

Operating manual MG Series - English

SEFELEC REFERENCE PENT0058



EATON

Powering Business Worldwide

THIS MANUAL IS WRITTEN FOR THE UNITS OF THE MG SERIES:

- **CMG30: EARTH CONTUITY TESTING**
- **DMG50, DMG500, DMG500F: DIELECTRIMETERS**
- **MMG500: MEGOHMMETERS**
- **RMG50, RMG500, RMG500F, RMG15AC: DIELECTRIC STRENGTH TESTERS**
- **SMG50, SMG500, SMG500F: ELECTRICAL SAFETY TESTERS**
- **FMG500, FMG501: LEAKAGE CURRENT TESTER**

PLEASE REFER ONLY TO THE SECTIONS OF THIS MANUAL DESCRIBING YOUR OWN UNIT.

WARRANTY:

SEFELEC warrants that units are free from defects in material and workmanship. SEFELEC warrants also that, when properly used, that units will perform in accordance with specifications of this manual.

If within one year after original delivery it is found not to meet this standard, it will be repaired at no charge in SEFELEC service facility in Lognes.

Changes in the unit not approved by SEFELEC will cancel this warranty.

SEFELEC will not be liable for any indirect damages resulting of the use of the unit.

This warranty is in lieu of all other warranties.

RESTRICTIONS DUE TO THE ACCESSORIES OR TO THE OPTIONS

A) GROUND CONTINUITY RÉSISTANCE

- - CO184/3 to CO184/10 : Maximum current regulation **10A** for 6V, **20A** for 12V.
- - CO183/3 to CO183/10 : Maximum current regulation **10A** for 6V, **20A** for 12V.
- - TE66/3 to TE66/10 : Maximum current regulation **10A** for 6V, **20A** for 12V.
- - TE80/3 to TE80/10 : Maximum current regulation **10A** for 6V, **20A** for 12V.
- - TE81/3 to TE81/10 : Maximum current regulation **10A** for 6V, **20A** for 12V.
- - CS1 : Maximum current regulation **10A** for 6V, **20A** for 12V.

B) DIELECTRIC STRENGTH

- - CO174 : **4000V** limited max. voltage.
- - CO185 : **4000V** limited max. voltage.
- - CO192 : **4000V** limited max. Voltage.
- - CO193 : **4000V** limited max. voltage.
- - CO200 to CO209 : **4000V** limited max. voltage.
- - FMG501 : **4200V** limited max. voltage.

C) INSULATION MEASUREMENT

- - DMG500F and SMG500F (Floating output) : **2GΩ** measurement limited.
- - CO178 : **2GΩ** measurement limited.
- - TE59 : **2GΩ** measurement limited.
- - TE67 : **2GΩ** measurement limited.
- - TE69 : **2GΩ** measurement limited.
- - FMG501 and MG-55 [Or MG-57](#) option (Triphased leakage) : **2GΩ** measurement limited.

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SPECIFICATIONS

Power supply :

- Mains : 115/230V~ $\pm 10\%$ single phase 47 to 63 Hz. (CMG30, DMG50, MMG500, RMG50, SMG50).
Mains : 230V~ $\pm 10\%$ single phase 47 to 63 Hz. (DMG500, RMG500, SMG500, DMG500F, RMG500F, SMG500F, FMG500, FMG501).
- Power consumption : 40VA without load, 550 VA maximum.
- Switching from 115 to 230 volts by switch in the line input plug.
- Temporized fuse protective in rear panel
 - RMG50, DMG50, SMG50, MMG500 : **2AT** for 230V **4AT** for 110V.
 - FMG500 et FMG501 : **2AT** for 230V
 - RMG500, DMG500, SMG500, RMG500F, DMG500F, SMG500F, RMG15AC : **3.15AT** for 230V.

Conditions of use :

- The instrument must be used inside, in horizontal position or on tripod.
- Temperature :
 - In storage : -10°C to +60°C.
 - In operation : 0°C to +45°C.
- Accuracy is rated after half an hour of warm up and for a relative humidity < 50%.
- Altitude : up to 2000 meters
- Max. humidity rate : 80% for a temperature of 31°C.

Weight and dimensions :

	MMG500	CMG30 – DMG50 RMG50	DMG500 - RMG500 DMG500F - RMG500F FMG500 - FMG501	SMG50	SMG500 SMG500F RMG15AC
Weight :	9Kg	15Kg	21Kg	27Kg	28Kg
Height :		131mm		177mm	
Width :		344mm		427mm	
Depth :		332mm		465mm	

Note : As SMG50, SMG500, SMG500F and RMG15AC are over 25Kg, 2 persons are necessary for manipulations.

Over voltage category :

- CAT II.

Rate of pollution :

- Pollution 2 : Occasional conductive pollution only by condensation.

Security range :

- Range I instrument : Earth protection by mains connection.

A. Dielectric strength operation 50VA (RMG50, DMG50, SMG50)

A.1 Output voltage

- Alternative 50 or 60Hz (DC voltage on option).
- From 0 to 5 kVAC in one range (0 to 6 KVDC). **Limited at 4.2 kVAC with FMG501 (leakage current)**
- Stability $< \pm 1\%$ for ΔV mains of $\pm 10\%$.
- Positive pole to earth (for the DC option).
- Residual $< 1\%$ for $I_s=100 \mu A$ (for the DC option).
- Internal resistance : $0.5 M\Omega$.
- Accuracy of the output voltage : $\pm(2\%+50\text{volts})$ in relation with the set value for voltages between 100 and 5000 volts (6000 volts for DC option) and for a current $< 100 \mu A$ in the fault detection modes : ΔI , IMAX or $\Delta I+IMAX$.
- Discharge of the tested specimen and of the internal capacity through a $1.5 M\Omega$ resistance (for the DC option).

A.2 Voltage reading

- By kilovoltmeter directly connected to the output terminals.
- Accuracy : $\pm(1.5\%+20\text{volts})$ of the read value.
- Display by 600 points digital indicator.

A.3 Short circuit current

- 10 mA $+0\%/-20\%$ for the adjustment of the maximum voltage (time limited to 5 seconds).

A.4 Fault detection

- Either by variation of ΔI current :
 - The $\Delta TEST$ detector automatically carries out the subtraction between the current which flows normally in the device under test ($I=U/Z$) and the one which occurs at the time of a fault ($I'=I+I_{\text{fault}}$).
 - Set amplitude : $1 \text{ mA} \pm 10\%$
 - Width of current pulse : $10\mu S \pm 20\%$
- By IMAX adjustable from 0.01mA up to 9.99mA by 0.01mA step
- By combination of both previous modes : $\Delta I+IMAX$
- By FIMAX adjustable from 0.01mA up to 9.99mA by 0.01mA step
- By combination of both previous modes : $\Delta I+FIMAX$
- Possibility to inhibit the detector in the OFF mode: the high voltage remains on the output in case of breakdown. Warning : in that mode, the hold time is limited to 5 seconds (otherwise possibility of thermal breakdown) and there is no automatic adjustment of the output voltage in accordance with the load of the specimen under test.

Possibility in the above detection modes to set a minimum value of current flowing through the specimen under test : IMIN value adjustable from 0.00mA up to 9.99mA.

A.5 Leakage current control

- Direct reading of the current on a shunt resistance in the test circuit.
- Display of the value on a 999 points digital indicator.

- Accuracy : $\pm(2.5\% + 2 U)$ of the read value ($1U=0.01mA$).
- In VDC for resistance loads $> 1 M\Omega$.
- Memory storage of the leakage current in IMAX detection mode.

A.6 Fault indication

- By message on the LCD display, red and green LED, and audible signal (possibility to inhibit).
- Memory storage of the breakdown voltage.
- Memory storage of the leakage current in IMAX mode.
- Cut off of the high voltage at the first zero crossing of the control sinusoidal signal of the HV transformer, thus without over voltage.

A.7 Timing

- MANUAL mode (without timing) and AUTO mode (with timing).
- Application of the test voltage during rise, hold, fall times adjustable from 000 up to 999 seconds.
- The time for each voltage step is 1 second (i.e. $1000V / 5 \text{ seconds} = 5 \text{ steps of } 200 \text{ volts}$)

B. Dielectric strength operation 500VA (RMG500, DMG500, SMG500, RMG500F, DMG500F, SMG500F)

B.1 Output voltage

- Alternative 50 or 60Hz according to the mains frequency (DC voltage on option).
- From 0 to 5 kVAC in one range (0 to 6 KVDC). **Limited at 4.2kVAC with FMG501 (leakage current)**
- Stability $< \pm 3\%$ for ΔV mains of $\pm 10\%$.
- Positive pole to earth (for the DC option).
- Accuracy of the output voltage : $\pm(3\%+50\text{volts})$ in relation with the set value for voltages between 100 and 5000 volts (6000 volts for DC option) and for a current $< 1\text{mA}$ in the fault detection modes : ΔI , IMAX or $\Delta I + \text{IMAX}$.

In fault detection mode : OFF, the output voltage changes according to the variation of the load connected on the HV output.

- Discharge of the tested specimen and of the internal capacity through a $1.5\text{ M}\Omega$ resistance (for the DC option).

B.2 Voltage reading

- By kilovoltmeter directly connected to the output terminals.
- Accuracy : $\pm(1.5\%+20\text{volts})$ of the read value.
- Display by 600 points digital indicator.

B.3 Short circuit current

- $\geq 200\text{ mA}$ for the adjustment of the maximum AC voltage.
- $\geq 20\text{ mA}$ for the adjustment of the maximum DC voltage.

B.4 Fault detection

- Either by variation of ΔI current :
 - The ΔTEST detector automatically carries out the subtraction between the current which flows normally in the sample under test ($I=U/Z$) and the one which occurs at the time of a fault ($I'=I+I_{\text{fault}}$).
 - Set amplitude : $10\text{ mA} \pm 10\%$
 - Width of current pulse : $10\mu\text{S} \pm 20\%$
- By IMAX adjustable from 0.1mA up to 99.9mA by 0.1mA step
- By combination of both previous modes : $\Delta I + \text{IMAX}$
- By FIMAX adjustable from 0.1mA up to 99.9mA by 0.1mA step
- By combination of both previous modes : $\Delta I + \text{FIMAX}$
- Possibility to inhibit the detector in the OFF mode: the high voltage remains on the output in case of breakdown. Warning : in that mode, the hold time is limited to 5 seconds (otherwise possibility of thermal breakdown) and there is no automatic adjustment of the output voltage in accordance with the load of the specimen under test.

* For RMG500F, DMG500 and SMG500F the ΔTEST detector characteristics are not valid.

Possibility in the above detection modes to set a minimum value of current flowing through the specimen under test : IMIN value adjustable from 00.0mA up to 99.9mA.

From 2.44X Version :

- IMAX value adjustable from 0.1mA up to 110mA by 0.1mA step.
- IMIN value adjustable from 00.0mA up to 110mA.

Mise en forme : Pucés et numéros

B.5 Leakage current control

- Direct reading of the current on a shunt resistance in the test circuit.
- Display of the value on a 999 points digital indicator.
- Accuracy : $\pm(2.5\% + 2 U)$ of the read value (1U=0.1mA).
- Memory storage of the leakage current in IMAX detection mode.
- Display of « STRONG CURRENT » message as well as « ---MA » when the current is over 100mA (AC current)
- The current indicated on the display in DC option is the real efficient current. That is to say

$$I_{\text{eff}} = \sqrt{I_{\text{ac}}^2 + I_{\text{dc}}^2}$$

- Display of « STRONG CURRENT » message as well as « ---MA » when current is over 20mA (DC current).

From 2.44X Version :

- Display of « STRONG CURRENT » message as well as « ---MA » when the current is over 110mA (AC current)

B.6 Fault indication

- By message on the LCD display, red and green LED, and audible signal (possibility to inhibit).
- Memory storage of the breakdown voltage.
- Memory storage of the leakage current in IMAX mode.
- Cut off of the high voltage at the first zero crossing of the control sinusoidal signal of the HV transformer, thus without over voltage.

B.7 Timing

- MANUAL mode (without timing) and AUTO mode (with timing).
- Application of the test voltage during rise, hold, fall times adjustable from 000 up to 999 seconds.
- The time for each voltage step is 1 second (i.e. 1000V/ 5 seconds = 5 steps of 200 volts)
-

B.8 Insulation impedance for SMG500F, RMG500F and DMG500F

- High voltage outputs insulation impedance in relation to the ground > 200 MΩ (VDE0104). Typical
100V : 5GΩ, 500V : 4 GΩ

C. Dielectric strength operation 500VA (RMG15AC)

C.1 Output voltage

- Alternative 50 or 60Hz according to the mains frequency .
- From 0.1 kV to 15 kVAC in one range
- Stability $< \pm 3\%$ for ΔV mains of $\pm 10\%$.
- Accuracy of the output voltage : $\pm (3\% + 50\text{volts})$ in relation with the set value for voltages between 100 and 15000 volts and for a current $< 1\text{mA}$ in the fault detection modes : ΔI , IMAX, FIMAX, $\Delta I + \text{FIMAX}$ or $\Delta I + \text{IMAX}$.

In fault detection mode : OFF, the output voltage changes according to the variation of the load connected on the HV output.

C.2 Voltage reading

- By kilovoltmeter directly connected to the output terminals.
- Accuracy : $\pm (1.5\% + 20\text{volts})$ of the read value.
- Display by 1500 points digital indicator.

C.3 Short circuit current

- $\geq 65\text{ mA}$ for the adjustment of the maximum AC voltage.

C.4 Nominal current

- 35 mA for the adjustment of the maximum AC voltage.

C.5 Fault detection

- Either by variation of ΔI current , **1000V to 15 kV** :
 - The ΔTEST detector automatically carries out the subtraction between the current which flows normally in the sample under test ($I = U/Z$) and the one which occurs at the time of a fault ($I' = I + I_{\text{fault}}$).
 - Set amplitude : $10\text{ mA} \pm 10\%$
 - Width of current pulse : $10\mu\text{S} \pm 20\%$
- By IMAX adjustable from 0.1mA up to 40.0mA by 0.1mA step
- By combination of both previous modes : $\Delta I + \text{IMAX}$
- By FIMAX adjustable from 0.1mA up to 40.0mA by 0.1mA step
- By combination of both previous modes : $\Delta I + \text{FIMAX}$
- Possibility to inhibit the detector in the OFF mode: the high voltage remains on the output in case of breakdown. Warning : in that mode, the hold time is limited to 7 seconds (otherwise possibility of thermal breakdown) and there is no automatic adjustment of the output voltage in accordance with the load of the specimen under test.

Possibility in the above detection modes to set a minimum value of current flowing through the specimen under test : IMIN value adjustable from 00.0mA up to 40.0mA .

C.6 Leakage current control

- Direct reading of the current on a shunt resistance in the test circuit.
- Display of the value on a 999 points digital indicator.
- Accuracy : $\pm(2.5\% + 3 U + (\text{Voltage}/5000)*U)$ of the read value (1U=0.1 mA) on resistive load for voltage > 1000 V
- Accuracy : $\pm(2.5\% + 10 U)$ of the read value (1U=0.1 mA) on resistive load for voltage between 0 and 1000 V
- Memory storage of the leakage current in IMAX detection mode.
- Display of « STRONG CURRENT » when the current is over 40 mA
- In OFF mode detection , the hold time is limited to 7 seconds if the current is upper than 60 mA

C.7 Fault indication

- By message on the LCD display, red and green LED, and audible signal (possibility to inhibit).
- Memory storage of the breakdown voltage.
- Memory storage of the leakage current in IMAX mode.
- Cut off of the high voltage at the first zero crossing of the control sinusoidal signal of the HV transformer, thus without over voltage.

C.8 Timing

- MANUAL mode (without timing) and AUTO mode (with timing).
- Application of the test voltage during rise, hold, fall times adjustable from 000 up to 999 seconds.
- The time for each voltage step is 1 second (i.e. 1000V/ 5 seconds = 5 steps of 200 volts)

D. Megohmmeter function

1) 500V Insulation card

D.1 Measurement voltage

- 50, 100, 250, 500 DC volts.
- Accuracy of the voltage : $\pm(1\%+2V)$.
- Positive pole grounded.
- Dynamic stability for ΔV mains = $\pm 10\%$: $>1\%$
- Maximum intensity in the measurement circuit : 2 mA $\pm 20\%$.
- Discharge current limited by a 2.2 k Ω resistance.

D.2 Ranges of measurement

Basic 200G Ω Version		Option 2T Ω Version	
Voltages	Ranges of measurement*	Voltages	Ranges of measurement
50V	50k Ω to 20G Ω	50V	50k Ω to 200G Ω
100V	100k Ω to 40G Ω	100V	100k Ω to 400G Ω
250V	250k Ω to 100G Ω	250V	250k Ω to 1T Ω
500V	500k Ω to 200G Ω	500V	500k Ω to 2T Ω

* Ranges of measurement for DMG500F and SMG500F limited to 2G Ω .

D.3 Accuracy of the resistance measurement

- Display on 2000 points digital indicator with unity indications (K Ω , M Ω , ...)
- Accuracy: (in % of the reading. 1U= 1 display count) :

Megohmmeter (MMG500)	Dielectrimeter (DMG50, DMG500) Security Tester (SMG50, SMG50)
200 G Ω Version : $\pm(1.5\% + 1U)$	200 G Ω Version : $\pm(1.5\% + 1U)$
2 T Ω Version : $\pm(2\% + 1U)$	2 T Ω Version* (Uessai=50 or 100V) : $\pm(2\% + 1U)$
	2 T Ω Version* (Uessai=250 or 500V) : $\pm(1\% \times U_{\text{essai}}/100 + 1U)$

*Only on DMG50 and DMG500

- CAPACITANCE mode: from 1.00 M Ω to 200 G Ω (2 T Ω for option 20)
With accuracy = (NORMAL mode accuracy) ± 100 k Ω .
Input impedance = 10 M Ω $\pm 1\%$

D.4 Measurement thresholds

- Adjustment of the digital value of 2 resistance thresholds from 50 k Ω up to 200 G Ω (2 T Ω for option 20).
- Comparison result indication on 2 LED and audible signal (possibility to inhibit).

D.5 Timing

Permanent measurement or during a time between 1 and 999 seconds (adjustable by 1 second step).

1) 1000V Insulation card (MG-26 option)

Those specifications replace the ones from the 500V insulation card, given on page 6.

D.1 Measurement voltage

- 100, 250, 500, 1000 DC volts.
- Accuracy of the voltage : $\pm(1\%+2V)$.
- Positive pole grounded.
- Dynamic stability for ΔV mains = $\pm 10\%$: $>1\%$
- Maximum intensity in the measurement circuit : 2 mA $\pm 20\%$.
- Discharge current limited by a 2.2 k Ω resistance.

D.2 Ranges of measurement

Basic 200G Ω Version		Option 2T Ω Version	
Voltages	Ranges of measurement*	Voltages	Ranges of measurement
100V	100k Ω to 20G Ω	100V	100k Ω to 200G Ω
250V	250k Ω to 50G Ω	250V	250k Ω to 500G Ω
500V	500k Ω to 100G Ω	500V	500k Ω to 1T Ω
1000V	1M Ω to 200G Ω	1000V	1M Ω to 2T Ω

* Ranges of measurement for DMG500F and SMG500F limited to 2G Ω .

D.3 Accuracy of the resistance measurement

- Display on 2000 points digital indicator with unity indications (K Ω , M Ω , ...)
- Accuracy: (in % of the reading. 1U= 1 display count) :

Megohmmeter (MMG500)	Dielectrimeter (DMG50, DMG500) Security Tester (SMG50, SMG500)
200 G Ω Version : $\pm(1.5\% + 1U)$	200 G Ω Version : $\pm(1.5\% + 1U)$
2 T Ω Version : $\pm(2\% + 1U)$	2 T Ω Version* (Uessai=50 or 100V) : $\pm(2\% + 1U)$
	2 T Ω Version* (Uessai=250 or 500V) : $\pm(1\% \times U_{essai}/100 + 1U)$

*Only on DMG50 and DMG500

- CAPACITANCE mode: from 1.00 M Ω to 200 G Ω (2 T Ω for option 20)
With accuracy = (NORMAL mode accuracy) ± 100 k Ω .
Input impedance = 10 M Ω $\pm 1\%$

D.4 Measurement thresholds

- Adjustment of the digital value of 2 resistance thresholds from 100 k Ω up to 200 G Ω (2 T Ω for option 20).
- Comparison result indication on 2 LED and audible signal (possibility to inhibit).

D.5 Timing

Permanent measurement or during a time between 1 and 999 seconds (adjustable by 1 second step).

E. Ground continuity résistance function

E.1 Measurement current

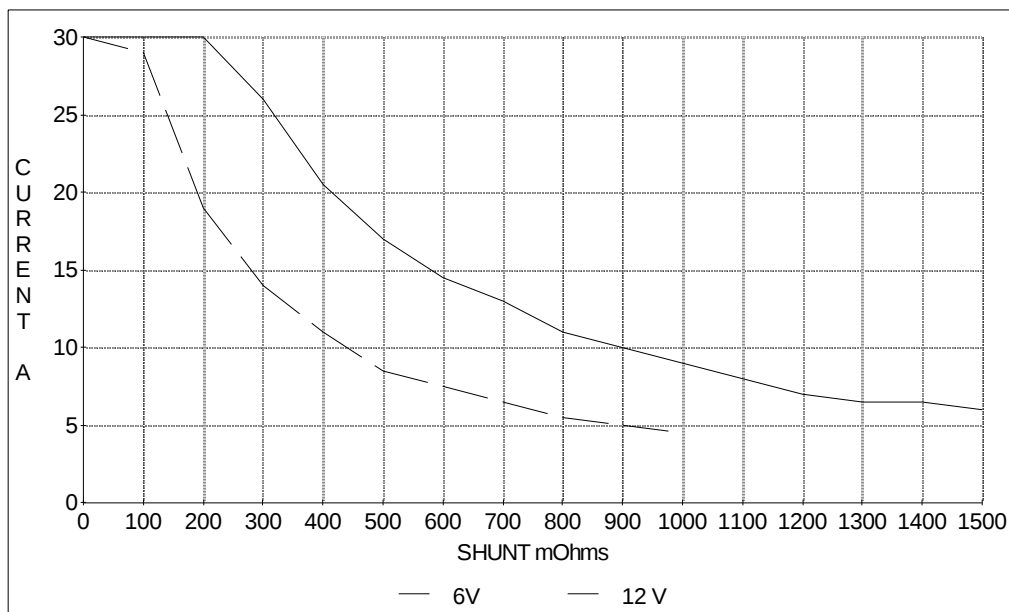
- From 5 to 30A AC by step of 0.5 AAC.
- Accuracy : $\pm(1\% + 500\text{mA})$.

E.2 Measurement voltage

- $< 6 \text{ VAC}$ ou $< 12 \text{ VAC}$.
- Sinus wave.
- Frequency identical to the mains.

E.3 Accuracy of the ground continuity resistance measurement

- Display on 1500 points digital indicator with unity indications ($\text{m}\Omega$).
- Accuracy (in % of the reading. $1\text{U} = 1 \text{ display count } 1\text{m}\Omega$) : $\pm(2.5\%+10\text{U})$.



E.4 Measurement thresholds

- Adjustment of the digital value of 2 resistance thresholds from 0.001 Ω up to 1.500 Ω .
- Comparison result indication on 2 LED and audible signal (possibility to inhibit).

E.5 Measurement thresholds

If the current generated is high ($\geq 25A$), it can lead to a current overheating of the transformer and start up its protection (See Section [5.3](#)).

The hereunder board indicates the maximum use times of the ground continuity resistance measurement according to the use cycle (1 $\frac{1}{2}$ cycle represents use of the current during one second for a total duration of the cycle of 2 seconds)

Note : All these duration concern a 30A current. For lower currents, these duration are higher.

Cycle	1/1	1/2	1/3
Use time	25 minutes	5 hours	Infiniti

SECTION 1: INTRODUCTION - OPERATING INSTRUCTIONS



Warning : This unit must be used by qualified people. Every precautions for the use of units connected to the main must be taken during its use. In particular, this unit must be connected to earth.

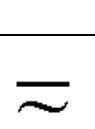
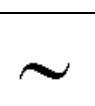
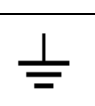
The specifications of this manual, the correct operation of the unit as well as the operator's security are guaranteed only when the supplied accessories (TE54, TE56, CO175, CO183, CO184, ...) are used. The measurement probes can include limitation or protective elements, therefore it is forbidden to modify without written agreement from SEFELEC company.

In case of use under other conditions than the one specified in this manual, the security of the user will be in danger.

Except for the earth controller CMG30, this unit can supply voltages and currents which could be lethal. Comply with the safety regulations related to the use of high voltage devices.

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE SPECIMENS.

1.1 MEANING OF THE DIFFERENT SYMBOLS ON THE INSTRUMENT

	Warning (See document attached)
	Warning, risk of electric shock.
	DC voltage.
	AC and DC voltages.
	AC voltage.
	Earth connection.

1.2 PRODUCT OVERVIEW

The MG series is a range of units performing very easily insulation resistance measurements, dielectric strength tests and ground continuity tests. The MMG500 is a megohmmeter, the RMG50, [RMG15AC](#) and RMG500 are dielectric strength testers under 50VA or 500VA and the DMG50 and DMG500 are dielectric strength testers under 50VA or 500VA including a megohmmeter, the CMG30 is a ground continuity controller and the SMG50 and SMG500 include all the above mentioned functions.

The MG series makes possible to perform insulation resistance measurement, ground continuity resistance measurement and dielectric strength test on a various number of insulating material as resin, porcelain, oil, plastic as well as on final products such as capacitors, transformers, switches, cables, connectors or on devices connected to the main or supplied by batteries. The instruments allow ground continuity measurement fitting most part of the existing standards regarding measuring and medical fields, office devices, machinery,...

The MG series is fitted with a high resolution liquid crystal display (LCD) and a keyboard allowing an easy use. A single output for the dielectric strength tests and the insulation resistance measurements makes easy the connection on the specimens. Red and green LED lamps indicate visually and without any confusion the tests results.

The dielectric strength tests are performed under adjustable voltages from 100 VAC up to 5000 VAC (up to 6000 VDC in option) with a short circuit current of 10 mA for 50VA models and 200 mA for 500VA models. The breakdown voltages and currents are memorized on the display after breakdown detection and voltage cut off.

The insulation resistance measurements are performed under voltages of 50, 100, 250 or 500 VDC. The MG unit indicates in a direct reading with unity display, the resistance values from 50 kohms up to 200 Gohms (2 Tohms in option).

The continuity resistance measurement are performed under voltages of 5 to 30A AC with open circuit voltages of 6 or 12V AC. The MG unit indicates in a direct reading with unity display, the resistance values from 1mΩ to 1500mΩ.

In option, the unit can be equipped with PLC input/output interface or with a serial RS232C interface enabling a full remote control by a PC computer.

1.3 FRONT PANEL DESCRIPTION



The main functions of the MG units have been arranged in the following areas :

- Z1 : Power on and off
- Z2 : Trigger/stop of the measurement and HV red indicator
- Z3 : LED lamps for test results
- Z4 : 4 functions keys with function name on the LCD display
- Z5 : 5 keys to change and enter parameters
- Z6 : Input/output connectors
- Z7 : Graphic liquid crystal display (LCD) to display test parameters and test results

1.3.1 Keyboard definition

The unit includes 10 keys arranged in 3 function areas. Each action on a key is followed by an audible signal, informing that the unit has decoded the key position.

The Z4 area includes 4 keys whose function changes according to the unit mode. In each mode, the right side of the LCD screen is used to indicate the meaning of the keys. If a key has no label, this one is not active.

The Z5 area includes 4 keys to change parameter values and 1 key to enter the inputs (at the center). The UP/DOWN keys allow to increase or decrease the parameters values and the LEFT/RIGHT keys allow to move the cursor on all the digits of the numbers. The key at the center enters the new value of the parameter.

The Z2 area includes a mechanical push button to trigger or to stop the MEASUREMENT mode. A red lamp, inside the push button, indicates when the MEASUREMENT mode is on, and therefore the possibility to have high voltage on the test probes.

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE SPECIMENS.

1.3.2 Liquid Crystal display description

The unit is fitted with a liquid crystal display (LCD) of 64 points per 240 points used in a graphic mode.

According to the position of the user related to the unit screen and the light conditions, it is possible to adjust the screen contrast by turning the potentiometer located on the rear panel (Z9). The screen is LED backlight, this allowing the use of the unit even the light conditions are poor.

The screen is divided in 5 areas arranged as follows :

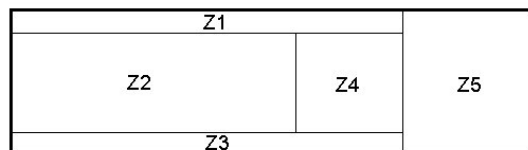
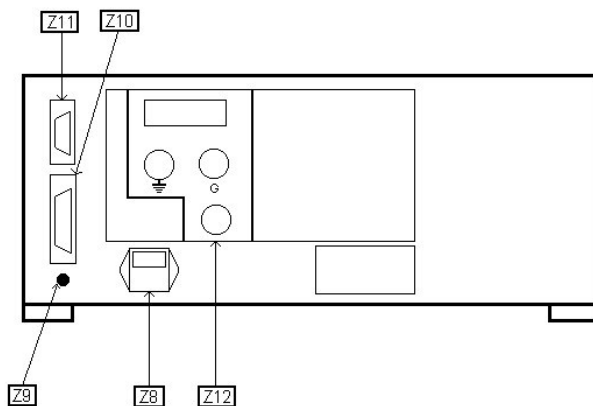


FIG.

- Area Z1 : Help messages (in normal video mode) or error messages (in reverse video mode)
- Area Z2 : Display of the measurement results with big characters (18 mm x 12 mm). In the input parameters mode, display of test parameters for possible changes.
- Area Z3 : Recall of the measurement parameters
- Area Z4 : Symbol recalling the selected test (MO, KV,.....)
- Area Z5 : Indicates the name of the function keys on the right side of the LCD display.

1.4 REAR PANEL DESCRIPTION :



The following areas are arranged on the rear panel :

Z8 : Power input connector with voltage selector (115V/230V)

Z9 : LCD contrast adjustment potentiometer

Z10 : 25 points female sub-D connector for remote control of the unit (see pin out in section [10.1](#))

Z11 : 9 points female sub-D connector for RS232C interface (option)

Z12 : Area for the output of the cables in the REAR PANEL OUTPUT option.

Z13 : 25 points female sub D connector for printout type CENTRONICS

1.5 ACCESSORIES INCLUDED

- Operating manual
- Power cord (SE1)
- Measurement return cable 50 or 500VA (CO175)
- 25 points male sub-D connector (FD25)

1.6 ACCESSORIES / OPTIONS AVAILABLE :

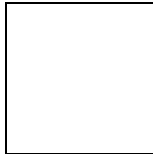
- TE54 : HV measurement probe (to hold in hand) for DMG50, RMG50, SMG50
- TE56 : Measurement probe for MMG500
- TE58 : Remote control probe for DMG50 / RMG50 / SMG50
- TE65 : HV measurement probe (to hold in hand) for RMG500, DMG500, SMG500
- TE66 : Ground continuity set including 1 x CO183 and 1 x CO184 for CMG30, SMG50 and SMG500
- TE67 : Pistol with remote control for RMG500, DMG500, SMG500
- CO160 : Red/green lamp to indicate when HV is on
- CO174 : External box equipped with female socket for RMG50, DMG50, SMG50
- CO177 : HV measurement probe for automatic test systems (for 50VA)
- CO179 : RS232C Cable
- CO180 : HV measurement probe for automatic test systems (FOR 500VA)
- CO183 : 2 wires with crocodile clip cable (CMG30, SMG50, SMG500)
- CO184 : 2 wires with retractable tip probe (CMG30, SMG50, SMG500)
- CO185 : External box equipped with female socket for RMG500, DMG500, SMG500
- CO192 : External box equipped with 6 X female socket for RMG50, DMG50, SMG50
- CO193 : External box equipped with 6 X female socket for RMG500, DMG500, SMG500
- CO200 to CO209 : External box equipped with international female socket for 50 and 500VA.
- AO10 : Trigger/stop of the measurement by remote control using 2 hands
- AO11 : Trigger/stop of the measurement by foot switch
- AO14 : Sub-D connector extension (x4)
- KRMG : Rack mount kit
- OPT01 : RS232C interface. Talker/listener
- OPT02 : Remote control interface by PLC
- OPT03 : 0-10 volts analog input/output (DMG50, MMG50, RMG50)
- OPT04 : Test sequence (DMG50, DMG500)
- OPT05 : Measurement input/output on the rear panel
- OPT10 : 5000 VAC and 6000 VDC for 50VA
- OPT13 : 5000 VAC and 6000 VDC for 500VA
- OPT20 : Measurement up to 2 Tohms (DMG50, DMG500, MMG500, SMG50, SMG500)
- OPT21 : Display of the insulation resistance by analog meter (MMG500)
- OPT22 : Display of the insulation resistance in Mohm per km (DMG50, MMG500)
- OPT23 : Built-in calibration resistance (MMG500)
- OPT26 : Measurement with voltage up to 1000V.
- MG-90 : Maintenance and calibration manual
- MG-91 : Calibration kit for 50VA
- MG-91-30A : Calibration kit for ground continuity function.
- MG-91-500VA : Calibration kit for 500VA
- MG-91-FUITE : calibration kit for leakage current.
- MG-91-15AC : calibration kit for RMG15AC.
- MG-92 : Printer output (SMG50, SMG500)

MG series OPERATING MANUAL - SEFELEC

- MG-93 : Remote box.
- MG-96 : (SmgPro) Software for MG series.

1.7 INSTALLATION

1.7.1 Preliminary instructions



WARNING :

This unit must be used by qualified people. Every precautions for the use of units connected to the main must be taken during its use. In particular, this unit must be connected to earth.

The specifications of this manual, the correct operation of the unit as well as the operator's security are guaranteed only when the supplied accessories (TE54, TE56, CO175, CO183, CO184, ...) are used. The measurement probes can include limitation or protective elements, therefore it is forbidden to modify without written agreement from SEFELEC company.

In case of use under other conditions than the one specified in this manual, the security of the user will be in danger.

Except for the earth controller CMG30, this unit can supply voltages and currents which could be lethal. Comply with the safety regulations related to the use of high voltage devices.

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE SPECIMENS.

The MG unit can be operated from either 115 or 230 volts $\pm 10\%$, 47 to 63 Hz power line. Before connecting the 3 wires power cord (SE1) between the unit and AC power source, make sure the voltage indicated on the inlet module (Z8) is in accordance with the power source. For a change of voltage selection proceed as follows:

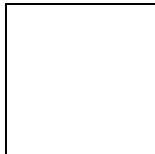
- Front panel ON/OFF switch (Z1) in the OFF position
- Remove the power cord SE1 from the inlet module
- WAIT AT LEAST 5 MINUTES BEFORE PROCEEDING
- With a small screwdriver, remove the selection sub-assembly from the inlet module
- Remove the fuses
- Take off the pale gray plastic piece
- Select voltage : 110 for a 115 volts main and 220 for a 230 volts main (the 240 position is not used).
- Replace the gray plastic piece to display in the window of the selection sub-assembly the required voltage.
- Put the right value for the fuses according to the main voltage
- Replace the selection sub-assembly in the inlet module
- Connect the SE1 power cord



The protective earth connection is COMPULSORY before using the 4U units. Use a screwed connection on the gudgeon located on the rear panel of units (minimum section 6 mm²).

1.7.2 Power on

Make sure the voltage indicated on the inlet module (Z8) is in accordance with the power source (see [1.7.1](#)). Connect the unit and AC source (with earth connection) with the SE1 power cord then press the power button (Z1) in the ON position. After a few seconds the LCD screen must display the instrument's designation (CMG30, DMG50, RMG50, MMG500, SMG500, ...):



According to the position of the user related to the unit screen and the light conditions, it is possible to adjust the screen contrast by turning the potentiometer located on the rear panel (Z9).

1.7.3 Safety advice

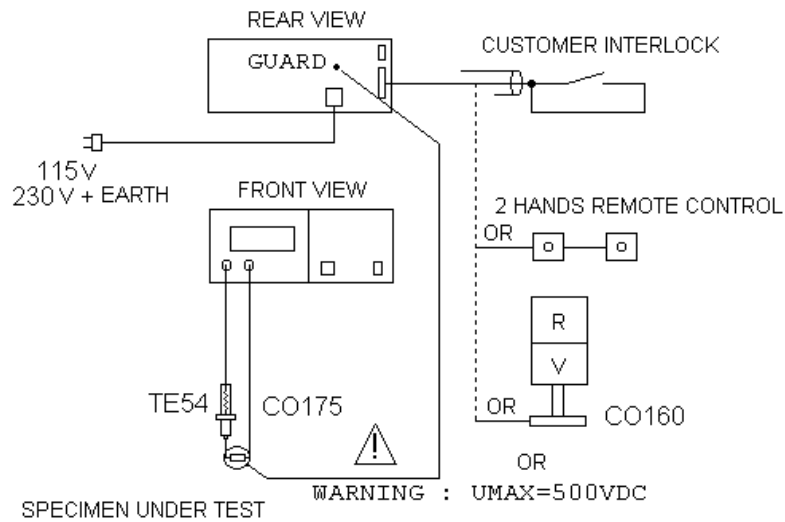
- **WARNING : NEVER TOUCH THE METALLIC TIP OF THE HV TEST PROBES (TE54, CO177,...) WHEN THE TEST PROBES ARE CONNECTED ON THE UNIT AND THE RED HV LAMP IS ON (Z2). The guard connection on the rear panel is at the measurement voltage ($U_{max} = 500 \text{ VDC} - 2\text{MA}$). The measurement probes can include limitation or protective elements, therefore it is forbidden to modify without written agreement from SEFELEC company.**
- The instrument must be placed in a position where the light ON/OFF can be easily seen.
- Check the good working of cables before use.
- Take every precaution necessary to avoid inadvertently touching the sample under test when there is a voltage passing through it (Red lamp in the push button Z2 on)
- Do not open the cover
- Do not place the unit close to a wall so that the air passes through the ventilation ears.
- The unit is supplied with a « SAFETY LOOP » preventing generation of voltage when pins 1 and 14 of the 25 points connector (Z10) located on the rear panel are not connected. The test can be carried out only when connected. In case of remote control test pins 13 to 25 must be connected too.
- Note : It is therefore advisable to put into operation in this connection, dry contacts in condition of safety (closed door, secured cover lowered,...)
- It is possible to connect a RED/GREEN lamp (CO160) on the rear connector Z10 in order to indicate in a visible way if the HV is ON or OFF on the outputs of the unit.

1.7.4 Connection to a specimen

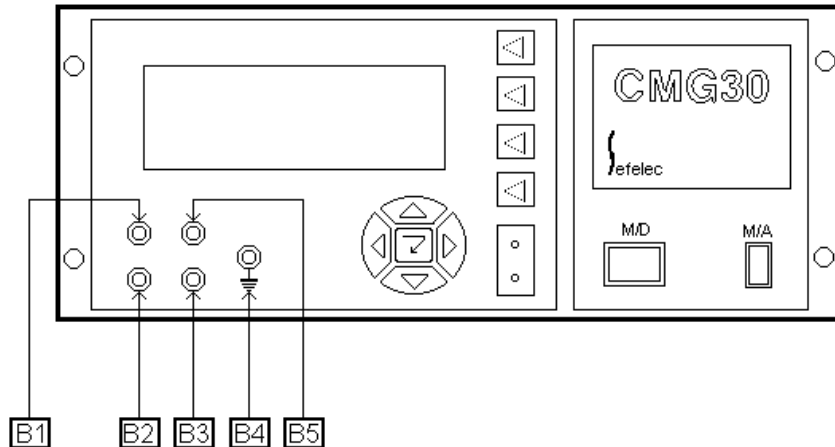
1.7.4.1 Connection for insulation resistance measurement and dielectric strength tests (DMG50, DMG500, MMG500, RMG50, RMG500)



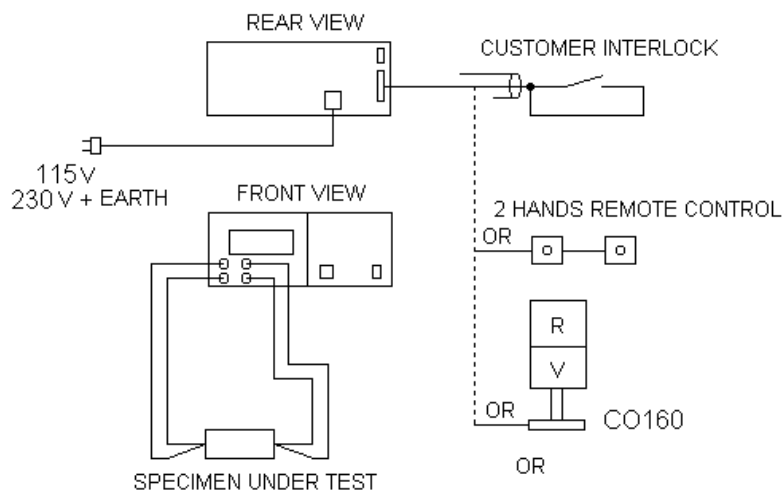
- Connect the measurement probe (TE54, TE56, ...) on the B1 connector
- Secure the probe by tightening the knurled ring
- Proceed the same way for the return probe (CO175) on the B2 connector.
- Connect the specimen to be tested as follows:



1.7.4.2 Connection for ground continuity measurement (CMG30)



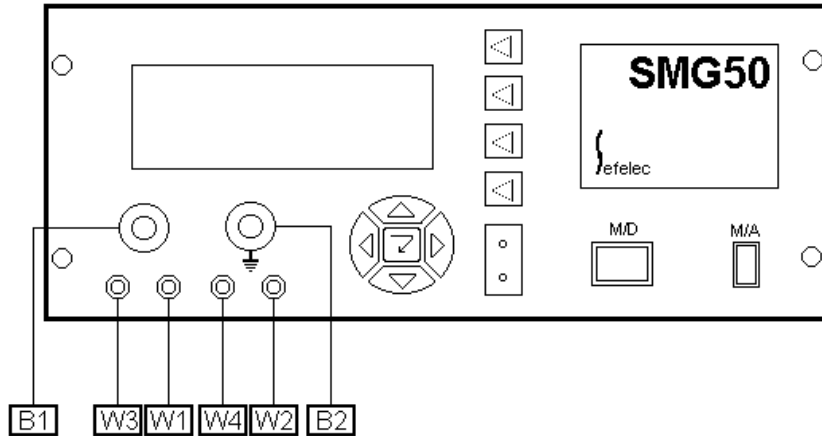
- Connect the measurement probe (CO183 or CO184) on the B1, B2, B3 and B5 connectors (GREEN Connector = CURRENT, GREY Connector = VOLTAGE).
- Connect the specimen to be tested as follows:



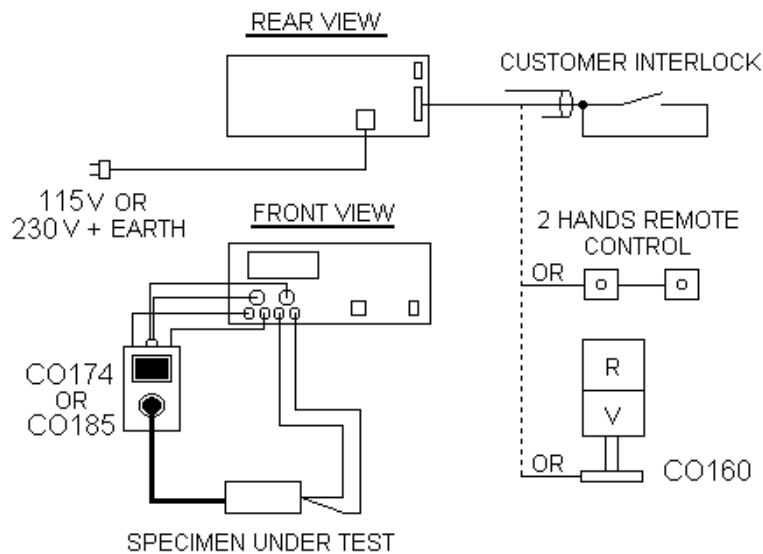
WARNING : Measurement on a specimen connected to earth.

In the case of ground continuity measurement on a specimen connected to earth, the grounded side must be connected to the terminals U and I, B1 and B2.

1.7.4.3 Connection for insulation resistance measurement, dielectric strength tests and ground continuity measurement (SMG50, SMG500)



- Connect the measurement probe (CO174, CO185, ...) on the B1, B2, W1, W2, W3 and W4 connectors. (GREEN Connector = CURRENT, GREY Connector = Voltage)
- Connect the specimen to be tested as follows:



WARNING : Measurement on a specimen connected to earth.

In the case of ground continuity measurement on a specimen connected to earth, the grounded side must be connected to the terminals I and U, W1 and W3.

SECTION 2 : SETUP

After switching on or returning to the menu of the figure 01 (1.7.2), press the [SETUP] function key of the Z4 area. Then the LCD screen displays as follows :

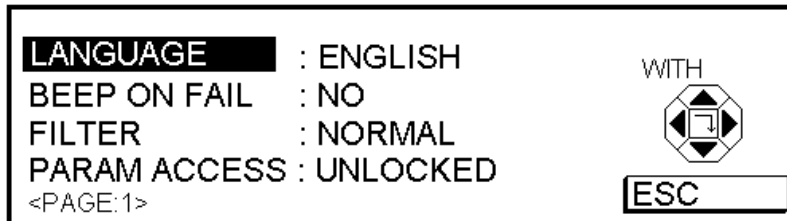


FIG. 02

With the UP and DOWN arrow keys, move the reverse video line and go into modification mode by pressing on the RIGHT arrow key or on the ENTER key (key at the center of the selection keyboard). Scroll the possible selections with the UP and DOWN arrow keys, then enter the choice with the validation key.

2.1 LANGUAGE

All the displayed messages on the LCD screen can be in several languages (French, English,.....). Display the required language with the UP/DOWN arrows, then enter. The unit goes back to its initialization menu.

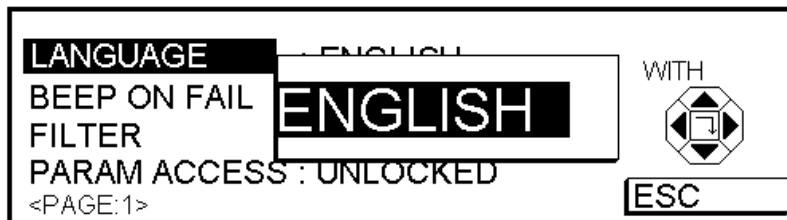


FIG. 03

2.2 BEEP ON FAIL

When a test result is failed, a permanent audible signal is emitted by the unit until the removal by pressing on the [MEASUREMENT-DISCHARGE] key. This function is active when **YES** is selected and not active when **NO** is selected. The choice is memorized after switching off the unit.

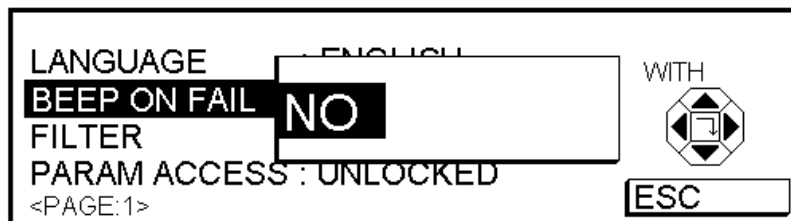


FIG. 04

2.3 FILTER

Allows to select a special functioning mode of the unit when making tests on capacitors or on specimens having a certain amount of capacitance.

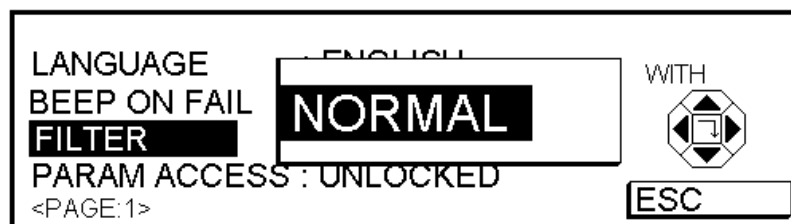


FIG. 05

Display the required mode with the UP/DOWN arrows : **NORMAL**, **CAPACITOR**, **R.H. TIME**..., then enter. The **CAPACITOR** mode allows to perform stable insulation resistance measurements on capacitive specimens (reel of cable, capacitors,...). During dielectric strength test with a DC voltage, the **CAPACITOR** mode inhibits the voltage adjustment to avoid overvoltage, switches the 1.5 Mohm discharge resistor at the beginning of the fall time and controls the residual discharge voltage until this one is lower than 100 volts. Operating this mode is recalled by the drawing of a capacitor over the unity display in the measurement menus.



The R.H. TIME (Real Hold Time) mode improves the operation of voltage ramp during the dielectric strength tests. It is suitable for tests using a DC high voltage on capacitive specimens. At the end of the rise time, the unit controls the output voltage and triggers the hold time only when the voltage has reached the pre-set value. During the fall time, the unit stops the measurement cycle when the output voltage is lower than 30 Volts.

2.4 PARAM ACCESS

The access to the parameter modification can be secured by a password.

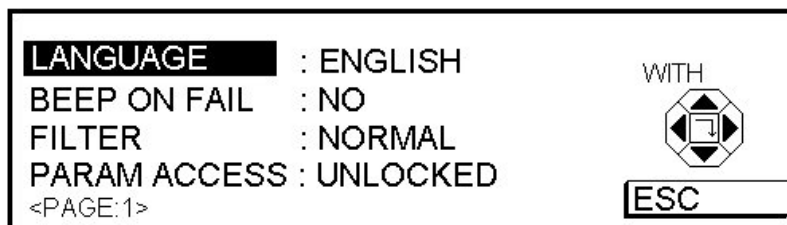
This limitation is made of three different levels :

- **FREE** : Let you modify all the parameters
- **READING** : Let you only recall the memories but you can not modify them
- **FORBIDDEN** : You can not modify anything ; security is total

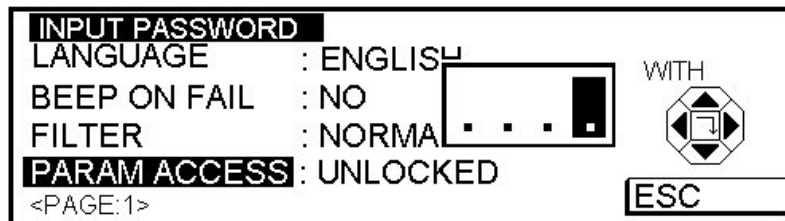
You can set up the password access in the configuration menu [CONFIG] and in the line [ACCES PARAM].

Follow the following instructions to modify the password and the access level.

Switch on the unit, and from the main menu, select the [CONFIG] menu. The display is then indicating the following information.



Then, with the up and down arrows go onto the « ACCES PARAM. » field and select it with enter. The display is then indicating the following information.

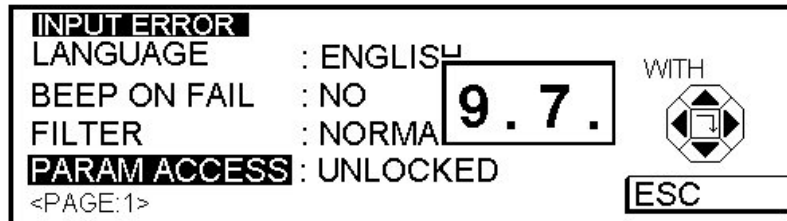


- Select the figure to modify with the right and left arrows.
- Increase or decrease the figures (0 1 2 3 4 5 6 7 8 9. 0 1 2...) to select your code. Repeat this action for each figure.
- Once each figure is entered, validate with Enter key.

WARNING

THE FIRST TIME YOU SWITCH ON THE UNIT, THE PASSWORD IS VOID. A PASSWORD IS A REAL NUMBER.

If the code is not a real number, you will get an error and the following message "INPUT ERROR".

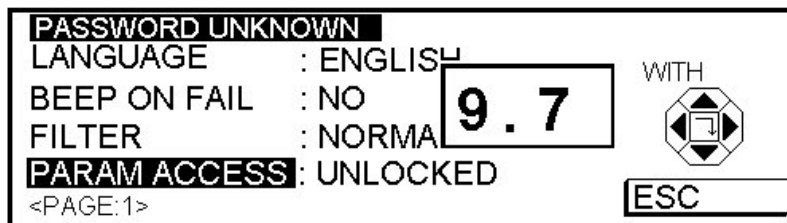


In this example, you would get an error, because of the dot.

Then to correct you have to :

- Type a new password
- Abandon the code by clicking on end key

If the password is not good, the following message will be displayed : "PASSWORD UNKNOWN"



Then to correct you have to :

- Type a new password
- Abandon the code by clicking on end key

In the case of a correct password, the following message will be displayed :



Then enter the access level you wish, as described in the chapter II from the MG manual.

PLEASE CONTACT OUR AFTER SALES SERVICE IN CASE YOU LOOSE THE PASSWORD
Tel : (33) 1 64 11 83 40

2.5 DISPLAY

Press on the UP or DOWN arrows to select the next setup menu.

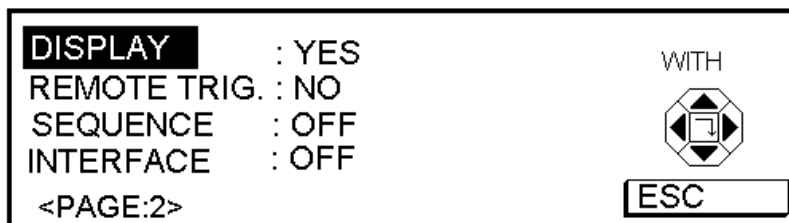


FIG. 07

Allows to inhibit the display of the digital measurement results, only the PASS-FAIL result is valid. This mode is specially interesting when controlling the unit by an external system (RS232C or PLC) because it allows to reduce the test times. When operating this mode, a fixed drawing is displayed in the measurement result window:



2.6 REMOTE TRIGGER MODE

Allows to use a remote control system to trigger the measurement mode. Operating this mode is recalled by the following drawing in the measurement windows :



WARNING : Please, follow carefully the procedure below to use the **REMOTE TRIGGER** mode :

- Remove the FD25 connector from the rear panel
- Connect on the 25 points rear panel connector a provided accessory for remote control (i.e. AO10) or connect the 2 wires provided for your own remote control system between the 13 and 25 points.
- Select YES on the input line REMOTE TRIG.
- Escape the setup menu with the [ESC] key
- Select measurement type with [MEGOHM] or [HIPOT]
- Verify the display of the remote control drawing
- The front panel [MEASUREMENT-DISCHARGE] push-button is inoperative
- Close the contact between 13 and 25
- Keep the contact closed during the test time
- Release the contact at the end of the test time

When operating this mode, the opening of the safety loop (points 1 and 14) inhibits to go in the measurement mode, but the unit will not indicate the INTERLOCK DISABLE error message.

IMPORTANT : If you have selected the **REMOTE TRIG.** mode and if the connections 1-14 and 13-25 are already done when selecting a measurement function (Megohm or Hipot), the following message is displayed :

INPUT ERROR

and the **REMOTE TRIG.** mode is automatically removed. Please refer to the above procedure to select correctly the **REMOTE TRIG.** mode.

2.7 INTERFACE SELECTION

Allows to select the remote control mode. Display on the LCD screen the various interface types with the UP and DOWN arrows :

OFF, PLC, RS232,.....

When using a remote control mode it is **necessary** to select it in this line. When pressing on ENTER key, if the option is not installed in the unit, the following message is displayed :

MISSING OPTION

For more details regarding the remote control modes, please refer to the [8.3](#) section of this manual.

WARNING :
RS232 speed :
9600 bauds for MG series.
19200 Bauds for "MG+" series .
19200 bauds for MG series with MG-70 option.

2.8 SEQUENCE (OPTION 04)

If the option is valid and only for a DMG50, this feature allows to perform automatic cycling of the megohm and dielectric strength functions.

Display on the LCD screen the various sequence modes with the UP and DOWN arrows :

OFF,M+H,H+M,M+H+M,.....

The **M** letter shows an insulation resistance measurement and the **H** letter shows a dielectric strength test. Operating the sequence mode is recalled in the measurement windows by the following drawing :



In a **M+H** sequence the unit performs first an insulation test and then a dielectric test. It is necessary to set the parameters specially the test times before running a sequence. In case of a fault during the test, the sequence is stopped. When operating in sequence mode, at power on, the first sequence function type is automatically selected. When attempting to trigger the measurement mode in a function type which is not the first one of the sequence, the following message is displayed :

SEQUENCE ERROR

Escape of the function and select either another function or another sequence mode.

Example of a sequence setup :

An operator wants to perform an insulation control on a specimen, then a dielectric strength test and finally a new insulation control to verify that the dielectric strength test hasn't degraded the specimen.

- SETUP menu

- <page2>, line SEQUENCE
- Select the sequence mode : M+H+M
- Escape with [ESC] key
- The unit switches automatically in the insulation test
- Check that parameters are correct (Necessary to select times)
- Press on the [MEASUREMENT-DISCHARGE] push button
- After the test time the unit switches automatically to the next test if the test result was PASS.
- When an insulation test has to be perform after a dielectric strength test, the unit controls the discharge voltage of the specimen and follows its sequence only if the voltage is lower than 100 volts with the display of :

DISCHARGE CONTROL

In case of a fault during the insulation test, the number 1 or 2 of the test is displayed.

At the end of a sequence, after release of the result by pressing the [MEASUREMENT-DISCHARGE] push button the unit switches in the first function of the sequence.

To escape of the SETUP menu, press on the function key [ESC].

SECTION 3 : INSULATION RESISTANCE MEASUREMENT (DMG50, DMG500, MMG500, SMG50, SMG500)

Access to the insulation resistance measurement function [MEGOHM] for a SMG50 or SMG500, dielectric strength test function [HIPOT] and ground continuity tester [GROUND].

From the initialization menu press on the [MEGOHM] key, display indicates :



FIG. 10

3.1 PARAMETERS

From the initialization menu press on the [MEGOHM] function key to get the menu shown in figure 10. The main test parameters are recalled on the bottom line of the LCD screen. If the message [ACCESS DENIED] is displayed, please refer to section 2.4.

To modify these parameters press on the [PARAM] function key of this menu.

Display shows :

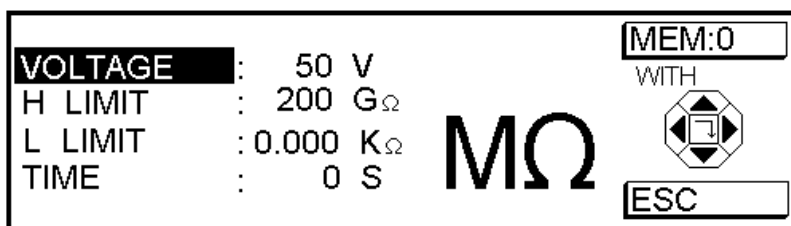


FIG. 13

Note : For DMG50, DMG500, SMG50, SMG500, parameters setup is made on a separate display in which you must select the required function.

3.1.1 Measurement, voltage selection

The unit offers the possibility to select preset measurement voltages (50-100-250-500 VDC). The voltage selection is done according to the standard or the specifications used for the test. Without any specifications, select 100 VDC.

- Move the reverse video line in front of the VOLTAGE line with the UP/DOWN arrows keys.
- Press on the RIGHT arrow or ENTER key
- Display shows :

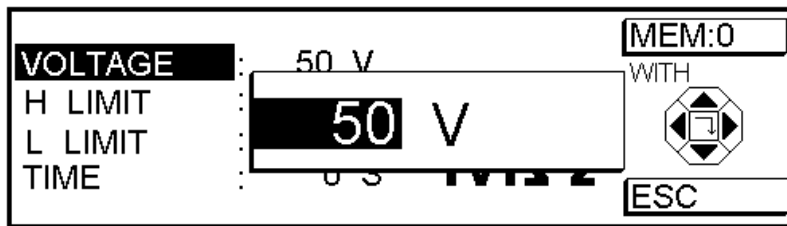


FIG.14

- With the UP/DOWN arrow keys scroll all the available voltages (50,100,250,500)
- Enter the selected value with the ENTER key.

3.1.2 Threshold selection

The unit includes 2 comparison thresholds making possible to check if the specimen under test is good or bad. The **HI-LIMIT** defines the maximum insulation resistance value for the specimen in order to detect a possible bad connection of the test probes on the specimen. The **LO-LIMIT** defines the minimum insulation resistance value that must be reached by the specimen under test. A specimen is good (PASS) if its insulation resistance value is < HI LIMIT and > LO LIMIT, otherwise the specimen is declared bad (FAIL).

In the basic version of the unit the thresholds are adjustable from 0 kΩ up to 200.0 GΩ. A **HI LIMIT** set to 200.0 GΩ cancels the comparison to the high threshold, in that case the value of the high threshold is not displayed on the parameters line of the figure 10. When a value above 200GΩ (or 2TΩ according to the option) is entered, the message **LIMIT ERROR** is displayed.

- Move the reverse video line in front of the **HI LIMIT** line.
- Press on the RIGHT arrow or ENTER key
- Display shows :

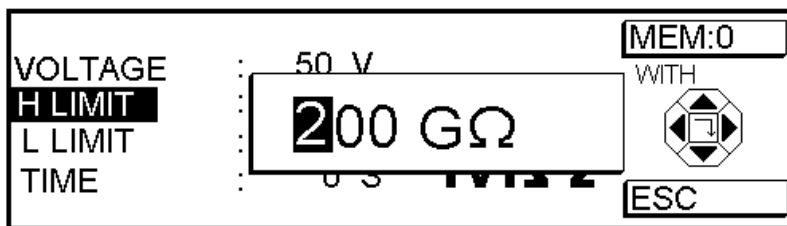


FIG.15

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 3 etc)
- Repeat operation for all the numbers if necessary
- With the RIGHT arrow key, move the cursor up to the unity zone
- Scroll the unity: KΩ (1 000 ohms), MΩ (1 000 000 ohms), GΩ (1 000 000 000 ohms) and TΩ (1 000 000 000 000 ohms).
- Enter the threshold with the ENTER key
- **WARNING : the HI LIMIT must be always higher than the LO LIMIT, otherwise an error message is displayed :**

HI LIMIT < LO LIMIT

- To set the LO LIMIT value proceed the same way as for the HI LIMIT.
- **WARNING: the LO LIMIT must be always lower than the HI LIMIT, otherwise an error message is displayed:**

LO LIMIT > HI LIMIT

3.1.3 Timer

The unit is equipped with a timer to define the insulation resistance measurement time (from 1 up to 999 seconds). This feature is particularly interesting when measuring on capacitive specimens of which the insulation resistance increases as a function of the measurement time. At the end of the test time, the unit automatically stops the test and memorizes the last measured value on the LCD screen.

In case where a test time is set to 0, the unit remains in the measurement mode permanently until the [MEASUREMENT/DISCHARGE] key is pressed.

- Move the reverse video line in front of the TIMER line
- Press on the RIGHT arrow or ENTER key
- Display shows :

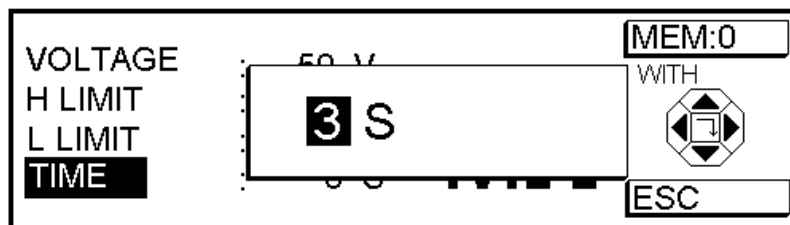


FIG. 16

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 3 etc).
- Repeat operation for all the numbers if necessary
- Enter the time with the ENTER key

3.1.4 Parameters memorization

This feature allows to store in 10 memories (numbers 0 to 9) measurement parameters (voltage, threshold, time,...). From the measurement menu, to modify the memory number :

- Press on the [MEM:x] function key
- Display shows :



FIG.17

- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The parameters recall line (area 3 of the LCD screen) indicates the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

From the parameter menu, to modify a memory number :

- Press on the [MEM:x] function key
- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The input parameters lines indicate the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

WARNING :

ANY PARAMETER MODIFICATION IS AUTOMATICALLY STORED IN THE MEMORY. See section 2.4 'PARAM ACCESS' to control the access to the parameter modifications.

3.2 INSULATION RESISTANCE MEASUREMENT

Select the voltage, threshold and time parameters as described in section [3.1.1 to 3.1.4](#).

NOTE : these parameters are stored even after the unit has been switched off.

- **WARNING : ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE SPECIMENS.**
- Connect the specimen to be measured as described in section [1.7.4](#)
- Press on the [MEASUREMENT/DISCHARGE] button
- Indicator inside the button is illuminated and the display shows :

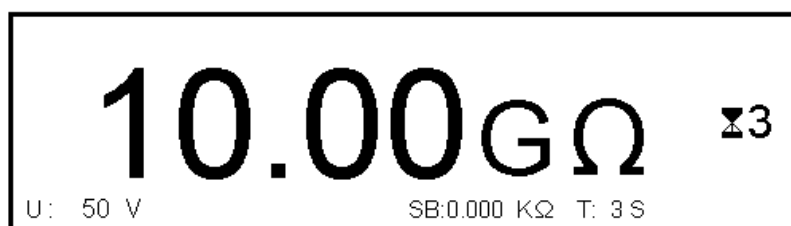


FIG.18

- In case where a test time is set to 0, the unit remains in the measurement mode permanently until the [MEASUREMENT/DISCHARGE] key is pressed.
- If a test time value has been selected, every second the value of the test time counts down one unit. When the displayed time reaches 0 the output voltage is cut off automatically and the last measured value is stored on the LCD screen. According to the insulation resistance value in comparison with the HIGH and LOW limits, the red LED (FAIL) or the green LED (PASS) is illuminated.

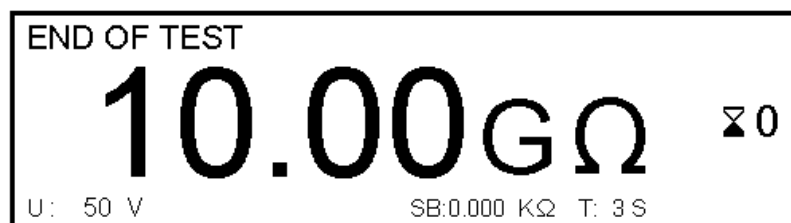


FIG.19

- Press on the [MEASUREMENT/DISCHARGE] key to cancel the memorization on the LCD screen. (The HV indicator goes out.)
- Display shows figure 11
- Press on the [ESC] key to escape the function

3.3 ERROR MESSAGES:

The following error messages may appear during the measurement :

- **INTERLOCK DISABLE** : the safety loop is not closed. There is no connection between the points 1-14 and 13-25 of the 25 points Z10 connector of the rear panel (See Section [1.7.3](#)). Make the connection, press again on the [MEASUREMENT/DISCHARGE] key to trigger the measurement mode.
- **OVER-RANGE** : the insulation resistance of the specimen under test exceeds the measurement specifications of the unit (refer to specification section of this manual).
- **UNDER-RANGE** : the insulation resistance of the specimen under test is lower than the measurement specifications of the unit (refer to specification section of this manual).
- **CHARGING** : the measurement voltage has not reached its final value. On capacitive specimen, wait for the end of the charge, on resistive specimen check with the current specifications of the power supply.
- **BOARD NOT READY** : the microprocessor board cannot communicate with the insulation resistance board. You cannot perform a measurement, get in contact with our Service department.

3.4 UNIT EQUIPPED WITH ANALOG METER (21 option)

In this case the insulation resistance is displayed as a scientific number format

For example :

18×10^5 Ohms

(1.8 Mohms) with 18 displayed by the pointer of the analog meter on a linear scale from 0 to 20 and the power of ten on the LCD display.

Accuracy of the measurement :

Megohmmeter

- version 200 Gohms : $\pm(1.5\%+CG^*)$
- version 2 Tohms : $\pm(2\%+CG^*)$

*CG = Class of the analog meter = 1.5 % of the full scale

SECTION 4 : DIELECTRIC STRENGTH TEST (DMG50, DMG500, RMG50, RMG500, SMG50, SMG500)

From the initialization menu press on the [HIPOT] function key to obtain the menu shown in figure 12. The main test parameters are recalled on the bottom line of the LCD screen.



FIG. 11

4.1 SETTING

To modify these parameters, press on the [PARAM] function key of this menu. If the message [ACCESS DENIED] is displayed, please refer to section [2.4](#).

The display shows then :

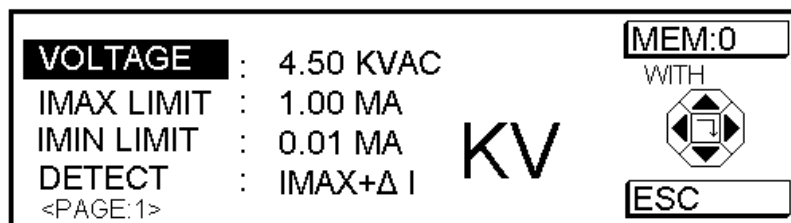


FIG. 20

In the basic version of the unit, the measurement parameters are stored in a battery backup memory and are automatically recalled at the power on. With the option OPT00 it is possible to store 10 various setups in the memory (see [3.1.4](#)).

Note : For DMG50, DMG500, SMG50, SMG500, parameters setup is made on a separate display in which you must select the required function.

4.1.1 Test voltage selection

The unit offers the possibility to select dielectric strength test voltages between 0.10 and 5.00 KVAC or 0.10 and 6.00 KVDC (option). The test voltage selection is done according to the standards.

- Move the reverse video line in front of the VOLTAGE line
- Press on the RIGHT arrow or ENTER key
- Display shows :



FIG. 21

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 3 etc)
- Repeat operation for all the numbers if necessary
- With the RIGHT arrow key, move the cursor up to the unity zone
- Scroll AC, DC (if option OPT10 is present) with the UP/DOWN arrow keys
- Enter the voltage with the ENTER key. If the value is higher than the maximum limits (5.00 in AC and 6.00 in DC), following error message appears :
LIMIT ERROR
- Enter a correct value or [ESC]

4.1.2 Current threshold selection

The unit includes 2 comparison thresholds making possible to check if the specimen under test is good or bad. The **IMIN LIMIT** defines the minimum current value which must flow through the specimen in order to detect a possible bad connection of the test probes on the specimen. The **IMAX LIMIT** defines the maximum current value which is allowed to flow through the specimen under test. According to the selected breakdown detection mode (see 4.1.3), a specimen is good (PASS) if the supplied current is < IMAX LIMIT and > IMIN LIMIT, otherwise the specimen is declared bad (FAIL).

The thresholds are adjustable from 0.00 mA up to 9.99 mA for 50VA and from 0.00 mA up to 99.9 mA for 500VA. A IMIN LIMIT set to 0.00 mA cancels the comparison to the minimum current threshold.

- Move the reverse video line in front of the IMAX LIMIT line
- Press on the RIGHT arrow or ENTER key
- Display shows :

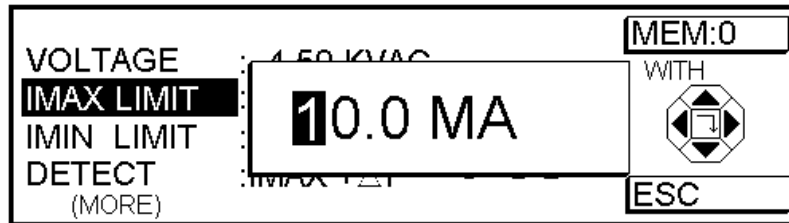


FIG.22

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 3 etc)
- Repeat operation for all the numbers if necessary
- Enter the threshold with the ENTER key

WARNING : the **IMAX LIMIT** must be always higher than the **IMIN LIMIT**, otherwise an error message is displayed :

IMAX LIMIT < IMIN LIMIT

- To set the **IMIN LIMIT** value proceed the same way as for the **IMAX LIMIT**.

WARNING: the **IMIN LIMIT** must be always lower than the **IMAX LIMIT**, otherwise an error message is displayed :

IMIN LIMIT > IMAX LIMIT

4.1.3 Breakdown detection mode selection

The unit offers the possibility to select several breakdown detection modes :

- **IMAX** mode : makes possible to monitor the permanent leakage current flowing through the specimen under test and compares this current in regard to an adjustable limit (see 4.1.2 IMAX LIMIT). This mode does not perform fast arc detection and its relatively slow reaction time can be destructive for the specimen under test. In addition the value of the IMAX threshold has to be adjusted regarding the 'normal' current of each specimen (AC leakage current under test voltage).
- **FIMAX** mode (Fast **IMAX**) : Same as IMAX but detection is made more rapidly.
- **Δ -I** mode : arc detection mode which monitors arcs having a minimum width of 10uS and an amplitude of 1 mA. This mode does not take care for the 'normal' leakage current and therefore does not need any adjustment. Its fast reaction time makes possible the limitation of the damages caused to the specimen under test. On the other hand, the Δ -I mode does not find a fault in case of specimen already in short circuit at the beginning of the test.
- **FIMAX+ Δ I** mode : combination of the two last mode. This mode allows you to realise hipot tests, in an easy and accurate way. IMAX detection is made more rapidly.
- **IMAX+ Δ -I** mode : combination of the two previous detection modes. This mode makes possible to perform reliable dielectric strength tests very easily.
- **OFF** mode : disable the detectors. This mode makes possible to locate a dielectric strength fault by burning.

WARNING : this mode can be used only for a limited time (5 seconds). In case of over heating a built-in thermal switch cuts off the high voltage generator. Wait for 3-5 minutes before going on. In this mode there is no automatic adjustment of the high voltage regarding the impedance of the load.

NOTE : the minimum leakage current control mode (IMIN LIMIT) is independent of the above breakdown detection modes.

- Move the reverse video line in front of the **DETECTION** line with the UP/DOWN arrows keys.
- Press on the RIGHT arrow or ENTER key
- Display shows:

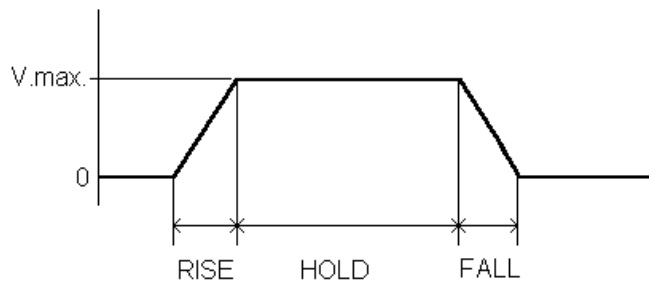


FIG. 23

- With the UP/DOWN arrow keys scroll the various detection modes available : **Δ -I, IMAX+ Δ -I, IMAX, OFF, FIMAX+ Δ I, FIMAX.....**
- Enter the selected mode with the ENTER key.

4.1.4 Timer

The sudden application of the test voltage on a specimen could stressed it more than required. Therefore the unit is fitted with a voltage rise time system. The same phenomena existing during the cut off of the high voltage, the unit can perform the following test cycle :



There are four possible ways to use the unit, let = AUTO, MANUAL, FAIL and U:2.

The AUTO mode is described here above.

The U:2 runs like the auto mode, but the test starts with the programmed voltage divide by 2.

The FAIL mode (only with 500VA model), let the test be permanent to a break détection, without rising time.

The MANUAL mode, the user can increase or decrease the output test voltage as he wants by pressing on respectively the UP or the DOWN arrow keys. It is necessary to press on the keys for each step.

From the parameters menu (FIG. 20), press on the DOWN or UP arrow keys as many times necessary to display the following menu :

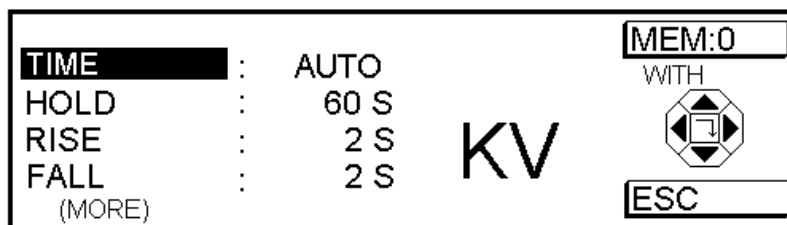


FIG. 24

- Move the reverse video line in front of the TIME line with the UP/DOWN arrows keys.
- Press on the RIGHT arrow or ENTER key
- Display shows :



FIG 25

- With the UP/DOWN arrow keys scroll the various available timer modes :

AUTO, MANUAL

- Enter the selected mode with the ENTER key.

In the AUTO mode, it is possible to set the RISE, HOLD and FALL times from 0 up to 999 seconds.

- Move the reverse video line in front of the HOLD line
- Press on the RIGHT arrow or ENTER key
- Display shows :

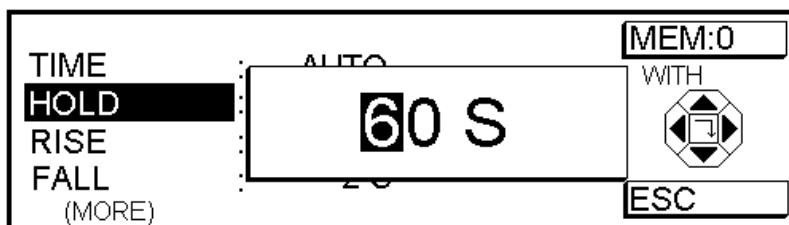


FIG 26

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 3 etc)
- Repeat operation for all the numbers if necessary
- Enter the time with the ENTER key

Proceed the same way for the **RISE** and **FALL** times.

4.1.5 Parameters memorization

This feature allows to store in 10 memories (numbers 0 to 9) measurement parameters (voltage, threshold, time,...). From the measurement menu, to modify the memory number:

- Press on the [MEM:x] function key
- Display shows :



FIG. 27

- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The parameters recall line (area 3 of the LCD screen) indicates the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

From the parameter menu, to modify memory number :

- Press on the [MEM:x] function key
- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The input parameters lines indicate the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

WARNING :

ANY PARAMETER MODIFICATION IS AUTOMATICALLY STORED IN THE MEMORY. See section 2.4 « PARAM ACCESS » to control the access to the parameter modifications.

4.2 DIELECTRIC STRENGTH TEST

Select the voltage, current thresholds, breakdown detection mode and time parameters as described in section 4.1.1 to 4.1.4.

NOTE : these parameters are stored even after the unit has been switched off.

WARNING :

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE SPECIMENS.

- Connect the specimen to be measured as described in section 1.7.4
- Press on the [MEASUREMENT/DISCHARGE] button
- Indicator inside the button is illuminated and the display shows :



FIG.28

- In case where the **MANUAL** test time mode has been selected, the unit remains in the measurement mode permanently until the [MEASUREMENT/DISCHARGE] key is pressed. Use the UP arrow key to increase the output voltage and the DOWN arrow key to decrease the output voltage. The maximum voltage which can be reached is those which is displayed on the parameter line :

VOLTAGE:x.xxKVAC

However according to the impedance of the specimen under test, the maximum reached voltage could be lower.

- If the **AUTO** test time has been selected, every second the value of the RISE time counts down one unit, then the value of the HOLD time and at least the value of the FALL time. When the FALL time reaches 0 the output voltage is cut off automatically. According to the leakage current value during the test time in comparison with the IMAX and IMIN limits, the red LED (FAIL) or the green LED (PASS) is illuminated.

In both modes (AUTO and MANUAL) if the leakage current flowing through the specimen under test overruns the set breakdown detection values (in Δ -I or IMAX modes) the unit declares breakdown with cut off of the high voltage (at the next zero crossing). The display shows :



FIG.29

The memorized voltage is the breakdown voltage and the leakage current is also memorized and is corresponding to a IMAX value.

- Press on the [MEASUREMENT/DISCHARGE] key to cancel the memorization of the breakdown data on the LCD screen (the HV indicator goes out).
- Display shows figure 11
- Press on the [ESC] key to escape the function

4.3 ERROR MESSAGES

The following error messages may appear during the measurement :

- **INTERLOCK DISABLE** : the safety loop is not closed. There is no connection between the points 1-14 and 13-25 of the 25 points Z10 connector of the rear panel (See Section 1.7.3). Make the connection, press again on the [MEASUREMENT/DISCHARGE] key to trigger the measurement mode. **In case of over heating a built-in thermal switch cuts off the high voltage generator. Wait for 3-5 minutes before going on. In this mode there is no automatic adjustment of the high voltage regarding the impedance of the load.**
- **VOLTAGE ERROR** : the test voltage has not reached its final value (impedance of the specimen under test too low), in DC voltage wait for the end of the charge, in AC voltage check with the current specifications of the power supply. In case of over heating a built-in thermal switch cuts off the high voltage generator. Wait for 3-5 minutes before going on.
- **I<IMIN** : during the HOLD time, the leakage current flowing through the specimen under test has not reached the minimum value set by the IMIN parameter (possible bad connection of the test probe). This fault gives a bad (FAIL) test result even there is no breakdown.
- **BOARD NOT READY** : the microprocessor board cannot communicate with the dielectric strength test board. You cannot perform a measurement, get in contact with our Service department.
- **SYNCHRO ERROR** : the dielectric strength test board is not able to generate the sinusoidal signal which drives the HV transformer. You cannot perform a test, get in contact with our Service department.

SECTION 5 : GROUND CONTINUITY RESISTANCE MEASUREMENT (CMG30, SMG50, SMG500)

From the initialization menu press on the [GROUND] function key to obtain the figure 12 for a CMG30 or on the [NEXT] key and then [GROUND] for a SMG50 or a SMG500. The main test parameters are recalled on the bottom line of the LCD screen.



FIG. 12

5.1 Parameters setting

To set parameters, press on the [PARAM] function key of this menu. If the message [ACCESS DENIED] is displayed, please refer to section [2.4](#).
The display shows then :

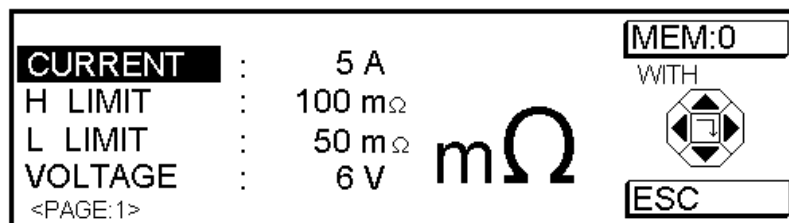


FIG. 30

Note : For DMG50, DMG500, SMG50, SMG500, parameters setup is made on a separate display in which you must select the required function.

5.1.1 Test current selection

The unit offers the possibility to select ground continuity test current (step of 0.5 A). The test current selection is done according to the standards.

- Move the reverse video line in front of the CURRENT line.
- Press on the RIGHT arrow or ENTER key.
- Display shows :

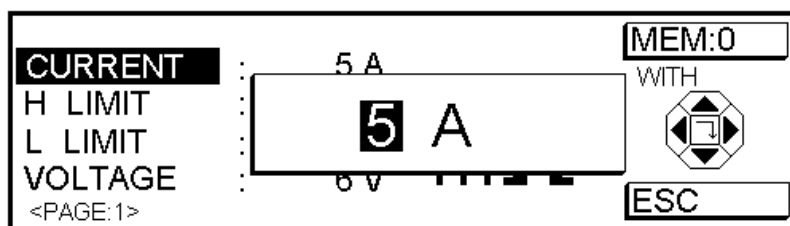


FIG. 31

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys.
- Increase or decrease the value with respectively the UP and the DOWN arrow keys. Repeat operation for all the numbers if necessary.
- Enter the current with the ENTER key. If the value is higher than the maximum limits (5.0A-30.0A), following error message appears : **LIMIT ERROR**. Enter a correct value or [ESC]

5.1.2 Test voltage selection

The unit offers the possibility to select ground continuity test voltage (6 and 12 Volts). The test voltage selection is done according to the standards.

- Move the reverse video line in front of the VOLTAGE line.
- Press on the RIGHT arrow or ENTER key.
- Display shows :

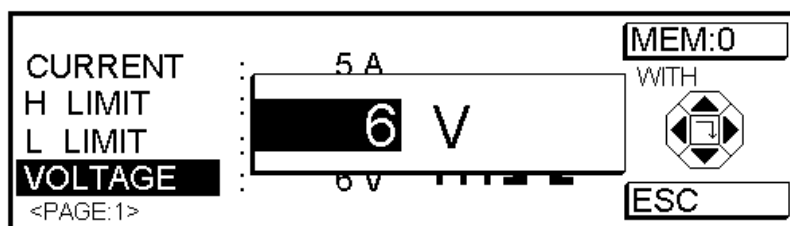


FIG. 32

- With the UP/DOWN arrow keys scroll all the available voltages (6, 12).
- Enter the selected value with the ENTER key.

5.1.3 Thresholds selection

The unit includes two comparison thresholds making possible to check if the specimen under test is good or bad. These thresholds can be **a resistance or a voltage** (according to the requirements of standard **EN60204-1**).

The H LIMIT defines the maximum resistance value which is allowed for the specimen under test. The L LIMIT defines the minimum resistance value in Ohms or Volts that can be reached by the specimen under test. A specimen is good (PASS) if the resistance is under H LIMIT and over L LIMIT, otherwise the specimen is declared bad (FAIL). Those thresholds are adjustable from 0 to 1500mΩ or 0.01V to 12.0V.

- Move the reverse video line in front of the H LIMIT line.
- Press on the RIGHT arrow or ENTER key.
- Display shows :

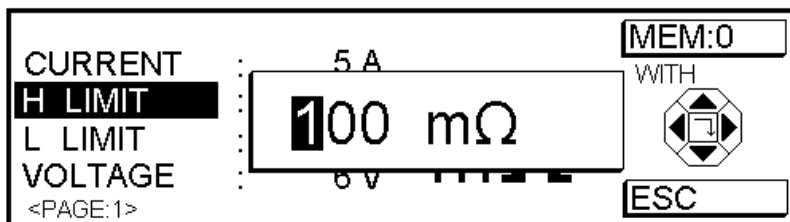
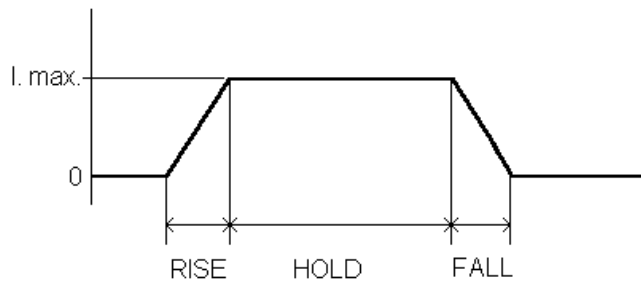


FIG. 33

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys.
- Increase or decrease the value with respectively the UP and the DOWN arrow keys (0 1 2 3 4 5 6 7 8 9. 0 1 2 ...).
- Enter the threshold with the ENTER key. Warning, the H LIMIT must always be higher than the L LIMIT, otherwise an error message is displayed : **H LIMIT < L LIMIT**.
- To set the L LIMIT value, proceed the same way as for the H LIMIT. Warning, the L LIMIT must always be lower than the H LIMIT, otherwise an error message is displayed **IMIN LIMIT > IMAX LIMIT**.
- **If you wish to modify the unit (for instance switch from Ohms to Volts), use the right arrow as much times as you need to place the specimen on reverse video. Then change it with UP and DOWN arrows.**
- **Warning : when changing the unit, you must enter again the two thresholds.**

5.1.4 Timer

The sudden application of the test current on a specimen could stressed it more than required. Therefore the unit is fitted with a current rise time system. The same phenomena existing during the cut off of the current the unit can perform the following test cycle:



The three possible ways to use the unit are the AUTO mode (described hereabove), the DEFAULT mode and the MANUAL mode. In that last mode, the current is permanently applied to the tested specimen. The **DEFAULT mode or stop on default** is similar to the **AUTO** mode except that the test is stopped when the first FAIL measurement regarding threshold appears.

From the parameters menu (figure 30), press on the DOWN or UP arrow keys as many times necessary to display the following menu :

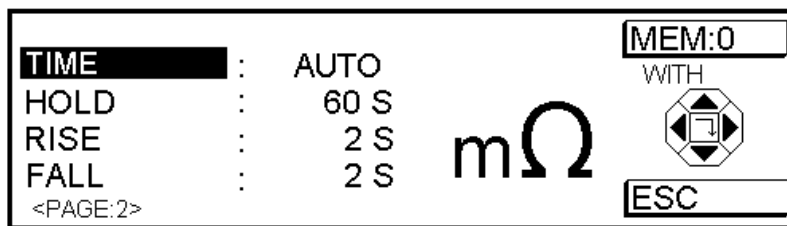


FIG. 34

- Move the reverse video line in front of the TIME line with the UP/DOWN arrows keys.
- Press on the RIGHT arrow or ENTER key.



FIG. 35

- With the UP/DOWN arrow keys scroll the various available timer modes (AUTO, MANUAL).
- Enter the selected mode with the ENTER key.

In the AUTO mode, it is possible to set the RISE, HOLD and FALL times from 0 up to 999 seconds.

- Move the reverse video line in front of the HOLD line.
- Press on the RIGHT arrow or ENTER key.

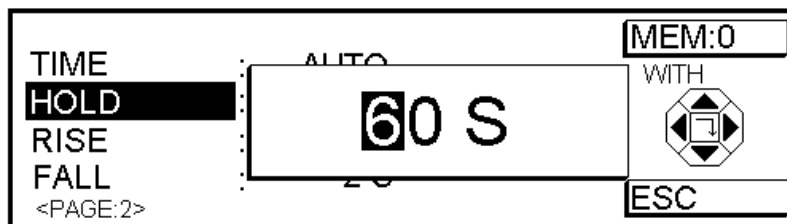


FIG. 36

- Select the number to be modified by moving the cursor with the RIGHT/LEFT arrow keys.
- Increase or decrease the value with respectively the UP and the DOWN arrow. Repeat operation for all the numbers if necessary.
- Enter the time with the ENTER key

Proceed the same way for the RISE and FALL times.

5.1.5 Parameters memorizations

The memorization feature allows to store in 10 memories (numbers 0 to 9) measurement parameters (voltage, threshold, time,...). From the measurement menu, to modify the memory number :

- Press on the [MEM:x] function key.

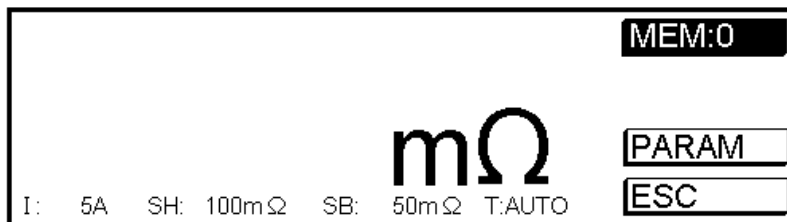


FIG. 37

- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The parameters recall line (area 3 of the LCD screen) indicates the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

From the parameter menu, to modify memory number :

- Press on the [MEM:x] function key.
- With the UP/DOWN arrow keys, increase or decrease the memory number (from 0 to 9). The input parameters lines indicate the content of each memory.
- Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the ENTER key.

Warning : Any parameter modification is automatically stored in the memory. See section [2.4](#) to control the access to the parameter modifications.

5.2 Ground continuity resistance measurement

Select the voltage, current, thresholds and time parameters as described in paragraphs [5.1.1 to 5.1.5](#). Note : those parameters are stored even after the unit has been switched off. They can be stored in various memories numbers.

- Connect the specimen to be measured as described in paragraph [1.7.4.2](#).
- Press on the [MEASUREMENT/DISCHARGE] button.
- The push button must switch on red light and the LCD display shows : in this example the unit of the thresholds is the Ohm, the result is given in Ohm and the voltage is reminded in the upper right corner.
- If the unit of the thresholds was the volt the given result is in Volt, and reminder is in Ohm.

The indicator inside the button is illuminated and the display shows :

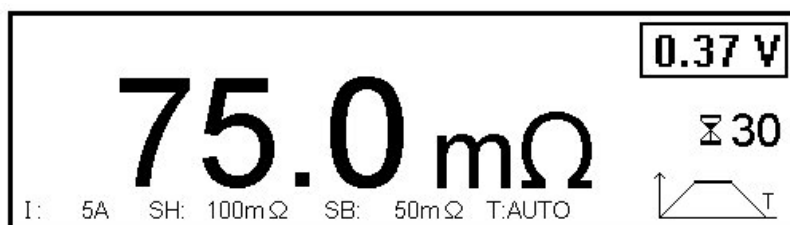


FIG. 38

If the AUTO test time has been selected, every second the value of the RISE time counts down one unit, then the value of the HOLD time and at least the value of the FALL time. When the FALL time reaches 0 the output current is cut off automatically. According to the resistance value during the test time in comparison with the H LIMIT and L LIMIT limits, the red LED (FAIL) or the green LED (PASS) is illuminated.

At the end of the test, the unit cut off the current and END OF TEST appears at top of the screen.

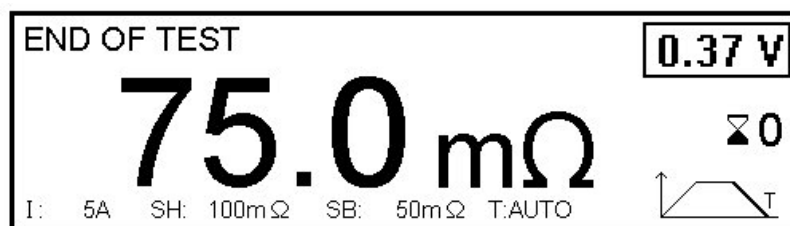


FIG. 39

- Press on the [MEASUREMENT-DISCHARGE].
- Press on the [ESC] key to escape the function.

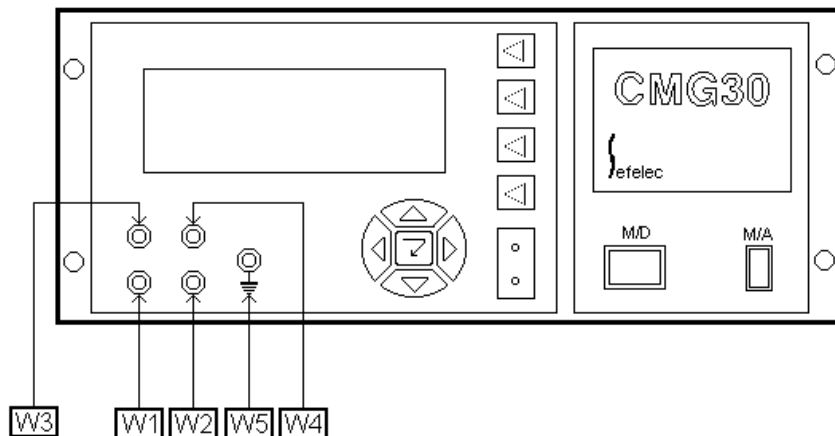
5.3 Error messages

The following error messages may appear during the measurement :

- **INTERLOCK DISABLE** : The safety loop is not closed. There is no connection between the points 1-14 and 13-25 of the 25 points Z10 connector of the rear panel (See paragraph [1.7.3](#)). Make the connection, press again on the [MEASUREMENT/DISCHARGE] key to trigger the measurement mode.
- **OVER-RANGE** : The continuity resistance of the specimen under test exceeds the measurement specification of the unit.
- **OVERHEATING** : The unit is equipped with a heating security checked to 80°. Wait half an hour before go on measure.
- **CONTINUITY ERROR** : Cables are not correctly connected or the continuity resistance of the specimen under test is too importante (some ohms) for the unit.
- **BOARD NOT READY** : The microprocessor board cannot communicate with the ground continuity test board. You cannot perform a measurement, get in contact with our Service department.

WARNING : Measurement on a specimen connected to earth.

In the case of ground continuity measurement on a specimen connected to earth, the grounded side must be connected to the terminals U and I, W1 and W3.



SECTION 6 : LEAKAGE CURRENT MEASUREMENT

SEE FMG 500 – FMG501 MANUAL

SECTION 7 : TEST SEQUENCING (SMG50, SMG500)

SMG50 and SMG500 are able to perform a measurement sequence including up to eight different test steps. Moreover, they can be used as independent measurement unit. Different measurement parameters and conditions can be defined for each test in the sequence.

7.1 Setting of measurement functions

To access to measurement functions, press the [FUNCT] key from the initialization menu, then press on the selected function key.

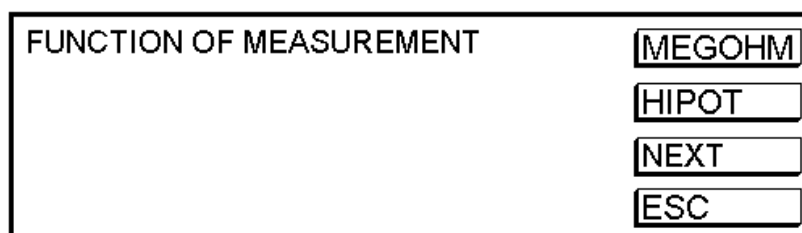


FIG. 40

Function not defined on the first screen, can be accessible with the [NEXT] key.

See section 3, 4 and 5 for details on the setting and the operation of the different functions.

7.2 Sequence setup

Press on the [SEQ.] key from the initialization menu to obtain the next screen.

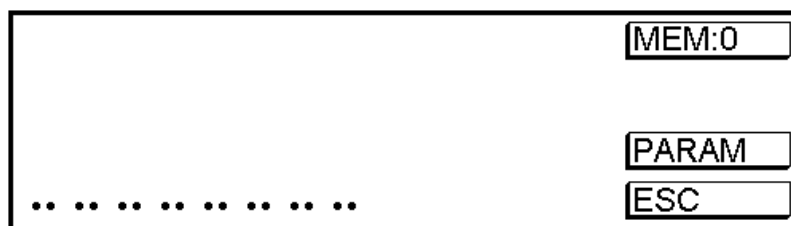


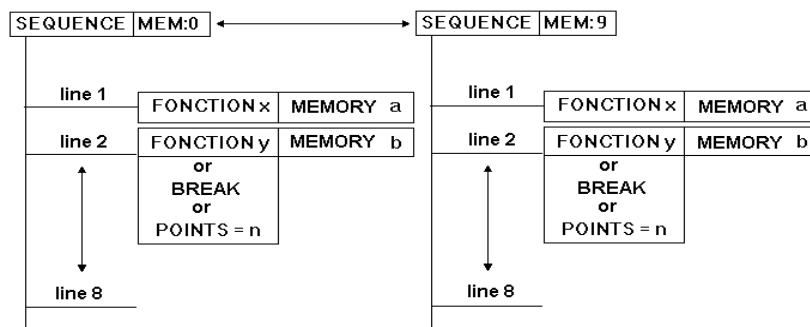
FIG. 41

Eight programme lines of the selected memory are recalled on the bottom line of the LCD screen. The contents of each line is described by 2 digits : for a function, the first digit sets for the type of test (M for Megohmmeter, H for Hipot, G for Ground continuity), the second digit referring to the number of the corresponding parameter set.

The 2 digits ".." feature an empty line, the word "OK" a break between 2 functions and the operator "x" a multiple ground continuity test.

7.2.1 Parameters memorization

The unit contains 10 measurement sequences (numbered from 0 to 9) including up to eight different test steps. Each step corresponds to a test function associated to a parameter set, a pause between two tests or to the operating of several test points (at least 2) of the function defined on the previous line (multiple ground continuity).



On the above drawing, a and b represent the numbers of parameters sets associated to functions x and y chosen between those available (HIPOT, MEGOHM, GROUND, LEAK, POINTS, and PAUSE) or EMPTY in case the test line is not used.

To modify the memory number from the measurement screen (figure 41), press on the [MEM:x] key. Display shows :

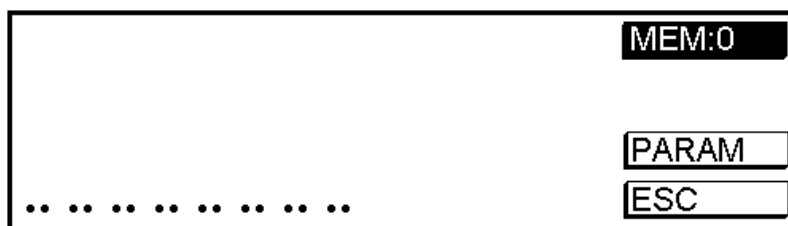


FIG. 42

With the up and down arrow keys, increase or decrease the memory number (from 0 to 9). The parameters recall line resumes the content of each memory.

Enter the selected memory either by pressing again on the [MEM:x] function key or by pressing the enter key.

WARNING : ANY PARAMETER MODIFICATION IS AUTOMATICALLY STORED IN THE MEMORY. See section 2.4 'PARAM ACCESS' to control the access to the parameter modifications.

7.2.2 Function selection

From the initialization menu, press on the [PARAM] key. Display shows :



FIG. 43

Select the test to be modified and enter it with the enter key. Display shows :

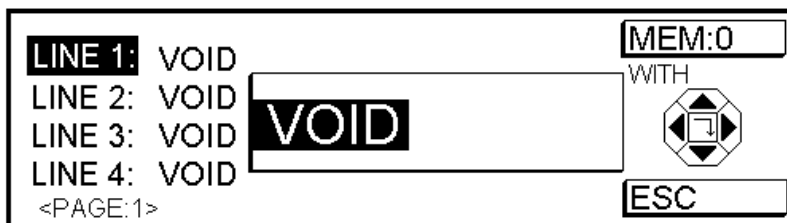


FIG. 44

Scroll the possible selection (HIPOT, MEGOHM, RIGID) with up and down arrow keys.

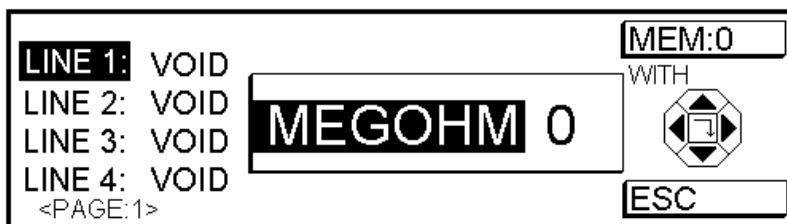


FIG. 45

7.2.3 Function memory selection

Select the memory number with the right arrow.

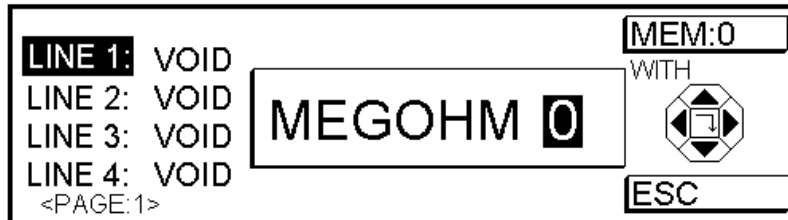


FIG. 46

With the up and down arrow keys, increase or decrease the memory number (from 0 to 9). Validate the function with its number memory by pressing on the enter key.

7.3 SERIES OF TESTS WITH MANUAL CONTROL

By default, the proceeding of a sequence is automatic. For instance, in the case of a sequence including the following lines :

```
LINE 1 : MEGOHM    3
LINE 2 : STRENGTH  4
```

The strength test will be carried out immediately after the insulation measurement without intervention of the user.

It is possible to control the step from one function to the other by inserting a pause between the lines.

The sequence will be as follows :

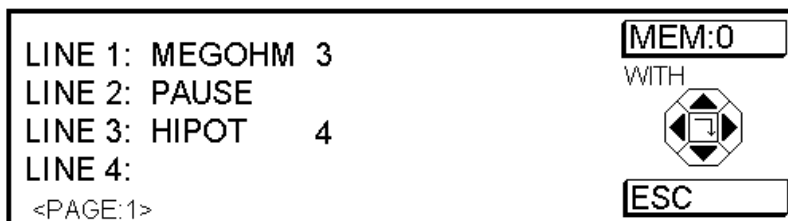


FIG.47

7.4 SIMPLE Sequence performing

From the measurement screen (figure 41), press on [MEASURE-DISCHARGE] button. The indicator inside the button is illuminated.

Warning : Always make sure the high voltage indicator is not on when connecting or disconnecting the specimens.

Tests go on and the result of each is written as soon as it is finished.

```
L1 C2 : 98.6mΩ
L2 R0 : 4.000KV 0.98mA
L3 M0 :

C2 R0 M0 .....
```

FIG. 48

When option 92 (Printer output) is installed in the unit, and when the result ticket print out has been activated (see section 8.4), the sequencing will be ended by the result ticket print out.

At the end of the sequence, the unit indicated END OF TEST. It possible to read the result of each step of the sequence.

```
END OF TEST
T1 C2 : 98.6mΩ
T2 R0 : 4.000KV 0.98mA
T3 M0 : 6.19 GΩ

C2 R0 M0 .....
```

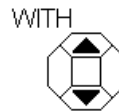


FIG. 49

Press on [MEASURE-DISCHARGE] and on [ESC].

Warning : Test results will be lost once the MEASURE-DISCHARGE key is pressed.

7.4.1 Sequence performing with manual control

Compared to the example on drawing n°47, the proceeding of a sequence is slightly different.
After the first test performing, i.e. insulation test, the screen displays as follows :

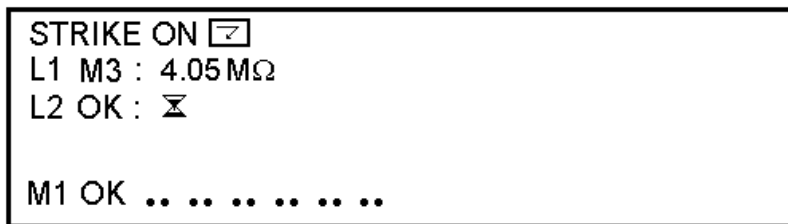


FIG. 50

The test in progress is stopped until the user presses the [ENTER] key.

7.5 REPEAT FUNCTION OF THE GROUND CONTINUITY

According to the device to be tested, it may be necessary to proceed to several tests on different points. This function is called multiple ground continuity and is set as follows :

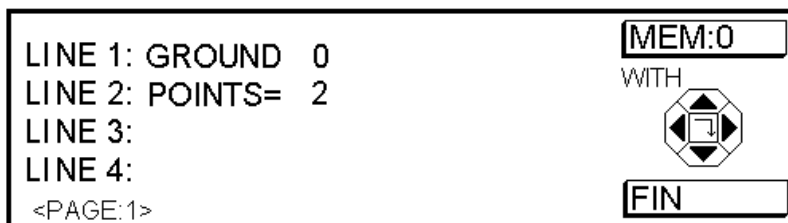


FIG. 51

In the above example, the user needs to test in the same conditions and successively two "Ground" points.
The number of test points is 2 min. and 99 max.

7.5.1 Proceeding to multiple ground continuity

If we refer to the above example where the user has to carry out two successive ground continuity tests in two different points of an electrical device,

When starting the test, the screen displays as follows :

```

STRIKE ON ☒
L1 C0 : WAITING
L2 x2 :  $\infty$  STEP : 1

C0 x2 .. .. .
    
```

FIG. 52

The first ground continuity test (STEP : 1) starts only when the user presses the [ENTER] key (or presses the button on the test probe if he has one).

The result of the measurement appears on line 1.

Then the screen displays as follows :

```

STRIKE ON ☒
L1 C0 : 3.36 m $\Omega$  0.02V
L2 x2 :  $\infty$  STEP : 2

C0 x2 .. .. .
    
```

FIG. 53

As mentioned above, the device stops until the user presses the [ENTER] key.

This operation is repeated as much time as steps have been programmed under the condition that the test result is PASS.

If not, the user has the opportunity either to repeat the failed test or to stop the sequence at this step (press END).

7.5.2 Multiple ground continuity followed by a strength test

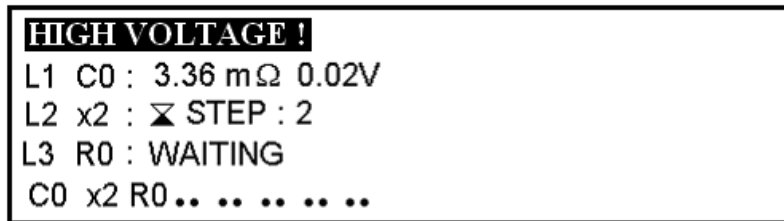


FIG. 54

The case of a multiple continuity immediately followed by a strength test requires a precise care.

The multiple ground continuity function means that the user sometimes enters the security area or is in direct contact with the DUT.

For that reason, in order to protect the user's safety, the SMG stops the proceeding of the test before starting the strength test.

At this stage, test can be released by :

1. **With the keyboard :**

Press [ENTER] and then [LOW ARROW] within 0,5 s and keep this key pressed until it is taken into account.

2. **Using the safety loop :**

If the safety loop is open during or at the end of the multiple continuity test, closing of the safety loop will start the strength test.

7.6 Error messages

7.6.1 Sequence error messages

- **INTERLOCK DISABLE** : The safety loop is not closed. There is no connection between the points 1-14 and 13-25 of the 25 points Z10 connector of the rear panel. Make the connection, press again on the [MEASUREMENT-DISCHARGE] key to trigger the measurement mode.
- **BOARD NOT READY** : The microprocessor board cannot communicate with one of the test board. You cannot perform a measurement, get in contact with our Service department.
- **PARAMETER ERROR** : Some function parameter are not correct. Verify parameters of the functions of your sequence.
- **SEQUENCE ERROR** : The programmed sequence includes at least one error such as :
 1. Less than 2 points for a multiple ground continuity
 2. No PAUSE between 2 tests
 3. Several pauses have been set one after the other
- **CONFIGURATION ERROR** : In the general configuration function of the device, on the INTERFACE line, option "WITHOUT" must be selected.

7.6.2 Function error messages

See paragraph [3 section 3.4 and 5](#) for the signification of the different error messages.

SECTION 8 : INPUT-OUTPUT INTERFACE

8.1 Input-Output for Programmable Logic Controller Interface (PLC) - 02 option

This option gives a functional control of the measurement unit by a Programmable Logic Controller system.

8.1.1 Electrical characteristics

INPUTS :

- Number : 7
- Type : Optoelectronic
- Input resistance : 1.5 kohms
- Minimum voltage : 11 VDC or 8 VAC
- Maximum voltage : 43 VDC or 30 VAC

OUTPUTS :

- Number : 5
- Type : Dry contacts
- Maximum voltage : 70 VDC
- Switching rating : 30W
- Maximum current : 0.15 ADC

8.1.2 Description of the logical states

Input :

- Logical state HIGH : DC or AC voltage with an amplitude between U_{min} and U_{max} .
- Logical state LOW : no voltage.

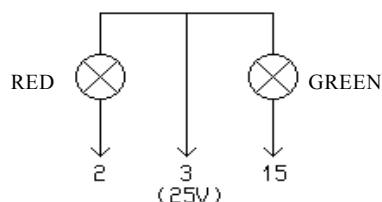
Output :

- Logical state HIGH : closed contact.
- Logical state LOW : opened contact.

8.1.3 Connections:

The previously described set of input/output signals are available on the rear panel of the unit on a 25 points Sub-D connector.

1	Safety loop: connect to 14
2	RED light (test voltage generated) : refer to connection drawing
3	25 VDC protected by internal fuse
4	I/O of the PLC option (opt02) = CTRLIN
5	I/O of the PLC option (opt02) = N1
6	I/O of the PLC option (opt02) = N3
7	I/O of the PLC option (opt02) = MES_DCH
8	I/O of the PLC option (opt02) = COM_OUT
9	I/O of the PLC option (opt02) = FAIL
10	I/O of the PLC option (opt02) = PASS
11	Input 0-10 volts (opt03)
12	Ground
13	Remote Control: connect to 25
14	Safety loop: connect to 1
15	GREEN light (no test voltage) : refer to connection drawing
16	I/O of the PLC option (opt02) = COM_IN
17	I/O of the PLC option(opt02) = N0
18	I/O of the PLC option (opt02) = N2
19	I/O of the PLC option (opt02) = TYPE
20	Not used
21	I/O of the PLC option (opt02) = CTRLOUT
22	I/O of the PLC option (opt02) = EOT
23	I/O of the PLC option (opt02) = ERROR
24	Output 0-10 volts (opt03)
25	Remote Control: connect to 13



Red and green lights connection drawing

In case of connection with a PLC system or any other relay control system, make sure to use shielded wire with braid connected to the metallic cover of Sub-D connector (connection at 360°, shielding connected at each side of the cable).

8.1.4 Description of the input output signals

- * **COM_IN** : electrical common between input signals.
- * **COM_OUT** : electrical common between output signals.
- * **CTRLIN (input)** : request for remote control of the measurement unit.
- * **TYPE (input)** : selection of the measurement function :
Logical state HIGH : Megohmmeter.
Logical state LOW : Strength Test.
- * **MES_DCH (input)** : selection of the measurement or discharge state :
Logical state HIGH : Measurement
Logical state LOW : Discharge

- * **N0,N1,N2,N3 (input)** : binary coded data lines for the number of the parameters set :

N3	N2	N1	N0	Memory
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
.	.	.	.	.
1	0	0	1	9

- * **CTRLOUT (output)** : acknowledgment of the CTRLIN signal.
- * **EOT (output)** : the contact of the relay is closed at the end of the test.
- * **PASS (output)** : the contact of the relay is closed when the test pass.
- * **FAIL (output)** : the contact of the relay is closed when the test fail.
- * **ERROR (output)** : the contact of the relay is closed when an error occurs ('CHARGE', 'OVERLOAD', 'OVERVOLTAGE', 'BOARD NOT READY', 'SYNCHRO ERROR', 'INTERLOCK DISABLE', 'VOLTAGE ERROR')..

8.1.5 Measurement / Discharge cycles

IMPORTANT :

PLC function must be selected in the configuration menu (line INTERFACE : PLC).

To take the control of the unit, you must be on the first screen. If not, you will have the DIALOG ERROR : <2> message displayed.

Note : For DMG50 and DMG500 in sequence mode, the control is taken from the measurement screen of the first sequence function.

To do a measurement :

- CTRLIN must be on high logical state,
- Except for CMG30, SMG50 and SMG500 where the state of the TYPE Line is not taken into account, the programmable logic controller must select a measurement function (Megohmmeter or dielectric strength test). For MMG or RMG, the choice of the measurement function must be the measurement function of the unit. If it is not the measurement function, the unit gives an error. To avoid this, it is advised to put TYPE line on a high logical state for a MMG and for the RMG, it advises to let it not connected. Thus, measurement function used will be measurement function of the unit. For CMG30, the TYPE line is not used.
- The programmable logic controller must choose a number of parameters which will be binary coded with N0 to N3 bits (N0 is the least significant bit and N3 is the most significant bit).
- To enter in measurement mode, a rising edge must be put on the MES_DCH line. The high logical state must be set all during the measurement.

Note : input states are enabled only on a rising edge of MES_DCH.

Then the unit will do a measurement or, if parameters aren't correct, will give an error. The CTRLOUT signal will appear at the first measurement and stay until a low logical state is set on the CTRLIN.

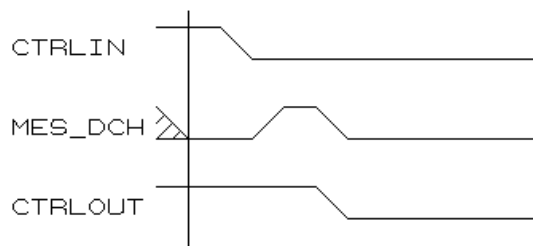
During measurement, the unit will send various signals according to the test running and the selected parameters. Those parameters can be an error signal (ERROR), an end of test signal (EOT), or a signal showing the test result (PASS or FAIL). Those signals are active on a high logical state.

For CMG30, DMG50, DMG500, RMG510 and RMG500, each measurement is made with a one measurement function. In the case of SMG50, SMG500, DMG50 and DMG500 used in sequence mode, the measurement includes all functions of the sequence.

Warning : For SMG50 and SMG500, only the sequence mode can be driven by the PLC option.

To force the unit to go in the discharge state, the programmable logic controller must set a low logical state on the MES_DCH input.

Then, the programmable logic controller can reset the CTRLOUT signal by resetting the CTRLIN, set the MES_DCH and reset it.



Drawing n° 1 : CTRLOUT signal off

Minimum test time in HIPOT :

- *Measurement parameters :*
 - Software revision = 1.57 or higher for DMG & RMG50
1.01 or higher for SMG50
 - MEASUREMENT DISPLAY = OFF (second page of the SETUP menu)
 - INTERFACE = PLC
 - Rise time = 0
 - Fall time = 0
 - Hold time = 1
 - Time = AUTO
 - Other test parameters = independent
- Test time = time between change of the MES_DCH (start test) signal and change of EOT (end of test) signal = **980 mS**
- *Measurement parameters :* same as above but with hold time = 0
Test time = **700 mS**. In this case there is no output voltage control.
- *Measurement parameters :* memory number change between each measurement
Test time = basic minimum test time + **1.3 S**

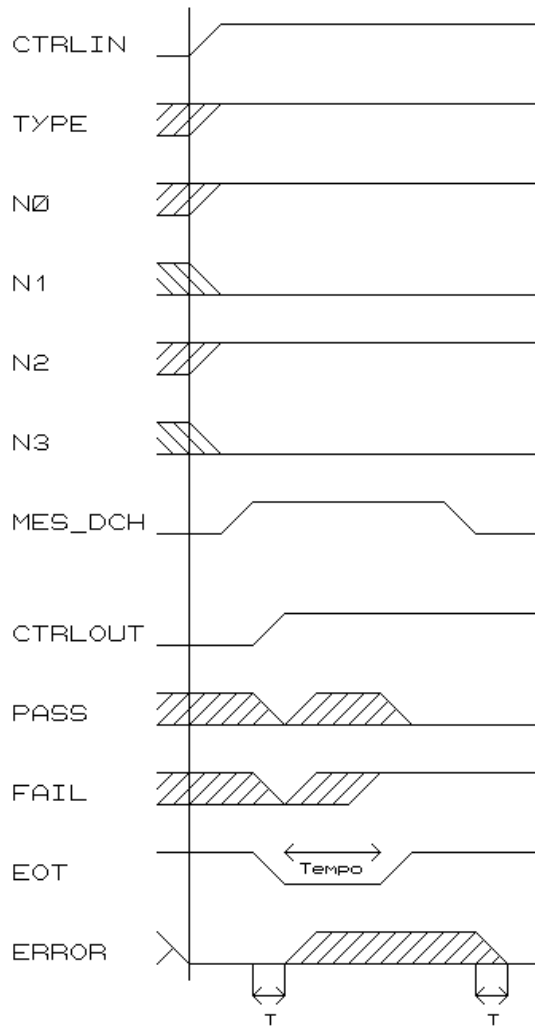
Minimum test time in MEGOHMMETER :

- *Measurement parameters :*
 - Software revision = 1.57 or higher for DMG & RMG50
1.01 or higher for SMG50
 - MEASUREMENT DISPLAY = OFF (second page of the SETUP menu)
 - INTERFACE = PLC
 - Hold time = 1
 - Other test parameters = independent
- Test time = time between change of the MES_DCH (start test) signal and change of EOT (end of test) signal = **1.58 S**
- *Measurement parameters :* memory number change between each measurement
Test time = basic minimum test time + **1.3 S**

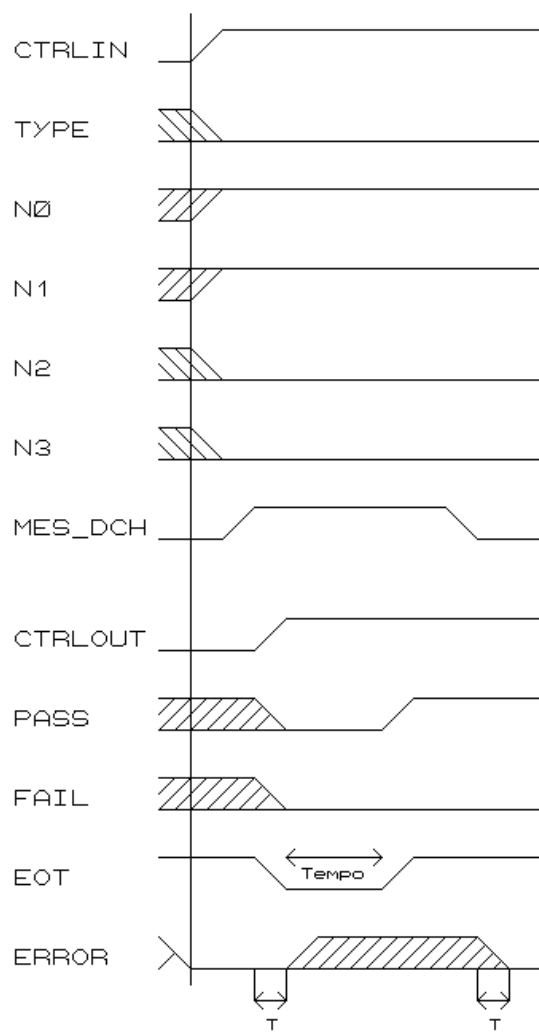
Minimum test time in GROUND CONTINUITY :

- *Measurement parameters :*
 - Software revision = 1.01 or higher
 - MEASUREMENT DISPLAY = OFF (second page of the SETUP menu)
 - INTERFACE = PLC
 - Rise time = 0
 - Fall time = 0
 - Hold time = 1
 - Other test parameters = independent
- Test time = time between change of the MES_DCH (start test) signal and change of EOT (end of test) signal = **1.19 S**
- *Measurement parameters :* memory number change between each measurement
Test time = basic minimum test time + **1.3 S**

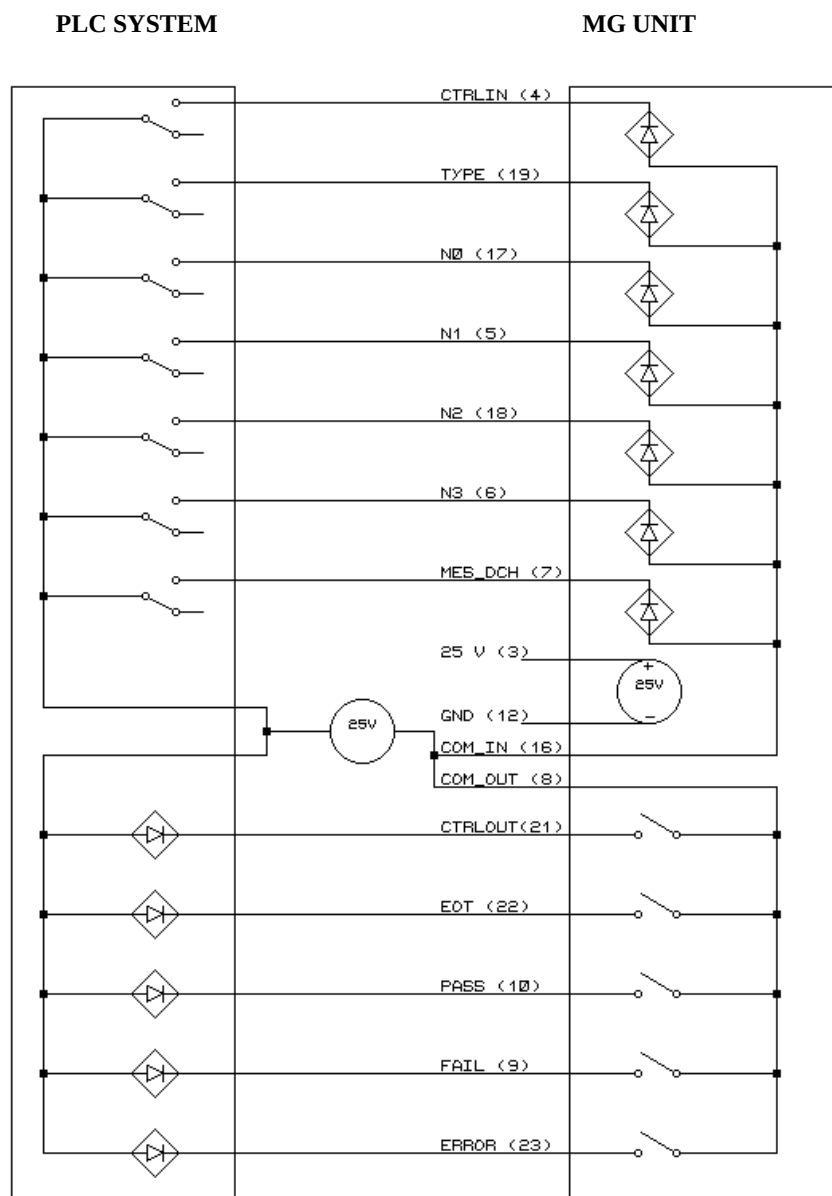
**Drawing n° 2 : Example of test with megohmmeter function on DMG50, DMG500, MMG500
Memory 5 - Test failed.**



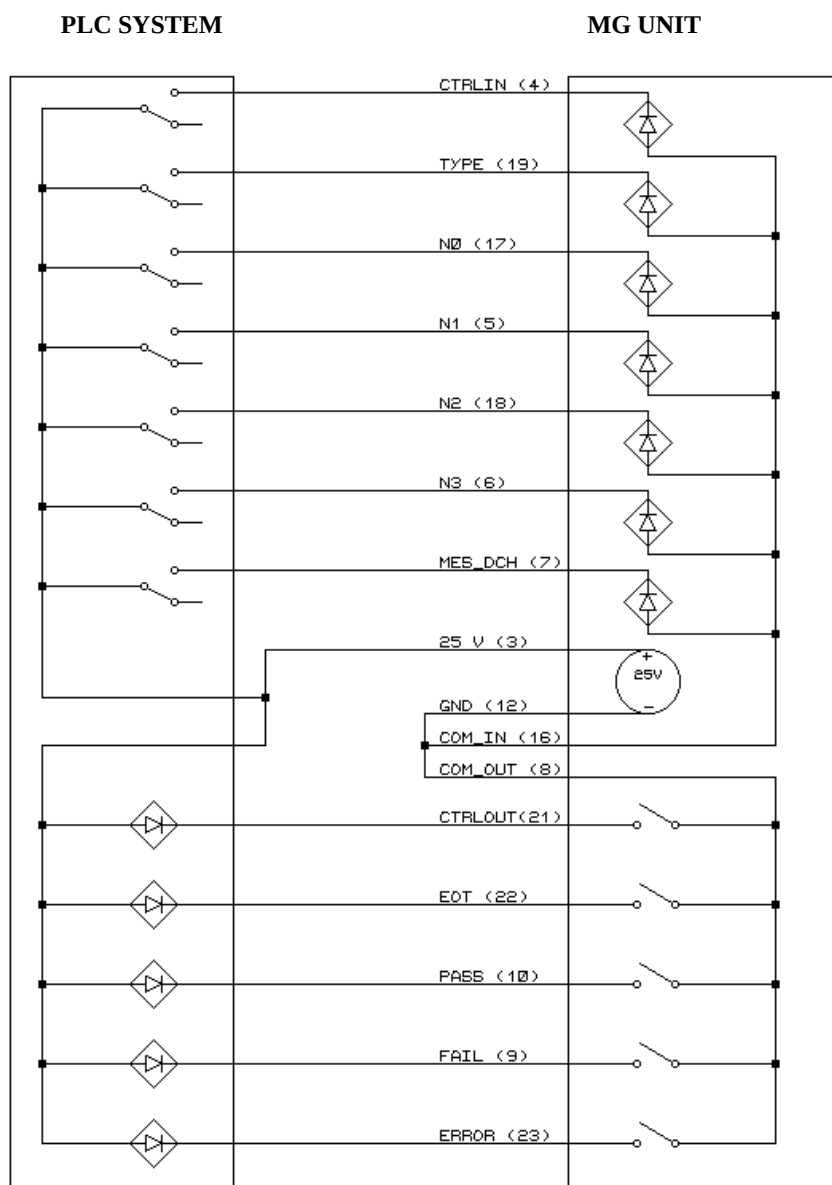
Drawing n° 3 : Example of test with strength test function on SMG50 or SMG500
Memory 3 - Test passed.



Drawing n° 4 : Connection of PLC option with external supply.



Drawing n° 5 : Connection of PLC option with internal supply.



8.2 0-10 VOLTS ANALOG INPUT-OUTPUTS - 03 OPTION

This option allows the unit to deliver a proportional analog voltage to the displayed measurements on the LCD screen (insulation resistance, test voltages, leakage currents) and allows to control the dielectric strength test high voltage by an analog voltage between 0 and 10 volts. Jumpers for the setup of the board allow to select different features.

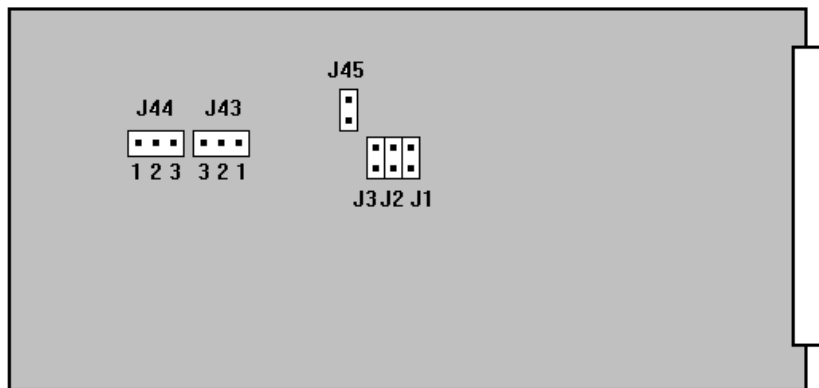
8.2.1 Electrical specifications

- **Output voltage** : from 0 to 10 VDC by 2.44 mV steps
- **Input voltage** : from 0 to 10 VDC
- **Output impedance** : 1 kohm $\pm$ 5%
- **Input impedance** : 10 kohms $\pm$ 5%
- **Insulation** : Not insulated, the ground is earthed
- **Connection** : 25 points, sub-D connector on the rear panel

11	0 to 10 VDC input or output - option 03
12	Ground
24	0 to 10 VDC output - option 03

8.2.2 Possible setups according to the units

The board includes some jumpers described on the schematic underneath. These jumpers allow to setup the board in a 2 analog outputs mode or in a 1 analog output + 1 analog input mode



0 - 10 VOLTS BOARD

LIST OF THE SETUPS :

MEGOHMMETER : 1 output for the linear value of the resistance in a range
1 output for the value of the range

J1	OFF (<i>factory setup</i>)
J43	1-2
J44	2-3
J45	ON

MEGOHMMETER : 1 output for the logarithmic value of the resistance
1 output not used

J1	ON
J43	1-2
J44	1-2 or 2-3 (not used in megohmmeter)
J45	ON

DIELECTRIC STRENGTH TEST : 1 output for the high voltage value
1 output for the leakage current

J1	OFF (<i>factory setup</i>)
J43	1-2
J44	2-3
J45	ON

DIELECTRIC STRENGTH TEST : 1 output for the high voltage value
1 input for the high voltage

J1	ON
J43	1-2
J44	1-2
J45	ON

8.2.3 Change of the board setup

IMPORTANT : the change of the board setup must be performed by skill people.

- Remove the power cord
- Remove the side handles screws
- Push the gray cover backward to access to the second board (remove the earth wire if necessary)
- Unscrew the board locking nut with a 7mm box spanner
- Pull the board out
- Set the jumpers as described here above
- Plug the board
- Lock the nut
- Put the cover in its original position (with the earth connection)
- Screw the side handles
- Connect the power cord
- Put the power on

8.2.4 Operating the 0 to 10 volts feature

- Go in the [SETUP] menu
- Go in <page 2>
- On the INTERFACE line, select the PLC mode (Programmable Logic Controller)

If the [MISSING OPTION] message is displayed, please check that the board has been correctly installed.

IMPORTANT : if the PLC mode isn't selected, the Analog input-output function isn't operating.

8.2.5 Megohmmeter mode, 2 outputs setup

Refer to section [8.2.2](#) for the board jumpers setup. This setup is the factory default setup.

The pin 24 of the rear panel connector gives the value of the resistance in a range (V1).

The pin 11 of the rear connector gives the value of the range (V2).

V1= value in a range, from 0 to 10 volts compared to the displayed value

V2= value of the range :

00.00 kohm	=	0 volt
000.0 kohm	=	1 volt
0.000 Mohm	=	2 volts
00.00 Mohm	=	3 volts
000.0 Mohm	=	4 volts
0.000 Gohm	=	5 volts
00.00 Gohm	=	6 volts
000.0 Gohm	=	7 volts
0.000 Tohm	=	8 volts

The resistor value is given by the following formula :

$$R = 2 \times V1 \times 10^{V2} \text{ kohms}$$

For example : if V1=5.2 V and V2=3.0 V then R=10.4 Mohms

Accuracy of the 0-10 volts output voltage compared to the display :

$$\pm(0.1\% + 5 \text{ mV})$$

8.2.6 Megohmmeter mode, 1 output setup

Refer to section [8.2.2](#) for the board jumpers setup.

The pin 24 of the rear panel connector isn't used

The pin 11 of the rear connector gives the logarithmic value of the measured resistor (V1)

The resistor value is given by the following formula :

$$R = 2 \times 10^{V1} \text{ kohms}$$

For example: if V1=3.7V then R=10.0 Mohms

Accuracy of the 0-10 volts output voltage compared to the display : $\pm(0.1\% + 5 \text{ mV})$

Accuracy of the resistance computed with the output voltage : $\pm 1\%$

8.2.7 Dielectric strength test mode, 2 outputs setup

Refer to section [8.2.2](#) for the board jumpers setup. This setup is the factory default setup.

The pin 24 of the rear panel connector gives the value of the measured high voltage (V1) :

- from 0 to 10 volts for 0 to 5000 VAC
- from 0 to 10 volts for 0 to 6000 VDC

The pin 11 of the rear connector gives the value of the leakage current (V2) :

- from 0 to 10 for 0.00mA to 9.99 mA

Test voltages and leakage current are given by the following formulas :

$$\begin{aligned} \text{HTVAC} &= (V1/10) \times 5000 \text{ volts} \\ \text{HTVDC} &= (V1/10) \times 6000 \text{ volts} \\ I &= (V2/10) \times I_{\text{max}} \\ \text{With } I_{\text{max}} &= \underline{9.99\text{mA}} \text{ for RMG50, DMG50 and SMG50} \\ \text{With } I_{\text{max}} &= \underline{99.9\text{mA}} \text{ for RMG500, DMG500 and SMG500} \end{aligned}$$

Accuracy of the 0-10 volts output voltage compared to the display : $\pm(0.1\% + 5 \text{ mV})$

8.2.8 Dielectric strength test mode, 1 output + 1 input setup

Refer to section [8.2.2](#) for the board jumpers setup.
This setup is operating only in the MANUAL mode

- Select HIPOT function
- Select PARAM
- On <page2>, on the line TIMER : select the MANUAL mode

The pin 24 of the rear panel connector gives the value of the measured high voltage (V1) :

- from 0 to 10 volts for 0 to 5000 VAC
- from 0 to 10 volts for 0 to 6000 VDC

Test voltages are given by the following formulas :

$$\begin{aligned} \text{HTVAC} &= (\text{V1}/10) \times 5000 \text{ volts} \\ \text{HTVDC} &= (\text{V1}/10) \times 6000 \text{ volts} \end{aligned}$$

Accuracy of the 0-10 volts output voltage compared to the display : $\pm(0.1\% + 5 \text{ mV})$

The pin 11 of the rear panel connector is an input which can receive voltages between 0 and 10 VDC for output high voltages from 0 to the maximum value displayed on the parameter line:

VOLTAGE:x.xx VAC.

If the input voltage is higher than 10 V +5%, the following message is displayed :

[LIMIT ERROR]

Accuracy of the output high voltage compared to the input voltage :

$\pm(1\% + 20 \text{ volts})$ for a leakage current $< 100\mu\text{A}$

There is no automatic adjustment of the output voltage according to the load.

Output high voltage response time for an input voltage variation :

- with display mode : $< 1 \text{ second}$
- without display mode : $< 0.5 \text{ second}$

8.2.9 Operating instructions

Use a shielding cable for the analog input and output lines. Connect the shielding to the pin 12 of the connector.

8.3 RS232C INTERFACE (01 OPTION)

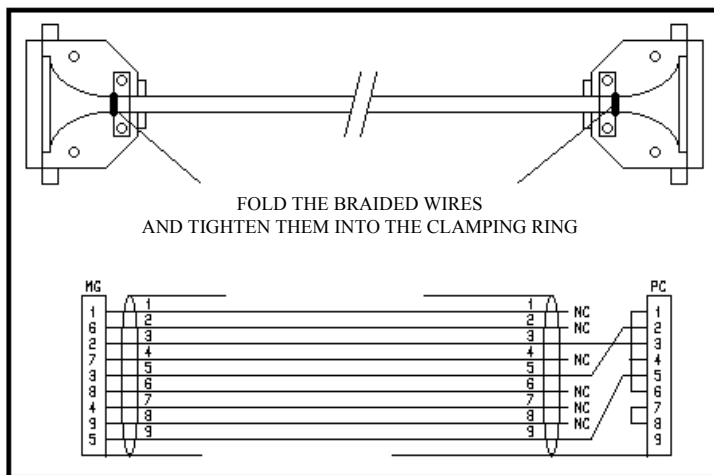
IMPORTANT: the RS232C function must be selected in SETUP menu, <page2> line INTERFACE: RS232 (see section 2.8).

The test units of the MG series can be equipped with a RS232C interface operating in talker and listener modes. This option makes possible the integration of any unit of the series in an automatic measurement or test system in manufacturing or incoming inspection department.

A 9 pins connector is provided on the rear panel for the interface connection. The RS232C standard defines electrical specifications for the transmission of serial information. The use of the RS232C port requires five lines:

- Receive data (RXD)
- Transmit data (TXD)
- Data terminal ready (DTR)
- Data set ready (DSR)
- Signal ground (GND)

This interface also requires a cable type CO179. Refer below for the cable wiring.



The communication parameters cannot be changed and are :

- **Speed : 19200 bauds for "MG+" series and MG series with MG-70 option , 9600 bauds for other.**
- Parity : no
- Format : 8 bits
- Stop bit : 1

8.3.1 Syntax rules

- The end of a message must be the **LF** character (hexadecimal 0A, decimal 10).
- The separators inside a message are ; or :
- The commands can be sent either in small letters or in capital letters.
- The maximum number of characters in the message is 100 or 8 different commands
- The end of the execution of a complete message by the unit is indicated by the emission of the **Xon** (hexadecimal 11, decimal 17) character and allows to synchronize the communication with the computer. The computer must wait the **Xon** character before sending the next message.
- The events occurring during the measurement are indicated to the computer by the emission of the **Z** character (format error, end of test, interlock open,...). To activate this function, it is necessary to send the SRQ command after the initialization of the unit. When receiving this character, a special command allows the computer to get the event (commands *STB?, *ESR?)
- If the message is not recognized by the unit, the error message <DIALOG ERROR : 1> is displayed
- If the code is out of context, the error message <DIALOG ERROR: 2> is displayed (special code for a function when the function was not selected or numerical value out of range)

8.3.2 List of the RS232C

The syntax of the commands complies with the IEEE488-2 standard (1992 revision).
IEEE488-2 numerical formats :

Format NR1 : ±<digit>...<digit>

Format NR3 : ±<digit>...<digit>.<digit>...<digit>E+/-<digit>.<digit>

Note : Codes in brackets are expanded codes which can be understood by the unit

8.3.2.1. General commands

REM(REMote) : Go to remote mode. **WARNING : first command to be sent**

GTL(GoToLocal) : Go back to the local mode.

LLO(LLockOut) : Return to the local mode is locked.

8.3.2.2. Common commands

- ***SRE <NR1>** : "Service Request Enable Register". Enables the corresponding summary messages (bits) in the status byte register. Thus, the application programmer can select reasons for the device to issue a service request (Z character). See *STB? code.
- ***ESE <NR1>** : "Standard Event Enable Status". Select which event bits in the corresponding Event register will cause a TRUE summary message when set. By use of the enable bits the programmer can program the device to request for a single event or an inclusive OR of any group of events.
- ***CLS** : Sets all the standard registers in the state the programmer finds them after a power on.
- ***RST** : The Clear status command almost resets the apparatus as a power on.

WARNING : the unit goes back to Local mode, send a REM command before any following commands.

8.3.2.3. Common queries

- ***STB?** : return in hexadecimal format a <NR1> which is the value of "STB". (i.e: "#H80")
 - b0 : 0 = Interlock opened
1 = Interlock closed
 - b1 : 0 = No error
1 = Error (voltage not correct,.....)
 - b2 : 0 = End of test
1 = Test running
 - b3 : 0 = Test failed
1 = Test pass
 - b4 : Not used
 - b5 : Logical OR of the ESR register bits
 - b6 : Logical OR of the STB register bits
 - b7 : Not used
- ***SRE?** : return in hexadecimal format a <NR1> which is the value of "SRE". (STB register mask)
- ***ESR?** : return in hexadecimal format a <NR1> which is the value of "ESR".
 - b0 to b3 : Not used
 - b4 : 1 = Dialog error type 2
(Numerical value out of range, out of context command)
 - b5 : 1 = Dialog error type 1 (incorrect command)
 - b6 : Not used
 - b7 : 1 = Power on

*NOTE : the bits are reset after the reading of the byte by the *ESR? command*

- ***ESE?** : return in hexadecimal format a <NR1> which is the value of "ESE". (ESR register mask)
- ***LRN?** : This device query allows the programmer to receive a response message units that informs the programmer on the current device state (function's running and current test parameters) and may be later used as program message unit elements to place the device in the state it was.
- ***IDN?** : Allows the identification of the unit. The message is as follows :
 - <field1>,<field2>,<field3>,<field4>
 - field1 : Manufacturer name = Sefelec
 - field2 : Unit reference = CMG30, DMG50, DMG500, RMG50, MMG500, SMG50...
 - field3 : Serial number = 0 (not used)
 - field4 : Software revision = VERSION 1.60

NOTE : the command must be used before selecting a function (from the start display)

- ***TST?** : Allows to check that the unit is correctly working. The message is as follows :
#H<NR1> with:

	b3	b2	b1	b0	Result
Hipot not present	X	X	X	1	#H01
Megohmmeter. not present	X	X	1	X	#H02
Ground not present	X	1	X	X	#H04
Leakage not present	1	X	X	X	#H08

with X = 0 or 1

NOTE : this command must be used before selecting a function (from the start display)

8.3.2.4. Device commands

- **MEG(MEGohmmeter)** : Selects the megohmmeter. Must be sent from the initialization display.
- **HIP(HIPot)** : Selects the hipot tester. Must be sent from the initialization display.
- **LEAK(LEAKage)** : Selects the leakage function. Must be sent from the initialization display.
- **GND(GrouND)** : Selects ground continuity function. Must be sent from the initialization display.
- **SEQ(SEQuence)** : Selects the sequence function. Must be sent from the initialization display.
- **CONF(CONFig)** : Selects the configuration function of the unit. Must be sent from the initialization display.
- **PAR(PARameter) <NR1>** : Selects the parameter set for the running function.
For instance : MEG : PAR 1
- **DCV(DCVoltage) <NR1>** : Sets a new value in volt to the current DC voltage parameter to the parameter set of the running function.
For instance : DCV 500
- **ACV(ACVoltage) <NR1>** : Sets a new value in volt to the current AC voltage parameter to the parameter set of the running function.
 - Hipot tester : Min. : 10 Max. : 5000 **limited 4200 with FMG501**
 - RMG15AC : Min : 10 Max : 15000
 - Leakage : Min. : 200 Max. : 270
 For instance : hipot : ACV 5000 leakage : ACV 244
- **ACC (ACCurent) <NR3>** : Sets a new value in ampere to the AC current parameter to the parameter set of the ground continuity function.
- **OHM (OHMmeter)** : Sets the main thresholds unit (Ohm) and the ground continuity display function. **Caution : The action on this command will erase all previous recorded thresholds (Reset to zero).**
- **VOLT (VOLTmeter)** : Sets the main thresholds unit (Volt) and the ground continuity display function. **Caution : The action on this command will erase all previous recorded thresholds (Reset to zero).**
- **HTIM(HTIME) <NR1>** : Sets a new value in second to the current hold time parameter to the parameter set of the running function. Min. to the leakage current function : 2 Seconds
For instance : HTIM 3
- **RTIM(RTIME) <NR1>** : Sets a new value in second to the current rise time parameter to the parameter set of the running function
For instance : RTIM 10
- **FTIM(FTIME) <NR1>** : Sets a new value to the current fall time parameter to the parameter set of the running function.
For instance : FTIM 5
- **UHLIM(UHLIMit) <NR1>** : Sets a new value to the high limit current AC voltage of the leakage current function. Min : 200 Max : 270
For instance : UHLIM 244

ULLIM(ULLIMit) <NR1> : Sets a new value to the low limit current AC voltage of the leakage current function.

Min : 200 Max : 270

For instance : ULLIM 230

- **HLIM(HLIMit) <NR3>** : Sets a new value to the high limit parameter to the parameter set of the running function.

For instance : MEG:HLIM 2.0E+6 (new value in Ohms)

RIG:HLIM 1.45E-4 (new value in Amps)

GND:HLIM 1.00E-1 (new value in milliohm)

LEAK:HLIM 3.5E-3 (new value in Amps)

The unity is automatic, given in Volt, Ohm or Amp and function dependent.

- **LLIM(LLIMit) <NR3>** : Sets a new value to the low limit parameter to the parameter set of the running function.

For instance : MEG:LLIM 1.0E+6 (new value in Ohms)

RIG:LLIM 3.50E-6 (new value in Amps)

GND:LLIM 5.02E-2 (new value in milliohm)

LEAK:LLIM 1.5E-3 (new value in Amps)

The unity is automatic, given in Volt, Ohm or Amp and function dependent.

- **WAY A1,A2,A3...A1A2A3A4PE** : Sets the test mode to the leakage measure.

Available modes are the followings : A1, A2, A3, A4, B, A1PE, A2PE, A3PE, A4PE, BPE, A1A2, A1A2A3, A1A2A3A4, A1A2PE, A1A2A3PE, A1A2A3A4PE, A1A4PE, A2A4PE, A3A4PE.

- **NORM 60335-1, 60950, 60601-1, 60598-1, 60065, 60990, 61010-1** : Sets the standard to use regarding the type of the device under test to leakage current function.

- **BREAK ON / OFF / END / ALL** : Sets the possibility to start time counting before / after operator intervention to leakage current function.

- OFF : No pause .

- ON : Pause before measurement.

- END : Pause after measurement.

- ALL : Pause before and after measurement.

- **CAP ON/OFF** : Sets the capacitor mode to leakage current function.

- **POWER EXT/INT** : Set INTERNAL or EXTERNAL power line to the leakage current function.

- **CORR ON/OFF** : Sets the correction mode to the leakage current function.

- **CONT** : In the leakage current function, when the mode PAUSE is activated, the time counting is waiting for an operation to start. This command is must be used to perform this.

- **MEDI** : Only concerns the leakage measurement function. Allow to receive the measured values continuously without that the PC asks them for. This code is sent 3 seconds after the MEAS code.

- **VAL AC / CR / A / COS** : Only concerns the leakage measurement function. Allow to send the function parameters that will be displayed on the LCD central section (in big characters).

- AC : true RMS leakage current value

- CR : peak leakage current value (depends on the leakage measurement options)

- A : phase current value (only with power measurement option)

- COS : cosinus Phi value (only with power measurement option)

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- **UNITR** V / W / VA : Only concerns the leakage measurement function. Allow to send the function parameters that will be displayed on the LCD top right section (in small characters).
 - V : true RMS voltage value between phase and neutral.
 - W : apparent power value (only with power measurement option)
 - VA : active power value (only with power measurement option)

← - - - - Mise en forme : Puces et numéros

- **SCH** G / H / F3 / F4 / F5 / A / B / A1 / A2 / A3 : Diagram setup (**SCH**ema) according the standard. Only for Leakage function.
 - G / H : Diagram for EN60598-1 standard (MG-56) before June 2000.
 - F4 / F5 : Diagram for EN60598-1 standard (MG-56) **after** June 2000.
 - F3 / F4 / F5 : Diagram for CEI990 (MG-60).
 - A / B : Diagram for EN60065 standard (MG-59).
 - A1 / A2 / A3 : Diagram for EN61010-1 standard (MG-61).

- **SWI** -- / ID / AP / APID : Switching setup (**SWI**tching) used according the standards. Only for leakage function.

- **(Aa, Bb, Cc, Dd, Ee, Ff, Gg, Hh)** : Parameters setting a sequence of 8 tests of the selected memory only for SMG50 and SMG500. Each test is defined by 2 letters : one for the function (M for megohmmeter, H (HIPOT) for strength, G (GROUND) for earth continuity, X(points=) for test number in case of multiple earth continuity test, P(Pause) to place a waiting phase between two consecutive tests and L (LEAKAGE) for leakage current), and one digit to indicate the memory number (cases M, H, G, L, V). V0 is an empty test. The case X is special, because it can be followed by one or 2 digits. These one indicate the step number of the multiple continuity. This number can be set from 2 to 99. **Caution : All 8 tests must be carried out (Enter V0 for an empty test).** For instance : SEQ : PAR 0 : (G1,M2,H1,M3,L1,V0,V0,V0)

- **DISP(DISPlay) ON/OFF** : This command is attached to the configuration function and controls the display mode.
For instance : CONF:DISP OFF

- **TIM(TIME) AUT/FAIL/UDIV2** : Select the temporization mode. AUT for automatic, FAIL for default and UDIV2 for U divided by 2.
The UDIV2 mode concerns the hipot function.
The FAIL mode concerns the ground continuity function and the hipot 500VA function only.

- ***MOD (MODE) AUT/MAN** : This command is attached to the setup function. It switches the mode AUTO and MANUAL of the sequence function (only with the family units of SMG and FMG).

← - - - - Mise en forme : Puces et numéros

- ***SBS (Step By Step) ON/OFF** : This command takes part of sequence function of the SMG and FMG.
It fixes on the way of the test results are send back to the controller (RS232, IEEE).
In ON mode, the result of every steps of test is transmitted as soon as available, without any request before (no MEAS?).
In OFF mode, all the results are transmitted together at the end of the sequence in answer to the command MEAS?

← - - - - Mise en forme : Puces et numéros

IMPORTANT : After power on the mode SBS is automatically set with OFF value.

- **FILT(FILTer) NOR/CAP/RHT** : Enables the normal or the capacitor or the Real Hold Time measurement modes.
For instance : CONF:FILT CAP

- ***DET(DETection) OFF / I / FI / I+DELTA / FI+DELTA / DELTA** : Hipot function only sets the mode of the breakdown.

← - - - - Mise en forme : Puces et numéros

- ***MEAS(MEASure)** : Runs the current function.

← - - - - Mise en forme : Puces et numéros

 ***STOP** : Stops the current function.

← | -- **Mise en forme** : Puces et numéros

 ***QUIT** : Exits the current function.

← | -- **Mise en forme** : Puces et numéros

- **SRQ** : Similar to the Service Request feature of the IEEE488-2 bus, this code allows the emission of the **Z** character to inform the computer about the events (end of test, format error, interlock open,...). This command has to be sent at the program start, after the REM command.

8.3.2.5. Device queries

 **MEAS?** : Return the current measurement value(s) regarding the running function.

 **Mise en forme** : Pucés et numéros

A) Following characters in the function

Insulation : OHM 4.700E+06
 Dielectric strength : VOLT 9.900E+02 AMP 7.000E-05
 Continuity : OHM 3.210E-1 VOLT 2.810E+00 (main unit =OHM)
 Continuity : VOLT 2.830E+00 OHM 3.230E-1 (main unit =VOLT)
 Leakage : - when the measure is running : XX VOLT <NR1> AMP <NR3>
 where XX is the name of the current step (A1,A2,A3,A4,B)
 - when the measure is finished (Discharge), it returns all the values
 delimited by a comma « , ».
 For instance : Between - A2 VOLT 234 AMP 1.02E-3
 After - A1 VOLT 232 AMP 1.02E-3,A2 VOLT 234 AMP 0.02E-3

B) Following characters in sequence mode

For instance :

L1 C0: 0.15mΩ 0.00V,L2 R0: 1.50KV 0.02mA,L3 M0: 41.7 GΩ,L4 F0:q 0.01mA 223V A2,L5 ...
 ,L6 ... ,L7 ... ,L8 ...

The syntax rules are the following :

- the end of the message is : CR (Carriage Return)
- each test step starts with a « L » and ends with « , » (except for the last one) .
- the « L » letter is followed by a number between 1 and 8 , giving the test step number and then by a « space ».
- then comes a letter according to the type of the test step :

Function	French	English	German
Insulation	M	M	M
Dielectric strength	R	H	H
Continuity	C	G	E
Leakage	F	F	A
Void	..	..	..
Paused	OK.	OK.	OK

- the measurement type is followed by the memory number which contains the measurement parameters , then by a separator character « : »
- if the test step is void , the measurement will be replaced by a « space »
- otherwise , the next character gives the test step result :
 - « space » indicates that the test is good
 - « q » indicates that the test is bad
- for the insulation and dielectric strength tests the previous character is followed by 1 'space' and for the ground continuity test by 2 'space'.
- then the numerical values are given . When the value cannot be measured (no continuity or overload) the numerical indication is replaced by « ---- »

To check if a tested specimen is good or bad at the end of a sequence , it is necessary to check the STB register (bit 3) .To get the result of each test step , check if the result character is « space » or « q ».

8.3.2.6 RS232 commands summary

CODE	Startup	Cnf.	mΩ	kV	MΩ	mA	Seq.
REM	X	X	X	X	X	X	X
*CLS	X	X	X	X	X	X	X
*ESE	X	X	X	X	X	X	X
*ESE?	X	X	X	X	X	X	X
*ESR?	X	X	X	X	X	X	X
*IDN?	X						
*LRN?			X	X	X	X	
*RST	X	X	X	X	X	X	X
*SRE	X	X	X	X	X	X	X
*SRE?	X	X	X	X	X	X	X
*STB?	X	X	X	X	X	X	X
*TST?	X						
GTL	X	X	X	X	X	X	X
LLO	X	X	X	X	X	X	X
ACC			X				
ACV				X		X	
BREAK						X	
CAP						X	
CONF	X	X					
CONT						X	
CORR						X	
DCV				X	X		
DET				X			
MOD		X					
SBS							X
CODE	Startup	Cnf.	mΩ	kV	MΩ	mA	Seq.

CODE	Startup	Cnf.	mΩ	kV	MΩ	mA	Seq.
DISP		X					
FILT		X					
FTIM			X	X			
GND	X		X				
HIP	X			X			
HLIM			X	X	X	X	
HTIM			X	X	X	X	
LEAK	X					X	
LLIM			X	X	X	X	
MEAS			X	X	X	X	X
MEAS?			X	X	X	X	X
MEG	X				X		
NORM						X	
OHM			X				
PAR			X	X	X	X	X
POWER						X	
QUIT	X	X	X	X	X	X	X
RTIM			X	X			
SEQ	X						X
SRQ	X	X	X	X	X	X	X
STOP			X	X	X	X	X
TIM			X	X			
UHLIM						X	
ULLIM						X	
VOLT			X				
WAY						X	
VAL						X	
UNITR						X	
CODE	Startup	Cnf.	mΩ	kV	MΩ	mA	Seq.

8.3.3 HINTS AND PROGRAM EXAMPLES

The information hereunder are from a control program for a MG unit, written in Quick Basic. These are tutorial information to help you to write your own software. You will find at the end of this section the complete demo program.

- **Serial port RS232 initialization**

```
OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
ON COM(1) GOSUB INTERRUPTIONRS
COM(1) ON 'enable of interrupts on COM1.
```

Serial port COM1 open with following setup :

```
- speed           : 9600 bauds,
- N               : no parity control,
- data bits       : 8,
- stop bit        : 1.
```

If a character arrives on the serial port, the program will go automatically to the subroutine INTERRUPTIONRS

- **RS232 interruptions subroutine**

```
INTERRUPTIONRS :
COM(1) OFF : nochr = 0 'disable of RS interruptions
char$ = INPUT$(1, #1) 'Reading of the first character (8bits) on COM1
IF char$ = CHR$(17) THEN varxon = 1: nochr = 1 'received character is XON
IF char$ = "Z" THEN 'received character is Z, and is equivalent to a
    GOSUB GESTIONSREQ 'service request from the MG unit (end of test,
    nochr = 1 'error...)
END IF
IF nochr = 0 THEN LINE INPUT #1, msg$ 'if other character, reading of the complete message
    msg$ = char$ + msg$ 'Rebuilt of the message
    varxon = 1 'Enable of next command emission (no XON wait)
    eom = 1 'End of the message (eom=1)
END IF
COM(1) ON
RETURN
```

The 'nochr' variable makes the difference between the XON et Z characters (nochr=1) and the others characters (nochr=0).

- **Emission of a command on the RS232 port**

Before sending a command on the RS232 port, the program **must wait** for the Xon reception of the previous command in order to synchronize the communication. **Warning**, for the first REM command, the program doesn't have to wait for the Xon reception of a 'non existing' previous command.

A\$ holds the code to be sent with the LF character to indicate the end of the command bloc.

```
ENVOI
ATTENTEXON           'waiting for the Xon of the previous command
varxon = 0
PRINT #1, A$ + CHR$(10)  'Emission of the command bloc + LF character
RETURN
```

- **Waiting for XON**

The subroutine makes a loop until the MG unit send the Xon character (see Xon reception in the INTERUPTIONRS sub-routine)

```
ATTENTEXON :
  WHILE varxon = 0 : WEND
RETURN
```

- **Waiting for a message**

The routine makes a loop until the MG unit send a message (see the message reception in the INTERUPTIONRS subroutine)

```
ATTENTMSG:
  WHILE eom = 0 : WEND
  eom = 0
RETURN
```

- **Analyze and emission of a command to the MG unit**

This part of the program allows to input through the keyboard commands and to send these commands to the MG unit.

The commands can be divided in 3 groups :

- 1) General commands, common commands, device commands, i.e. : REM, *RST, MEG, HIP
- 2) Common queries i.e. : *TST?, *LRN?
- 3) Device queries i.e. : MEAS?

According to the command, the program will wait or not for a message coming from the MG unit. For a command which isn't finishing by '?', the code is sent to the MG unit and the program makes a loop on the input of the next code.

For a command starting with '*' and finishing by '?', the program sends the command and waits only for the message coming from the MG unit.

For the 'MEAS?' command, the program sends the code to the MG unit and then waits for Xon character and finally for the message.

COMMAND :

COM(1) ON

PRINT "Enter the command to send to MG unit (RETURN to exit)"

LOOP1:

PRINT "A\$="; LINE INPUT A\$

IF LEN(A\$) = 0 THEN GOTO SORTIE ELSE GOSUB ENVOI

'Sending the code if A\$ isn't empty

IF RIGHT\$(A\$, 1) = "?" THEN

IF LEFT\$(A\$, 1) <> "*" THEN

'MEAS? command:

GOSUB ATTENTEXON

' - waiting for Xon

GOSUB ATTENTEMSG

' - waiting for the message l

ELSE

'common query

GOSUB ATTENTEMSG

' - waiting for the message

END IF

PRINT "Message: "; msg\$

'display of the message

END IF

GOTO LOOP1

SORTIE :

'exit of the function

RETURN

- **Interruptions handle**

Warning : To operate in the SRQ mode (the MG unit sends the Z character to indicate an end of test or a possible error), it is necessary to initialize this mode by sending the SRQ command.

The call of the GESTIONSRQ routine is done from the RS232 interruption routine (INTERUPTIONRS)

GESTIONSRQ :

```

COM(1) ON                                     'enable interruption on the COM1 port
A$ = "*STB?": GOSUB ENVOI                     'Sending the '*STB?'command
GOSUB ATTENMSG                                'Waiting for the answer
IF LEN(msg$) = 4 THEN errdec = VAL("&H" + RIGHT$(msg$, 2))
IF LEN(msg$) = 3 THEN errdec = VAL("&H" + RIGHT$(msg$, 1))
                                                'hexa to decimal conversion
FOR i = 0 TO 7                                'decimal to binary conversion
  IF (errdec AND (2 ^ i)) <> 0 THEN bitstb(i) = 1 ELSE bitstb(i) = 0
NEXT i
IF bitstb(5) = 1 THEN                         'If ESR bit is set to 1:
  A$ = "*ESR?": GOSUB ENVOI                   'Sending of '*ESR?'
  GOSUB ATTENMSG                               'Waiting for the answer
  IF LEN(msg$) = 4 THEN errdec = VAL("&H" + RIGHT$(msg$, 2))
  IF LEN(msg$) = 3 THEN errdec = VAL("&H" + RIGHT$(msg$, 1))
                                                'hexa to decimal conversion
  FOR i = 0 TO 7                                'decimal to binary conversion
    IF (errdec AND (2 ^ i)) <> 0 THEN bitesr(i) = 1 ELSE bitesr(i) = 0
  NEXT i
                                                'errors definition according to the ESR bits set at 1
  IF bitesr(4) = 1 THEN PRINT "DIALOGUE 2 ERROR"
  IF bitesr(5) = 1 THEN PRINT "DIALOGUE 1 ERROR"
  ELSE
                                                'message definition according to STB bits set at 1
    IF bitstb(0) = 0 THEN PRINT "INTERLOCK OPEN !"
    IF bitstb(1) = 1 THEN PRINT "ERROR !"
    IF bitstb(2) = 0 THEN PRINT "END OF TEST"
    IF bitstb(3) = 0 THEN PRINT "TEST FAIL." ELSE PRINT "TEST PASS"
  END IF
RETURN

```

- **Functions cycling example**

a. Example for DMG50 or DMG500

This program automatically sequences the commands allowing to setup the MG unit, to set the insulation resistance measurement and dielectric strength test parameters and then to run tests and get back the tests results as well as possible error messages.

```

CYCLE:
COM(1) ON
A$ = "REM:SRQ": GOSUB ENVOI                                'remote mode and SRQ mode
A$ = "CONF:DISP ON:FILT NOR:QUIT": GOSUB ENVOI              'Setup of the unit
A$ = "MEG:PAR 0:DCV 500:HLIM 1.0E+9:LLIM 10.0E+3:HTIM 5:QUIT": GOSUB ENVOI 'megohmmeter parameters
A$ = "HIP:PAR 0:TIME AUT:HTIM 5:RTIM 1:FTIM 2": GOSUB ENVOI 'dielectric parameters
A$ = "ACV 1000:HLIM 1.0E-3:LLIM 1.0E-5:DET I:QUIT": GOSUB ENVOI 'measurement in dielectric test
A$ = "HIP:MEAS": GOSUB ENVOI                                'waiting for end of test Srq
WHILE srq = 0: WEND: srq = 0                                'request for measurement results
A$ = "MEAS?": GOSUB ENVOI                                    'waiting for XON
GOSUB ATTENTEXON                                             'waiting for measurement result message
GOSUB ATTENTMSG                                              'display of the measurement results
PRINT "Measurement result: "; msg$                          'discharge and exit of the function
A$ = "STOP:QUIT": GOSUB ENVOI                                'megohmmeter and measurement
A$ = "MEG:MEAS": GOSUB ENVOI                                "waiting for end of test Srq
WHILE srq = 0: WEND: srq = 0                                'request for measurement results
A$ = "MEAS?": GOSUB ENVOI                                    'waiting for XON
GOSUB ATTENTEXON                                             'waiting for measurement result message
GOSUB ATTENTMSG                                              'display of the measurement results
PRINT "Measurement result: "; msg$                          'discharge and exit of the function
A$ = "STOP:QUIT": GOSUB ENVOI
RETURN
    
```

b. Example for CMG30

This program automatically sequences the commands allowing to setup the MG unit, to set the ground continuity resistance measurement parameters and then to run tests and get back the tests results as well as possible error messages.

```

CYCLECMG:
COM(1) ON
A$ = "REM:SRQ": GOSUB ENVOI                                'remote mode and SRQ mode
A$ = "CONF:DISP ON:FILT NOR:QUIT": GOSUB ENVOI              'Setup of the unit
A$ = "GND:PAR 0:DCV 6:LLIM 50.0E-3:HLIM 1.0E-1:DCC 5.0E+0": GOSUB ENVOI
A$ = "TIME AUT:HTIM 5:RTIM 1:FTIM 2": GOSUB ENVOI           ' memory 0 parameters
A$ = "PAR 1:DCV 12:LLIM 0.0E+0:HLIM 5.0E-1:DCC 1.0E+1": GOSUB ENVOI
A$ = "TIME AUT:HTIM 3:RTIM 2:FTIM 1": GOSUB ENVOI           ' memory 1 parameters
A$ = "PAR 0:MEAS": GOSUB ENVOI                               'measurement in parameter 0
WHILE srq = 0: WEND: srq = 0                                'waiting for end of test Srq
A$ = "MEAS?": GOSUB ENVOI                                   'request for measurement results
GOSUB ATTENTEXON                                           'waiting for XON
GOSUB ATTENTMSG                                           'waiting for measurement result message
PRINT "Measurement result: "; msg$                         'display of the measurement results
A$ = "STOP": GOSUB ENVOI                                    'discharge
A$ = "PAR 1:MEAS": GOSUB ENVOI                              'parameters 1 and measurement
WHILE srq = 0: WEND: srq = 0                                'waiting for end of test Srq
A$ = "MEAS?": GOSUB ENVOI                                   'request for measurement results
GOSUB ATTENTEXON                                           'waiting for XON
GOSUB ATTENTMSG                                           'waiting for measurement result message
PRINT "Measurement result: "; msg$                         'display of the measurement results
A$ = "STOP:QUIT": GOSUB ENVOI                               'discharge and exit of the function
RETURN

```

c. Example for SMG50 and SMG500

This program automatically sequences the commands allowing to setup the MG unit, to set the ground continuity resistance measurement parameters, insulation resistance measurement, dielectric strength and leakage current measurement and then to run tests and get back the tests results as well as possible error messages.

```

CYCLESEQUENCE:
COM(1) ON
A$ = "REM:SRQ": GOSUB ENVOI      'Remote mode and SRQ mode
A$ = "CONF:DISP ON:FILT NOR:QUIT": GOSUB ENVOI
                                   'Setup of the unit
A$ = "MEG:PAR 0:DCV 500:HLIM 1.0E+9:LLIM 10.0E+3:HTIM 5:QUIT": GOSUB ENVOI
                                   'Parameters of insulation of memory 0
A$ = "HIP:PAR 2:TIME AUT:HTIM 5:RTIM 1:FTIM 2": GOSUB ENVOI
A$ = "ACV 1000:HLIM 1.0E-3:LLIM 1.0E-5:DET I:QUIT": GOSUB ENVOI
                                   'Parameters of hipot tester of memory 1
A$ = "GND:PAR 1:DCV 6:LLIM 50.0E-3:HLIM 1.0E-1:DCC 5.0E+0": GOSUB ENVOI
A$ = "TIME AUT:HTIM 1:RTIM 0:FTIM 0:QUIT": GOSUB ENVOI
                                   'Parameters of ground continuity of memory 1
A$ = "LEAK:PAR 0:ACV 244:UHLIM 250:ULLIM 230:WAY A1A2PE": GOSUB ENVOI
A$ = "LEAK:PAR 0:HLIM 3.5E-3:LLIM 1.5E-3:HTIM 3:NORM 60335-1": GOSUB ENVOI
A$ = "LEAK:PAR 0:CORR OFF:BREAK OFF:CAP ON:POWER EXT:QUIT": GOSUB ENVOI
                                   'Parameters of leakage current of memory 0
A$ = "SEQ:PAR 0:(G1,M0,H2,M0,L0,VO,VO,VO):QUIT"
                                   'Parameters of sequence of memory 0
A$ = "SEQ:PAR 0:MEAS": GOSUB ENVOI      'measurement in parameter 0 of sequence
WHILE srq = 0: WEND: srq = 0           'Waiting for end
A$ = "MEAS?": GOSUB ENVOI              'Demande de résultat de mesure
GOSUB ATTENTEXON                       'Attente du caractère XON
GOSUB ATTENTMSG                        'Attente du message de l'appareil MG
PRINT "Résultat de la mesure :"; msg$  'Affichage du résultat de la séquence
A$ = "STOP:QUIT": GOSUB ENVOI          'Passage en décharge et sortie de la séquence
RETURN

```

8.3.4 TROUBLE SHOOTING THE RS232C INTERFACE

When the RS232C interface is not operating as described in this manual, please check the following points:

1 - No reaction from the MG unit when sending commands :

1-1 - The cable between the MG unit and the PC computer must be correctly connected at both ends. The cable is a special wiring cable : check that the cable is a Sefelec CO179 model or check that the wiring has been done according to the instructions of section [8.3](#).

1-2 - The MG series units have several possible interface types : check that in the SETUP menu <page2>, the RS232 mode has been selected on the INTERFACE line.

1-3 - The end of message must be the LF (hexa 0A,decimal 10) character. If this character is not sent, the MG unit won't handle the message : check that this character is added to the command.

1-4 - The first command must be the REM command, which displays the REMLOC message on the LCD display, the unit being ready to receive all the others commands. WARNING : the first REM command should not wait for the Xon character before being sent.

2 - The unit goes in REMOTE mode and then hang up :

2-1 - Before sending a new command, it is mandatory to wait that the MG unit indicates its non busy state by sending the Xon character (hexa 11,decimal 17). If a code arrives during the handle of the previous one, it can produce an erratic operating mode of the unit or stop it.

8.3.5. QUICK BASIC PROGRAM EXAMPLE

'General initialization :

SCREEN 0, 0, 0: COLOR 14, 1: CLS

varxon = 1

srq = 0

eom = 0

msg\$ = ""

'Serial port RS232 initialization :

OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1

ON COM(1) GOSUB INTERRUPTIONRS

COM(1) ON

'Program main menu :

KEY 1, "Codes": KEY 2, "Cycle"

ON KEY(1) GOSUB COMMAND

ON KEY(2) GOSUB CYCLE

KEY(1) ON: KEY(2) ON

KEY ON

10 GOTO 10

'RS232 interruptions subroutine :

INTERRUPTIONRS:

COM(1) OFF: nochr = 0

char\$ = INPUT\$(1, #1)

IF char\$ = CHR\$(17) THEN varxon = 1: nochr = 1

IF char\$ = "Z" THEN GOSUB GESTIONSRQ

nochr = 1

END IF

IF nochr = 0 THEN

 LINE INPUT #1, msg\$

 msg\$ = char\$ + msg\$

 varxon = 1

 eom = 1

END IF

COM(1) ON

RETURN

'Emission of a command on the RS232 port :

ENVOI:

GOSUB ATTENTEXON

varxon = 0

PRINT #1, A\$ + CHR\$(10)

RETURN

'Waiting for XON :

ATTENTEXON:

```
  WHILE varxon = 0: WEND
RETURN
```

'Analyse and emission of a command to the MG unit :

COMMAND:

```
  COM(1) ON
  PRINT "Enter codes to send to the unit MG (RETURN pour escape)"
LOOP1:
  PRINT "A$=";: LINE INPUT A$
  IF LEN(A$) = 0 THEN GOTO SORTIE ELSE GOSUB ENVOI
  IF RIGHT$(A$, 1) = "?" THEN
    IF LEFT$(A$, 1) <> "*" THEN
      GOSUB ATTENTEXON
      GOSUB ATTENTEMSG
    ELSE
      GOSUB ATTENTEMSG
    END IF
  PRINT "Message coming from the unit MG: "; msg$
  END IF
  GOSUB ATTENTEXON
  GOTO LOOP1
SORTIE:
CLS
RETURN
```

'Waiting for a message :

ATTENTEMSG:

```
'srq = 0
  WHILE eom = 0: WEND
  eom = 0
RETURN
```

'Interruptions handle :

GESTIONSREQ:

```
  TEMP$ = A$
  COM(1) ON
  A$ = "*STB?": GOSUB ENVOI
  GOSUB ATTENTEMSG
  IF LEN(msg$) = 4 THEN errdec = VAL("&H" + RIGHT$(msg$, 2))
  IF LEN(msg$) = 3 THEN errdec = VAL("&H" + RIGHT$(msg$, 1))
  FOR i = 0 TO 7
    IF (errdec AND (2 ^ i)) <> 0 THEN bitstb(i) = 1 ELSE bitstb(i) = 0
  NEXT i
```

```

IF bitstb(5) = 1 THEN
  A$ = "*ESR?": GOSUB ENVOI
  GOSUB ATTENTEMSG
  IF LEN(msg$) = 4 THEN errdec = VAL("&H" + RIGHT$(msg$, 2))
  IF LEN(msg$) = 3 THEN errdec = VAL("&H" + RIGHT$(msg$, 1))
  FOR i = 0 TO 7
    IF (errdec AND (2 ^ i)) <> 0 THEN bitesr(i) = 1 ELSE bitesr(i) = 0
  NEXT i
  IF bitesr(4) = 1 THEN PRINT "DIALOG ERROR 2"
  IF bitesr(5) = 1 THEN PRINT "DIALOG ERROR 1"
  ELSE
    IF bitstb(0) = 0 THEN PRINT "INTERLOCK DISABLE"
    IF bitstb(1) = 1 THEN PRINT "ERROR"
    IF bitstb(2) = 0 THEN PRINT "End of Test."
    IF bitstb(3) = 0 THEN PRINT "Test: Fail." ELSE PRINT "Test: Pass."
  END IF
  srq = 1
  A$ = TEMPS$
RETURN

```

‘Function cycling example for DMG50 or DMG500 :

```

CYCLE:
PRINT "Number of cycle ? "; INPUT nb
COM(1) ON
FOR j = 1 TO nb
  PRINT: PRINT "Cycle n°"; j
  A$ = "REM:SRQ": GOSUB ENVOI
  A$ = "CONF:DISP ON:FILT NOR:QUIT": GOSUB ENVOI
  A$ = "MEG:PAR 0:DCV 500:HLIM 1.0E+9:LLIM 10.0E+3:HTIM 5:QUIT": GOSUB ENVOI
  A$ = "HIP:PAR 0:TIME AUT:HTIM 5:RTIM 1:FTIM 2": GOSUB ENVOI
  A$ = "ACV 1000:HLIM 1.0E-3:LLIM 1.0E-5:DET I:QUIT": GOSUB ENVOI
  A$ = "HIP:MEAS": GOSUB ENVOI
  WHILE srq = 0: WEND: srq = 0
  A$ = "MEAS?": GOSUB ENVOI
  GOSUB ATTENTEXON
  GOSUB ATTENTEMSG
  PRINT "Measure result: "; msg$
  A$ = "STOP:QUIT": GOSUB ENVOI
  A$ = "MEG:MEAS": GOSUB ENVOI
  WHILE srq = 0: WEND: srq = 0
  A$ = "MEAS?": GOSUB ENVOI
  GOSUB ATTENTEXON
  GOSUB ATTENTEMSG
  PRINT "Measure result: "; msg$
  A$ = "STOP:QUIT": GOSUB ENVOI
NEXT j
WHILE INKEY$ = "": WEND
CLS
RETURN

```

'Function cycling example for CMG30 :

```

CYCLECMG:
PRINT "Number of cycle ? "; : INPUT nb
COM(1) ON
FOR j = 1 TO nb
PRINT : PRINT "Cycle n°"; j
A$ = "REM:SRQ": GOSUB ENVOI
A$ = "CONF:DISP ON:FILT NOR:QUIT": GOSUB ENVOI
A$ = "GND:PAR 0:DCV 6:LLIM 50.0E-3:HLIM 1.0E-1:DCC 5.0E+0": GOSUB ENVOI
A$ = "TIME AUT:HTIM 5:RTIM 1:FTIM 2": GOSUB ENVOI
A$ = "PAR 1:DCV 12:LLIM 0.0E+0:HLIM 5.0E-1:DCC 1.0E+1": GOSUB ENVOI
A$ = "TIME AUT:HTIM 3:RTIM 2:FTIM 1": GOSUB ENVOI
A$ = "PAR 0:MEAS": GOSUB ENVOI
WHILE srq = 0: WEND: srq = 0
A$ = "MEAS?": GOSUB ENVOI
GOSUB ATTENTEXON
GOSUB ATTENTEMSG
PRINT "Measure result: "; msg$
A$ = "STOP": GOSUB ENVOI
A$ = "PAR 1:MEAS": GOSUB ENVOI
WHILE srq = 0: WEND: srq = 0
A$ = "MEAS?": GOSUB ENVOI
GOSUB ATTENTEXON
GOSUB ATTENTEMSG
PRINT "Measure result: "; msg$
A$ = "STOP": GOSUB ENVOI
NEXT j
A$ = "QUIT": GOSUB ENVOI
WHILE INKEY$ = "": WEND
CLS
RETURN

```

8.4 Printing output (92 option)

8.4.1 Parameters setup

This option allows the unit to print out a result ticket at the end of a test sequence (SMG50 and SMG500). The print out is done through a Centronics interface (parallel printer) with its connector located on the rear panel. Any model of parallel printer can be used. Connect the printer to the unit using a standard Centronics cable. The code page used is 437, allowing to print semi-graphic and symbol characters.

Some parameters can be set through a menu located on the second page of the functions (FUNCT then NEXT) as follows :

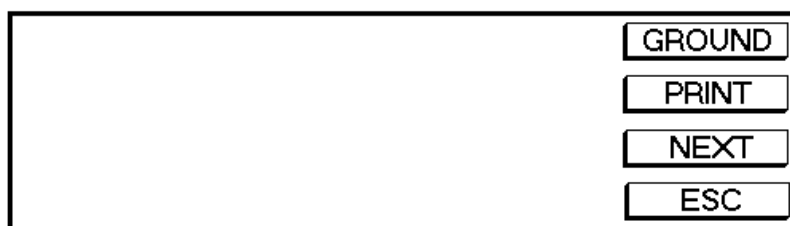


FIG.

When pressing the « PRINT » key, the first parameters page is displayed as follows :

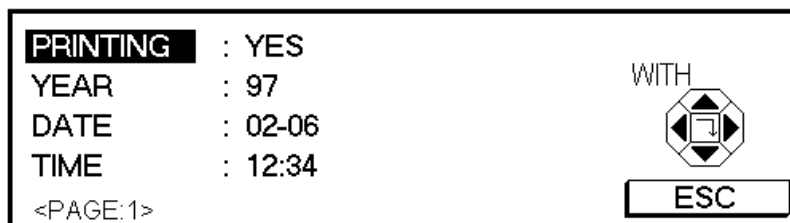


FIG.

The first line allows to enable/disable the printing at the end of the sequence. A « YES » means that the print out will be performed. In case of « NO », the test sequence will end without printing.

The year can be set on the second line. The SMG unit is fitted with a real time keeper to provide Date and Hour.

The third line allows to set the day and the month.

The fourth line allows to set the hours and the minutes.

The setup of these parameters is done in factory, the timer will update automatically the data. In order to limit unwanted actions, the access is protected by a switch inside the device (INT2-refer to section [8.4.3](#)). The following drawing shows the second page of the print out parameters.

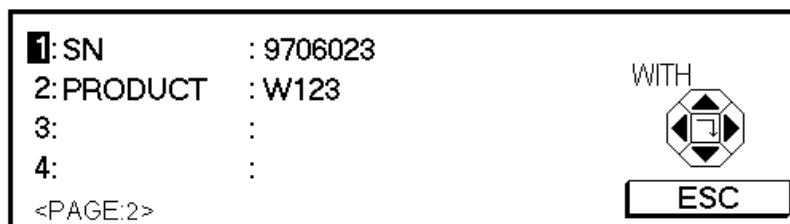


FIG.

This second page of parameters can display on the ticket free information, like company name, tested product name, serial number... These data are set in 8 fields (4 lines of 2 fields) of alphanumerical characters ('A'..'Z','0'..'9',' ').

8.4.2 Operation

At the end of a test sequence, the ticket is printed as follows :

SEFELEC SMG50 101		02-06-97	12:34
SN : 9706023	PRODUCT : W123		
:	:		
INSULATION	15.2GΩ	⇒	PASS
DIELECTRIC	1.50kV 2.0mA	⇒	PASS
CONTINUITY	1.348mΩ	⇒	PASS
		⇒	
		⇒	
		⇒	
		⇒	
SEQUENCE			PASS

The first line gives the unit model (SMG50 or SMG500), its serial number, the date and the test hour. The second and third lines show the free information mentioned hereabove. In this example, only 4 fields have been used. The lines number 4 to 11 show each performed test step with the name of the measurement (INSULATION, HIPOT, GROUND), the measured values, and the PASS/FAIL result according to the test parameters. The last line gives the complete test result.

8.4.3 Configuration

The configuration of the board is done by a set of 2 jumpers located on the printer board. The printer board is a daughter board of the MPU board as describes on the following drawing.

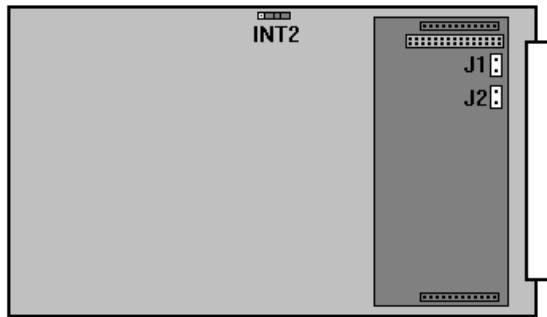


FIG.

The J1 jumper, when set, will automatically increase a serial number in the free field of the first line. After each test, the numerical value will be increased : this is a factory setup.

When J1 jump is removed, the free field of the line 1 is like the other lines.

The J2 jumper, when set, will send automatically a Form Feed to the printer at the end of the printout. This gives only one sequence result by page. When the jumper is removed, the printouts are separated by a blank line : this is a factory setup.

The following board is a summary of available configurations.

Jumper	Position	Default	Action
J1	ON	*	Incremental serial number
	OFF		Free field
J2	ON		Form Feed
	OFF	*	Line Feed

To modify the date and hour, you must access to the INT2 switch.

Switch INT2 in the other position, modifies the data and then sets the switch in its original position.

SECTION 9 : APPLICATION NOTES

9.1. WHY DIELECTRIC TESTS ?

The dielectric tests are performed in order :

- to detect manufacturing fault on electrical equipment
- to verify the quality of the insulating material of an electrical equipment
- to verify that an electrical installation has been correctly done
- to control the insulation resistance of an equipment or an installation to trace its changes during the years.

Dielectric tests consist of both insulation resistance measurements and dielectric strength tests.

9.2. GLOSSARY OF TERMS

- **LEAKAGE DISTANCE** : The smallest required distance, measured on the surface of the insulating material, between 2 conductive parts, to avoid breakdown.
- **LEAKAGE CURRENT** : Steady current flowing through an insulating material subject to high voltage.
- **BREAKDOWN** : The immediate break of the dielectric property of an insulating material. Every breakdown creates more or less damages to the insulating material. The breakdown tests can be therefore destructive or not.
- **INSULATION RESISTANCE** : Characteristic of an insulating material that being subject to a voltage, shows a resistance such as the value of the leakage current which flows through it stays within acceptable limits.
- **DIELECTRIC STRENGTH** : Ratio between the voltage at which a dielectric break of the insulating material occurs and the distance between the two points subject to the voltage (generally given in kV/cm). Regarding the insulating material type (solid, liquid or gas) a dielectric break can be : a perforation, a flashover or an arc.

9.3 ENVIRONMENTAL INFLUENCES

Temperature, pressure and humidity conditions have an influence on the dielectric tests results.

- **TEMPERATURE** : The temperature having an influence on the gas density, this one is altering the performances of the liquid or gaseous insulating material. The oils, often used as insulation are never pure, the dissolved quantity of gas increases with the temperature and is decreasing the insulation quality of the oil. The large variety of materials used as solid insulation doesn't allow to deduce a general rule on their behavior with the temperature (the insulation specifications having a tendency to dissipate when the temperature increases).
- **PRESSURE** : The withstand voltage in gas changes with the pressure following the Paschen's law. This law shows a minimum of the breakdown voltage for a particular value of the pressure by distance product, otherwise the more the pressure increases, the more the breakdown voltage is high. The liquids used as dielectric insulation are influenced by the pressure, the dielectric strength increasing with the pressure. In theory, the solid insulations are a little influenced by the pressure because this one doesn't modify a lot their thickness and their internal composition.
- **HUMIDITY** : The withstand voltage of gas changes with humidity. In example for the air and for values of relative humidity < 80%, the dielectric strength increases a little with the humidity increasing (the water molecules, more dense than the gas, slows down the avalanche phenomena). The water presence in an insulating liquid such as oil degrades the dielectric strength by water electrolysis, development of gas producing partial discharges bringing to breakdown. Under combined effect of the humidity (>95%) and the temperature (>100°C) most of the polymers dissipate. The water can produce inflating in the insulation and create cracks which will facilitate the electric arcs advance.

9.4 INSULATION RESISTANCE MEASUREMENT

The insulation resistance measurement is intended to verify that the various components and sub-assemblies of an electrical equipment have an insulation resistance such as the leakage currents don't reached inadmissible values.

The principle is to apply a DC voltage, stable and specified (selected among the standard values) between defined points and after a prescribed time, to measure the current flowing through the tested material. By using the Ohm's law (resistance = voltage / current), the result is given by the value of the insulation resistance. Then this value is compared to the minimum threshold specified by the standard used for the test.

9.4.1 PRECAUTIONS TO BE OBSERVED

It is important to connect the specimen to be measured in taking care of the parasite leakages which could be created by the measurement operating procedure.

The supplied accessories have a shielding which is connected to a guard potential, this insures a good immunity of the measurement regarding the parasitic leakage currents and the AC residuals.

When using extendings of the basic probes, take the necessary cares to avoid to introduce measurement errors (short leads, leads not touching any metallic or insulating parts,...)

During insulation resistance measurements having high values (> 100 Gohms), the proximity of the operator putting his hand close to the specimen under test, can alter or make unstable the measurement. It is important to beware of Nylon blouses or of insulating material things capable of generating by static electricity, high electrical fields which can alter the measurement of high value resistances (100 Gohms under 100 VDC = 1 nA of measurement current).

9.4.2. MEASUREMENTS OF CAPACITORS

We remind that a lot of recent electrical units are fitted with main line filters including capacitors for the electromagnetic compatibility. When measuring on capacitors it is advised to select the filter mode **CAPACITOR** of the SETUP menu in order to stabilize the measured values.

- A) Indeed, on capacitors, the variations of the measurement power supply, even small as well as the interferences are entirely transmitted to the input of the current measurement system which have a very high gain, and therefore will amplify these variations. The **CAPACITOR** filter switches on circuits which will limit the instability of the measurement.
- B) Never perform insulation resistance measurements on capacitive specimens in reducing the measurement voltage between each test, but always in increasing the voltage. The hysteresis and polarization phenomenas of the dielectric material will alter the results. In that case the unit indicates its maximum value and takes a long time to come back to the real measured value.
- C) The insulation resistance value of a capacitor being a function following a time exponential law, it is important to make sense to the measured value, to indicate the duration of the measurement. The units of the MG series allow to comply with this requirement with the built-in timer, able to measure times going from 1 second up to 16 minutes.
- D) Never disconnect a capacitive specimen before switching into DISCHARGE mode and waiting the necessary time to discharge its capacitance through the 2.2 kohms built-in resistance of the discharge circuit (about 1 second per 100 uF).

9.4.3 MEASUREMENTS ON CABLES

The measurement on cables is similar to the measurement on capacitors, please refer to the section [9.4.2](#) for the basic advice.

The measurement configurations on cables are very varied. The measurements have to be performed either between each conductors for multi-wires cables, either between main conductor and shielding for shielded cables, either between the cable and its environment for mono-wire cables.

A) In that last case, the generally used way is to immerse the cable reel in a water tank (called SWIMMING POOL), to wait for the water penetration in to the cable reel center, and then to perform the insulation resistance between the cable and the water. For safety and construction reasons the water tank is grounded. The insulation resistance measurement unit must be able to measure a specimen with one grounded end. The units of the MG series allow to perform easily this type of measurement, because the hot point of the high voltage generator is already grounded. You just have to connect the measurement input of the unit (with the HV probe) on the cable to be measured and to trigger the measurement.

B) Another specific point, when measuring on cables, is that the specifications of the cable manufacturers give resistance values for a standard length of cable equal to 1 km (1000 meters).

When testing the reels of cable, those are never equal to the standard length, that forces the operators to calculate the resistance as a function of the cable length and the number of wires in parallel for the multi-wires cables. Consequently the built-in comparators of the measurement units can not be used, because they compare regarding to the total insulation value and not regarding the standard value. The units of the MG series allow with the option 23 to display insulation resistance measurements reduced to 1 km and 1 wire, and therefore allow the use of the built-in comparators. The operator can enter in a specific menu of the unit the length of the cable under test as well as the number of wires. The result is given in Mohm per km.

i.e. : the unit measures a value of 10 Mohms for a 10 km long mono-wire cable. Therefore, the value reduced to 1 km will be :

$$(R_{\text{totale}} / 1 \text{ km}) \times \text{Length} = 100 \text{ Mohm.km}$$

For the same cable with 10 wires, the value for 1 wire will be :

$$100 \text{ Mohm.km} \times 10 = 1000 \text{ Mohm.km}$$

C) The insulation resistance value of a cable being a function following a time exponential law, it is important to make sense to the measured value, to indicate the duration of the measurement. The units of the MG series allow to comply with this requirement with the built-in timer, able to measure times going from 1 second up to 16 minutes.

9.4.4 MEASUREMENT VOLTAGE SELECTION

The insulation resistance measurements intending to verify that materials or equipments comply with standard requirements, it is important to refer to these standards to select the voltage. The standard voltages are generally : 50, 100, 250, 500 VDC.

In case of no standard, select a 100 VDC value.

When measuring on capacitive specimens and when studying the voltage influence on the insulation resistance values, it is important to start always with the lowest voltage and then to follow the measurements in increasing the voltage. A procedure in the reverse way could give incoherent results.

9.5 DIELECTRIC STRENGTH TESTS

The dielectric strength test is intended to stress components and sub-assemblies of electrical equipments and to check that the leakage lines either between points or between points and ground are correctly designed according to the used technology.

The principle of a dielectric strength test is to apply a voltage (DC or AC) between defined points and after voltage stabilization, to check that the leakage current, created by breakdown phenomenas or breakdown discharges (in the air or in the insulating materials), is not greater than the nominal acceptable value.

The default sanction is determined by the analyze of the shape, the amplitude and the holding time of the current supplied by the generator to the specimen under test and by comparison with a preset limit.

9.5.1 SELECTION OF THE TEST VOLTAGE

The dielectric strength tests intending to verify that materials or equipments comply with standard requirements, it is important to refer to these standards to select the voltage.

In case of no indication regarding the test voltage, a common rule is to apply the following formula :

$$U_{test} = 2 \times U_{nominal} + 1000 \text{ volts}$$

Most of the standards specify the type of the test voltage : AC (50-60Hz) or DC. A common rule is to test the specimen with a test voltage of the same type that the voltage which will be apply during the final use. However, it is existing a certain among of technical difficulties which force to depart from this common rule.

9.5.1.1.DIELECTRIC STRENGTH TESTS WITH AN AC VOLTAGE

BENEFITS :

- The specimen is stressed with the both voltage polarities.
- The specimen being not charged, there is no need for a discharge system

DISADVANTAGES :

- Most of the tested specimens having a certain amount of capacitance, the HV source have to supply the leakage current as well as the reactive current, this involves an over-sized generator with an increase in prices, in weight and a decreasing of the operator safety who is exposed to higher currents.

The reactive current can be evaluated with the following formula :

$$\text{Impedance} = \text{Voltage} / \text{Current (Ohm's law : } Z=U/I)$$

for capacitances : $Z = 1 / Cw$ with $w = 2\pi f$

reactive current : $I_r = U \cdot C \cdot 2\pi f$

i.e. $U=3000 \text{ volts } C=1\text{nF} (\sim 10 \text{ meters of shielded cable})$

$$I_r = 3000 \cdot 1\text{E-9} \cdot 2\pi \cdot 50 = 0.942 \text{ mA}$$

- Require to adjust the permanent leakage current threshold (IMAX) regarding the capacitance of each specimen.
- When testing a specimen which will be used with a DC voltage, the AC voltage test can result in a decreasing of the life time because in particular of the heating and the CORONA effect. Under the effect of an electrical field, the orientation of molecules is done with friction which will occur with an AC voltage at each cycle (every 20 or 16 mS). Consequently the AC test is more severe than the DC voltage test.

9.5.1.2. DIELECTRIC STRENGTH TESTS WITH A DC VOLTAGE

BENEFITS:

- The power of the HV source can be lower than the one necessary in AC voltage (less weight and more safety for the operator). The current flows through the specimen only during the charging phase.

DISADVANTAGES:

- The charging current can trigger the breakdown detection
- The specimen being charged, it must be discharged through the built-in discharge resistance (1.5 Mohm).
WARNING : Wait enough for the discharge of the specimen capacitance before disconnection from the unit (about 8 seconds per uF).
- The specimen is tested in only 1 polarity
- The test voltage must be higher than the one provided with AC test voltage. A common rule is to use a 1.4 correction factor between the DC and the AC voltages (= square root of 2 = ratio between the rms value of a sinusoidal wave and its crest value) :

$$U_{dc} = U_{ac} * 1.4$$

9.5.2 BREAKDOWN DETECTION MODE SELECTION

The most common and simple leakage current control mode is the threshold current control mode or IMAX mode. This mode allows to set a maximum limit of current flowing through the specimen under test above which the unit detects a breakdown and stops the test by cutting off the HV generation and memorizing the voltage value on the LCD screen. As described in section 9.5.1, the HV source has to supply the leakage current as well as the reactive current coming from its capacitance. Therefore this requires to adjust the breakdown threshold regarding the reactive current of each specimen, and to follow the procedure :

- Make a test on a good specimen
- Collect the total current flowing
- Adjust the current threshold to a value greater than the total current.

The MG series units offer the above described detection mode, combined with the Δ-I detection mode (called sometimes ARC detection mode). The Δ-I mode allows to release from the reactive current flowing through the capacitive specimens.

To detect a breakdown, the Δ-I mode (ARC detection) monitors only the fast current variations ($t > 10\mu s$ and amplitude $> 1mA$). This doesn't require any adjustment regarding the specimen capacitance. However this mode can not detect a dielectric strength defect in case of a specimen in short-circuit since the high voltage application. That is why the MG series units allow to combine the IMAX and the Δ-I modes in order to make reliable and without adjustment of dielectric strength tests. The IMAX value is set to a value close to the unit short-circuit current under the test voltage.

The MG series units allow to inhibit the detection systems (OFF mode) in order to locate visually where is the dielectric strength fault. WARNING : this mode doesn't cut off the high voltage and therefore it is possible to destroy or burn the specimen under test. The power of the HV source being limited, a continued use of the OFF detection mode can trigger the built-in thermal safety switch. Under those circumstances (display of the message : INTERLOCK DISABLE) wait between 3 and 5 minutes before proceeding to the tests.

9.6 Protective earth continuity measurement

On a unit or an electrical device using or generating hazardous voltages, ground continuity measurements insure that all the accessible protective parts are correctly connected to the protective earth connection wire.

This measurement is almost a low resistance measurement except that it has to be performed with a high current, mostly in AC .

The principle is to flow a current between each metallic accessible parts and the protective earth connection, to measure the voltage drop between the 2 parts and to check with the Ohm's law that the equivalent resistance is lower than the standard required value.

9.6.1 Current selection

The measurement current is defined by the safety standards which have to be used for each product. According to the main standards, this high current is comprised between 10 and 25 A AC or equal to 2 times the nominal operating current of the device.

The choice is justified by the fact that the protective earth connections have to be able to flow the fault current for the maximum value of the unit operating current and this during the reaction time of the other protective devices (fuses, breakers, etc...)

9.6.2 Voltage selection

This is the open voltage of the current generator used for the measurement. This voltage, mostly given by each safety standards is mandatory a low value (lower than the threshold defining an hazardous voltage) but it must allow the measurement current flowing, taking care of the voltage drops between the generator and the measurement points.

The open voltages are comprised between 6 and 12 AC volts.

9.6.3 Test time

Unlike a simple resistance measurement, the time that the current is being flowing for the ground continuity measurement is important because of the 'Safety' function of the tested connection.

Beyond the ohmic value evaluation, it is mandatory to test the quality of the connection to the earth potential (diameter of the wire, solders quality, screwing quality,...). A manufacturing fault of one of these connections may in certain circumstances give an immediate correct ohmic value, but increasing quickly by heating causes by the high current value used for the test : this high current can produce a break of the wire (wounded wire, which diameter becomes too small).

This is why some standards are requiring a minimum test time from 1 to 5 minutes for this measurement. Other standards don't give any time indication, but it is advised to apply for type test a minimum time of 1 minute and for series tests at least 10 seconds.

9.6.4 Precautions to be observed

The measured resistance values being very low ($< 1 \text{ ohm}$), it is necessary to perform the measurement in using the 4 wire method to avoid the measurement lead parasitic resistance (interfaces, adapters, ...) It is necessary to warrant this measurement principle when connecting the measurement unit to the test points.

If specific connections have to be done, it is necessary to use correctly rated cables (at least $5\text{A}/\text{mm}^2$) for the current and to connect voltage measurement cables as close as possible to the measured points.

During the test time, it is advised not to move the probe to avoid breaking the current flowing which will produce sparks. This can modify the real total test time and can alter the contact surface of the specimen.

SECTION 10: THEORETICAL PRINCIPLES

10.1 UNIT ARCHITECTURE

The unit has an architecture organized on a communication bus between the microprocessor board and the test and measurement boards. This communication bus is on a printed circuit called mother board. On the mother board there is also a power supply consisting in a two inputs voltages (115/230V) supplying AC voltages which are used to make the DC voltages for the measurement functions:

+5VM : Logic power supply, red Led comes up when voltage on
 ±25VG : Relays and hipot power assembly supply
 VEE : LCD display contrast adjustment between -9 and -13volts on the rear panel.

A double outputs winding (18VAC1/18VAC2) insulated from the others windings allows to supply the insulation function.

The mother board consists also in :

- A 25 points female sub-D connector with the following pin out :

1	Safety interlock to connect with point 14
2	Red lamp(voltage ON)
3	25VDC protected by an internal fuse
4	I/O for the PLC option (OPT02) = CTRLIN
5	I/O for the PLC option (OPT02) = N1
6	I/O for the PLC option (OPT02) = N3
7	I/O for the PLC option (OPT02) = MES_DCH
8	I/O for the PLC option (OPT02) = COM_OUT
9	I/O for the PLC option (OPT02) = FAIL
10	I/O for the PLC option (OPT02) = PASS
11	0-10volts input (OPT03)
12	Ground
13	Trigger remote control, to connect to 25
14	Safety interlock to connect to point 1
15	Green lamp(voltage OFF)
16	I/O for the PLC option (OPT02) = COM_IO
17	I/O for the PLC option (OPT02) = N0
18	I/O for the PLC option (OPT02) = N2
19	I/O for the PLC option (OPT02) = TYPE
20	Not used
21	I/O for the PLC option (OPT02) = CTRLOUT
22	I/O for the PLC option (OPT02) = EOT
23	I/O for the PLC option (OPT02) = ERROR
24	Output 0-10volts (OPT03)
25	Trigger remote control to connect to point 13

- A 9 points female sub-D connector for the connection of the unit to a computer via a serial RS232C interface (OPT01).

It is possible to connect the following boards on the mother board :

- 1 microprocessor board
- 2 test or measurement boards
- 1 option board

10.2 MICROPROCESSOR BOARD DESCRIPTION

The core of the unit control board is based on a microcontroller from the INTEL's 80C188 family. The selected version, 80C188EB-8Mhz includes the time measurement feature, serial interfaces and address decoders.

In combination with the microcontroller, there are the main elements of an embedded system :

static RAM (64ko), EPROM (256ko), battery backup RAM (64ko) and programmable logic devices (EPLD) which complete the address decoding.

The communication with the different boards is done through a handshake bus called « MG BUS », which consists of 8 data bits, 8 address bits and 6 decoding bits.

A set of 8 jumpers allows to dedicate the unit control software. The LCD screen and the 10 keys keyboard are directly connected to the microprocessor board. A serial interface component makes the necessary voltage level shift to comply with the RS232C interface.

10.3 INSULATION RESISTANCE MEASUREMENT FUNCTION

The insulation resistance measurement function consists of a DC voltage generator combined with an ammeter. The unit measures the current flowing through the resistance under test and the voltage across the resistance, by using the Ohm's law ($U=R*I$) the insulation resistance value is displayed. The measurement conditions involving for safety reasons to earth the positive pole of the generator, the features of the board have to be optically or by a galvanic way insulated from the microprocessor board signals.

The insulation resistance measurement board communicates with the microprocessor board through the MG bus. The signals coming from the MG bus interface having to be insulated to control the measurement board functions, a serial to parallel conversion allows to reduce the number of insulation components.

A reference voltage is supplied by a 10 bits resolution digital to analogic converter to the voltage generator. This reference voltage controls a pulse width modulation circuit (PWM) which drives by switching a step-up transformer through a power transistors stage. The secondary voltage of the transformer is rectified by a high voltage diode bridge then filtered. A high voltage high impedance resistive divider allows to the PWM circuit to perform the output voltage regulation regarding the load while another divider allows to measure the value of the voltage.

This value is multiplexed with the ground, the reference and the current signals before being connected on the input of a voltage to frequency converter working at a 100 kHz maximum frequency. This frequency after optical insulation is sent on the MG bus and is measured by the built-in counter of the microcontroller.

The whole current scale is made by switching different feedback resistance values on an operational amplifier used as a current to voltage converter. A low pass active filter and an integration network insure the measurement stability on capacitive specimens.

10.4 DIELECTRIC STRENGTH TEST FUNCTION

The dielectric strength test function consists of a high voltage AC and DC (option) generator combined with a current measurement.

The dielectric strength test board communicates with the microprocessor board through the MG bus. A clock signal coming from the microcontroller built-in frequency divider scans all the locations of a PROM memory which contains the digitalised Sinus function. The output of this memory is connected on a 8 bits resolution digital to analogic converter which gives at its output a microcontroller controlled frequency sinusoidal wave.

This wave is modulated in amplitude by a digital to analogic converter used as a multiplier, and then controls a semiconductor power stage which drives the high voltage step-up transformer.

A current measurement resistance in the return circuit of the dielectric strength test allows to measure the current flowing through the specimen under test and to control fast current variations. That is why the voltage created by the current across the resistance is differentiated by a capacitive network and then amplitude compared by two fast comparators. If one of these comparators detects and if the unit is set in the Δ -I detection mode, the primary control signal of the HV transformer is cut off at the next zero crossing of the sinusoidal wave and the microcontroller is kept informed of the breaking.

A high value resistance located across the output terminals allows the high voltage measurement. The signal coming out from the resistance is rectified, filtered then multiplexed with the ground, reference and current signals before being connected on the input of a voltage to frequency converter working at a 100 kHz maximum frequency. This frequency is sent on the MG bus and is measured by the built-in counter of the microcontroller.

10.5 Ground continuity resistance measurement function

The ground continuity resistance measurement includes an AC current generator combined to a voltage measurement.

The ground continuity board communicates with the microprocessor board through the MG bus.

A reference voltage is supplied by a 8 bits resolution digital to analog converter (8 bits DAC) to the current amplifier. The current amplifier controls through a switching converter system a transformer with at secondary winding, voltages of 6 or 12 volts and a maximum current of 30A.

The reading of the current is done on a 5 mohms shunt resistor in a 4 wire measurement method. The values of the current through the specimen and the voltage across the specimen are multiplexed and sent to the input of an AC to DC converter and then to a voltage to frequency converter. The frequency is sent on the MG bus and measured by the internal timer of the microcontroller.

The microcontroller computes the U/I ratio according the Ohm's law to get and display the ground continuity resistance value

SECTION 11: MAINTENANCE AND CALIBRATION

11.1 PRELIMINARY

Our warranty (refer to the beginning of this manual) attests the quality of materials and workmanship in our products. If malfunction should be suspected or other information be desired call our technical assistance: (33) 1.64.11.83.40 for FRANCE or contact your local distributor.

11.2 INSTRUMENT RETURN

Before returning an instrument to our Service Department, please call them at the above phone number for shipment instructions. Use packaging that is adequate to protect it from damage.

11.3 MAINTENANCE

Our units don't need particular maintenance except an annual calibration. If problems, please follow the brief check list here after. If the problem continues, call our service department at the above number.

- **LCD SCREEN DOESN'T COME UP:**
 - Check the correct connection of the main cord SE1
 - Check that the main voltage is in accordance with the value displayed on the main inlet on the rear panel of the unit (see [1.7.1](#))
 - Check the fuse in the main inlet on the rear panel (see [1.7.1](#))
- **DISPLAY OF THE MESSAGE : INTERLOCK OPEN**
 - Check that the 25 points connector has been correctly connected on the rear panel
 - Check that the correct connection have been done in the 25 points connector (see [1.7.3](#))
 - If using an external contact to close the safety interlock, check that the contact works as expected.
 - If the loop is closed, wait 3 to 5 mn so that the thermic security included in the unit allows again voltage supply.

The other possibilities for a bad functioning need an intervention inside the unit by qualified people. However we can supply a service manual including schematics of our units. Please get in contact with our Service department in order to know price and delivery time.

11.4 CLEANING

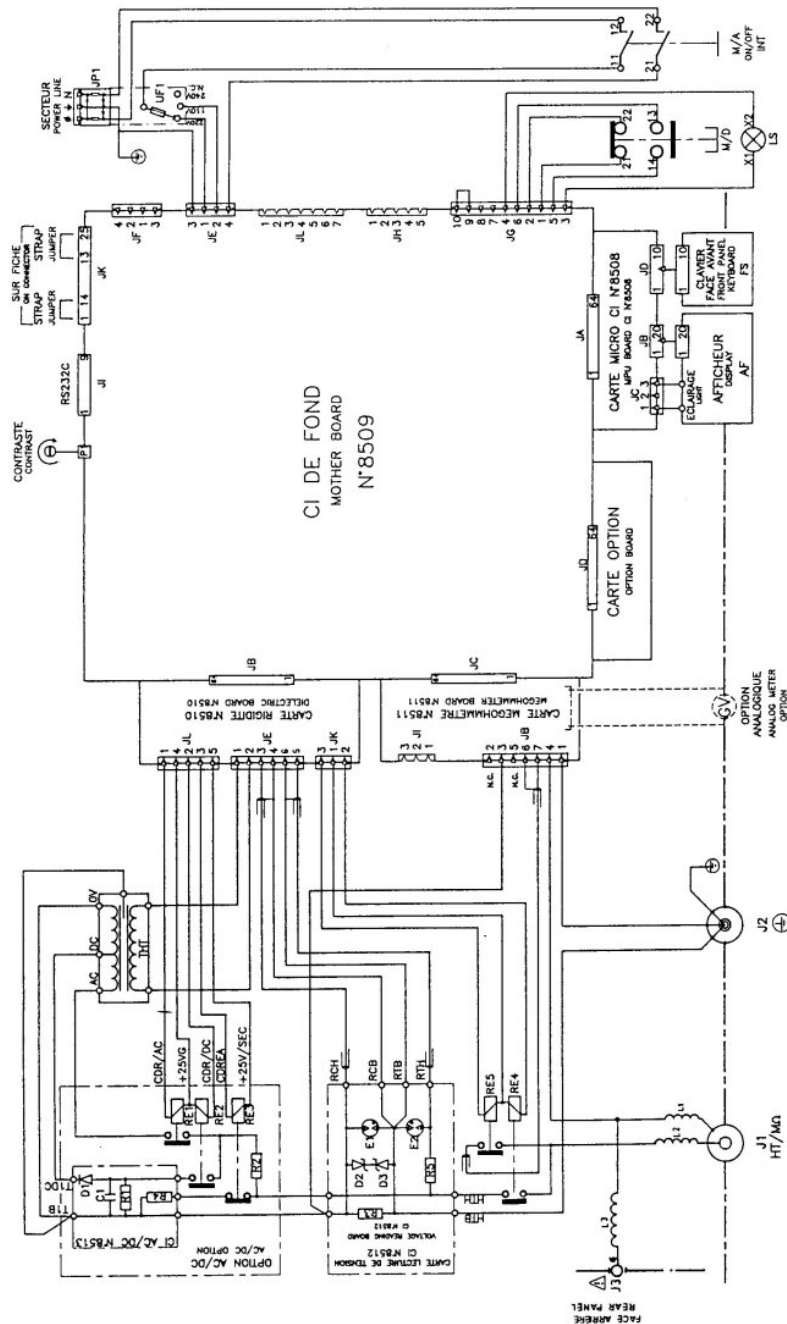
Only clean the instrument with a mild rag or slightly soaked with water.

11.5 CALIBRATION

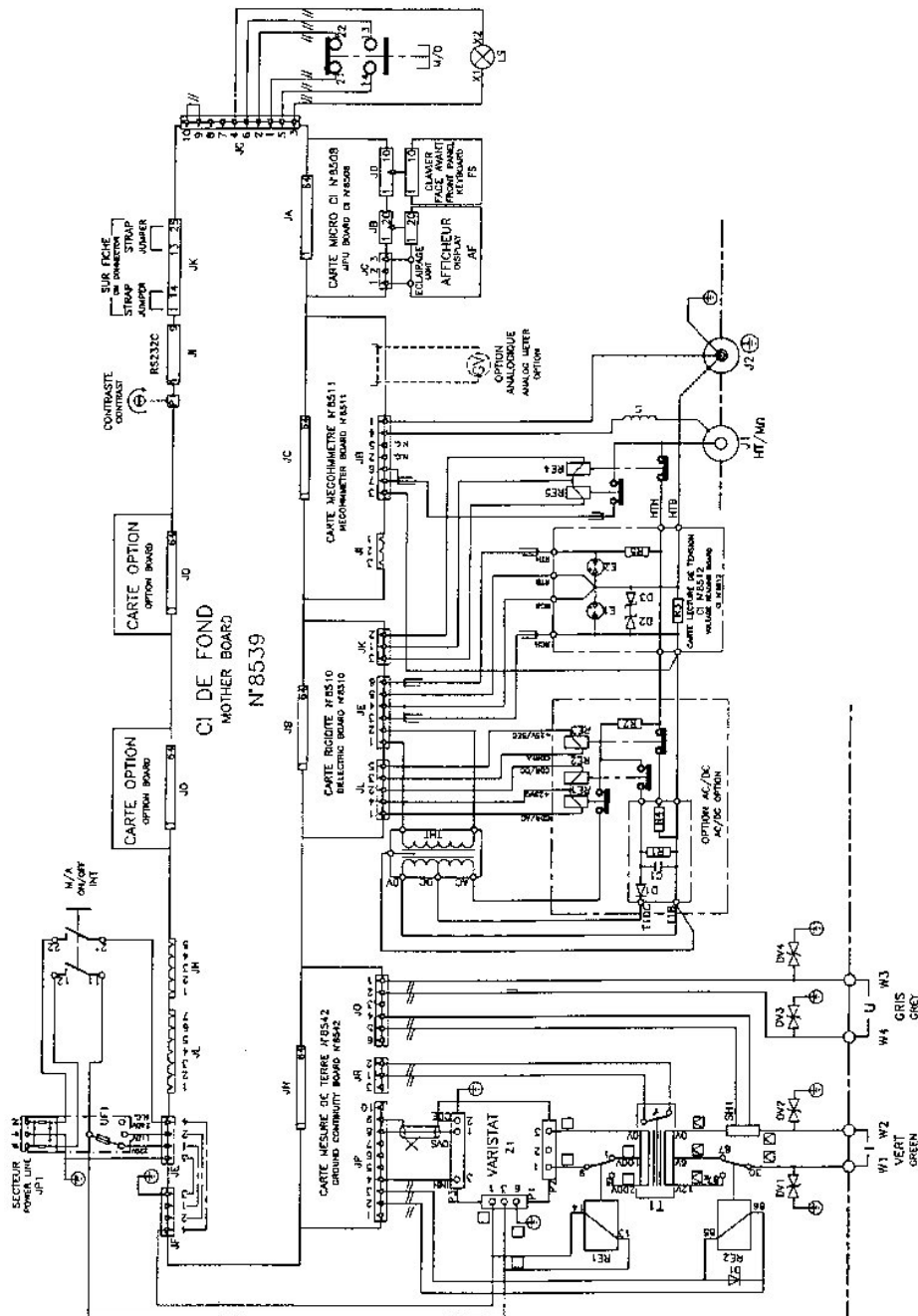
We recommend to calibrate our units each year. The calibration must be performed by qualified people having the complete procedure as well as correctly checked standards. Our Maintenance department is at your service to perform the annual calibration. Nevertheless, if you wish to perform yourself the calibration, we can provide a calibration kit including a manual (MG90) and a calibration box (MG91). Please get in contact with our Maintenance department in order to know the price and the delivery time.

SECTION 12: DRAWINGS

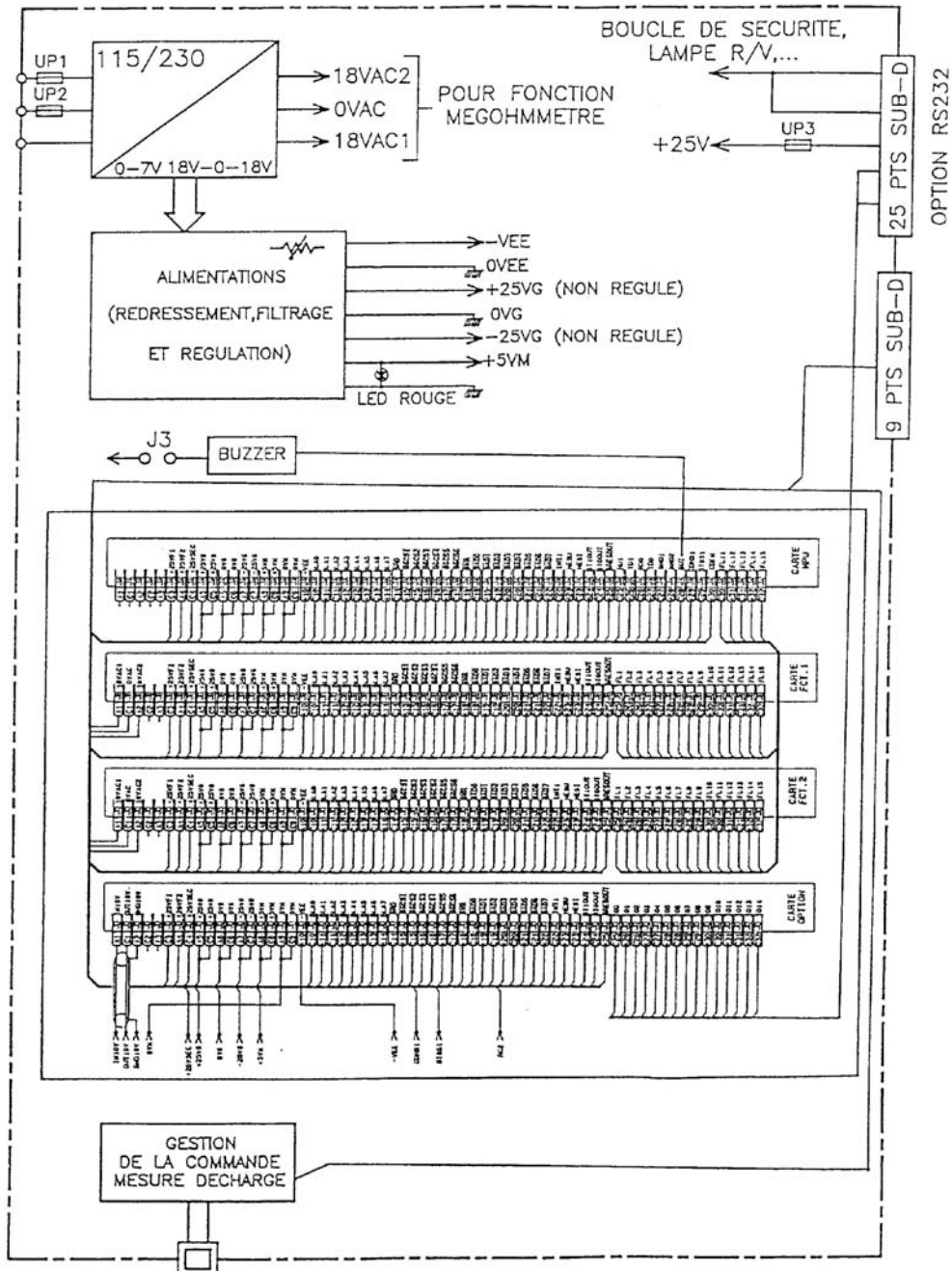
12.1 General Drawing DMG50



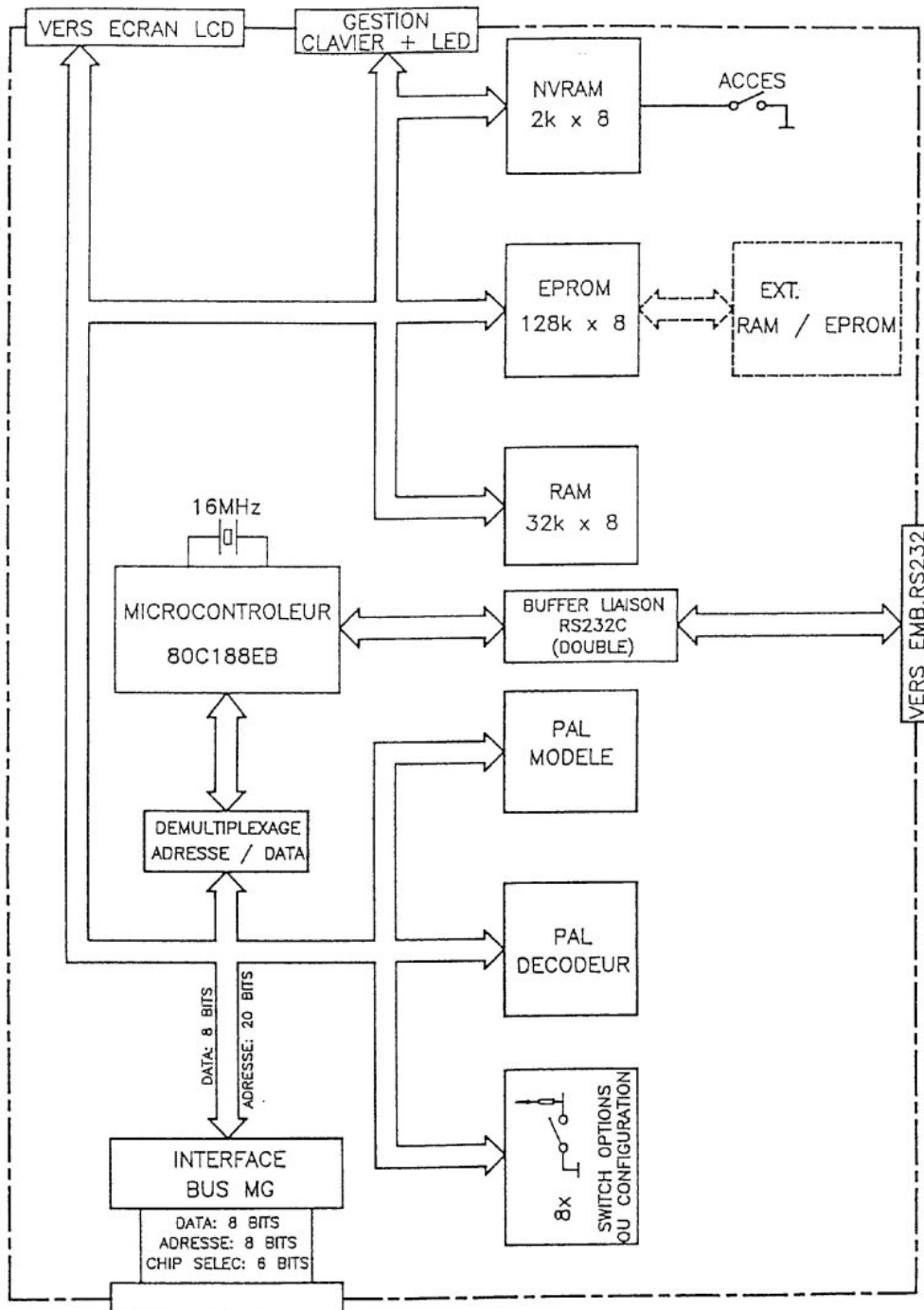




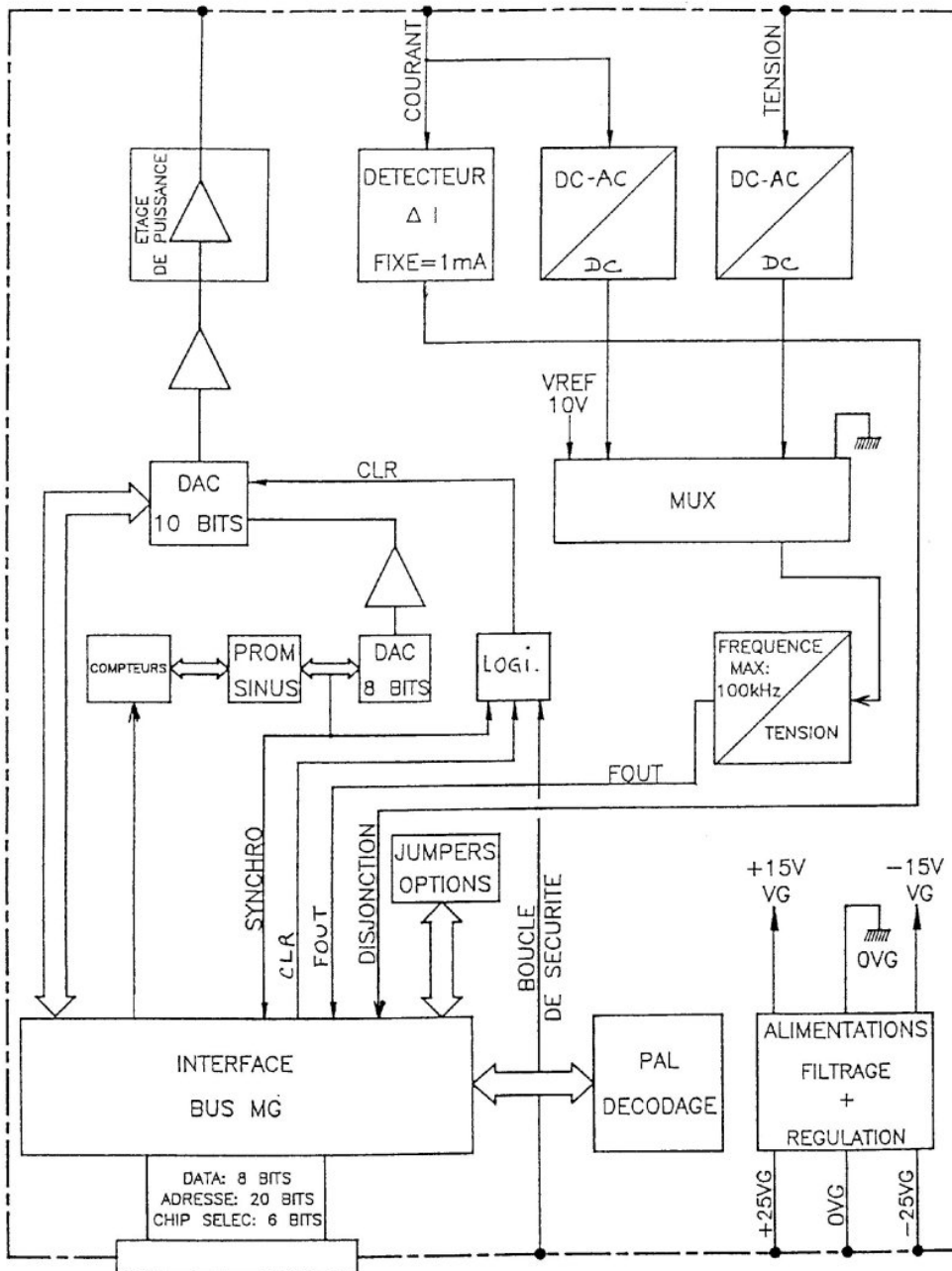
12.4 Mother board



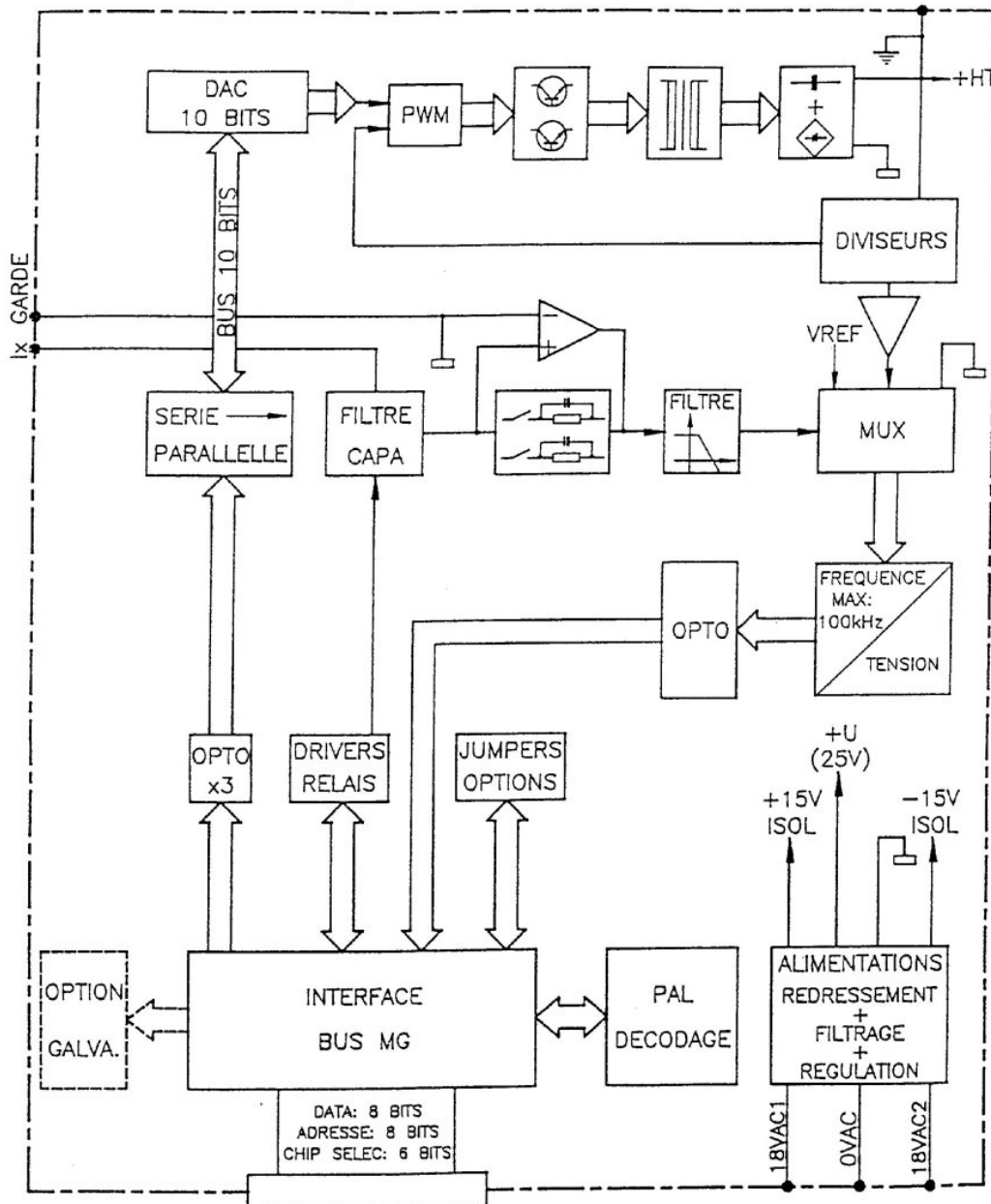
12.5 Microprocessor board



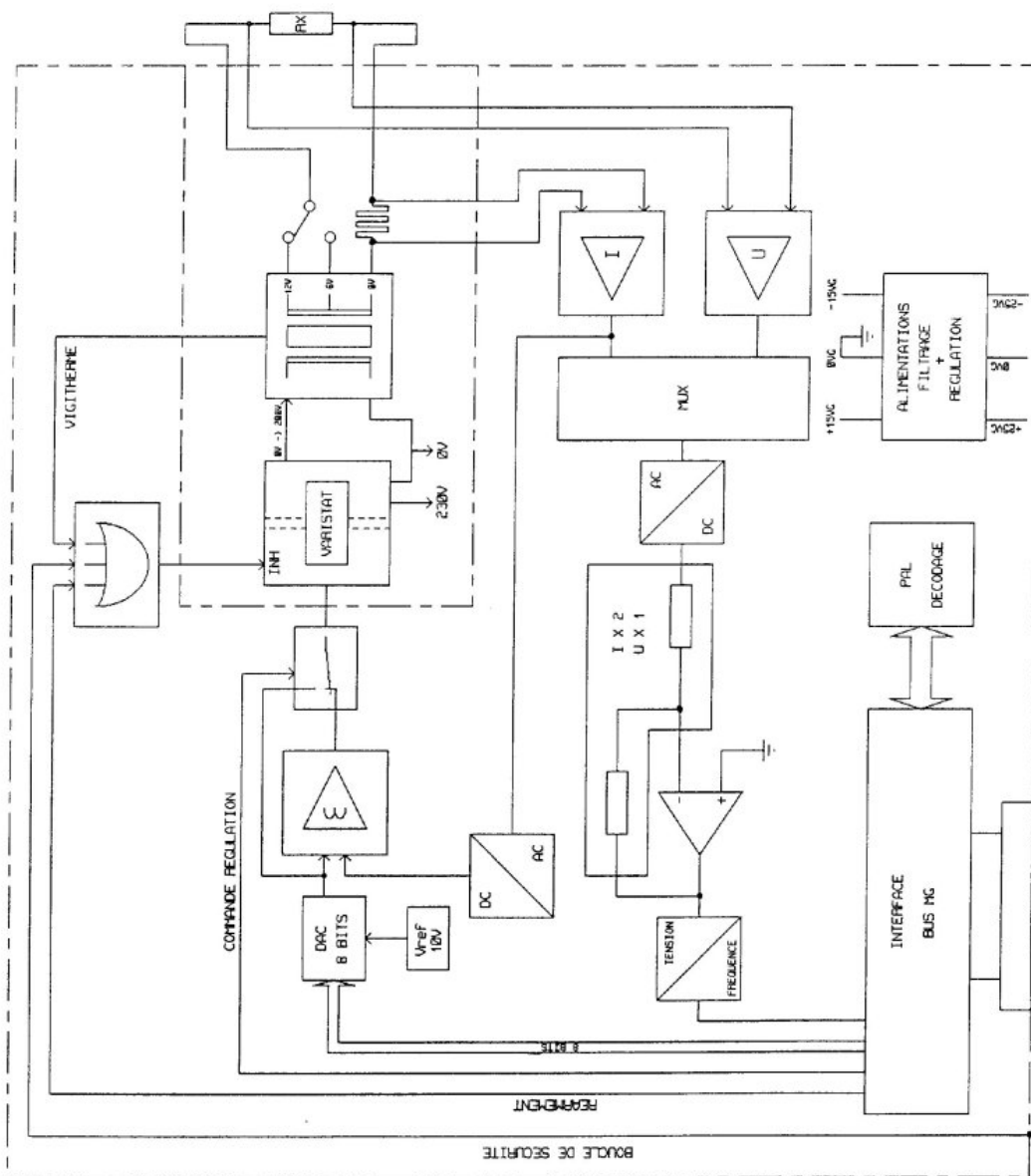
12.6 Dielectric strength board



12.7 Megohmmeter board



12.8 Ground continuity board



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