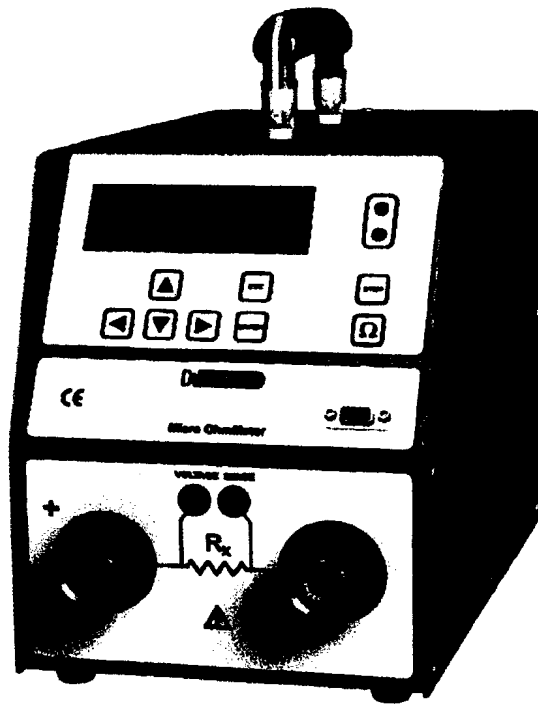


RMO600

MICROOHMMETER

Manual



IBEKO POWER AB
DVpower

Manual Version: RMO600. MV.02_A
IBEKO POWER AB 2004

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1 Introduction

1.1 About this Manual

This manual contains helpful instructions on how to use RMO600 in a safe, proper and efficient way.

Following these instructions can help you to avoid dangerous situations, repair costs and other miss happenings due to incorrect operation. Furthermore it ensures the reliability and life cycle of your RMO600.

RMO600 must be used in observance of all existing safety requirements/ regulations from national/local standards for accident prevention and environmental protection.

Reading the RMO600 manual alone does not release the user from the duty of complying with all national and international safety regulations relevant for working with RMO600.

2 Safety Instructions



Before operating RMO600, please carefully read the following safety instructions.

It is not recommended that the RMO600 will be used (or even turned on) without the understanding of this manual.

RMO600 should only be operated by trained and authorized personnel.

Rules for Use

- RMO600 should only be used when in a technically fit condition. Its use should be in accordance with the safety regulations for the actual working site and application. Always be aware of the dangers of high voltages and currents associated with this equipment and its environment. Pay attention to the information provided in the operations manual.
- RMO500 is intended exclusively for the application areas specified in "Designated Use". The manufacturer and distributors are not liable for damage resulting from unintended usage. The user alone assumes all responsibility and risk.
- The instructions provided in this manual are considered part of the rules governing proper usage.
- Do not open RMO600.

Orderly Practices and Procedures

- The manual should always be available on the site where the RMO600 is used.
- Before using RMO600, all personnel (even personnel who only occasionally, or less frequent, work with RMO600) assigned to RMO600 should read the operations manual.
- Do not undertake any modifications, extensions, or adaptations to the RMO600.

Cleaning

To clean RMO600, use a cloth dampened with isopropanol alcohol or water.

Operator Qualifications

- Testing with RMO600 should only be carried out by authorized and qualified personnel.
- Personnel receiving training, instruction, direction or education on the RMO600 should remain under the constant supervision of an experienced operator while working with the test set and the test object.

Safe Operation Procedures

- Hazardous voltages of up to 400V can occur inside RMO600. Therefore is not permitted to open RMO600.
- Do not insert objects (e.g., screwdrivers, etc.) into the ventilation slots.
- Before putting RMO600 into operation, check the test set for visible damages.
- Do not operate RMO600 under wet or moist conditions (condensation).
- Do not operate RMO600 when explosive gas or vapors are present.
- The serial interface of RMO600 should only have external devices connected that meet the requirements for SELV equipment according to EN 60950 or IEC 60950.
- When setting up RMO600, make sure that the air slots of the test set remain unobstructed.
- If RMO600 is opened by the customer, all guarantees are invalidated.
- If RMO600 seems to be functioning improperly, please call the IBEKO POWER AB (refer to section "Manufacturer Contact Information").
- Do not use RMO600 without the extra protective ground (PE) cable set connected.

Power Supply

- Supply RMO600 only from a power outlet that is equipped with protective ground (PE).
 - Instead of supplying RMO600 from phase – neutral (L1-N, A-N), it may also be supplied from phase – phase (e.g., L1-L2; A-B). However, the voltage must not exceed 240 V AC, please refer to section 8.1.
-

3 Designated Use

The microohm meter RMO600 is designed for measuring contact resistances of non-inductive test objects used in the electric power industry or similar branches. It is employed for resistance measurement during manufacturing, commissioning and testing of

- power circuit breakers,
- interrupters,
- bar installation,
- cable splices,
- welded joints,
- grounding.

Any other use of the RMO600 than the ones mentioned above is to be considered improper and will not only invalidate all customer warranty claims but also exempt the manufacturer from its liability for repair or exchange.

4 Functionality

4.1 Single Test

The RMO600 generates a filtered (true) DC current and outputs it in an automatically regulated current ramp. The current increases with a constant slope from zero up to a set maximum value. When the current has reached its maximum, RMO600 measures the resistance of the test object. After test the output current ramps back down to zero with a constant slope. By sloping the current up and down, magnetic transients are virtually eliminated.

4.2 Continuous Test

RMO600 can generate DC current continuously using the **Cont** menu. In this menu the current can be chosen the same way like in the **Sing** menu, but the duration of the test can be preset. The test is started pressing the **Ω** button. During the test, a new result is shown on the display and stored into the PC (RMOWin) each second. Using RMOWin the result can be printed like an Excel table which later can be shown as a diagram and used for a report.

The RMO600 current output is rated at 300 A for 1,5 minutes, at 200 A for 3 minutes, and 100 A continuously.

Test is completed when the test time previously set in the menu has elapsed, or when the **STOP** button is pressed.

By pushing **STOP** button test could be performed at any time. In case of test interruption by pushing the **STOP** button, the last measured result will remain saved in the internal memory.

Upon expiry of the selected test lasting time, the last result remains saved at selected memory location.

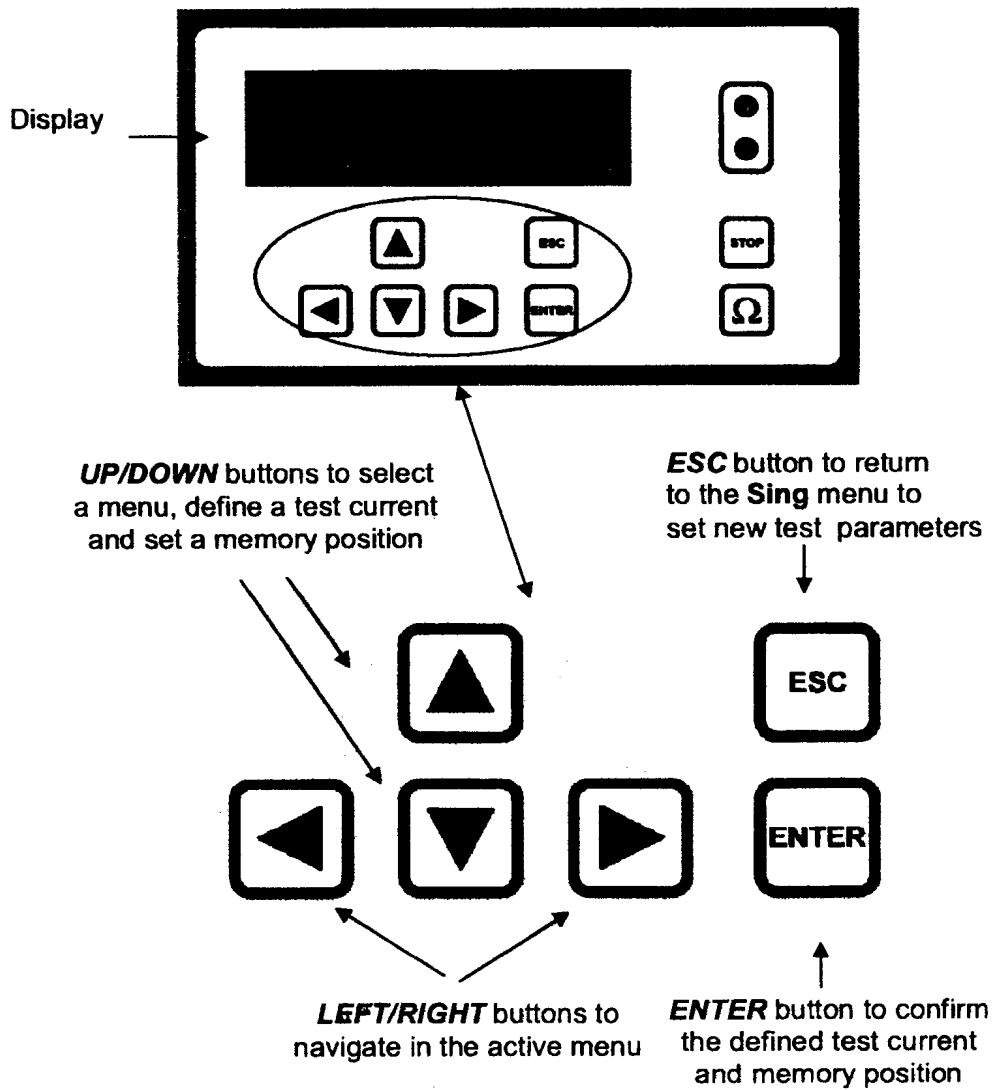
Note: At the start of the test (Single and Continuous), a check of cables connection is done. In case of disconnection, an alarm is activated, and the error message is shown on the display.

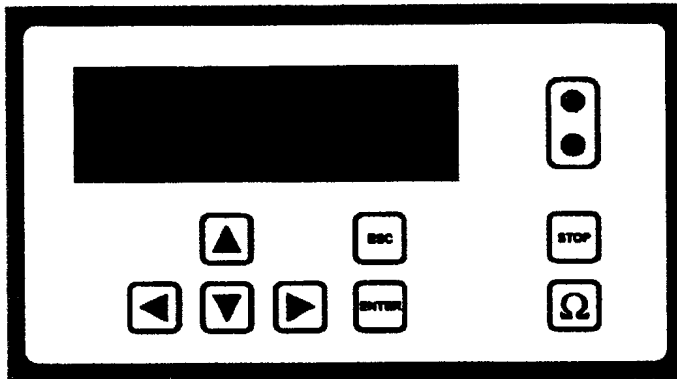
Voltage sense cables disconnection, occurred during the test, will cause an erroneous result. The display will not show this as an error message.

During tests the high continued DC current will heat up the test set. To prevent RMO600 from overheating, duty cycles apply. The duty cycles depend on the used test current, please refer to section "Duty Cycles".

5 Description

5.1 Front Panel Components

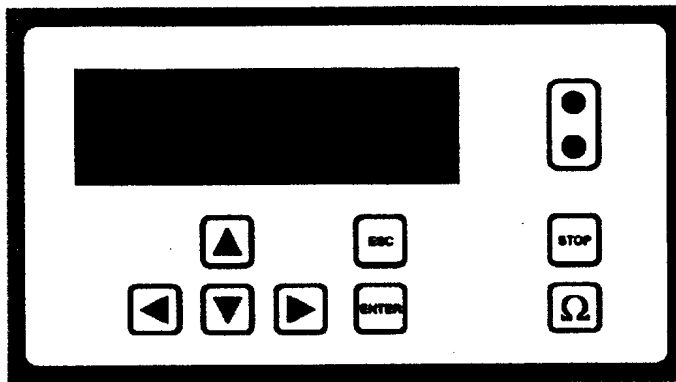


**STOP button**

Press to stop a test or to acknowledge the alarm buzzer.

Ω button

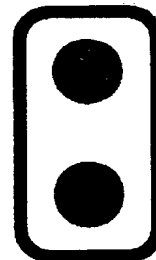
Press to start a test. Test current and memory position must be selected beforehand.

**green LED**

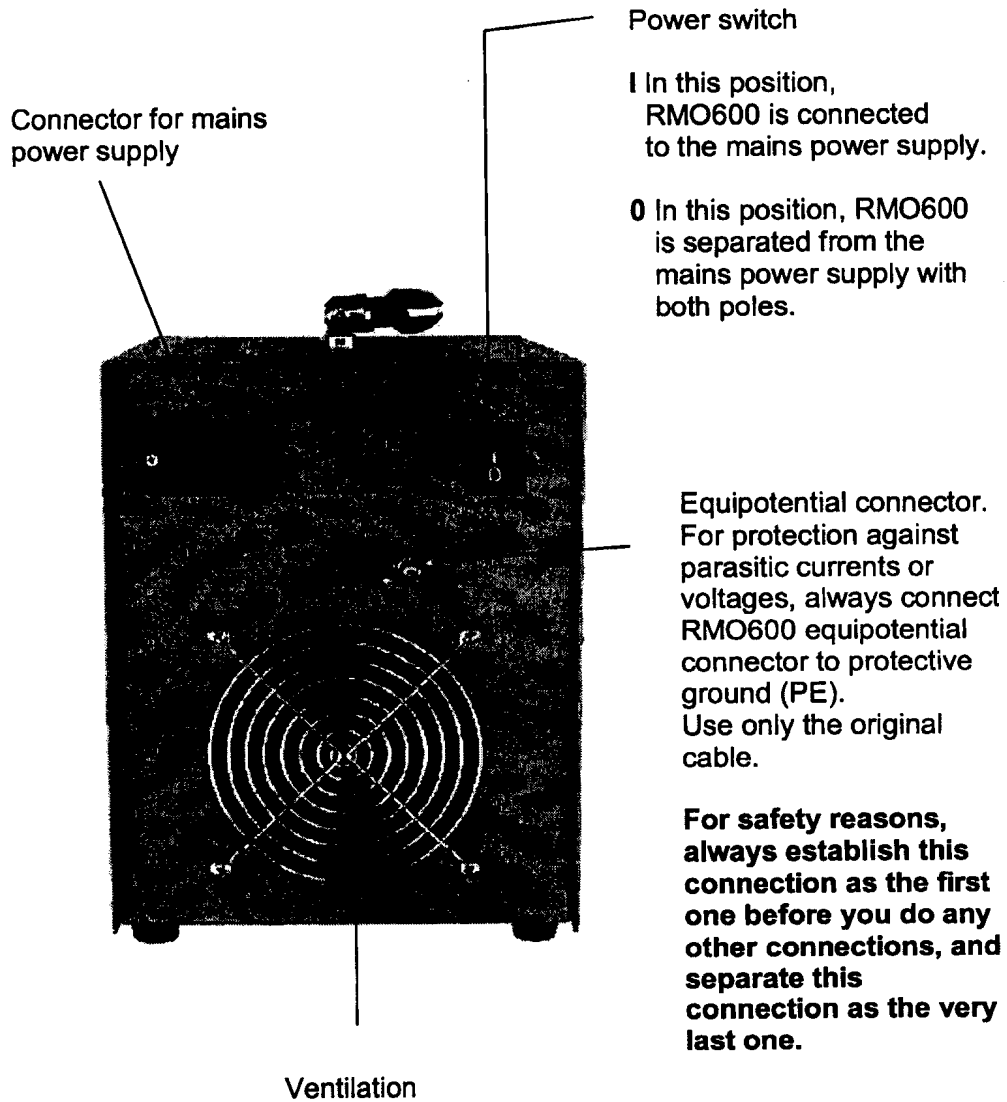
- Lights continuously when RMO600 is turned on.
- Flashes when a test can be started.
- Flashes alternately with the red LED during a test.

red LED

- Lights continuously in case of operational error.
- Flashes alternately with the green LED during a test.



5.2 Rear Panel Components



5.3 Setting RMO600's Language

To set RMO600's language, use the **UP/DOWN** buttons to select the **Language** menu.

Figure 5-1:
The **Language**
menu



Move the cursor to the bottom line using the **LEFT/RIGHT** buttons, and select the language of your choice.

Pressing **ENTER** to confirm, returns you to the **Sing** menu.
Pressing **ESC** to cancel, returns you to the **Sing** menu.

5.4 Setting RMO600's Time and Date

To set RMO600's internal time and date, use the **UP/DOWN** buttons to select the **Time** menu.

Figure 5-2:
The **Time** menu
showing RMO600's
internal time and date



Move the cursor to the position of your choice using the **LEFT/RIGHT** buttons, and change the value with the **UP/DOWN** buttons.

Pressing **ENTER** to confirm, returns you to the **Sing** menu.
Pressing **ESC** to cancel, returns you to the **Sing** menu.

6 Getting Started

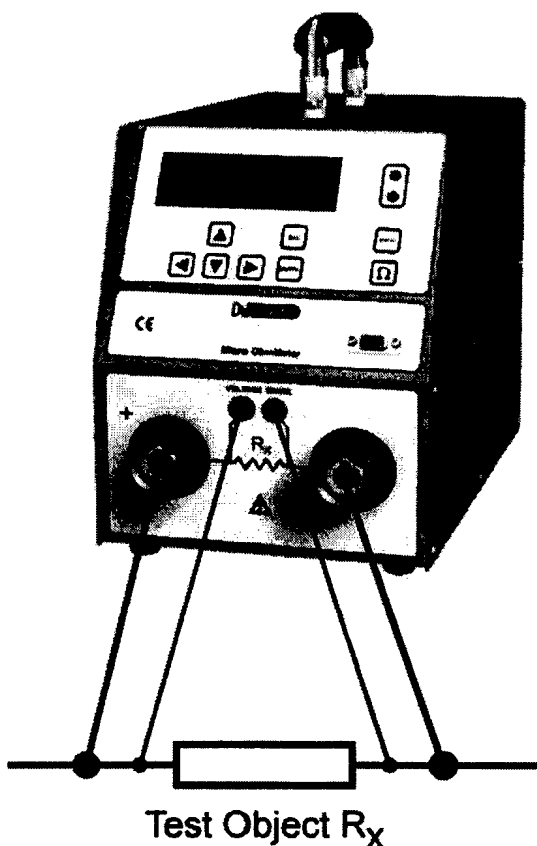
6.1 Connecting a Test Object to RMO600

Before you connect a test object to RMO600, make sure that:

- the test object is disconnected or separated from its circuit in accordance with the national safety regulations
- the test object is properly grounded to protective earth (PE)
- RMO600 itself is properly grounded. To do so, connect the grounding screw on the back of RMO600's to PE using a grounding cable.

With RMO600 turned off, connect RMO600 to the test object (R_x) in such a way that the measuring cables from the "Voltage Sense" sockets are attached as close as possible to R_x , and in between the current feeding cables. That way, resistance of both cables and clamps is almost completely excluded from the resistance measurement.

Figure 6-1:
Connecting a test
object to RMO600

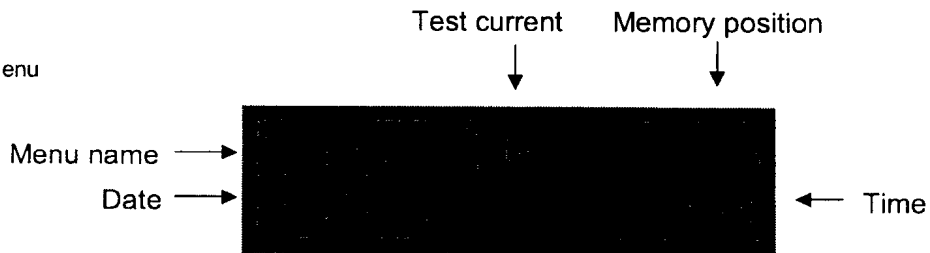


6.2 Setting the Measurement Parameters

Single Test

Turn on RMO600 with the power switch on the back of the test set. The display shows the **Sing** menu.

Figure 6-2:
The **Sing** menu



In the **Sing** menu, define a test current for the test. To do so, use the **RIGHT** button to move to the test current position (here **300A**), and set the value of your choice by means of the **UP/DOWN** buttons.

The memory position (here **m:30**) denotes a position the test data is stored during the test. It can be recalled later by selecting that position's number.

Once a test is finished, the memory position is automatically switched over to the next position.

Continuous Test

Turn on RMO600 with the power switch on the back of the test set. The display shows the **Sing** menu.

Go to **Cont** menu using **UP** button.

Figure 6-3:
The **Cont** menu



In the **Cont** menu, define a test current, memory location and test current duration time.

Using button **RIGHT** move cursor to the position of the test current (here **200A**), and set the value of your choice using **UP/DOWN** buttons. Maximum duration of the current depends on its value, please refer to section "Duty Cycles".

Using **RIGHT** button move cursor to the position of test current duration (here **60 sec**), and using **UP/DOWN** buttons select desired value.

Using button **RIGHT** move cursor to the position of memory location, and using **UP/DOWN** select desired memory position (here **m:40**) to which obtained results will be saved. Upon performed measurement (either due to time expire or due to push to the **STOP** button) the last measured result will remain registered in RMO600.

Note: In case of PC and RMOWin software use during the test, all performed measurements will be registered. Results will be shown in a table in Excel format with option of additional edit and graphic presentation.

Using RMOWin after testing for transfer of results from selected internal memory location to PC, it is possible to transfer only the result of the last test.

6.3 Measuring with RMO600

Single Test

Before a test can be started, both test current and memory position need to be defined using the **Sing** menu. Once these parameters are defined, press **ENTER** to change to the **Test** menu.

Figure 6-4:
The **Test** menu before
the test



The **Test** menu displays the test current and memory position defined. If one of these values has to be changed, press **ESC** to return to the **Sing** menu.

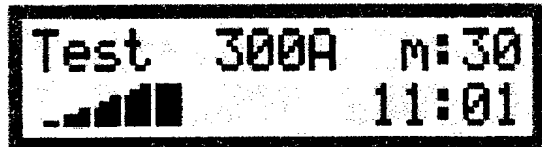


The flashing green LED indicates that RMO600 is now ready to start the test. Press the **Ω** button to run a test.



During the test, both the green and the red LEDs flash alternately. The display shows a graphical representation of the output current that ramps from 0A to the defined maximum value (here **300A**).

Figure 6-5:
The **Test** menu during
the test with the output
current ramped from 0A
up to maximum (here
300A)



Once the current ramp reaches its maximum value, RMO600 measures the current through the test object and the voltage at the test object for 1s, calculates the resistance from these values, and saves the data at the present memory position.

Afterwards, RMO600 ramps down the output current from the maximum value to 0A.



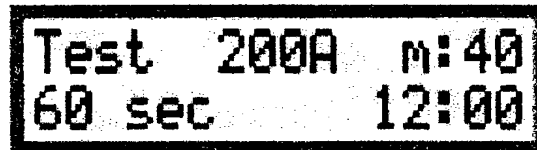
When 0A is reached, the test is finished and the green LED lights up.

Note: To stop the test prematurely, press the **STOP** button at any time during the test. The current will immediately drop to 0A.

Continuous Test

Before a test could be started, test current, its duration and memory location must be defined using **Cont** menu. Press **ENTER** to change to the **Test** menu.

Figure 6-6:
The **Test** menu
before the test



The **Test** menu displays selected test current (here **200A**), its duration (here **60 sec**) and memory location of the result (here **m:40**). If one of these values has to be changed, press **ESC** to return to the **Cont** menu.

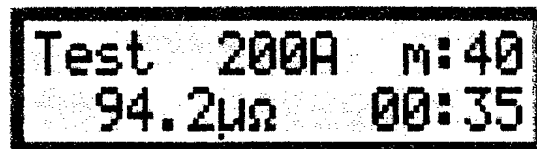


The flashing green LED indicates that RMO600 is now ready to start the test. Press the **Ω** button to run a test.



During the test, both green and red LEDs flash alternately. The display shows test current (here **200A**) and the current value of the measured resistance (here **94.2μΩ**). The time passed since the test beginning is also shown on the display (here **00:35**).

Figure 6-7:
The **Test** menu
during the test



Upon completed test (due to expire of selected time or due to push to the **STOP** button) at selected memory location the last measured result will remain registered.

Note: In case of PC and RMOWin software use during the test, all performed measurements will be registered. Results will be shown in a table in Excel format with option of additional edit and graphic presentation.

Using RMOWin after testing for transfer of results from selected internal memory location to PC, it is possible to transfer only the result of the last test.

To stop the test prematurely, press the **STOP** button at any time during the test. The current will immediately drop to 0A.

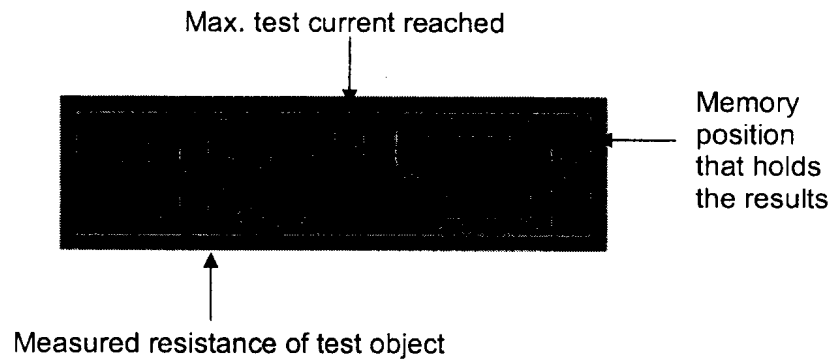
6.4 Viewing the Test Results

Once a Single test is finished, RMO600 automatically changes to the **Result** menu to display the test results.

For Continuous Test only the last performed test is shown.

Note: If the defined test current could not be reached, this could be due to a too high contact resistance of the test object and/or of the current cables. The test current value displayed here is the maximum test current reached.

Figure 6-8:
The **Result** menu
showing the test
results



Now there are two choices:

1. Starting a new test with a different current value:
 - press the **ESC** button to change to the **Sing** menu,
 - set a new current value and/or another memory position,
 - confirm your entries by pressing the **ENTER** button,
 - start the test by pressing the **Ω** button.

2. Starting a new test with the same current value:
 - press the **ESC** button to change to the **Sing** menu,
 - press the **ENTER** button to change to the **Test** menu,
 - start the test by pressing the **Ω** button.

The current value remains the same as in the previous test. the memory position increases by one.

6.5 Viewing Results of Previous Tests

RMO600 stores up to 100 test results. They can be viewed using the **Memory** menu at memory positions 0 ... 99.

Selecting a memory position on the **Memory** menu displays:

- the current fed into the test object,
- the memory position of these results,
- the test object's measured resistance,
- the date or the time,

of this particular test.

To view the creation date of the test rather than the time, position the cursor on the latest number of the memory position (here **0**), and use the **RIGHT** button to toggle between date and time.

Figure 6-9:
The **Mem** menu showing
the previously saved test
results of memory
position **30**



6.6 Duty Cycles

During tests, RMO600 generates a high DC current that heats up the test set. To prevent RMO600 from overheating, certain duty cycles apply depending on the used test current.

Table 6-10:
Cooling time
between single
tests

S i n g l e T e s t		
Test current (A)	Cooling time between first 4 tests (sec)	Cooling time after 4 tests (sec)
10	0	0
20		
50		
100		
200		
300	5	20
400	10	40
500	30	90
600	60	180

Table 6-11:
Cooling time
between
continuous
tests

C o n t i n u o u s T e s t		
Test current (A)	Maximal test duration time (sec)	Cooling time between tests (sec)
10	300	0
20		
50		
100		
200	180	300
300	90	

A built-in control prevents these cooling times from being skipped. If you try to start a test within the cooling period, the display shows "Wait" and a timer counting down. After the cooling period has elapsed, start the test using the set test parameters by pressing the Ω button.

Cooling of RMO600 is supported by a built-in fan that is automatically activated every time a test is started from the **Test** menu. It continues running 5 minutes after the test is finished.

7 Error Messages

Any operational error is indicated by a red LED and accompanied by an alarm.

Furthermore, the display indicates an error status message.

- To stop the alarm buzzer and keep the status message on the display, press the **STOP** button.
- To acknowledge the alarm buzzer and return to the **Sing** menu, press the **ESC** button.

7.1 Error Message "Voltage Sense"

Figure 7-1:
Disconnection of a
"Voltage Sense"
cable

If one of the "Voltage Sense" cables to the test object is disconnected, on either the test set or the test object side at the start of the test, the error message "Voltage sense" is displayed.

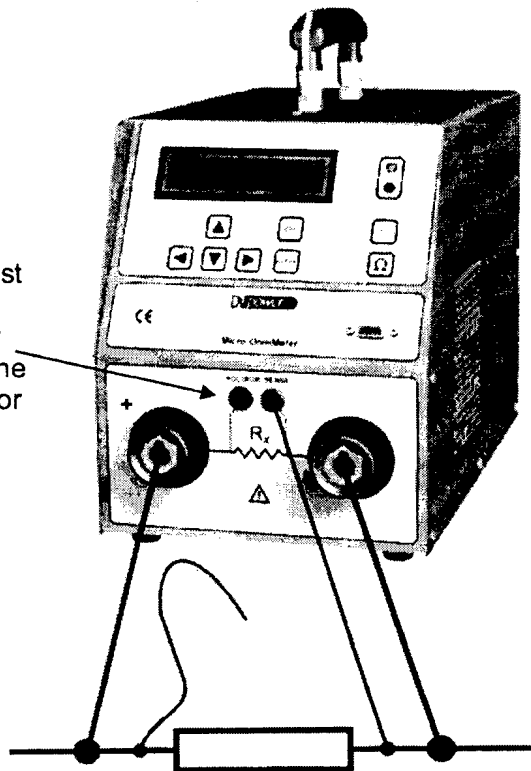


Figure 7-2:
Error message
"Voltage
sense"



Note: Voltage sense cables disconnection, occurred during the test, will cause an erroneous result. The display will not show this as an error message.

7.2 Error Message "Open Connection"

Figure 7-3:
Disconnection of the
current cables

If one of RMO600 current cables ("+" or "-") to the test object is disconnected, on either the test set or the test object side at the start or during the test, the error message "Open Connection" is displayed.

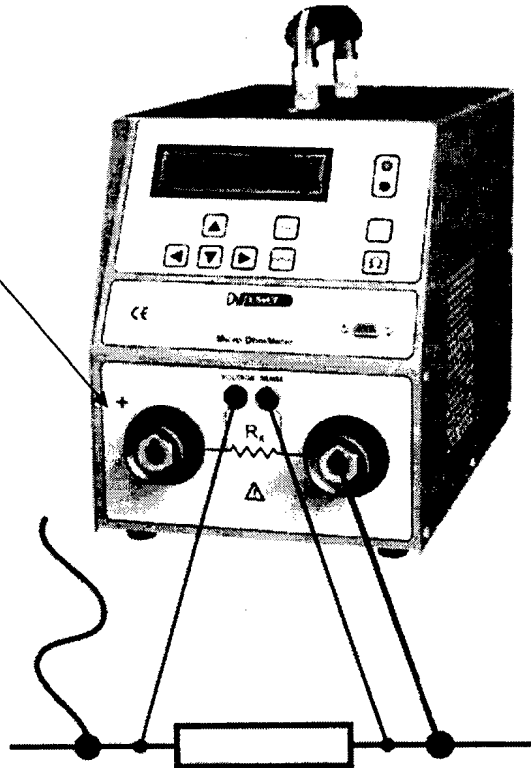


Figure 7-4:
Error message
"Open Connection"



7.3 Error Message "I x R > 2,5V"

This message is displayed if during the test the voltage at the test object exceeds 2.5V. In this case reduce the test current and repeat the test.

Figure 7-5:
Error message
"I x R > 2.5V"



7.4 Error Message "Overheat"

This message is displayed when RMO600's operating temperature rises too high due to a high ambient temperature (refer to section 8.3) or, despite the duty cycle time control (refer to section 6.6), too many high current tests were performed in too short of a time.

Figure 7-6:
Error message
"Overheat"

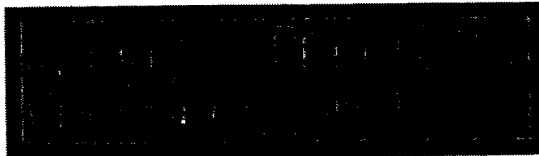


In this case, wait for the test set to cool down and repeat the test.

7.5 Error Message "Malfunction"

If this message is shown on the display, or if RMO600 cannot be operated anymore at all, a serious internal error occurred.

Figure 7-7:
Error message
"Malfunction"



Please do not open RMO600 by yourself. Contact the IBEKO POWER AB (refer to section "Manufacturer Contact Information").

8 Technical Data

8.1 Mains Power Supply

- Connection	according to IEC/EN60320-1; UL498, CSA 22.2
- Voltage single phase	110 – 240 VAC, +10% – -15%
- Frequency	50/60 Hz

8.2 Output data

- Test current	10A – 600A DC
- Measuring range/Resolution	1 – 99,9 $\mu\Omega$ / 0,1 $\mu\Omega$ 100 – 999 $\mu\Omega$ / 1 $\mu\Omega$ 1 – 9,99 m Ω / 10 $\mu\Omega$ 10,0 – 99,9 m Ω / 100 $\mu\Omega$ 100 – 200 m Ω / 1m Ω
- Accuracy	$\pm 0,25\% + 1 \text{ LSD}$

8.3 Environmental conditions

- Operating temperature	-10° - +50°C / 14° - +122°F -10° - +40°C / 14° - +104°F (Continuous test)
- Storage temperature	-25° - +70°C / -13° - +158°F
- Humidity	5 – 95% relative humidity, non condensing

8.4 Dimensions and Weight

- Dimensions	198 x 255 x 380 mm (W x H x D) without handle 7,8 x 10 x 15 in
- Weight	8 kg / 17,5 lbs

8.5 Safety Standards

- European standards	EN 61010-1
- International standards	IEC 61010-1 UL 3111-1 CAN/CSA-C22.2 No 1010.1-92

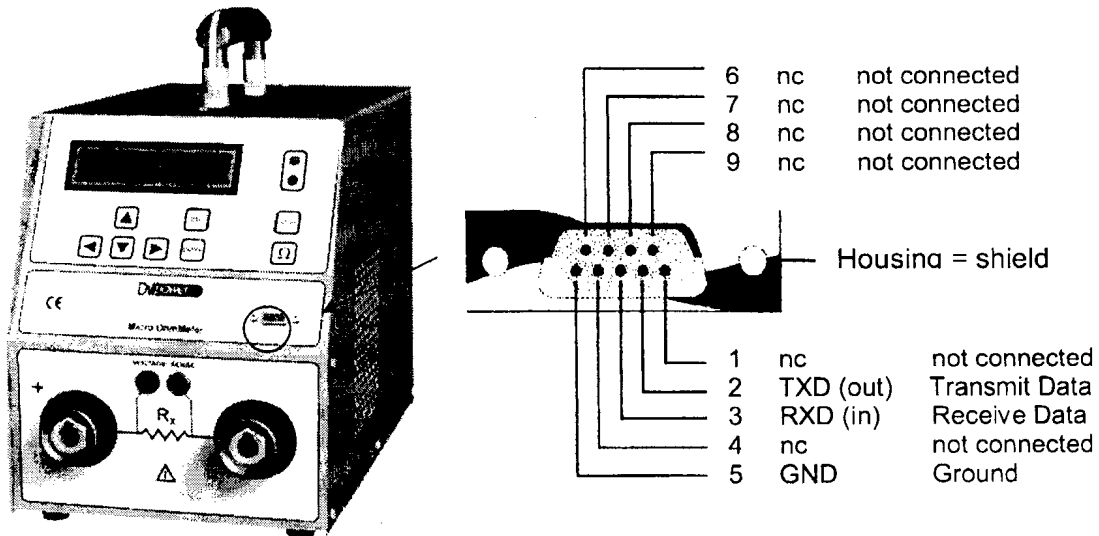
8.6 Electromagnetic Compatibility (EMC)

CE conformity	EMC standard 89/336/EEC
Emission	EN 50081-2, EN 61000-3-2/3
Interference Immunity	EN 50082-2

8.7 RS232 Interface

RMO600 is equipped with an RS232 serial interface to connect to an external computer.

Figure 8-1:
RS232 serial interface
connector on RMO600
front panel to connect to
an external computer



9 Accessories

Standard	Article No
Current cables 2 x 5m, 50mm ² , 4,2 mΩ with battery clips	
Sense cables 2 x 5m, 2,5mm ² with alligator clips	
Transport bags	
RMO-Win PC software including RS232 cable	
Mains power cable	
Ground cable	

Additional	Article No
Transport case	
Test shunt 100 μΩ (600A/60mV)	
Current cables 2 x 3m, 70mm ² , 1,8 mΩ with battery clips	
Current cables 2 x 5m, 70mm ² , 3 mΩ with battery clips	
Current extension cable 1 x 5m, 70mm ² , 1,5 mΩ	
Current extension cable 1 x 5m, 50mm ² , 2,1 mΩ	
Current extension cable 1 x 10m, 70mm ² , 3 mΩ	
Sense cables, extension 2 x 5m, 2,5mm ²	
Sense cables, extension 2 x 10m, 2,5mm ²	
Sense cables 2 x 10m, 2,5mm ² with alligator clips	

10 Manufacturer Contact Information

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