

# **SWISSPRO**® **SMART CITIES**

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## **B-PLC Systems**

Series NX-9x Nodes

Technical Manual

# Index

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<b>Contact Information</b> .....	3
<b>Warning</b> .....	3
<b>Disclaimer</b> .....	3
<b>1. Overview</b> .....	4
1.1 PLC Node .....	4
1.2 Series NX-9x .....	4
1.3 Block diagram .....	6
1.4 Connectors .....	7
1.5 Connection to the power mains .....	8
<b>2. Technical specifications</b> .....	9
<b>3. Environmental data</b> .....	10
<b>4. Dimensions and weight</b> .....	10
<b>5. Installation guide</b> .....	11
5.1 Node connectors .....	11
5.2 Mains connector .....	12
5.3 Low voltage signal and control connector .....	13
5.4 Ethernet connector .....	13
<b>6. Safety and warning statements</b> .....	13
<b>7. Limited product warranty</b> .....	14
<b>8. Document revisions</b> .....	16
<b>Annex I. Declaration of Conformity</b> .....	17

## Contact Information

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- Web Site: <http://www.swissprocity.sg>

## Warning

This guide is for professionals who have received training and are qualified to work with electricity and electrical metering equipment. All applicable national and local electrical codes and standards must be followed. Failure to follow proper procedures may result in serious bodily harm including death.

## Disclaimer

The product described herein may be changed or enhanced from time to time. This information does not constitute commitments or representations by SWISSPRO and is subject to change without notice.

Images shown are a representation only. They may not match exactly with the real equipment.

# 1. Overview

## 1.1 PLC Node

The PLC (Power Line Communication) Node is a device which allows to transmit and receive data from/to the low voltage power line, using OFDM (Orthogonal Frequency Division Multiplexing) multicarrier modulation technology. It communicates to a Head End or other Nodes.

It uses a 10 MHz bandwidth (2 – 12 MHz). Its Firmware allows the management of multipoint MACs (Medium Access Control) with auto-repeating capability, so each Node is able to extend the network. At the same time, it allows the auto-regeneration of the network depending on the changes at the power line environment.

Nodes uses an optimal path selection protocol. The technology finds the best route in terms of attenuation and number of repeaters to connect a Node to the Head End.

The device includes a powerful error correction system which provides maximum robustness over any power line wire. The DES, 3DES and AES encryption guarantees total data security.

Nodes are Plug and Play devices which simplifies the installation.

These Nodes are devices for PLC communication and can use any electrical conductor (with or without power). These Nodes are used with great success in Smart City solutions based on smart street lighting.

## 1.2 Series NX-9x

The NX-9x series is a PLC node with additional interfaces and functionalities.

The series consists of four devices with common features and some specific ones.

Every NX-9x node includes:

- A DALI interface, e.g. for (control) dimming of luminaires.
- One open collector control output for 12Vdc relays.
- One digital input for potential free (dry) contacts.
- Real Time Clock (RTC) which ensures the maintenance of the date and time after an OFF state.
- Auxiliary 12Vdc/50mA power output.
- B-PLC connectivity (Broadband).

Optional features are:


- Pass-through current measurement of up to 4A (100...277VAC) for fault detection.
- Ethernet 10/100 Mbps
- Full-Duplex port and auto MDI/MDIX with RJ45 connector for IP connectivity to devices such as computers, cameras, audio systems etc.

These are the Series NX-9x models:

Model	Features		
	Power Meter	Ethernet (RJ-45)	0...10Vdc control
NX-92	X		X
NX-94	X	X	X

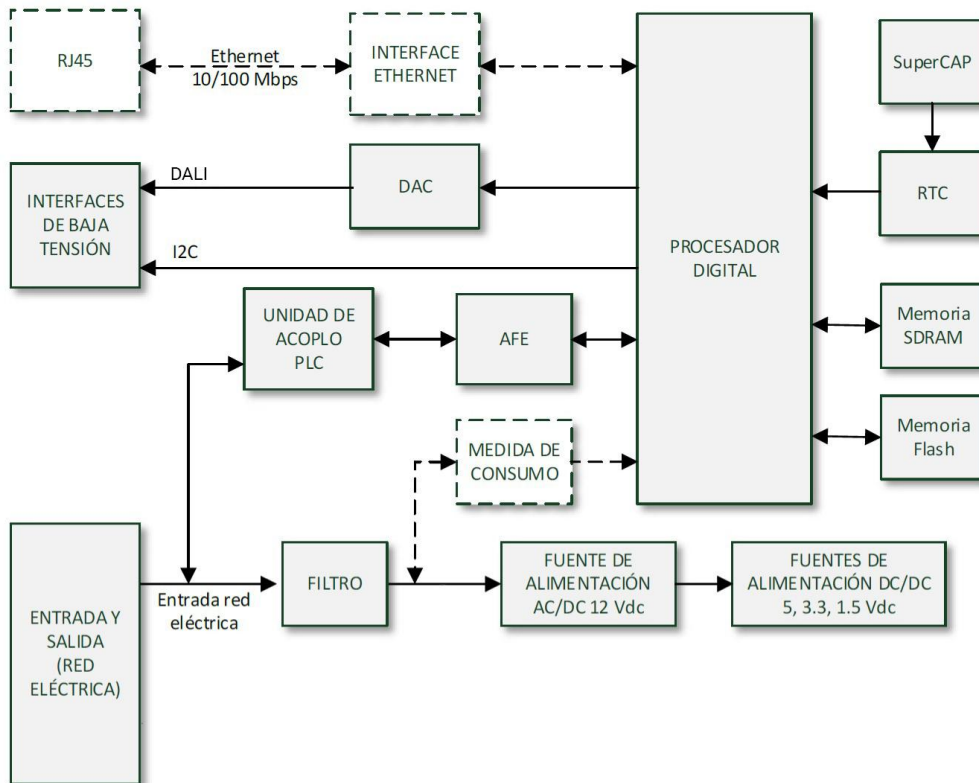
The DALI interface allows among others, to control LED drivers for LED luminaires.

NX-9x Nodes have an AC output of up to 4A with the same voltage as the input (bypass). This output passes through a filter to avoid interference in the PLC signal.

 **WARNING:** These Nodes are connected between Phase and Neutral of the power grid. In no case should they be connected to a three-phase/polyphase power system.

### 1.3 Block diagram

This is the NX-9x block diagram:



*NOTE: Optional features are marked with dashed lines.*

The power supply (115/230VAC) of the Node is isolated by a filter that separates it from the injection of the PLC signal. Once the power supply (115/230VAC) is filtered, it is derived to the output through a relay.

The digital processor manages communications and has large SDRAM and Flash memories. The real-time clock (RTC) allows to retain the date and time at all times (even after a mains disconnection of the Node) by means of a SuperCAP.

The PLC communication goes through the AFE (Analog Front End), block of amplifiers and transmitting and receiving filters, and injected into the mains through a Coupling Unit.

As optional blocks to the NX-9x series, 10/100 Mbps Ethernet port and power consumption measurement can be provided.



**WARNING:** The NX-9x Nodes supply power to the DALI interface, and therefore, no other DALI device providing power to this interface can be connected simultaneously on the same DALI bus. Doing so will damage this interface. Please contact SWISSPRO for clearing this. **¡Otherwise, NO WARRANTY will be granted!**

## 1.4 Connectors

The unit has the following connectors inside.

**Mains Input/Output connector.** These are the terminals (pins):

- |                          |                              |
|--------------------------|------------------------------|
| - Earth (Line Input):    | Earth terminal (mains IN)    |
| - Phase (Line Input):    | Phase terminal (mains IN)    |
| - Neutral (Line Input):  | Neutral terminal (mains IN)  |
| - Neutral (Line Output): | Neutral terminal (mains OUT) |
| - Phase (Line Output):   | Phase terminal (mains OUT)   |
| - Earth (Line Output):   | Earth terminal (mains OUT)   |

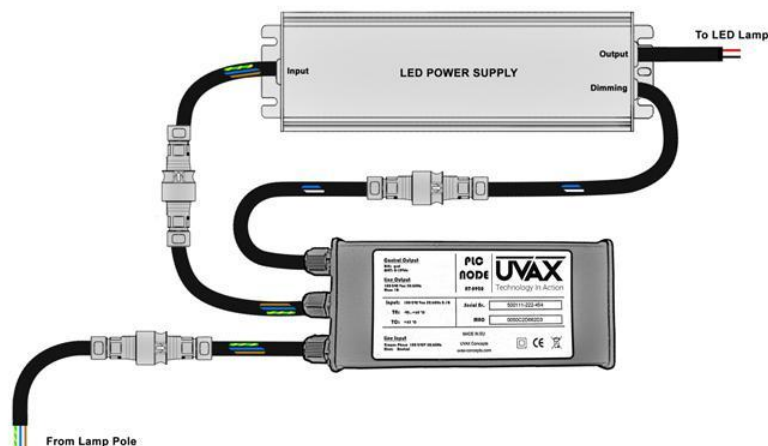
**Low voltage/signal connector.** These are the terminals (pins):

- DALI+, DALI-: DALI interface (with bus power)
- Options:
  - GND (Ground)
  - Output (Open Collector)
  - Input (potential free/dry contact)
  - 12VDC (auxiliary power output 12V/50mA)

**RJ-45 connector (optional).** This is the Ethernet interface within the NX-93 and NX-94 models.

Every device is supplied with two additional aerial connectors where input and output wiring will be connected. These are located inside the same Node enclosure.

The following illustration shows an example of wiring for a Node model with 3 cable glands (without Ethernet):



## 1.5 Connection to the power mains

In order to easily manipulate and disconnect the equipment from the mains, it is always advisable to have a circuit breaker that allows the equipment to be disconnected from the mains. Likewise, said circuit breaker must have a protection against short circuits, or a fuse correctly sized for the application or installation.



The overvoltage protective elements that protect the devices controlled by the Node, can generate an attenuation of the PLC signal, so it is recommended to install these protections at the Node's power output. It is at the discretion of the installer to judge whether or not the power grid is secure and stable enough to also protect the Node with such devices, decreasing somehow the B-PLC communication performance.



## 2. Technical specifications

### Mains Input

Mains Voltage Range (VAC):	100 - 277V
Max. Current consumption:	40mA
Frequency:	50 - 60Hz
Power Factor:	> 0.80
Power Consumption:	4W

All devices have at the mains input a PTC protection element which limits the maximum drawn current by the device to 60mA.

### Mains Output

Type of power:	Single phase
Output Voltage Range (VAC):	100 - 240V
Maximum Output Current (bypass):	4A

### DALI interface

DALI interface with power on the bus lines.

### Auxiliary 12Vdc Power Output

Max. Output:	12V/50mA
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### GPIOs

- General Purpose Input for potential free (dry) contact.
- Open Collector Output (12V).

### B-PLC Bandwidth

Start Frequency:	2MHz
Stop Frequency:	12MHz
Bandwidth:	10MHz

### Ethernet (only models with this feature/functionality)

Operating Mode:	10/100 Mbps
MDI/MDIX capability:	YES
Full Duplex:	YES

### 3. Environmental data

Usage for open type applications:

- IEC 60529, IP-20 (IP-68 on demand)
- Nema, Type-1

Operating Temperature: -25 °C to 50 °C

Storage Temperature: -25 °C to 85 °C

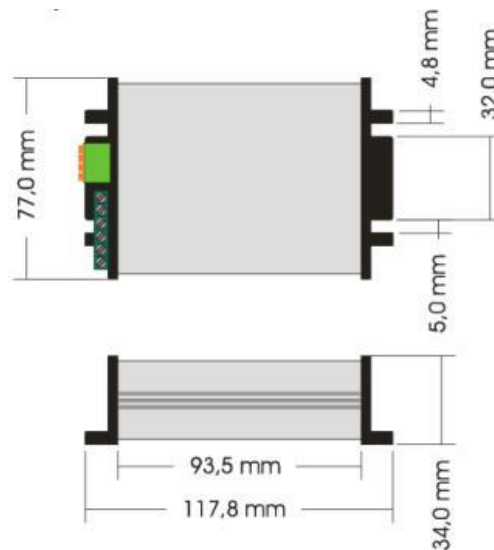
Max. Case Temperature (T<sub>c</sub>): 55 °C

Pollution Degree: 2

### 4. Dimensions and weight

These are the dimensions and the weight of the Nodes:

- 77 mm (W) x 118 mm (L) x 34 mm (H).
- 370 g



**NOTE:** The dimensions don't include areal connectors.  
The drawing shows the IP20 model.  
IP68 models have larger dimensions. Information on request.

## 5. Installation guide

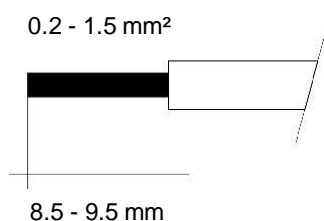


**NOTE:** The illustrations shown in the following sections of the installation process may vary slightly from the model supplied, the latter corresponding to an improved model used for photographs or other similar.

### **Cable type, wire gauge and stripping recommendations.**

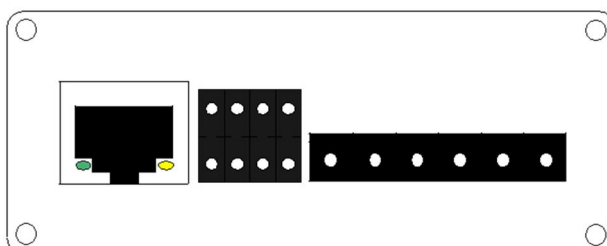
Most suitable are stranded cables with a wire gauge of 0.2 - 1.5 mm<sup>2</sup> (32-15 AWG). Strip the wires 8.5 - 9.5 mm to make sure there will be a perfect electrical contact inside the terminals.

Stripped stranded cable:

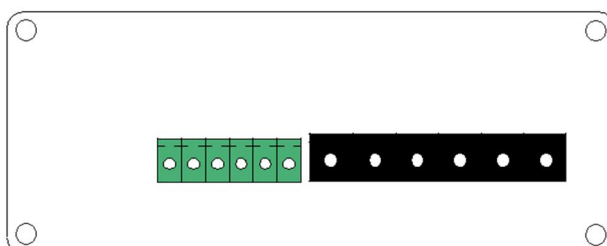


### 5.1 Node connectors

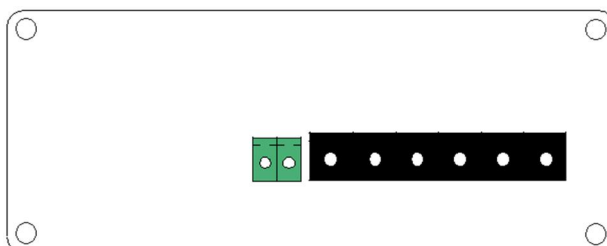
NX-94 - GPIO



NX-92 - GPIO



NX-9x



All cables connected to the equipment (Nodes), be it the mains cables or low voltage signal and control cables, have to use an aerial terminal block plugged into their corresponding mate in the equipment (Node).

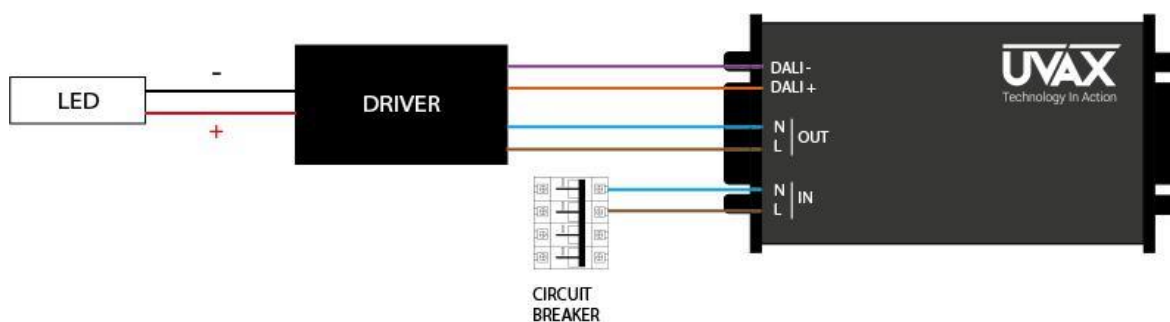



## 5.2 Mains connector


Mains cables have to comply with the required safety standards.

All loads controlled by the Node have to be powered (mains) from the Node (Filter issue).

The following image shows an example of a connected LED driver for luminaires, where the control is a DALI interface.



 **WARNING:** There is no need to connect the mains earth line in “class 2” equipment.

 **WARNING:** Make sure to use wire ferrules to avoid lose wire strands.

Regulations in many countries make it mandatory to use certified wire ferrules. Remember to always use the right wire ferrule diameter to get the appropriate crimp termination.

Once the wire assembly with the aerial terminal block is completed, make sure the mating connection with the equipment terminal block is plugged in correctly and tight.

### 5.3 Low voltage signal and control connector

The low voltage signal and control connections are similar to the mains connections, but with a smaller pitch format. Follow the same assembly instructions as for the mains connections. The signals are (but may vary in different models):

- GND (Ground).
- +12VDC (Auxiliary power output 12V/50mA)
- GPIO
- DALI (DALI bus “-”)
- DALI (DALI bus “+”)

### 5.4 Ethernet connector

To be used with a standard CAT5 (or higher) UTP Ethernet cable.

## 6. Safety and warning statements

- Do not install equipment with visual defects. Make sure everything looks right before installing the Nodes.
- There are no replaceable parts in the Nodes, avoiding any kind of maintenance.
- For safety reasons, the installation process has to follow all instructions within this manual or the related product information provided by the manufacturer.
- If the equipment is manipulated or handled differently as specified in this manual or the information provided by the manufacturer, no warranty on performance or safety is granted by the manufacturer or supplier.
- Disconnect the device from the mains and return it to the manufacturer or supplier if it doesn't perform as specified.
- Do not install the equipment in hazardous environments (classified as hazardous areas).
- Never install or disconnect the device with power at the mains terminals.
- Comply with all safety related measures while handling electrical equipment.
- Make sure all electrical connections are correct and comply with all related safety rules.
- Follow all installation guidelines within this manual or related documents.

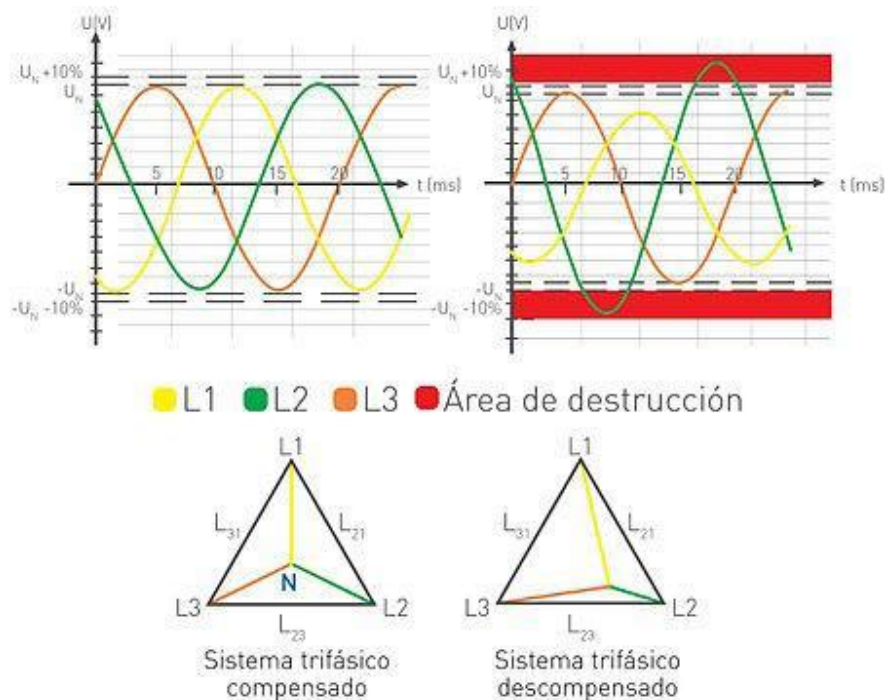
## 7. Limited product warranty

The Limited Warranty is described and defined in the sales documentation. The Limited Warranty does not apply to ancillary equipment, consumables and components sold separately from the Products, such as, for example, cables, fuses, fans, wires and connectors, whether supplied by SWISSPRO or others.

The Limited Warranty only applies to the buyer who has purchased the Products from an authorized seller of SWISSPRO for use in accordance with their intended purpose, provided that the Products are not moved outside its original installation and any reinstallation is done in accordance with the installation directions and use guidelines accompany the Products (collectively the “Documentation”).

In case of installing SWISSPRO products in environments connected to mains power subject to surges or electrical disturbances, it is the installers’ responsibility to protect the equipment with dedicated devices. Reference and examples are cited in the next section based on information from the French manufacturer CITELE, whose products are aimed at such protection. It is recommended to use Type 2 or similar protections as the DS40 family.

Overvoltages (spikes or permanent) are voltage increases greater than 10 percent of the nominal voltage and of indeterminate duration, generally due to unbalanced loads in a three-phase system, or N-Wire breaks. If the N-wire breaks, it is inevitable that the load neutral point will be seriously offset, which produces a reduction in the useful life of the equipment, or even immediate destruction of the same.



*Graph of a permanent overvoltage. If all or part of our installation is single phase and connected to phase L2, the equipment connected to it will be destroyed (area marked in red).*

The supply of equipment with a voltage higher than that for which they have been designed can result in:

- Temperature rises within the equipment
- Reduced lifespan
- Fire hazard
- Equipment fault
- Performance failure

The use of protectors according to those indicated is essential in areas where there are fluctuations in the grid voltage value.

The integrated switched power supply in the equipment can show abnormal behavior or deterioration if said voltage surges occur. Therefore, if the supplied equipment once installed show these symptoms, will be excluded from any warranty.

We reiterate the importance of installing protection devices.

Annex 2 provides more related information, and preventive measures to mitigate issues related to surges and similar interferences in the power source.

SWISSPRO limits its warranty to repair of Products or parts covered by the limited warranty to correct the Product defect; and where UAX decides to replace the Product or part(s) to which the Limited Warranty applies. Warranty coverage does NOT include the cost of the replacement of the Product or part(s). All other costs, including, without limitation, travel and boarding costs of SWISSPRO service personnel that are incurred for repairs of Products on-site, as well as costs related to buyer's employees and contractors repair or replacement activities, are not covered by the Limited Warranty and, unless otherwise agreed in writing in advance by SWISSPRO, shall be borne by the buyer.

## 8. Document revisions

Manual	Revision	Date	Origin
NX-9x	R01	19/01/2016	Initial release.
NX-9x	R02	24/01/2016	ANNEX warranty added.
NX-9x	R03	01/02/2016	WARNING adds for power on DALI interface.
NX-9x	R04	17/04/2017	Modified to comply with CE standards. (ITE)
NX-9x	R05	04/08/2017	Modified to comply with CE standards. (ITE)
NX-9x	R06	08/08/2017	Details about terminal blocks and its wiring clarified.
NX-9x	R07-R10	22/09/2017	Manual updated to include all NX-9xmodels in one single document.
NX-9x	R11	12/12/2019	New design and general review to clean up writing and new design.



## **Annex I. Declaration of Conformity**

## CE DECLARATION OF CONFORMITY

1. NX-94 (product name).
2. SWISSPRO Pte Ltd./15 Jalan Kilang Barat/Frontech Centre #04-07/Singapore 159357
3. This declaration of conformity is issued under the sole responsibility of the manufacturer.
4. Multifunction B-PLC communication controller.



5. The object of declaration described above is in conformity with the relevant Community Harmonized Standards:
6. European Directives: 2014/35/EU - LVD and 2014/30/EU - EMC
7. The conformity with the essential requirements of the 2014/35 and 2014/30 has been demonstrated against the following harmonized standards:  
EN 62493:2010  
EN 55015:2013  
EN 61000-3-2:2014  
EN 61000-3-3:2013  
EN 61547:2009  
EN 60950-1:2007 + /CORR:2007+ /A11:2009+ /A1:2011+ /A12:2011+ /AC:2012+ / A2:2015  
EN 60950-1:2006+ /A11:2009+ /AC:2011+ /A1:2010+ /A12:2011+ /A2:2013
8. The conformity assessment procedure referred to the EU Directives has been followed by the involvement of the following Notified Bodies:
  - a) ITE (Instituto Tecnológico de la Energía), Parque Tecnológico Valencia, Avda. Juan de la Cierva, 24 - 46980 Paterna/Valencia, Spain.
  - b) TECNOCREA, S.L., Calle Colón, 41 - 46210 Picanya/Valencia, Spain

Thus, the product is marked CE.

9. The technical Construction File (TCF) relevant to the product described above, and which supports this Declaration of Conformity, is held at:

SWISSPRO Pte  
15 Jalan Kilang Barat / Frontech Centre #04-07  
Singapore 15937

Signed for and on behalf of SWISSPRO Pte  
Singapore, 2017/10/02

Antonio Royo, CEO



This declaration of conformity is issued in compliance with 768/2008/EC

[www.swissprocity.sg](http://www.swissprocity.sg)

Date: Dec. 12<sup>th</sup>, 2017  
Doc. Nr.: 09576-4855 Rev. 3  
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