

# **MD10KVx**

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*10 kV Digital insulation tester*

## **User guide**



## **Safety warnings**

- Before to use this instrument the User guide and Safety warnings must be read and understood.
- Safety procedures and rules for working near high voltage energized systems must be observed during the use of this equipment. The generated voltages may be dangerous.
- Do not connect or disconnect the test leads during the measurement.
- Do not touch the test leads before the high voltage indicator turn-off.
- Be careful not to make short-circuit between the high voltage terminals and the “R” or “Guard” terminals while a measurement is running, because it could be dangerous for the operator.
- Be sure that there are not any voltage difference between the points to which the equipment will be connected to, neither between them and ground.
- The panel, terminals and connectors of the equipment must stay dry and clean.
- Use only accessories / replacement parts provided by the manufacturer.

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**This equipment should be used only by a trained and competent person, strictly applying suitable safety rules.**

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## Used symbols

	Caution, risk of electric shock.
	Caution, refer to User Guide.
	Equipment complies with current EU Directives.
	Battery
	Printer
	Capacitance
	Backlight
<b>CAT III</b>	Measuring category III
	The rubbish bin with a line through it means that in the European Union, the product must undergo selective disposal for the recycling of electric and electronic material, in compliance with Directive WEEE 2002/96/EC.

## **Measurement Categories (CAT)**

### **CAT II - Measurement Category II**

Measurement Category II corresponds to measurements taken on circuits directly connected to low-voltage installations.

### **CAT III - Measurement Category III**

Measurement Category III corresponds to measurements on building installations.

### **CAT IV - Measurement Category IV**

Measurement Category IV corresponds to measurements taken at the source of low-voltage installations.

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## 1. Description

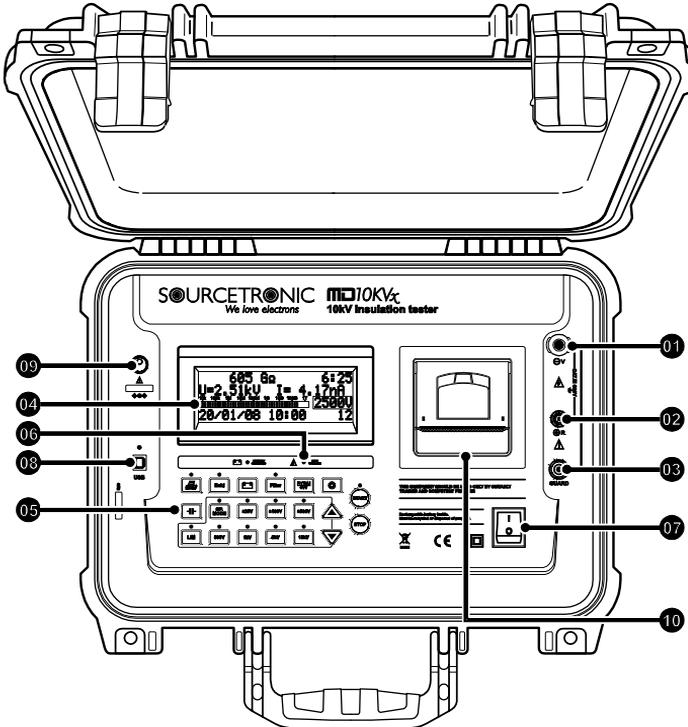
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The digital insulation tester model **MD10KVx** is SOURCETRONIC's cutting edge insulation analyzer equipment and it is one of the most complete and sophisticated available in the international market. A software allows for further analysis of tests results, including features such as graphical representation and automatic report generation. Its proven technology provides safe, reliable and accurate measurements of insulation resistances up to 10 T $\Omega$ , with 4 pre-selected test voltages, 500 V - 1 kV - 5 kV - 10 kV. Other test voltages may be selected in steps of 25 V, 100 V or 500 V.

A state-of-the-art microprocessor controls the equipment operation and enables the incorporation of advanced features which make measurements easier: auto-range selection, 4000 readings memory, AC/DC voltmeter, automatic measurement of Absorption Index and Polarization Index, leakage current and capacitance measurement, timer enabling programming of test duration, configurable Pass-Fail test, Step voltage test, real time clock and calendar. Built-in chronometer, indicating elapsed time, in minutes and seconds, since the test started, up to 90 minutes.

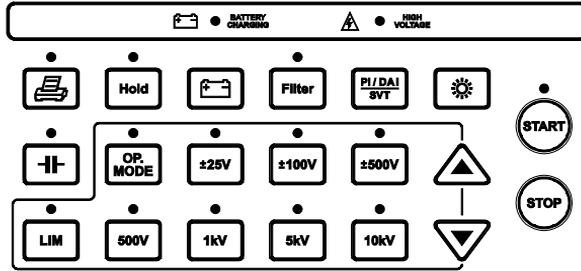
Measured values are transmitted through the USB interface and are printed in the built-in printer as a registration of the performed test. Furthermore, the measured values are stored in a non-volatile internal memory. Up to 4000 measured values may be stored, to be transferred afterward to a computer running the ST Logger program. This software allows a further analysis of the test results, including a graphical representation and automatic report generation. The real time clock and calendar, and the sequential test number, facilitates the identification of each test, and the organization of a predictive maintenance system by trend analysis. The MD10KVx is powered using a rechargeable battery and the cabinet is strong and lightweight, easy to carry, impact-resistant and suitable to be used under severe weather conditions. Thus the insulation tester supplies very reliable and accurate measurements both in laboratory and out in the field.

## 2. Panel control functions



- 01 Voltage output terminal (-V)
- 02 Zero reference terminal (+R)
- 03 Guard (G) Terminal
- 04 Display
- 05 Keyboard
- 06 High Voltage led
- 07 On / Off key
- 08 USB communication port
- 09 Power supply input
- 10 Printer

## 2.1. Keyboard

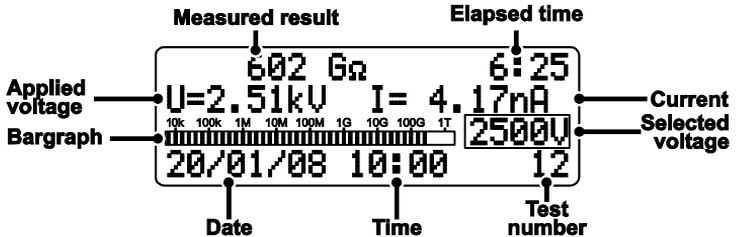


Key	Function	LED
	Turns the printer on/off	Indicates that the printer is turned on.
	<b>Hold</b> - Freeze the last reading on the display	The Hold function is on
	<b>Battery</b> - shows the battery charge status on the display	—
	<b>Filter</b> - Activates the filter that minimizes external noise interference	Indicates that the filter is on
	Shows the calculated results of the Step Voltage Test (SVT), Polarization Index (PI) and Dielectric Absorption Index (DAI) on the display	—
	<b>Backlight</b> - activates the display light	—
	<b>Capacitance</b> - exhibit the capacitance value	—
	Activated enables the programming of the Operation Mode (Normal, SVT or with TIMER of selectable time)	Indicates that the selection of the Operation Mode is enabled

	Activated, enables programming of tests voltages in 25 V steps	25 V steps activated
	Activated, enables programming of tests voltages in 100 V steps	100 V steps activated
	Activated, enables programming of tests voltages in 500 V steps	500 V steps activated
	Selection of 500 V test voltage	Indicates 500 V selected
	Selection of 1 kV test voltage	Indicates 1 kV selected
	Selection of 5 kV test voltage	Indicates 5 kV selected
	Selection of 10 kV test voltage	Indicates 10 kV selected
	These keys (decrease or increase) enable the selection of the value that is being programmed.	–
	Activates / enables programming of the limit for the "Pass / Fail" test	Indicates when the measured resistance is lower than programmed limit
	<b>Start</b> - Start test	Indicates that the test is being executed
	<b>Stop</b> - End of test	–

## 2.2. Display

Measurement results in the corresponding measuring unit, elapsed time since the measurement started, selected test voltage, analogue indication by means of a bargraph and several messages to the operator are displayed on alphanumeric LCD.



### 3. Charging battery

The **MD10KVx** uses a rechargeable LiFePO4 12 V - 6000 mAh battery.



At the end of battery's useful life, the battery must be recycled or disposed of properly, in order to protect the environment.

#### Charging procedure:

- Check if the **MD10KVx** is turned-off and connect it to the mains (AC adapter).
- The charging indicator (  **BATTERY CHARGING**) will turn on red and will remain that way until the battery is totally charged. Then the light will remain green and keep in that way until the **MD10KVx** is disconnected of the mains.



Use only the AC Adapter provided by the manufacturer. The use of any other AC Adapter may compromise the equipment safety.

**Perform a full charge cycle before using the equipment for the first time, or after a period without using the equipment (the battery loses some of its charge being stored).**

The rechargeable battery does not have “memory effect” and there are no restrictions to start charging it as many times as is needed. Charge the battery before leaving the equipment in storage and don't let pass more than 30 days without recharge.

**IMPORTANT:** While the equipment is connected to the mains supply, the START key is inhibited, so you will not be able to make measurements.

This is necessary to ensure the device is completely isolated with floating output.

## 4. Connecting the MD10KVx

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**ATTENTION:** For a safe operation, the procedures detailed below should be carried out with the device Powered-Off.

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Use only the accessories / test leads supplied by the manufacturer. Using accessories / test leads not provided by the manufacturer may compromise the equipment safety.

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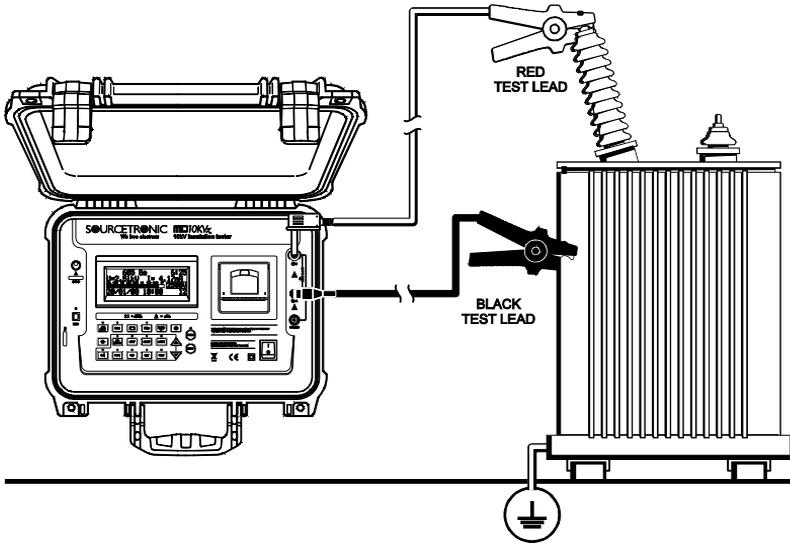
Please, do check there is no difference of potential voltages between the points where the **MD10KVx** shall be connected to. Please, check the same between those points and the ground.

At the time of the connection and power-on, the equipment automatically enters in the voltmeter mode and begins to show the circuit voltage in the display.

The circuit to be tested must be de-energized to avoid interferences in the measurement. The equipment will block the start of measurement if it detects a voltage greater than 60 V in the circuit.



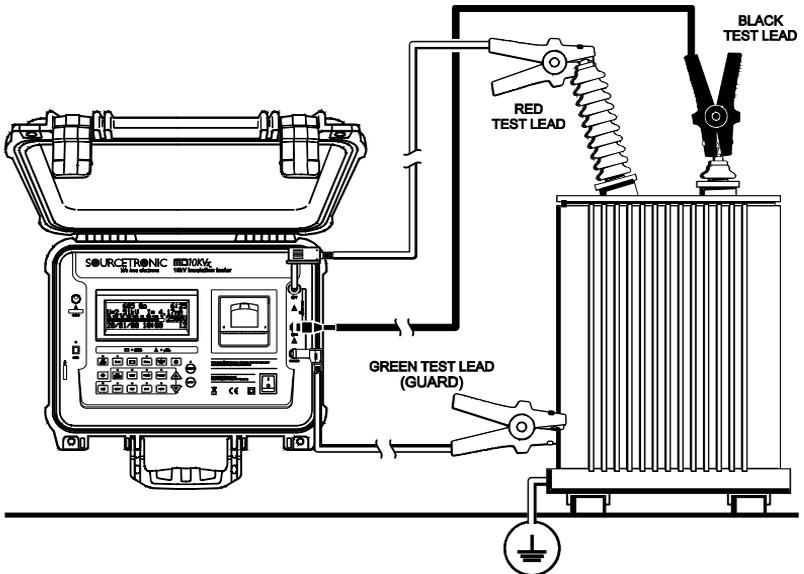
Connect the red cable security terminal to the equipment (-V) **output terminal**, the BNC terminal of the black cable to the **zero reference (+R)** terminal and the “alligator” terminals to the element to be measured as indicated in the next figure.



The test leads in the picture are merely illustrative.

## 5. Use of “Guard” (G) terminal

Depending on the measurement to be made, the **Guard (G)** may be used or not. During the measurements, the equipment should be electrically grounded to avoid unsteady readings. When insulation is measured regarding grounding, the **R** terminal is connected to earth and the condition by means of which the equipment potential setting is fulfilled. If the measurement is performed between two parts, which are not grounded (for example, between two phase conductors in a three-phase cable), the equipment **GUARD** terminal must be grounded. This implies that **whenever a measurement is performed, one of the GUARD or R terminals must be grounded, but not both of them simultaneously.**



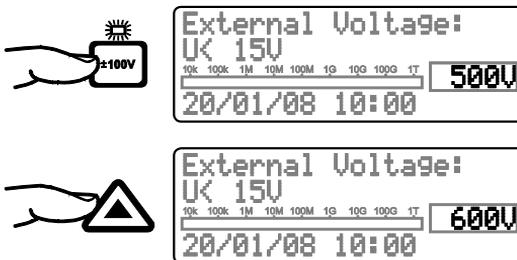
Technical Note 32, reproduced at the end of the manual, explains the usage of GUARD terminal in order to eliminate the parasite resistance effect over the result of measurements.

## 6. Setting tests

The insulation tester **MD10KVx** is an extremely versatile instrument that enables automatic performance of several types of insulation tests, and records them in its internal memory and/or prints the results. Thus, it is necessary to appropriately define the tests to be performed, setting the following parameters before starting the measurement: Test voltage, Test duration for “TIMER” mode test, Maximum Voltage for step voltage test (SVT) and Minimum resistance limit for “Pass/ Fail” tests.

### 6.1. Test voltage definition

In order to define the test voltage value, first it is necessary to select one of voltage adjustment keys:  $\pm 25V$ ,  $\pm 100V$  or  $\pm 500V$ . These keys enable both the pre-programmed voltage selection ( $500V$ ,  $1kV$ ,  $5kV$  y  $10kV$ ) and the  $\blacktriangle$  and  $\blacktriangledown$  keys which increase or decrease the value of the step voltage test for 25 V, 100 V or 500 V, depending on the selected voltage adjustment key.



As long as the equipment is on, the voltage adjustment key  $\pm 500V$  will be selected. Please, press again the adjustment key selected at the moment with the aim of leaving the test voltage selection mode.

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**Note:** Test voltage is the only one parameter that may be modified during tests.

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## 6.2. Selection of the operation mode

The **MD10KVx** insulation tester has four operation modes: Normal, with “TIMER”, SVT and “Pass / Fail”. The first three modes are selected using the **OP MODE** key; the “Pass/ Fail” test mode is activated pressing **LIM** key.

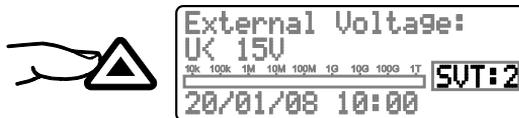
### 6.2.1. Normal mode

The normal mode is used in the resistance measurement with unique voltage, without time limit. When selected, there are no special indications in the display.



### 6.2.2. SVT Mode (step voltage tests)

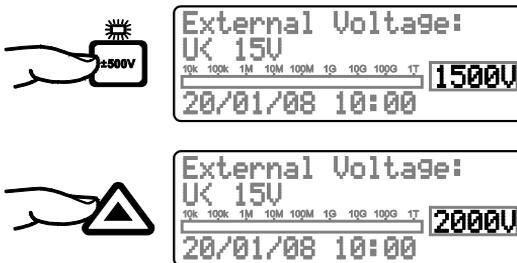
The use of **OP MODE** key allows the **MD10KVx** setting for the performance of a step voltage test type 1 or type 2; when this mode is selected, the display shows the **SVT:1** or **SVT:2** abbreviation.



### SVT:1 Mode

Under this operation mode, the user does not define a specific voltage test, but a maximum voltage value. The device will start the test applying a 500 V voltage and increase this value in 500 V steps each minute until reaching the programmed voltage. At each stage, the **MD10KVx** measures the resistance before advancing towards the following step.

The use of voltage adjusting keys, determines the value of the highest voltage – which will be, in all cases, a multiple of 500 V, up to a 10000 V limit. It is advisable to use the  $\pm 500V$  key in order to select this value;  $\pm 25V$  and  $\pm 100V$  keys may be used, but if the selected value is not a multiple of 500, it will be rounded down.



### SVT:2 Mode

In this mode, if the maximum voltage value is set to 2500 V or lower, the test will perform the same way as SVT:1 mode.

If the maximum voltage is set to a higher value than 2500 V, the test will always perform 5 steps with one minute duration each. The step voltage value will be the defined max. voltage divided by 5.

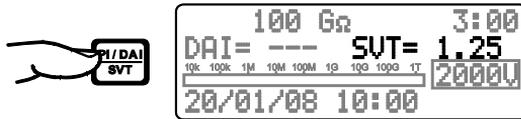
Example: if the max. voltage is set to 3000 V, the step voltage will be 600 V.

### SVT test result

The test result is calculated according to the following formula:

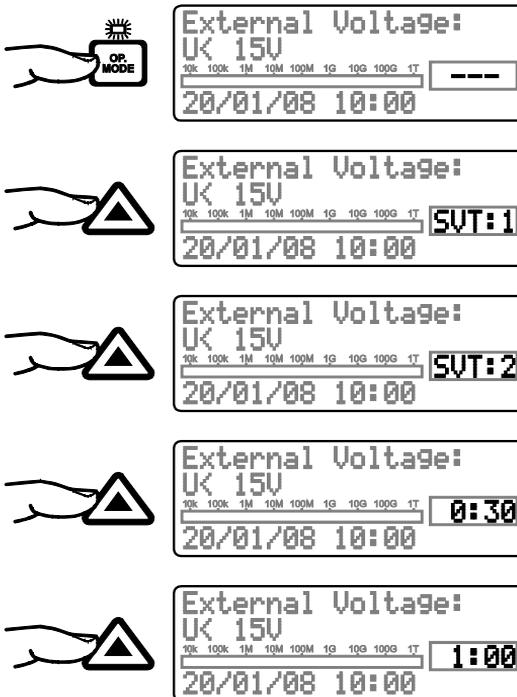
$$SVT = \frac{R_{VMAX}}{R_{500}}$$

After test ending, the value may be recovered by pressing  key.



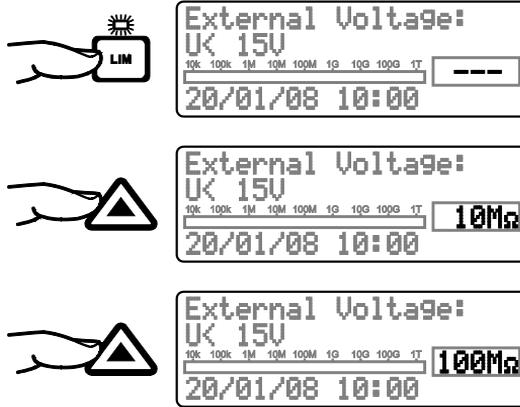
### 6.2.3. "TIMER" Mode

The use of  key allows the MD10KVx setting for the performance of a pre-set - duration test; when this mode is selected, the display shows the programmed time. Use  and  keys to define the duration of the tests in 30 seconds, 1 minute, 3 minutes, 10 minutes or 30 minutes.



#### 6.2.4. “Pass / Fail” Test mode

Press **LIM** key in order to determine the lower insulation limit for type “Pass / Fail” test. Select this value using **▲** and **▼** keys. Possible values are 10 MΩ, 100 MΩ, 1 GΩ or 10 GΩ.



During a “Pass/ Fail” test, the **MD10KVx** will indicate when the insulation resistance is lower than the programmed limit, both with an intermittent beep and the **LIM** key led flashing. The **LIM** key led will remain flashing until the end of tests, or until the measurement of the resistance value is greater than the programmed limit.

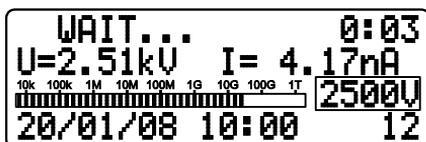
## 7. How to perform tests

After having set the desired measurement, press the  key. The **HIGH VOLTAGE** indicator will turn on indicating that the insulation tester is applying high voltage to the element under test.



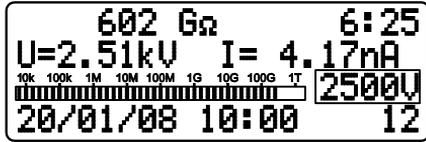
 **HIGH VOLTAGE**

During some seconds the intelligent auto-range system will search for the most convenient range for the value under measure. At this moment the display will show the message “WAIT...”.



As soon as the **MD10KVx** selects the appropriate range, the display will show the number of test, the selected voltage value, exhibiting the value of the applied voltage and the leakage current, date and time, will start counting the elapsed time and the resistance value indication will be exhibited with its corresponding unit, and the analogue indication will start by bargraph. In order to end the test, press the  key. At that moment, last measured values will remain frozen in the **MD10KVx** display. By pressing the  key again, the equipment will return to the voltmeter function.

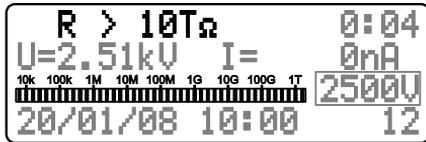
**Example:**



The display exhibits the test number (12), the measured resistance value (602 G $\Omega$ ), the voltage selected of 2500 V, the elapsed time (6:25 minutes), the applied voltage (2.51 kV), the leakage current (4.17 nA), date and time.

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**NOTE:** If the resistance measured is greater than 10 T $\Omega$  @ 10 kV, the following message will be exhibited: **R > 10T $\Omega$**



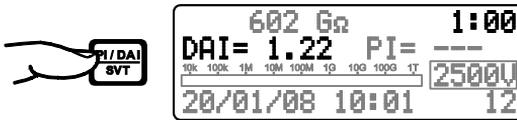
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**ATTENTION:** Please, never connect or disconnect the test leads with the equipment under operation or while the High Voltage LED is on. If there is a need to modify the connections, this should be done with the equipment disconnected and with discharged potentials (High Voltage LED off).

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## 7.1. Measurement of the Dielectric Absorption Index (DAI)

When pressing the  key during the test, the Dielectric Absorption Index (DAI) value will be exhibited on the display. It is only possible to apply this function after a minimum of 1 minute of measurement; in case the key is pressed before this minimum limit, the display will show the DAI display zone, but will not show any value.

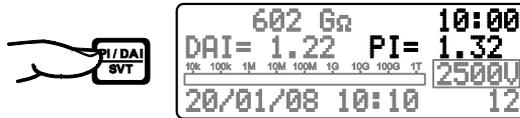


The polarization index is the quotient between the values of the insulation resistance measured at the 60 and 30 second, and it is useful for preventive and predictive maintenance of windings (present in transformers, motors, generators, etc.), high-voltage capacitors and solar cells.

$$DAI = \frac{R_{60 \text{ seconds}}}{R_{30 \text{ seconds}}}$$

## 7.2. Measurement of the Polarization Index (PI)

When pressing the  key during the test, the Polarization Index (PI) value will be exhibited on the display. It is only possible to apply this function after a minimum of 10 minutes of measurement; in case the key is pressed before this minimum limit, the display will show the PI display zone, but will not show any value.



The polarization index is the quotient between the values of the insulation resistance measured both in 10 minutes and 1 minute. This index is useful to detect damage of the insulation resistance by excessive presence of dust, dirt and greases or through the action of chemical and physical agents.

$$PI = \frac{R_{10 \text{ minutes}}}{R_{1 \text{ minute}}}$$

## 8. Other functions

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### 8.1. Backlight

The equipment display has a built-in backlight. In order to activate it, press the  key. After 10 seconds the backlight will auto-turn off. If you want to reactivate it, press  key again.

### 8.2. Filter

When insulation measurements are carried out in transformers or in large dimension machines, or otherwise in presence of strong electromagnetic fields, it is possible for the equipment reading to be unstable, especially for resistance values higher than 100 MΩ. In these cases it is convenient to press the  key before starting the measurement, activating the filter which allows for reaching the insulation resistance value in an upward curve without significant oscillation.

### 8.3. True RMS AC/DC Voltmeter

In order to use this function, connect the test points and turn on the **MD10KVx**. The measured value will be exhibited automatically in the display.

AC	DC
15 V up to 600 V <sub>RMS</sub>	15 V up to 600 V

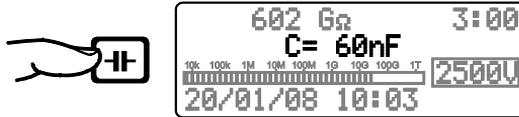
Precision: ± (5% of the reading + 3 digits)

### 8.4. Leakage current measurement

During the tests, the equipment measures and exhibits in the display the leakage current value within a range from 1 nA up to 1500 μA, with a precision of ± (10% of the reading + 3 digits).

## 8.5. Capacitance measurement

The capacitance value is obtained by measuring the insulation resistance. After finishing measuring (When the  key has been pressed), wait a few seconds (until the LED   **HIGH VOLTAGE** turn off) and then press the  key. The capacitance value will be exhibited on the display.



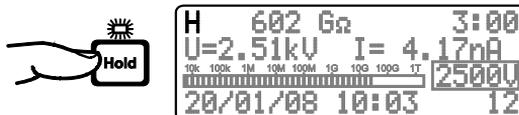
Voltage	Capacitance
500 V	50 nF up to 10 $\mu$ F
1,000 V	50 nF up to 5 $\mu$ F
2,500 V	30 nF up to 2 $\mu$ F
5,000 V	30 nF up to 1 $\mu$ F
10,000 V	30 nF up to 680 nF

Precision:  $\pm 10\%$  of the measured value  $\pm 3$  digits

**Note:** "0" will be exhibited on the display when measuring values lower than 50 nF

## 8.6. Hold

This function allows holding the last performed reading on the display at the moment when pressing the  key, without interrupting the test. When this key is pressed again, the equipment updates the resistance and chronometer values. The LED in the  key and the letter **H** on the display indicate that the function has been activated



### 8.7. Internal memory

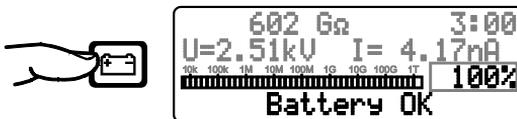
This equipment has an internal memory that can hold up to 4000 measured values (approx. 29 polarization index tests). When the memory free space is smaller than 30%, the display will show a warning message with the remaining free space:



To avoid lost of data, always download and erase the memory after finishing the measurements.

### 8.8. Battery status check

Hold and press the  key in order to check the battery status during measurements. The analog bargraph will give an approximate visual representation of the remaining charge percentage; additionally, the display will show the message “**Battery OK**” if the charge is enough, or “**Battery Low**” if the charge is low. In the latter case, it is highly advisable to charge the battery before using the apparatus. If battery charge is under 20% of the total, the message **Battery Low** will automatically appear on the display.



### 8.9. Auto power-off

The MD10KVx auto-turns off after 10 minutes of inactivity, or after 35 minutes of measuring without checking the battery status.

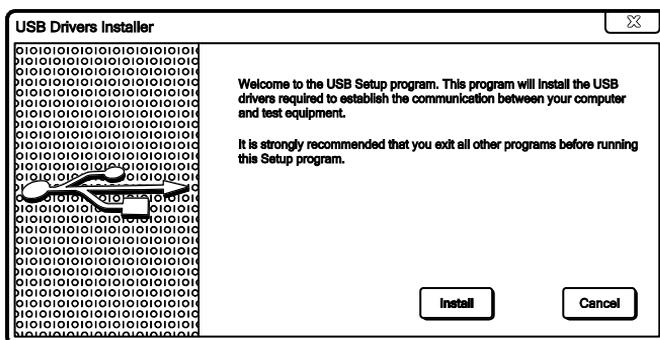
## 9. Software

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### 9.1. USB Drivers

To install the USB drivers required for the communication between PC and equipment follow the instructions:

1. Connect the equipment in the PC using the USB cable.
2. If there is an available Internet connection, Windows will silently connect to the Windows Update website and install any suitable driver it finds for the device. If no suitable driver is automatically found then you need to insert the CD-ROM supplied with the equipment into the PC, run the executable “**usb-install.exe**” and click on “**Install**”.



### 9.2. ST Logger Software

This software makes communication between the equipment and a computer with Windows operating system easier. It makes it possible to synchronize the date and time of the equipment’s internal clock with the computer date and clock, to transfer the stored data, to clear the memory, to generate tests graphics and protocols, etc. The installation and operation instructions are included in the software.

## 10. Remote control

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The SOURCETRONIC devices that have a Bluetooth interface can be controlled remotely via a tablet running the SOURCETRONIC Android application.

### Minimum requirements tablet

- 7" screen (600 x 976 pixels or higher);
- Android 4.1 JELLY BEAN System (API 16) or higher;
- Bluetooth Communication.

### Installation Instructions

- Access the screen "Settings" on your tablet, touch in the option "Security" and check the "Unknown sources" option. This option will allow you to install applications that are not in the Android Play Store.
- Transfer the file "SOURCETRONIC-[version].apk" from the supplied CD-ROM to your mobile device.
- Open the file manager and navigate to the location you transferred the .apk file to.
- Touch the file "SOURCETRONIC-[version].apk" and select the "Install package" option.
- A dialog with the permissions required for the app appears, touch the "Install" button.

### Pairing

To perform the pairing between equipment and tablet, follow the procedure:

- To enable the Bluetooth on your mobile device, in screen "Applications", tap "Settings" > "Bluetooth" and drag the Bluetooth slider to the right.
- To pair your equipment, on screen "Applications", tap "Settings" > "Bluetooth" > "Search". Select the equipment and wait for the end of the pairing (If necessary, accept the automatically generated password to confirm or enter the PIN 1234).

### **Operating instructions**

- To start the remote control, go to the screen "Applications" and tap the icon "SOURCETRONIC".
- A list of paired devices in the tablet will appear, select your device (MD10KVx [S/N]).
- The SOURCETRONIC App will automatically try to establish a communication with the equipment. If it does not succeed, tap the "CONNECT" button.

### **Equipment setup**

- Tap the "SETUP" button. A dialog will appear where you can set all the test parameters (voltage, threshold, timer, SVT, etc.). Tap the "SAVE" button to confirm.

### **Performing measurements**

- To start a test, hold the button "START" for 3 seconds. During this time the equipment will sound short beeps.
- To stop the test, tap the "STOP" button.
- After completion of the test, wait a few seconds while the equipment calculates the capacitance value. If the capacitance value is "0", no further information will be displayed on the screen.

### **Lock the remote control**

- During the remote control, any direct action taken on the equipment (eg. changing the test voltage) will lock out SOURCETRONIC App functions, except the "Stop" button. The lock is maintained until the end of the current test.

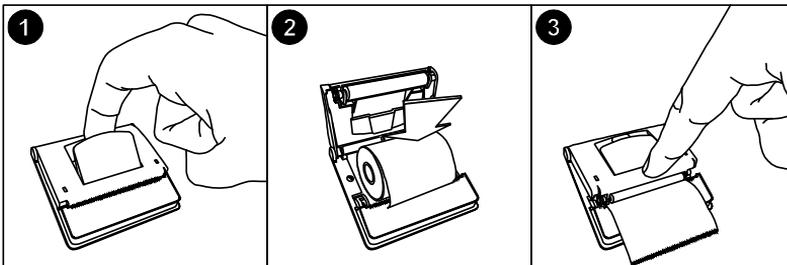
## 11. Printer

In order to enable the printing function press  key. Measured values will be printed each 15 seconds, and the Dielectric Absorption Index and Polarization Index will be automatically printed after 1 minute and 10 minutes respectively. Printing may be started or stopped at any time during the test. However, it is convenient to turn the printer on before starting the test in order to print it completely, including the header.

**ATTENTION:** Don't pull the paper. The printer can be easily damaged.

This printer uses 56 mm-wide thermal paper, which comes in a 30 mm-diameter reel.

- 1 Pull the lever located on the lid.
- 2 Insert the paper reel as shown in the figure.
- 3 Keep the tip of the paper out of the printer and close the lid.



## 12. Cleaning

The panel, terminals and connectors of the equipment must stay dry and clean. Cleaning should be made using a wet cloth with water and a soft detergent or isopropyl alcohol (be sure that the products to be used for cleaning does not affect plastic goods).

## 13. Technical specifications

<b>Test voltages</b>	: 500 V - 1 kV - 5 kV - 10 kV with fast selection. From 500 V to 10 kV selectable in 25 V, 100 V or 500 V steps. DC, negative in relation to grounding.
<b>Maximum resistance reading</b>	: 10 TΩ @ 10 kV
<b>DC Voltmeter</b>	: 15 V up to 600 V <sub>DC</sub> Precision: ± (5% of the reading + 3 digits)
<b>AC voltmeter</b>	: 15 V up to 600 V <sub>RMS</sub> Precision: ± (5% of the reading + 3 digits)
<b>Over voltage protection</b>	: CAT III – 600 V
<b>Current measurement</b>	: 1 nA up to 1500 μA ± (10% of the reading + 3 digits)
<b>Capacitance measurement</b>	: 50 nF up to 10 μF @ 500 V 50 nF up to 5 μF @ 1,000 V 30 nF up to 2 μF @ 2,500 V 30 nF up to 1 μF @ 5,000 V 30 nF up to 680 nF @ 10,000 V  Precision: ± 10% of the reading ± 3 digits
<b>Short circuit current</b>	: Max. 2 mA
<b>Display</b>	: Alphanumeric. It exhibits measurements both digitally and analogically by bargraph.
<b>Test voltages accuracy</b>	: ± 3% of nominal value over a 10 GΩ resistance
<b>Equipment accuracy</b>	: ±5% of reading between 1MΩ and 1TΩ @ 10kV ±20% of reading between 1TΩ and 10TΩ @ 10kV (For lower test voltages, the upper limit is proportionally reduced) ±20% of the reading between 10kΩ and 100kΩ ±10% of the reading between 100kΩ and 1MΩ

<b>Advanced features</b>	: <ul style="list-style-type: none"><li>• Automated Polarization Index computing</li><li>• Automated Dielectric Absorption Index computing</li><li>• “Pass-fail” and fixed time tests</li><li>• Step Voltage Test</li><li>• Memory for up to 4000 measurements</li><li>• Filter to minimize interferences</li></ul>
<b>Printer</b>	: Prints elapsed time, actual voltage applied to the element under test, measured resistance; also DAI and PI after 1 resp. 10 minutes.
<b>PC Interface</b>	: USB
<b>Built-in chronometer</b>	: Indicates elapsed time from the beginning of the measurement mm:ss format, up to 90:00
<b>Environmental protection index</b>	: IP54 (with closed lid)
<b>Safety</b>	: In accordance with IEC 61010-1
<b>Electromagnetic compatibility (E.M.C.)</b>	: In accordance with IEC 61326-1
<b>Electromagnetic irradiation immunity</b>	: In accordance with IEC 61000-4-3
<b>Electrostatic immunity</b>	: In accordance with IEC 61000-4-2
<b>Power supply</b>	: Internal rechargeable battery LiFePO4 12 V - 6000 mAh
<b>Battery charger</b>	: 18 V - 2 A
<b>Operating temperature</b>	: -5°C to +50°C
<b>Storage temperature</b>	: -25°C to +65°C
<b>Humidity</b>	: 95% RH (non condensing)
<b>Equipment weight</b>	: Approx. 6.3 kg
<b>Dimensions</b>	: 406 x 330 x 174 mm

**Supplied accessories**

- : • 3 measurement cables
- AC Adapter
- Cable for USB
- Carrying bag
- Operation manual
- License key for ST Logger software

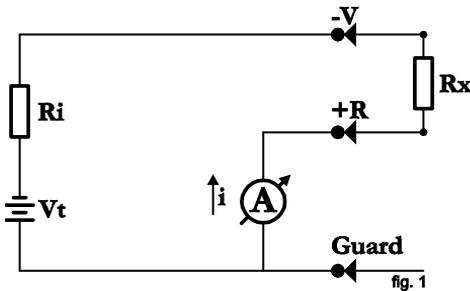
Subject to technical change without notice.

## 14. Application note 32

### Use of “Guard” terminal in insulation testers

When insulation resistance measurements are performed with insulation testers, especially with high sensitivity instruments measuring high resistance values, the use of the *GUARD* terminal avoids the harmful influence of stray resistances.

In order to better explain the function of this terminal, let us start reviewing the insulation tester basic circuit diagram in fig. 1.



Where:

- $V_t$  : DC high-voltage generator
- $R_i$  : Generator internal resistance
- $A$  : Indicator meter (micro-ammeter)

The unknown resistance ( $R_x$ ) is connected between  $V$  and  $R$  terminals. Its value determines the current passing through the circuit, which in turn is indicated by the micro-ammeter. The value of  $R_x$  can be determined as follows:

$$R_x = \frac{V}{i} - R_i$$

In many cases the resistance to be measured is in parallel with other stray resistances which influence on  $R_x$  should be minimized.

A typical example of this situation is when the insulation resistance between primary and secondary windings of a transformer mounted inside a metal housing is to be measured.

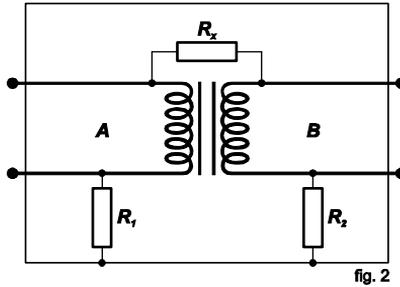


fig. 2

$R_x$ : Insulation resistance between primary and secondary winding.

$R_1$ : Insulation resistance between primary winding and housing.

$R_2$ : Insulation resistance between secondary winding and housing.

If the insulation tester (terminals V and R) is connected to transformer terminals A and B, and considering that the resistance of the coils on each side of the transformer may be disregarded,  $R_x$  appears to be in parallel with  $(R_1 + R_2)$ . The situation is changed if we connect the transformer housing to GUARD terminal. Then the circuit will be:

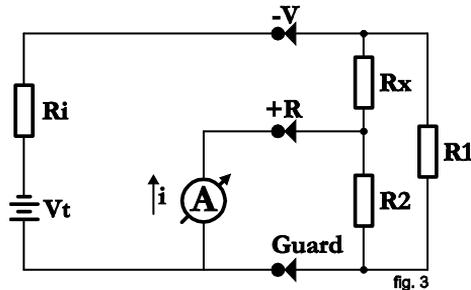


fig. 3

In the circuit of Fig. 3 it may be noted that R1 is in parallel with a low-value resistance (the one from the micro-ammeter) therefore its influence is reduced during reading.

Through resistance R2 circulates a current which is not passing through the meter and consequently does not affect the reading. In fact, current through R2 causes a certain error, since it creates an additional voltage drop in Rx which was not regarded during equipment calibration. As regarding the practical use of the instrument, it shall be considered that if R1 and R2 are higher than 100 M $\Omega$ , any value of Rx will be measured with an insignificant error. For example: Let us consider Rx = 3000 M $\Omega$  and R1 = R2 = 100 M $\Omega$ , the reading without using the GUARD terminal would be 187.5 M $\Omega$ , which is quite wrong. On the other hand, if the GUARD terminal is properly used, we would have 3000 M $\Omega$ .

## **15. Warranty**

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SOURCETRONIC warrants to the original purchaser that each equipment it manufactures will be free from defects in material and workmanship under normal use and service. The warranty period is valid for **12 months**, except the built-in rechargeable battery that has **6 months**, and begins on the date of shipment. The manufacturer's warranty does not apply to any product or accessories which, in the manufacturer's opinion, has been misused, altered, neglected, or damaged by accident or abnormal conditions of operation and handling.

To obtain warranty service, send the equipment, with a description of the difficult, shipping and insurance prepaid, to SOURCETRONIC. The manufacturer assumes no risk for damage in transit. SOURCETRONIC will, at its option, repair or replace the defective equipment free of charge. However, if SOURCETRONIC determines that the failure was caused by misuse, alteration, accident or abnormal condition or handling, you will be charged for the repair and the repaired equipment will be returned to you transportation prepaid.

This warranty is exclusive and is valid instead of all other warranties, express or implied, including but not limited to any implied warranty or merchantability or fitness for a particular purpose or use. SOURCETRONIC will not be responsible for any special, indirect, incidental, or consequential damages or loss of data, whether in contract, or otherwise.

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