

Protection and control



Measuring and testing equipments for substations

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 5 kV
- Kelvin Bridge (Microhmmeter)
- Forward and contact voltage meter
- Earth resistance meter. (Earth resistance and resistivity meter)
- Portable dielectric rigidity verification unit used to check the dielectric rigidity of insulating oil
- 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.



Product selection table

	Equipment	Application	Features				Page
GETEST		Indirect earth contact simulator	5 A / 50 A - 30 V·A				5
CR		Current injection relay tester	50 A	100 A	250 A		7
			CR-50	CR-100	CR-250		
MH-10		Microhmmeter	1 mA ... 10 A Resolution 1 μΩ				8
MD-5060e		Digital megohmmeter	5 kV				9
MI		Analogue megohmmeter	5 kV	10 kV	15 kV	20 kV	9
			MI-5500e	MI-10kVe	MI-15kVe	MI-15kVe	
TL-5		Earth resistance meter - 4 ways	Resistance 0.01 Ω ... 20 kΩ				10
DPT		Voltage presence detector	3.4 ... 45 kV				11

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 (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

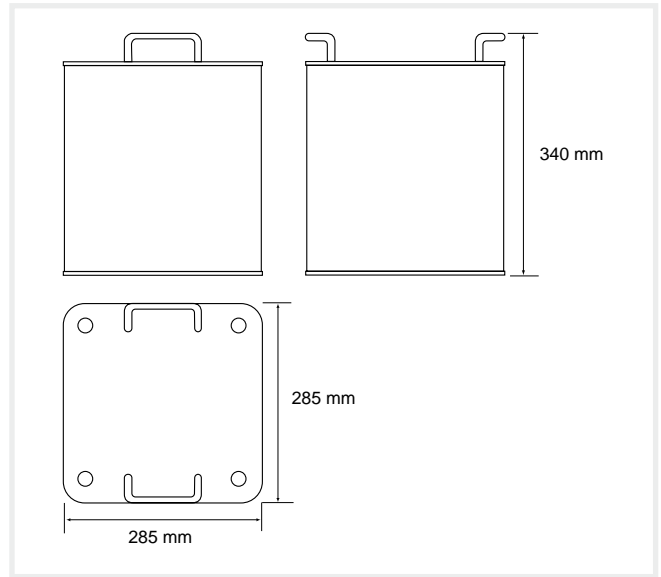
Features

Power supply	
Voltage	Single-phase 230 Vac
Tolerance	±20 %
Frequency	50 ... 60 Hz
Current	15 Aac
Current injection	
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
Measurement	
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
Construction features	
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
Standards	
MIE-RAT13, IEC 60348, IEC 60664, UNE 20553	

GETEST

Indirect earth contact simulator

Dimensions



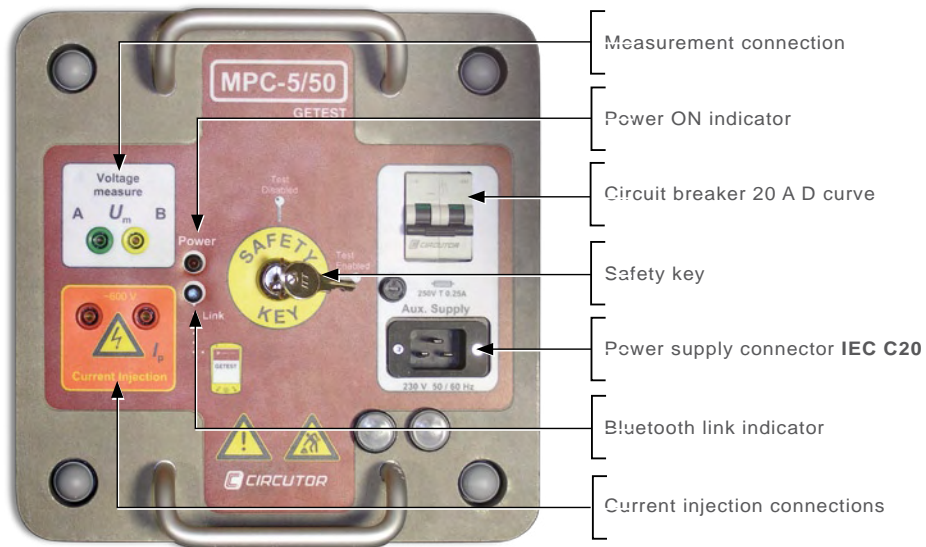
References

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	CR-50: 1,5 I_n , 1 min (12 V max.) CR-100: 2,5 I_n , 10 s (6 V max.) / 1,5 I_n , 1 min (12 V max.) CR-250: 2,5 I_n , 10 s (6 V max.) / 1,5 I_n , 1 min (12 V max.)
Nominal power	CR-50: 300 V·A CR-100: 600 V·A CR-250: 2 500 V·A
Current	CR-50: 1.6 A max. CR-100: 6 A max. CR-250: 20 A max.
Current generation system	CR-50: 0 to 6 V: $I_n = 50$ A max. 0 to 30 V: $I_n = 10$ A max. CR-100: 0 to 6 V: $I_n = 100$ A max. 0 to 30 V: $I_n = 20$ A max. CR-250: 10 to 50 V: $I_n = 50$ A max. 0 to 10 V: $I_n = 250$ A max.
Measurement	
Current measurement	digital instrument
Accuracy	CR-50: 1 % of the reading / ± 2 digits CR-100: 0.5 % of the reading / ± 1 digits CR-250: 0.5 % of the reading / ± 1 digits
Time measurement	Digital clock
Measurement range	CR-50: up to 99 999.9 s CR-100: up to 99,999.99 s CR-250: 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	CR-50: 320 x 200 x 215 mm CR-100: 430 x 312 x 265 mm CR-250: 280 x 470 x 500 mm
Weight	CR-50: 11 kg CR-100: 22 kg CR-250: 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)	CR-50	P60211
100 A relay check system (case version)	CR-100	P60212
250 A relay check system	CR-250	P60213

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 Ω > 10 A 0-200 m Ω > 1 A 0-2 000 m Ω > 100 A 0-20 Ω > 10 A 0-200 Ω > 1 A
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 ± 2 digits
Display	Alphanumerical, with 4 ½ 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

MI / MD

Megohmmeter



Description

The **MD** and **MI** portable megohmmeters have been specially designed to measure insulating resistances with values of $T\Omega$, 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			
Power supply characteristics					
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 μ A	
Measurement features					
Scope	5 000 000 M Ω / 5 kV	10 000 000 M Ω	2 000 000 M Ω	3 000 000 M Ω	4 000 000 M Ω
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			
Communications					
Serial data output	RS-232 at 4 800 bps	Not available			
Printer	PR-01 (optional)	Not available			
Ambient conditions					
Operating temperature	-5 ... +50 $^{\circ}$ C				
Storage temperature	-25 ... +65 $^{\circ}$ C				
Relative humidity	95 % (non-condensing)				
Maximum height	3 000 m above sea level				
Build 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
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
Digital megohmmeter 5 kV (with memory and communications)	MD-5060e	P60521
Analogue megohmmeter 5 kV	Mi-5500e	P60511
Analogue megohmmeter 10 kV	Mi-10kVe	P60512
Analogue megohmmeter 15 kV	Mi-15kVe	P60513
Analogue megohmmeter 20 kV	Mi-20kVe	P60514

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 Ω to 20 k Ω .

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 Ω - 20 k Ω
Resistivity	0.01 Ω m - 50 k Ω m
Voltage	0 - 60 Vac
Accuracy	
Resistance and resistivity	± 2 % of the value measured ± 2 digits
Voltage	± 2 % of the value measured ± 2 digits
Reading resolution	
Resistance	0.01 Ω
Resistivity	0.01 Ω m
Voltage	0.1 V
Communications	
Series output	RS-232
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

DPT

Medium voltage presence detector



Description

The **DPT** is the element that indicates the presence of voltage in the medium voltage line of a substation. The unit works with a capacitive effect. When the voltage is above a value that has been pre-selected, the **DPT** emits a flashing light signal. The full control of the line requires the installation of a **DPT** in each phase.

The voltage can be adjusted using a rotary switch located at the bottom of the device. Turn it left or right to select the detection point within the work margins of the **DPT**.

The two slots on the said switching elements can be used to insert the adequate pole and modify the adjustment once it has been installed in the line.

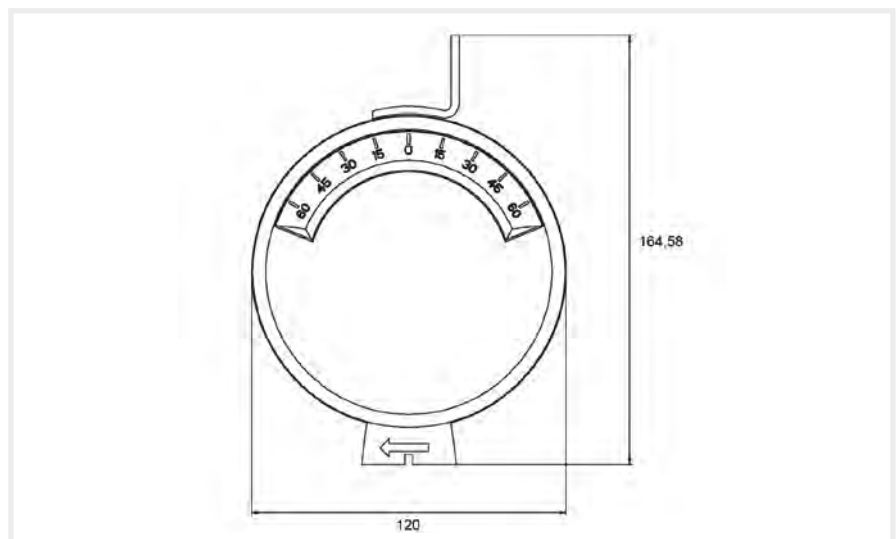
Features

Power supply	
Voltage	Self-powered
Frequency	50 ... 60 Hz
Operating temperature	0 °C ... + 50 °C
Features	
Detection range	3.4 kV at 45 kV
Construction features	
Protection	IP20
Use	Indoor

References

Description	Type	Code
Voltage detector 3.4...45 kV (MV and HV)	DPT	P61000

Dimensions



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	
	P69903	P69902	P69901	P69911		
CR		● Only for type CR-250	● Only for type CR-250	● Only for type CR-250	--	--
MI / MD		--	--	--	● Only for type MD-5060e	--
TL-5		--	--	--	●	--
GETEST		--	--	--	--	●