function selection
2	Connect tested appliance		Connect tested appliance to test socket <u>1</u>
3			Test socket <u>1</u> energizing (Locking of the [START] key)
4	Switch on tested appliance		
5	Press the test tip connected to the $I_D$ terminal against exposed conductive part of tested appliance.		Touch leakage current measurement
7	Switch off tested appliance		End of measurement with L-N default
8			Test socket <u>1</u> deenergizing (Unlocking of the [START] key)
9			L-N reversal in test socket <u>1</u>
Proceed once more with above described procedure from Step 3 to Step 8.			

Fig. 11 – Touch leakage current of protective class II appliances measurement

##### Step 1 - preparation for measurement

- Connect test lead P2011 with test tip P3011 to the  $I_D$  terminal.
- Accomplish preparation for measurement described in chapter 4.5.1. Step 1.

##### Step 2 – measurement with L-N default

- Press and release either the [IPE] or the [ $I_\Delta$ ] key. If the indicator (INV) lights up, then press and release corresponding key once more in order to turn off the indicator (INV).
- Press the [START] key. It is recommended to lock the measurement - press the [START] key and then press the [LOCK] key. Release both keys. The presence of

voltage in test socket **1** and measurement in progress is indicated by the **(START)** indicator (see chapter 4.1. for measurement control details).

- Switch on tested appliance's mains switch and put it into operation.
- Press the test tip of the test lead (connected to the **I<sub>D</sub>** terminal) against exposed conductive part of tested appliance. Measurement starts; measured values are displayed.
- Switch off tested appliance's mains switch.
- Disconnect voltage from test socket **1** by pressing and releasing of the **[START]** key. The indicator **(START)** turns off.

### Step 3 – measurement with L-N reversal

- Press and release either the **[I<sub>PE</sub>]** or the **[I<sub>Δ</sub>]** key. If the indicator **(INV)** does not light up, then press and release corresponding key once more in order to turn on the indicator **(INV)**.
- Proceed once more with above described procedure from Step 2, 2nd item.

### 4.6.2. Protective class I appliances



*There is used the same circuitry both for touch leakage current measurement and for leakage current measurement. It means the instrument measures at the same time both mentioned leakage currents. In order to separate these currents it is firstly necessary to measure PE current during operation and memorise its value by means of the **[I<sub>D</sub>]** key. Thereafter it is practicable to measure touch leakage current - formerly memorised value is automatically subtracted from the measured total value of leakage current and thus only touch leakage current is displayed.*

#### Step 1 - preparation for measurement

- Connect test lead P2011 with test tip P3011 to the **I<sub>D</sub>** terminal.
- Accomplish preparation for measurement described in chapter 4.5.1 Step 1.

#### Step 2 – measurement with L-N default

- Start the procedure described in chapter 4.5.1 Step 2.
- As soon as displayed leakage current is stabilized, press the **[I<sub>D</sub>]** key and release it. Displayed value is memorized, the **(I<sub>D</sub>)** indicator lights up and 0.000 mA is displayed afterwards.
- Press the test tip of the test lead (connected to the **I<sub>D</sub>** terminal) against exposed conductive part of tested appliance. Measurement of the touch leakage current starts. Formerly memorised value is automatically subtracted from the measured total value of leakage current and thus only touch leakage current is displayed.
- Switch off tested appliance's mains switch.
- Disconnect voltage from test socket **1** by pressing and releasing of the **[START]** key. The indicator **(START)** turns off.

#### Step 3 – measurement with L-N reversal

- Start the procedure described in chapter 4.5.1 Step 3.
- Proceed once more with Step 2.



*If the PE leakage current fluctuates and it is unstable during touch leakage current measurement, this fluctuation affects measured value of touch leakage current. In such case we recommend not to use the **[I<sub>D</sub>]** key for its memorizing, but to remember the value which was displayed immediately before pressing of the test tip against exposed conductive part of tested appliance and to subtract it “manually”.*

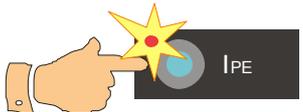
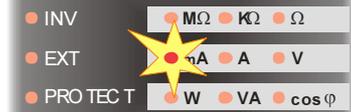
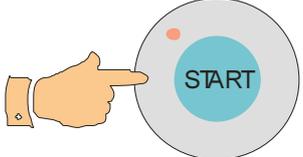
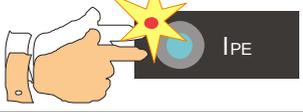
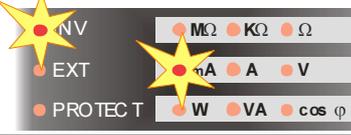
1			Function selection
2	Connect tested appliance		Connect tested appliance to test socket <u>1</u>
3			Test socket <u>1</u> energizing (Locking of the [START] key)
4	Switch on tested appliance		PE current during operation measurement
5			Memorizing of PE current during operation.
6	Press the test tip connected to the $I_D$ terminal against exposed conductive part of tested appliance.		Measurement of touch leakage current (PE current during operation is automatically subtracted; displayed result is thus correct).
7	Switch off tested appliance		End of measurement with L-N default
8			Test socket <u>1</u> deenergizing (Unlocking of the [START] key)
9			L-N reversal in test socket <u>1</u>
Proceed once more with above described procedure from Step 3 to Step 8.			

Fig. 12 – Touch leakage current of protective class I appliances measurement

#### 4.7. Mains voltage and current consumption – [U, I]



Function U measures L-N voltage in mains outlet from which the REVEXplus is powered.

Function I measures current consumption of tested appliance connected to test socket 1.

#### 4.7.1. Mains voltage measurement

- Press the [U, I] key and release it repetitively in order to select voltage measurement function U. The (V) indicator has to light up.
- Press the [START] key and release it. Measurement is indicated by the (START) indicator.
- After finishing of measurement (the (START) indicator turns off) the last measured value of mains voltage is displayed.

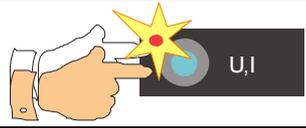
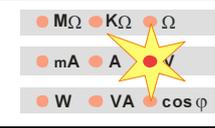
1			Function selection
2			Measurement

Fig. 13 – Mains voltage measurement

#### 4.7.2. Current consumption measurement



##### WARNING - DANGER!

- If test voltage is present in Test socket 1 – it is indicated by the (START) indicator, then tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after mains switch is switched on!
- Test Socket 1 of the REVEXplus must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 60 s @ 16A.

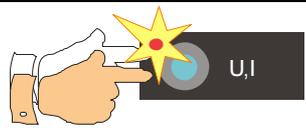
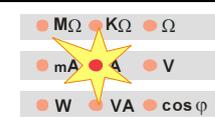
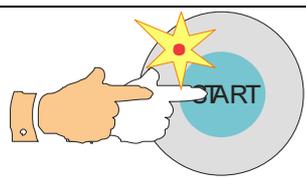
1			Function selection
2	Connect tested appliance		Connect tested appliance to test socket <u>1</u>
3			Test socket <u>1</u> energizing
4	Switch on mains switch of tested appliance		Measurement

Fig. 14 – Current consumption measurement

- Press the [U, I] key and release it repetitively in order to select current consumption measurement function I. The (A) indicator has to light up.
- Connect tested appliance to test socket 1.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator.
- Switch on tested appliance's mains switch and put it into operation.
- Finish measurement after displayed result is stabilized (see chapter 4.1. for measurement control details).
- After finishing of measurement (the (START) indicator turns off) the last measured value of tested appliance's supply current is displayed.
- Switch off tested appliance's mains switch.

#### 4.7.3. Current measurement by means of current clamp - [EXT]



The [EXT] key activates external input **EXT INPUT**. If it is activated, the (EXT) indicator lights up and test socket 1 is not functional!

- Connect optional current clamp to the **EXT INPUT** terminal on the rear side of the REVEXplus.
- Press and release the [EXT] key repetitively until the (A) indicator lights up. The (EXT) indicator is turned on, too.
- Switch on tested appliance's mains switch and put it into operation.
- Enclose with current clamp's jaws live conductor L of measured appliance.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator.
- Finish measurement after displayed result is stabilized (see chapter 4.1. for measurement control details).
- After finishing of measurement (the (START) indicator turns off) the last measured value of current is displayed.
- Switch off tested appliance's mains switch.

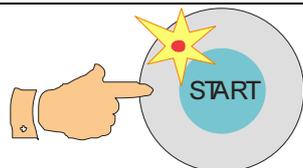
1			Function selection
2	Connect current clamp to the instrument and enclose with its jaws live conductor of measured appliance.		Connect current clamp
3	Switch on mains switch of tested appliance		
4			Measurement

Fig. 15 – Current measurement by means of current clamp

## 4.8. Active power consumption, apparent power consumption and $\cos \varphi$ – [P, S]

During measurement of any electrical quantity carried out in test socket 1 (measurements 1-3 in the following table) or by means of current clamp (measurements 4-6 in the following table) remaining quantities 1-3 or 4-6 are automatically measured and memorized. Measured results (1-3 or 4-6) can be then successively displayed by pressing/releasing of the [P, S] key. Currently displayed quantity is indicated by the indicator (W), (VA) or ( $\cos \varphi$ ) and possibly (EXT).

	Function	El. quantity indicator	Input indicator
1	Active power - tested appliance connected to test socket <u>1</u>	(W)	
2	Apparent power - tested appliance connected to test socket <u>1</u>	(VA)	
3	Cos $\varphi$ - tested appliance connected to test socket <u>1</u>	( $\cos \varphi$ )	
4	Active power - by means of current clamp	(W)	(EXT)
5	Apparent power - by means of current clamp	(VA)	(EXT)
6	Cos $\varphi$ - by means of current clamp	( $\cos \varphi$ )	(EXT)

### 4.8.1. Power consumptions and $\cos \varphi$ measured in test socket 1



#### WARNING - DANGER!

- If test voltage is present in Test socket 1 – it is indicated by the (START) indicator, then tested equipment starts to run after its mains switch is switched on! Take into consideration all safety warnings, referred to equipment under test!
- Do not touch exposed conductive parts of tested object after mains switch is switched on!
- Test Socket 1 of the REVEXplus must not be used for continuous power supply of appliance! It is intended for test purposes only; max. test duration is 60 s @ 16A.

1			Function selection
2	Connect tested appliance		Connect tested appliance to test socket <u>1</u>
3			Test socket <u>1</u> energizing
4	Switch on mains switch of tested appliance		Measurement
5			Displaying of other measured quantities

Fig. 16 – Power consumption and  $\cos \varphi$  measurement

- Press the [P, S] key and release it repetitively in order to select required function. The (W), (VA) or ( $\cos \varphi$ ) indicator has to light up.
- Connect tested appliance to test socket **1**.
- Press the [START] key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the (START) indicator.
- Switch on tested appliance's mains switch and put it into operation.
- Finish measurement after displayed result is stabilized (see chapter 4.1. for measurement control details).
- After finishing of measurement (the (START) indicator turns off) the last measured value is displayed. You can check other measured quantities – press and release the [P, S] key repetitively.
- Switch off tested appliance's mains switch.

#### 4.8.2. Power consumptions and $\cos \varphi$ measured by means of current clamp



It is important to observe these principles for proper measurement:

- Both REVEXplus and tested appliance must be powered from identical phase.
- Current clamp must enclose live conductor in a way that arrow on current clamp points from power source to appliance. Mains outlet from which the instrument is powered has to have live contact located on left side. If apparent power value or  $\cos \varphi$  value fluctuates randomly and even values out of specified measuring ranges are displayed then reverse either clamp's or mains plug's orientation.

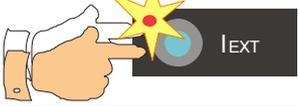
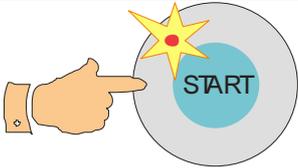
1			Function selection
2	Connect current clamp to the instrument and enclose with its jaws live conductor of measured appliance.		Connect current clamp
3	Switch on mains switch of tested appliance		
4			Measurement
5			Displaying of other measured quantities

Fig. 17 – Power consumption and  $\cos \varphi$  measurement by means of current clamp

- Connect optional current clamp to the **EXT INPUT** terminal on the rear side of the REVEXplus.
- Press and release the **[P, S]** key repetitively in order to select required function. The **(W)**, **(VA)** or **(cos φ)** indicator has to light up and **(EXT)** indicator has to light up, too.
- Switch on tested appliance's mains switch and put it into operation.
- Enclose with current clamp's jaws live conductor L of measured appliance in a way that arrow on current clamp points from power source to appliance.
- Press the **[START]** key; measurement starts to run (see chapter 4.1. for measurement control details). Measurement is indicated by the **(START)** indicator.
- Finish measurement after displayed result is stabilized (see chapter 4.1. for measurement control details).
- After finishing of measurement (the **(START)** indicator turns off) the last measured value is displayed. You can check other measured quantities – press and release the **[P, S]** key repetitively.
- Switch off tested appliance's mains switch.

#### 4.9. Utilization of other external adapters – **[EXT]**

By repetitive press and release of the **[EXT]** key it is possible to select besides other functions the function, where both the **(V)** and **(EXT)** indicators are turned on.

This function is intended for connecting of other adapters, e.g. the **WELDtest** - adapter enabling measuring of arc welding equipments output voltage in accordance with EN 60974-4.



- *The way of connecting of adapter to instrument, description of measuring procedure and other necessary information are published in adapter's user manual.*
- *The **[EXT]** key activates external input **EXT INPUT**. If it is activated, the **(EXT)** indicator lights up and test socket **1** is not functional.*



**It is prohibited to connect any external voltage to the EXT INPUT terminal!  
Use original accessories only!**

## 5. ADDITIONAL INFORMATION

### 5.1. Displayed messages

#### *Operational state*

The instrument is ready for measurement.



#### *Overflow*

Measured value is higher than the highest measurable value.



#### *Protection activated*

Protective circuitry is activated. Measurements will be possible after removal of fault.



Possible causes of protective circuitry activation:

Error indication	Action statement	Cause of fault condition
(PROTECT)  (+ eventually "Prot" displayed)	The <b>(PROTECT)</b> indicator lights up instantly after the instrument is plugged in to mains outlet.  If operator presses the <b>[START]</b> key for all that, the measurement will not start and message „ <b>Prot</b> “ appears on the display.	PE connection in mains outlet from which the REVEXplus is powered is inadequate.
(PROTECT)  (+ eventually "Prot" displayed)	The <b>(PROTECT)</b> indicator lights up when operator's finger touches the <b>[START]</b> key.  If operator presses the <b>[START]</b> key for all that, the measurement will not start and message „ <b>Prot</b> “ appears on the display.	Dangerous contact voltage arises on PE.
(PROTECT) + "Prot" displayed	R <sub>PE</sub> measurement – at any time.	External voltage > 10 V is present on tested appliance.
(PROTECT) + "Prot" displayed	R <sub>ISO</sub> measurement – after the <b>[START]</b> key is pressed.	External voltage > 10 V is present on tested appliance.
(PROTECT) + "Prot" displayed	I <sub>PE</sub> , I <sub>A</sub> , I <sub>D</sub> measurement – at any time.	Leakage or touch leakage current exceeds about 12 mA.

## 5.2. Reset of the instrument

It is advised to execute instrument's RESET in case of any malfunction. Disconnect the REVEXplus from mains, wait 30 s and plug it in again. If malfunction persists, contact your local distributor.

## 5.3. Communication with PC (REVEXplus USB only)

The Hyperterminal program (which is standard component of Windows installation) is utilized for communication with PC.

Information related to USB driver installation, Hyperterminal setup and communication are on enclosed CD-ROM.

## 5.4. Maintenance

Regularly check the technical safety and integrity of insulation of power supply cord, plastic case and all accessories. 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!**

## 5.5. Calibration and service

### Calibration

Measuring instruments should be regularly calibrated. We recommend interval of calibration 2 years. Furthermore we recommend carrying out calibration after each repair.

### Service



**Unauthorized persons are not allowed to open the REVEXplus.  
There are no replaceable components inside the instrument.  
Any claims for guarantee will become invalid in the event of damage that results from non-observance of the User's Manual. We do not accept responsibility for such damage.**

Contact your local distributor for further information.

**Manufacturer**

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**tel./fax: +420 516 417 355**

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**<http://www.illko.cz>**

**5.6. Ecology****Transportation packing**

It is made of corrugated board; it is recyclable.

**Instrument**

This symbol signifies that the product should not be thrown away to municipal waste at end-of-life.

Please dispose of this product according to the relevant statutory requirements.

## 6. TECHNICAL SPECIFICATION

### 6.1. General data

Protective class ..... II (double insulation)  
 Over voltage class ..... CAT II  
 Pollution degree..... 2  
 Degree of protection..... IP 20  
 Reference condition:  
 Line voltage .230V $\pm$ 1%/50Hz,60Hz  $\pm$ 1%  
 Ambient temperature ..... (23  $\pm$  2) °C  
 Humidity ..... 45  $\div$  55 % RH @ 23 °C  
 Position ..... arbitrary  
 Operating condition:  
 Line voltage 230V $\pm$ 10%/50Hz,60Hz  $\pm$ 1%  
 Ambient temperature ..... 0°C  $\div$  40°C

Humidity ..... max. 75 % RH @ 23°C  
 (condensation not allowed)  
 Elevation.....max. 2000 m  
 Max. supply current..... 16 A  
 (it depends on tested appliance)  
 Quiescent current..... < 50 mA  
 Dimensions (w x d x h) .150 x 195 x 50 mm  
 Mass (without accessories)..... 1 kg  
 Storage temperature / storage humidity.....  
 .....-10°  $\div$  50°C / max. 75% RH  
 Case resistance to temperature ..... 70°C  
 PE test..... automatic  
 PC connection (REVEXplus USB only).USB

### 6.2. Functions

#### *Earth bond 200 mA*

Entire measuring range	0.000 $\div$ 20.00 $\Omega$
Measuring sub range	0.000 $\div$ 0.999 $\Omega$
Resolution	0.001 $\Omega$
Reference error	$\pm$ (1 % of R + 5 D)
Operating error	$\pm$ (2 % of R + 5 D)
Measuring sub range	1.00 $\div$ 20.00 $\Omega$
Resolution	0.01 $\Omega$
Reference error	$\pm$ (1 % of R + 3 D)
Operating error	$\pm$ (2 % of R + 3 D)
Operating range of use (according to EN 61557-4)	0.018 $\div$ 20.00 $\Omega$
Open-circuit voltage	AC 5 $\div$ 12 V
Test current (R $\leq$ 2 $\Omega$ )	$\geq$ AC 200 mA
Test lead compensation	yes (up to 2 $\Omega$ )

#### *PE current during operation*

Entire measuring range	0.000 $\div$ 10.00 mA
Measuring sub range	0.000 $\div$ 1.499 mA
Resolution	0.001 mA
Reference error	$\pm$ (1 % of R + 5 D)
Operating error	$\pm$ (2 % of R + 8 D)
Measuring sub range	1.50 $\div$ 10.00 mA
Resolution	0.01 mA
Reference error	$\pm$ (1 % of R + 5 D)
Operating error	$\pm$ (2 % of R + 5 D)
Test voltage	line voltage
Frequency characteristic of internal test circuitry	according to EN 61010
Functionality test	0.090 $\div$ 0.110 mA

#### *Insulation resistance*

Entire measuring range	0.000 k $\Omega$ $\div$ 100.0 M $\Omega$
Measuring sub range	0.0 k $\Omega$ $\div$ 999.9 k $\Omega$
Resolution	0.1 k $\Omega$
Reference error	$\pm$ (2 % of R + 8 D)
Operating error	$\pm$ (3 % of R + 8 D)
Measuring sub range	1.000 M $\Omega$ $\div$ 3.999 M $\Omega$
Resolution	0.001 M $\Omega$
Reference error	$\pm$ (2 % of R + 8 D)
Operating error	$\pm$ (3 % of R + 8 D)
Measuring sub range	4.00 M $\Omega$ $\div$ 19.99 M $\Omega$
Resolution	0.01 M $\Omega$
Reference error	$\pm$ (2 % of R + 8 D)
Operating error	$\pm$ (3 % of R + 8 D)
Measuring sub range	20.0 M $\Omega$ $\div$ 100.0 M $\Omega$
Resolution	0.1 M $\Omega$
Reference error	$\pm$ (4 % of R + 15 D)
Operating error	$\pm$ (5 % of R + 15 D)
Operating range of use (accord. to EN 61557-2)	3.0 k $\Omega$ $\div$ 100.0 M $\Omega$
Nominal output voltage $U_n$	DC 500 V
Open-circuit voltage	(-0%, + 50%) $U_n$
Nominal test current	$\geq$ DC 1 mA
Short-circuit current	< DC 10 mA
Functionality test	2.000 $\div$ 2.600 M $\Omega$

#### *Mains voltage $U_{L-N}$*

Measuring range	207.0 $\div$ 253.0 V
Resolution	0.1 V
Reference error	$\pm$ (1 % of R + 2 D)
Operating error	$\pm$ (2 % of R + 2 D)

**Differential leakage current**

Entire measuring range	0.000 ÷ 10.00 mA
Measuring sub range	0.000 ÷ 0.999 mA
Resolution	0.001 mA
Reference error	±(1 % of R + 5 D + X*)
Operating error	±(2 % of R + 10 D + X*)
Measuring sub range	1.00 ÷ 10.00 mA
Resolution	0.01 mA
Reference error	±(1 % of R + 5 D + Y*)
Operating error	±(2 % of R + 5 D + Y*)
Test voltage	line voltage
Frequency characteristic of internal test circuitry	according to EN 61010
Functionality test	0.090 ÷ 0.110 mA

\*X = S (0.01 IΔ + 0,005) \*Y = S (0.001 IΔ + 0,005)

S.... Apparent power of tested appliance [VA]

IΔ... Displayed value of leakage current [mA]

**Substitute leakage current**

Entire measuring range	0.000 ÷ 20.00 mA
Measuring sub range	0.000 ÷ 3.999 mA
Resolution	0.001 mA
Reference error	±(1 % of R + 8 D)
Operating error	±(2 % of R + 8 D)
Measuring sub range	4.00 ÷ 20.00 mA
Resolution	0.01 mA
Reference error	±(1 % of R + 5 D)
Operating error	±(2 % of R + 5 D)
Nominal open-circuit test voltage	230 V ± 15 % 50 Hz ÷ 60 Hz
Short-circuit current	< 3,5 mA
Internal resistance of test voltage source	> 80 kΩ
Functionality test	0.090 ÷ 0.110 mA

**Leakage current by means of current clamp or three-phase adapter**

Measuring range	0.00 ÷ 20.00 mA
Resolution	0.01 mA
Reference error	±(3 % of R + 10 D) (1)
Operating error	±(4 % of R + 15 D) (1)

**Touch leakage current**

Specifications are identical with measuring method selected for touch leakage current measurement.

**Notes:**

R - Reading

D - Digit

Some functions have more measuring sub ranges.

These sub ranges are switched over automatically.

**Active power, apparent power**

Measuring range	5 ÷ 3680 W, VA
Resolution	1 W, VA
Reference error	±(3 % of R + 2 D)
Operating error	±(5 % of R + 5 D)

**Cos φ**

Displayed range	0.00 ÷ 1.00
Measuring range	0.40 ÷ 1.00 (2)
Resolution	0.01
Reference error	±(1 % of R + 2 D)
Operating error	±(2 % of R + 4 D)

**Current consumption**

Measuring range	0.00 ÷ 16.00 A
Resolution	0.01 A
Reference error	±(2 % of R + 5 D)
Operating error	±(3 % of R + 5 D)

**Current by means of current clamp**

Entire measuring range	0.00 ÷ 100.0 A
Measuring sub range	0.00 ÷ 4.99 A
Resolution	0.01 A
Reference error	±(3 % of R + 4 D) (1)
Operating error	±(4 % of R + 10 D) (1)
Measuring sub range	5.0 ÷ 100.0 A
Resolution	0.1 A
Reference error	±(3 % of R + 4 D) (1)
Operating error	±(4 % of R + 4 D) (1)

**Cos φ by means of current clamp**

Displayed range	0.00 ÷ 1.00
Measuring range	0.40 ÷ 1.00 (2)
Resolution	0.01
Reference error	±(2 % of R + 2 D) (1)
Operating error	±(5 % of R + 5 D) (1)

**Active power, apparent power by means of current clamp**

Measuring range	10 ÷ 9999 W, VA
Resolution	1 W, VA
Reference error	±(5 % of R + 5 D) (1)
Operating error	±(8 % of R + 5 D) (1)

(1) Current clamp or three-phase adapter error has to be considered additionally

(2) Measuring error is not specified out of this range

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