

SWISSPRO® **SMART CITIES**

B-PLC Systems

Series CA-1x Gateway

Technical Manual

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Contact Information

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- Tech Support: sat@swissprocity.sg
- 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 Gateway

The PLC (Power Line Communication) Concentrator 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 other Head Ends (Concentrators) or other B-PLC 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.

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

The Concentrator (also known as “Head End”) is the device controlling the power efficiency of the system. It can communicate by means of different interfaces with wired and wireless interfaces.

All Concentrators have a Web Server application to connect directly to SWISSPRO remote management platform (CMS) Smart FireFly®.

The Head End runs on a complete Linux system and an internal power supply with three-phase rectifier, which ensures its operation in both single-phase and polyphase power grids and features the redundancy to work even if two phases of a polyphase system fail.

It can be installed inside an electrical panel (switchboard), from where the supply provides power to all the loads within the same power distribution. The Concentrators responsibility is to manage the network through the Nodes in its range and can be integrated with different auxiliary devices by means of its RS-485 bus.

The powerful processor runs the LINUX operating system, and allows remote update of all its software and functionality.

An integrated 4G module allows remote access to the Concentrator (Gateway) through the internet, and features information exchange by means of emails or SMS for system alerts.

The integrated polyphase power meter measures V, I, PF, Power and Energy, registering all the values in FLASH memory to be downloaded by the user anytime for power management task.

1.2 CA-1x Series

The CA-1x family of Concentrators are “Gateways” allowing direct remote control by means of the cloud (internet) as it has a build-in WEB Server.

The different functionalities integrated in these Concentrators serve to attend a whole range of applications mainly oriented to energy efficiency, but also solutions applied in other segments such as Smart Cities or Smart Buildings.

The Concentrators integrate the following features (model dependent):

- Powerful 1GHz microprocessor with 1Gb RAM and up to 16Gb Flash.
- Class 1 polyphase power meter, enabling a precise management of energy consumption and control of related energy efficiency in the system to be monitored.
- 4G communication (with slot for SIM card).
- ETHERNET interface (RJ-45) Auto MDI/MDIX.
- RS-485 (MODBUS) interface.
- A snap-on mounting for DIN rail is available as accessory.
- LINUX operating system.
- “WEB-Server” application built-in, enabling access to the system by means of any internet browser.
- Open API RESTful provided so any client can integrate and use the Concentrator for its own CMS (Central Management Software).

These devices are used in SWISSPRO Smart City solutions, to connect IoT networks (of all types) with the SmartFireFly (S2F) management platform (CMS), thus providing a complete remote control and management solution.

This manual detail all the technical characteristics of the CA-1x models and their functionalities.

These are the different CA-1x models available:

Model	Power Meter			4G
	Star	Delta	/5	
CA-11-E	X			
CA-11-D		X		
CA-11-E/5	X		X	
CA-11-D/5		X	X	
CA-12-E	X			X
CA-12-D		X		X
CA-12-E/5	X		X	X
CA-12-D/5		X	X	X
CA-13-E	X			X
CA-13-D		X		X
CA-13-E/5	X		X	X
CA-13-D/5		X	X	X

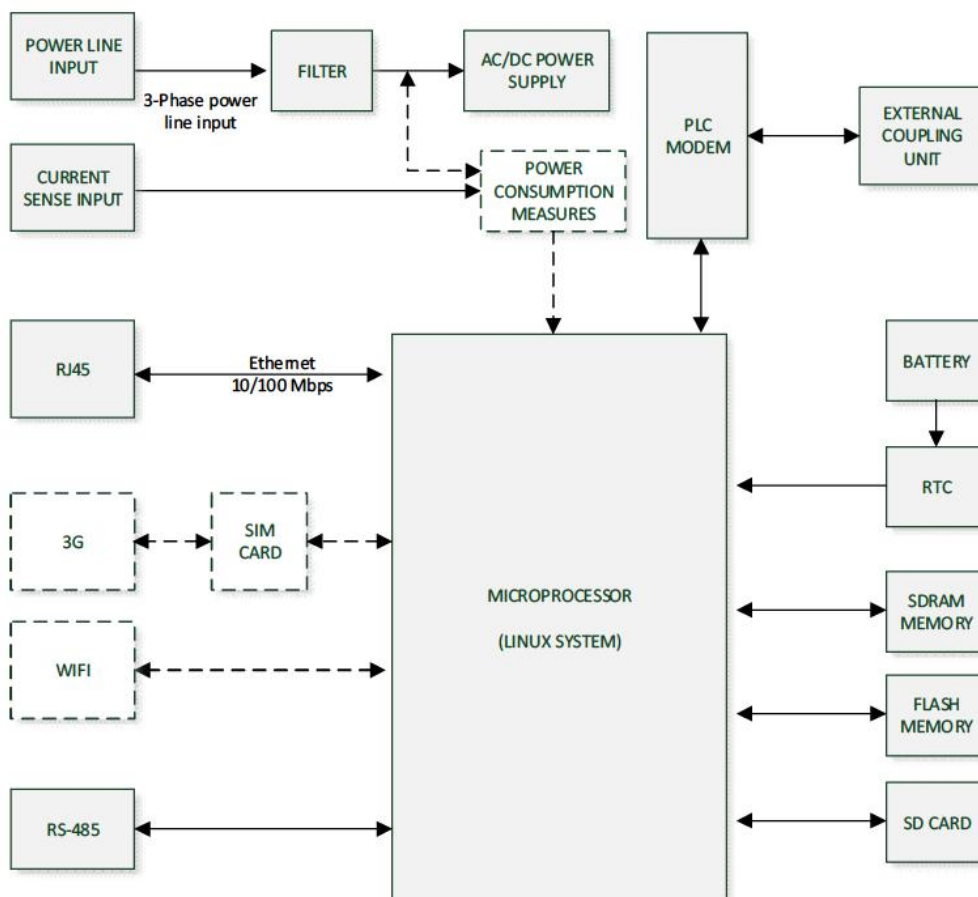
1.3. The polyphase power meter

All power meter values and parameters can be accessed directly through WEB-Server application integrated in the Concentrator and shown graphically.



1.4 Block diagram

This is the block diagram of a Concentrator (Head End – Gateway):



NOTE: Optional elements of functions are shown with dashed lines.

The Concentrator (Gateway or Head End) can be powered from a single-phase or a three-phase power source and can work even if one or two phases drop. All power and signal lines are filtered and conditioned to comply with all international regulations.

The electric energy meter incorporated in the Concentrator is an indirect type, it requires external current transformers with a variable rated primary current and a secondary rated current of 5A for the standard “/5A” CTs model, or device specific (small form factor CTs) that allow a maximum measurement of 80A and can be supplied by SWISSPRO. The signals of both magnitudes (current and voltage) have their independent input connectors.

The powerful microprocessor manages all the system, and has large SDRAM and a Flash memory to keep track of all alarms, events, configurations, communications, etc. It also integrates a real time clock (RTC) to time stamp all events and data recording. A rechargeable backup battery allows the RTC to run for 10 years without external power, and helps also to safely power down the system after a power shut off, closing all the data bases and communication interfaces in a clean way to avoid any data corruption.

The battery also allows to send alarm messages to remote control systems, to alert system operators of the power down event or other alarm states in the Head End before shutting down.

The wireless communications in the models with such functionality have 2G (GPRS, GSM), 3G and 4G, with its external antenna and SIM card* holder size 2FF easily accessible from the edge.

** The SIM card must not have an active PIN and the communications service provider must facilitate the APN and, where appropriate, a username and password.*

Ethernet communication (international standard IEEE 802.3) is built in. It also provides a serial port type RS-485 with MODBUS protocol.

1.5 Connectors

Power line (Mains) input connector, with the following terminals:

- Earth: Earth connection
- Neutral: Neutral input
- Phase 1: Phase 1 input
- Phase 2: Phase 2 input
- Phase 3: Phase 3 input

Current transformers, with the following terminals:

- CT Phase 3: Phase 3 current sense input (two terminals)
- CT Phase 2: Phase 2 current sense input (two terminals)
- CT Phase 1: Phase 1 current sense input (two terminals)

RJ-45 connector. Ethernet port.

RS-485 connector. Used to communicate to other MODBUS devices using an RS-485 bus, and mainly to interface with SWISSPRO MR-4859 actuators.

PLC Signal connector, for plugging to the external Coupling unit.

4G/LTE Antenna connector. SMA connector for external the 4G/LTE antenna.

SIM connector. Connector to insert a SIM card.

SD connector. Internal SD card holder for adding additional none-volatile memory space to the system, or to re-flash a complete new system software, though remote software upgrade is also possible.

Some of the above mention connectors are only with certain Head End models available.



WARNING: Make sure the power meter wiring (current transformers and voltages) are in the same order and installed in the same direction for each phase, as otherwise the measured values will be wrong.

2. Technical specifications

Input

Input voltage range (1-phase) (V _{AC}):	100 - 277 V
Maximum input current range:	60 – 160 mA
Input frequency:	50/60 Hz
Power factor:	> 0.80
Maximum power consumption:	15 W
Internal “Current limiting” PTC protection device on each power line input.	

Ethernet

Throughput:	10/100 Mbps
MDI / MDIX	Yes
Full Duplex	Yes

PLC Bandwidth

Initial frequency:	2 MHz
Final frequency:	12 MHz
Bandwidth:	10 MHz

2.1 Connecting to the power mains

It is recommended for easy power ON/OFF the device, to install an external circuit breaker as shown. In many standards and low voltage regulations such a circuit breaker is mandatory.

Depending if the Head End is powered by a single-phase power line or a three-phase power line, you'll have to use an appropriate circuit breaker. The current limiting capacity of the circuit breaker can be as low as 1A.



WARNING: Some Low Voltage Directives, such as the EU **(LVD) 2014/35/EU** make it mandatory to provide equipment (as the one described in this manual) with external devices to disconnect power from the equipment, providing additional safety measures to the low voltage installation.

3. Environmental data

Usage for open type applications:

- IEC¹ 60529: IP-20
- Nema²:Type-1.

Operating temperature range: -25 °C - 55°C

Storage temperature range: -25 °C - 85°C

Maximum temperature at the case: 55 °C

Pollution grade: 2

4. Dimensions and weight

These are the dimensions and weight of a standard Concentrator.

- Dimensions: 105 mm (W) x 225 mm (L) x 30 mm (H)
- Weight: 700 g

NOTE: Dimensions don't include the aerial connectors nor the antenna.

5. Installation guide

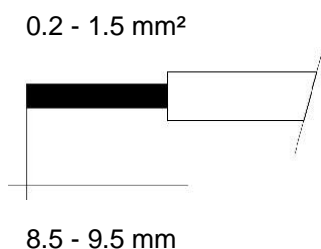


NOTE: The illustrations shown in the following sections of the installation process may vary slightly from the model supplied, the latter corresponding to an improved model used for photographs or other similar.

Cable type, wire gauge and stripping recommendations.

Most suitable are stranded cables with a wire gauge of 0.2 - 1.5 mm² (32-15 AWG). Strip the wires 8.5 - 9.5 mm to make sure there will be a perfect electrical contact inside the terminals.

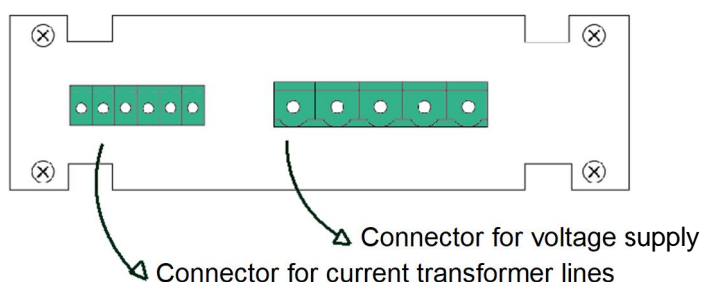
Stripped stranded cable:



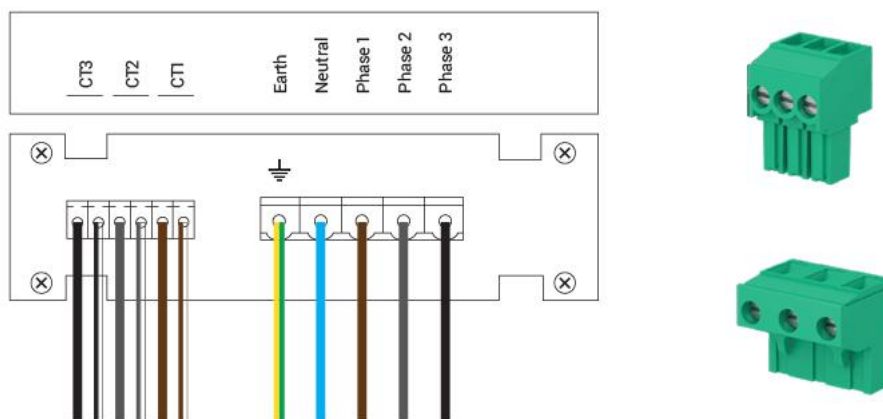
5.1 Connecting to a single/polyphase power grid

An aerial connector is available for the connection of the voltage inputs (Earth, Neutral and Phases).

Front side of aerial connectors



Below is a wiring type of the three-phase power supply and the connector of the current transformer lines. It is important to remember the need to braid the wires of the current transformers in order to avoid induced interference into them. According to the regulations it is mandatory to provide the terminations of stripped cables with standardized tips (ferrules).



NOTE: The current transformer wires have to be braid (avoid noise).

5.2 Connecting the current transformers

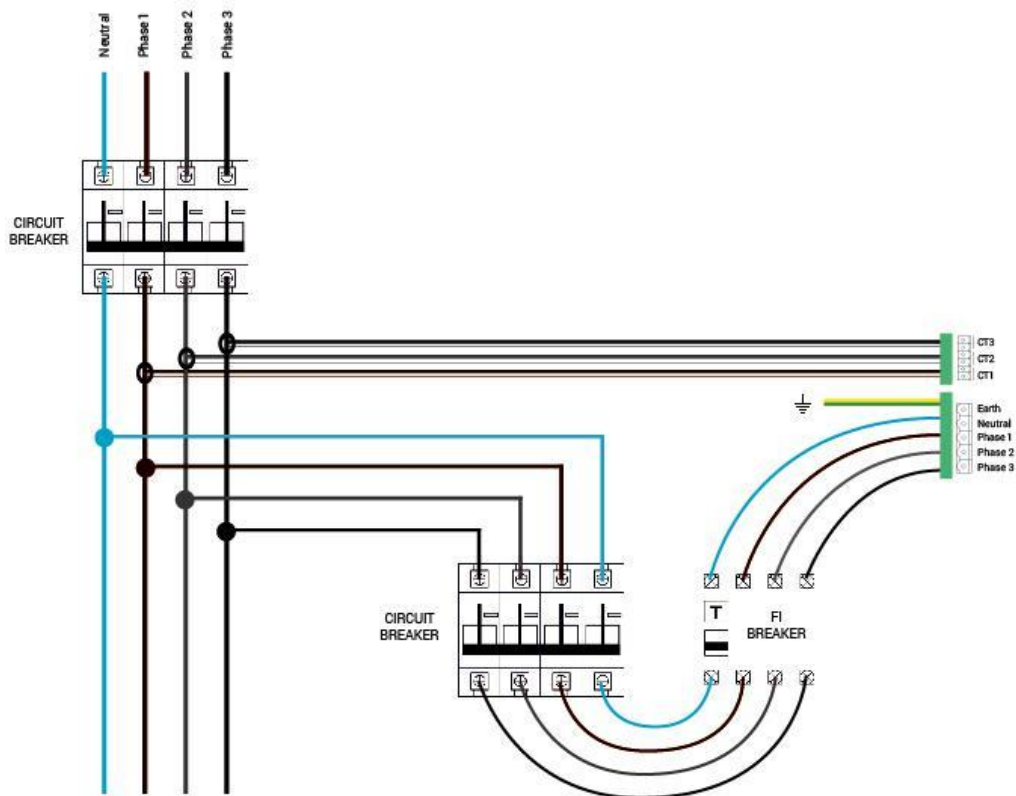
For measuring electricity consumption, three current transformers are supplied with the equipment which must be coupled to the mains lines of the electric (power) supply. The wires of the current transformers, once braided, will be screwed firmly to the aerial input connector of the Concentrator.



WARNING: It is important to maintain the same polarity of the current transformers' wires in a three phases system, as well as the direction of said transformers when coupling them to their corresponding phase.



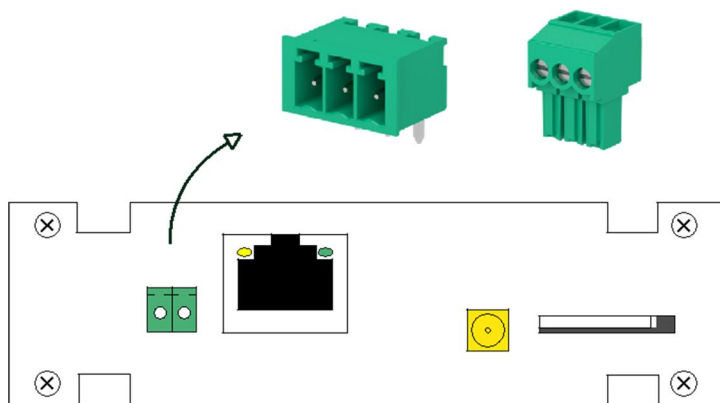
WARNING: Never disconnect the aerial connector from the base of the Concentrator while the system is powered. Open the main circuit breaker before disconnecting the current transformers, as otherwise a high voltage surge will destroy the electronic components of the power meter input stage.



5.3 Connecting the RS-485 interface

RS-485 communication is done by means of two wires. It is a differential signal and is mainly used to control peripheral devices.

These wires will be screwed to the supplied aerial connector.



Back side with, Ethernet connector, RS-485 aerial connector, antenna connector, and SIM card slot.

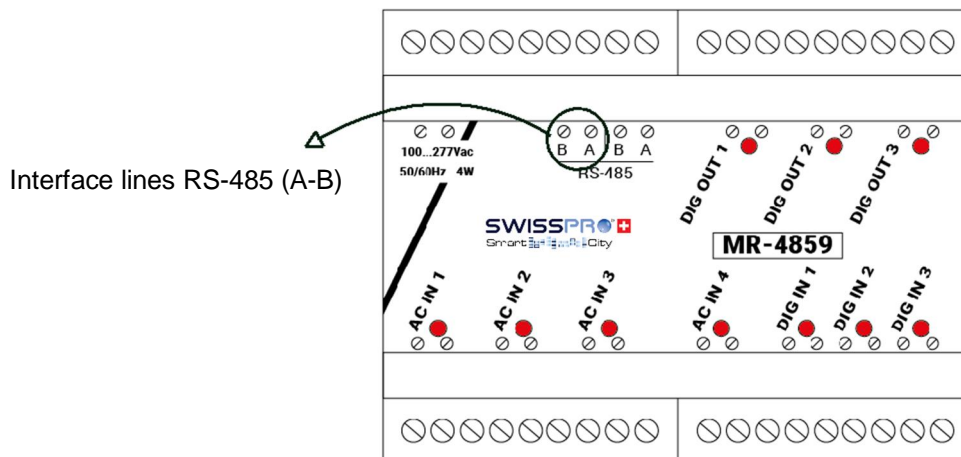


NOTE: There is also a Concentrator model with a 12Vdc output connector.



NOTE: The shown terminals are just as a reference, and may vary from the final ones.

As an example, the below drawing shows an SWISSPRO MR-4859 Actuator, where the RS-485 interface is clearly highlighted.



5.4 Installing the GPRS/3G/4G/LTE antenna

The models with 3G/4G mobile communications have their antenna mounted by default.

Where mobile coverage at the installation point is low, or metal electrical cabinets are being used which attenuate telephony signals, the antenna can be replaced with a higher gain one, or one more appropriate for the installation point.

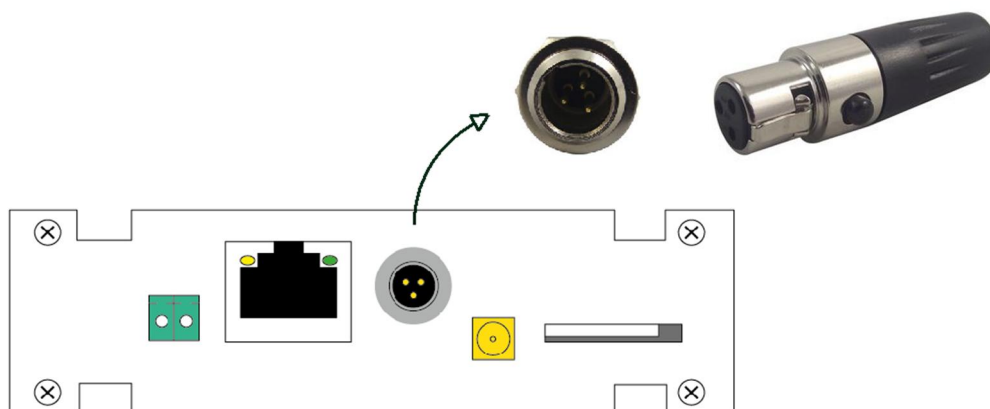
5.5 PLC connection

The external coupling unit, whose other end will be connected to the mains, will have a plug to connect the PLC Signal at the Concentrator.

The Application Note “PLC Injection Techniques in Low Voltage Power Lines” explains how to make the best connection from the coupling unit within the electrical panel.

Basically, the equipment will be fed at the entrance of the panel, and the coupling of the B-PLC signal "downstream", closest to the outgoing lines of the different electrical circuits.

There are single phase and three phase coupling units, and depending on the application, either one will be used and supplied. Nevertheless, a three-phase coupling unit can also be used to inject the B-PLC signal into a single-phase circuit or system.



5.6 How to connect a CA-13 Concentrator to an MR-4859

The following graphic illustrates the assembly of the CA-12 header with an MR-4859 Actuator inside a three-phase switch board. The function of the Actuator is to control the ON/OFF of the different electrical circuits going out from the cabinet and monitoring the circuit lines as well.

The Actuator MR-4859 takes its power from any of the three phases and the neutral, as it's powered from a single phase.

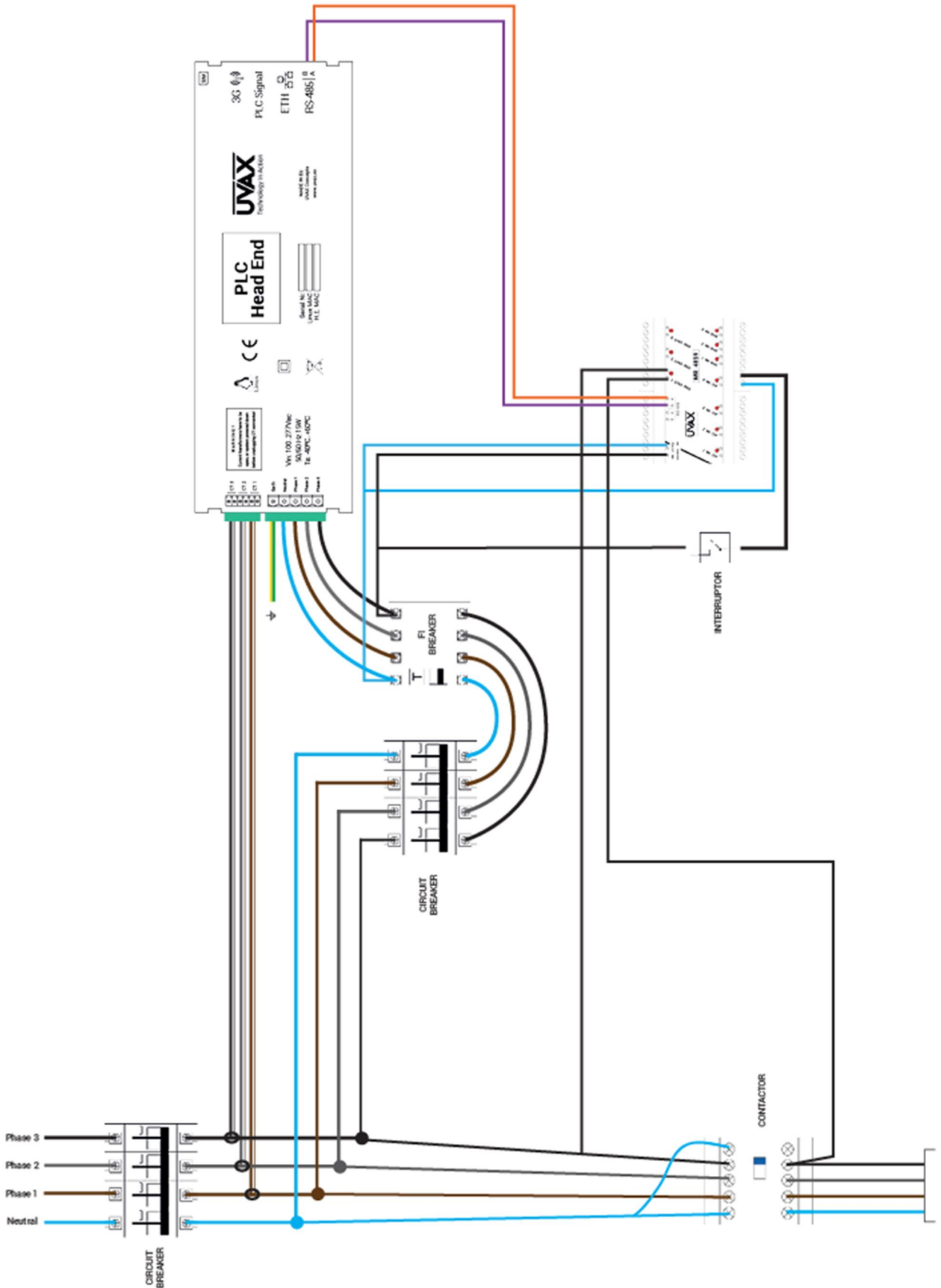
For the installation of the MR-4859, the steps mentioned in the previous sections must be followed.



NOTE: It is **FUNDAMENTAL** to respect the **PHASE** and **NEUTRAL** lines in the **LINE IN** and **RELAY OUT** inputs. Otherwise, short-circuiting **PHASE** and **NEUTRAL** could be the case.



NOTE: Refer to Actuator Manual MR-4859 for more details and avoid errors while installing the equipment.



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. Such defects won't be covered by the warranty.

8. Document revisions

Manual	Revision	Date	Origin
CA-1x	R01	15/01/2016	Initial release
CA-1x	R02	19/01/2016	Extended B-PLC description.
CA-1x	R03	17/04/2017	Modified to comply with CE standards.
CA-1x	R04	14/06/2017	Modified to comply with CE standards.
CA-1x	R05-R10	22/09/2017	Modified to include all CA-1x models in one
CA-1x	R11	11/12/2019	New design.

Annex I. Declaration of Conformity

CE DECLARATION OF CONFORMITY

1. CA-13 (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:
 - ITE (Instituto Tecnológico de la Energía), Parque Tecnológico Valencia, Avda. Juan de la Cierva, 24 - 46980 Paterna/Valencia, Spain.
 - 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 159357

Signed for and on behalf of SWISSPRO Pte

Singapore, 2017/10/02

Antonio Royo



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

www.swissprocity.sg

Date: Dec. 12th, 2017
Doc. Nr.: 09576-4855 Rev. 3
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