

# RMO-H Series

## Handheld Micro Ohmmeters



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# Serie RMO-H

Micro Ohmímetros portátiles

- Handheld – only 0,95 kg / 2.1 lbs
- Powerful – regulated current up to 300 A DC
- No rest time needed between the tests
- High-capacity Li-Po battery (2 types available):
  - 8200 mAh, 3,8 V DC (RMO-H1, -H2, -H3)
  - 4100 mAh, 7,6 V DC (RMO-H21, -H22, -H23)
- Measuring range 0,1  $\mu\Omega$  – 3000 m $\Omega$
- Typical accuracy  $\pm (0,1 \% \text{ rdg} + 0,1 \% \text{ FS})$
- Both Sides Grounded Measurement



## Description

The RMO-H series – battery operated and handheld micro-ohmmeters are unique solution for the contact resistance measurement of switchgears according to international standards (e.g. IEC 62271-100). RMO-H can be used for number of applications where non-inductive resistance is checked, during factory inspections or testing in the high-induction field environments. The set is equipped with the overcurrent protection.

RMO-H Series contains six models in total, divided in 2 sub-series depending of the test leads length requirement and the battery type:

- **RMO-H1, RMO-H2 y RMO-H3** models are intended for use with short type cables (e.g. 1,3 m). 1-cell Li-Po battery with 8200 mAh capacity provides output voltage up to 4,1 V DC.
- **RMO-H21, RMO-H22 y RMO-H23** smodels are ideal for applications where 5 m test leads (or longer) are required. The high output voltage (up to 8,3 V DC) is provided by 2-cell 4100 mAh Li-Po battery.

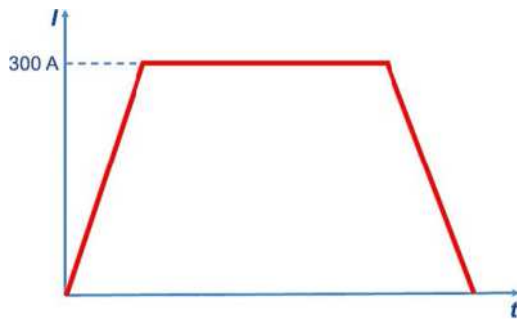
The test current is regulated and can be selected in a range of 1 A to maximum 300 A, depending of the maximum test current rating:

- RMO-H1, RMO-H21 models - up to 100 A DC
- RMO-H2, RMO-H22 models - up to 220 A DC
- RMO-H3, RMO-H23 models - up to 300 A DC

The high-capacity Li-Po battery enables generating a true DC ripple-free current. The main advantages of Li-Po technology over ultra-capacitor technology are:

- **No rest time needed between tests** since there is no ultra-capacitor charging.
- **Test current is regulated** and it is not load-dependent like in case of ultra-capacitor. This means that user can select certain current value for the measurement (from 1 A to 300 A).

With use of automatic test ramp (picture bellow), the test current is gradually increased before the measurement and decreased after the measurement is competed. This significantly decreases influence of magnetic transients.



The RMO-H instrument can internally store up to 1000 measurements (time and date stamped).

DV-Win software enables download of the results, creating and exporting test reports in different formats. Communication between the RMO-H and a PC is through a Bluetooth communication.

## Applications

Typical application is accurate low resistance measurement during manufacturing, commissioning and maintenance inspections on:

- High and medium voltage Switchgears and Circuit Breakers (as per IEC 62271-100 standards)
- High and medium voltage Disconnecting Switches (as per IEC 62271-100 standards)
- High-current Busbar joints
- Terminals of the conductors on HV power lines
- Bonding of Lighting conductors

RMO-H instruments are also ideal testing tool for quality control checking during production process of high-voltage equipment and equipment used in railway and aircraft industry:

- Welding joints
- Cable splices and cable resistance
- OLTC contacts checking (off-line, not connected to transformer)
- Railway joints, lines and conductor rails
- Bonds and joints checking in aircraft manufacturing industry

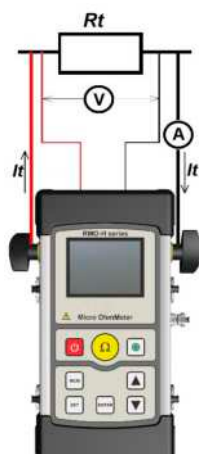
## Connecting RMO-H to a test object

The connection diagram of the RMO-H devices corresponds to the Kelvin's (4-point) measurement principle. The measuring cables from the "Voltage Sense" sockets are attached as close as possible to the test object  $R_t$ , and in between the current feeding cables. That way, a resistance of both cables and clamps is almost completely excluded from the resistance measurement..

The combined current and voltage sense leads with TTA clamps are specially designed to fulfill the Kelvin's

4-point principle. This test leads design is particularly useful for field testing, when the least possible cabling is required.

For the contact resistance measurement of a medium voltage circuit breaker, as well as applications where remote control is required, it is convenient to use the cables with Kelvin probes (with trigger button).



When testing HV circuit breakers, switchgears or connection on high power lines with RMO-H, one of the following two connection diagrams can be used:

#### a) Connection diagram – use of short cables

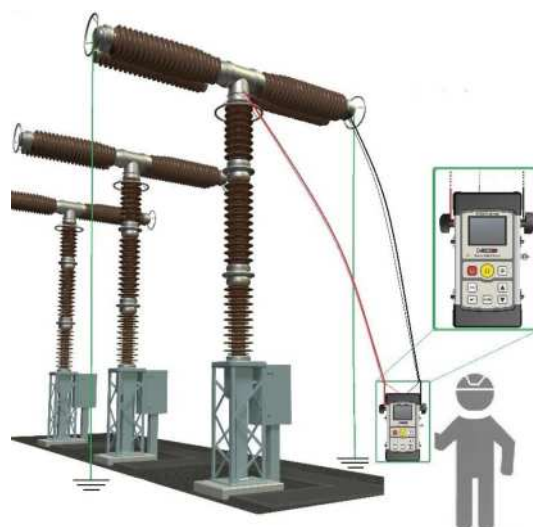
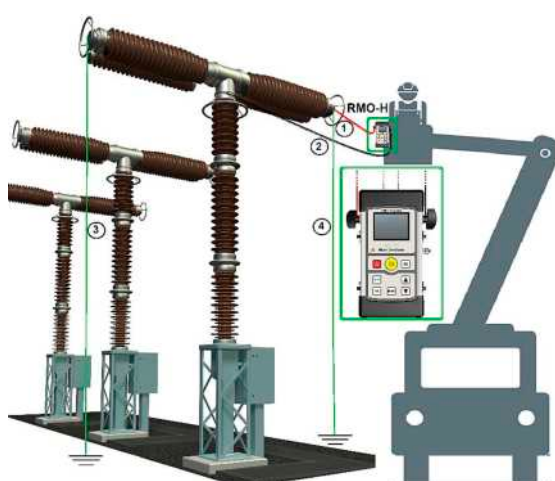
Since RMO-H is handheld device, it can be used with short cables (up to 5 m length) even in case of live-tank circuit breakers, switchgears or power cable terminals testing.

A test operator can bring the device with himself in the bucket lift, connect test cables directly to each breaking

chamber terminals (or some other measurement point) and take measurement (1-click to test principle).

#### b) Connection diagram – use of 5 m of longer cables

Internal testing procedures in some utilities or service companies may require use of cables longer than 5 m for testing high voltage live-tank circuit breakers. This is conventional (traditional) procedure for contact resistance measurement. Although long cables usually lead to very heavy current carrying cables, this is not case for RMO-H21, RMO-H22 and RMO-H23 devices. This is achieved with high output voltage (up to 8,3 V DC).



1 y 2 - Cables combinados de detección de corriente y tensión  
3 y 4 - Cables de tierra (el cable de tierra "4" se utiliza para las pruebas en condiciones de conexión a tierra por ambos lados)

NOTA  
Los modelos RMO-H1, RMO-H2, RMO-H3 NO tienen cables de prueba intercambiables con los modelos RMO-H21, RMO-H22, RMO-H23.

## Both Sides Grounded testing

The RMO-H device provides a safe measurement of circuit breakers with both terminals grounded. The connection diagram is the same as for the one-side-grounded circuit breakers.

*NOTE This type of measurement could be less accurate comparing to the measurement in one-side-grounding conditions, because of a small amount of the current that can flow through groundings.*

## Benefits and features

RMO-H is a handheld micro-ohmmeter ideal for a field and factory testing, with a very user-friendly interface (1-click to test). This is achieved with an intuitive keyboard and menu design.

The high capacity Li-Po battery enables multiple measurements in the field/factory. This technology proved itself as much efficient over the ultra-capacitor technology (table below).

RMO-H1, RMO-H2 and RMO-H3 models use short test leads (up to 5 m). Since an operator takes the device with himself and makes the measurements, use of longer cables is not required.

For applications where use of test leads longer than 5 m is mandatory or preferable, RMO-H21, RMO-H22 and RMO-H23 models are the ideal solution, due to their high output voltage.

| RMO-H<br>(Li-Po technology)                                                                                               | Micro ohmmeters<br>with ultra-capacitor                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| No rest time needed between consecutive tests.                                                                            | User needs to wait for ultra-capacitor to charge between the tests.                                                             |
| Precise value of the test current value can be selected in range from 1 A to I <sub>max</sub> (e.g. 1 – 300 A for RMO-H3) | It is not possible to select precise test current value since it depends on the ultra-capacitor's voltage and load resistance.. |
| Test current is stable during measurement. It is generated by an automatic test ramp..                                    | Test current is not stable during the measurement; it is decreasing due to discharging of the ultra-capacitor.                  |

The RMO-H instruments have a very high typical accuracy  $\pm (0,1\% \text{ rdg} + 0,1\% \text{ FS})$ , with the best resolution of 0,1  $\mu\Omega$ .

The additional feature is the pass/fail criteria implemented through the R<sub>max</sub> function. When this function is turned ON, the RMO-H device displays information if the measured resistance is higher than the set R<sub>max</sub> resistance value.

RMO-H devices can store up to 1000 test results to internal memory. The results can be transferred to PC with use of Bluetooth communication.

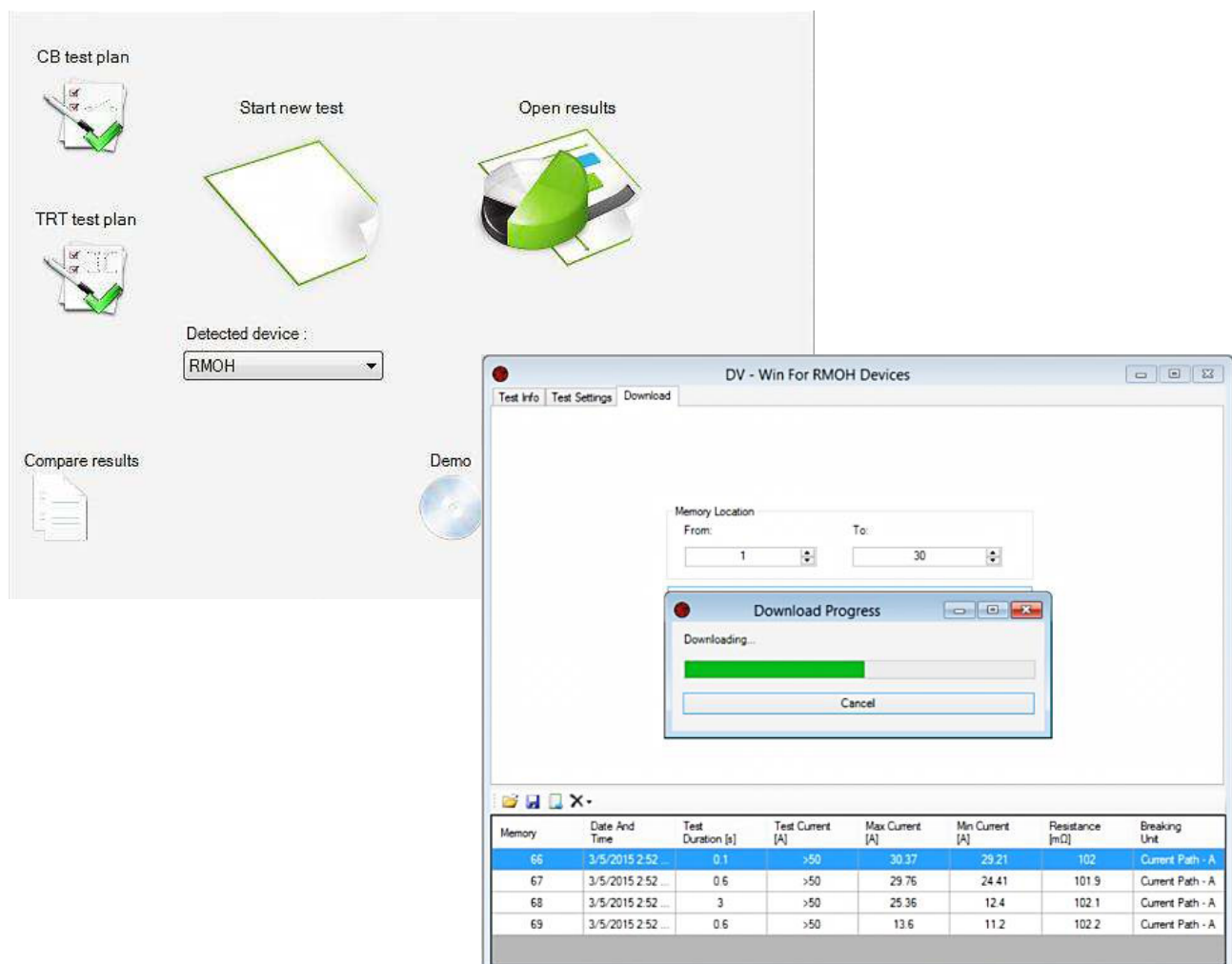
## DV-Win software

\*included in the purchase price

DV-Win software for the RMO-H device is an application set of tools based on the Windows operating system. It enables communication between a standard PC and the RMO-H device over the Bluetooth connection.

The main features of the software are:

- Download of the test results to a PC
- Saving the test results in different formats
- Test reports (fully customized)



## Technical data

### Battery

- Type: Li-Po (User-replaceable)
  - 1-cell, 8200 mAh (RMO-H1, -H2, -H3)
  - 2-cells 4100mAh (RMO-H21, -H22, -H23)
- Recharge time: 2 hours

### AC Adapter

- Input voltage 90 – 264 V AC, 50/60 Hz
- Output voltage 12 V DC
- Output current 3 A

### Output data

- Test current range::
  - 1 – 100 A DC (RMO-H1, -H21)
  - 1 – 220 A DC (RMO-H2, -H22)
  - 1 – 300 A DC (RMO-H3, -H23)*\*Test current is regulated and user-selectable*
- Maximum DC output voltage @Imax:
  - 4,1 V (RMO-H1, -H2, -H3)
  - 8,3 V (RMO-H21, -H22, -H23)

### Measurement

- Resistance range 0 – 3000 mΩ
- Resolution
 

|                  |          |
|------------------|----------|
| 0,1 – 999,9 μΩ   | 0,1 μΩ   |
| 1,000 – 9,999 mΩ | 0,001 mΩ |
| 10,00 – 99,99 mΩ | 0,01 mΩ  |
| 100,0 – 999,9 mΩ | 0,1 mΩ   |
| 1000 – 3000 mΩ   | 1 mΩ     |
- Typical accuracy\*
  - ± (0,1 % rdg + 0,1 % FS) - up to 1 Ω range
  - ± (0,25 % rdg + 0,25 % FS) - from 1 Ω to 3 Ω*\*Accuracy is valid under the maximal test current per the range being used (as defined in the RMO-H's Manual Section 3.6))*

### CE – marking

- EMC 2004/108/EC
- LVD 2006/95/EC

### Memory

- Internal: 2 GB SD Card
- RMO-H can store up to 1000 measurements

### Interface

- Bluetooth communication

### Environment conditions

- Operating temperature:
  - 10 °C - +55 °C / -4 °F - +131 °F
- Storage & transportation temperature:
  - 40 °C - +70 °C / -40 °F - +158 °F
- Humidity 5 % - 95 % relative humidity, non-condensing

### Environmental protection (IP rating)

- Device: IP54
- Device in plastic case: IP67 (closed lid)

### Dimensions and Weight

- Dimensions (L x W x D):
  - 226 mm x 116 mm x 50 mm
  - 8.9 in x 4.5 in x 1.9 in
- Weight: 0,95 kg / 2.1 lbs

### Applicable Standards

- Installation/overvoltage: category II
- Pollution: degree 2
- Environmental tests – Shock: IEC 60068-2-27:
- Environmental tests – Vibrations: EC 60068-2-6
- Safety: Directive 2014/35/EU (CE conform) Standard EN61010-1
- EMC: Directive 2014/30/EU (CE conform) Standard EN 61326-1:2006
- CAN/CSA-C22.2 No. 61010-1, 2nd edition

### Warranty

- 3 years

*All specifications herein are valid at the rated battery voltage (or higher output voltage), ambient temperature of + 25 °C and recommended accessories.*

*Specifications are subject to change without notice..*

## Accesorios



Current cables and Sense cables with TTA clamps for RMO-H1, RMO-H2 and RMO-H3 devices



Current cables and Sense cables with TTA clamps for RMO-H21, RMO-H22 and RMO-H23 devices



Power supply adapter and a car charger



Current cables and Sense cable with Kelvin probes



Current cables with battery clamps & Sense cables with alligator clamps



Transport case with device and accessories

## RMO-H models selection

### RMO-H1, RMO-H2 & RMO-H3



#### Test current rating:

- RMO-H1 (from 1 A to 100 A DC)
- RMO-H2 (from 1 A to 220 A DC)
- RMO-H3 (from 1 A to 300 A DC)

Battery type: Li-Po, 1 cell, 8700 mAh

Output voltage: up to 4,1 V DC

#### Included accessories:

- USB with DV-Win PC software
- Ground (PE) cable
- Carrying belts
- Cable plastic case – small size

#### Recommended accessories::

- 2 x 1,3 m current & 2 x 1,3 m sense leads

### RMO-H21, RMO-H22 & RMO-H23



#### Test current rating:

- RMO-H21 (from 1 A to 100 A CC)
- RMO-H22 (from 1 A to 220 A CC)
- RMO-H23 (from 1 A to 300 A CC)

Battery type: Li-Po, 2 cells, 5700 mAh

Output voltage: up to 8,3 V DC

#### Included accessories:

- USB with DV-Win PC software
- Ground (PE) cable
- Carrying belts
- Cable plastic case – medium size

#### Recommended accessories:

- 2 x 5 m combined current & sense leads

## Order info

### RMO-H1, RMO-H2 and RMO-H3 devices

| Instrument with included accessories                                                                                                                | Article No.  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Handheld Micro Ohmmeter RMO-H1                                                                                                                      | RMOH100-N-00 |
| Handheld Micro Ohmmeter RMO-H2                                                                                                                      | RMOH220-N-00 |
| Handheld Micro Ohmmeter RMO-H3<br>- USB with DV-Win PC software<br>- Ground (PE) cable<br>- Carrying belts<br>- Plastic transport case – small size | RMOH300-N-00 |
| Power supply adapter 3 A EU                                                                                                                         | PWR-ADP3A-EU |

| Recommended accessories                                                                                   | Article No.    |
|-----------------------------------------------------------------------------------------------------------|----------------|
| Current and sense cables 2 x 1,3 m with TTA clamps (up to 220 A rated)<br><i>*for RMO-H1 &amp; RMO-H2</i> | CS2-1Z3-10CLWC |
| Current and sense cables 2 x 1,3 m with TTA clamps (300 A rated)<br><i>*for RMO-H3</i>                    | CS2-1Z3-25CLWC |

| Optional accessories                                                                                     | Article No.    |
|----------------------------------------------------------------------------------------------------------|----------------|
| Current and sense cables 2 x 1,3 m with Kelvin probes (up to 200 A rated)<br><i>*for RMO-H1 y RMO-H2</i> | CS2-1Z3-10CLKP |
| Current and sense cables 2 x 1,3 m with Kelvin probes (250 A rated)<br><i>*for RMO-H3</i>                | CS2-1Z3-16CLKP |
| Current and sense cables 1,3 m (red) and 3 m (black) with TTA clamps (100 A rated)                       | CS-1Z33-10CLWC |
| Current and sense cables 1,3 m (red) and 3 m (black) with TTA clamps (220 A rated)                       | CS-1Z33-16CLWC |
| Current and sense cables 1,3 m (red) and 3 m (black) with TTA clamps (250 A rated)                       | CS-1Z33-25CLWC |
| Current and sense cables 1,3 m (red) and 5 m (black) with TTA clamps (100 A rated)                       | CS-1Z35-10CLWC |
| Current and sense cables 1,3 m (red) and 5 m (black) with TTA clamps (220 A rated)                       | CS-1Z35-16CLWC |
| Current and sense cables 1,3 m (red) and 5 m (black) with TTA clamps (250 A rated)                       | CS-1Z35-25CLWC |
| Current cables 2 x 1,3 m with TTA clamps (270 A rated)<br><i>*for RMO-H3</i>                             | C2-1Z3-16CLWC  |
| Sense cables 2 x 1,3 m with alligator clamps (A2)                                                        | S2-1Z3-02BPA2  |
| Current cables 1,3 m and 3 m with TTA clamps (220 A rated)<br><i>*for RMO-H2 y RMO-H3</i>                | C-1Z33-16CLB1  |
| Sense cables 1,3 m and 3 m with alligator clamps (A2)                                                    | S-1Z33-02BPA2  |
| Current cables 2 x 1,3 m with battery clamps (300 A rated)<br><i>*para RMO-H3</i>                        | C2-1Z3-25CLB1  |
| Current cables 1,3 m and 3 m with battery clamps (100 A rated)                                           | C-1Z33-10CLB1  |
| Current cables 1,3 m and 3 m with battery clamps (220 A rated)                                           | C-1Z33-16CLB1  |
| Current cables 1,3 m and 3 m with battery clamps (250 A rated)                                           | C-1Z33-25CLB1  |

|                                                                |               |
|----------------------------------------------------------------|---------------|
| Sense cables 1,3 m and 3 m with alligator clamps (A2)          | S-1Z35-02BPA2 |
| Current cables 1,3 m and 5 m with battery clamps (100 A rated) | C-1Z35-10CLB1 |
| Current cables 1,3 m and 5 m with battery clamps (200 A rated) | C-1Z35-10CLB1 |
| Current cables 1,3 m and 5 m with battery clamps (250 A rated) | C-1Z35-10CLB1 |
| Sense cables 1,3 m and 5 m with alligator clamps (A2)          | S-1Z35-02BPA2 |
| Test shunt 240 $\mu\Omega$ (250 A/60 mV)                       | SHUNT-240-MK  |
| Test shunt 1 m $\Omega$ (150 A/150 mV)                         | SHUNT-150-MK  |
| Power supply adapter (car charger)                             | PWR-ADP3-CC0  |

**RMO-H21, RMO-H22 and RMO-H23 devices**

| Instrument with included accessories                                                                                                                  | Article No.   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Handheld Micro Ohmmeter-H21                                                                                                                           | RMOH100-N2-00 |
| Handheld Micro Ohmmeter RMO-H22                                                                                                                       | RMOH220-N2-00 |
| Handheld Micro Ohmmeter RMO-H23<br>- USB with DV-Win PC software<br>- Ground (PE) cable<br>- Carrying belts<br>- Plastic transport case – medium size | RMOH300-N2-00 |
| Power supply adapter 3 A EU                                                                                                                           | PWR-ADP3A-EU  |

| Recommended accessories                                                           | Article No.  |
|-----------------------------------------------------------------------------------|--------------|
| Current and sense cables 5 m with TTA clamps (100 A rated)<br><i>*for RMO-H21</i> | CS-05-06CLWC |
| Current and sense cables 5 m with TTA clamps (220 A rated)<br><i>*for RMO-H22</i> | CS-05-16CLWC |
| Current and sense cables 5 m with TTA clamps (300 A rated)<br><i>*for RMO-H23</i> | CS-05-25CLWC |

| Optional accessories                                              | Article No.   |
|-------------------------------------------------------------------|---------------|
| Current and sense cables 2 x 5 m with Kelvin probes (220 A rated) | CS2-05-16CLKP |
| Current and sense cables 2 x 5 m with Kelvin probes (300 A rated) | CS2-05-25CLKP |
| Current and sense cables 10 m with TTA clamps (100 A rated)       | CS-10-10CLWC  |
| Current and sense cables 10 m with TTA clamps (220 A rated)       | CS-10-25CLWC  |
| Current and sense cables 15 m with TTA clamps (100 A rated)       | CS-15-16HTWC  |
| Current cables 2 x 5 m with battery clamps (100 A rated)          | C2-05-06CLB1  |
| Current cables 2 x 5 m with battery clamps (220 A rated)          | C2-05-16CLB1  |
| Current cables 2 x 5 m with battery clamps (300 A rated)          | C2-05-25CLB1  |

|                                                           |              |
|-----------------------------------------------------------|--------------|
| Current cables 2 x 10 m with battery clamps (100 A rated) | C2-10-10CLB1 |
| Current cables 2 x 10 m with battery clamps (220 A rated) | C2-10-25CLB1 |
| Current cables 2 x 15 m with battery clamps (100 A rated) | C2-15-16CLB1 |
| Sense cables 2 x 5 m with alligator clamps (A2)           | S2-05-02BPA2 |
| Sense cables 2 x 10 m with alligator clamps (A2)          | S2-10-02BPA2 |
| Sense cables 2 x 15 m with alligator clamps (A2)          | S2-15-02BPA2 |
| Cable bag                                                 | CABLE-BAG-00 |
| Test shunt 240 $\mu\Omega$ (250 A/60 mV)                  | SHUNT-240-MK |
| Test shunt 1 m $\Omega$ (150 A/150 mV)                    | SHUNT-150-MK |
| Power supply adapter (car charger)                        | PWR-ADP3-CC0 |

**NOTE:**

*RMO-H21, RMO-H22, RMO-H23 devices DO NOT HAVE interchangeable test leads with RMO-H1, RMO-H2, RMO-H3 models. Any use of non-suitable test leads (not mentioned in accessory list above) will be considered as improper device use and can lead even to the device malfunctioning.*

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PROYECTO COFINANCIADO POR EL IGAPE, XUNTA DE GALICIA Y FONDO EUROPEO DE DESARROLLO REGIONAL DEL PROGRAMA OPERATIVO 2014-2020



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