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**200 Amp Digital Micro-Ohm Meter**

**Model: MC2**

# RAYTECH USA, Inc.

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## **SAFETY PRECAUTIONS!**

**1 – 0**

The following safety precautions must be observed during all phases of operation, service, and repair of this instrument. By purchasing this equipment the purchaser assumes all liability for the operation and use of this equipment. The intended use of the instrument, its design and manufacture, is to be conducted within the precautions or other specific warnings located within this manual. Failure to comply with these precautions and other specific warnings violates safety standards of design, manufacture, and intended use. Raytech USA, Inc. assumes no liability for the operation and use of this equipment.

### **SAFE OPERATION**

Only qualified knowledgeable persons should be permitted or attempt to operate this test equipment. All test personnel should fully familiarize themselves with the correct application and operation of this and all test equipment prior to operation. Persons directly and indirectly engaged in the operation of this test equipment should keep clear of all high voltage apparatus while conducting tests and measurements.

### **BEFORE APPLYING POWER**

Read this manual carefully before operating the system.

The MC2 is line operated. The system operates from an auto-sense input power from the main power input from 100 to 250 vac 50/60Hz.

### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE**

Do not operate the instrument in the presence of flammable gases or fumes.

### **KEEP AWAY FROM LIVE CIRCUITS**

Operating personnel must not remove instrument covers. Component replacement and internal repairs must be made by qualified service personnel. Do not replace components with power cable connected. To avoid injuries, always disconnect power, discharge circuits, and remove external voltage sources before touching components.

### **DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT**

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Raytech USA service department for service to ensure proper operation and that safety features are maintained.

Instruments, which appear damaged or defective, should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

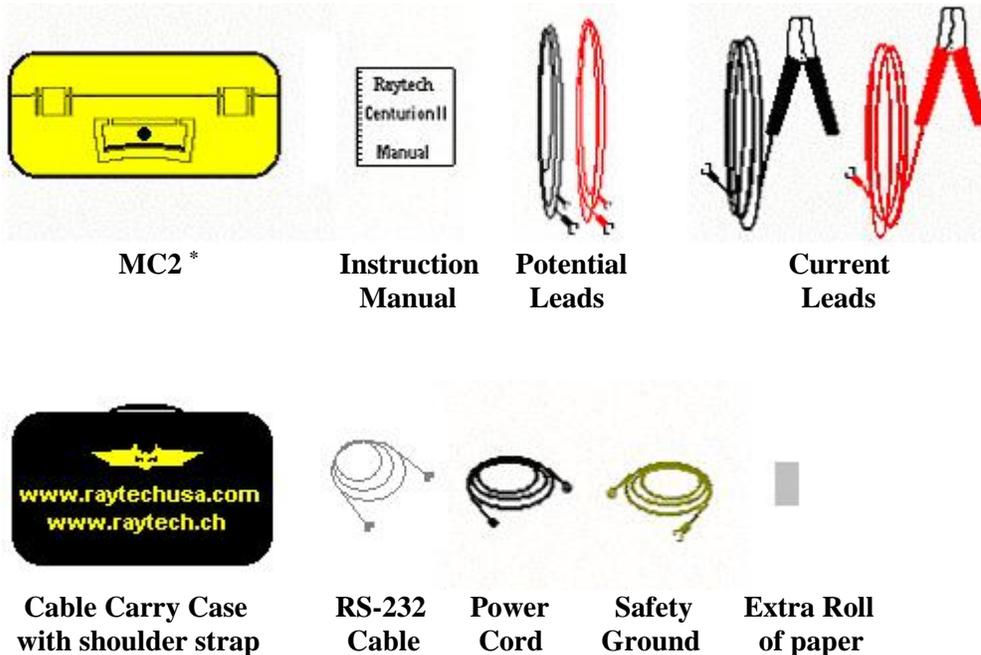
## **TEST WARNINGS!**

- 1. Do not use on live circuits.**
- 2. Do not use a faulty or under-powered Generator or Inverter to power the system.**
- 3. Do not vary the input mains voltage or frequency while operating.**
- 4. The system is not intended for the testing of Inductive loads (transformers).**

## UNCRATING:

2 – 0

Unpack your new MC2 and check to see that you have the following standard items:



If any of the above items are missing or damaged contact your local representative or Raytech USA, Inc. immediately. The test leads may be ordered other than shown.

**RAYTECH Toll free service & support telephone: 1 888 4 THE SPY**

\* Note:

1. The MC2 Field case is a waterproof design that incorporates an automatic pressure relief valve that will adjust to various atmospheric changes; i.e... Airplane Travel, High altitudes, etc... The valve is designed to be water resistant.
2. The field case is not a shipping container.

**SPECIFICATIONS**

<b>MODEL:</b>	<b>MC2</b>
<b>SIZE:</b>	<b>L:</b> 20.5" (521 mm) <b>W:</b> 17" (432 mm) <b>H:</b> 8.5" (216 mm)
<b>WEIGHT:</b>	31.5 lbs. (14.4 kg)
<b>INPUT POWER:</b>	100 to 250 Vac (1kW max.), 50/60 Hz, Automatic ranging
<b>TEST CURRENT:</b>	User Selectable: 200, 100, 50, 20, 10 Ampere
<b>PANEL DISPLAY:</b>	LCD Graphic with back lighting
<b>FRONT PANEL:</b>	Sealed anodized with a multi-actuation rotary knob
<b>INTERFACE:</b>	9 Pin RS232 Serial / 25 Pin Centronics Parallel
<b>MEMORY STORAGE:</b>	Stores up to 2000 complete test results

**RESISTANCE RANGE :** 0.01 $\mu\Omega$  to 5  $\Omega$

**MEASURING DUTY CYCLE :** 200A 10 min. on 5 min off. 100A & under continuous

**MEASUREMENT PARAMETERS:**

<b>Current Range</b>	<b>Measuring Range</b>	<b>Accuracy</b>	<b>Highest Resolution</b>
200 Amp :	0.00 $\mu\Omega$ ... 20m $\Omega$	$\pm 0.1\%$ Rdg $\pm 0.01$ $\mu\Omega$	5 Digits or 0.01 $\mu\Omega$
100 Amp :	0.00 $\mu\Omega$ ... 40m $\Omega$	$\pm 0.1\%$ Rdg $\pm 0.02$ $\mu\Omega$	5 Digits or 0.02 $\mu\Omega$
50 Amp :	0.00 $\mu\Omega$ ... 100m $\Omega$	$\pm 0.1\%$ Rdg $\pm 0.04$ $\mu\Omega$	5 Digits or 0.05 $\mu\Omega$
20 Amp :	0.0 $\mu\Omega$ ... 1.0 $\Omega$	$\pm 0.1\%$ Rdg $\pm 0.1$ $\mu\Omega$	5 Digits or 0.1 $\mu\Omega$
10 Amp :	0.0 $\mu\Omega$ ... 5.0 $\Omega$	$\pm 0.1\%$ Rdg $\pm 0.2$ $\mu\Omega$	5 Digits or 0.2 $\mu\Omega$

**TEMPERATURE:** Operating: - 10° C to 60° C      Storage: -20° C to 70° C

**CABLE SET / ACCESSORIES**

Current and potential lead set: 5 meters, Power cord: Heavy duty 7.6 meters, Instruction Manual, Safety ground lead, RS-232 cable, cable carry case, extra roll of paper (5), spare fuses.

**MC2 FEATURES:**

- Automatic measurements of Low Resistance from 0.01 $\mu\Omega$  ...5 $\Omega$
- Pure filtered DC Power source for the highest accuracy readings
- Microprocessor based system with internal storage for test results
- Single or continuous measurements with automatic data storage
- Automatic shut off for over-temperature condition
- Complete automatic calibration system and system diagnostics
- Internal Panel Mount Printer
- Centronics (Parallel) Interface & RS232 (serial) Interface
- 5 Year standard warranty

**OPTIONS:**

- Part No - 2021A-05001 – 200 A Kelvin clip lead set, 5 meters
- Part No - MC02 – Custom clamping devices (user specified)
- Part No - 2021N-26001 – External Temperature probe, 10 meters
- Part No - 2021N-15001 – Annual Warranty Extension

\* Specifications are subject to change at anytime.

## INTRODUCTION

4 – 0

**Raytech** Digital Micro-ohm meter, Micro-Centurion 2 (MC2), was designed for a high degree of accuracy for the measurement of very low resistance. This technology was then packaged into a portable test system for use by apparatus manufacturers, rebuild shops, and electrical maintenance crews.

**Ease of use:** This intelligent system has an easy to use operation screen, which allows quick selection of the current level and resistance level to be measured. The system has the ability to detect the resistance level and suggest the correct range to select which provides for extremely accurate results.

**Impressive Accuracy:** The MC2 is a high precision, fully automatic, microprocessor based system. This system is designed for highly accurate readings on-site with laboratory precision.

**Unique Measuring Technique:** This newly designed technique of measurement incorporates a high precision measurement circuit and modular power source. Extensive filtering and high precision standards are used within the test system. The system is capable of precision measurements to 200 A.

**Operation:** The MC2 applies a preset current level and resistance range selected by the user. The results of the test are displayed within a few seconds automatically. The results are reported on the easy to read liquid crystal display and can be stored or printed out.

**Compact Design:** The MC2 is one of the most lightweight systems available that comes complete with its own rugged waterproof Fieldcase.

**Simple Maintenance:** There is No maintenance required. There is No calibration procedure (No potentiometers to turn). This is due to the utilization of high precision components in the design.

**Advanced Protection:** Upon powering on the system initializes itself with a self-calibrating, circuit checking sequence. If any problems are detected during this initialization period, or during operation, the operator is immediately notified. The system constantly monitors the condition when turned on. The MC2 has extensive protection built in to the circuitry. This is one of the many reasons we can extend our warranty to 5 years.

### Advantages & Features:

- Highest accuracy and Precision of any high current test system
- Automatic measurements of Low Resistance from  $0.01\mu\Omega$  ... $5\Omega$
- Microprocessor based system with internal storage for over 2000 test results
- Single or continuous measurements with automatic data storage
- User can preset a number of tests, at various timed intervals, for automatic data storage
- Printing and Storage of test results while the test system is measuring
- Complete automatic calibration system and system diagnostics
- Standard Centronics (Parallel) Interface & RS232 (serial) Interface
- Pure filtered DC Power source for the highest accuracy readings
- Automatic, high efficiency cooling system to dissipate internal temperatures
- Automatic shut off for over-temperature condition
- Panel mounted Emergency Stop Switch
- Wide input power source range
- Lightweight and Portable, Less than 33 lbs
- 5 Year standard warranty

**System Check:**

The instrument is Line operated. The system is designed to be used with voltage power sources (mains power) between 100-250 vac 50/60Hz. The system performs a self check each time that it is powered on. The user should always visually inspect all connectors, cables and devices to be measured to avoid any safety issues.

**Limitations of Resistance Testing:**

The Test system is capable of sourcing 200 amperes DC. The current test leads should have a total resistance not exceeding 40 milliohms. Beyond the 40 milliohms the test set decreases the available output current at lower current settings. A warning message may appear: "Use 10 Amp range". The system is just letting the user know that the selected current output that the user wishes to use may not be 100%. However, the system will continue to measure and display a less accurate result. If the message "Rx Too High" or "+++." is viewed in the display, then mandatory range switching must be complied with to continue to test.

**Transformer windings:**

Use of the MC2 for high inductive winding resistance is not recommended. The inductive characteristics of transformer winding testing require a long period to saturate the winding to get a stable reading. In addition, care must be taken when removing test leads such that a voltage charge does not remain on the winding. Lethal currents might remain and may cause personal injury and possibly damage the instrument. Specialized test sets with heavy duty discharge circuits and higher potential compliance voltages and current should be considered for winding resistance measurements (Raytech WR50 Series of test instruments).

**Do not use test probes (MJ04 or other) when testing Inductive loads (Motors, transformers) or at current levels above 10 amperes. Consult the factory for additional information.**

**Low Resistance Testing:**

The MC2 is an extremely useful device for checking Switch Contacts, SF6 Switchgear, Bus bars, Splices, Joints, Fuses, Breaker contacts, Rail bonds, and Low inductive windings.

The MC2 utilizes a 4 wire measuring technique. The Two (2) connections on the front plate marked +I & -I are the current leads. The Two (2) connections on the front plate marked +P & -P are the Potential or Voltage leads. By connecting a test specimen to the Current leads (See figure 1) and applying the Potential leads across the resistance to be measured. The points where the potential leads are connected determine the resistance reading.

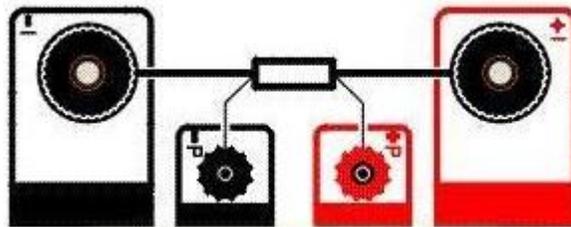


Figure 1

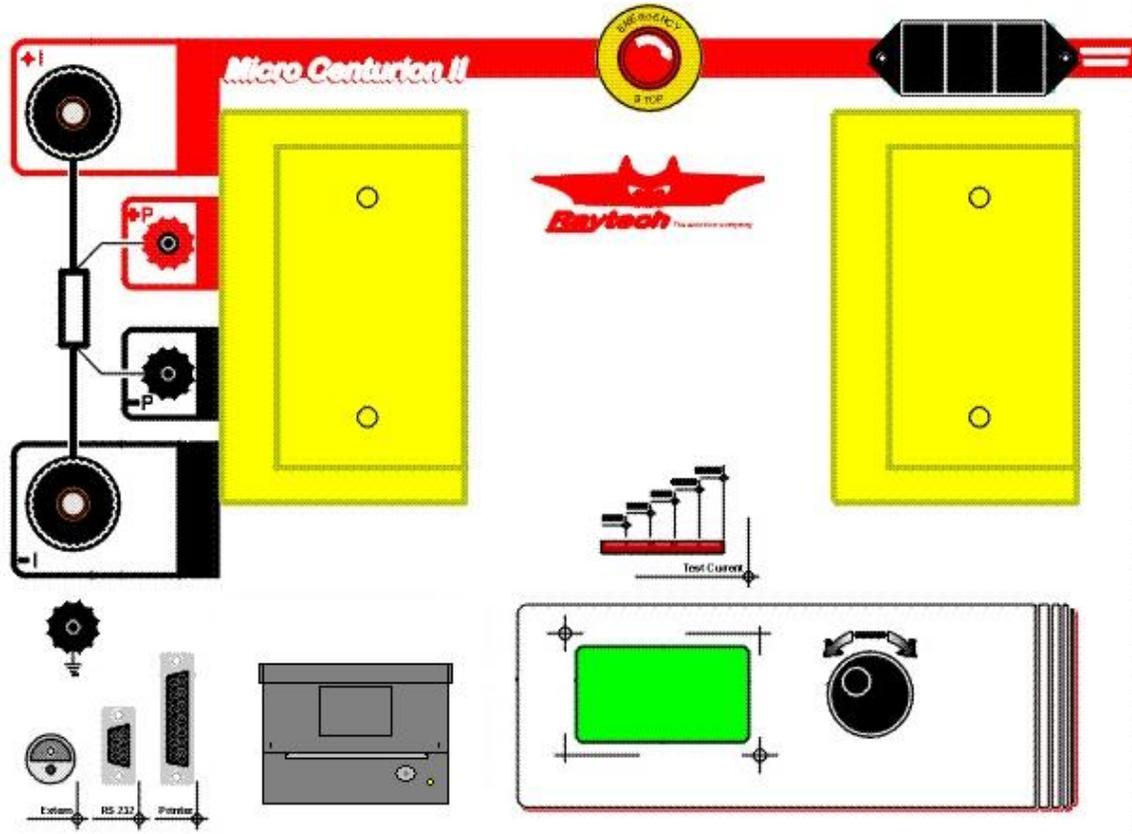
The test set employs a very simple principle of Ohm's law:  $R=V/I$

**R** = Resistance, **V** = Voltage, **I** = Current

**FRONT PANEL:**

6-0

**FRONT PANEL DESCRIPTION:**



**Power, Positive and Negative Test Leads, Emergency stop Button:**



Power cord Connection and On/Off switch  
Accepts 100...250 Vac



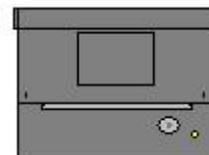
Emergency OFF  
Press to stop - Turn Clockwise to release

**Computer Connections:**



Serial Port: RS232 Bi - directional,  
Female 9 pin connector (See Section 10)  
Parallel Port: Standard Centronics,  
Female 25 pin connector (See Section 10)

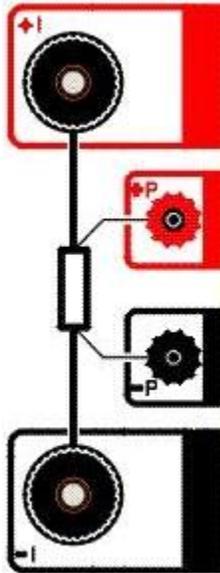
**Printer:**



The panel mount printer uses thermal heat transfer technology. The single button is for form-feed. To tear paper, pull towards the front of the instrument along the serrated cutting edge.

## FRONT PANEL DESCRIPTION:

6 – 0



### Test Connections:

- +I = Positive Current connection**
- +P= Positive Potential (voltage) connection**
- I = Negative Current connection**
- P= Negative Potential (voltage) connection**

**Earth Ground Terminal**



**Temperature Probe connection:** 2 pin Connection for optional (external) temperature probe.

### Buttons:



This is a multi-actuation, rotary knob which is the main user input and control

This rotary knob allows the user:

- To select the current level and resistance range.
- To setup the test system parameters.
- To start a test sequence.
- To store or print a test.
- To put the test set into various measuring modes
- To view archive data (previous test reports saved into memory).

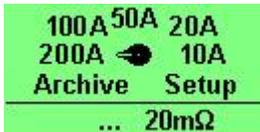
## TYPICAL DISPLAY SCREENS:

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Ver. 2.3

7 – 0

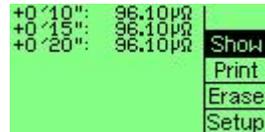
9



**MAIN SELECTION**



**SETUP**



**ARCHIVE**

**MAIN SELECTION Screen:**

Allows access to the Archive (Memory), Setup and Resistance & Current test levels. Selection is made by turning the rotary knob to the desired position then pressing down on the rotary knob to confirm selection.

**SETUP Screen:**

All selections for Printer options, LCD Contrast, Auto Test mode and Clock adjustments. Selections are made by turning the rotary knob to highlight the desired position then pressing the rotary knob for the selection.

**ARCHIVE Screen:**

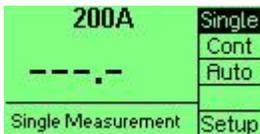
This is where the memory locations are kept.

**SHOW:** This selection will allow viewing of all of the memory locations.

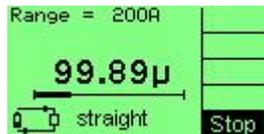
**PRINT:** This selection will print all of the memory locations.

**ERASE:** This selection will erase all of the memory locations.

**SETUP:** This selection will return to the MAIN SELECTION screen.



**START TEST**



**TEST IN PROGRESS**



**END OF TEST**

**START TEST Screen:**

Selection of “Single” starts a test sequence for a single test with the duration of about 8 seconds. Selection of “CONT” starts a continuous test sequence. In the continuous test mode the system will measure until the user presses stop. Also, while testing in continuous mode the user may Print or Store at test result at anytime.

Selection of “AUTO” puts the system into the “Automatic measure and save mode”. The system will measure and save data at “user selectable” time intervals into the system’s memory location (Archive).

**TEST IN PROGRESS Screen:**

This screen shows that the test is in progress and that there is current flowing.

**END OF TEST Screen:**

At the completion of a test the user can select to following:

**GO:** Run the same test again.

**STORE:** Store the results of a test in a memory location

**PRINT:** Print the results via the Internal printer, Serial or Parallel port output.

**MODE:** Select a different test mode: AUTO, SINGLE, or CONTinuous.

**SETUP:** Return to the Main Selection Screen.

200A	Go
100.22µ	Store
	Print
	Mode
Store Data	Setup

**STORE**

100A	Go
99.88µ	Store
	Print
	Mode
Print Data	Setup

**PRINT**

100A	Header
99.88µ	Data
	FF
	Stop
Print Data	

**PRINT MENU**

**STORE Screen:**

By pressing the rotary knob, with STORE highlighted, the system will store the test result in the next available memory location.

**PRINT & PRINT MENU Screen:**

By pressing the rotary knob, with STORE highlighted, the system will open the sub-menu PRINT MENU, and allow the following to be selected:

Selection of “HEADER” allows the user to Print a Header.

Selection of “DATA” allows the user to Print the data.

Selection of “FF” allows the user to print a Report form or advance the paper on the internal printer.

Selection of “STOP” returns to the Test screen.

Setup	Printer
$N \times T_i$	LCD
$T_i$	Auto
$T_i$	Clock
$T_i = 3'00 \text{ sec}$	OK
$N = 15$	

**AUTO TEST**

13.03.2003	Printer
13:37	LCD
	Auto
	Clock
	OK

**CLOCK**

Setup	Printer
LCD Contrast	LCD
	Auto
	Clock
	OK

**CONTRAST**

**AUTO TEST Screen:**

The Auto Test screen is accessed through the Set-up screen. This feature allows setting the number of tests required at certain time intervals set by the user.

**CLOCK and CONTRAST Screens:**

The Clock and Contrast screens are accessed through the Set-up screen. The time can be set by turning the rotary knob and pressing the desired selection. Selections are made in this order: Year, Month, Day, Minute, and Hour.

The Contrast (LCD) can be changed by pressing and then turning the rotary knob for the desired view.

**GETTING STARTED:**

**WARNINGS!**

BEFORE OPERATING THIS OR ANY OTHER TEST EQUIPMENT READ ALL SAFETY WARNINGS AND UNDERSTAND THEM FULLY.

**OPERATION:**

This section describes a typical, step by step, operation of the MC2. Open the top protection lid of the case and attach the test leads to the test set. The Two (2) connections on the front plate make **+I** & **-I** are the current leads. The Two (2) connections on the front plate make **+P** & **-P** are the Potential or Voltage leads. By connecting a test specimen to the Current leads (See figure 2) and applying the potential leads across the specimen the resistance readings will be determined.

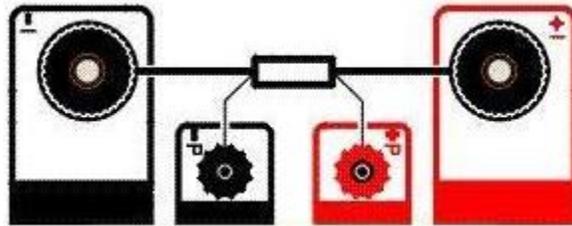


Figure 2

Turn the Power switch, located at the power input connector to the “ON” position. The Initial screen, MAIN SELECTION, will appear. The Instrument will also make the initial calibration.

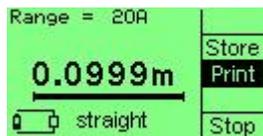
Select the resistance range expected to be measured with the multi-turn Knob. Press the multi-turn Knob when the indicator is pointing (Highlighted) at the resistance and current level to be measured (If unsure of current level, then start at the 10A range and increase the current ranges until a valid reading appears).

After the current range is selected press the multi-turn Knob again. The following measuring modes can then be made:

**SINGLE** (Single test -8 seconds), **CONT** (Continuous Test), **AUTO** (Automatic Test)

**SINGLE:** The SINGLE mode allows a single test to be made. Turn the multi-turn Knob until SINGLE is highlighted. Press the multi-turn Knob to select. The test set will start a measuring sequence immediately. The system will sense the current output and, if it is a valid reading, record the results on the display. The results can then be STORED or PRINTED.

**CONT (Continuous):** The CONT (Continuous) mode allows a single test to be made continuously. The instrument will continuously measure until the operator presses STOP. Turn the multi-turn Knob until CONT is highlighted. Press the multi-turn Knob to select. The test set will start measuring immediately. The system will sense the current output and, if it is a valid reading, display the results on the display. If the STOP button is selected the last valid reading displayed will remain on the display.



**CONTINUOUS TEST**

**NOTE:** The results displayed can be stored or printed at anytime during the measurement process.

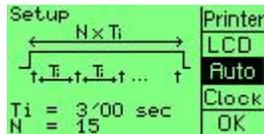
**OPERATION:**

**8 – 0**

**AUTO (Automatic)**

The **AUTO** (Automatic) mode will measure and store, automatically, numerous single sequential tests at timed intervals that are preset by the operator. To preset the number of tests at timed intervals please go to the Set-UP screen (See below) and select **AUTO**.

In this **AUTO** mode the instrument will continuously measure multiple tests until the operator selects and presses **STOP** or until the number of tests that were preselected have been achieved. The instrument will automatically save test results in a numbered memory location that will increment by a timed interval.



**AUTO Setup screen:**

**Ti** = Test Interval

**N** = Number of Tests desired.

A maximum of 10 minutes at 5 second intervals can be preset.

**Measurement Notes:**

Note 1: The instrument will halt the measuring process if excessive interference is detected.

Note 2: If a warning message, "Rx Too High" is displayed, Or if "+++." is displayed, Then return to the "SET UP" screen and select the next higher current range.

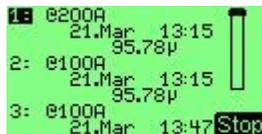
The "+++." is displayed when no input is measured on the +P & - P terminals.

**ARCHIVE:**

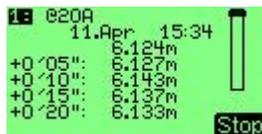
**9 – 0**

The Archive or Memory allows over 2000 complete test results to be saved. The method used for the memory location is:

Each memory location is designated a number, a date and time on which it was recorded, the results measured, and the current it was tested at.



If multiple tests are taken in one test sequence the memory location will appear like this:



The test results can be printed from the Archive via the RS232 port or Parallel printer port.

**PRINTER:**

Selecting Printing options:

From the SETUP Menu Select “Printer”:



The user now has the option to select:

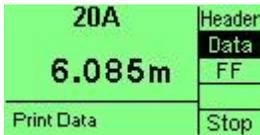
**Internal** – The panel mount printer. The system comes standard in a built in printer.

**Parallel** – An external printer connected to the 25 Pin connector.

**Serial** – An external printer connected to the 9 Pin connector.

**Internal Printer:**

The internal thermal printer report has the following options:



**Header** – Prints the header lines onto the report.

**Data** – Prints the Data onto the report.

**FF** – Form Feed

The user may at the completion of each test print the results or may recall previous tests from a memory location and print these results as well.

The test report is printed in the general following manner:

**Test  Report**  
*Measured by Raytech Type MC II*  
**S/N : 231-002**  
**Fw : u200 1.29**

**Operator :** .....  
**Date :** .....  
**Object :** .....  
**Site :** .....

**#1 at 200 A**  
**10. Jan 02 12:00:00**  
**+ 0'05" 10.000 m**  
**+ 0'10" 10.001 m**  
**+ 0'15" 10.003 m**  
**+ 0'20" 10.004 m**  
**+ 0'25" 10.006 m**

**TEMPERATURE PROBE:**  
(Option 2021N-26001)

**11 – 0**

This probe can be purchased for the MC2 for the purpose of recording temperatures. Recording the temperature of the device under test is highly recommended due to the characteristics of the increase of resistance of a metallic object as its temperature increases.

There are temperature compensation tables for Copper and Aluminum available to calculate the conversion factor. The MC2 is a very accurate and precise test system. To take full advantage of this high accuracy, the temperature of the device under test should be recorded.

The temperature probe is mounted to a flexible extension cable that plugs into the front panel of the MC2. This option enables the user to record the ambient temperature or the actual temperature of the device under test.

The MC2 will automatically sense when the optional temperature probe, 2021N-26001, is connected to it. The temperature will be displayed on the instrument screen during a test and will appear when a print report is requested. The temperature, as well as the test results, can be saved into memory. The temperature can only be viewed during a test and on a printed report.

The actual temperature measured is displayed and can be saved into memory.

## **BASIC INSTRUCTION – QUICK TEST:**

**12 – 0**

### **WARNINGS!**

BEFORE OPERATING THIS OR ANY OTHER TEST EQUIPMENT READ ALL SAFETY WARNINGS AND UNDERSTAND THEM FULLY.

### **WARNINGS!**

BEFORE USING THE BASIC OPERATING INSTRUCTIONS THE OPERATOR SHOULD BE COMPLETELY FAMILIAR WITH THE TEST SYSTEM AND THIS TYPE OF TESTING.

## **OPERATION:**

**12 – 1**

This section outlines the basic measurement instruction, step by step, for the MC2. These are basic instructions, simplified, for the trained and qualified operator.

1. Connect the test leads (2 Current / 2 Potential) to an un-energized device to be measured.
2. Connect the Safety Ground on the front panel to known good Earth Ground.
3. Turn on the system.
4. Turn the Rotary knob to select the Resistance Range / Current Range.
5. Press the rotary knob once.
6. Turn the Rotary knob to (highlight) select the required test: Single, Continuous, Automatic.
7. Press the rotary knob once and the system will perform the test.
8. Save or print the data.

# Troubleshooting

## General

13 – 0

After powering on, the MC2 internal calibration and check sequence is performed. Upon completion of the check sequence the test set will proceed to the “MAIN SELECTION“ Screen.

### SYSTEM DOES NOT DISPLAY ANYTHING:

1. Check the display for any Initialization.
2. Check the fuse. The fuse is located in the Power switch / plug connector.

### SYSTEM POWERS ON BUT THE DISPLAY FADES OUT OR BLINKS:

1. Check the input power line for faults.
2. If an extension cord is being used, check the size and condition of. An extension cord should not exceed 25 feet long and should be at least #12 wire minimum.

### TEST CURRENT CANNOT BE TURNED ON.

1. Does the unit have an external safety switch incorporated? Is it properly operating?
2. Is the Emergency stop switch pushed in? Turn to release it.
3. Is the system connected in an excessive interference area?

### “WARNING Rx TOO HIGH” or “+++.” IS DISPLAYED.

1. A warning message, ”Rx Too High” or “+++.” will be displayed if the resistance being measured is too high for the range selected.  
The ”+++.” is displayed when no input is measured on the +P & - P terminals.
2. The current leads total resistance has exceeded the current capability of the instrument.  
Reduce the current lead length or increase the wire gauge of the current lead used.

### THE DISPLAY CANNOT BE SEEN OR APPEARS TO BE NOT ON

1. The contrast has been set too low.

### ERRATIC OR ERRONEOUS READINGS

Possible causes

1. Test lead damaged or not connected.
2. Poor test lead connection.
3. Poor supply power. Check extension cords, plugs cables carefully.
4. Test set attached to a “Live” load or high interference load.

### NO DATA ON PRINTOUT

Possible causes

1. Paper is not Thermal Paper
2. Paper inserted incorrectly (see below).

CORRECT



INCORRECT



The MC2 was designed to be trouble free.

If problems or questions do arise, please contact our service support group.

RAYTECH USA, Inc. warrants to the original purchaser of any new MC2, that it will be free from defects in material and workmanship under normal use and service for a period of 5 years from the original date of shipment. This 5-year warranty is provided at no cost to the end user, for the products covered under this warranty if the products are returned on each calendar year from the original date of shipment, prepaid, to Raytech USA, for system evaluation.

The obligation of RAYTECH USA, Inc. under this warranty is limited, in its exclusive option, to repair, replace, or issue credit for parts or materials which prove to be defective, and is subject to purchaser's compliance with the RAYTECH USA, Inc. warranty claim procedure as set forth within this manual.

This warranty covers only those parts and/or material deemed to be defective resulting from manufacturer's workmanship. The liability of RAYTECH USA, Inc. shall be limited to the repair, replacement, or issuance of credit for parts deemed defective within the meaning of this warranty. Costs for labor or other expenses that may have occurred incidental to the inspection, repair, replacement, or issuance of credit for such parts and/or materials shall be the sole responsibility of purchaser. This warranty shall not apply to any accessories, parts, or materials not manufactured or supplied by RAYTECH USA, Inc.

Equipment must be returned prepaid with a Return Material Authorization (RMA) to:

RAYTECH USA, Inc. 118 S. 2 <sup>nd</sup> Street Perkasio, PA 18944 USA Tel. 1 267 404 2676 Fax. 1 267 404 2685 www.RaytechUSA.com	or	RAYTECH GmbH Oberebenestrasse 11 CH-5620 Bremgarten Switzerland Tel. + 41 56 648 60 10 Fax. + 41 56 648 60 11 www.Raytech.ch
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### **LIMITATION OF WARRANTY**

The foregoing warranty shall not apply to defects resulting from improper and unauthorized modifications or misuse and abuse of the product, negligence, alteration, modification, faulty installation by the customer, customer's agents or employees. Attempted or actual dismantling, disassembling, service or repair by any person, firm, or corporation not specifically authorized in writing by RAYTECH USA, Inc.

Defects caused by or due to handling by carrier, or incurred during shipment, trans-shipment, or other move.

Inadequate maintenance by the customer, second source supplied software or interfacing, operation outside the environmental limits, or improper site preparation.

Exclusive remedies provided herein are the customer's sole and exclusive remedies.

RAYTECH USA, Inc. shall not be liable for any damages resulting from the use of this equipment whether direct, indirect, special, incidental, or consequential damages, or whether based on contract, tort, or any other legal theory.

**NO OTHER WARRANTY IS EXPRESSED OR IMPLIED.**