

# P.6

## Measuring and testing equipments for substations



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## Measuring and testing equipments for substations

Royal Decree RD 3275/1982 on the technical conditions and safety guarantees in electrical power plants and substations is still in force. The said regulations establish the compulsory maintenance contracts required for the said installations before their commissioning.

The maintenance activities in installations regulated by the regulations mentioned above can only be carried out by companies registered in the register of high-voltage installation maintenance companies (REMAT) of the Territorial Industry and Energy Service where they carry out their activities.

A series of requirements have been established in order to guarantee the conversion and maintenance tasks, which must be complied with by all high-voltage installations, in accordance with the regulations and MIE-RAT additional technical instructions. In addition, the owner must comply with all requirements related to the resolution of faults detected.

A company that wishes to be registered in the REMAT must have the adequate technical resources, which will be used during the maintenance tasks.

The minimum technical resources required are described below:

- Three-phase power analyser with printer and internal memory. (type **AR5-L**)
- Insulation meter (Megohmmeter), up

to 10 kV

- Kelvin Bridge (Microhmmeter)
- Forward and contact voltage meter (**GETEST**) 50 A
- Earth resistance meter. (Earth resistance and resistivity meter) **TL-5**
- Portable dielectric rigidity verification unit used to check the dielectric rigidity of insulating oil **OT2-60D**
- Direct and indirect relay verification case
- Hook-on meter
- 5 kV-A Generator set
- Field thermometer with a measurement scale of - 10 °C ... + 250 °C
- Voltage detection insulating pole
- Earthing and short-circuit equipment
- HV protection gloves, helmet and stool
- Vacuum to clean centres

The new Regulations related to the technical conditions and safety guarantees required in high-voltage power lines have also been published recently, in accordance with Royal Decree 223/2008, which also mentions the equipment that must be used by authorised installation companies.

The equipment supplied by **CIRCUTOR** to comply with the said requirements is described next.



# GETEST

Indirect earth contact simulator



## Description

The **MPC-5/50 GETEST** unit can be used to measure the voltages between ground points (forward voltage) or earth and conductive parts (contact voltage) when there are leakage currents through earth. In Spain, these measurements are compulsory in substations and distribution centres, in compliance with MIE-RAT-13, BOE 183 of 01/08/94.

The tests are carried out by connecting the current generation system between different points that are far from an earth line, measuring the voltage between the two weights that are a metre apart (forward voltage) or between earth and accessible conductive parts. The current source is adjusted to the desired value with a PDA, displaying and storing the data measured.

- Forward and contact voltage measuring, based on current injection during a grid cycle (20 ms) (maximum usage safety).
- Earth resistance measurement.
- Provides up to 50 A with a 12 ohm load. Maximum output voltage of 600 Vac
- Maximum power equivalent to 30 kV·A, with a weight of only 45 kg.
- Remote control and display of the data measured with a PDA, with bluetooth connection to the equipment.
- Storage of data in the PDA, so it can be easily transferred to the PC.
- Voltage measurement with a resolution of 10 mV. Self-scale, up to 700 Aac
- Current measurement with a resolution of 10 mV. Self-scale up to 700 Aac

## Features

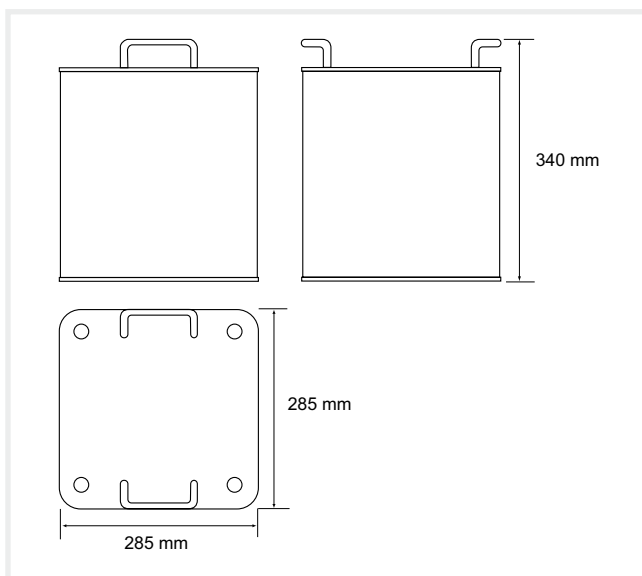
<b>Power supply</b>	
Voltage	Single-phase 230 Vac
Tolerance	±20 %
Frequency	50 ... 60 Hz
Current	15 Aac
<b>Current injection</b>	
Maximum current injected	Depending on the load and limited to 100 A 5 A with 120 Ω maximum 50 A with 12 Ω maximum
Maximum output voltage	600 Vac
Unit power	30 kVA
Maximum earthing resistance (including auxiliary earths)	Depending on the current injected R = 600 / I
<b>Measurement</b>	
Voltage measurement	Type: true RMS Input impedance: 10 MΩ or 1 kΩ, adjustable Resolution: • Scale 700 Vac = resolution 0.5 Vac • Scale 280 Vac = resolution 0.1 Vac • Scale 105 Vac = resolution 0.1 Aac • Scale 70 Vac = resolution 0.1 Vac • Scale 30 Vac = resolution 0.1 Vac • Scale 0.8 Vac = resolution 0.01 Vac Maximum voltage: 700 Vac Accuracy: 1% reading + 2 digits
Current measurement	Type: true RMS Input impedance: less than 0.1 Ω Resolution: • Scale 100 Aac = resolution 0.1 Aac • Scale 10 Aac = resolution 0.01 Aac Maximum current: 100 Aac Accuracy: 2 % reading / ± 2 digits
Resistance measurement	Range: 0 ... 120 Ω Accuracy: 2.5 % reading / ± 2 digits
<b>Construction features</b>	
Instrument dimensions	285 x 285 x 340 mm
Instrument weight	45 kg
Testing weight dimensions	170 Ø x 300 mm
Weight of the testing weights	2 x 25.5 kg
<b>Standards</b>	
MIE-RAT13, IEC 60348, IEC 60664, UNE 20553	

# GETEST

## Indirect earth contact simulator



### Dimensions



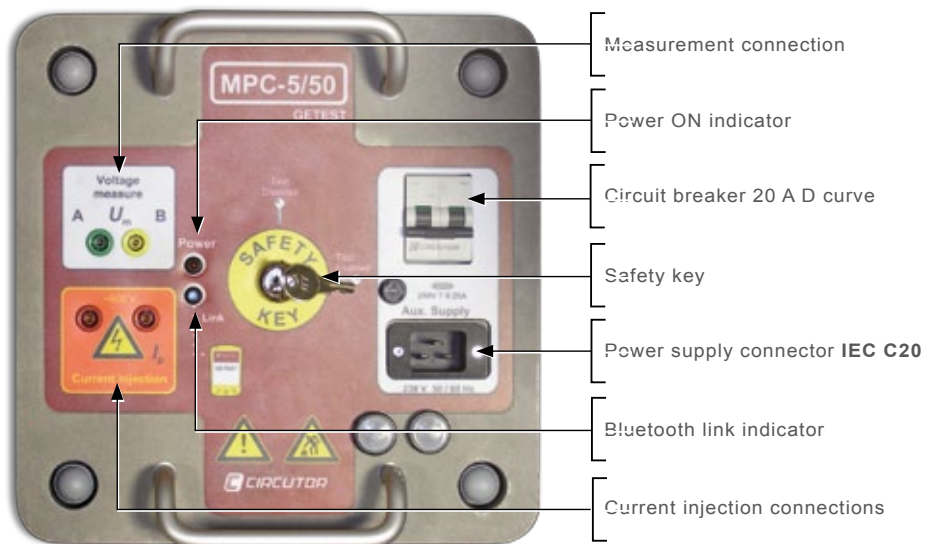
### References

Description	Type	Code
Indirect earth contact simulator, from 5 ... 50 A	MPC-5/50 GETEST	P60123

In addition to the MPC-5/50 GETEST, this product includes: 1 PDA, 3 cable reels, Two 25 kg weights and a terrain resistance measurement gauge.

### Connections

#### Connections and front elements



# CR

## Current injection relay tester



### Description

The **CR-50**, **CR-100** and **CR-250** units include specially designed current generation systems that can check the current / time trigger curve of automatic switches and indirect protection relays.

Its operation principle is based on the injection of an alternating current that can be adjusted throughout the circuit being tested with a short-circuit cable loop. The connection of an auxiliary contact of the switch being tested can be used to measure the trip time for each current selected.

The test is easily carried out with a start-stop control. An automatic meter is responsible for taking the measurements and showing them on the display.

We can highlight that the unit can be used to check the full protection system, including the current transformer in the case of indirect relays, since the current can be injected on the primary side of these transformers.

After the test, a digital display automatically shows the value of the current injected and the trip time until the RESET button is pressed.

### Features

Features	
Power supply	230 Vac (-15 ... +10 %)
Frequency	50 ... 60 Hz
Current generation system	Insulated, short-circuit potential, adjustable with the controls on the front of the unit
Overload capacity	<b>CR-50:</b> 1,5 $I_n$ , 1 min (12 V max.) <b>CR-100:</b> 2,5 $I_n$ , 10 s (6 V max.) / 1,5 $I_n$ , 1 min (12 V max.) <b>CR-250:</b> 2,5 $I_n$ , 10 s (6 V max.) / 1,5 $I_n$ , 1 min (12 V max.)
Nominal power	<b>CR-50:</b> 300 V·A <b>CR-100:</b> 600 V·A <b>CR-250:</b> 2 500 V·A
Current consumption of the equipment	<b>CR-50:</b> 1.6 A max. <b>CR-100:</b> 6 A max. <b>CR-250:</b> 20 A max.
Current generation system	<b>CR-50:</b> 0 to 6 V: $I_n = 50$ A max. 0 to 30 V: $I_n = 10$ A max. <b>CR-100:</b> 0 to 6 V: $I_n = 100$ A max. 0 to 30 V: $I_n = 20$ A max. <b>CR-250:</b> 10 to 50 V: $I_n = 50$ A max. 0 to 10 V: $I_n = 250$ A max.
Measurement	
Current measurement	digital instrument
Accuracy	<b>CR-50:</b> 1 % of the reading / $\pm 2$ digits <b>CR-100:</b> 0.5 % of the reading / $\pm 1$ digits <b>CR-250:</b> 0.5 % of the reading / $\pm 1$ digits
Time measurement	Digital clock
Measurement range	<b>CR-50:</b> up to 99 999.9 s <b>CR-100:</b> up to 99,999.99 s <b>CR-250:</b> up to 99,999.99 s
Test method	Start: with start button Automatic stop: aux. contact open or closed Manual stop: with stop button
Construction features	
Dimensions	<b>CR-50:</b> 320 x 200 x 215 mm <b>CR-100:</b> 430 x 312 x 265 mm <b>CR-250:</b> 280 x 470 x 500 mm
Weight	<b>CR-50:</b> 11 kg <b>CR-100:</b> 22 kg <b>CR-250:</b> 43 kg
Standards	
IEC 348, IEC 664, UNE 20 553, VDE 0110 (*also see the regulations to check the test methods)	

### References

Description	Type	Code
50 A relay check system (case version)	<b>CR-50</b>	<b>P60211</b>
100 A relay check system (case version)	<b>CR-100</b>	<b>P60212</b>
250 A relay check system	<b>CR-250</b>	<b>P60213</b>

# MH-10

## Microhmmeter



### Description

The **MH-10** digital microhmmeter is a portable instrument controlled by a microprocessor and it is used as a high precision reading unit that can measure very low resistances of circuit breaker contacts, keys, conductive bars, transformer coils and motors, weld points, etc., with test currents ranging from 1 mA to 10 A.

The **MH-10** microhmmeter operates with the 4-arm method (Kelvin bridge), so that it avoids the effects of resistance on injection cables. The test current can be adjusted by the operator and the values are obtained by comparing them with highly stable internal patterns. The results will be displayed on an alphanumerical display that is very easy to read.

### Features

Power supply characteristics	
Sealed rechargeable battery	12 V - 7 A·h
Built-in charger	Yes
Mains power supply	Yes
Fuse protection	Schurter, type SPT 5 x 20 (Time-lag) 5 A / 250 Vac High circuit-breaking capacity
Measurement features	
Resistance measurement ranges	0-2 000 $\mu\Omega$ > 10 A 0-20 m $\Omega$ > 10 A 0-200 m $\Omega$ > 1 A 0-2 000 m $\Omega$ > 100 mA 0-20 $\Omega$ > 10 mA 0-200 $\Omega$ > 1 mA
Resolution	1 $\mu\Omega$ for 10 A
Test voltage	Up to 10 Cdc for 1 A open circuit
Basic accuracy	$\pm 0.2\%$ of the value measured $\pm 2$ digits
Display	Alphanumerical, with 4 $\frac{1}{2}$ digits
Communications	
Serial data output	RS.232 at 4 800 bps
Build features	
Dimensions	378 x 308 x 175
Weight	8.8 kg (including accessories)
Degree of protection	IP 54 with the cover closed
Ambient conditions	
Operating temperature	-5 ... +50 °C
Storage temperature	-25 ... +65 °C
Relative humidity	95 % (non-condensing)
Maximum operation height	3 000 m above sea level
Standards	
IEC 61010-1/990, IEC 61010-1/992 amendment 2, IEC 61326-1, IEC 1000-4-2	

### References

Description	Type	Code
Microhmmeter (Thomson bridge)	MH-10	P60711



# MH-100e

Digital microhmmeter up to 100 A



## Description

The **MH-100e** digital microhmmeter is a portable instrument controlled by a microprocessor and it is used as a high precision reading unit that can measure very low resistances of circuit breaker contacts, keys, conductive bars, transformer coils and motors, weld points, etc., with test currents ranging from 1 mA to 100 A.

The **MH-100e** microhmmeter operates with the 4-arm method, so that it avoids the effects of resistance on injection cables. The test current can be adjusted by the operator and the values are obtained by comparing them with highly stable internal patterns. The results will be displayed on an alphanumeric display that is very easy to read.

## Features

Power supply characteristics	
Power Supply	Network 100 - 130 V o 220-240 V
Internal battery	Built-in. Rechargeable (for measurements with test current of up to 10 A)
Measurement features	
Test current	1 mA, 10 mA, 100 mA, 1 A, 10 A, 100 A. Each current can be adjusted between 0 and 100% of its nominal value
Resistance measurement ranges	0-2000 $\mu\Omega$ to 100 A 0-20 m $\Omega$ to 10 A 0-200 m $\Omega$ to 1 A 0-2000 m $\Omega$ to 100 mA 0-20 $\Omega$ to 10 mA 0-200 $\Omega$ to 1 mA
Resolution	0.1 $\mu\Omega$ to 100 A 1 $\mu\Omega$ to 10 A 10 $\mu\Omega$ to 1 A 100 $\mu\Omega$ to 100 mA 1 m $\Omega$ to 10 mA 10 m $\Omega$ to 1 mA
Test voltage	Up to 10 Vdc (open circuit) to 1A
Basic accuracy	R < 0.5 m : $\pm$ (0.5% of the mean value) R > 0.5 m : $\pm$ (0.20% of the mean value)
Printer	No
Communications	
Serial data output	RS-232 at 4800 bps
Build features	
Dimensions	502 x 394 x 190 mm
Weight	Approximately 14 kg
Protection degree	IP 54 with the cover closed
Ambient conditions	
Operating temperature	-5 ... +50 °C
Storage temperature	-25 ... +65 °C
Relative humidity	95 % (non-condensing)
Maximum operation height	3 000 m above sea level
Standards	
IEC 61010 : 1990, IEC 61010-1 : 1992	

## References

Description	Type	Code
Digital microhmmeter up to 100 A	MH-100e	P60713



# MI / MD

## Megohmmeter



### Description

The **MD** and **MI** portable megohmmeters have been specially designed to measure insulating resistances with values of TΩ, using a test voltage that can be selected by the user.

Its highly reliable technology enables the intake of accurate measurements and easy reading of insulated low and medium voltage electrical systems, transformers, motors, cables, equipment and home installations, distribution grids, etc. It incorporates a rechargeable internal battery, but it can also be powered from the mains.

It is ideal for outdoor work: it resists severe usage conditions, including impacts, very high and low temperatures, intense vibrations during the transport on bumpy roads, prolonged direct exposure to the sun, etc.

The **MD-5060e** unit includes the following advanced features: automatic calculation of the polarization and dielectric absorption indices, penetration/no penetration tests and fixed time and digital stop-watch.

### Features

	MD-5060e	MI-5500e	MI-10 kVe	MI-15 kVe	MI-20 kVe
Technology	Electronic	Analogue			
<b>Power supply characteristics</b>					
Rechargeable battery	12 V - 2.3 A-h	12 V - 7 A-h			
Battery charger	18 V - 1.2 A-h	220 - 240 Vac			
Short-circuit current	1.5 mA (± 0.5 mA)	1 mA		500 µA	
<b>Measurement features</b>					
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 - 33,5 - 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
Change of scale	Automatic	Manual			
Basic accuracy	5 % of the reading ± 3 digits	Class 1	Class 2 (± 2 % of the scale base deflection)		
Indicator	LCD+bars analogue	Analogue			
Record memory	Yes	No			
<b>Communications</b>					
Serial data output	RS-232 at 4 800 bps	Not available			
Printer	PR-01 (optional)	Not available			
<b>Ambient conditions</b>					
Operating temperature	-5 ... +50 °C				
Storage temperature	-25 ... +65 °C				
Relative humidity	95 % (non-condensing)				
Maximum height	3 000 m above sea level				
<b>Build features</b>					
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
Degree of protection	IP 54 (with the cover closed)				
<b>Standards</b>					
IEC 61010-1/1990, IEC 61010-1/1992 appendix 2, IEC 61326-1, IEC 61000-4-3, IEC 61000-4-2					

### References

Description	Type	Code
Digital megohmmeter 5 kV (with memory and communications)	<b>MD-5060e</b>	<b>P60521</b>
Analogue megohmmeter 5 kV	<b>Mi-5500e</b>	<b>P60511</b>
Analogue megohmmeter 10 kV	<b>Mi-10kVe</b>	<b>P60512</b>
Analogue megohmmeter 15 kV	<b>Mi-15kVe</b>	<b>P60513</b>
Analogue megohmmeter 20 kV	<b>Mi-20kVe</b>	<b>P60514</b>

# TL-5

## Earth resistance meter



### Description

The **TL-5** earth resistance meter is a digital instrument controlled by a microprocessor. It has been designed to take earth resistance and resistivity measurements, with the use of the Wenner method.

The **TL-5** unit is fully automatic and easy to use. Before taking a reading, the unit controls the installation's conditions to check that they are within the adequate limits, notifying the user of any abnormal situation (very high interference voltages, very low intensity of the test current, etc.).

The **TL-5** can be used to select two frequencies to generate the test current (270 Hz or 1470 Hz), in order to optimise the earthing test.

The instrument has 4 ranges to measure resistances, covering the range that goes from 0.01  $\Omega$  to 20 k $\Omega$ .

This instrument has been specially designed to monitor earthing systems in substations, industries, energy distribution grids, etc. in accordance with IEC 61557-5. It is also very useful to measure the specific earth resistivity, with the purpose of optimising the earthing system projects.

### Features

#### Power supply circuit

Internal rechargeable battery	12 V - 2.3 A-h
Battery charger	95 - 240 Vac 50 ... 60 Hz
Short-circuit current	< 3.5 mA

#### Measurement circuit

Resistance	0.01 $\Omega$ - 20 k $\Omega$
Resistivity	0.01 $\Omega$ m - 50 k $\Omega$ m
Voltage	0 - 60 Vac

#### Accuracy

Resistance and resistivity	$\pm 2$ % of the value measured $\pm 2$ digits
Voltage	$\pm 2$ % of the value measured $\pm 2$ digits

#### Reading resolution

Resistance	0.01 $\Omega$
Resistivity	0.01 $\Omega$ m
Voltage	0.1 V

#### Communications

Series output	USB
Printer	PR-01 (optional)

#### Ambient conditions

Operating temperature	-10 ... +50 $^{\circ}$ C
Storage temperature	-25 ... +65 $^{\circ}$ C
Relative humidity	95 % (non-condensing)
Maximum height	3 000 m

#### Build features

Dimensions	274 x 250 x 124 mm
Weight	3.6 kg
Degree of protection	IP 54 (with the cover closed)

#### Standards

IEC 61010-1/1990, IEC 61010-1/1992 appendix 2, IEC 61326-1, IEC 61000-4-3, IEC 61000-4-2

### References

Description	Type	Code
Earth resistance meter - 4 ways	TL-5	P60621

# OT2-60D

dielectric strength tester for isolating oils



## Description

The OT2-60D range is automatic equipment especially designed to test the disruptive voltage of isolating oils in new or used transformers, cables with oil, automatic switches, capacitors, etc.

The disruptive voltage is not a basic property of the oil, but it indicates us the degree of contamination of this oil (water, solid materials in suspension), allowing us to decide on the possibility of carrying out a treatment of drying and filtration, or replacing the oil.

The method that the OT2-60D uses can be applied to oils of nominal viscosity of up to 350 mm<sup>2</sup>/s at 40°C, according to IEC-156 standard.

The OT2-60D is supplied with a complete series of protectors making it highly protected and reliable.

It is easy to handle, all buttons or illuminated switches are on the front control panel.

The test cell is especially designed to easily change the electrodes in accordance with the different standards in operation, the easy insertion into the registering transformer terminals and for its complete cleaning

## Features

<b>Power supply</b>	
Voltage	230 V, single-phase
Current	3 A
Frequency	50/60 Hz
<b>Output</b>	
Voltage	0-60kV AC, 800VA resistive load, between bushings
Termination	Dual Capacitively Graded Bushings
Oil Test Cells Available	IEC 156
Oil Test Cells Under demand	ASTM D1816, ASTM D877
<b>accuracy</b>	
Meter	2 % Full scale
Distortion	< 5%
<b>Ambient conditions</b>	
Operating temperature	+5 ... +40 °C
Storage temperature	-10 ... +60 °C
Relative humidity	80% hasta 31 °C
Maximum height	1 500 m al 100%; +4500 m al 85%
<b>Build features</b>	
Dimensions	380 x 360 x 295 mm
Weight	27 kg
Installation	Categoria II
Pollution	Degree 2

## References

Description	Type	Code
Dielectric strength tester for isolating oils	OT2-60D	P60312

## Relation between products and accessories

		CR-250 Transformer	CR-250 Cable	CR-250 Trolley	PR-01	GETEST Trolley
						
	2500 A Transformer	1.5m Long Cable	Transport trolley	Printer	Transport trolley for GETEST	
	<b>P69903</b>	<b>P69902</b>	<b>P69901</b>	<b>P69911</b>	<b>P6990A</b>	
CR		● Only for type <b>CR-250</b>	● Only for type <b>CR-250</b>	● Only for type <b>CR-250</b>	--	--
MI / MD		--	--	--	● Only for type <b>MD-5060e</b>	--
TL-5		--	--	--	●	--
GETEST		--	--	--	●	●



Unit 6/22 Moselle Ave, Henderson, Auckland, New Zealand  
PO Box 21-872, Henderson, Auckland, New Zealand  
Phone: +64 9 833 5749  
Fax: +64 9 833 5726  
Email: [info@LPINZ.co.nz](mailto:info@LPINZ.co.nz)  
Web: [www.LPINZ.co.nz](http://www.LPINZ.co.nz)

Auckland 09 833 5749 - Wellington 04 282 0925 - Christchurch 03 281 8041 - Waikato 07 282 1011