



MEASURING AND TESTING EQUIPMENTS FOR SUBSTATIONS





CONTENTS

Micro-ohmmeter	MH-10	Page 3
Mega-ohmmeter	MI (5, 10, 15, 20 kV)	Page 4
	MD (5 kV)	Page 4
Indirect earth contact simulator	TL-5	Page 5
Indirect earth contact simulator	MPC (5, 20, 50 A)	Page 6
Trip time tester	CR (50, 100, 250 A)	Page 7
Dielectric strength tester	OT-60	Page 8

INTRODUCTION

In order to enter a company in the HVMCR, technical measures must be available which subsequently shall be used during maintenance for these installations.

Below is a list of the minimum necessary technical requirements:

- Three phase system analyzer-recorder with printer or internal memory. (Our **AR.5L**)
- Insulation measurer (Mega-ohmmeter) up to 5 kV
- Kelvin bridge (Micro-ohmmeter)
- Step and contact voltage measuring equipment
- Indirect earth contact simulator. (Earth resistance checker and ground resistivity checker)
- Portable dielectric rigidity checker for the insulating oil
- Direct and indirect relay checker case
- Ammeter clamp
- 5 kV·A generating set
- Field thermometer with a measurement range of -10 °C / +250 °C
- Voltage detecting insulating pole
- Earth and short circuit equipment
- Pair of gloves and bench suitable for HV.
- Vacuum cleaner for cleaning stations

Below is a list of equipment supplied by **CIRCUTOR** for transformation centre maintenance.

MICRO-OHMMETER MH-10



The digital **MH-10** micro-ohmmeter is portable equipment controlled by microprocessor for highly accurate measurements of very low resistance circuit breaker contacts, keys, conductor bars transformer coils and motors, welded points, etc., with test currents from 1 mA to 10 A.

The **MH-10** micro-ohmmeter operates according to the terminal method (Kelvin bridge). In this way resistance from the injection cables themselves is avoided. The test current is selected by the operator and the read out is obtained by comparing it with highly stable internal master currents. The results are shown on an easy to read alpha-numeric screen.

Type	Code
MH-10	P60711

FEATURES

Power supply features		Communications	
Rechargeable sealed battery	12 V - 7 A·h	Series data output	RS-232 to 4.800 bps
Built in charger	Yes	Assembly features	
Supplied from mains	Yes	Dimensions	378 x 308 x 175 mm
Protected by fuse	Schurter, SPT 5x20 (Time-lag) 5 A / 250 V a.c. High cut off capacity	Weight	8,8 kg (including accessories)
Measurement features		Protection index	IP 54 with closed cover
Resistance measurement ranges	0-2 000 $\mu\Omega$ \rightarrow 10 A 0-20 m Ω \rightarrow 10 A 0-200 m Ω \rightarrow 1 A 0-2 000 m Ω \rightarrow 100 mA 0-20 Ω \rightarrow 10 mA 0-200 Ω \rightarrow 1 mA	Environmental conditions	
Resolution	1 $\mu\Omega$ for 10 A	Operating temperature	- 5 °C / + 50 °C
Test voltage	Up to 10 V d.c. for 1 A to open circuit	Storage temperature	- 25 °C / + 65 °C
Basic accuracy	\pm 0,2 % of the measured value \pm 2 digits	Humidity	95 % HRA (without condensation)
Display	Alpha-numeric 4 ½ digits	Maximum operating altitude	3 000 m above sea level
		Standards	IEC 61010-1/990, IEC 61010-1/992 amendment 2 IEC 61326-1 IEC 1000-4-2

ACCESORIES INCLUDED

- Combined test points (current and power)
- Carrying bag
- Supply cable
- RS-232 Cable



MEGA-OHMMETER MI / MD



MD and **MI** portable mega-ohmmeters have been specially designed to measure insulation resistances up to TΩ, using test currents selected by the user.

Its highly reliable technology allows accurate measurements to be taken and easily read for low and medium voltage electrical system insulation, transformers, motors, cables, domestic equipment and installations, distribution systems, etc.

They include a rechargeable internal battery and may be supplied from the electrical system.

It is ideal for use in field work: being protected against severe handling conditions which inevitably includes frequent knocks, very high and low temperatures, strong vibrations during transport on bad roads, prolonged exposure to direct solar radiation, etc.

System	kV	Type	Code
Analogue	5	MI-5500e	P60511
Digital	5	MD-5060e	P60521
Analogue	10	MI-10 kVe	P60512

System	kV	Type	Code
Analogue	15	MI-15 kVe	P60513
Analogue	20	MI-20 kVe	P60514

FEATURES

	MD-5060e (*)	MI-5500e	MI-10 kVe	MI-15 kVe	MI-20 kVe
Technology	Electronic	Analogue			
Power supply features					
Rechargeable battery	12 V - 2,3 A·h	12 V - 7 A·h			
Battery charger	18 V - 1,2 A	220 - 240 V a.c.			
Short circuit current	1,5 mA (± 0,5 mA)	1 mA		500 µA	
Measurement features					
Scope	5 000 000 MΩ / 5 kV	10 000 000 MΩ	2 000 000 MΩ	3 000 000 MΩ	4 000 000 MΩ
Test voltage	0,5 - 1 - 1,5 - 2 - 2,5 - 3 - 3,5 - 4 - 4,5 - 5 kV	0,5 - 1 - 2,5 - 5 kV	1 - 2 - 5 - 10 kV	1 - 5 - 10 - 15 kV	5 - 10 - 15 - 20 kV
Scale change	Automatic	Manual			
Basic accuracy	5 % of the reading ± 3 digits	Class 1	Class 2 (± 2 % of the deflection at the end of the scale)		
Indicator	LCD + analogue bars	Analogue			
Recording memory	Yes	No			
Communications					
Series data output	RS-232 to 4.800 bps	Not available			
Printer	Optional (PR-01)	Not available			
Environmental conditions					
Operating temperature	- 5 °C / + 50 °C		- 5 °C / + 50 °C		
Storage temperature	- 25 °C / + 65 °C				
Humidity	95 % (without condensation)				
Maximum operating altitude	3 000 m above sea level				
Assembly features					
Dimensions	274 x 250 x 124 mm		378 x 308 x 175 mm		
Weight	3 kg	4,1 kg	9,5 kg	9,7 kg	9,8 kg
Protection index	IP 54 (With cover closed)				
Standards	IEC 61010-1/1990, IEC 61010 1/1992 appendix 2, IEC 61326-1, IEC 61000-4-3, IEC 61000-4-2				

(*) Includes advanced features such as: automatic calculation of polarization and dielectric absorption index, fixed time step / non step tests and built in digital chronometer

INDIRECT EARTH CONTACT SIMULATOR TL-5



The **TL-5** indirect earth contact simulator is digital equipment controlled by a microprocessor and designed to measure earth resistances and resistivity (using the Wenner method). It can also detect parasite voltages in the ground. It is therefore ideal equipment for measurements in electrical substations, industrial settings, distribution systems, etc, under the IEC 61557-5 Standard.

The **TL-5** is totally automatic and very easy to use. Before starting to measure, the equipment checks if the installation is within the appropriate limits and will notify the user if there is any anomaly (interference voltages too high, very low test current, etc). It also has a memory capable of storing up to 4 000 recordings.

Type	Code
TL-5 indirect earth contact Simulator	P60621
Printer (PR-01)	P69911

FEATURES

Power supply features		Communications	
Rechargeable battery	12V - 2,3 A·h	Series output	RS-232
Battery charger	95 - 240 V a.c. 50...60 Hz	Printer	Optional
Short circuit current	< 3,5 mA	Environmental conditions	
Measurement circuit		Operating temperature	-10 °C / +50 °C
Resistance	0 - 20 kΩ	Storage temperature	-25 °C / +65 °C
Resistivity	0 - 50 kΩ	Humidity	95 % (without condensation)
Voltage	0 - 60 V a.c.	Maximum operating altitude	3 000 m
Accuracy		Assembly features	
Resolution and Resistivity	±2 % of the measured value ±2 digits	Dimensions	274 x 250 x 124 mm
Voltage	±3 % of the measured value ±2 digits	Weight	3 kg
Reading resolution		Protection index	IP 54 (with cover closed)
Resistance	0,01 Ω	Standards	
Resistivity	0,01 Ωm	IEC 61010-1/1990, IEC 61010, 1/1992 appendix 2, IEC 61326-1, IEC 1000-4-2, IEC 61000-4-3	
Voltage	0,1 V		

ACCESSORIES INCLUDED

Printer (Optional)
P69911



- 4 Probes
- 1 40 cm red cable
- 2 20m green and blue cables
- 1 5 m black cable
- 1 Cable 5 m cable to connect to earth measurement system
- Probe case
- Battery charger with 95-240 V a.c. power supply source.



INDIRECT EARTH CONTACT SIMULATOR



fig.1



fig.2



fig.3

MPC-5, MPC-20 and MPC-50 simulators allow voltages appearing between points in the ground to be measured (step voltages) or can measure voltages between earth and conducting parts (contact voltage) when there are leakages through the earth.

Simulators have an alternating current source which is injected between two points on an earth to simulate a leakage current. They also have an electronic voltmeter which measures the voltage drops caused by this current. The **MPC-5** may inject up to 5 A, the **MPC-20** up to 20 A and the **MPC-50** up to 50 A.

In order to carry out the test, the current source is connected between distant points on an earth line and the voltage between two weights one meter apart is measured by a voltmeter (step voltage) or the voltage between two weight one meter apart (step voltage) or between earth and accessible conducting parts is measured. The current source may be set at the required level.

The measurer, controlled by a microprocessor, carries out the measurement using a standard current and can calculate the step and contact voltage for any other preset current. Earth resistance between two points may also be measured. The results are memorized and shown on an LCD display.

A	Type	Code	Figure
5	MPC-5	P60111	fig.1
20	MPC-20	P60112	fig.2
50	MPC-50	P60113	fig.2

ACCESSORIES FOR CR-250		
Trolley for CR-250 / MPC-5	P69901	fig.3

FEATURES

	MPC-5 + test weights + measurement cables + auxiliary earth rods	MPC-20 + test weights + measurement cables + auxiliary earth rods + trolley	MPC-50 + test weights + measurement cables + auxiliary earth rods + trolley
Electrical features			
Power supply voltage	230 V a.c.	230 / 400 V a.c.	
Voltage tolerance	+10 % / -15 %		
Consumption current	15 A	60 A	97 A / 57 A
Frequency	50...60 Hz		
Measurement			
Maximum injected voltage	500 V	600 V	400 V
Digital voltmeter scales	500 V and 10 V		
Input impedance	300 k Ω / 1 k Ω		
Digital ammeter scale	99,9 A		
Analogue ammeter	---	20 A	50 A
Maximum earth resistance (including auxiliary earth socket)	100 Ω	8 Ω	8 Ω
Accuracy			
Voltage	1 % of the reading / \pm 2 digits		
Current	1 % of the reading / \pm 2 digits		
Resistance	3 % of the reading / \pm 2 digits (0...25 Ω) (current supply cables not included)		
Mechanical features			
Equipment size	280 x 470 x 500 mm	450 x 870 x 600 mm (with trolley)	
Equipment weight	42 kg	120 kg	120 kg
Accessories weight	12 kg		
Test weight dimensions	170 \varnothing x 300 mm		
Test weight	2 x 25,5 kg		
Standards	(MIE-RAT-13), IEC 348, IEC 664, UNE 20 553, VDE 0110		

TRIP TIME TESTER



CR-50, CR-100 and CR-250 equipment is made up of current sources especially designed to check the current / time trip curve for automatic switches and indirect protection relays.

They operate on the principle of injecting an adjustable alternating current into the circuit being tested via a cable loop in short circuit. Connecting an auxiliary contact to the switch being tested allows the trip time to be measured for each current selected.

The test is very easily carried out using a stop-start command. An automatic measuring system carries out the measurements and shows them on the display.

It is worth highlighting that the whole protection system may be checked, including the current transformer in the case of indirect relays, because the current may be injected on their primary side.

After the test the digital display automatically shows the size of the injected current and the trip time. These are displayed until the RESET is pressed.

A	Type	Code	Figure
50	CR-50	P60211	fig.1
100	CR-100	P60212	fig.2
250	CR-250	P60213	fig.3

FEATURES

	CR-50	CR-100	CR-250
Electrical features			
Power supply voltage	230 V a.c. (+10 % / -15 %)		
Frequency	50...60 Hz		
Current supply	Insulated, short circuitable, adjustable from front control		
Overload capacity	1,5 I _n , 1 min (12 V max.)	2,5 I _n , 10 s (6 V max.) / 1,5 I _n , 1 min (12 V max.)	
Nominal power	300 V·A	600 V·A	2500 V·A
Current	1,6 A max	6 A max	20 A max
Current supply	0 to 6 V : I _n = 50 A max 0 to 30 V : I _n = 10 A max	0 to 6 V : I _n = 100 A max 0 to 30 V : I _n = 20 A max	10 to 50 V : I _n = 50 A max 0 to 10 V : I _n = 250 A max
Measurement			
Current measurement	Digital equipment		
Accuracy	1 % of the reading / ± 2 digits	0.5 % of the reading / ± 1 digit	
Time measurement	Digital clock		
Measurement field	Up to 99 999.9 s	Up to 9 999.99 s	
Test method	start Automatic stop Manual stop	With start button Aux. contact open or closed With stop button	
Mechanical features			
Weight	11 kg	22 kg	43 kg
Dimensions	320 x 200 x 215 mm	430 x 312 x 265 mm	280 x 470 x 500 mm
Standards	IEC 348, IEC 664, UNE 20 553, VDE 0110 *see also regulations on determining test methods		

ACCESSORIES



Trolley
P69901



Cable 2 500 A
P69902



Transformer 2 500 A
P69903



DIELECTRIC STRENGTH TESTER FOR INSULATING OIL



This equipment has been especially designed to determine the dielectric strength of any type of insulating oil used in transformers, industrial cables, automatic switches and new or old capacitors.

Controlled by microprocessor, their memory includes parameters set by the different standards to carry out these tests. Simply by pressing the corresponding command for the selected Standard, the microprocessor sets the test in accordance with the conditions set by that Standard.

Type	Code
OT-60	P60311

FEATURES

Electrical features	
Power supply voltage	230 V a.c. (+10 % / -15 %)
Frequency	50..60 Hz
Consumption	100 V·A / 1200 V·A point
Equipment operating temperature	0 °C / +50 °C
Test circuit	
Maximum voltage	60 kV a.c.
Accuracy	± 2 %
Frequency	50 Hz ± 2 %
Voltage ramp (selectable)	5, 3, 2 or 0,5 kV / s
Disconnection time on producing the arch	< 20 ms
Agitation time	60 s (preset)
Standby time before test	60 s (preset)
Equipment operating temperature	+ 15 °C / +25 °C
Voltage measurement	With digital voltmeter
Assembly features	
Dimensions	385 x 300 x 400 mm
Weight	38 kg
Test cell	Methacrylate
Useful capacity of cell	480 ml
Electrodes	Stainless steel
Oil agitator	TEFLON (P.T.F.E.), included
Light	Fluorescent lighting the test chamber
Insulating oil	60 kV
Standards *preset test standards in each piece of equipment	UNE 21 309, IEC 156, DIN VDE 0370 (p5), UTE C-27221
On request, test electrodes for ASTM 877, ASTM 1816, etc. standards may be supplied	



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code C3P063-01

P6-8

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