



SENTINEL A[®] - Fault Passage Indicator

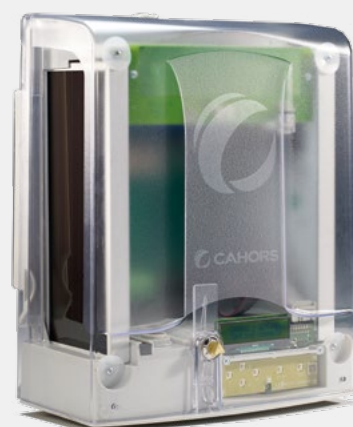
COMMUNICATING AMPEREMETRIC FAULT PASSAGE INDICATORS FOR OVERHEAD MV NETWORKS

Installed on poles of overhead lines, the **Overhead-Sentinel-A** range allows locating the fault arisen on the MV network, whether they are single phase to earth, multi-phase, transient or permanent. It allows identifying quickly the failing section of the network, supplying:

- a blinking light for the permanent fault.
- reporting all events counters fault (transient or permanent).

The **Sentinel-A** is an amperemetric fault passage indicator (FPI) adapted to the MV overhead lines (fault current always higher than capacitive current):

- network with impedance earthing,
- network with direct earthing.



FRENCH
PRODUCTION



sigfox



> DESCRIPTION



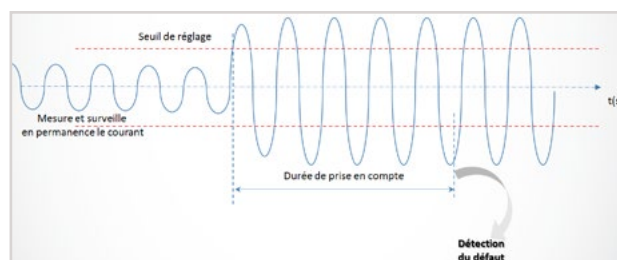
Functioning

Amperemetric detection

The **Overhead Sentinel-A** measures the electromagnetic field and the electric field supplied by the overhead line. The sensor integrated in the indicator provides an image of the residual current.

Other sensors provide an image of the line current flowing in the power grid and an image of the residual voltage.

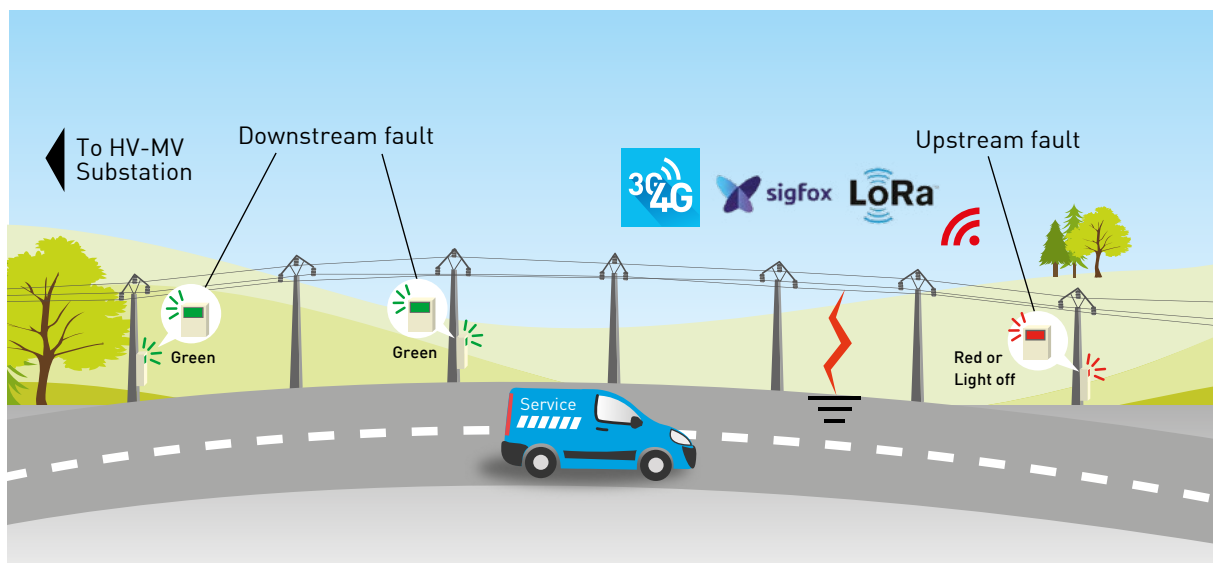
Fault is detected when its value exceeds an adjustable threshold (homopolar residual current or phase current) for a fixed period.



> FAULT LOCALIZATION

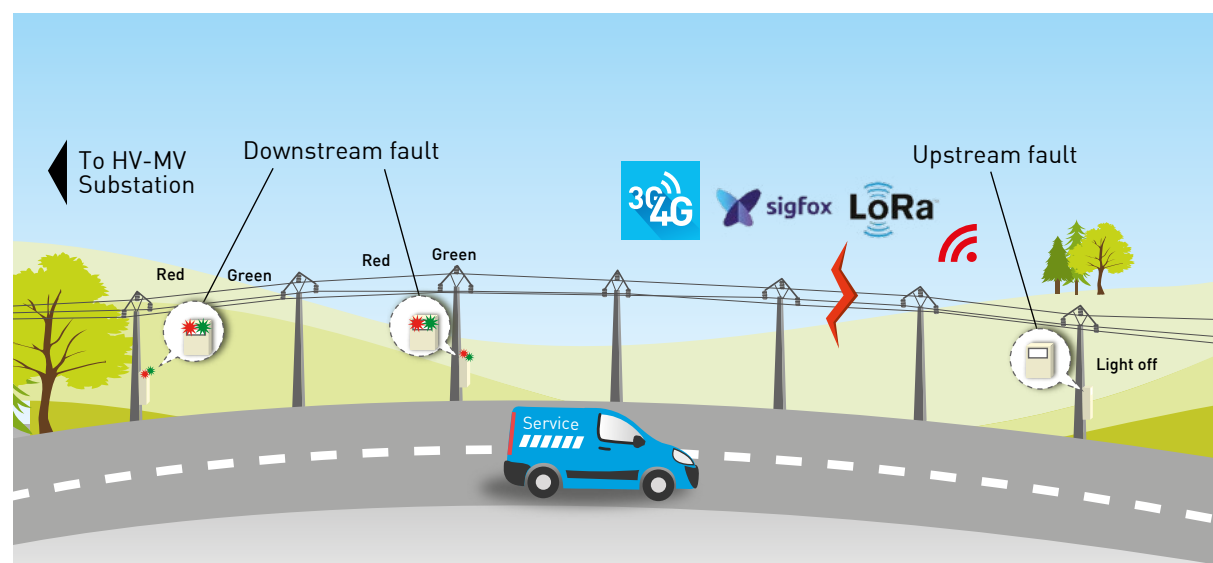
Single phase earth faults

The single-phase earth faults are indicated with only one color light. Only detectors located between the high voltage station and the defect flash. The fault is located on the network section between the last FPI whose flashes and the first whose is not flashing.



Dual and multi-phase faults

They differ from other defects by double colors (alternating Red and Green). Only detectors located between the high voltage station and the defect flash. The fault is located on the network section between the last FPI (Fault Passage Indicator) whose flashes and the first whose is not flashing.





> SIGNALLING FAULTS

Flashing information

The information of the presence of a fault that led to the definitive trip of feeder is indicated locally by a LED.

The signalling is performed at a rate of one flash per second :

- **Red flash** in the event of a single-phase fault
- **Alternately red flash and green flash** in the event of a multi-phase fault or double fault to earth



Relay dedicated to remote control

Two relay outputs (dry potential free contacts) copy the light signalling. These contacts (NO) allow to bring back fault information to an external application.

These contacts are activated for 100 ms to the appearance of transient fault then, if the fault becomes permanent, the contacts are activated for the duration of the light signalling.

Relay of alarm « Equipment fault »

A third relay output provides to an external application, information on the correct operation of the fault passage indicator. Two dry contacts («normally open» and «normally closed») are activated from the loss of supply of the fault passage indicator (end of autonomy of the rechargeable element - ultra capacitor - end of battery life) or in the event of processor failure (watchdog).

It indicates that the detector is no longer operational:

- the “NO” contact opens
- the “NC” contact closes

> COMMUNICATION

As an option, the overhead line fault passage indicator **Sentinel-A** can be equipped with a communication module that transmits the information from the remote FPI directly to the operator or control room system responsible for network management.

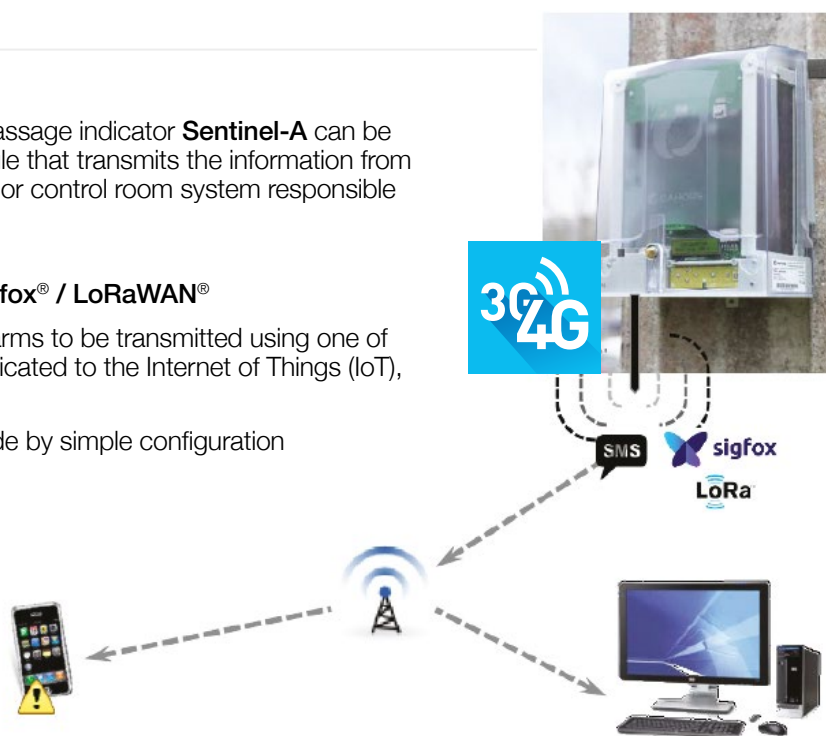
LPWAN communication module Sigfox® / LoRaWAN®

This communication module allows alarms to be transmitted using one of the new communication networks dedicated to the Internet of Things (IoT), Sigfox® or LoRaWAN®

The choice of the network used is made by simple configuration of the Fault Passage Indicator.

Cellular communication module

With this communication module, alarm messages are sent to the operator by SMS (Short Message Service) via GSM/2G/3G/4G/4G cellular networks.



> HUMAN MACHINE INTERFACE

The overhead line fault passage indicator **Sentinel-A**, in addition to the basic functions of detecting and signalling the faults that led to the final tripping of the outgoing circuit-breaker, counts and returns the number of fugitive, semi-permanent and permanent faults of the various types (single-phase and multi-phases).

As an option, the FPI **Sentinel-A** has a local machine interface to access the same menu as the remote control.

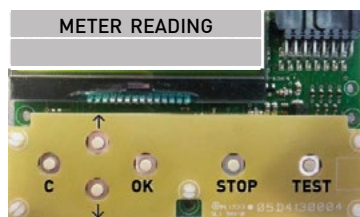
A Bluetooth® radio remote control and/or an Android Sentinel-RMT application allows you to remotely consult and configure the **Sentinel-A**. With a range of about 20 meters, these tools facilitate the configuration and reading of FPI:

- without getting out of the vehicle
- in hard-to-reach areas
- when the detector is placed more than 2 m high.

Equipped with a display and push buttons, the remote control allows the user to make:

- the consultation of messages in clear text
- the visualization of the numbers and fault types (counters)
- the configuration of the various parameters and setting thresholds

It uses standard commercial batteries (2 x LR06 alkaline AA 1.5V batteries)



> KEY BENEFITS

AMPEREMETRIC OR DIRECTIONAL FAULT PASSAGE INDICATORS FOR OVERHEAD MV NETWORKS.

- No contact with Medium Voltage line during installation
- Electrical field sensor technology without line contact for FPI (Fault Passage Indicator)
- Communication facilities for fast fault localization with Sigfox, LoraWan or GSM telecom technologies
- A local blinking light for the permanent fault localization
- Reporting all events counters (transient or permanent) for analysis
- Power supply with integrated solar panel or batteries



> INSTALLATION

The **Overhead-Sentinel-A** is designed to be installed on electric poles of overhead lines. The supports can be concrete, wood or metal.

The box is fixed to the pole height **between 3 m and 6 m** (5 m being the default position).

The height between the floor and the lowest of the line wire shall be **between 7 m and 14 m**.

The pole must be free of all vegetation high on **a radius of 3 meters around the support**.



Warning:

To maintain its sensitivity, the **Overhead-Sentinel-A** should not be installed:

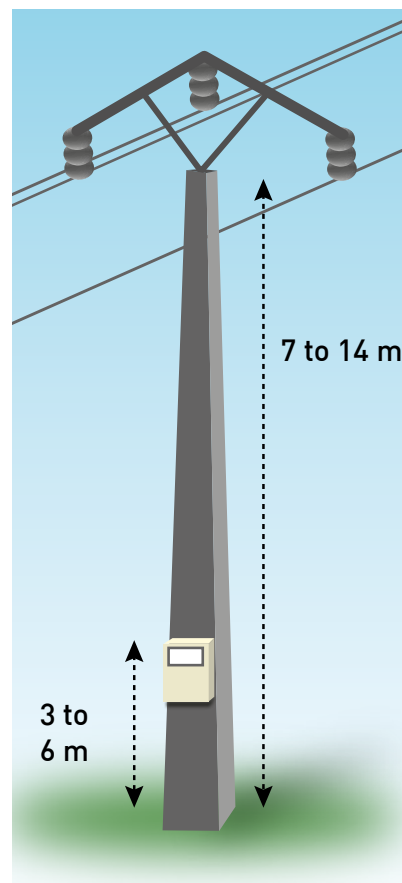
- less than 50 m from another MV line.
- less than 200 m from HV line (<100kV) or railway.
- less than 500 m from HV line (>100kV).
- less than 50 m from an overhead-underground connection.



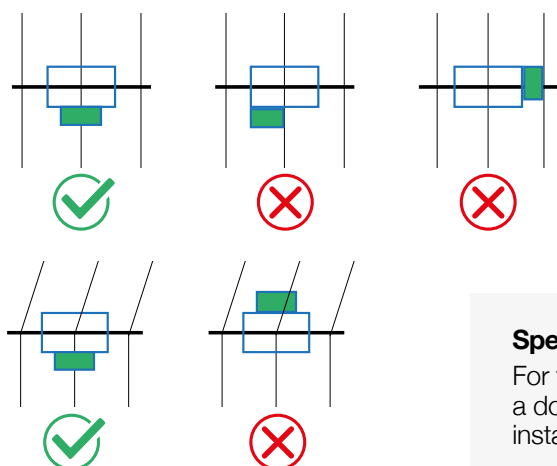
Warning:

The **Overhead-Sentinel-A** should not be installed in the following cases:

- on cross supports.
- on overhead-underground connection.
- on mix supports (with multiple networks HV, LV).

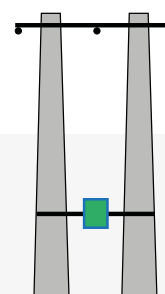


The **Overhead-Sentinel-A** must be installed at the center of the pole in the center of the overhead line:



Special case

For the use of **Overhead-Sentinel-A** on a double support, the detector must be installed on a crossbar between two poles.



> POWER SUPPLY

The **Overhead-Sentinel-A** fault indicator is powered by ultra capacitor charged with solar panels. It does not require any replacement.

This version is equipped with a switch in order to turn off the current of the indicator if necessary.



Warning:

When commissioning, the ultra capacitor of the overhead Sentinel A indicator needs to be charged.

In order to do so, 2 solutions are available:

- place the overhead Sentinel A in full sun for at least 2 hours before commissioning (depending on the weather)
- use the quick charge with the micro USB connector:
 - by plugging a standard phone charger (the charger must supply a voltage of 5 V and a current greater or equal to 500 mA). This charger could be connected to the power supply or on a 12 V cigarette lighter socket.
 - by plugging the indicator on the USB interface of the PC (with a USB-A cable/micro USB)

Charging time will be about 20 minutes. While charging, a red flash lights up and turns off at the end of the process.

> OPERATION

Display of fault counters

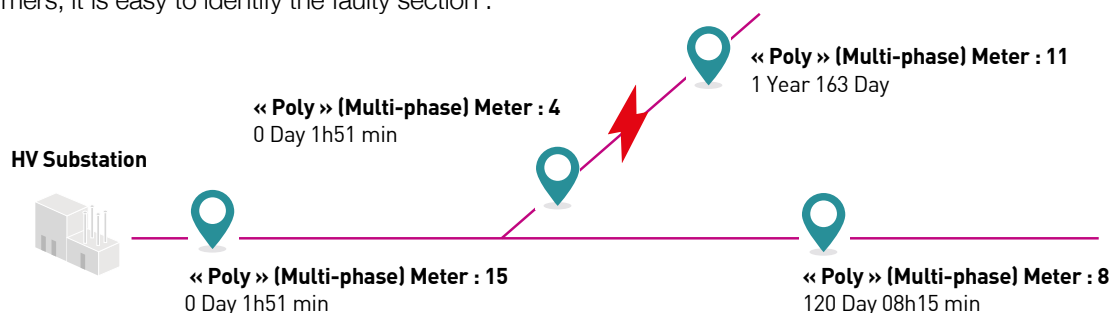
The buttons "↑" and "↓" allow scrolling the display of 2 fault counters. Once these were read, the user has the ability to perform their reset.

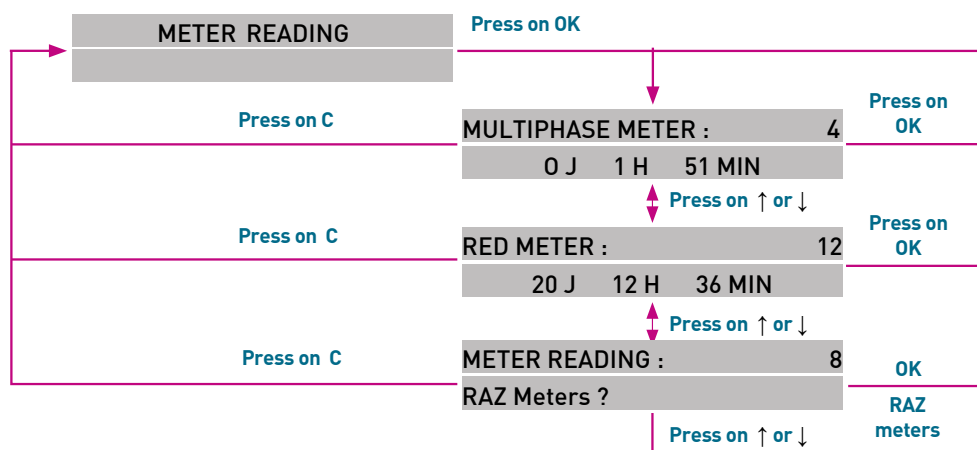
In addition to the default counters, the **Overhead-Sentinel-A** indicates the time since the last increment of each counter. This additional information:

- allows to know, after the extinction of the signals, if the **Overhead-Sentinel-A** has seen the fault.
- provides assistance for preventive maintenance of the HV line. When an unusual increase in the number of transient faults occurs, the **Overhead-Sentinel-A** provides valuable information on the section of the HV network causing these transient faults. With fault counters and this time information, it is possible to know which fault passage indicators have seen these faults and so, to identify the fault location before it causes a definitive trip.

Example of using the fault counters to find the section causing transient faults.

With timers, it is easy to identify the faulty section :



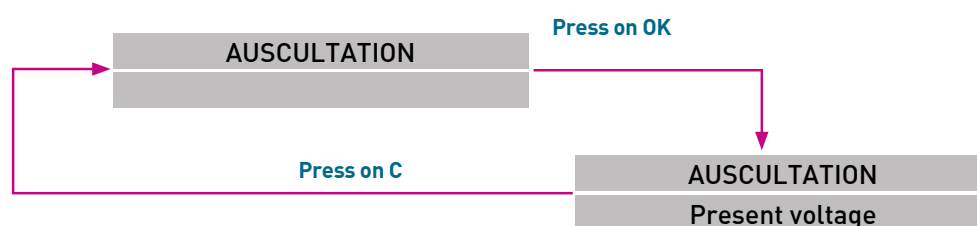


Fault display

While fault searching, the alphanumeric display can provide the operator, additional assistance by indicating clearly the type of fault, "multiphase", "double", or " phase ".

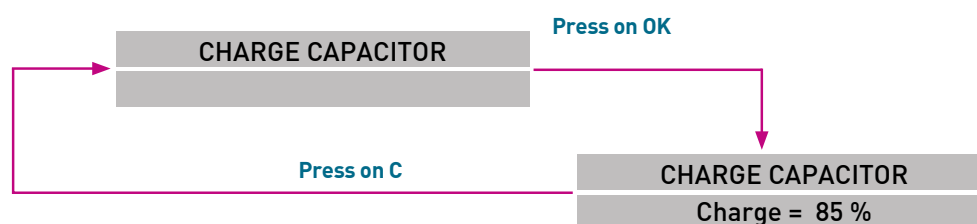
The fault is stored as long as the MV voltage is absent.

In the absence of fault, the **Overhead-Sentinel-A** indicates the presence or absence of MV voltage.



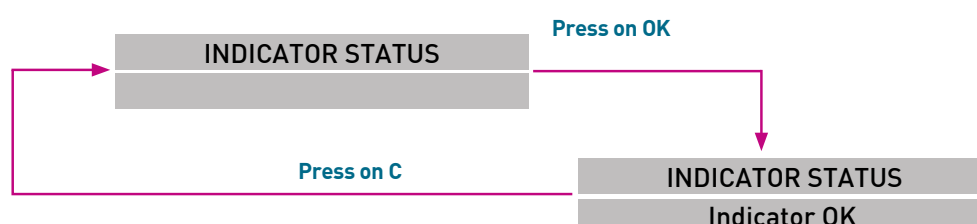
Charge level of the ultra-capacitor (depending on model)

Use this menu to check the charge level of the ultra-capacitor associated with photovoltaic panels.



Status of the fault passage indicator

The «fault passage indicator status» menu allows for a diagnosis in an event of equipment failure of **Overhead-Sentinel-A**.



> ELECTRICAL CHARACTERISTICS

MV NETWORK	OVERHEAD-SENTINEL-A
Rated voltage U_N	Until 36 kV
Rated frequency	50 Hz
Detection of single- phase earth faults	
Detection principle	Amperemetric (threshold exceedance for a period)
Phase current detection threshold	20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240 A
Handling time	60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 280, 300, 400, 500 ms
Signalling	RED
Detection of dual single phase faults	
Detection principle	Amperemetric (threshold exceedance for a period)
Phase current detection threshold	250, 300, 350, 400, 450, 500, 600, 700 A
Handling time	60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 280, 300, 400, 500 ms
Signalling	RED and GREEN
Detection of multi-phase faults	
Detection principle	Amperemetric (threshold exceedance for a period)
Phase current detection threshold	250, 300, 350, 400, 450, 500, 600, 700 A
Handling time	60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 280, 300, 400, 500 ms
Signalling	RED and GREEN
Time delays	
Before a fault is counted (T delay)	340 ms, 800 ms or 3 sec
Before the indication of a permanent fault (T permanent)	1 sec, 10 sec, 20 sec ou 70 sec
Voltage MV presence for «setting» the detection of single phase faults	5 sec
MV voltage return for clearing the current fault	5 sec
Indication	
External indicator light	High brightness flashing LEDs
External contact	Closing dry contact
Indication stopped	
Clearing the fault Through MV voltage return Voltage level Delay	0.5 U_N 5 s
Stop of signalling with fault ever stored Through a front panel pushbutton Automatically after a time delay	2h, 4h, 12h, 24h
Communication	
Sigfox™ Network Technology Frequency Protocol	Radio Ultra Narrow Band 868 MHz ISM Band Sigfox™
LoRaWAN™ Network Technology Frequency Protocol	LoRa Radio 868 MHz ISM Band LoRaWAN™
Cellular network Technology Protocol	2G/3G/4G GSM SMS

> ENVIRONMENTAL CONDITIONS

	NORMS	OVERHEAD-SENTINEL-A
Mechanical		
Dimensions (W x H x D)		320 x 260 x 140 mm
Protection rating	NF EN 60529 NF EN 62262	IP 54 IK 09
Vibrations	NF EN 68068-2-6	Acceleration : 2g/ displacement : 0,15 mm (peak value) - 10 Hz to 500 Hz
Climatical		
Operating temperature	NF EN 60068-2-1 NF EN 60068-2-2	- 25° C to + 55° C
Storage temperature	NF EN 60068-2-14	- 40° C to + 70° C
Relative humidity	NF EN 60068-2-3	Tests Ca - 93% à 40°C 96h closed box, 4h opened box
Salt mist	NF EN 60068-2-11	178 h
Dielectric strength		
Input voltage 12 V and dry contact outputs compared to the box	CEI 60255-5	2 kV - 50 Hz (1 mn) 5 kV shock (1,2/50 µs)
Electromagnetic		
Dampened oscillating waves	NF EN 61000-4-12	2.5 kV un common mode (100 kHz et 1 MHz) 1 kV in differential mode (100 kHz et 1 MHz)
Fast transients	NF EN 61000-4-4	4 kV on power circuits 2 kV on other circuits
Shock waves	NF EN 61000-4-5	1 kV coupling between wires 2 kV coupling wire /ground
Electrostatic discharges	NF EN 61000-4-2	Harshness 4 (8 kV contact discharge, 15 kV air discharge)
Electromagnetic field-amplitude	NF EN 61000-4-3	10 V / m 27 MHz to 6 GHz
Power supply		
Battery self-sufficiency		3 lithium batteries 13Ah format D (not included)
External supply 12V DC		12 V + 30% - 10%
Solar panels save by ultra-capacitor		2.5 V maintenance free (15 years)

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