



TECHNICAL OFFER – 37558 REV00

CONTROL COMMAND BOX e-RTU2020 4 REMOTE CONTROL

eRTU2020-4S 3DD

eRTU2020-4S 2DD

1 OBJECT

This document represents the Ensto Novexia technical offer for the supply of 4 way MV switch remote control boxes with 3 or 2 fault detection card and accessories.

2 OVERVIEW

The eRTU 2020-4S box combines in a small footprint all the functions required for the remote control from 1 to 4 motorized MV functional units.

The manoeuvre can be carried out locally via the control panel or by remote control via a UHF digital radio (not supplied).

The communication protocol is IEC 870-5-104 and IEC870-5-101. To switch to other protocols an update, by downloading, of the software of the central processing unit will be sent to you on request to our sales department.

The box provides channel amperometric fault detection via current sensors or directional fault detection (according to EDF HN45-S-51 specification) with the help of voltage sensors.

Each eRTU is equipped with a 4G modem (compatible 2G and 3G) to ensure the communication with a SCADA and also with an interface RS232/RS485 with MODBUS protocol to connect an external low voltage measurement module.

Each eRTU2020-4S is delivered with different request :

- Three or two sets of three split current sensors with a 5m cable long
- Three or two 5m long cables to connect to each switchgear of the RMU
- An external flash indicator with its cable to be fitted outside the building
- A 12V 38Ah battery
- One set of three PPACS type voltage sensors with a 5m long cable, for directional fault detections,

Commissioning assistance tools, described at the end of this document, are available on demand. These are MV cell simulators and a secondary current injection case to test fault detection and opening in the voltage dip.



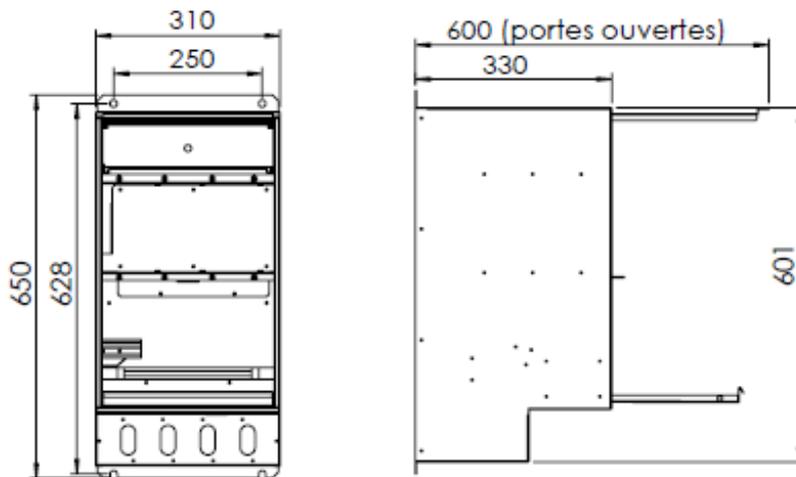
Technical CHARACTERISTICS

2.1 Installation

The box is fixed inside a station on a flat surface by four screws.
Without the battery, its low weight makes it very easy to set up.

2.2 Dimensions

1 to 4 channels:

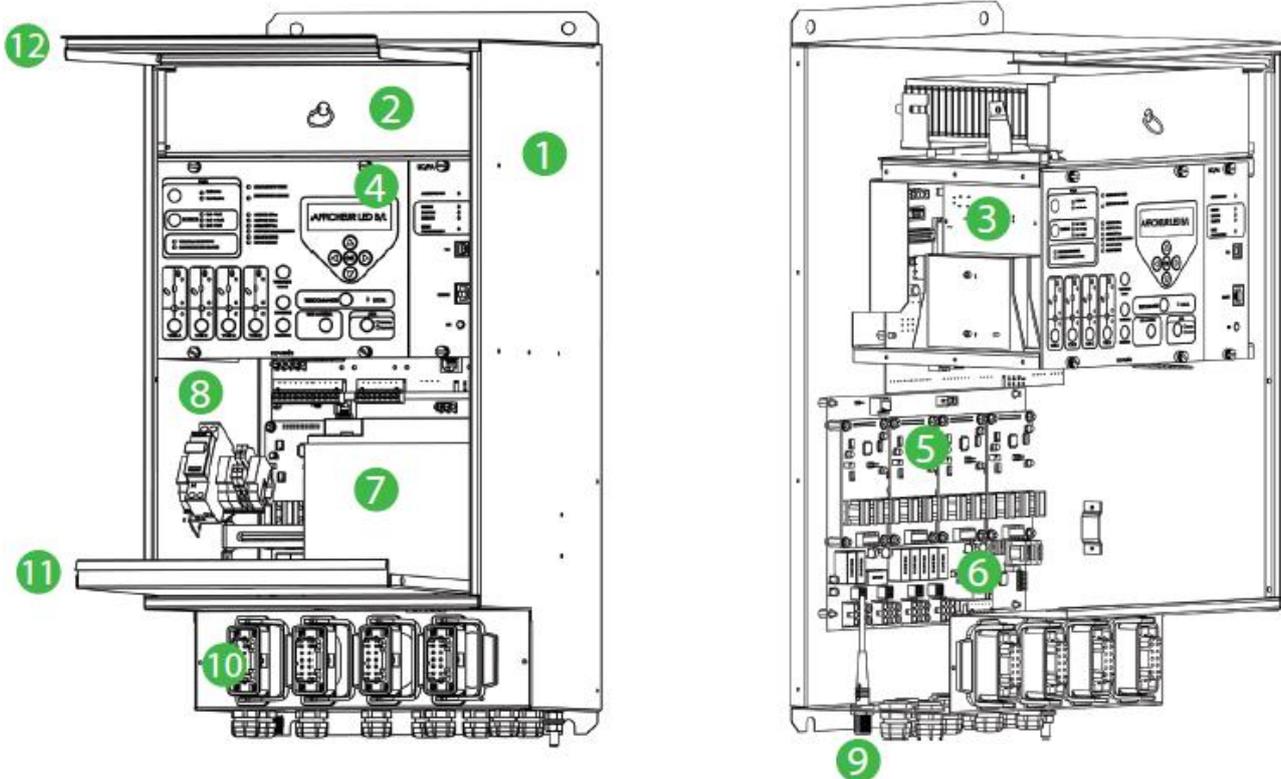


Main characteristics

- Supply voltage : 172 / 230 VAC
- Battery voltage : 12 V
- Battery capacity : 38 Ah
- Communication media : Routeur Modem 4G Robustel
- Communication protocol : IEC870-5-104 / IEC 870-5-101
- Battery test : Yes
- Protection index : IP2XC– IK07
- Weight with the battery : 38 Kg (1 to 4 channels) or 40 Kg (1 to 8 channels)
- Operating temperature : -15°C à +55°C
- Storage temperature : -25°C à +70°C

Overview of the cabinet

The e-RTU 2020-4S box is broken down into several sub-assemblies accessible at different access levels



1. Metallic box
2. Metallic drawer supporting the communication media (radio, GSM/GPRS)
3. Tray containing the LV transformer, power supplies, central unit and modem card.
4. Human Machine Interface (HMI)
5. Line and fault current acquisition modules
6. Electronic board supporting the current acquisition modules (1 per channel), MV voltage acquisition module and different external input/outputs.
7. 12VDC Battery
8. Input for AC supply
9. Antenna connector
10. Multi-pin connectors for management of the 1 to 4 electrical commands of the MV switch
11. Lower part of the door
12. Upper part of the door



3 FUNCTIONS OF THE CABINET

3.1 The box

The box is made of galvanized steel, it integrates all the modules necessary for the management of MV switches both locally and remotely, that is to say that it will integrate the communication support installed by you without having to use an additional box. A two part hinged door allows access to the controls after removing the security padlock

Its shape and construction give it:

- A sealing to penetration of water and solids index IP2XC
- A resistance to mechanical impacts with a 2 joules energy index IK07

It has three (3) access levels:

- Level 0 : Everybody
The cabinet is closed, when padlocked it is IP2XC.
All the status information are available through a transparent window.
- Level 1 : Utility Operator
The upper part of the door can be retracted; the cabinet maintains an IP2X protection level
The lower part of the door remains closed as well as the communication drawer.
In this situation, the local operations are available thanks to the HMI.
- Level 2 : Maintenance operator

The cabinet is fully accessible, all information from levels 1 and 2 are available.
The maintenance operator has a full access to all the components of the cabinet.

3.2 The power supply

3.2.1 External source

150V to 250V LV AC supply

A gf 2A fuse (size10.3x38) protects this AC supply input.

The LV/VLV isolation over moulded transformer withstand the 10kV 50Hz 1min and 20kV 1.2/50µs impulse between primary and secondary.

3.2.2 The 12V DC supply

The UPS provides a regulated and temperature compensated voltage of 13.8V, 3.6 A at 20°C.

A 4A fuse (size 5x20mm) protects the external loads.

In case of a consumption of the communication media higher than 2A for more than 3min its 12VDC supply will be switch off (these values are adjustable).



3.2.3 The 48V DC supply:

The 12V/48V converter provides a 48V, 7A regulated voltage for the motorization of the switches (it is able to provide a 15A for 50ms) necessary when the motor starts.

A 6,3A fuse (size 5x20mm) protects the 48VDC.

3.2.4 Management of the AC supply:

The UPS manages the AC input to give the information about the AC supply. It will give the two following information:

- "AC supply off" when the 230VAC voltage decrease to a value of 180V.
- "End of the fault current" when the 230VAC voltage decrease to a value of 70V, this information is used by the internal fault passage indicator.

3.2.5 Battery

When the 230VAC supply is OFF the 12V 38Ah leaded battery powers all the electronics and accessories.

The battery provides the control box a 16 hours autonomy and the ability to operate the switch for 150 O/C manoeuvres of a switch at 20°C.

To avoid deep discharges of the battery, the UPS makes an automatic disconnection of the battery-powered loads after 16 hours (configurable 16 to 48) of loss of the AC supply voltage.

The activation of the RESET/TEST pushbutton restarts a new 8 hours loads powering cycle.

The return of the AC supply will automatically re-power all the disconnected loads.

An automatic and daily test of the battery ensures that its autonomy is enough to perform some operations of the switches. In case the test result is bad it means the battery is end of life, the alarm sent to the remote control centre informs the operators in charge of remote operations. Therefore, they will request the maintenance team to replace this end of life battery as soon as possible.

3.3 Local mode

The switches can be operated locally and electrically on site with the use of the control box.

Push Buttons fitted on the front panel allow you to:

- Electrically opening and closing the switches
- Make a test to verify the correct functioning of the equipment
- Enable or disable the remote commands
- Enable or disable the auto sectionalizing function
- Enable or disable the PASA automatism (PASA is an Automatic Transfer of Source Supply automatism which can define the direction of the transfer).
- Navigate into the LCD display menu



The following information are available on the front panel with colour leds:

About the network:

- Fault passage indication on each channel equipped (max 8 channels)

About the switches:

- Status of the switches. (Open / Closed)
- Remote commands. (Enabled / Disabled)
- Activity of the communication (transmitting / receiving)
- Auto sectionalizing function (Enabled / Disabled).
- PASA automatism (Enabled / Disabled).
- Direction and conditions of the transfer (link to PASA automatism)

About the status of the equipment:

- Status of the equipment (Ready / Faulty)
- AC supply power (ON / OFF)
- Status of the 48VDC (OK / Faulty)
- Status of the 12VDC (OK / Faulty)
- Status of the battery (OK / end of life)
- Overconsumption of the communication media

The four (4) lines 20 characters LCD display allow you to.

- Visualize and change the main parameters to operate the cabinet
- Visualize the measurement made on the network

3.4 Remote mode

The control box allows managing the switches remotely with the SCADA control system.

The communication with the Dispatching/SCADA/Control centre is made with the IEC104 protocol through an Ethernet port connected to a router or a radio equipped with an Ethernet port (these equipment are not part of our furniture) and with the IEC 101 protocol through an RS232 serial link connected to a UHF digital radio (not part of our furniture).



A sufficient volume (300x300x90mm) is available to fit the communication support.

It includes:

- A grid to fix the communication UHF digital radio equipment
- A GSM/GPRS router can be installed on the DIN rail in the lower part of the cabinet to ensure a communication redundancy.
- A RS232 serial link cable to transmit data between the CPU and the communication media.
- An Ethernet RJ45 cable to transmit data between the CPU and the GSM/GPRS or radio.
- A 12VDC supply for the communication media (radio and/or GSM/GPRS).

It manages the two following protocols:

- IEC 870-5-101 (balanced or unbalanced) for a radio communication
- IEC 870-5-104 for a communication with a GSM/GPRS or a radio.
- The interoperability file, provided with this technical offer, describes all the available functions.
- Any changes from these two protocols to any MODBUS or DNP3 is possible with a simple upgrade of the software version and the settings.
- The IEC 61850 protocol is still under development.

We ensure the communication redundancy as follows:

- When the central control office establishes the dialogue with the control box with a serial protocol, the communication takes place by radio or GSM.
- When the central control office establishes the dialogue with the box with an IP protocol, the communication takes place via GPRS.
- When the box must send information on its own initiative, it establishes dialogue with the two communication media (by radio or GSM (serial link) and by GPRS IP link)).

There is therefore no modification of the communication medium to be carried out; everything is done automatically without the intervention of an operator, if the box and the control centre have been correctly configured.

The following remote operations are available:

- Electrically opening and closing of the switches
- Enabling or disabling the auto sectionalizing function
- Enabling or disabling the automatic transfer of source supply



The controller sends the following information and measurement to the remote control centre:

About the network:

- Fault current passage indication
- Measurement of the load (measurement)

About the switches:

- Status of the switches. (Open / Closed)
- Remote commands. (Enabled / Disabled)
- Auto sectionalizing function (Enabled / Disabled).
- PASA automatism (Enabled / Disabled).

About the status of the equipment

- Status of the equipment (Ready / Faulty)
- AC supply power (ON / OFF)
- AC supply (measurement)
- Status of the 48VDC (OK / Faulty)
- Status of the 12VDC (OK / Faulty)
- 12VDC and 48VDC (measurement)
- Status of the battery (OK / end of life)
- Overconsumption of the communication media
- Some other remote information can be added to this list by a simple change in the settings during commissioning or later.

About the stampings:

- Number of manoeuvres (measurement)
- Network fault current number (measurement)
- Auto sectionalizing opening number (measurement)

3.5 Fault current detection

The current sensors fitted on each phase of each switch give the load current measurement and detect the faults on the network.

Thus, a default on the network located downstream the switch resulting in an abnormal current level will be detected by the control box.

The fault current thresholds can be configured as follows (according to the HN 64-S-44 and HN 45-S-50):

- Phase to earth fault
Threshold adjustable from 20 A to 240 A with 1A steps.
- Double Phase to earth fault
Threshold adjustable from 250 A to 1200 A with 1A steps.



- Phase-to-Phase fault
Threshold adjustable from 500 A to 1600 A with 1A steps.
- Definite time for faults
Time threshold adjustable from 100 to 500ms with 10ms steps.
- Reset of the fault information and visualisation
Adjustable from 1 min to 2h. This time is factory set to 2h.

In addition, the e-RTU2020 box makes it possible to carry out directional fault detection by combining the measurement of the load current (by the current sensors) with the measurement of the MV voltage (via PPACS type voltage sensors mounted on the MV separable connector).

This directional fault detection complies with the EDF HN 45-S-51 specification and makes it possible to define the position of the fault upstream or downstream of the switches.

You can select the fault detection (definite time or directional) required on site under the condition of having PPACS voltage sensors installed.

External light signaling device

A flashing indicator light is supplied with each box. This two-colour LED (Red and Green) installed outside the substation indicates the passage of a fault current. It is visible, in clear weather, day and night.

3.6 Measurements

Current measurements

The current acquisition modules make the measurement of the load current on the 3 phases of each of the channels installed on the cabinet.

The device calculates the average current for each channel over a configurable period of 1 to 60min and stores the maximum value of the current.

It saves the maximum value of the load current (fault current values are not stored)

MV voltage measurement

The MV value is calculated from LV measurement by applying a coefficient that you will configure with you laptop during commissioning.

The device calculates the MV average voltage over a configurable period of 1 to 60min.

Temperature measurement

The UPS module measures the temperature every seconds. This value is used to monitor the regulation of the battery recharging voltage. With your laptop, you will have access to this temperature value.



External measurements

An external measurement unit can be connected to the RS485 serial port of the RS232/RS485 converter module installed on the DIN rail in the lower part of the cabinet. The dialogue between this measurement unit and the box is made by MODBUS protocol.

3.7 Auto sectionalizing function

When enabled, the auto sectionalizing function automatically insulate a faulty part of the network

Detects the network faulty part

If anything abnormal appears on the network, the substation protections will open the circuit and then start a reclosing cycle.

After the first reclosing, the control box analyses the current. If a fault current is detected this means that the faulty part of the network is downstream and the auto sectionalizing cycle starts.

Count the reclosing operations

The automatism counts the reclosing operations made by the protections and analyses if the current is over the threshold.

Isolate the faulty part of the network

After a configurable number of reclosing and when the line is dead, the automatism opens the switch. The faulty part of the network is isolated; the other part can be powered again.

The automatism sends an alarm to the remote control centre to indicate the automatic opening of the switch.

Then the automatism is reset. If all the required conditions are not present within the reclaim time the automatism is also reset.

The simplicity and flexibility for settings of this function (phase-to-phase fault and earth fault current thresholds, timers, and number of defaults) allow to easily changing the settings in order to adapt them to the circuit breaker protection.

Configurable parameters:

- Minimum time between two faults: threshold adjust 0.1s to 2.5s with 0.01s steps,
- Delay before opening: threshold adjust 1s to 60 s with 1s steps,
- Reclaim time: threshold adjust 15s to 60s with 1s steps,
- Number of fault before opening: 1 to 7

3.8 Automatic Transfer of Source Supply automatism (PASA)

The automatic source transfer devices are installed to ensure the continuity of supply to priority subscribers, for reasons of personal safety or maintaining a production cycle, for example.

Their start-up is controlled either by a failure of the main power supply normally in service, or by a voluntary action.

This PASA automatism constantly analyses the state of the network and switches between two MV supply sources. A source can consist of several switches in parallel.

The automatism performs the transfer from one source to another source according to the following conditions:

- At least one switch is closed and connected to the active source. The switches must not be electrically disabled (operations are accepted).
- The switches connected to the rescue source are in open position
- No voltage on all closed switches connected to the active source.
- MV voltage available on at least one switch connected to the rescue source (this switch must not be electrically disabled)
- The 48VDC must be ok to ensure a complete transfer of the sources.
- No external locking order in progress.
- Direction of transfer allowed.
- No MV fault locking order generated by the MV fault detectors of the active source

Configurable parameters:

- Definition of the transfer pair Src1 and Src2 : 1 to 3 channels per source
- Kind of automatism : Full (MV fault monitoring) or Simplified
- Direction of the transfer : Src1 -> Src2 ; Src1 <-> Src2 ; Src1 <- Src2
- Delay before transfer (Tr) : 1, 5, 25, 45s
- Number of tries allowed : 1 to 4

3.9 Cyber security

In order to secure access to data and remote control of our range of eRTU200 boxes, the following features have been implemented:

- Firewall configurable from the web interface to secure incoming and outgoing flows
- Protection against DOS (deny of service) attacks
- Local and remote access for secure administration managed by:
 - o HTTPS protocol,
 - o Dedicated Ethernet port,
 - o User authentication,
 - o Individualized passwords, stored, hashed with a SHA256 function
 - o Management of access controls and user rights,
 - o Storage of user data (logins, passwords, access rights, etc.) in the MySql database,
 - o Ability to enable two-factor authentication for remote access (password + user certificate),
 - o Blocking of users in case of repeated connection failure.



- Dedicated log files for each service:
 - o Access to web pages and modifications to the configuration of the cabinet,
 - o Events related to secure communications,
 - o System events,
 - o Remote control events.
- Services managed by VPN secure channel (Open VPN or IPsec), SSH (not accessible to the client, activation/deactivation from the Web interface), firmware update locally or remotely secure.
- Securing at the hardware level by disabling any unused service.
- Compliance with the IEC 62351-3 standard: security of networks and communication systems – Profiles including TCP/IP (under development)
- Compliance with standard IEC 62351-5: Safety for standard IEC 60870 and derivatives (under development).

The certification of this cyber security aspect is in progress.

3.10 Management of the events

The controller stores up to 20 000 events in a stack with a 100ms accuracy.

3.11 Configuration

The display and configuration of the box parameters are carried out using a simple internet browser (Edge, Firefox, etc.) without any additional software to be installed on a computer. The parameter setting function is embedded in the central processing unit.

The ETHERNET socket (RJ45) located on the front panel of the communication module allows connection to the laptop using an ETHERNET cable



3.12 Commissioning tool

Ensto Novexia developed two dedicated tools to facilitate commissioning and maintenance operations.

This first equipment called VISIO II will perform a current injection on the box input (secondary injection) to simulate phase-phase faults and earth faults (the current and voltage sensors must be disconnected from the box). It can also simulate the cycles of the upstream circuit breaker to test the automatic opening function in the voltage dip.



This second equipment called Cells Simulator, emulates the behaviour of an MV cell. It makes possible to test the opening / closing functions by replacing a MV switch which cannot be operated for various reasons. During the cabinets commissioning, it also makes possible to test some functions (presence of MV voltage or neutralized cell) and display some information. It is plugged in multi pin sockets used to connect the controller to the cell.





TYPE TESTS

The NF EN 61326 standard define the insensitivity as follows:

Criterion A

- No material or component must be damaged or deteriorated;
- No failure or temporary loss of quality should affect the operation of the box;
- No anomaly must affect the remote control dialogue;
- No unsolicited order must be transmitted to the electrical controls;
- No local or remote signaling and no false alarms must occur.

Criterion B

- No material or component must be damaged or deteriorated;
- Failure or temporary loss of acceptable quality during the test and self-recovering;
- Temporary loss of the remote control dialogue;
- No unsolicited order must be transmitted to the electrical controls;
- No remote signaling and no false alarms must occur;
- Temporary degradation of local light signals acceptable during the test

Radiated/Conducted disturbances test			
Electromagnetic Compatibility			
Radiated/conducted disturbances tests for industrial environments			
Test	Standard	Test level / Criterion	Comments
Radiated electric field in a cage	CISPR 22 (2008)	<p><u>30 – 230 MHz</u> : 50 dB (µV/m) quasi-peak at 3m</p> <p><u>230 – 1000 MHz</u> : 57 dB (µV/m) quasi-peak at 3m</p> <p><u>1000 – 3000 MHz</u> : 76 dB (µV/m) peak at 3m</p> <p><u>1000 – 3000 MHz</u> : 56 dB (µV/m) average at 3m</p> <p><u>3000 – 6000 MHz</u> : 80 dB (µV/m) peak at 3m</p> <p><u>3000 – 6000 MHz</u> : 60 dB (µV/m) average at 3m</p> <p>Specifications ERDF: 72.525 – 73.1125MHz: 0dBµV/m</p>	Compliant
Conducted disturbances on AC supply input	CISPR 22 (2008)	<p><u>0.15 – 0.5 MHz</u> :</p> <p>79 dB (µV) quasi-peak</p> <p>66 dB (µV) average value</p> <p><u>0.5 – 30 MHz</u> :</p> <p>73 dB (µV) quasi-peak</p> <p>60 dB (µV) average value</p>	Compliant

Immunity tests			
Electromagnetic Compatibility Radiated/conducted disturbances tests for industrial environments			
Test	Standard	Test level / Criterion	Comments
Immunity to electrostatic discharges	CEI 61000-4-2 (2008)	± 2, ±4 et ±8kV contact ± 2, ±4 et ±15kV in the air Criterion B	Compliant
Immunity to electromagnetic field	CEI 61000-4-3 (2010)	30 V/m : 27 -80 MHz 30 V/m : 80 – 1000 MHz 30 V/m : 1000 – 6000 MHz AM 80% -1 kHz Criterion A	Compliant
Radiated, radio-frequency, electromagnetic field immunity test	CEI 61000-4-3 (2010)	3V/m : 1M – 1GHz Criterion A	Compliant
Electrical fast transient/burst immunity test on inputs and outputs	CEI 61000-4-4 (2011)	±4 kV AC supply ±4 kV switched line ±4 kV current sensors input ±4 kV voltage sensors input ±2 kV inputs Criterion A	Compliant
Surge immunity test on inputs and outputs	CEI 61000-4-5 (2005)	± 1kV : AC supply ± 2kV : switched line ± 2kV : current sensors input ± 2kV : voltage sensor input Criterion A	Compliant
Immunity to conducted disturbances, induced by radio-frequency field on inputs and outputs	CEI 61000-4-6 (2008)	10 V : 0.15-80 MHz on AC supply input 10 V : 0.15-80 MHz on switched line input 10 V : 0.15-80 MHz on current sensors inputs 10 V : 0.15-80 MHz on voltage sensors input 10 V : 0.15-80 MHz on inputs/output AM 80% -1 kHz Criterion A	Compliant
Power frequency magnetic field immunity test	CEI 61000-4-8 (2009)	100A/m Criterion A	Compliant
Impulse magnetic field immunity test	CEI 61000-4-9 (2001)	1000A/m Criterion A	Compliant
Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase	CEI 61000-4-11 (2004)	0% Ut – 1000 ms 0% Ut – 100 ms 40% Ut – 1000 ms 70% Ut – 20 ms Criterion A	Compliant
Immunity to frequency variations	EDF specification HN 64-S-44 (2011)	47Hz and 53Hz Criterion A	Compliant
Harmonics and inter harmonics including mains signalling at AC power port, low frequency immunity tests	CEI 61000-4-13 (2009)	Class 2 Criterion A	Compliant
Immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz	CEI 61000-4-16 (2011)	30V permanent 300V pendant 1 second Criterion A	Compliant
Damped oscillatory wave immunity test	CEI 61000-4-18 (2006) + A1 (2010)	±2.5kV longitudinal mode s Criterion A ±1kV transverse mode Criterion A	Compliant



Environment tests			
Test	Standard	Applicable values	Comments
Isolation resistance		Measurement under 500VDC Isolation resistance > 100 M Ohm	Compliant
Dielectric 50 Hz		Voltage test value : 10 kV Frequency : 50 Hz Duration : 1 min	Compliant
Surge		Voltage test value: 20 kV 5 positive impulse then 5 negative impulse.	Compliant
Temperature influence		+55°C under AC supply +15% = 264,5 V -15°C under AC supply -15% = 195,5 V	Compliant
Change of temperature	IEC 60068-2-14	Five successive cycles spaced of 2 minutes Low temperature: -25 °C High temperature: 55°C	Compliant
Damp heat, steady state	IEC 60068-2-78	Temperature de 40 °C, Humidity de 93% - Duration 96h	Compliant
Protection index of the box	IEC 60529 IEC 62262	IP2XC IK07	Compliant
Battery autonomy		According to a specific cycle with 10 O/C operations while the AC supply is OFF for 16 hours.	Compliant
Vibration (sinusoidal)	IEC 60068-2-6	Vibrations in the 3 directions Frequency range : 10Hz to 500Hz	Compliant
Shock and bump tests	IEC 60255-21-2 class 2	Vibrations in the 3 directions Frequency range : 1Hz to 35Hz	Compliant
Damp heat, cyclic (12 h + 12 h cycle)	IEC 60068-2-30 variant 2	6 cycles (variant 2)	Compliant
Salt mist	IEC 60068-2-11	Exposure time: 178 h	Compliant
Extended power supply		Functioning @ +55 °C for 1000h under AC supply +10% (252V)	Compliant