■ **MÉGOHMMÈTRES**
■ **MEGOHMMETERS**

# C.A 6549


**FRANCAIS**
**ENGLISH**

**Mode d'Emploi**
**User's manual**

CHAUVIN ARNOUX

**Meaning of symbol** 
**CAUTION !** Refer to the user manual before using the instrument.
Failure to follow or carry out the instructions in this User Manual preceded by this symbol may result in personal injury or damage to the instrument and the installations.

**Meaning of symbol** 
This instrument is protected by double or reinforced insulation. It does not need to be grounded for electrical safety.

**Meaning of symbol** 
**CAUTION !** Risk of electric shock.
The voltages of the parts identified by this symbol may be ≥ 120VDC. For safety reasons, this symbol lights on the display unit as soon as a voltage is generated.

Thank you for purchasing this C.A 6549 megohmmeter and for your confidence.
For the best possible service from your instrument:
- **read** this User Manual carefully,
- **comply** with the precautions for use.

##  PRECAUTIONS FOR USE 

- Comply with the conditions of use : temperature, humidity, altitude, degree of pollution and place of use.
- This instrument may be used directly on installations of which the operating voltage does not exceed 1000V with respect to ground (measurement category III), or on circuits by-passing the network and protected, or on circuits not by-passing the network (measurement category I). In the latter case, the operating voltage must not exceed 2500V, with impulse voltages limited to 2.5kV (cf. NF EN 61010 ed.2 of 2001).
- Use only the accessories delivered with the instrument, compliant with safety standards (NF EN 61010-2-031).
- Use a fuse having the appropriate rating and type (see § 8.1.2); failure to do so may damage the instrument and void the warranty.
- Set the switch to OFF when the instrument is not in use.
- Check that none of the terminals is connected and that the switch is set to OFF before opening the instrument.
- Repairs and metrological verifications must be carried out by approved, qualified personnel.

# CONTENTS

# 1. PRESENTATION

## 1.1. C.A 6549 MEGOHMMETER

**The C.A 6549 megohmmeter** is a top-of-line measuring instrument, portable, in a rugged construction-site housing with cover, with a graphic screen, operating from battery or line power.
Its main functions are:

- automatic detection and measurement of voltage / frequency / input current,
- quantitative and qualitative insulation measurement:
  - measurement at 500/ 1000/ 2500/ 5000V DC or other test voltage between 40 and 5100 V DC ("adjustable voltage"),
  - measurement in voltage step mode (the applied voltage increases in steps),
  - automatic calculation of DAR/PI and DD (dielectric discharge index) quality ratios,
  - automatic calculation of measurement result referred to a reference temperature.
- automatic capacitance measurement,
- automatic measurement of residual current.

This megohmmeter helps ensure the safety of electrical installations and equipment.
Its operation is controlled by microprocessor for the acquisition, processing, and display of measurements and the storage and printing of results.
It has many advantages, among them:

- digital filtering of insulation measurements,
- automatic voltage measurement,
- automatic detection of external AC or DC voltages on the terminals, before or during insulation measurements, disabling or stopping the measurements when measurement accuracy is no longer guaranteed,
- threshold programming to trigger audible alarms,
- timer for measurement time checks,
- protection of the instrument by fuse, with detection of defective fuses,
- operator safety by automatic discharge of residual high voltage on the equipment tested,
- automatic shutdown of the instrument to save battery power
- battery charge indication,
- large backlit graphic display unit that is very easy for the user to read,
- Memory (128 KB), real time clock, and serial interface
- PC control of the instrument (using the optional DataViewer Pro software)
- Printing in RS 232 or Centronics mode.

## 1.2. ACCESSORIES

- **Measuring cables**

The megohmmeter is delivered with 3 measuring cables as standard:
- 2 3m safety cables (red & black with rear pick up), with an HV plug for connection to the instrument and an HV alligator clip for connection to the item tested
- 2 blue cables (3m and 0.3m with rear pick up) to measure high insulation values (cf. § 5.1).

Optionally, you can order the same cables in lengths of 8m and 15m, and also simplified cables (the crocodile clip is replaced by a 4mm banana jack in which standard crocodile clips or contact pins can be connected).

- **DataViewer Pro PC software**

This is used to:
- recover stored data (results, graphs, etc.)
- print personalized test protocols in accordance with user needs,
- create text files to be able to use spreadsheets (Excel™, etc.),
- configure and completely control the instrument via the RS 232 port.

The minimum recommended configuration is a PC with a 486DX100 processor.

- **Serial printer (optional)**

This compact printer can be used to print measurement results, whether stored or not, directly in the field.

- **Serial-parallel adapter (optional)**

The optional RS232/Centronics adapter converts the serial interface (RS232) into a parallel printer interface (Centronics), making it possible to print all measurements directly on A4-format office printers, without using a personal computer.

# 2. DESCRIPTION

## 2.1. HOUSING

View of the front panel of the instrument

### 2.1.1. FRONT PANEL OF THE C;A 6549

- 3 4mm-dia. safety terminals identified as «+», «G», and «-»
- Access to the fuse that protects terminal “G”
- 8-way rotary switch:
  - Off: switches instrument power off
  - 500 V-2 TΩ: insulation measurement at 500V up to 2 TΩ
  - 1000 V-4 TΩ: insulation measurement at 1000V up to 4 TΩ
  - 2500 V-10 TΩ: insulation measurement at 2500V up to 10 TΩ
  - 5000 V-10 TΩ: insulation measurement at 5000V up to 10 TΩ
  - Adjust. 50...5000 V: insulation measurement with adjustable test voltage (from 40V to 5100V: 10V steps from 40 to 1000V and 100V steps from 1000 to 5100V)
  - Adjust. Step: insulation measurement with voltage step function (the test voltage varies in steps)
  - SET-UP: adjustment of instrument configuration
- 1 yellow START / STOP key: beginning / end of measurement
- 8 elastomer keys each having a main function and a secondary function.
- 1 backlit graphic screen
- 1 socket for connection to line power (direct operation on line power and/or battery charging)
- 1 RS 232 serial INTERFACE male connector (9 pins) for connection to a PC or printer.

**Note:** The battery compartment is inside the housing.

### 2.1.2. KEYS

8 keys each having a main function and a secondary function :

***2nd*** select the secondary function written in yellow italics below each key.

**MODE** **Primary function** : before insulation measurements, select the desired type of measurement.
***PRINT*** **Secondary function** : immediate printing of measurement result(s) on a serial or parallel printer.

**DISPLAY** **Primary function** : browse throught the various screens accessible before, during and after the measurement.
***GRAPH*** **Secondary function** : after a "timed run" measurement, display insulation resistance versus measurement time.

▸ **Primary function :** select a parameter to be modified, to the right. At the end of the line, the cursor jumps to the beginning of the line (all the way to the left).
❊ **Secondary function** : activate / deactivate display backlighting.

◂ **Primary function** : select a parameter tobe modified, to the left
***T°*** **Secondary function** : activate the calculation to refer the measurement value to the reference temperature programmed in SET-UP.

▲ **Primary function** : in the various menus, select a function; otherwise, generally, increment the flashing parameter on which the cursor is positioned. Pressing and holding the key increases the rate of change of the parameter.
***ALARM*** **Secondary function** : activate / deactivate the alarms programmed in the SET-UP menu.

▼ **Primary function** : in the various menus, select a function; otherwise, generally, decrement the flashing parameter on which the cursor is positioned. Pressing and holding the key increases the rate of change of the parameter.
***SMOOTH*** **Secondary function** : enable / disable display smoothing in insulation measurement.

**MEM** **Fonction première** : store measured values.
**MR** **Fonction seconde** : retrieve stored data (this function is dependent of the switch position), except in the OFF and SET-UP positions.

## 2.2. DISPLAY

### 2.2.1 GRAPHIC DISPLAY UNIT

The display unit is a graphic display unit with a resolution of 320 x 240 pixels. It has built-in backlighting that can be activated or deactivated using the ✳ key.
The various screens that are accessible are presented and explained throughout this manual.
We explain below, however, the various symbols that may appear on the screen.

### 2.2.2 SYMBOLS

**REMOTE** Indicates that the instrument is controlled remotely via the interface.
In this mode, all of the keys and the rotary switch are inactive, except for shutdown of the instrument (OFF position).

**COM** Flashes when data are transmitted to the serial interface.
Lit steadily if there is a problem in transmission.

**2nd** Indicates that the secondary function of a key will be used.

🕘 Indicates that the "programmed time test" mode was selected before the measurement was started.

**DAR** Indicates that the "automatic calculation of Dielectric Absorption Ratio" mode was selected before the measurement was started.

**PI** Indicates that the "automatic calculation of Polarization Index" mode was selected before the measurement was started

**DD** Indicates that the "automatic calculation of Dielectric Discharge Index" mode was selected before the measurement was started.

**SMOOTH** Smoothing of insulation measurement display.

**ALARM** Indicates that the alarm is activated. An audible alarm will be emitted if the value measured is above the limit value defined in the SET-UP menu.


Indicates the battery charge condition (cf. § 8.1.1.)

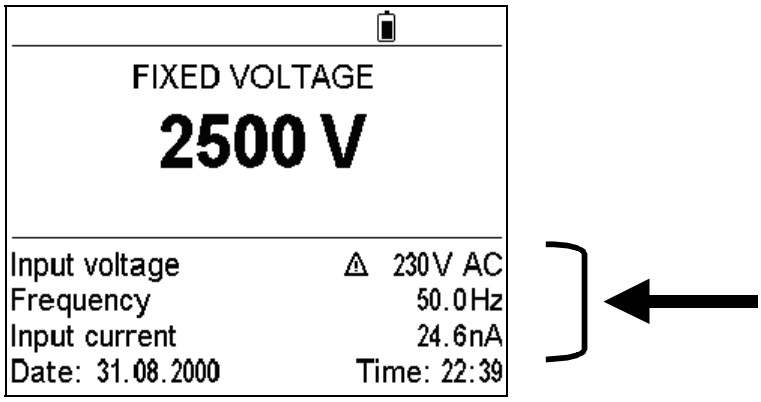

Voltage generated dangerous, U > 120VDC.


External voltage present, symbol activated following press on START key, if U > 25VRMS

# 3. MEASUREMENT FUNCTIONS

## 3.1. AC / DC VOLTAGE

Turning the switch to an insulation position (position other than OFF or SET-UP) sets the instrument to automatic AC / DC voltage measurement.
The voltage between the input terminals is measured at all times and indicated on the display unit: Input Voltage.
Also, as soon as the switch is turned, the frequency and the residual DC current between the terminals of the instrument are measured. The residual current is measured in order to evaluate its impact on the insulation measurement to come.



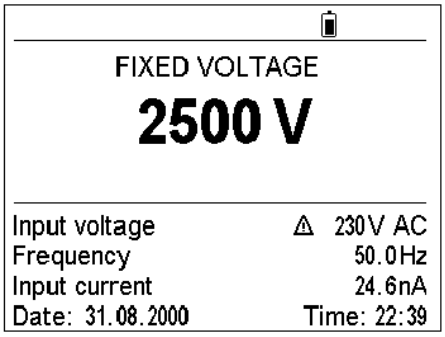

The insulation measurements cannot be started if there is an excessively high external voltage on the terminals.
Also, if an excessively high spurious voltage is detected during the measurement, the measurement is automatically stopped : the symbol ⚠ is displayed next to the measured external voltage (see § 3.2).
Switching between the AC and DC modes is automatics; in AC, RMS values are measured.

## 3.2. INSULATION MEASUREMENT

▪ When the switch is turned to an insulation position, one of the following displays appears :

**Case 1**
You select an insulation measurement with a fixed / standard test voltage, in manual mode.

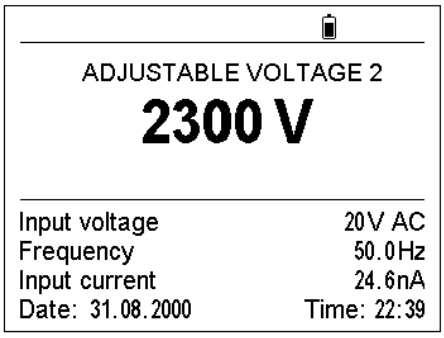
Positions :
**500V - 2TΩ**
**1000V - 4TΩ**
**2500V - 10TΩ**
**5000V - 10TΩ**




**Case 2**
You select an insulation measurement with a test voltage other than those proposed as standard.

Position :
**Adjust. 50V...5000V**

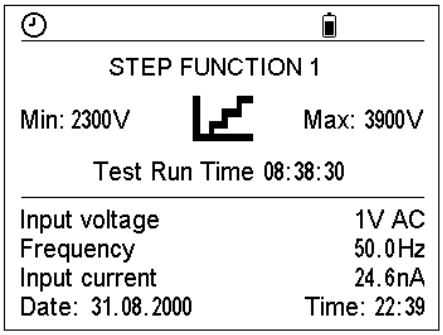
You can choose from the 3 "adjusted" voltages predefined in SET-UP using the ▲ and ▼ keys, or define another voltage by selecting it with the ▶ key and adjusting it with the ▲ and ▼ keys.




**Case 3**
You select an insulation measurement with a test voltage that varies in steps : this is the "step function" mode.

Position :
**Adjust. Step**

You can choose among the three step functions (▲ and ▼ keys) you defined earlier in SET-UP.




▪ **Pressing the START/STOP key immediately triggers the measurement.**
An audible beep is emitted every 10 seconds to indicate that a measurement is in progress.
A number of special functions can be used during the measurement (cf. § 4.).

***Important remark:***
These insulation measurements cannot be started if there is an excessively high external voltage on the terminals.

- **If, when the START key is pressed**, the external voltage on the terminals of the instrument is greater than the value U peak defined below, the insulation measurement is not triggered and an audible alarm is emitted; the instrument then returns to automatic voltage measurement.

U peak ≥ dISt x Un

where - Upeak : external voltage, peak or DC, on the terminals of the instrument.
- dISt : coefficient that can be adjusted in SET-UP - 3% (defaut value), 10% or 20%.
- Un : test voltage selected for the insulation measurement.

▪ Similarly, if during the insulation measurements, an external voltage greater than the value U peak defined below is detected, the measurement is stopped and the symbol ⚠ appears next to the value of the external voltage measured.

U peak ≥ (dISt + 1,05) x Un,

where - Upeak : external voltage, peak or DC, on the terminals of the instrument.
- dISt : coefficient that can be adjusted in SET-UP - 3% (defaut value), 10% or 20%.
- Un : test voltage selected for the insulation measurement.

**Note :**
The dISt factor is adjusted to optimize the measurement build-up time.
If there is no spurious voltage, dISt can be adjusted to its minimum value to obtain the shortest possible measurement build-up time.
If there is a large spurious voltage, dISt can be increased so that the measurement will not be interrupted as soon as a negative alternation occurs during the generation of the test voltage; this amounts to optimizing the measurement build-up time in the presence of a spurious voltage.

**▪ Pressing the START/STOP key again stops the measurement**
If the "programmed time test" mode (Timed Run or Timed Run + DD) was selected as measurement mode, the measurement is stopped (without action on the START/STOP button) at the end of this time.
Similarly, if the DAR and PI modes are selected as measurement modes, the measurement is stopped only after the time needed to calculate them (time defined in SET-UP).

A number of special functions can be used during the measurement (cf. § 4.).

### 3.3. CAPACITANCE MEASUREMENT

The capacitance measurement is performed automatically during the insulation measurement, and is displayed after the measurement stops and the circuit has been discharged.

### 3.4. RESIDUAL CURRENT MEASUREMENT

The residual current circulating in the installation is measured automatically upon connection to the installation, then during and after the insulation measurement.

# 4. SPECIAL FUNCTIONS

### 4.1. *MODE / PRINT* KEY

■ **The primary function of the MODE key is very important : it is used before the measurement to define the course of the measurement.**

This key is inactive in the "Adjust. Step" and SET-UP positions.

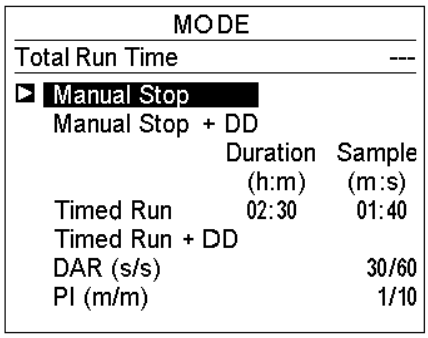
Pressing the MODE key gives access to the list of possible measurement modes. Select the mode using the ▲, ▼, ▶ and ◀ arrows.

**To validate the mode selected, press the MODE key again.**
The various measurement modes are as follows :

- **MANUAL STOP** :

This is the conventional quantitative insulation measurement mode :
The measurement is started by pressing START / STOP and stopped by pressing START / STOP again.

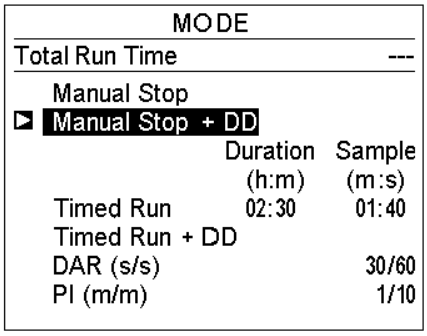
The user determines the duration, which is indicated by the measurement duration chronometer.




- **MANUAL STOP + DD** :

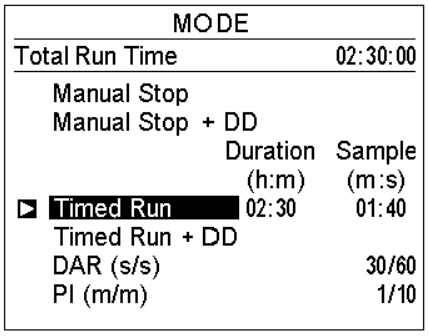
The measurement is started by pressing START/ STOP and stopped by pressing START/STOP again.

1 minute after the end of the measurement, the instrument calculates and display the DD term. The time remaining during this minute is displayed.




- **TIMED RUN**
*(TIMED RUN TEST)*

This mode is used to perform a measurement for a duration defined in advance, with a predetermined number of measurement samples : the measurement is started by pressing START / STOP and stops automatically after the time programmed by the user.
This duration (Duration) and the time interval between samples (Sample) must be specified when the Timed Run mode is selected.




When the measurement is started, the chronometer counts down the time remaining. When this time (Remaining Time) is zero, the measurement is stopped.

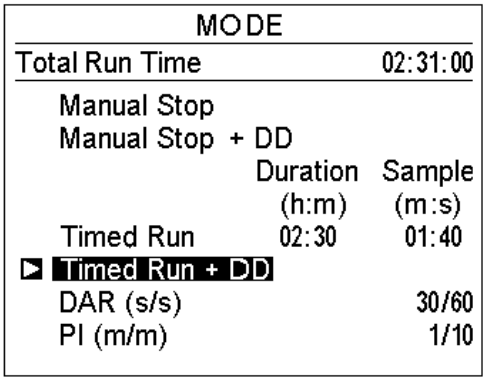
During the execution of a timed run test, the intermediate samples are automatically stored: they are used to plot insulation resistance vs. time. This curve can be displayed after the measurement by pressing GRAPH, as long as no new measurement has been started.
The samples and the curve are automatically stored with the final value of the resistance, if it is stored.

*During the measurement, **if the position of the rotary switch is changed**, or **the STOP key is pressed**, the measurement is stopped.*

- **TIMED RUN +DD** :

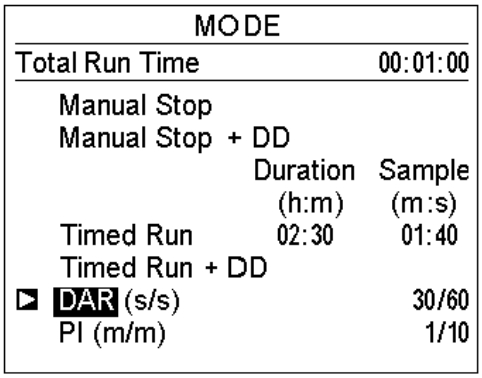
This mode is identical to the foregoing except that 1 minute after the end of the measurement the instrument calculates and displays the DD term.
The measurement duration is therefore : duration of timed run + 1 minute.

The insulation resistance vs. time curve can be displayed after the mesurement by pressing GRAPH, as long as no new measurement has been started.




- **DAR** :

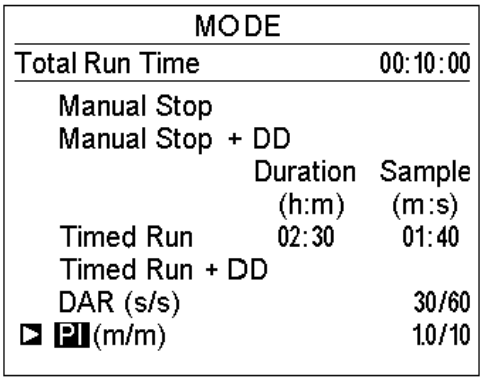
The measurement is started by pressing START / STOP and stops automatically when the DAR ratio has been calculated, i.e. after 1 minute, the time taken to recable the second insulation rasistance value needed for the calculation (the recableing times can be modified in SET-UP).




- **PI** :

The measurement is started by pressing START / STOP and stops automatically when the PI ratio has been calculated, i.e. after 10 minutes, the time taken to recable the second insulation resistance value needed for the calculation (the recableing times can be modified in SET-UP).

*Remark : in this mode, the DAR ratio will also be calculated automatically if the times needed to calculate it are less than the second time needed to calculate the PI ratio.*




**Important remarks**

- *What is the DD (Dielectric Discharge index)?*

In the case of multilayer insulation, if one of the layers is defective but the resistance of all the others is high, neither the quantitative insulation measurement nor the calculation of the PI and DAR quality ratios will reveal the problem.

This makes it judicious to perform a dielectric discharge test, from which the DD term can be calculated. This test measures the dielectric absorption of heterogeneous or multilayer insulation and disregards parallel-surface leakage currents.
It involves applying a test voltage for long enough to electrically "charge" the insulation to be measured (typically, a voltage of 500V is applied for 30mn).
At the end of the measurement, the instrument causes a rapid discharge, during which the capacitance of the insulation is measured; 1mn later, the residual current circulating in the insulation is measured.
The DD term is then calculated as follows:

**DD = current measured after 1 minute (mA) / [test voltage (V) x measured capacitance (F)]**

The insulation quality rating as a function of the value found is as follows:

| Value of DD | Quality of insulation |
|---|---|
| DD > 7 | Very poor |
| 7 > DD > 4 | Poor |
| 4 > DD > 2 | Doubtful |
| DD < 2 | Good |

**Note:** The dielectric discharge test is especially well suited to insulation measurements on rotating machines, and, in general, to insulation measurements on heterogeneous or multilayer insulations containing organic materials.

- *What are the DAR (Dielectric Absorption Ratio) and the PI (Polarization Index)?*

It is useful to calculate insulation quality ratios in addition to the quantitative insulation resistance value, because they can be used to eliminate the influence of certain parameters likely to invalidate the «absolute» insulation measurement.
The most important of these parameters are:
- temperature and relative humidity, with which insulation resistance varies to a quasi-exponential law.
- the spurious currents (capacitive charging current, dielectric absorption current) created by the application of the test voltage. Even though they gradually vanish, they perturb the measurement at the start, for a length of time that depends on whether the insulation is in good condition or degraded.

These ratio complete the "absolute" insulation value, and reliably reflect whether the insulations are in good or poor condition.

In addition, changes in these ratios over time can be observed and used for predictive maintenance, e.g. to monitor the aging of the insulation of a population of rotating machines.

The DAR and PI ratios are calculated as follows:

**PI = R 10 min / R 1 min** (2 values to be noted during a 10-mn measurement.)
**DAR = R 1 min / R 30 sec** (2 values to be noted during a 1-mn measurement.)

*Remark:*
*Note that the times of 1 & 10 mn for the calculation of PI and 30 & 60 seconds for the calculation of DAR are those currently used and programmed as defaults in the instrument.*
*They can however be modified in SET-UP to adapt to a possible change in a standard or to the needs of a specific application.*

Interpretation of the results:

| DAR | PI | Condition of insulation |
|---|---|---|
| < 1,25 | < 1 | Poor or even dangerous |
| | < 2 | |
| < 1,6 | < 4 | Good |
| > 1,6 | > 4 | Excellent |

■ **The *PRINT* secondary function** is described in § 6.3 (***Printing of measured values***).

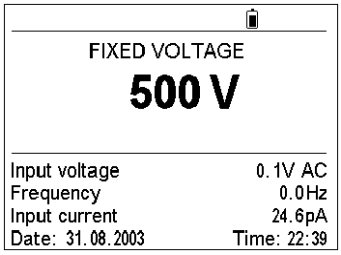
## 4.2 DISPLAY / *GRAPH KEY*

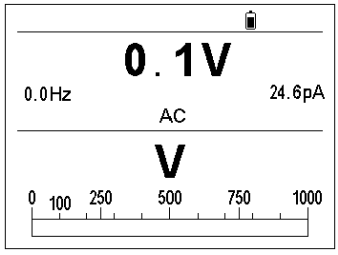
■ **Fonction première DISPLAY**

This key is used to browse through the various accessible screens containing all information available before, during or after the measurement.
The screens vary depending to the mode selected before the measurement is started.

▪ ***MANUAL STOP mode***

Before the measurement

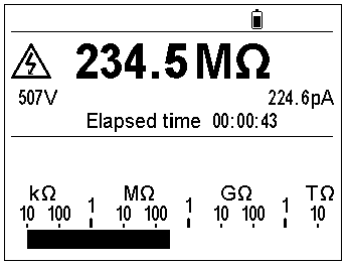


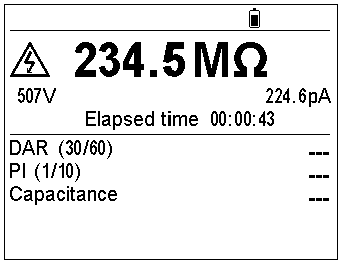




Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| DC test voltage<br>AC / DC input voltage<br>Frequency<br>Residual current<br>Date, time | AC / DC input voltage<br>Frequency<br>Residual current<br>Voltage bargraph |

During the measurement

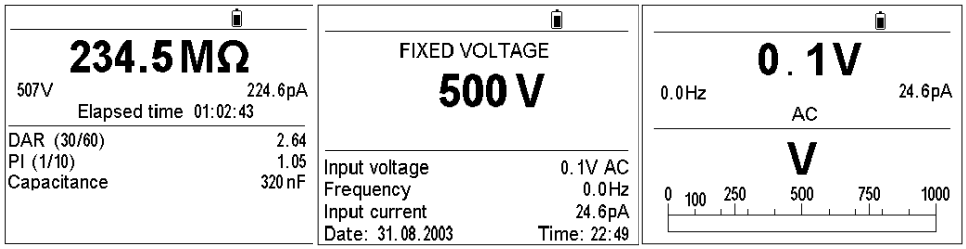


Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| Measured resistance<br>DC test voltage<br>Residual current<br>Measurement duration<br>Insulation bargraph | Measured resistance<br>DC test voltage<br>Residual current<br>Measurement duration<br>DAR, PI, Capacitance |

After the measurement

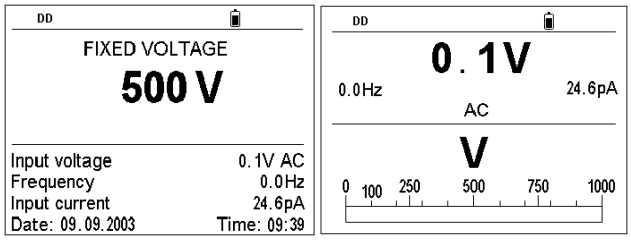



Information accessible :

| First screen | Press on *DISPLAY* | 2nd press on *DISPLAY* |
|---|---|---|
| Measured resistance<br>DC test voltage<br>Spurious input current<br>Measurement duration<br>DAR, PI, Capacitance | Test voltage<br>AC / DC input voltage<br>Frequency<br>Spurious input current<br>Date, time | AC / DC input voltage<br>Frequency<br>Spurious input current<br>Voltage bargraph |

- ***MANUAL STOP + DD mode***

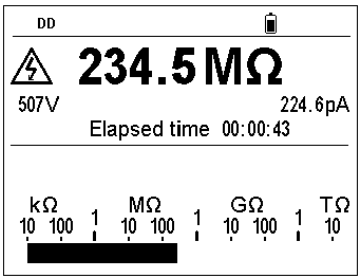
Before the measurement

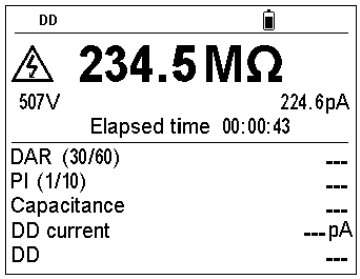



Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| DC test voltage<br>AC / DC input voltage<br>Frequency<br>Spurious input current<br>Date, time | AC / DC input voltage<br>Frequency<br>Spurious input current<br>Voltage bargraph |

During the measurement

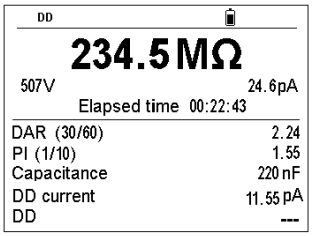


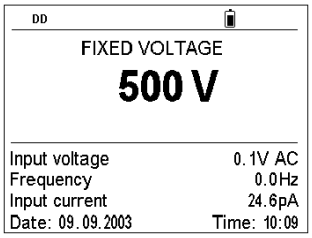



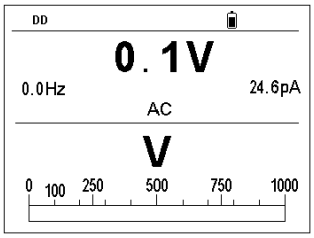

Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| Measured resistance<br>DC test voltage<br>Spurious input current<br>Measurement duration<br>Insulation bargraph | Measured resistance<br>DC test voltage<br>Spurious input current<br>Measurement duration<br>DAR, PI, Capacitance<br>Residual current<br>(for the calculation of DD)<br>DD |

After the measurement



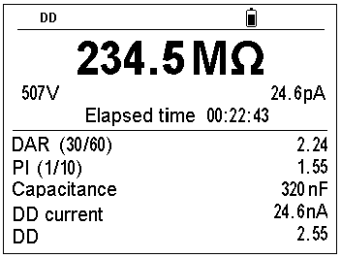




Information accessible :

| First screen | Press on *DISPLAY* | 2nd press on *DISPLAY* |
|---|---|---|
| Measured resistance<br>DC test voltage<br>Spurious input current<br>Measurement duration<br>DAR, PI, Capacitance<br>Residual current<br>(for the calculation of DD)<br>DD | DC test voltage<br>AC / DC input voltage<br>Frequency<br>Spurious input current<br>Date, time | AC / DC input voltage<br>Frequency<br>Spurious input current<br>Voltage bargraph |

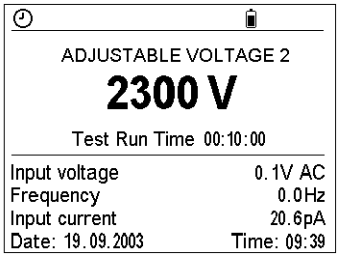
1mn after the measurement

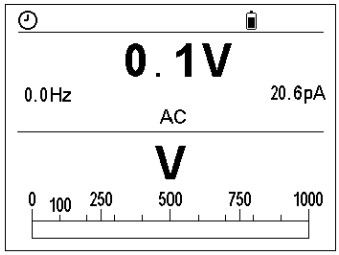



The first screen displays the value of DD and the current used to calculate it (DD current)

- ***TIMED RUN mode***

Before the measurement

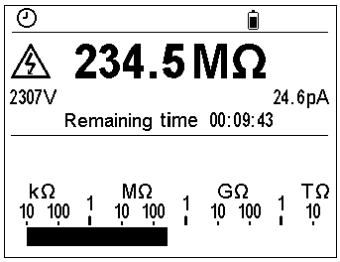


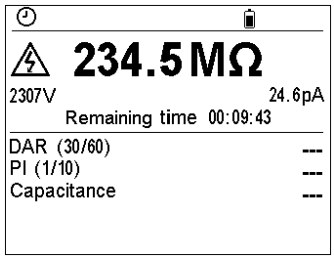




Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| DC test voltage<br>Programmed duration of test<br>AC / DC input voltage<br>Frequency<br>Residual current<br>Date, time | AC / DC input voltage<br>Frequency<br>Residual current<br>Voltage bargraph |

During the measurement

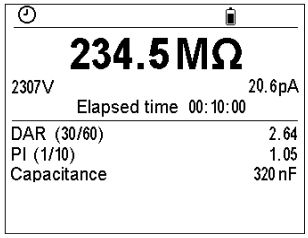


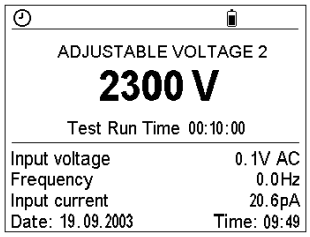



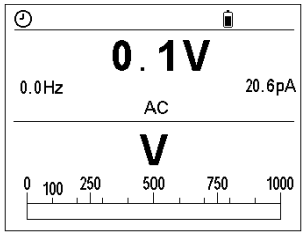
Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| Measured resistance | Measured resistance |
| DC test voltage | DC test voltage |
| Residual current | Residual current |
| Remaining measurement time | Remaining measurement time |
| Insulation bargraph | DAR, PI, Capacitance |

After the measurement



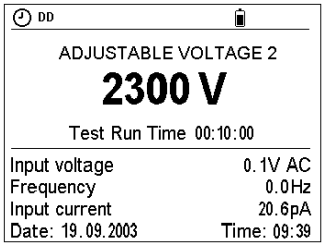



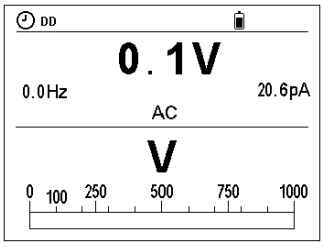

Information accessible :

| First screen | Press on *DISPLAY* | 2nd press on *DISPLAY* |
|---|---|---|
| Measured resistance | DC test voltage | AC / DC input voltage |
| DC test voltage | Programmed duration of test | Frequency |
| Residual current | AC / DC input voltage | Spurious input current |
| Measurement duration | Frequency | Voltage bargraph |
| DAR, PI, Capacitance | Spurious input current | |
| | Date, time | |

- ***TIMED RUN + DD mode***

Before the measurement

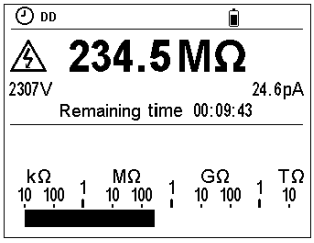


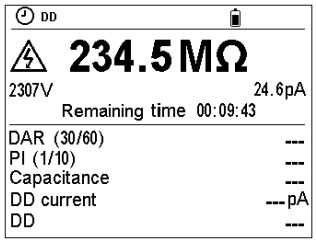



Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| DC test voltage<br>Programmed duration of test<br>AC / DC input voltage<br>Frequency<br>Residual current<br>Date, time | AC / DC input voltage<br>Frequency<br>Residual current<br>Voltage bargraph |

During the measurement

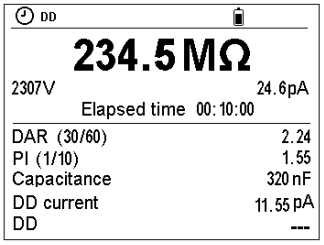


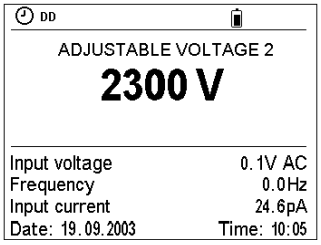



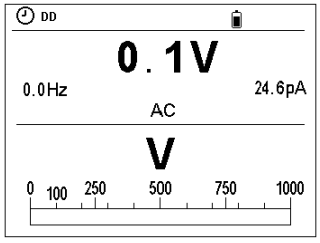

Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| Measured resistance<br>DC test voltage<br>Residual current<br>Remaining measurement time<br>Insulation bargraph | Measured resistance<br>DC test voltage<br>Residual current<br>Remaining measurement time<br>DAR, PI, Capacitance<br>Residual current<br>(for the calculation of DD)<br>DD |

After the measurement



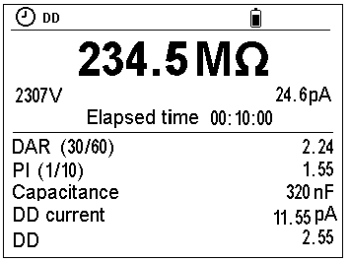



Information accessible :

| First screen | Press on *DISPLAY* | 2nd press on *DISPLAY* |
|---|---|---|
| Measured resistance<br>DC test voltage<br>Spurious input current<br>Measurement duration<br>DAR, PI, Capacitance<br>Residual current<br>(for the calculation of DD)<br>DD | DC test voltage<br>AC / DC input voltage<br>Frequency<br>Spurious input current<br>Date, time | AC / DC input voltage<br>Frequency<br>Spurious input current<br>Voltage bargraph |

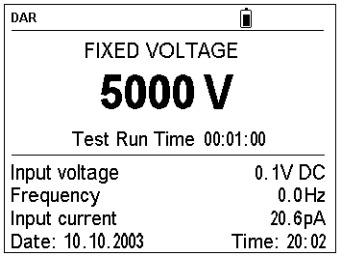
1 mn after the measurement

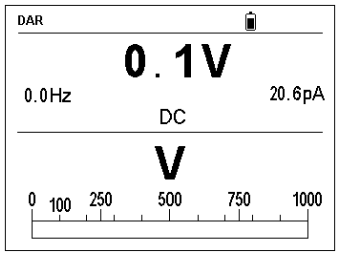



The first screen displays the value of DD and the current used to calculate it (DD current)

- ***DAR mode***

Before the measurement

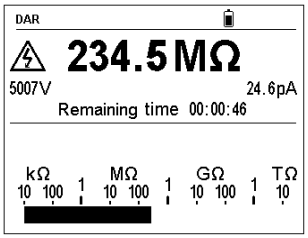


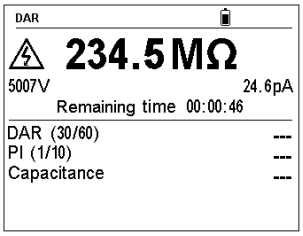




Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| DC test voltage<br>Programmed duration of test<br>AC / DC input voltage<br>Frequency<br>Residual current<br>Date, time | AC / DC input voltage<br>Frequency<br>Residual current<br>Voltage bargraph |

During the measurement

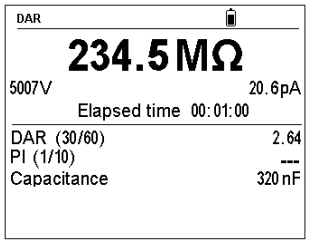


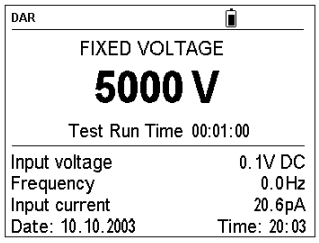



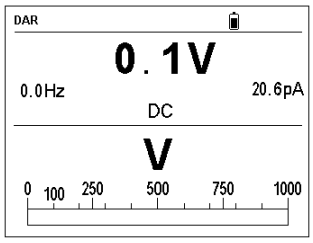

Information accessible :

| First screen | Press on *DISPLAY* |
|---|---|
| Measured resistance | Measured resistance |
| DC test voltage | DC test voltage |
| Residual current | Residual current |
| Remaining measurement time | Remaining measurement time |
| Insulation bargraph | DAR, PI, Capacitance |

After the measurement




Information accessible :

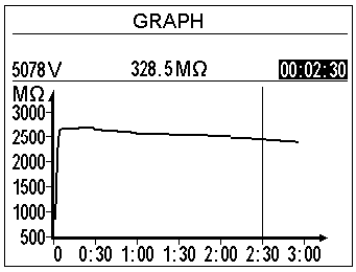
| First screen | Press on *DISPLAY* | 2nd press on *DISPLAY* |
|---|---|---|
| Measured resistance | DC test voltage | AC/DC input voltage |
| DC test voltage | Programmed duration of test | Frequency |
| Residual current | AC/DC input voltage | Spurious input current |
| Measurement duration | Frequency | Voltage bargraph |
| DAR, PI, Capacitance | Spurious input current | |
| | Date, time | |

- ***PI mode***

Same as DAR mode except:
- PI instead of DAR at the top left of the display unit
- Remaining Time = 10 mn
- After the measurement : display of DAR and PI .

- ***GRAPH secondary function***

After a "programmed time test" measurement (Timed Run or Timed Run + DD), pressing this key displays the insulation resistance versus measurement time curve.
This curve is plotted from the samples noted during the measurement.
The ▸, ◂, ▴ and ▾ keys can be used to move along the curve to know the exact values of each sample.




## 4.3 KEYS ◂ / *T°*

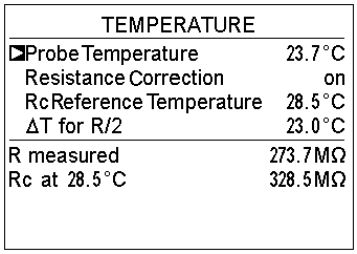
■ **The T° secondary function** is used to refer the result of the measurement to a temperature other than that of the measurement.
This makes it possible to observe the insulation resistance over time and judge its evolution under comparable temperature conditions.
This is because insulation resistance varies with temperature according to a quasi-exponential law. As part of a maintenance program covering of a population of motors, for example, it is important to perform periodic measurements under similar temperature conditions. Otherwise, the results obtained must be corrected to refer them to a fixed reference temperature.
This function does this.

**Attention :**

- ***T°*** can be activated only after a measurement has been made (whatever the mode used to make it) and before it is stored.
- If the result of your measurement is outside of the range (the display unit displays < or > to the range possible with the test voltage used), this function cannot be applied.

***Procedure :***

- You have made a measurement and not yet stored it. Check that the result is not outside of the range.
- Enter the T° mode by pressing 2nd + T°




- Enter the estimated temperature («Probe Temperature») at which you made the measurement (by default, the instrument proposes the value set in SET-UP).
- Set “Resistance Correction” to On to perform the calculation.
- The calculation is performed immediately and the result is displayed: Rc.

*This indicates what the measurement result would have been at the reference temperature.*
*The Reference temperature (Rc Reference Temperature) and the coefficient DT indicated and used for the calculation are those defined in SET-UP.*
*To modify them, see § 4.5.*

**Attention :**

- To store this calculation, press 2nd + T° again (OK is then displayed) before storing everything.

Remarks :

- During the procedure, pressing DISPLAY or turning the switch cancels the calculation in progress.
- If the coefficient ΔT used for the calculation is not known, the instrument can calculate it in advance, using at least 3 stored measurements made at different temeperatures (cf. § 4.5.3)
- Detail concerning the calculation performed :

The insulation resistance varies with the measurement temeperature.
This dependence can be approximated by an exponential function :

$$Rc = KT * RT$$

where Rc : insulation resistance at reference temperature (Rc Temperature Reference)
RT : insulation resistance measured at T°C (Probe Temperature)
KT : coefficient at T°C defined as follows :
KT = (1/2) * ((Rc Temperature Reference-T) / DT)
T : estimated temperature at time of measurement (Probe Temperature)
ΔT : temperature difference for which the insulation is divided by 2.
Rc Temperature Reference :
reference temperature to which the measurement is referred.

## 4.4 ▼ / *SMOOTH KEY*

■ **The *SMOOTH* secondary function** activates / deactivates an insulation measurement digital filter. It affects only the display (which is smoothed), not the measurements.
This function is useful if the insulation values displayed are very unstable.
The filter is calculated as follows:
RSMOOTH = RSMOOTH + (R – RSMOOTH) / N
Since N is set to 20, the time constant of this filter is approximately 20 seconds.

## 4.5 SET-UP FUNCTION (INSTRUMENT CONFIGURATION)

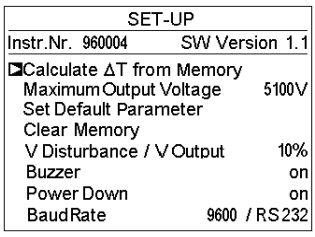
This function, located on the rotary switch, can be used to change the configuration of the instrument by accessing directly the parameters to be modified.

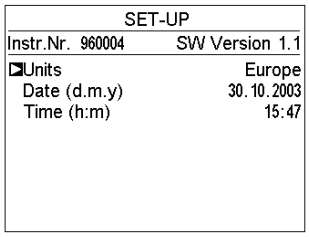
Turning the rotary switch to SET-UP gives you access to the menu of all modifiable parameters. Select the parameter to be modified and its value using the ▶, ◀, ▲ and ▼ keys.

### 4.5.1 SET-UP MENU

| SET-UP | |
|---|---|
| Instr.Nr. 960004 | SW Version 1.1 |
| ▶Display contrast | 80 |
| Alarm Settings | |
| Adjustable Voltage 1 | 2700V |
| Adjustable Voltage 2 | 370V |
| Adjustable Voltage 3 | 4300V |
| Timed Run (h:m) | 0:10 |
| Sample Time (m:s) | 0:30 |
| DAR (s/s) | 30/60 |

| SET-UP | |
|---|---|
| Instr.Nr. 960004 | SW Version 1.1 |
| ▶PI (m/m) | 1/10 |
| Set Step Function 1 | |
| Set Step Function 2 | |
| Set Step Function 3 | |
| Temperature Unit | Celsius |
| Default probe temperature | 23 °C |
| Rc reference temperature | 30 °C |
| ΔT for R/2 | 10 °C |




***Description of each instrument configuration parameter :***

▪ **Display Contrast** : modification of display unit contrast

| Default value | Range |
|---|---|
| 80 | 0…255<br>*Attention : the display unit is no longer legible above 130* |

▪ **Alarm Settings :** programming of measurement threshold values below which an audible alarm is triggered.

| | Default value | Range |
|---|---|---|
| 500V | < 500 kΩ | 30kΩ . 2TΩ |
| 1000V | < 1,0 MΩ | 100kΩ . 4TΩ |
| 2500V | < 2,5 MΩ | 300kΩ . 10TΩ |
| 5000V | < 5 MΩ | 300kΩ . 10TΩ |
| Adj. Voltage 1 | < 50 kΩ | 10kΩ . 10TΩ |
| Adj. Voltage 2 | < 100 kΩ | 10kΩ . 10TΩ |
| Adj. Voltage 3 | < 250 kΩ | 10kΩ . 10TΩ |

**Note :** to return to the SET-UP menu, press the DISPLAY key

▪ **Adjustable Voltage 1, 2, 3** adjusted voltage : 3 different values can be predefined

| | Default value | Range |
|---|---|---|
| Adjustable Voltage 1 | 50V | 40 . . 5100V<br>(in steps of 10V from 40V to 1000V<br>(in steps of 100V from 1000V to 5100V) |
| Adjustable Voltage 2 | 100V | |
| Adjustable Voltage 2 | 250V | |

▪ **Timed Run** (h : m) duration of test in "Timed run" mode

| Default value | Range |
|---|---|
| 00 : 10 (h:m) | 00 . . 49 : 01 . . 59 (h:m) |

▪ **Sample Time** (m : s) time interval between samples noted in Timed Run mode for plotting R(t)

| Default value | Range |
|---|---|
| 00 : 10 (m:s) | 00 . . 59 : 05 . . 59 (m:s) |

▪ **DAR** (s : s) 1st and 2nd times for the DAR calculation

| Default value | Range |
|---|---|
| 30 : 60 (s:s) | 10..90 : 15..180 (s:s)<br>5-second steps |

▪ **PI** (m : m) 1st and 2nd times for the PI calculation

| Default value | Range |
|---|---|
| 01 : 10 (m:m) | 0,5..30 (0.5-then 1-mn steps)<br>1..90 (0.5, then 1-, then 5-mn steps) |

▪ **Set Step Function 1, 2, 3** for each predefined step function mode, definition of the various voltages, of the duration of each step, and of the duration for the recableing of samples.

| | Default value | | Range | |
|---|---|---|---|---|
| | Voltage | Duration (h:m) | Voltage | Duration (h:m) |
| Step Function 1 | | | | |
| step 1 | 50V | 00 : 01 | 40V à 5100V<br>(in 10-V, then 100-V steps) | 00..09 : 01..59 |
| step 2 | 100V | 00 : 01 | | 00..09 : 01..59 |
| step 3 | 150V | 00 : 01 | | 00..09 : 01..59 |
| step 4 | 200V | 00 : 01 | | 00..09 : 01..59 |
| step 5 | 250V | 00 : 01 | | 00..09 : 01..59 |
| | sample time | 00 : 01 (m:s) | | see note<br>(00..59 : 0..59) |
| Step Function 2 | | | | |
| step 1 | 100V | 00 : 01 | 40V à 5100V<br>(in 10-V, then 100-V steps) | 00..09 : 01..59 |
| step 2 | 300V | 00 : 01 | | 00..09 : 01..59 |
| step 3 | 500V | 00 : 01 | | 00..09 : 01..59 |
| step 4 | 7000V | 00 : 01 | | 00..09 : 01..59 |
| step 5 | 900V | 00 : 01 | | 00..09 : 01..59 |
| | sample time | 00 : 01 (m:s) | | see note<br>(00..59 : 0..59) |
| Step Function 3 | | | | |
| step 1 | 1000V | 00 : 01 | 40V à 5100V<br>(in 10-V, then 100-V steps) | 00..09 : 01..59 |
| step 2 | 2000V | 00 : 01 | | 00..09 : 01..59 |
| step 3 | 3000V | 00 : 01 | | 00..09 : 01..59 |
| step 4 | 4000V | 00 : 01 | | 00..09 : 01..59 |
| step 5 | 5000V | 00 : 01 | | 00..09 : 01..59 |
| | sample time | 00 : 01 (m:s) | | see note<br>(00..59 : 0..59) |

**Note :** the minimum sample time is related to the total duration of the test (Total Run Time). It is equal to : Sample Time (seconds) = (h+1)*5 where h= total run time in hours.

▪ **Temperature Unit** selection of temperature unit

| Default value | Range |
|---|---|
| °C | °C or °F |

- **Default Probe Temperature**

  estimated measurement temperature unit

| Default value | Range |
|---|---|
| 23°C | -15°C..+75°C |

- **Rc Reference Temperature**

  reference temperature to which the measurement result must be referred

| Default value | Range |
|---|---|
| 40°C | -15°C..+75°C |

- **ΔT for R/2** estimated ΔT to obtain an insulation resistance / 2

| Default value | Range |
|---|---|
| 10°C | -15°C..+75°C |

- **Calculate ΔT from Memory**

  used to calculate ΔT from 3 stored measurements performed on the same instrument but at different temperatures (see § 4.5.3)

- **Maximum Output Voltage**

  imposes maximum test voltage

| Default value | Range |
|---|---|
| 5000V | 40..5100V |

- **Set Default Parameter**

  default configuration : reinitializes the instrument with the default values of all parameters.

- **Clear Memory** can be used to partially or completely erase stored data cf. § 4.5.2

- **V Disturbance / V Output** = dISt factor (cf. § 3.2 - *«important remark»*)

| Default value | Range |
|---|---|
| 3% | 3%, 10% or 20% |

- **Buzzer** activation / desactivation of buzzer (keys, measurements, alarms)

| Default value | Range |
|---|---|
| ON | ON or OFF |

- **Power Down** automatic shut-down of the instrument after 1mn if no key is activated

| Default value | Range |
|---|---|
| OFF | ON or OFF |

- **Baud Rate** RS 232 communication format and rate (cf. § 6.1)

| Default value | Range |
|---|---|
| 9600 / RS 232 | 300..9600 / RS 232 or — / Parallel |

- **Units** display version

| Default value | Range |
|---|---|
| Europe | Europe or USA |

- **Date** current date or set date

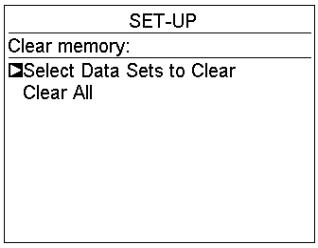
| | |
|---|---|
| Europe | jj.mm.aaaa |
| USA | mm.dd.yyyy |

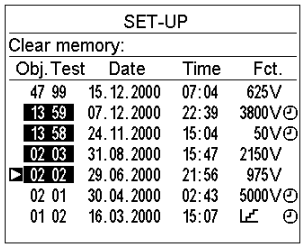
- **Time** h:m - current time or set time

### 4.5.2 MEMORY ERASURE

In SET-UP, select ***Clear memory***

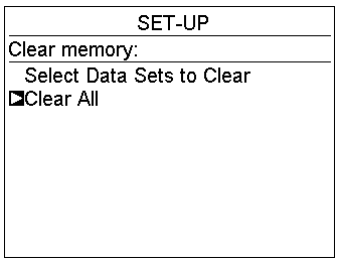
➢ *To erase the content of one or more specific OBJ : TEST numbers*
- select ***Select Data Sets to Clear*** by pressing ▸
- then each memory to be erased using ▸, ◂, ▴ and ▾
- validate by pressing *DISPLAY*. The operation is confirmed or cancelled by pressing ▸

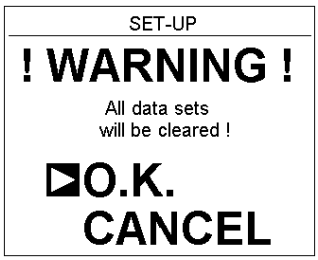




➢ *To erase the entire memory*
- select ***Clear All*** by pressing ▸
- The operation is confirmed or cancelled by pressing ▸



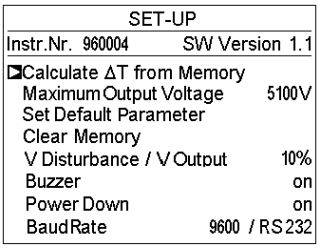
### 4.5.3 CALCULATION OF ΔT FROM STORED DATA

The coefficient ΔT is used to calculate the insulation resistance at a temperature other than the measurement temperature (cf. § 4.3).
It is the temperature difference at which the insulation concerned is divided by 2.
This coefficient is variable: it depends on the type of insulation.
When it is not known, the instrument can calculate it from three or more stored measurements.
Attention, these 3 measurements must have been made on the same device (identical insulation) but at 3 different temperatures, and the temperatures must have been recorded (2nd function + T°) at the same time as the measurements, without applying the correction (Resistance Correction OFF).

**Procedure :**

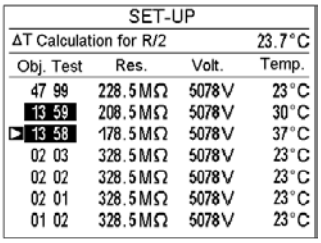
- In SET-UP, select ***Calculate ΔT from Memory*** and press ▸

The display unit proposes all values recorded with a temperature



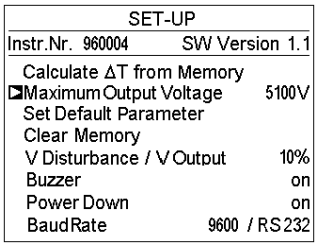

- Select at least 3 measurements using the ▸, ◂, ▴ and ▾ keys.
- ΔT is calculated and recorded automatically once 3 stored measurements have been selected, and updated as more measurements are selected.
- The larger the number of measurements, the more "accurate" the calculation of ΔT.

Note : this calculation is possible only for resistance values < 200GΩ.




### 4.5.4 MAXIMUM OUTPUT VOLTAGE

- In the SET-UP menu, select ***Maximum Output Voltage***
- Adjust the maximum output voltage using the ▸ key, then the ▴ and ▾ keys.




This function prohibits the use of certain test voltages for the insulation measurement.
The instrument can then be used by less experienced persons for specific applications (telephony, aeronautics, etc.) where it is important not to exceed some maximum test voltage.
For example, if the maximum output voltage is set to 750V, the measurement will be made at 500V in switch position 500V, and at not more than 750V in all other positions.

### 4.6 LIST OF CODED ERRORS

If an anomaly is detected when the instrument is started up or in operation, the display unit indicates an error code. The format of this error code is a 1- or 2-digit number. This number identifies the anomaly and the action to be taken.

Possible errors :

- ❑ The codes from 0 to 9 identify fatal errors in the hardware. The instrument must then b returned.

- ❑ The codes from 20 to 25 identify semi-fatal errors, except for codes 21 and 25. The instrument must be returned.

Error 20 Communication failed
Error 21 Check of options failed
Error 22 Check of contants failed
Error 23 Check of calibration values failed
Error 24 Check of instrument identification number failed
Error 25 Check of print file failed

For non-fatal errors 21 and 25, it is not necessary to return the instrument : simply use SET-UP to restore the default parameters (Set Default Parameter).

Other possible error :

- ❑ If it is impossible to store data, the entire content of memory must be erased using SET-UP (Clear Memory)

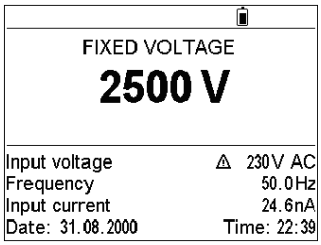
# 5. PROCEDURE

## 5.1. COURSE OF MEASUREMENTS

- Start up the instrument by setting the switch to the position corresponding to the measurement to be made.

The instrument can measure insulation values from 10 kΩ to 10 TΩ, depending on the test voltage selected- from 40V to 5100V DC.

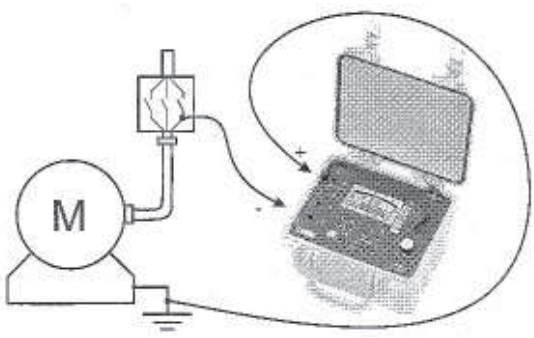
The screen is as follows :




It displays :
- the battery symbol and battery charge condition,
- the test voltage selected,
- the voltage, frequency and residual current on the input terminals,
- the date and time.

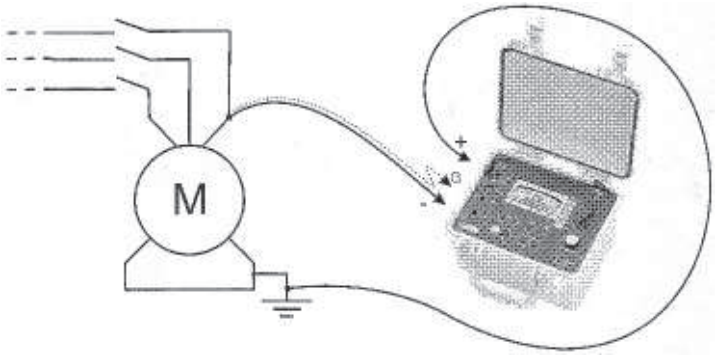
- Connect the cables of the + and - terminals to the measurement points..

❑ **Connection diagram for measurement of low insulation values** (example of a motor)




**To measure high insulation values (> 1 GΩ)**, we recommend using guard terminal «G» to avoid leakage and capacitive effects or eliminate the influence of superficial leakage currents. The guard terminal is connected to a surface where superficial currents may circulate through dust and humidity, e.g. the insulation surface of a cable or transformer, between two measurement points.

❑ **Connection diagram for measurement of high insulation values**
a) Example of a motor (reduction of capacitive effects)
b) Example of a cable (reduction of superficial leakage effects)




▪ Unless the step function mode is selected («***Adj. Step***»), select the measurement mode to be used (Manual Stop, Manual Stop +DD, Timed Run, Timed Run +DD, DARor PI) by pressing the **MODE** key (cf. § 4.1)

▪ A press on **START/STOP triggers the measurement**.
**If the voltage present is greater than the maximum allowed value, the measurement will be disabled** (see §3.2).
The ***DISPLAY*** key can be used to consult all information available during the measurement.
This information depends on the measurement mode selected (cf. § 4.2).
If the insulation values displayed are very unstable, a digital filter can be activated by pressing ***SMOOTH*** to smooth them (cf. § 4.4).
The alarm mode can be activated by pressing ***ALARM***. An audible beep will sound if the measurement result is below the value defined in SET-UP (cf. § 4.5).

- Pressing **START/STOP** again **stops the measurement**.

The last result remains displayed until the next measurement is made or the switch is turned.

**When the insulation measurements stop, the circuit tested is automatically discharged via a resistor in the instrument.**

The ***DISPLAY*** key can be used to consult all information available after the measurement.
This information depends on the measurement mode selected (cf. § 4.2).

If the measurement was in Timed Run or Timed Run + DD mode, pressing ***GRAPH*** displays the insulation measurement versus time curve (cf. § 4.2).

Pressing ***T°*** refers the measurement result to the reference temperature defined in SET-UP (cf. § 4.3).

## 5.2 STEP FUNCTION MODE

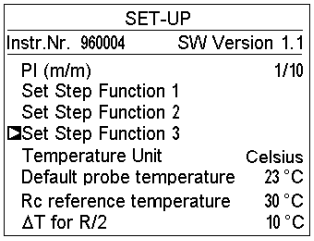
Test based on the principle that an ideal insulation produces the same resistance whatever the test voltage applied.
Any negative variation of this resistance therefore means that the insulation is defective: the resistance of a defective insulation decreases as the test voltage increases.
This phenomenon is barely observed with "low" test voltages.
In consequence, at least 2500V must be applied.

The usual test condition is a voltage increasing in steps: 5 1-mn steps.

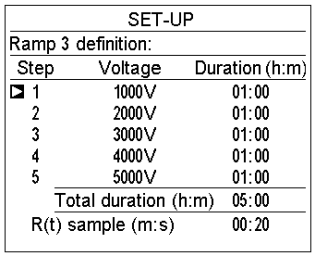
Assessment of the result:
- a deviation of the resistance = f(test voltage) curve that exceeds 500ppm/V generally indicates the presence of mould or other deterioration.
- a larger deviation or a sudden drop indicates the presence of localized physical damage (arcing, "perforation" of the insulation, etc.).

**Procedure :**

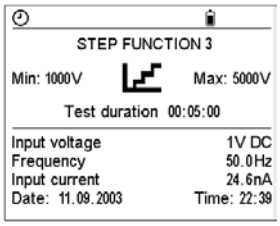
- In the SET-UP menu, select ***Set Step Function 1, 2 or 3***
  Example : here, step function n°3




- Define the step function and the desired number of measurement samples (R(t) sample).

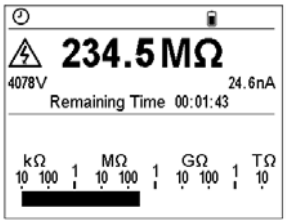


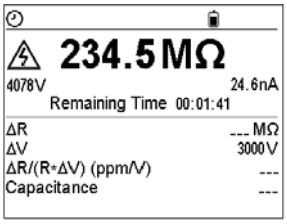
- Once the step function is defined, set the switch to Adl. Step and select Step Function n°3 using the ▸ key.




- Start the measurement by pressing START/ STOP

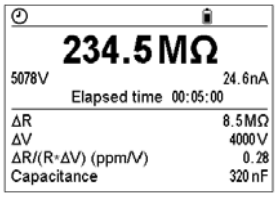
- During the measurement, the following screens can be accessed by pressing the DISPLAY key.



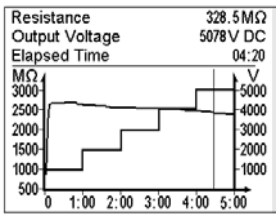

- At the end of the measurement, the following are indicated :

-the difference ΔR in insulation resistance between the final resistance (with the highest test voltage) and the initial resistance (with the lowest test voltage)
- the difference ΔV between the final and initial test voltages.
- the slope of the curve in ppm / V
- the capacitance




- Pressing the GRAPH key displays the resistance versus applied test voltage curve.

Using the ▸ , ◂ , key, it is possible to scroll the various samples recorded and, for each recable, to know :
- the insulation resistance value
- the applied test voltage
- the time of recableing.




# 6. MEMORY / RS 232

## 6.1 RS 232 CARACTERISTICS

- ❑ The baud rate can be adjusted to 300, 600, 1200, 2400, 4800, 9600, or "Parallel" for printing on parallel printers via the optional serial / parallel adapter.
  This adjustment is performed in the SET-UP (see § 4.5)
- ❑ Data format : 8 data bits, 1 stop bit, no parity, Xon / Xoff protocol

❑ Connexion to the serial printer : DB9F ➔ DB9M
2 → 2  5 → 5
3 → 3  6 → 6
4 → 4  8 → 8

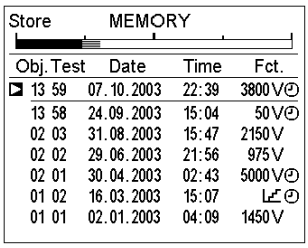
❑ Connexion to a PC or to a parallel printer : DB9F Ô DB9F
2 → 3  5 → 5
3 → 2  6 → 4
4 → 6  8 → 7
**Note :** check that there is no connection between pins 6 and 8 of the RS232 port of the instrument.

## 6.2 RECABLEING / PLAYBACK OF STORED VALUES (MEM/*MR* KEY)

### 6.2.1 MEM PRIMARY FUNCTION (STORAGE)

This function is used to recable the results in the instrument's RAM.
The results can be stored at addresses identified by an object number (OBJ) and a test number (TEST). An object represents a "box" in which 99 tests can be stored. An object can thus represent a machine or an installation on which a number of measurements are performed.

1. When the MEM key is activated, the following screen is displayed.




The flashing cursor idetifies the first free Obj : Test location, here :
**13 : 59**
(the Obj. number is that of the last measurement stored, but the Test number is incremented by 1).

It is always possible to modify Obj. : Test using the ▸, ◂, ▴ and ▾ keys.
If a new Obj. is selected, Test is set to 01.

If the user selects a memory address that is already occupied, this screen is displayed and prompts the user to confirm or cancel erasure of the content of the address.

To validate, use the ▸ key.


**2.** When the MEM key is pressed again, the results of measurements in progress are recorded at the selected memory address (whether occupied or not).
All information about a measurement will be stored at a single location in memory: date, time, test mode and voltage, insulation resistance, capacitance, residual current, and, possibly, DAR, PI, DD, measurement referred to the reference temperature, or even the R(t) graph.

***Note: If a key other than MEM or the switch is activated before MEM is presses a second time, the recable mode is exited without the results being stored.***

❑ **Estimate of result recableing capacity**

Total memory space: 128 Kbytes
Internal management: 8 Kbytes
Memory space available: 120 Kbytes
An insulation measurement result requires approximately 80 bytes.
It is therefore possible to recable approximately 1500 insulation measurements.

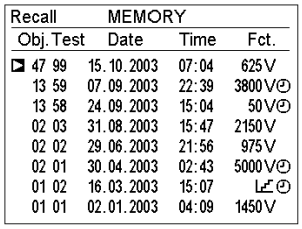
❑ **Memory space available**

This function is automatically activated when a result is recorded.
Press MEM once to obtain the next free OBJ. TEST number; the bargraph indication is proportional to the free memory available.
- If the entire memory is free, the bargraph is completely empty.
- If the entire memory is full, the bargraph is all black.

One segment of the bargraph represents approximately 50 records.

### 6.2.2 *MR SECONDARY FUNCTION*

The MR function is used to recall any data from memory, whatever the active position of the rotary switch, except for the OFF and SET-UP positions.
When the MR key is activated, the following screen is displayed.




The flashing cursor identifies the last occupied Obj. Test number, here
**47 : 99**

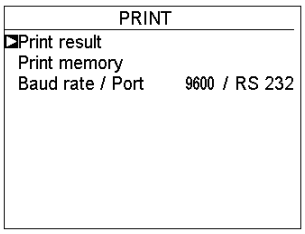
Use the ▸, ◂, ▴ and ▾ keys to select the desired Obj. Test number.

After selecting the Obj. Test, press ▸ to access the first item of information relative to this measurement. To access the other items, press ***DISPLAY*** repeatedly, or ***GRAPH***, if the mode selected before the measurement was begun allows.

**To exit from the MR function**, press MR again or turn the switch.

## 6.3 PRINTING MEASURED VALUES : PRINT KEY

Pressing the PRINT key gives access to the menu below :




❑ **Print result** :
***immediate printing of the measurement*** : following a measurement or after access to the MR mode.

❑ **Print memory**
***printing of stored data***

❑ **Baud rate / Port**
baud rate adjusted in the SET-UP menu (cf. § 4.5).

After selection of the printing mode :
**- If the transmission of data to the printer goes well,** the COM symbol flashes at the top left of the display unit.
**- If a problem occurs,** the COM symbol remains lit steadily at the top left of the display unit.

### 6.3.1 IMMEDIATE PRINTING OF THE MEASUREMENT : PRINT RESULT

When this printing mode is selected, the following are printed, in order:
- general information concerning the measurement,
- the measurement result,
- if the T° function was activated, the measurement result referred to the reference temperature,
- for a Timed Run test, the list of recorded samples.

**To stop printing**, change the setting of the rotary switch.

Depending on the measurement performed, the following models are obtained.

❑ Any measurement except srep function measurements :

```
CHAUVIN ARNOUX C.A 6549
Instrument number: 000 001
Company:.........................
Address:.........................
.................................
Tel.:.................
Fax:.................
Email:.................
Description:.....................

OBJECT:  01    TEST:   01              (printed only in MR mode)

INSULATION RESISTANCE TEST
Date                      31.01.2003
Starting time:                 14h55
Running time:               00:15:30
Temperature:                   23°C
Relative humidity:           .... %
Test voltage:               1000 V
Insulation resistance:     385 GOhm
___________________-
Rc - calculated resistance 118,5 GOhm
   at reference temperature    40°C
   with ÄT for R/2             10°C
___________________-
DAR (1'/30")                  1,234
PI (10'/1')                   2,345
DD                            -,--
Capacitance                 110 nF
___________________-
Elapsed time   Utest     Resistance      (after timed run test)
___________________-
00:00:10     1020 V      35,94 GOhm
00:00:30     1020 V       42,0 GOhm
00:00:50     1020 V       43,5 Gohm
...etc.....................................
```

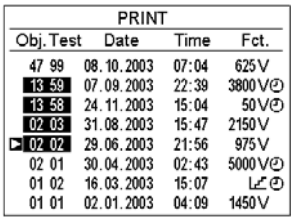
```
Date of next test:      ../../.....
Remarks:.........................
.................................
Operator: ... .....................
Signature: ........................
```

❑ Step function measurement:

```
CHAUVIN ARNOUX C.A 6549
Instrument number: 000 001
Company:.........................
Address:.........................
.................................
Tel.:..................
Fax:...................
Email:.................
Description:.......................

OBJECT:  01    TEST:   01                                  ((printed only in MR mode)

STEP FUNCTION TEST
Date                        31.01.2003
Starting time:                   14h55
Running time:                 00:00:50
Temperature:                     23°C
Relative humidity:             .... %
——————————Step Duration   Voltage  Resistance
 No.  h:mm    def. actual
————————————-
 1   0:10   1000 V 1020 V  2,627 GOhm
 2   0:10   2000 V 2043 V  2,411 GOhm
 3   0:10   3000 V 3060 V  2,347 GOhm
 4   0:10   4000 V 3755 V  2,182 GOhm
 5   0:10   5000 V 3237 V  2,023 GOhm

ΔR                             604 GOhm
ΔV                            4000 V
ΔR/(R*ΔV) (ppm/V)             -57 ppm
Capacitance                    110 nF
————————————-
Elapsed time   Utest     Resistance
————————————-
00:00:10     1020 V      2,627 GOhm
00:00:30     1020 V      2,627 GOhm
00:00:50     1020 V      2,627 Gohm
…etc.....................................

Date of next test:      ../../.....
Remarks:.........................
.................................
Operator:. ... ...................
Signature: ........................
————————————-
```

### 6.3.2 PRINTING OF STORED DATA : PRINT MEMORY

When this printing mode is selected, the content of the memory is displayed.
Stored measurements to be printed are selected using the ▸, ◂, ▴ and ▾ keys.




Here, the measurements to be printed are :
**13 : 59**
**13 : 58**
**02 : 03**
**02 : 02**

Once they have been selected,
**To start printing**, press the ***PRINT*** key again.
**To exit without printing**, change the setting of the rotary switch.
**To stop printing**, change the setting of the rotary switch.
The printing of each group of data is reduced to the main results.

Depending on the measurement performed, the following models are obtained.

❑ Any measurement except step function measurements :

```
CHAUVIN ARNOUX C.A 6549
Instrument number: 000 001
Company:.........................
Address:.........................
.................................
Tel.:...................
Fax:...................
Email:.................
Description:.....................

OBJECT:  01    TEST:   01

INSULATION RESISTANCE TEST
Date                      31.01.2003
Starting time:                 14h55
Running time:               00:15:30
Temperature:                   23°C
Relative humidity:           .... %
Test voltage:               1000 V
Insulation resistance:     385 GOhm
——————————————-
Rc - calculated resist.  118,5 GOhm
   at reference temperature    40°C
   with ΔT for R/2             10°C
——————————————-
DAR (1’/30”)                    1,234
PI (10’/1’)                     2,345
DD                              -,—-
Capacitance                   110 nF
OBJECT:  01    TEST:   02
```

```
INSULATION RESISTANCE TEST
Date                        31.01.2003
Starting time:                   17h55
Running time:                 00:17:30
Temperature:                      23°C
Relative humidity:             .... %
Test voltage:                  1000 V
Insulation resistance:      385 GOhm
———————————————-
Rc - calculated resist.   118,5 GOhm
   at reference temperature      40°C
   with ΔT for R/2               10°C
———————————————-
DAR (1’/30”)                     1,234
PI (10’/1’)                      2,345
DD                               -,—-
Capacitance                    110 nF
…etc.....................................

Date of next test:       ../../.....
Remarks:.....................
.................................
Operator:. ... ...................
Signature: .....................
```

- Step function measurement:

```
CHAUVIN ARNOUX C.A 6549
Instrument number: 000 001
Company:.........................
Address:.........................
.................................
Tel.:.................
Fax:..................
Email:................
Description:.....................

OBJECT:  01    TEST:   01

STEP FUNCTION TEST
Date                        31.01.2003
Starting time:                   14h55
Running time:                 00:00:50
Temperature:                      23°C
Relative humidity:             .... %
——————————————Step Duration  Voltage   Resistance
 N°  h:mm    def. actual
———————————————-
```

```
1  0:10  1000 V 1020 V  2,627 GOhm
2  0:10  2000 V 2043 V  2,411 GOhm
3  0:10  3000 V 3060 V  2,347 GOhm
4  0:10  4000 V 3755 V  2,182 GOhm
5  0:10  5000 V 3237 V  2,023 GOhm

ΔR                          604 GOhm
ΔV                            4000 V
ΔR/(R*ΔV) (ppm/V)            -57 ppm
Capacitance                   110 nF

OBJECT:  01    TEST:   03
```
*…etc.....*

```
Date of next test:      ../../.....
Remarks:.........................
.................................
Operator:. ... ..................
Signature: ......................
```

#### 6.3.3 PRINTING WITH THE SERIAL-PARALLEL ADAPTER

**1.** Connect the RS232 null - modem cable to the C.A 6549
**2.** Connect this cable to the adapter, then the adapter to the printer cable
**3.** Power up the printer
**4.** Power up the C.A 6549
**5.** To start printing, press ***PRINT***:
to print a measurement immediately, proceed as described in § 6.3.1
to print stored data, proceed as described in § 6.3. 2

**ATTENTION:**
**This adapter is designed to be used only with the C.A 6543, C.A 6547, and C.A 6549 and is unsuitable for any other application.**

# 7. SPECIFICATIONS

## 7.1 REFERENCE CONDITIONS

| Influence quantities | Reference values |
|---|---|
| Temperature | 23°C ±3 K |
| Relative humidity | 45% to 55 % |
| Power supply voltage | 9 to 12 V |
| Frequency range | DC and 15,3...65 Hz |
| Capacitance in parallel with resistor | 0 µF |
| Electric field | 0 |
| Magnetic field | < 40 A/m |

## 7.2 CHARACTERISTICS PER FUNCTION

### 7.2.1 Voltage

❑ Characteristics

| | | | | |
|---|---|---|---|---|
| ***Measurement domain*** | 1.0...99,9 V | 100…999 V | 1000...2500 V | 2501...5100 V |
| ***Resolution*** | 0.1 V | 1 V | 2 V | 2 V |
| ***Precision*** | ± (1% reading + 5 points) | ± (1% reading + 1point) | | |
| ***Frequency range*** | 15 Hz...500 Hz or DC | | | DC |

❑ Input impedance : 750 kΩ to 3 MΩ depending on voltage measured

| | | | | |
|---|---|---|---|---|
| ***Measured voltage*** | 0…900 V | 901…1800 V | 1801…2700 V | 2701…5000 V |
| ***Input impedance*** | 750kΩ | 1.5MΩ | 2.25MΩ | 3MΩ |

❑ Measurement category : 1000V CAT III or 2500V CAT I (transients ≤ 2,5kV)

### 7.2.2 LEAKAGE CURRENT MEASUREMENT

❑ Before an insulation measurement :

| | | | | |
|---|---|---|---|---|
| ***DC measurement domain*** | 0.000…0.250 nA | 0.250…9.999 nA | 10.00…99.99 nA | 100.0…999.9 nA |
| ***Resolution*** | 1 pA | 1 pA | 10 pA | 100 pA |
| ***Precision*** | ± (15%L+ 10 pts) | ± 10% L | ± 5% L | |

| | | | | |
|---|---|---|---|---|
| ***DC measurement domain*** | 1.000…9.999 µA | 10.00…99.99 µA | 100.0…999.9 µA | 1000…3000 µA |
| ***Resolution*** | 1 nA | 10 nA | 100 nA | 1 µA |
| ***Precision*** | ± 5% L | | | |

❑ During an insulation measurement :

| | | | | |
|---|---|---|---|---|
| ***DC measurement domain*** | 0.000…0.250 nA | 0.250…9.999 nA | 10.00…99.99 nA | 100.0…999.9 nA |
| ***Resolution*** | 1 pA | 1 pA | 10 pA | 100 pA |
| ***Precision*** | ± (15%L+ 10 pts) | ± 10% L | ± 5% L | ± 3% L |

| | | | | |
|---|---|---|---|---|
| ***DC measurement domain*** | 1.000…9.999 µA | 10.00…99.99 µA | 100.0…999.9 µA | 1000…3000 µA |
| ***Resolution*** | 1 nA | 10 nA | 100 nA | 1 µA |
| ***Precision*** | ± 3% L | | | |

### 7.2.3 INSULATION RESISTANCE

❑ Method : voltage-current measurement (as per DIN VDE 0413 Part 1/09.80, EN61557, 500V to 1000V)

❑ Nominal output voltage: 500, 1000, 2500, 5000 V DC
Precision ± 2% adjustable from 40 V to 1000 V DC in 10V steps
adjustable from 1000 V to 5100 V DC in 100V steps

❑ Nominal current: ≥ 1 mA DC

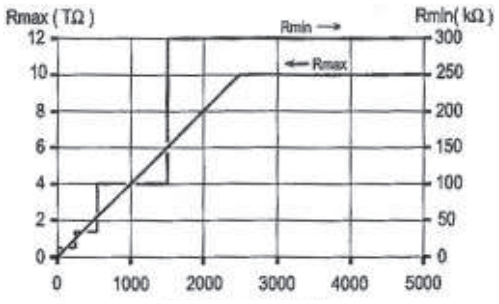
❑ Short-circuit current: < 1,6 mA ± 5% DC ( 3,1mA maximum starting)

❑ Maximum acceptable AC voltage: = (1,05 + dISt) *Unominal + 50V

❑ Measurement ranges :

| | | |
|---|---|---|
| 500 V | : | 30 kΩ... 1,999 TΩ |
| 1000 V | : | 100 kΩ... 3,999 TΩ |
| 2500 V | : | 100 kΩ... 9,99 TΩ |
| 5000 V | : | 300 kΩ... 9,99 TΩ |
| Variable (40 V...5100 V) : | | see graph below |

Resistance range in voltage mode




Variable voltage (V)

❑ Precision and resistance range in fixed voltage mode

| ***Test voltage*** | 500 V | 500 V - 1000 V 2500 V | 500 V - 1000 V - 2500 V - 5000 V | | | |
|---|---|---|---|---|---|---|
| ***Specified measurement domain*** | 30kΩ to 99kΩ | 100kΩ to 299kΩ | 300kΩ to 999kΩ | 30kΩ to 99kΩ | 100kΩ to 299kΩ | 300kΩ to 999kΩ |
| ***Resolution*** | 1kΩ | | | | 10kΩ | 100kΩ |
| ***Accuracy*** | ± (5% reading + 3 points) | | | | | |

| ***Test voltage*** | 500 V - 1000 V – 2500 V -5000 V | | | | 1000 V - 2500 V 5000 V | 2500 V 5000 V |
|---|---|---|---|---|---|---|
| ***Specified measurement domain*** | 400MΩ to 3.999GΩ | 4,00GΩ to 39.99GΩ | 40,0GΩ to 399.9GΩ | 400GΩ to 1.999TΩ | 2,000TΩ to 3.999TΩ | 4,00TΩ to 10.00TΩ |
| ***Resolution*** | 1MΩ | 10MΩ | 100MΩ | 1GΩ | | 10GΩ |
| ***Accuracy*** | ± (5% reading + 3 points) | | ± (15% reading + 10 points) | | | |

❑ Precision and resistance range in variable / adjustable voltage mode
Max. resistance measured = test voltage / 250pA

| ***Test voltage*** | 40…160V | 170…510V | 520…1500V | 1600…5100 V |
|---|---|---|---|---|
| ***Min. measured resistance*** | 10 kΩ | 30 kΩ | 100 kΩ | 300 kΩ |
| ***Max. measured resistance*** | 160.0 GΩ to 640.0 GΩ | 640.0 GΩ to 2.040 TΩ | 2.080 TΩ to 6.000 TΩ | 6.400 TΩ to 10.00 TΩ |

Note : the precision in variable mode must be interpolated from the precision tables provided for fixed test voltages.

❑ Measurement of DC voltage during insulation test

| ***Specified measurement domain*** | 40.0...99.9 V | 100...1500 V | 1501...5100 V |
|---|---|---|---|
| ***Resolution*** | 0.1 V | 1 V | 2 V |
| ***Accuracy*** | 1% L | | |

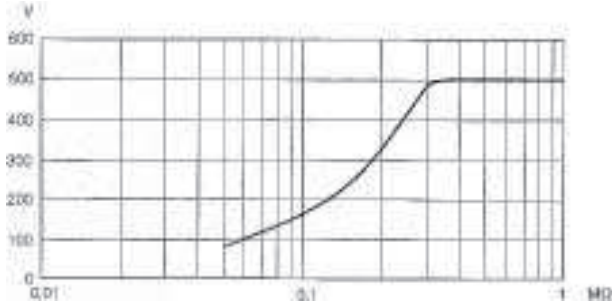
During the measurement, the maximum acceptable voltage on the terminals is (AC or DC):
U peak = U nominal * (1.05 + dISt) where dISt = 3%, 10%, or 20%

❑ Measurement of DC voltage during insulation test

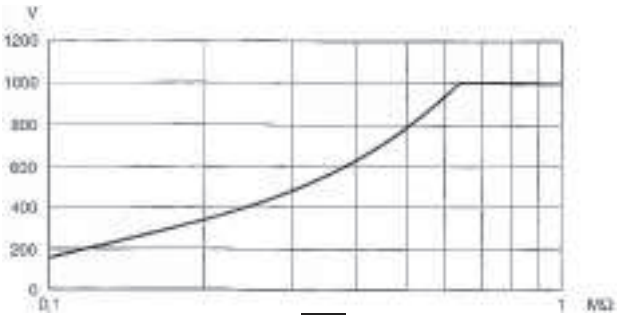
| ***Specified measurement domain*** | 25...5100 V |
|---|---|
| ***Resolution*** | 0,2% Un |
| ***Accuracy*** | ± (5% R + 3 points) |

❑ Typical curves, test voltage versus load

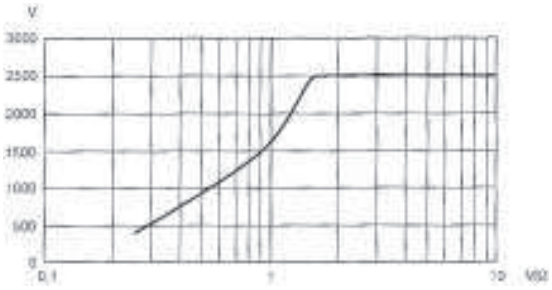
Range 500 V



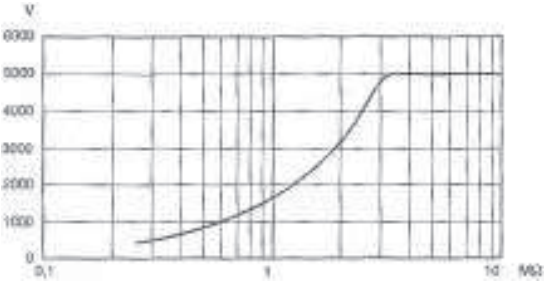

Range 1000 V



Range 2500 V



Range 5000 V



❑ Calculation of the DAR and PI terms

| | |
|---|---|
| ***Specified domain*** | 0.02...50.00 |
| ***Resolution*** | 0.01 |
| ***Accuracy*** | ± (5% R + 1 point) |

❑ Calculation of the DD term

| | |
|---|---|
| ***Specified domain*** | 0.02...50.00 |
| ***Resolution*** | 0.01 |
| ***Accuracy*** | ± (10% R + 1 point) |

❑ Capacitance measurement (after discharge of tested element)

| | | |
|---|---|---|
| ***Specified measurement domain*** | 0.005...9.999 µF | 10.00...49.99 µF |
| ***Resolution*** | 1 nF | 10 nF |
| ***Accuracy*** | ± (10% R + 1 point) | ± 10% R |

## 7.3 POWER SUPPLY

❑ The instrument is supplied by :
- NiMH rechargeable batteries - 8 x 1,2V / 3,5Ah
- External charging : 85 to 256V / 50-60Hz

❑ Minimum battery life (as per Nf EN 61557-2)

| ***Test voltage*** | 500 V | 1000 V | 2500 V | 5000 V |
|---|---|---|---|---|
| ***Nominal load*** | 500 kΩ | 1 MΩ | 2,5 MΩ | 5 MΩ |
| ***Nbr. of 5s measurements on nominal load*** ***(with 25s pauses between measurements)*** | 6500 | 5500 | 4000 | 1500 |

❑ Mean battery life
Assuming a 1-minute DAR measurement 10 times a day and a 10-minute PI measurement 5 times a day, the battery life will be approximately 15 working days, or 3 weeks.

❑ Charging time
6 hours to recover 100% capacity (10 hours if the battery is completely run down)
0.5 hours to recover 10% capacity (battery life approximately 2 days)

**Remark**: it is possible to charge the batteries while making insulation measurements, provided that the values measured are greater than 20 MΩ. In that case, the charging time is longer than 6 hours, and depends on the frequency of the measurements made.

## 7.4 ENVIRONMENTAL CONDITIONS

❑ Operation
- While batteries are charging
  -10°C to 40°C and 10% to 80 % relative humidity
- During measurement
  -10°C to 35°C and 10% to 75% relative humidity
  -10°C to 55°C and 10% to 80% relative humidity

❑ Storage
-40°C to 70°C
10% to 90% relative humidity

❑ Altitude : < 2000m

## 7.5 CONSTRUCTION SPECIFICATIONS

❑ Overall dimensions of the instrument (L x l x h) : 270 x 250 x 180mm
❑ Weight : approx. 4,3kg

## 7.6 COMPLIANCE WITH INTERNATIONAL STANDARDS

❑ Electrical safety as per : EN 61010-1 (Ed. 2 of 2001), EN 61557 (Ed. 97)
❑ Double insulation:
❑ Pollution level : 2
❑ Measurement category : III
❑ Max. voltage relative to earth : 1000 V (2500 V in measurement category I)

### 7.6.1. ELECTROMAGNETIC COMPATIBILITY :

NF EN 61326-1 (Ed. 97) + A1, industrial environment category

### 7.6.2. MECHANICAL PROTECTION

IP 53 as per NF EN 60529 (Ed. 92)
IK 04 as per NF EN 50102 (Ed. 95)

## 7.7 VARIATIONS WITHIN DOMAIN OF USE

| Influence quantity | Range of influence | Quantity influenced (1) | Influence | |
|---|---|---|---|---|
| | | | typical | max. |
| Battery voltage | 9 V - 12 V | V<br>MΩ | < 1 pt<br>< 1 pt | 2 pts<br>3 pts |
| Temperature | -10°C...+55°C | V<br>MΩ | 0.15% R/10°C<br>0.20% R/10°C | 0.3% R/10°C + 1pt<br>1% R/10°C + 2 pts |
| Humidity | 10%...80% RH | V<br>MΩ (10kΩ to 40GΩ)<br>MΩ(40GΩ to 10 TΩ) | 0.2% R<br>0.2% R<br>3% R | 1% R + 2 pts<br>1% R + 5 pts<br>15% R + 5 pts |
| Frequency | 15...500 Hz | V | 0.3% R | 0.5% R + 1 pt |
| AC voltage superimposed on test voltage | 0% Un...20%Un | MΩ | 0,1% R/% Un | 0,5% R/% Un + 5 pts |

*(1) The DAR, PI and DD terms and the capacitance and leakage current measurements are included in the quantity "MΩ"*

# 8. MAINTENANCE

**For maintenance, use only the specified spare parts. The maker is not liable for any accident occurring following a repair done other than by its customer service department or an approved repairer.**

## 8.1. SERVICING

### 8.1.1. BATTERY CHARGING

*If the instrument is charging in the OFF position*: the battery symbol is displayed and the 3 bars flash throughout the charging - «Charging battery» is also indicated.
When the battery is full, the symbol and its 3 bars are lit steadily and “Charging Full” is indicated.

*If the instrument is charging in a measurement position*: the battery symbol flashes.
There is no full charge indication. The “Charging Full” indication is displayed only when the instrument is returned to the OFF position.

If the instrument is started up and the battery voltage > 8 V, normal use of the instrument is allowed.

**The battery should be replaced by Manumesure or by a repairer approved by CHAUVIN ARNOUX.**
**Attention: changing the battery causes a loss of stored data.**
Carry out a complete erasure of the memory, in the SET-UP menu (see § 4.5), to be able to use the MEM / MR functions again.

### 8.1.2. REPLACING THE FUSES

If **GUARD FUSE** appears on the display unit, you must change the fuse accessible on the front panel after checking that none of the terminals is connected and that the switch is OFF.
Exact type of fuse (printed on the front panel label): FF - 0.1 A - 380 V - 5 x 20 mm - 10 kA

**Remark :** This fuse is in series with a 0.5 A / 3 kV internal fuse active only if there is a major fault in the instrument. If the display unit still indicates **GUARD FUSE** after the fuse on the front panel is changed, the instrument must be sent in for servicing (see § 8.2).

#### 8.1.3. CLEANING

**The instrument must be disconnected from any source of electricity.**
Use a soft cloth moistened with soapy water. Rinse with a wet cloth and dry rapidly with a dry cloth or forced air. Do not use alcohol, solvents, or hydrocarbons.

#### 8.1.4. STORAGE

**If the instrument is left unused for a long time** (more than two months), it is best to carry out three complete charging-discharging cycles before using it again.
The battery can be fully discharged:
- outside the instrument, at 3 A
  or
- at the setting in which consumption is highest, i.e. 5000 V

### 8.2 METROLOGICAL VERIFICATION

**As with all measuring or testing instruments, a periodic verification is necessary.**
We recommend checking this instrument at least one a year. For verifications and calibrations, contact our COFRAC-accredited metrology laboratories or the Manumesure agencies.
Information and coordinates on request:
Tél. : 02 31 64 51 43 Fax : 02 31 64 51 09

#### 8.2.1. REPAIR UNDER AND OUT OF WARRANTY

Send your instruments to one of the CHAUVIN-ARNOUX-approved MANUMESURE regional agencies.
Information and coordinates on request:
Tél. : 02 31 64 51 43 Fax : 02 31 64 51 09

#### 8.2.2. REPAIR OUTSIDE MAINLAND FRANCE

For any repair work, whether under or out of warranty, return the instrument to your distributor.

## 9. GUARANTEE

Unless otherwise stated, our guarantee is valid for twelve months after the date on which the equipment is made available (extract from our General Conditions of Sale, available on request).

## 10. TO ORDER

C.A 6549.....P01.1397.03
Delivered with a bag containing :
*2 3-m safety cables, with an HV plug and an HV crocodile clip (red and blue)*
*1 3-m guarded safety cable, with an HV plug with rear pick up and an HV crocodile clip (black)*
*1 2-m power cable*
*1 0.35-m blue cable with rear pick up*
*1 User Manual in five languages.*

**Accessories :**

- PC software.....P01.1019.38A
- Serial printer.....P01.1029.03
- serial-parallel adapter.....P01.1019.41
- Set of 2 simplified HT cables (red + black).....P01.2952.31
- Set of 2 crocodile clips (red + black).....P01.1018.48A
- Set of 2 contact pins (red + black).....P01.1018.55A
- Simplified HT guard cable + blue crocodile clip.....P01.2952.32
- 8-m blue HT cable with crocodile clip.....P01.2952.14
- 8-m red HT cable with crocodile clip.....P01.2952.15
- 8-m HT cable with crocodile clip with long grounding reminder.....P01.2952.16
- 15-m blue HT cable with crocodile clip.....P01.2952.17
- 15-m red HT cable with crocodile clip.....P01.2952.18
- 15-m HT cable with crocodile clip with long grounding reminder.....P01.2952.19
- Thermocouple thermometer, C.A 861.....P01.6501.01Z
- Thermo-hygrometer, C.A 846.....P01.1563.01Z

**Spare parts :**

- 3 3-m HT cables (red + blue + guarded black).....P01.2952.20
- 0.35-m cable with rear pick up.....P01.2952.21
- Bag n° 8 for accessories.....P01.2980.61
- Fuse FF 0.1A - 380V - 5x 20mm - 10kA (lot of 10).....P03.2975.14
- Battery 9.6V - 3.5AH - NiMH.....P01.2960.21
- Cable RS 232 PC DB 9F - DB 25F x 2.....P01.2951.72
- Printer cable, RS 232, DB 9F - DB 9M N°01.....P01.2951.73
- Power cable, 2P.....P01.2951.74

CHAUVIN ARNOUX

12 - 2003

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