DIGITAL MICRO-OHMMETER

32000 points autorange 10nΩ ÷ 3200Ω

mod. 20046

USER MANUAL

PROFESSIONAL MEASURING INSTRUMENTS

20046 MAN_GB –A4.DOC OCTOBER 2020

CE

INDEX

INTRODUCTION

The digital micro-ohmmeter mod. **20046** is a instrument with performance absolutely unique: although size and weight are extremely low, provides resolutions and features never present together so far. Also noteworthy is the possibility of saving up to 1000 measurements in the non-volatile memory and automatically saving the measurement at selectable intervals in order to easily obtain graphs.

- *32000 measuring points / 4 measurements per second*
- *8 ranges from 3200Ω to 320μΩ (from 100mΩ to 10nΩ of resolution)*
- *choice of automatic or manual range measurement*
- *saving up to 1000 measurements, each with date and time up to one second of resolution*
- *possibility of saving/automatically recording the measurement every 1-2-5-10-30-60 sec*
- *graphic display*
- *auto-zeroing the instrument*
- *compensation of test leads*
- *choice and display of the extent of measurement filtering*
- *backlight on/off*
- *acoustic signaling of the correct selection*
- *line and battery standard operation*
- *indication of the state of battery charge*
- *reading of data and measurements saved in non-volatile memory via optically isolated USB connection using the dedicated SW **20046 Remote Viewer** that can be interfaced with Excel*
- *recording, visualization on a graph, saving of data acquired automatically or manually through the SW **Recorder 20000**, which can be interfaced with Excel, connected with optically isolated USB*
- *transfer from instrument to PC of 1000 measurements saved in 3.7 seconds*

Accuracy, number of measurement points and resolution, as well as reduced size and weight, make this instrument certainly unique considering that it is mainly intended for use in the field. In fact the presence of internal rechargeable batteries shall release from the necessity of the mains voltage, with an autonomy that can reach a maximum of about 200 hours.

All the information is present on a single screen and there are no key combinations to access secondary functions. In this way the use is simple, intuitive and direct.

The main measurement is also represented with large characters of 10mm in height that allow it to be read even at a distance of three meters.

DESCRIPTION

The instrument is mounted in a container in plastic material of high resistance in the form of briefcase. Of limited weight, has a handle for easy carrying.

The graphic display 64x128 pixel is very large relative to the size of the instrument, so as to facilitate the reading even from a distance and in low light. Even the arrangement of the information (measuring primary, settings, indications and auxiliary information) has been designed to be easily readable and never create confusion.

The entire instrument is managed by microprocessor, while the technique of measurement is ratiometric four-wire, otherwise known as Kelvin connection, the only one that allows you to get off at accuracies and resolutions so thrusts.

The amplifier and converter are in a monolithic device so as to have an equivalent input noise (with filter = 32) of only 100nVpp typical in a minute and drifts lower than typical 300nVpp in 10 minutes.

On the front there are four bushings (**A+**, **A-**, **V+**, **V-**), two of which provide for the measuring current and two for the detection of the voltage drop across the resistor. The four-wire method makes it insensitive the measure from resistance of the wires that carry the current and the various contact resistances in the circuit *microohmmeter - test leads - unknown resistance*. The input signal is then amplified and compared with the reference internal resistance: the result, properly prepared and processed by a microprocessor, is shown on the LCD.

The low current used for the measurement reduced to the negligible power dissipation for Joule effect, with the consequent very low alteration of the measurement. For the same reason the fall of the maximum rated voltage of 32mV which avoids any semiconductor junctions in parallel to the unknown resistance make the measurement invalid.

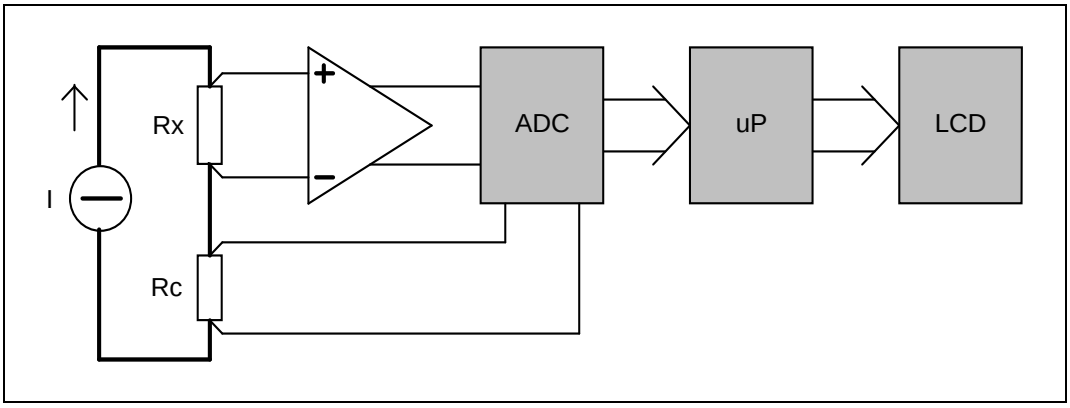


Fig. 1 Block diagram of the microohmmeter **20046** and the four-wire measurement.

CAUTION:	The presence of the sign "-" before the value of the measure is only to indicate that they exchanged the terminal voltage **V-** with **V+**: this does not result dangerous to the instrument, but does not guarantee the validity of the measure because the amplifier is optimized for positive signals.

AUTO HOLD

The instrument has the Auto Hold function, ie the ability to "freeze" the measurement on the display when the test leads or the pliers are disconnected from the element under test. In particular, this occurs when there is an interruption in the current circuit by disconnecting at least one of the current terminals.

This is indicated in the status line at the bottom right of the screen with the writing **AHld** flashing.

CAUTION:	This function is automatically activated only when the instrument is in *Manual* mode. This allows you to maintain the auto-ranging function for automatic selection of the most suitable range to measure.

DEFINITION BUTTONS AND INPUTS

BUTTONS

The instrument has 9 buttons whose functions and modes of operation are detailed below and summarized in a table below. Through them you can directly select all the functionality of the instrument without resorting to menus or key combinations.

Some buttons have a double function and the selection of the function is based on the time in which they are pressed: short if less than 1 second or long if greater than one second.

The two functions mainly refer to the same functionality. As an example consider the **A/Z** button. By pressing it briefly auto-zeroing is performed, while pressing it for a long time allows compensation of the measurement cables.

An appropriate acoustic signal warns if the function or the button pressed are active or not. In fact in particular conditions some buttons are disabled and pressing them gives a long acoustic signal. An example is the impossibility of performing an auto-zeroing procedure while the list of saved measurements is displayed: by pressing the **A/Z** button you have a long beep.

The buttons and their functions are listed below.

▲ **- Selection of the upper range**
- Selection of the automatic saving times of the measurement
- Ascending scroll of the saved measures when viewing the list
- Increase in the clock date and time values

Selection of the upper range

The instrument is in the normal measurement representation mode.
If the instrument is in *Automatic* mode go to *Manual* mode.
If the instrument is in *Manual* mode it selects the next higher ohmmetric range, unless the range of 3200Ω has already been reached. In this case, a long acoustic signal is given.

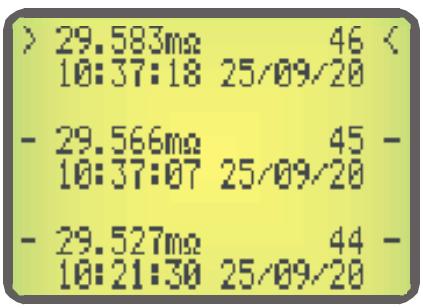
Selection of the automatic saving times of the measurement

The instrument is displaying the window for selecting the automatic saving times of the measurement.

This button moves the **>** and **<** highlighters upwards. Once the word *Off* is reached, the highlighters reappear in correspondence with the word *60 sec*, allowing you to select the desired automatic recording time or deactivate this function.
More details are available in the paragraph **HOW TO SET UP AUTOMATIC SAVE** on page 15.

Ascending scroll of the saved measures when viewing the list

The instrument is displaying the list of measurements (also called records) saved.
Each time the button is pressed briefly, the list scrolls upwards by one measure.
Referring to the following figure, the 47th measurement saved would be displayed at the top while the 44th measurement would come out from the bottom of the display.



By holding down the button permanently, after a first scrolling of one measurement and after a second, the list would scroll quickly until the eventual last and most recent saved measurement is reached.

Increase in the clock date and time values

The instrument is displaying the window concerning the clock setting.
This button increases the value (hour, minute, second, day, month or year) currently selected.
Reached the maximum value for that particular parameter this passes to the minimum value, 0 or 1 depending on the parameter itself. In particular, the maximum day of the month depends on the month selected at that time.
More details will be provided in the paragraph **HOW TO SYNCHRONIZE THE TIME AND DATE OF THE CLOCK** on page 17.

▼

- **Selection of the lower range**
- **Selection of the automatic saving times of the measurement**
- **Discending scroll of the saved measures when viewing the list**
- **Decrease in the clock date and time values**

Selection of the lower range

The instrument is in the normal measurement representation mode.
If the instrument is in *Automatic* mode go to *Manual* mode.
If the instrument is in *Manual* mode selects the range immediately below, unless the range of 320μΩ has already been reached. In this case, a long acoustic signal is given.

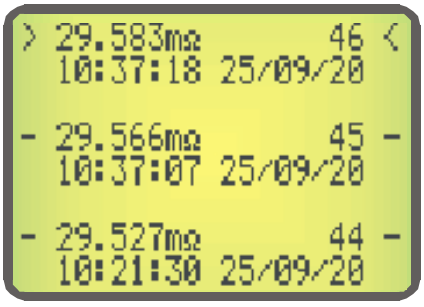
Selection of the automatic saving times of the measurement

The instrument is displaying the window for selecting the automatic saving times of the measurement.

This button moves the **>** and **<** highlighters down. Once the word *60sec* is reached, the highlighters reappear in correspondence with the word *Off*, allowing you to select the desired automatic recording time or deactivate this function.
More details are available in the paragraph **HOW TO SET UP AUTOMATIC SAVE** on page 15.

Discending scroll of the saved measures when viewing the list

The instrument is displaying the list of measurements (also called records) saved.
Each time the key is pressed briefly, the list scrolls down by one measure.



Referring to the following figure, the 45th saved measurement would be displayed at the top and the 43nd would be entered at the bottom.
By holding down the button permanently, after a first scrolling of one measurement and after a second, the list would scroll quickly until the eventual first and oldest saved measure is reached.

Decrease in the clock date and time values

The instrument is displaying the window concerning the clock setting.
This button decreases the value (hour, minute, second, day, month or year) currently selected.
Reached the minimum value (0 or 1) for that particular parameter, this passes to the maximum value depending on the parameter itself. In particular 0 for hours, minutes and seconds, 1 for days and months and 20 for years.
More details will be provided in the paragraph **HOW TO SYNCHRONIZE THE TIME AND DATE OF THE CLOCK** on page 17.

AUTO **Automatic/Manual mode**

The instrument is in the normal measurement representation mode.
If the instrument is in *Automatic* mode is brought into *Manual* mode and vice versa.
The **AUTO** button is operative only during the display of the measurement.

FLT **Selecting Filter**

The instrument is in the normal measurement representation mode.
Each time the button is pressed you select a different filter value in the sequence 1-2-4-8-16-32-64-1-2-4 - ..... The number, which is also displayed at the bottom of the screen after the word **Flt:,** indicates the number of acquisitions used to calculate the average, which is the main measure represented.
The greater the number of measurements over which the average is performed and more slowly responds the instrument. While maintaining a frequency of update of the measurement on the display of 4 Hertz, has the advantage of better stability of the representation.
It may happen that switching to a following filter value the main measure proves unreliable temporarily, until the buffer of the measures is refilled.
The **FLT** button is operative only during the display of the measurement.

A/Z **Zeroing procedure**

The instrument is in the normal measurement representation mode.

Button pressed < 1 sec ***Auto-zeroing***

This multifunction button allows the auto-zeroing the instrument without the need to disconnect the terminals of current or voltage and short circuit them. This procedure, on instruments of high sensitivity such as this, if not done properly could make it completely unreliable the measurement.
With the automatic procedure is also obtained compensation of the various thermoelectric effects in the contact points between the terminal voltage and the unknown resistance as well as all along the measuring cable up inside the instrument for each contact of different metal materials.
During execution of auto-zeroing is obtained also the elimination of the drift of the measuring amplifier.
Pressing the button for less than 1 second appear the words **AUTOZERO** flashing until the completion of the procedure, the duration of which is variable depending on the number of readings to be performed to obtain the average, the value of which is set by **FLT** button.

Button pressed > 1 sec **Lead current compensation**

The second function of this button is activated if this is pressed over a second and allows to compensate the voltage drop on the current cables in a better way than does the procedure of auto-zeroing. In fact, despite the high common mode rejection of the input amplifier, when current cables have high voltage drop due to the measurement currents of 1 ÷ 10A, or the section of these is insufficient or they are too long, the amplifier is not able to fully compensate for the common mode voltage variation that it comes to have between the normal operating conditions (with the current circulating in the cables) and that of auto-zeroing (when current is interrupted momentarily).
Although specifically designed for the compensation described above, and then especially in the presence of measurement currents of 1A and 10A, this possibility is active on all ranges since also allows zeroing the measurement if it appears that, connected to the terminals as shown in Fig 2, the main measure is not of zero value.

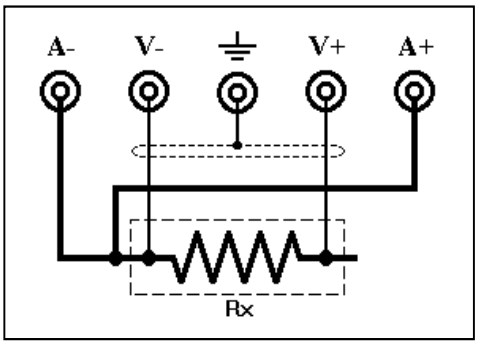


Fig. 2 Connection to be made during the compensation of the voltage drop on the current cables.

The **A/Z** button is operative only during the display of the measurement.

By its nature, the compensation is different for each range and according to the measurement current, i.e. the compensation that is carried out is valid only for the range active at that moment. For this reason the instrument saves the particular compensation in the memory cell corresponding to that range, so as to recall it when they are selected again. The compensation is saved in non-volatile memory at power down. Since the saved values are highly dependent on the measurement conditions (length and cross-section of cable current, potential thermoelectric and internal temperature of instrument, as well as elapsed time from power on of the latter) it may happen that the next time you turn on the instrument the compensation is no longer valid.

BKL **Backlight**

Turns on/off the display backlight both during the measurement display and in all other windows.
In case of battery operation it is recommended to turn on the backlight only when absolutely necessary since the power absorbed by the instrument, excluding the measuring current, increases from about 250mW to 480mW, reducing the operating time of the instrument considerably. The autonomy, however, does not fall below 50 hours with the backlight actived and range 320mΩ or higher.

MEM
- **Saving the measurement (or record)**
- **Access to the setting of the automatic saving of the measurement**
- **Selection of the clock parameter to be modified**

Button pressed < 3 sec ***Saving the measurement (or record)***

The instrument is in the normal measurement representation mode.
By pressing the button for less than 3 seconds, when released the measurement is saved, together with the date and time with a resolution of 1 second, even if the maximum visible resolution of the clock on the display is one minute.

The moment the button is pressed there is a short acoustic signal. On his release there can be two different cases:

- No other acoustic signal
  *The saving of the measure was successful and you can see the increase in the number of records at the **Rcd:** writen*
- Long acoustic signal
  The save was not performed due to these possible causes:
  - *The maximum limit of records that can be saved has been reached*
  - *It is performing an auto-zeroing*
  - *The current circuit is open and the instrument is in Auto Hold*
  - *The measurement is beyond the full scale, indicated by the wording OVL*

Button pressed > 3 sec ***Access to the setting of the automatic saving of the measurement***

The instrument is in the normal measurement representation mode.
If you want the instrument to automatically save the measurement, you can access the window shown here by holding down the **MEM** button for more than 3 seconds. At the end of this time there is also a short acoustic signal.

Using the ▲ and ▼ button you can scroll the highlighters **>** and **<** until you select the desired time interval or the word *Off* to disable the function.
While you are in this window no automatic saves are performed, even if the function was active before entering it.
Press the **MEM** button again to exit this window and return to the measurement window and the selected operating mode becomes active.
In sector 3 of the auxiliary information, in the lower part of the screen, the writing *Off* or *1s*, *2s*, *5s*…. appears, depending on the selection made. In the event that a time has been selected and therefore the function is active, at the end of the interval, while saving the measurement, the fact is highlighted with the representation of an uppercase "**S**" instead of a lowercase "**s**".
Upon reaching the maximum number of saves allowed, the automatic saving function excludes itself by going to *Off* and warning with a long acoustic signal.

Selection of the clock parameter to be modified

The instrument is in the clock setting mode.
The **MEM** button is also used to select the parameter (with sequence hours - minutes - seconds - day - month - year - hours -…..) to be modified.
More details will be provided in the paragraph **HOW TO SYNCHRONIZE THE TIME AND DATE OF THE CLOCK** on page 17.

The **MEM** button is not operational while viewing the list of saved measurements.

LIST **Enters/exits in the representation of the list of saved measurements**

By pressing the button you pass from the representation of the measurement to that of the list of saved measurements and vice versa.
If there are no saved measurements, the message **** No Record Found **** appears and to return to the measurement display simply press the **LIST** button again.
This button is not operational when setting the clock or setting the automatic measurement save.

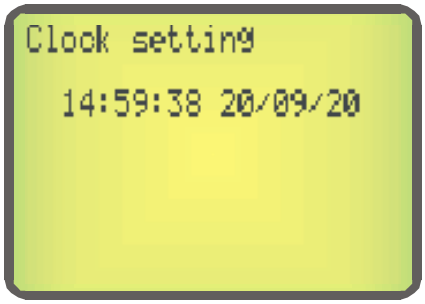
DEL **- Deletion of saved measurements**
- Access to the clock setting

Deletion of saved measurements

The instrument is displaying the list of measurements (also called records) saved.
Since the deletion from the list of single or all measures is an irreversible operation, this button has a delay in the execution of its function in order to avoid accidental deletions.
As soon as it is pressed, a short acoustic signal is emitted to warn of its activation, but it does not perform any operation. If it is held down for at least 3 seconds, a second acoustic signal is emitted and the highest record in the list, between the pair of highlighters **>** and **<**, is deleted and the other underlying recordings scroll upwards.
If at this point the button is no longer pressed, only this measurement is deleted, selected using the ▲ and ▼ buttons. Vice versa if the **DEL** button is kept pressed for another 2 seconds, until the fifth second has elapsed from when it started to be pressed, the entire list is deleted, a long acoustic warning is emitted and the message **** No Record Found **** appears.

Button pressed > *3 sec* ***Access to the clock setting***

The instrument is in the normal measurement representation mode.
When it is necessary to synchronize the clock because it no longer indicates a sufficiently precise time, you can access the corresponding window using the **DEL** button .
By pressing this button initially the instrument responds with a long acoustic signal, but after about 3 seconds, after a short acoustic signal, it accesses the clock setting.
To exit the clock setting, simply press the **DEL** button briefly again.
This button is not operational during the setting of the automatic saving of the measurement.
More details will be provided in the paragraph **HOW TO SYNCHRONIZE THE TIME AND DATE OF THE CLOCK** on page 17.



The following table summarizes the functions of each key and the type of acoustic signal resulting from it depending on the window currently active (measurement, auto save, list of records or clock) and the time for which the button is pressed.

Button name	Visualization	Action short/ long	Function		Signaling acoustic short/long
▲	measure	any	If in *Autorange* mode:	It exits the autorange mode staying in the selected range	short
			If in *Manual* mode:	If it has not reached the 3200Ω range, it switches to higher ohmmetrical ranges	short
				If it is on the 3200Ω range it does not execute the command	long
	auto save	any	Scroll up by a position of the selection highlights		short
	list	short	Scroll up by one position of the list		short
		long	Scroll up one position of list followed, after one second, by a fast scroll		short
	clock	any	Increase the clock parameter you want to change		short
▼	measure	any	If in *Autorange* mode:	It exits the autorange mode staying in the selected range	short
			If in *Manual* mode:	If it has not reached the 320μΩ range, it switches to lower ohmmetrical ranges	short
				If it is on the 320μΩ range it does not execute the command	long
	auto save	any	Scroll down one position of the selection highlights		short
	list	short	Scroll down by one position of the list		short
		long	Scroll down by one position of list followed, after one second, by a fast scroll		short
	clock	any	Decreases the clock parameter you want to change		short
AUTO	measure	any	If in *Autorange* mode:	Switch to *Manual* mode leaving the range unchanged	short
			If in *Manual* mode:	Switch to *Autorange* mode by selecting the most suitable range	short
	auto save / list / clock	any	It does not execute any commands		long
FLT	measure	any	Each time the button is pressed, a different filtering value is selected in the sequence 1-2-4-8-16-32-64-1-2-4-.....		short
	auto save / list / clock	any	It does not execute any commands		long
A/Z	measure	short	Performs the instrument auto-zeroing procedure		short
		long	If the measurement is in Overload:	It does not execute the command	long
			If the measurement <1000 points:	It acquires the value and treats it as zero	short
			If the measurement ≥1000 points:	It does not execute the command	long
	auto save / list / clock	any	It does not execute any commands		long
BKL	measure/ auto save / list / clock	any	Turns the display backlight on/off		short
MEM	measure	< 3 sec.	Saves the measurement value in non-volatile memory when the button is released		short when the button is pressed
		> 3 sec.	After 3 seconds from which the button is pressed, it switches to the display of the automatic measurement saving setting		short when it enters the new window
	auto save	any	Switch to view the measurement		short
	list	any	It does not execute any commands		long
	clock	any	Select the clock parameter to modify		short

LIST	measure	any	Switch to view the list of saved measurements	short
	auto save	any	It does not execute any commands	long
	list	any	Switch to view the measurement	short
	clock	any	It does not execute any commands	long
DEL	measure	> 3 sec.	After 3 seconds from which the button is pressed it switches to the clock setting display	long when the button is pressed, after 3 sec. other short signaling
	auto save	any	It does not execute any commands	long
	list	> 3 sec.	Deletes the record highlighted by **>** and **<**, present in the upper part of the display	short when the button is pressed, after 3 sec. other short signaling
		> 5 sec.	Delete all records in the list	long after 5 sec. since the button was pressed
	clock	any	Switch to view the measurement	short

INPUTS

On the panel there are the measuring inputs, present with the four bushing indispensable if we want to measure resistances of low and very low value with the Kelvin method, the socket for the mains supply, the switch and the communication port.

A+ / A- **Current Terminals**

These terminals provide the measuring current. With the current circuit open the voltage present at the output is between 2V and 2.4V, depending on the state of the battery and the presence or absence of the mains voltage.

V+ / V- **Voltage Terminals**

Through these terminals the voltage drop across the unknown resistance is detected, with a sensitivity on all ranges which is normally 1µV, with the exception of the range of 320µΩ where the sensitivity reaches 100nV.

LINE **Power Socket**

Power plug from the mains 230V ± 10% 48-66Hz and 5x20mm fuse holder with fuse 250mA delayed.

ON **Power Switch**

Switch of the instrument.
Even with the switch in the OFF position the charger section is always active in the presence of the line power, to keep the batteries charged.

COM **Communication Port**

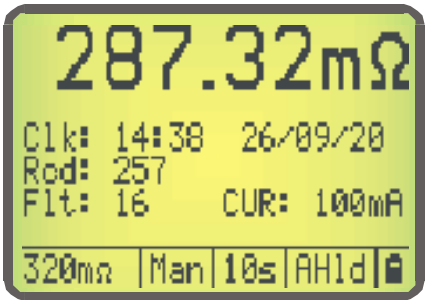
The communication port of the instrument allows the optically isolated connection to a PC which can both read the data and the entire setup of the instrument. Through it, it is also possible to synchronize the clock of the instrument with that of the PC with the precision of one second.

INFORMATION ABOUT THE MEASURE

As visible in the image on the side, other useful information is provided with the measurement.

Clk:

Next to it is the date and time of the instrument clock.
When the measurement is saved, it is associated with the value marked by the clock, but with a resolution of 1 second, even if these do not appear on the display. Therefore if two measures are saved within a very short time span, the same time may be shown on the display, but the time saved in the measure memory is different, including the seconds.



Rcd:

The number of records saved up to that moment by means of the **MEM** button or with automatic saving is indicated alongside, for a maximum value of 1000 saves.

Flt:

Indicates the number of acquisitions used to calculate the average of the measurements.
The value is changed using the **FLT** button in the sequence 1-2-4-8-16-32-64-1-2-4-…..

CUR:

Indicates the current used by the instrument for measurement.

AUXILIARY INFORMATION

In the five sectors of the lower part of the display, in the status line, various auxiliary information is provided, summarized in the table below.

Sector	Information	Indication	Notes	Type of report
1	**Range**	3200Ω 320Ω 32Ω 3200mΩ 320mΩ 32mΩ 3200µΩ 320µΩ	Selected range	permanent on all ranges
2	**Automatic / Manual**	Aut Man	Instrument in automatic range selection Instrument in manual range selection	permanent permanent
3	**Auto save**	Off 1s 2s 5s 10s 30s 60s	Auto save disabled The time interval between saving one measurement and the next is indicated	permanent the letter "s" becomes a capital "S" at the moment of saving
4	**Hold**	AHld no indication	The instrument is in *Auto Hold* as the current circuit is open The instrument is not in *Auto Hold*	flashing
5	**Battery status**	no indication image of a battery with gradually decreasing charge level image of a flashing empty battery	Full battery Battery increasingly discharged Fully discharged battery	 permanent flashing

HOW….

HOW TO SET UP AUTOMATIC SAVE

The automatic save function allows you to perform an automatic recording by setting the desired time interval selectable between 1 second and 60 seconds.

To activate/deactivate the function, enter the window shown on the side by pressing the **MEM** button for at least 3 seconds. Both the instant the button is pressed and at the end of the 3 seconds there is a short acoustic signal.

With the ▲ and ▼ buttons you can choose the time interval between one saving and the next, or deactivate the function by selecting the word *Off*.

To exit the window, simply press the **MEM** button. The selection made is stored automatically when you exit the window.

When this window is open, automatic saves are not performed, even if the function is active.

Obviously it is possible to make recordings in succession with different times, it is also possible to perform "manual" saving by pressing the **MEM** button even with automatic saving active.

HOW TO SAVE A MEASUREMENT

To save a measurement simply press the **MEM** button for less than 3 seconds while the measurements are being displayed. The moment the button is pressed there is a short acoustic signal. The measurement is saved when the button is released, provided that there are no causes that prevent the command from being executed, such as:

- *The maximum limit of records that can be saved has been reached*
- *It is performing an auto zeroing*
- *The current circuit is open and the meter is in Auto Hold*
- *The measurement is over the full scale, indicated by the wording OVL*

In case of failure to save, there is a long acoustic signal. On the contrary the successful completion of the operation is signaled by increasing the number highlighted by **Rcd:**.

"Manual" saves can be performed even when the automatic save function is active.

HOW TO VIEW THE LIST OF RECORDS

To access the view of the list of saved measurements, press the **LIST** button, which also allows you to return from the list to view the measurement.

If there are no measurements recorded, pressing the **LIST** button displays the message **** No Record Found **** accompanied by a short acoustic signal. If there are data saved, the list appears and the acoustic signal is short.

The first time the list is displayed after switching on the instrument, the first record at the top is the most recent saved. If you scroll through the list and then exit, when you reenter the list view, the record at the top is the same as that which was displayed at the previous exit.

HOW TO SCROLL THE LIST OF RECORDS

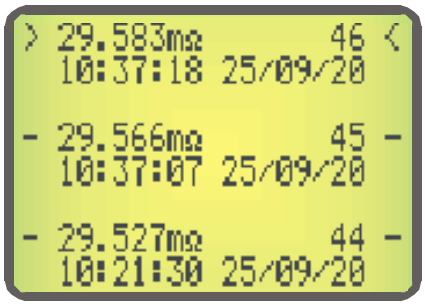
When you are in the list of records, the ▲ and ▼ buttons scroll the records respectively towards the most recent or the oldest ones.

Briefly pressing the buttons scrolls by one position, but if you keep the button pressed after about 1 second, you scroll quickly.

When the most recent or oldest recording arrives in the top position, where the **>** and **<** highlighters are present, scrolling stops and a long acoustic signal is generated.

HOW TO INTERPRET THE SAVED AND DISPLAYED DATA

Each record consists of two lines. The first data, in the upper left row, is the measurement that has been saved. In the same line on the right there is the progressive saving number.



The higher the number, the more recent the save.

The second line is entirely dedicated to the date and time of saving, with a resolution of 1 second, even if the clock present in the representation of the measurement displays the minimum time of 1 minute.

Taking the image on the side as a reference, it can be seen that measurement 46, placed higher, was saved more recently than measurement 45, which is more recent than 44, and so on.

Furthermore only the first record at the top is highlighte with the **>** and **<** highlighters, while the remaining records, for a maximum of 2, are highlighted with the **-** highlighters. The motivation is essential: when you want to delete a single record it must be scrolled to the **>** and **<** highlighters. Only the record thus highlighted will be deleted.

HOW TO DELETE A SINGLE RECORD

If you want to delete a single specific record, you must enter the list window, scroll the list with the ▲ and ▼ buttons until the desired record is aligned with the **>** and **<** highlighters on the first line at the top of the display. At this point, press the **DEL** button until the second short acoustic signal is heard, about 3 seconds after the button has been pressed and a first short signal has been given. Then immediately release the **DEL** button.

The numbering of the recordings will be reworked by scaling the total number by one, keeping the numbering of the records older than the deleted one unchanged and scaling all the more recent records.

When a record between the first and last of the list is deleted, this memory location is no longer available for saving a measurement, while if the last record saved is deleted, the memory location is still available for subsequent saving. However if the memory location in which the most recent record was located before being deleted was contiguous to one or more previously deleted memory locations, these memory locations also become available for subsequent saving. Obviously deleting the entire memory makes this totally available.

HOW TO DELETE THE ENTIRE LIST

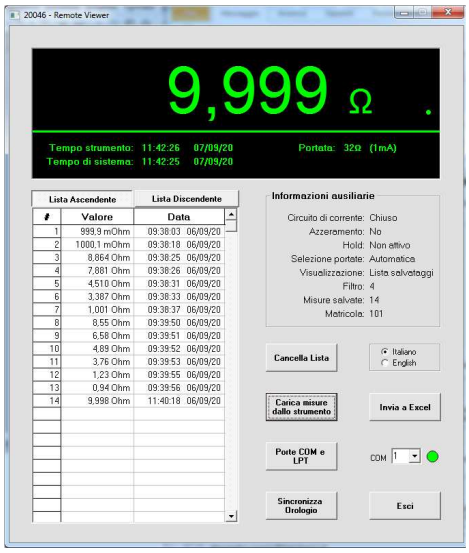
To delete the entire list, enter the list screen and press the **DEL** button for at least 5 seconds. As soon as the button is pressed, a short acoustic signal will be given to warn that the button has been pressed; after about 3 seconds there will be a second short acoustic signal and the registration between the **>** and **<** highlighters will be deleted. After about 5 seconds from

pressing the **DEL** button the entire list will be deleted, there will be a long acoustic signal and the message **** No Record Found **** will appear.

HOW TO SYNCHRONIZE THE TIME AND DATE OF THE CLOCK

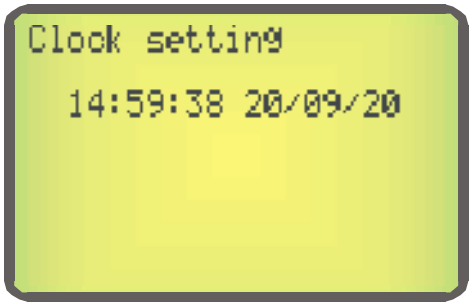
There are two alternatives to synchronize the clock:

Synchronization via SW *20046 Remote Viewer* or SW *Recorder 20000*



With the **20046 Remote Viewer** software it is possible to synchronize the instrument clock to that of the PC simply by pressing the Synchronize Clock button at the bottom, in the center of the program window, as can be seen from the image on the side.
The PC will send to the instrument the command with the system date and time of the PC itself (considered valid and correct) with the resolution of the second, without the need to do anything else.
The same operation can be performed with the SW **Recorder 20000** by pressing the ***Synchronize Clock*** button located in the Setup window.

Manual setting from instrument



Of course it is also possible to set/modify the clock directly from the instrument. To access the dedicated window go to the measurement window and press the **DEL** button for at least 3 seconds. At first there will be a long acoustic signal, but after 3 seconds there will be a short signal and an image similar to the one alongside will appear with the hours flashing.

The **▲** and **▼** buttons allow you to increase/decrease the value currently flashing, while to pass from one value to the next, in the sequence hours - minutes - seconds - day - month - year - hours -...., use the **MEM** button. The new selected value starts flashing immediately. Obviously it is possible not to make any changes to the selected parameter and move on to the next parameter.

Each time the value is increased/decreased this is immediately saved, so there is no need to save the data before exit the clock window because the new value has already been saved.

The only exception to the increase / decrease of the value concerns the seconds, which are reset, regardless of the **▲** or **▼** button pressed.

To exit the clock setting simply press the **DEL** button again. If the date setting is incorrect, the message ***** Wrong setting ***** appears and a correct date must be set in order to return to the measurement display.

DEL Allows you to enter/exit the clock screen and delete the incorrect setting warning: ***** Wrong setting *****.

▲ and ▼ Increase/decrease the value by one unit of the selected parameter, highlighted by flashing. Depending on the month, it goes from 29 to 1 or from 1 to 29 if the month is a leap February or from 1 to 28 and from 28 to 1 if it is a non-leap February, so it also passes from 1 to 30 and from 30 to 1 or from 1 to 31 and from 31 to 1 in the other months. Furthermore if, for example, *31/08/27* is set and the month is changed to *09*, the day automatically changes to *01* since the date *31/09/27* is not valid.

MEM Select the next parameter in the sequence hours - minutes - seconds - day - month - year - hours -.…

CAUTION:	The instrument checks the number of the day on the basis of the month set at that time, also taking into account the leap year and accepts, for example, the setting of 29/02/24, but not 29/02/23 when it is changed the day with month and year correctly set. On the other hand, it is not able to perform an immediate check if, for example, it passes from the date 31/01/27 to the date 31/02/27 by changing the month after setting the day. When you try to exit the clock by pressing the **DEL** button, a setting check is still performed and if this is incorrect, the message ***** Wrong setting ***** appears. It is possible to proceed with the correction both before and after pressing the **DEL** button which will make the alarm message disappear and, if there are no more incorrect settings, it will allow the return to the measurement.

HOW TO REPLACE THE BATTERY OF THE NON-VOLATILE MEMORY

On average the duration of the backup battery used in saving the list data is about 10 years. No indication of the state of charge of this battery is given, but it is possible to understand that this is discharged if the saved data is lost or assumes incoherent values or the clock no longer has the accuracy indicated in the technical specifications.

To replace the battery it is necessary to disconnect the instrument from the mains, turn it off and open it by unscrewing the four screws that fix the panel and extracting the instrument from the plastic case with extreme care.

On the main printed circuit there is a single circuit of about 3x3cm where the 3V CR2032 battery housed in its battery holder is clearly evident. Once the battery has been replaced, close the instrument.

CAUTION:	During battery replacement all data saved in the memory will be lost and the clock will be reset, so it becomes necessary to synchronize/set it again.

TECHNICAL SPECIFICATIONS

Power supply	230V ±10% 48-66Hz fuse 250mA delayed
Power requirement	15VA
Battery	visual indication of charge status battery
Battery autonomy	view Tab. 2
Representation	on backlighted graphic display 64x128 pixels 62x44mm
Points of measure	32000
Display refresh rate	4 Hz
Ranges	320,00μΩ, 3200,0μΩ, 32,000mΩ, 320,00mΩ, 3200,0mΩ, 32,000Ω, 320,00Ω, 3200,0Ω
Range selection	automatic / manual
Automatic change of scale	switch to range higher >31999 points switch to range lower <3000 points
Resolution and measuring current	view Tab. 1 **RESOLUTION AND MEASURING CURRENT**
Measurement accuracy (ranges 3200Ω ÷ 3200μΩ)	±(0,05% + 2 digit)
Measurement accuracy (range 320μΩ)	±(0,06% + 3 digit)
Noise (referred to input from 0,01Hz to 0,1Hz)	0,2μ V_{pp} with filter = 16
Compensation current cable / Zeroing	compensation of emf of voltage circuit and the offset of the instrument up to ± 1000 digits
Heating time after the power up	about 10 minutes within a tolerance of ±0,3 μV
Open circuit voltage (**A+**) - (**A-**) (current circuit open)	2,20 Vmax (battery operation) 2,40 Vmax (mains operation)
Filter	average on 1, 2, 4, 8, 16, 32, 64 measures
Automatic saving/recording	yes, it can be activated with selectable saving times of 1-2-5-10-30-60s
Number of records that can be saved in the non-volatile data memory (List)	1000
Type of data saved in the List	measurement, date and time with 1 second resolution
Transfer time of saved measurements from instrument to PC	3.7 seconds to transfer 1000 records
Retention time of the saved data	about 10 years, with new battery
Battery type of data memory	CR2032 3V
Accuracy of the instrument clock	better than 5 seconds a day
Working temperature	0 ÷ 50 °C
Storage temperature	-20 ÷ 60 °C
Weight	4850 gr. approximately
Dimension	265x245x170mm (W x H x D)

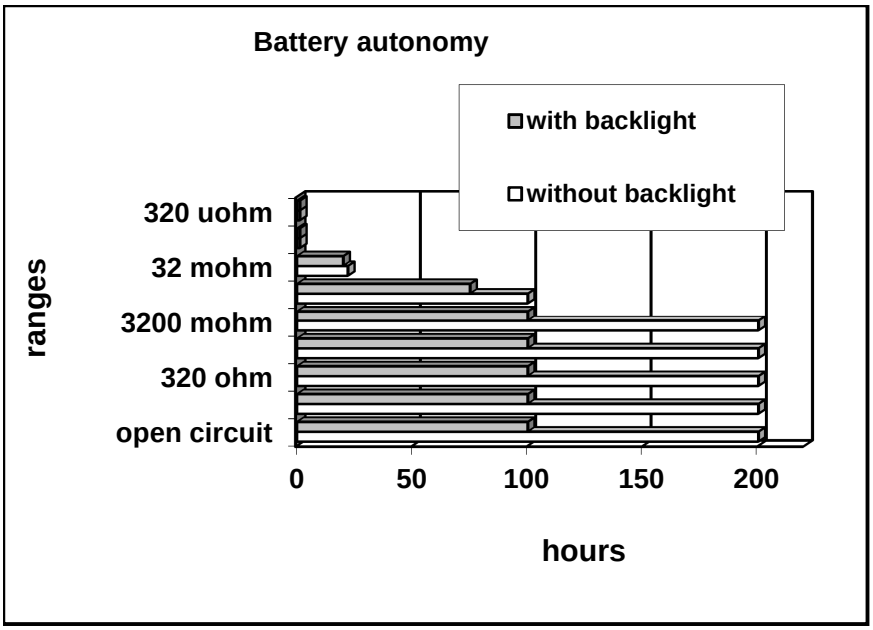
The table below shows the values of resolution, measuring current and maximum power dissipated by the unknown resistance depending on the selected full scale.

RESOLUTION AND MEASURING CURRENT					
Range	**Resolution** (resistance)	**Resolution** (voltage)	**Voltage of f.s.**	**Current**	**Maximum power**
320μΩ	10nΩ (10^{-8} Ω)	0,1μV	3,2mV	10A	32mW
3200μΩ	100nΩ (10^{-7} Ω)	1μV	32mV	10A	320mW
32mΩ	1μΩ (10^{-6} Ω)	1μV	32mV	1A	32 mW
320mΩ	10μΩ (10^{-5} Ω)	1μV	32mV	100mA	3,2mW
3200mΩ	100μΩ (10^{-4} Ω)	1μV	32mV	10mA	320μW
32Ω	1mΩ (10^{-3} Ω)	1μV	32mV	1mA	32μW
320Ω	10mΩ (10^{-2} Ω)	1μV	32mV	100μA	3,2μW
3200Ω	100mΩ (10^{-1} Ω)	1μV	32mV	10μA	0,32μW

Tab. 1 Summary table of the resolutions, sensitivity, measuring current and maximum power dissipation of the unknown resistance as a function of the selected range.

To prevent excessive internal heating of the instrument from causing drifts in the measurement, particularly on the lower range, the battery is charged with a current of approximately 1A when the instrument is on and with a current of 2A when it is off. Consequently, the complete charge with the instrument off takes about 20 hours, while with the instrument on and with the measuring current always circulating, the charging time can vary considerably according to the range selected and the status of the backlight. Even for a measurement current already of 1A and backlighting on, there is in any case a slight discharge of the battery which, if the measurement current rises to 10A, is discharged in just over 1 hour.

Below is the graph concerning the battery autonomy, without connection to the network, according to the range selected and the on/off status of the display backlight.



Tab. 2 Graph representing the battery autonomy in function of the selected range and the status of the backlight.

TIPS ON THE MEASUREMENT EXECUTION

CONTACT POTENTIALS

After switching on the instrument, before taking any measurements, it would be advisable to wait at least 10 minutes. This allows the necessary thermal settling of the components of the microohmmeter.

In carrying out the measure is essential, in order to obtain the best results, follow the connection diagram of the terminals of measurement shown in Fig 3. In this way it is avoided that in the circuit voltage there are the contact resistances of the current terminals, with a macroscopic alteration of the measurement results.

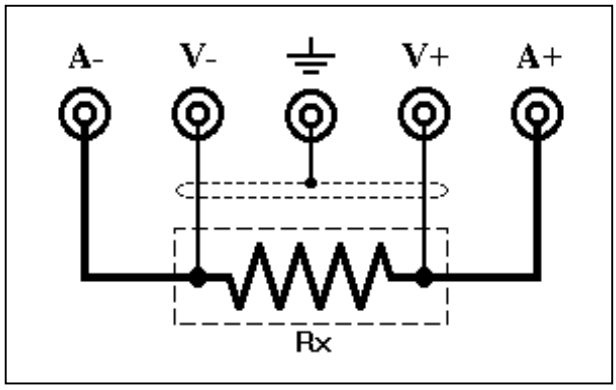


Fig. 3 Connection diagram for measuring four wires of a resistor of low value.

With cables of Kelvin type this problem does not exist since the two tweezers placed to end are connected in such a way as to avoid that the contact resistances adversely affect the measurement.

Other sources of error may be the potential of contact that you have when two different metal materials meet.

To minimize the influence of this physical phenomenon, it must try to have the same type of contact between positive and negative terminal voltage and the unknown resistance. This contemplates both the state of the surfaces (polished, oxidized, dirty, etc..) that the material (other than material of a head of the unknown resistance compared to another), as well as the different temperature at which they can be the points of contact of the element under test.

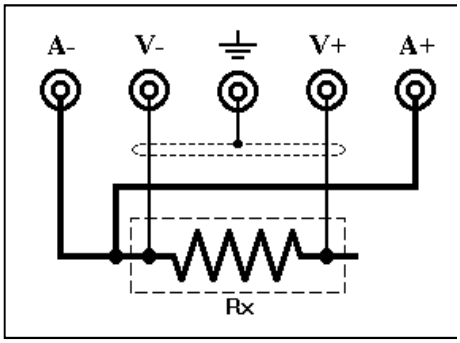
If the type of contact to the positive terminal is similar to the negative terminal, the two effects tend to cancel and at most remains a potential equal to the difference of the two. If this effect remains constant over time is sufficient to compensate him once and for all, on the contrary should be periodically reset by pressing **A/Z** button.

The change that you mention is mainly due to variations in temperature between the two points where the voltage probes touch the unknown resistance: the only way to get a stable and reliable measure is to take every precaution to ensure that immediately after an zeroing there are not fluctuations in the temperature difference of the two points of contact.

All the above said phenomena are, in absolute value, certainly modest (generally a few tenths of microvolts), but unfortunately they are more than detectable by instruments of similar sensitivity. That's why it is essential to take some basic and essential precautions to have a good quality of the measurement. The main, but not the only ones, are:

- Clean the surfaces of the terminals of the unknown resistance and measuring cables from oil, water, oxides etc.
- If the section of the current cables is less than or equal to 4mm2 these must be of equal cross section, to avoid that a different heating by Joule effect causes a drift of the measurement over time. In any case, it is strongly recommended that you use cables of not less than 6mm2 when using the lower ranges with current of 10A.
- Wait for the cooling of the object to be measured.
- Avoid heating/cooling, even slightly and in whatever way, a terminal of the resistor to be measured relative to each other.
- Avoid concatenate the measurement cables with varying magnetic fields that can cause a bad reading.

- Always perform an auto-zeroing and possibly a compensation of test lead to the first measure, and wait at least 10 minutes after the power on before you use the instrument, if you want good accuracy and stability of the measurement.
- Always perform an auto-zeroing when you are on the range 320μΩ or the test leads are connected to another resistance.
- To obtain a correct zeroing of the instrument and to guarantee a measurement as accurate as possible, the voltage leads/terminals must not be moved after performing an auto zeroing. If you want to check or carry out the correct zeroing of the instrument and the relative contact potentials of the voltage terminals, it is **ABSOLUTELY ESSENTIAL** to use the configuration shown in the diagram below, where **ONLY ONE** of the current terminals is **MOVED**.



Since the potential of contact may vary from point to point is essential, to have the best results, do not move the points of measurement, even if these are assumed to be equipotential: current flows and potential of contact different in different points alter the measure . This is absolutely valid also if you wanted to run an auto-zeroing: do not ever alter the electrical connection of the terminal voltage between measurement and the auto-zeroing.

ELECTROMAGNETIC FIELDS

Other causes of instability or failure of the measurement or in zeroing are attributable to the presence of magnetic fields can induce electrical noise can move the level in DC of the signal. The best way to mitigate this influence is to keep the test leads, both current and voltage, as short as possible and neighbors, ensuring also that the test leads do not wobble or vibrate in proximity to static magnetic fields: this will cause the occurrence of induced voltages of amplitude and frequency dependent on the movement.

CURRENT CABLES OF INSUFFICIENT SECTION

Another cause of error, even if in this case decidedly modest and found only on the range 3200μΩ and 320μΩ, is due to the limited section of the current leads. If in fact the section is less than 6 mm2 and the cable is proportionally too long it has, between zeroing and measurement, a difference in the voltage drop on the cable that the measuring amplifier is no longer able to properly compensate, by introducing a error, with the cables supplied, usually not more than 1÷2 digits. The remedy is to use, on the lower range, cables of elevated section and as short as possible.

If there is any cables that provide high falls and compensation is necessary to reduce the error, see the instructions on page 6 relating to paragraph **A/Z Zeroing procedure**.

SLOW OF MEASUREMENT

This is certainly not a cause of the error, but it may seem, sometimes, that the instrument is too slow or even stop it: the reason is due to the value that has been set in the filter. The higher this value, the longer the time that the instrument takes to make a series of measurements on the unknown resistance.

MEASUREMENT OF HIGHLY INDUCTIVE ELEMENTS

The microohmmeter **20046** is able to measure the resistive component also highly inductive elements such as transformers with a power of more than 1 MVA. To avoid damage or malfunction of the instrument is advisable to connect, in parallel to the unknown resistance, a diode as shown in Fig 4.

Such protection diode should however put only if actually there is a need and in the presence of inductive loads, since on high range the reverse current of the same diode can alter, although modestly, the measurement.

To protect the range from 3200Ω to 320mΩ including is sufficient a diode of the type 1N4004 or similar, able to withstand currents of 1A. For the lower range (32mΩ and 320μΩ) is advisable to use a diode can withstand higher currents.

Its function is mainly to protect the amperometric circuit. The voltage circuit is protected against continuous differential voltages up to ± 35V and pulse up to ± 100V for 1 second.

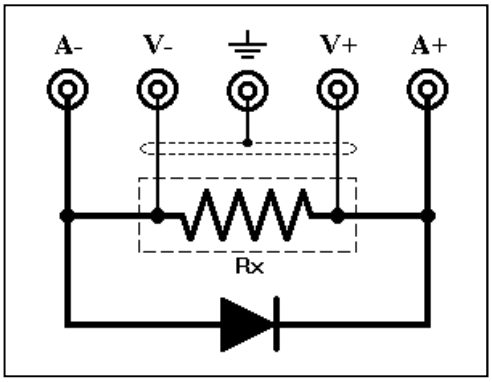


Fig. 4 Connection diagram of the protection diode in parallel with an strongly inductive ele-ment. Note the direction of insertion of the diode.

CAUTION:	It is important that the protective diode is connected in parallel to inductive element and not between the terminals of current or voltage, otherwise it is not able, disconnecting current cables, to eliminate the strong glitter that is created. The spark can also reach voltages of thousands of volts and irreparably damage some electronic circuits of the current generator.

PROTECTION FROM OVERVOLTAGE AND OVERCURRENT

The instrument is provided with adequate protection against voltage surges on voltage inputs, as specified in the technical specifications, but requires, in the case of measurement of predominantly inductive elements, an external protective diode. Such a diode as shown in the previous section, is fully sufficient to protect the generator current circuit. This does not mean, however, that the instrument is able to withstand electrical stress such as connection to motors or transformers connected to its power supply, especially if this is the line network. The electric power at stake in this case would be well beyond those tolerable by the protection circuitry, internal and external, of microohmmeter and its damage would be certain.

CAUTION:	The instrument is not able to bear, on the bushings of measurement, the application of external voltages or currents, especially if due to the direct connection with the network line.

MEASUREMENT PERFORMED ON 320μΩ RANGE

This range is the only one to have a voltage sensitivity of only 0.1μV, against a sensitivity of 1μV of all the others. This makes it more susceptible to the various disturbing effects listed in this chapter, but a minimum of attention and possibly an auto-zeroing is sufficient, as suggested in the **CONTACT POTENTIALS** paragraph, to guarantee a correct measurement.

TEST CERTIFICATE

INSTRUMENT MODEL 20046

SERIAL NUMBER INSTRUMENT . . . _____

BATTERY . . . . . OK

USB PORT . . . . . OK

TEMPERATURE of CALIBRATION . . . . _____

RANGE	RESISTANCE of REFERENCE	MEASURED VALUE	PRECISION DECLARED	RESULT
3200Ω			0,5 ‰ + 2dgt	OK
320Ω			0,5 ‰ + 2dgt	OK
32Ω			0,5 ‰ + 2dgt	OK
3200mΩ			0,5 ‰ + 2dgt	OK
320mΩ			0,5 ‰ + 2dgt	OK
32mΩ			0,5 ‰ + 2dgt	OK
3200μΩ			0,5 ‰ + 2dgt	OK
320μΩ			0,6 ‰ + 3dgt	OK

TEST NOISE . . . . . OK
TEST EMC . . . . . OK
TEST BURN-IN . . . . . OK
MANUAL, CABLES, SOFTWARE . . . . . OK

This is to certify that the instrument conforms to the technical specifications relating thereto, as stated in the specifications.

Date

_____

The Operator

_____

DECLARATION OF CONFORMITY

The company PEDRANTI ELIO, Via Cesare Battisti 33/B, Cardano al Campo - Varese, Italia, declare under our sole responsibility that the instrument **20046**, to which this declaration relates, is in conformity with the rules laid down in directive CEE89/336.

Cardano al Campo, 05/10/20

. Pedranti Elio .