Life Is On | Schneider Electric

Power Meter

Power Meter 5000 & 8000 series

Implementation Guide
Inside Okken Switchboards

schneider-electric.com

1. SAFETY INFORMATION

1.1 IMPORTANT INFORMATION

Read these instructions carefully before trying to install, configure, or operate the system. The following special messages may appear throughout this document or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result** in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.
Failure to follow these instructions **can result** in equipment damage.

1.2 PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.
A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

1.3 SAFETY PRECAUTIONS

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel familiar with low and medium voltage equipment are to perform work described in this set of instructions. Workers must understand the hazards involved in working with or near low and medium voltage circuits.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See or applicable local standards.
- Perform such work only after reading and understanding all of the instructions contained in this bulletin.
- Turn off all power before working on or inside equipment.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feeding.
- Handle this equipment carefully and install, operate, and maintain it correctly in order for it to function properly. Neglecting fundamental installation and maintenance requirements may lead to personal injury, as well as damage to electrical equipment or other property.
- Do not make any modifications to the equipment or operate the system with the interlocks removed. Contact your local field sales representative for additional instruction if the equipment does not function as described in this manual.
- Carefully inspect your work area and remove any tools and objects left inside the equipment.
- Replace all devices, doors and covers before turning on power to this equipment.
- All instructions in this manual are written with the assumption that the customer has taken these measures before performing maintenance or testing.
- Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Do not exceed the device's ratings for maximum limits.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme shall consider the potential failure modes of paths and, for certain critical control functions, provides a means to achieve a safe state during and after a path failure. Example of critical control functions are emergency stop and over travel stop.
- Separate or redundant control paths shall be provided for critical control functions.
- System control paths may include communication links. Consideration shall be given to the implications of anticipated transmission delays or failures of the link. *
- Each implementation of equipment utilizing communication links shall be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury or equipment damage.

*** For additional information about anticipated transmission delays or failures of the link, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation and Maintenance of Solid State Control* or its equivalent in your specific country, language, and/or location.**

The architecture described in this document has been fully tested and validated in our laboratories using all the specific devices and accessories references available all along this document. Of course, your specific application requirements may be different and will require additional and/or different components. In this case, information provided in this document shall to be adapted to your specific needs. To do so, you will need to consult the specific product documentation of the components that you are substituting in this architecture. Pay attention in conforming to any safety information, different electrical requirements and normative standards that would apply to your adaptation.
It should be noted that there are some major components in the architecture described in this document that cannot be substituted without completely invalidating the architecture, descriptions, instructions, wiring diagrams and compatibility between the various software / firmware and hardware components specified herein. You must be aware of the consequences of component substitution in the architecture described in this document as substitutions may impair the compatibility and interoperability of software and hardware.

⚠ CAUTION

EQUIPMENT INCOMPATIBILITY OR INOPERABLE EQUIPMENT

Read and thoroughly understand all hardware and software documentation and specification before attempting any component substitutions.

Failure to follow these instructions can result in injury or equipment damage.

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2. CONTEXT

2.1 POWER METER IN A NUTSHELL

2.1.1 Power Meter PM5000 series

The PowerLogic™ series meter is meticulously engineered to provide high-end cost management capabilities in a straightforward metering platform. An essential combination of features, such as multiple tariffs and data logging, merges with industry-leading measurement accuracy to match the requirements of energy cost management applications in buildings and industry. Compliant with stringent, international metering standards, the PM5000 series meters remove any uncertainty in billing for energy costs and ensure a high level of performance that noncompliant devices cannot match.

The highly capable PowerLogic PM5000 series meters are designed to provide the best combination of features to match all your energy cost management needs. They provide the measurement capabilities needed to allocate energy usage, perform tenant metering and subbilling, pinpoint energy savings, optimize equipment efficiency and utilization, and perform a basic assessment of the power quality of the electrical network.

Use the PowerLogic PM5000 series meters reduce installation time by 75% (PM5310R and PM5320R Quick Click meters only), help maximize energy cost savings, optimize operational efficiency, and improve business performance.

Identify consumption, recoup energy costs

- Reduce consumption of electricity and water
- Subbill tenants and identify process energy use
- Identify savings opportunities
- Integrate other water, air, gas, electricity, and steam meter data

Improve energy supply

- Optimize energy improvement
- Verify billing

Reduce energy bills

- Reduce billing penalties and optimize energy procurement
- Shed unnecessary loads
- Participate in demand response and peak shaving programs

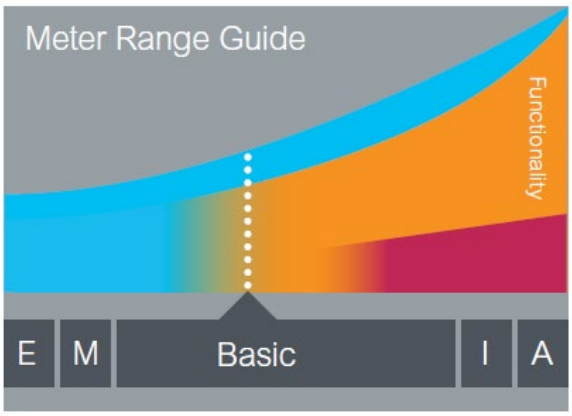
Motor to increase power system reliability

- Receive fast fault alarms
- Identify underperforming electrical assets
- Increase maintenance personnel productivity

Newest features

- ‘Quick Click’ (PM5310R / PM5320R only) allows tool-less, plug and play LVCT connectivity, for up to 75% installation time savings — autodetection means no manual CT setup is required
- BACnet/IP protocol on Ethernet models
- Ethernet-to-serial gateway functionality
- Remote display option for PM5563 meter
- Cybersecurity enhancements
- Compatible with Meter Insights QR code application

Meter Range Guide



- High-end cost management, simple network management
- Submetering and feeders

Key:
- E Entry
- M Multicircuit
- B Basic
- I Intermediate
- A Advanced
- Cost management
- Network management
- Asset management

2.1.2 Power Meter PM8000 series

Simplifying power quality, maximising versatility

These compact meters help ensure the reliability and efficiency of your facility by simplifying the management of power quality, availability, and reliability. Measure, understand, and act on insightful power and energy data gathered from your entire system. The PowerLogic™ PM8000 has the versatility to perform nearly any job you need a meter to do, wherever you need it!

Address power issues before they cause problems

- Monitor harmonics to mitigate excessive heating and premature failure of transformers
- Use trending and alarming to detect fluctuations in current pull of critical equipment to prevent motor failure
- Utilize millisecond time stamping to analyze sequence of events
- Identify root cause by analyzing electrical faults with patented disturbance direction detection
- Identify power quality issues per EN 50160, including frequency inconsistency, voltage fluctuations and unbalance, and harmonic contribution
- Allocate costs for water, air, gas, electricity, and steam (WAGES) across departments, phases of industrial process, or cost centers
- Utilize time-of-use calendar to capture electrical consumption for specific times, including on/off peak and holidays

The best choice for power management

The PowerLogic PM8000 series is highly accurate, extremely reliable, and unmatched in flexibility and usability. Compliant with stringent international standards that guarantee accuracy, these meters are ideal for industrial and critical power facilities.

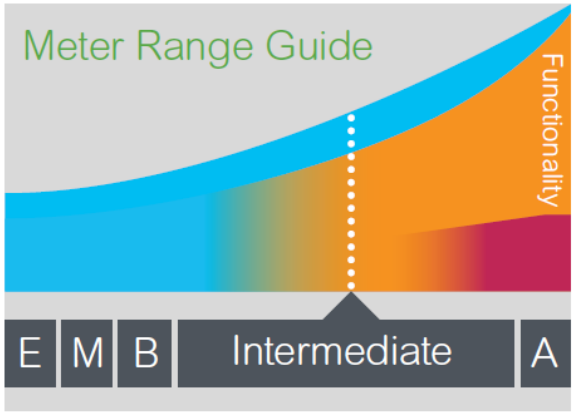
PM8000 series meters combine accurate three-phase energy and power measurements with data logging, power quality analysis, alarming, and I/O capabilities not typically available in such compact meters. Patented ION™ technology provides convenient preconfigured functionality and customization to meet unique requirements.

Plus, simple installation and networking make energy information quickly accessible, while integration with StruxureWare™ software and your energy management system make it immediately actionable.

Your power monitoring prodigy

- Reveal and understand complex power quality conditions
- Gather and act on facility wide energy and consumption data
- Integrate easily with energy management systems
- Protect your investment with adaptable ION technology

Meter Range Guide



- High-end cost management, simple network management
- Submetering and feeders

Key:

- E Entry
- M Multicircuit
- B Basic
- I Intermediate
- A Advanced
- Cost management
- Network management
- Asset management

3. BEFORE TO BEGIN

Along this document, many rules, information and pictures will be given, to easily catch the main information and essential points; you will find the following icons in the guide:

Expert tips, this will give you some guidelines to ease the installation.

Important points to consider.

Installation rules that must be followed.

4. REFERENCES

4.1 REFERENCE DOCUMENTS

The following table lists the documents that have been used as reference for the redaction of this guide, and that would be helpful all along the installation and project life cycle.

Title	Reference
Guides	
Electrical installation guide According IEC international standards	-
iPMCC Intelligent Power and Motor Control Center Guides	
Okken Communications Cabling & Wiring Guide	
Selection Guide – How to select your Ethernet or Profibus-DP communication architecture?	DSED314001EN
Okken DS installation & commissioning guide – iPMCC solution	-
HIPER-Ring or RSTP backbone and Dual RSTP commissioning guide	-
Auxiliary Power Supply Panel Builders Guide	-
Control Panel Technical Guides	
How to reduce damage to components through effective thermal management?	CPTG001_EN
How to prevent machine malfunctions and electronic damage due to voltage surges?	CPTG002_EN
How to protect a machine from malfunctions due to electromagnetic disturbances?	CPTG003_EN
User Guides	
PowerLogic PM5100 series user manual - EN	EAV15105-EN
PowerLogic PM5300 series user manual - EN	EAV15107-EN
PowerLogic PM5500 series user manual - EN	HRB1684301
PowerLogic PM5350 Installation Guide	63230-401-202
PowerLogic PM5350 User Guide	63230-401-203
PowerLogic PM8000 series user manual	
Instruction Sheets	
PM5000 Technical Datasheet - Web Version	PLSED310052EN_Web
PM8000 Technical Datasheet - Web Version	PLSED310058EN_Web
PowerLogic PM8000 – I/O Module - Digital - Inputs + 2 relays outputs	-
PowerLogic PM89M2600 & PM89M0024 digital and analog option module – Installation sheet	-

Table 1: Reference documents

5. INSTALLATION RULES

First, all the rules detailed in this part of the document, are presented in detail in the Okken communication cabling & wiring guide.
Please, refer to the Table 1: Reference documents on page 12. Many other rules are presented in this guide, so it is recommended to have a look at it before starting the integration of Power Meters and other devices inside Okken switchboards.

5.1 GENERAL RULES FOR CABLING

The aim of this section is to give you a quick overview of the cabling rules that if not properly respected, could be often the sources of loss of reliability, performances, communication stability and malfunctioning, not only at device level, but mostly at overall system level.

5.1.1 Segregate power cables and sensitive cables

This wiring rule is well known by panel builders and easy to understand. But in some case, because the installation inside a switchboard is not so easy, it would be difficult to apply this rule.
It is important to remember that this segregation concerns:

- Power means:
  - Main power: U > 400 V A.C. or U > 400 V D.C. (Cables or busbar)
  - Power supply: 24 V A.C. < U < 400 V A.C.; 60 V D.C. < U < 400 V D.C.
  - Inputs / Outputs

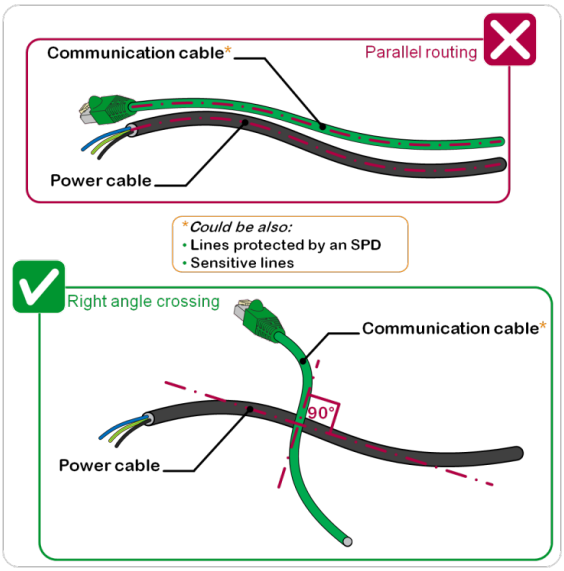
AND:

- Communication cables (Whatever the protocol)
- Analog signals cables (0-10 V, 4-20 mA…)
- Lines protected by a surge arrester upstream
- Sensitive lines (24 V D.C. power supply…)

Avoid the parallel routing between these two different categories.

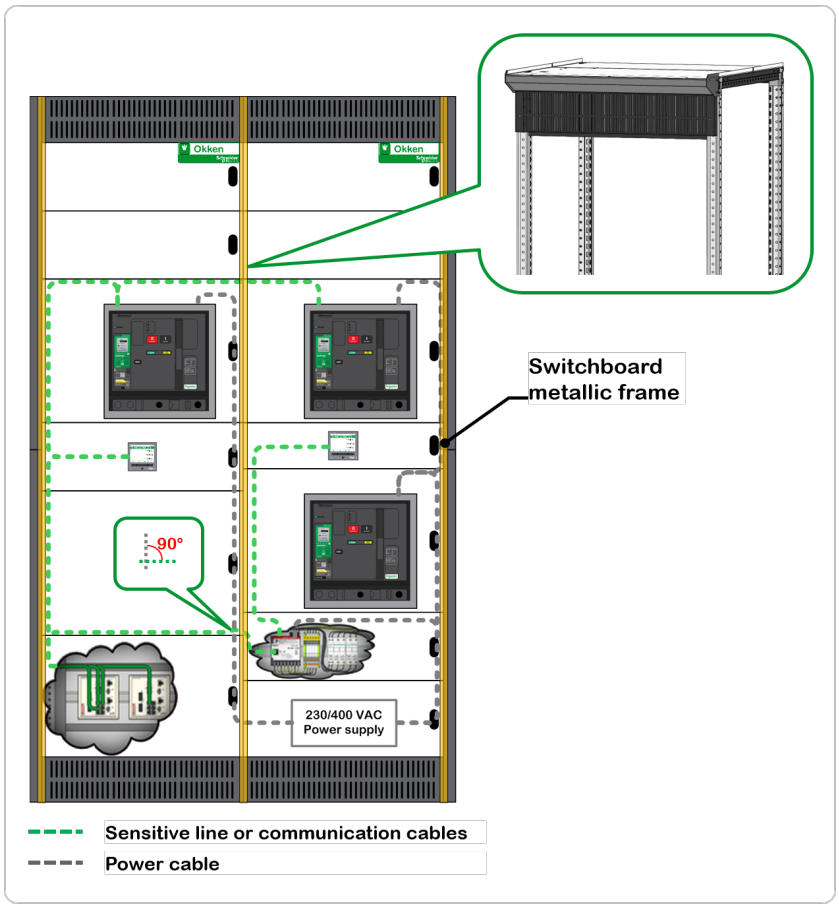
If lines were to cross, respect a right angle between power cables (perturbed line) and sensitive lines. By respecting the right-angle crossing, the coupling of disturbances will be avoided.

The following picture sums up this fundamental rule:



Picture 1: Wiring rules - cables segregation

By construction, Okken switchboards offer many solutions helpings to apply this rule. Indeed, if sensitive signals and power cables need to be routed side by side (lack of space), it is possible to use the metallic frame of the switchboard as “shield” between both, as shown on the following picture.



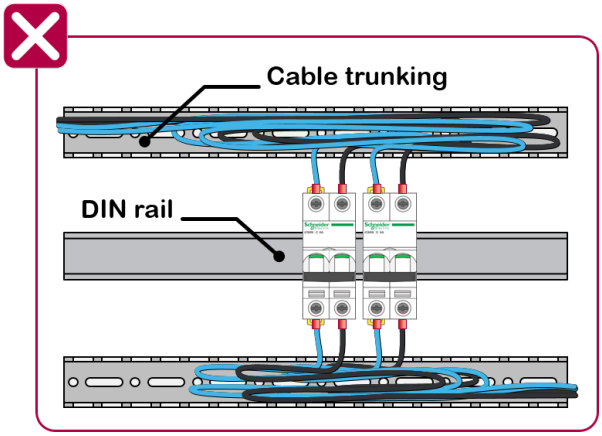
Picture 2: Use switchboard metallic frames as shield

5.1.2 Cables length

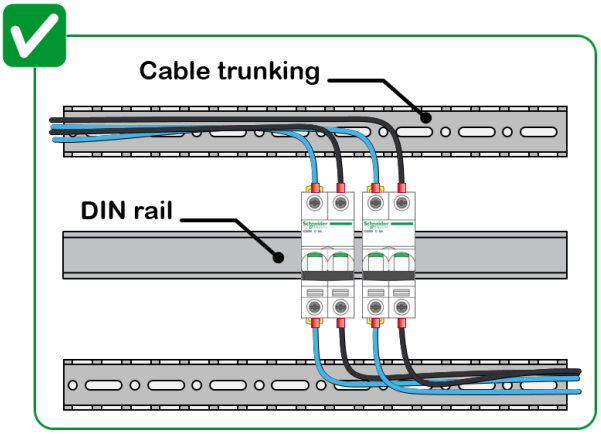
5.1.2.1 Power cables

Another common mistake during installation consists to keep some margin on cables length in order to be more flexible with device integration. This has a huge impact on the system immunity against electromagnetic fields, but also on the robustness of the installation. Moreover, by installing too long cables, the situation of parallel routing and non-90°-angle crossing will be more frequent.

As shown by the following picture, too long cables are rolled and stuffed inside the electrical and cabling trunking.
To avoid this situation, cables length needs to be adapted to the physical location of the devices.
Hereunder, the picture shows a typical installation with appropriate cables lengths.



Picture 3: Too long power cables

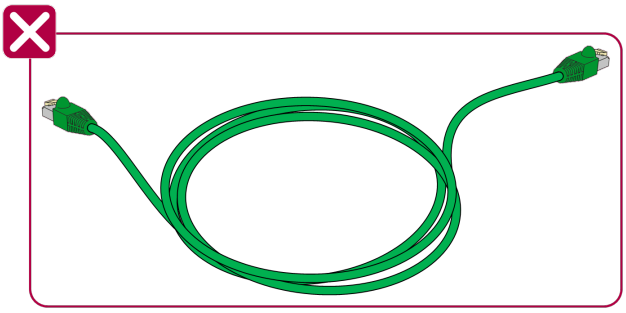


Picture 4: Adapted power cables

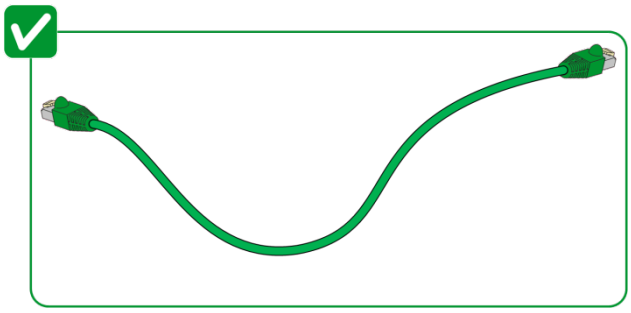
- Avoid aluminum DIN rails because of corrosion effect

5.1.2.2 Communication cables

This rule must be applied to the communication cables as well. The lengths must be adapted. If this solution is not convenient, the remaining length must be put in a quiet area far (20 cm) away from all kind of signals and laid on the metallic frame of the enclosure without making a loop.



Picture 5: Too long communication cable



Picture 6: Adapted communication cable

5.2 RULES FOR COMMUNICATION NETWORK

This section gives the main rules concerning the cables related to the communication network:

- Modbus RS-485 network cables
- Ethernet or Modbus TCP/IP network cables

All the communication cables of Power Monitoring system must be selected in accordance with this document and installed by respecting the best practices of wiring. Please, refer to the previous paragraph “General rules for cabling” on page 13 to get an extract of the main cabling rules.

5.2.1 RS-485 network cables

Use a shielded 2 twisted pair or 1.5 twisted pair RS-485 cable to wire the devices.
Use one twisted pair to connect the (+) and (-) terminals and use the other insulated wire to connect the C terminals.

The total distance for devices connected on an RS-485 bus should not exceed
1200 m (4000 ft.). The following table gives some references of RS485 cables in the Schneider Electric offer:

Schneider Electric recommended RS485 cords references		
Length	Reference	Remark
L = 10 m (32.8 ft.)	TSXSCMCN010	Cable S/FTP
L = 25 m (82.02 ft.)	TSXSCMCN025	Cable S/FTP
L = 50 m (164.04 ft.)	TSXSCMCN050	Cable S/FTP

Table 2: RS485 cords references

- Use RS-485 S/FTP cables only.
- Only the use of Schneider Electric referenced cables or cables with strictly equivalent characteristics, allows to maintain the level of EMC performances.

5.2.2 Ethernet network cables

As Power Meters 5000 and 8000 series could be integrated in a very severe environment, with a high probability of perturbations (thermal, electromagnetic, radio…), it is highly recommended to use category 5e S/FTP Ethernet cables at least, and preferably category 6a S/FTP.
It is the best way to protect the system against external perturbation, and to avoid malfunctions or communication issues.

Please, refer to the appendix number 11.1 Ethernet cables categories details, on page 56 of this document to learn more about the different Ethernet cables categories.
The following table gives the references of the category 6a S/FTP cables available in the Schneider Electric offer:

Schneider Electric recommended Ethernet cords references		
Length	Reference	Remark
L = 1 m (3.28 ft.)	VDIP185X46010	Cat. 6a S/FTP
L = 2 m (6.56 ft.)	VDIP185X46020	Cat. 6a S/FTP
L = 3 m (9.84 ft.)	VDIP185X46030	Cat. 6a S/FTP
L = 5 m (16.4 ft.)	VDIP185X46050	Cat. 6a S/FTP
L = 10 m (32.8 ft.)	VDIP185X46100	Cat. 6a S/FTP

Table 6: Ethernet cords references

- Use Ethernet Cat. 5E- S/FTP or Cat. 6A- S/FTP cables only.
- Only the use of Schneider Electric referenced cables or cables with strictly equivalent characteristics, allows to maintain the level of EMC performances.

5.2.3 Ethernet connector

If your switchboard is equipped with an RJ45 bulkhead crossing, it is important to ensure that the connector have the following characteristics:

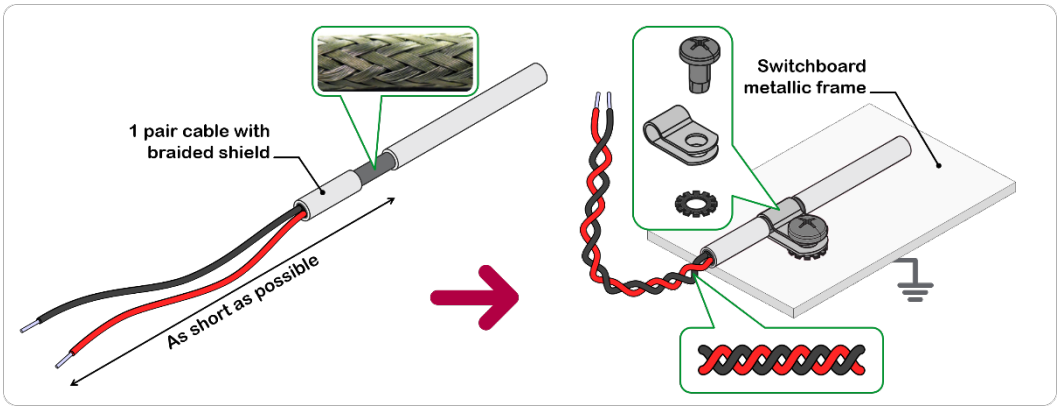
- The connector must be metallic to ensure the shield continuity
- The connector must be installed to guarantee ground continuity. The contact must be metal on metal. The frame surface must be clean and isolating materials must be removed (grease, paint...). A spray or special grease can be used to avoid corrosion near the contact surface after the installation.
- The metal housing must be installed on the metallic frame of the switchboard to ensure electrical continuity
- As the Ethernet cables, the connector must be at least Cat 5e S/FTP certified

5.3 24 V D.C. POWER SUPPLY CABLE

This section deals with the 24 V D.C. power supply cables for the Ethernet switches.
For these devices, the power supply cable must have the following characteristics:

- 1 pair cable, with braided shield
- Flexible wires (No need of twisted pair cable)
- Cross section from AWG22 (0.4mm²) to AWG14 (2.5mm²)
- Max length: Shall be adapted to respect a maximum voltage drop of 10%
- The wires shall be manually twisted before being connected to the device
- Use a 360° steel earthing clamp (do not use aluminum clamps) distance between device connection and shield connection shall be as short as possible

The following picture highlights the rules to be followed to implement an efficient and robust 24 V D.C. power supply wiring architecture.

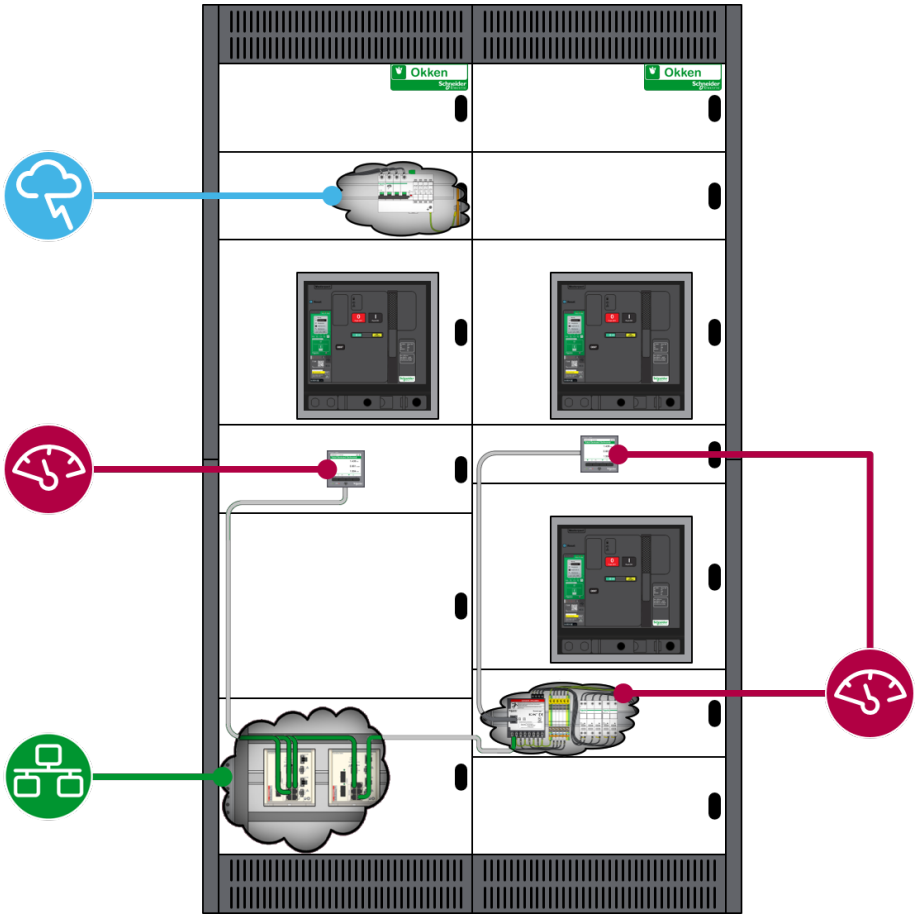


Picture 7: Power supply cable details

The use of cable instead of 2 wires will improve the robustness (Immunity against EMC phenomena) of the system and the flexibility of the cable routing inside the switchboard.

6. OKKEN REFERENCE ARCHITECTURE

6.1 OKKEN SWITCHBOARD WITH MASTERPACT MTZ AND POWER METER GLOBAL OVERVIEW



Picture 8: Okken switchboard overview

Details		Page
	Surge protective devices module	
	This part deals with the installation and wiring of a surge protective devices architecture	P. 20
	Power Meter installation overview	
	This section deals with the installation guideline of Power Meter with remote display.	P. 28
	Network architectures	
	This part of the document presents the network connectivity and network reference architecture for the power monitoring system.	P. 40

7. SURGE PROTECTIVE DEVICES

7.1 WHY IT IS RECOMMENDED TO INSTALL A SURGE PROTECTIVE DEVICE?

☑ **Okken environment**

Okken switchboards have been designed to support up to 12 kV of voltage surge on its main busbar, this correspond to an OVC[1] level of 4.
All devices directly connected to the main busbar of the switchboard will be subject to the same level of voltage surge (up to 12 kV).

☑ **Power Meter control power (Power supply)**

Due to the wide range of the control power (power supply) of the Power Meter 8000 and 5000 ranges (i.e. for PM8000 range: 110 to 415 V DC ± 15% or, 50/60 Hz ± 10%: 90 to 415 V ± 10% or, 400 Hz: 90 to 120 V ± 10%), Power Meters could be supplied directly from the main busbar of the switchboard with the addition of dedicated protection device (fuse or circuit breaker).
The power supply of Power Meters has been designed for OVC 3 environment.

☑ **Power Meter voltage measurement inputs**

The voltage measurement inputs of the PM8000 and PM5000 ranges are designed to be part of an environment characterized by an Over Voltage Category 3 and even category 2 for PM5350.

Due to the direct connection to the main busbar of the installation, and due to the difference of design between Okken switchboards and Power Meters, insulation coordination shall be considered.

☑ **What is an OVC level?**

- OVC deals with the level of surge that it is supposed to occur in a specific point of the installation. It is important to note that there can have multiple OVC level inside a same switchboard (OVC IV and OVC III i.e.).
- The OVC level deals also with the availability level required by the devices.

For example, a circuit breaker is a protection device, and if it becomes not available due to a surge, the full installation could be impacted (loss of productivity, cost, production…), this is not acceptable.
In the other hand, if a Power Meter becomes not available due to a surge, we can suppose that this is not critical because it is only a power monitoring device without control or protection function.
In this case, the availability level of a Power Meter is less than the circuit breaker one.

Base on that, there are two options to manage the gap between OVC level of the main switchboard and the OVC level of Power Meter range:

- Adapt the OVC level of the Power Meter, by adding a surge protective device, the resulting OVC level of the Power Meter range will be increased to match OVC IV, with the highest level of availability
- Install the Power Meter without surge protective device (no adaptation of the OVC level) with the awareness that in case of surge, the availability of the Power Meter could be impacted with the possibility to never recover the device.

The choice between these two implementations can be based on customer requirements.

[1] OVC: Over Voltage Category

- Schneider Electric highly recommends the installation of a surge protective device to help to ensure an efficient level of device availability.

7.2 SELECTION OF SURGE PROTECTIVE DEVICE

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set-up procedures have been completed.
- Verify that all installation rules have been applied.

Failure to follow these instructions can result injury, or equipment damage.

Depending on the earthing system of your installation and on the type of electrical network (Phase + neutral or 3 phases + neutral) you will have to select the right SPD[2], to ensure the right level of protection.

- The surface protective device shall have a protection voltage of maximum 2.5 kV
- $Up \leq 2.5\ kV\ L/N$
- For more information about surge protective devices, please refer to the Schneider Electric Electrical Installation Guide.

Depending on the system earthing arrangement, it is necessary to provide for a SPD architecture ensuring protection in common mode (CM) and/or differential mode (DM).
The following table will help you to select the appropriate SPD that fits to your requirements:

Surge protective devices selection table				
Earthing system:	**TT**	**TN-C**	**TN-S**	**IT**
Phase to neutral (DM[3])	ℹ *	✗	ℹ	⊖
Phase to earth (PE or PEN for TN-C) (CM[4])	✓	✓	✓	✓
Neutral to earth (PE) (CM)	✓	✗	✓	✓ **

✓ Needed
ℹ Recommended
⊖ Not useful
✗ Not allowed

* The protection between phase and neutral can either be incorporated in the SPD placed at the origin of the installation, or can be remote, close to the equipment to be protected
** If neutral distributed. (If not, not allowed)

Table 3: SPD selection table - Source: Electrical installation guide (2015)

[2] SPD: Surge Protective Device
[3] DM: Differential Mode
[4] CM: Common Mode

EXAMPLE:
In this example, let's consider a TT earthing system. Therefore, the SPD to be installed shall cover the following protection specifications:

- Phase to neutral (DM)
- Phase to earth (PE) (CM)
- Neutral to earth (PE) (CM)

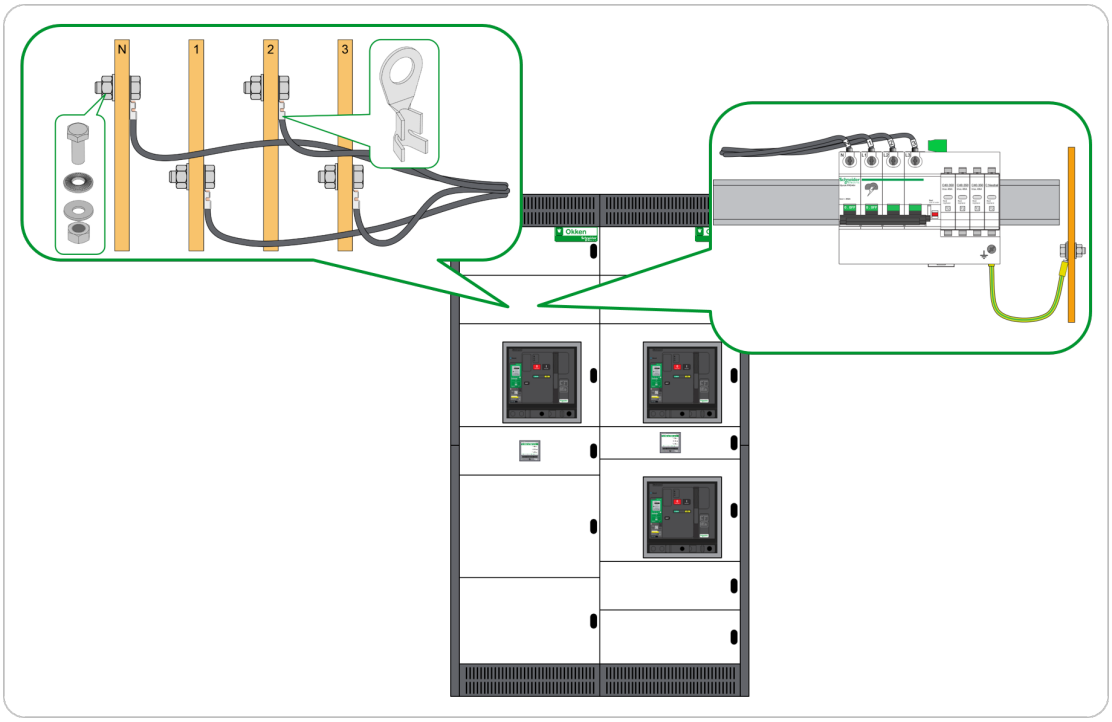
By considering that the voltage protection shall not exceed 2.5 kV, the following SPDs could answer to the requirements:

- iQuick PRD40r modular surge arrester 3P+N, ref: A9L16294
- iQuick PRD8r modular surge arrester 3P+N, ref: A9L16300
- iQuick PRD40r modular surge arrester 3P, ref: A9L16293
- iQuick PRD8r modular surge arrester 3P, ref: A9L16299

7.3 SURGE PROTECTIVE DEVICE IMPLEMENTATION RULES

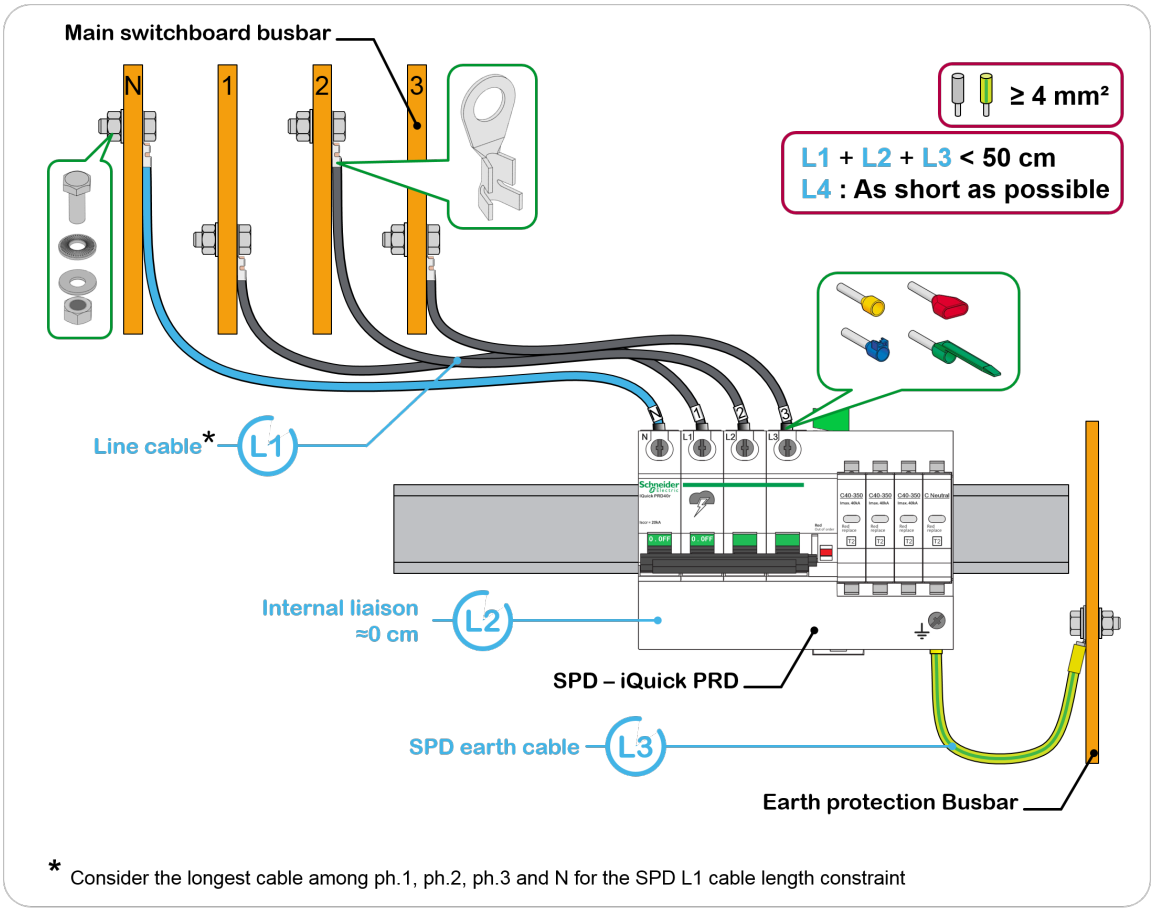
To be efficient, a surge protective device shall be installed at the origin of the installation, as close as possible to the customer main incomer cables connections.
In case of more than one incomer, all the incoming customer connections shall be equipped with an SPD.
The SPD is directly connected to the incoming busbars and to the Earth busbar, thanks to adapted cables and accessories.
The connection between the incoming busbar and the Earth busbar shall be short as possible.

The following picture gives an example of SPD integration location inside Okken, switchboard:

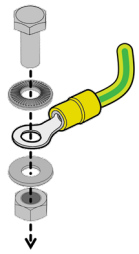


Picture 9: Surge Protection Device inside Okken switchboard

The following picture gives the main rules for wiring three phases + neutral surge protective device on Okken switchboard:



Picture 10: Surge Protective Device wiring rules



Connect the earth cable of the surge protective device to the Earth protection busbar, with:

- Insulated ring lug
- Hexagon nut
- Screw
- Serrated conical washer also called a contact washer to ensure a perfect contact.

☑ **As short as possible.**

- Earth cable connection length of the Surge Protective Device shall be connected to the earth protection busbar as short as possible.
- Cross section of the earth and line cables shall be equal or more than 4 mm².
- Length 1 + Length 2 + Length 3 shall be lower than 50 cm
- Use non-insulated ring lugs to connect Surge Protective Device to the main busbar.
- Use insulated cable ends to connect wires on Surge Protective Device.

8. POWER METER

8.1 TWO HARDWARE THAT ALLOW TO FIT MANY SWITCHBOARD CONFIGURATIONS

Among the Power Meter 8000 and 5000 range, we can identify two different hardware, that will help to fit most of the switchboard configurations.

The following table gives the specificities of each device configuration:

	Measurement unit with integrated display	Measurement unit with remote display
		
Display type:	Embedded	Remote (up to 5m)
Mounting option:	Flush mounted	DIN rail for measurement unit Flush mounted for the display
Minimum compartment size to integrate the display:	8 modules height (20 cm)	6 modules height (15 cm)
Minimum compartment size to integrate the measurement unit:	N/A (same compartment as display)	8 modules height (20 cm)
Recommended* location for display integration:	From 60 cm to 195 cm high	From 60 cm to 195 cm high
Possible location for measurement unit integration:	N/A (same recommendations as display)	From 15 cm to 195 cm high

* Recommendations are based on ergonomic rules, and view angle capabilities of the display

The table below gives an overview of Power Meter mounting configuration and main features according their commercial reference:

Commercial reference	Description – Main features	Mounting configuration
METSEPM5110	PM5110 Cl 0.5s, RS-485 Modbus	
METSEPM5111	PM5111 Cl 0.5s, RS-485 Modbus, MID[5]	
METSEPM5310	PM5310 Cl 0.5s, RS-485 Modbus, 2DI/2DO	
METSEPM5320	PM5320 Cl 0.5s, Modbus TCP/IP, up to 31st Harmonics, 2DI/2DO, Alarming	
METSEPM5330	PM5330 Cl 0.5s, RS-485 Modbus, 2DI/2DO, Relay, Multi-tariff	
METSEPM5331	PM5331 Cl 0.5s, RS-485 Modbus, 2DI/2DO, Relay, Multi-tariff, MID	
METSEPM5340	PM5340 Cl 0.5s, Modbus TCP/IP, up to 31st Harmonics, 2DI/2DO, Alarming, Multi-tariff	
METSEPM5341	PM5341 Cl 0.5s, Modbus TCP/IP, up to 31st Harmonics, 2DI/2DO, Alarming, Multi-tariff, MID	
METSEPM5350	PM5350 Cl 0.5s, RS-485 Modbus, up to 31st Harmonics, Alarming, Multi-tariff	
METSEPM5560	PM5560 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff	
METSEPM5561	PM5561 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, MID	
METSEPM5562	PM5562 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, RMICAN approved, HW lockable	
METSEPM5562MC	PM5562MC Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, RMICAN approved, Factory sealed	
METSEPM8240	PM8240 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, EN 50160	
METSEPM5563	PM5563 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, DIN mounted, Without display	
METSEPM8243	PM8243 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, EN 50160, DIN mounted, Without display	
METSEPM5563RD	PM5563RD Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, DIN mounted, With remote display	
METSEPM8244	PM8244 Cl 0.2s, RS-485 Modbus, Modbus TCP/IP (2), up to 63st Harmonics, 4DI/2DO, Alarming, Multi-tariff, EN 50160, DIN mounted, With remote display	

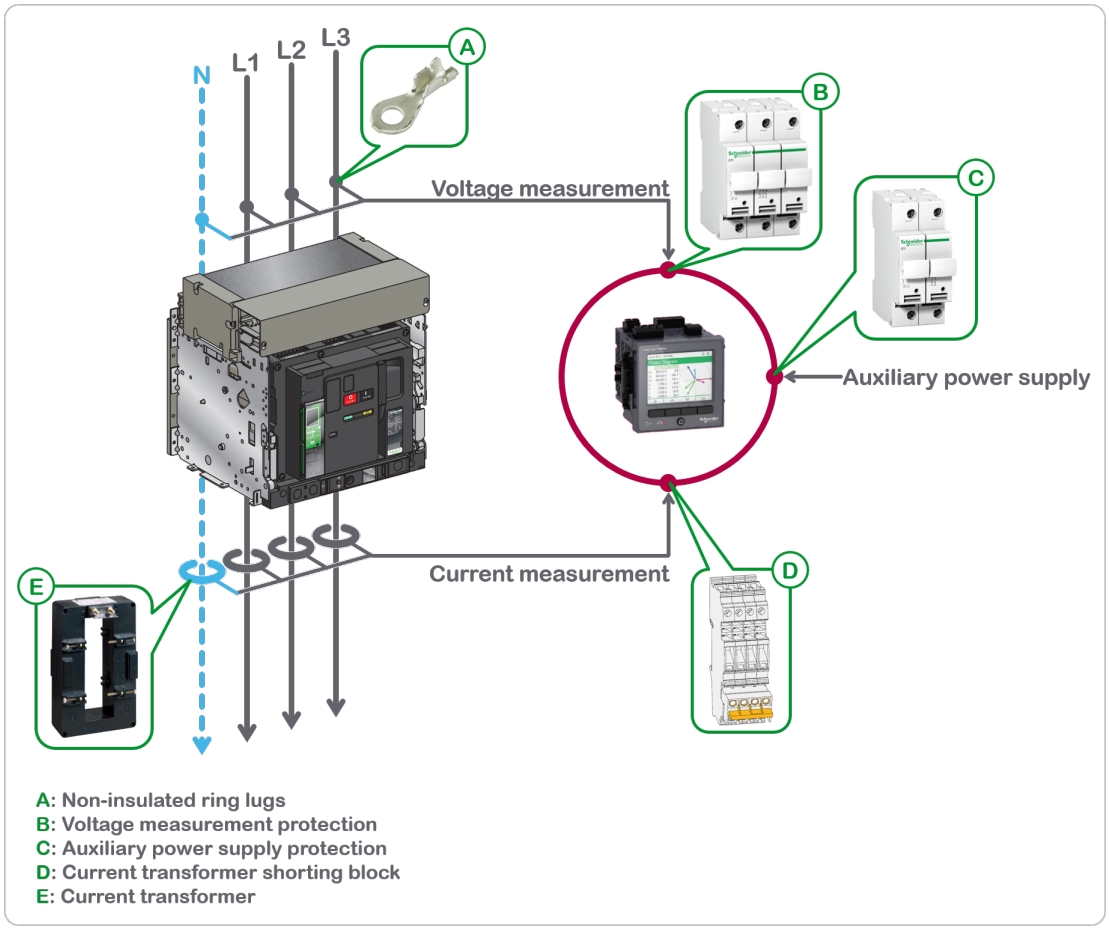
[5] MID: Measuring Instruments Directive - Compliant with the 2004 European Directive applicable to measuring devices

8.2 POWER METER SUB-SYSTEM DEFINITION

The Power Meter sub-system has been defined as:

- The Power Meter itself.
- The voltage measurement protection (fuse or circuit breaker).
- The current measurement shorting block.
- The auxiliary power supply protection (fuse or circuit breaker).
- The current transformers and wires used to connect CT to Power Meter.
- The wires and accessories for voltage measurement.

Indeed, the Power Meter needs accessories to be connected to its environment. Some of these accessories are DIN rail mounted and need to be implemented inside the same compartment as the Power Meter or measurement unit.
The following picture shows the Power Meter sub-system:



Picture 11: Power Meter sub-system

8.2.1 Non-insulated ring lugs

Due to the high temperature that can occur on the busbar of the switchboard (up to 140°C), Schneider Electric recommends implementing non-insulated ring lugs to connect the voltage measurement circuit to the busbar. To ensure the appropriate level of immunity of the installation, the wires used to measure the voltage shall respect the following requirements:

- Flexible wire
- Rated voltage (V): 1kV
- Rated temperature mini range: -30°C to 140°C
- Cross section: 1.0mm²

8.2.2 Voltage measurement protection

8.2.2.1 Fuses

To ensure the protection of the voltage inputs of the Power Meter (either PM5000 and PM8000 ranges), fuses shall be installed.
By considering that the installation voltage range can be measured without addition of voltage transformer (690 Vac line to line max), the following table gives the characteristics of the fuse to install to protect the voltage inputs:

General	
Type	Low voltage fuse
Version	Quick acting
Electrical characteristics	
Breaking capability	120kA
Rating	0.5A (PM5000 series) 2A (PM8000 series)
Specials	
Specification	Gl-gG 500/400V
Measures	
Length	38.0 mm
Ø	10.3 mm

Table 4: Fuse characteristics for voltage inputs

8.2.2.2 Fuse holder

Base on the electrical system (3 poles or 3 poles + neutral), the following fuse holder shall be implemented to protect the voltage inputs of the Power Meter:

- A9N15658: Acti 9 - fuse-disconnector STI - 3 poles + N - 25 A - for fuse 10.3 x 38 mm
- A9N15656: Acti 9 - fuse-disconnector STI - 3 poles - 25 A - for fuse 10.3 x 38 mm

8.2.3 Auxiliary power supply protection

8.2.3.1 Fuses

To ensure the protection of the Power Meter auxiliary power supply, (either PM5000 and PM8000 ranges), fuses shall be installed.
The following table gives the characteristics of the fuse to install to protect the voltage inputs:

General	
Type	Low voltage fuse
Version	Quick acting
Electrical characteristics	
Breaking capability	120kA
Rating	0.5A (PM5000 series) 2A (PM8000 series)
Specials	
Specification	Gl-gG 500/400V
Measures	
Length	38.0 mm
Ø	10.3 mm

Table 5: Fuse characteristics for auxiliary power supply

8.2.3.2 Fuse holder

Base on the electrical system (3 poles or 3 poles + neutral), the following fuse holder shall be implemented to protect the auxiliary power supply of the Power Meter:

- A9N15646: Acti 9 - fuse-disconnector STI - 1P+N - 25 A - for fuse 10.3 x 38 mm

8.2.4 Current transformer shorting blocks

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Never open circuit a current transformer (CT).
- Always use grounded external current transformer (CT) for current inputs.
- Always use a shorting block to connect the current measurement circuit to the Power Meter terminals.
- Always use insulated ring lugs to connect current measurement circuit to Power Meter and current transformer terminals.
- Always use insulated cable ends.
- Insulated cable ends and rig lugs shall be adapted to the section of the wires.
- Never use current protection device (fuse or circuit breaker) on the current measurement circuit.

Failure to follow these instructions will result in death or serious injury.

☑ IMPORTANT:

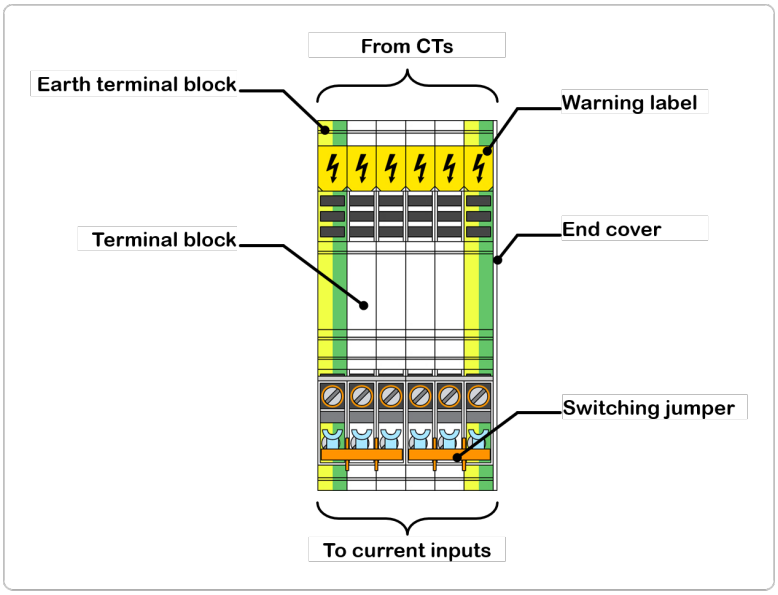
No current protection devices are needed on the current measurement network due to the very low short circuit power of a current transformer. Also, the use of a circuit breaker or fuse to protect the current measurement network could lead to let open the current transformer circuit, that can result in death or serious injury.

Some specific accessories references can be found inside the Schneider Electric offer to ensure the shorting function needed to connect current transformers to Power Meter current inputs.

Two different measurement networks shall be considered:

- 3 phases network
- 3 phases + neutral network

The following picture shows a shorting block for 3 phases + neutral electrical network:



Picture 12: Shorting block for 3P+N electrical network

Depending the electrical network, the bill of material may be slightly different as shown by the following table:

Designation	Reference	Recommended quantity for:	
		3P network	3P+N network
Earth terminal block (set of 50)	**NSYTRV62TTPE**	1	2
Terminal block (set of 50)	**NSYTRV62TT**	3	4
End cover (set of 50)	**NSYTRACT22**	1	1
3 points switching jumper (set of 10)	**NSYTRASJ3**	N/A	2
4 points switching jumper (set of 10)	**NSYTRASJ4**	1	N/A
Warning label (set of 10)	**NSYTRACS6**	1	1

Table 6: Shorting block BOM

8.3 WHERE TO INSTALL POWER METER AND THEIR ACCESSORIES?

The choice of the location of the electronic devices inside an LV equipment is related to several parameters:

- The location height inside the cabinet
- The internal temperature in this location
- The EMC environment

With the Power Meter, regarding the integration of electronic devices, optimized location for electronic devices integration has been identified and tested regarding EMC and thermal phenomena.

8.3.1 Recommended size of the dedicated compartment

Each time a Power Meter is integrated inside Okken switchboard, a functional unit compartment must be dedicated to the implementation of the solution. The location shall respect a following rules:

8.3.1.1 Flush mounted Power Meter or DIN mounted measurement unit

The minimum height of the functional unit (compartment) used to install a flush mounted Power Meter or a DIN mounted measurement unit and their accessories shall not be smaller than 20 cm height (7.87 in). That is corresponding to:

- 8 modules (2.5 cm by module) for Okken switchboards.

Also, a clearance of at least 17 cm (6.69 in) deep behind the door shall be respected, to ease the wiring and device implementation.

8.3.1.2 Remote display

To integrate a remote display only, if any, the functional unit could be smaller due to the small footprint of the screen, in this case the compartment could measure only 15 cm height (5.9 in). That is corresponding to:

- 6 modules (2.5 cm by module) for Okken switchboards.

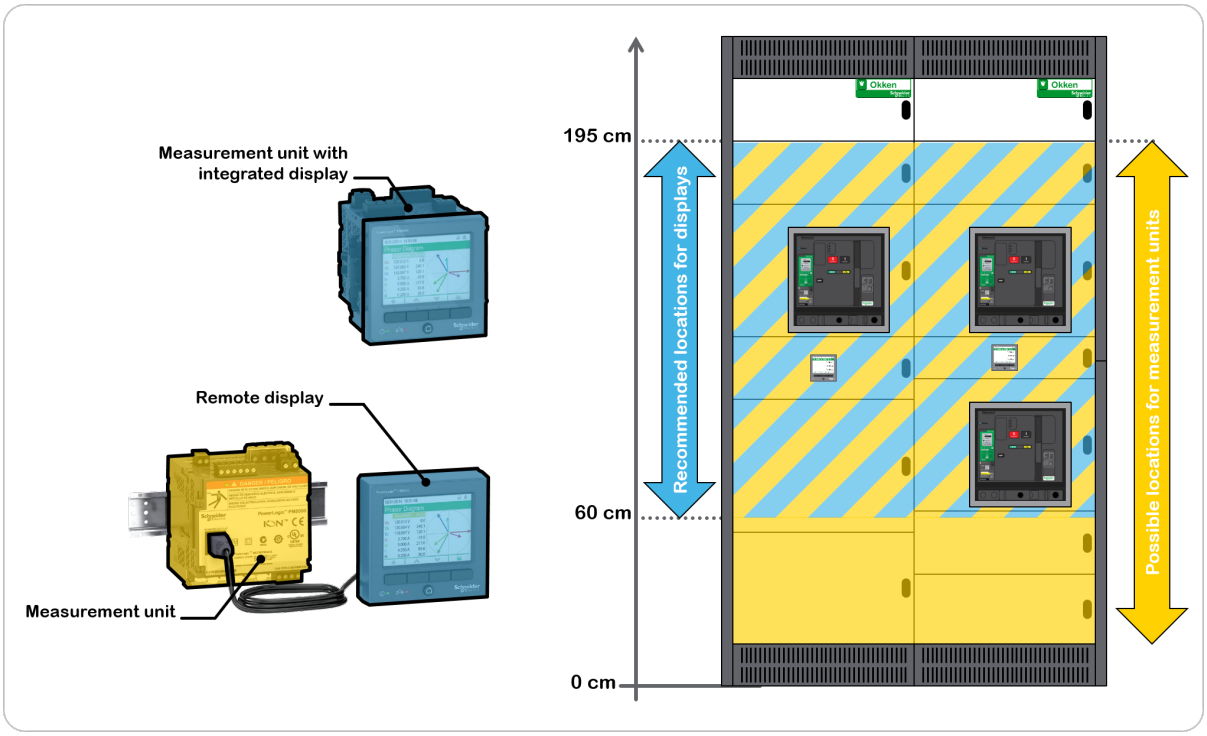
To master the wiring of the screen, a clearance of at least 5 cm (1.96 in) deep behind the door shall be respected.

8.3.2 Recommendations for display location

Based on ergonomic rules and display angle capacity of Power Meter displays, Schneider Electric recommends installing the display of Power Meter (integrated display or remote display) between 60 cm (23.62 in) height from the floor and 1.95m (6’ 5”)

In case of Power Meter without remote display, the measurement unit can be installed lower than 60 cm height.

The following picture gives an example of Power Meter and accessories compartment location into a standard Okken switchboard:



Picture 13: Ergonomic rules for integration inside Okken

Depending the Power Meter configuration and number, it is possible to integrate more than one device per compartment, this will allow to optimize the footprint of the switchboard.
The following table highlights the recommendations for display and measurement unit integration:

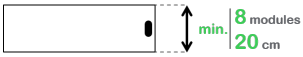
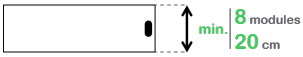
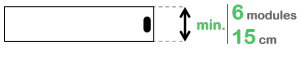
	Device configuration	Minimum compartment size	Recommended location range for the compartment	Quantity of device
Integrated display		 min. 8 modules 20 cm	From 60 cm to 1.95 m	Up to 3 per compartment
Remote display and measurement unit inside the same compartment				Up to 2 per compartment
Remote display and measurement unit inside two separate compartments		 min. 8 modules 20 cm	From the floor to 1.95 m	Up to 2 per compartment
		 min. 6 modules 15 cm	From 60 cm to 1.95 m	Up to 3 per compartment

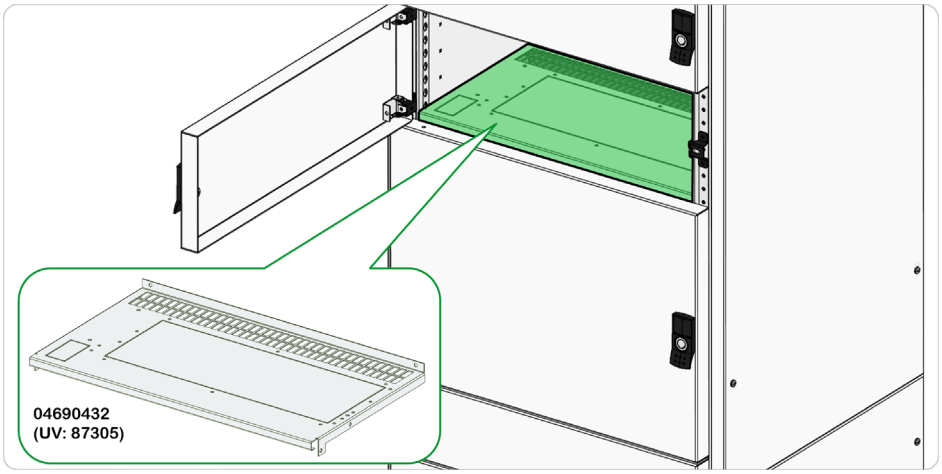
Table 7: Display and meters integration rules

8.4 INSTALLATION RULES

NOTICE
EQUIPMENT OPERATION HAZARD • Verify that all devices have been installed in dedicated locations. • Verify that all installation and set-up procedures have been completed. • Remove tools, meters, and debris from equipment. **Failure to follow these instructions can result in injury or equipment damage.**

8.4.1 Compartment characteristics

Due to high level of electromagnetic field that can occur inside an Okken switchboard, Schneider Electric recommends adapting each functional unit used to integrate Power Meters and their accessories. The adaptation consists in the installation of a specific metal plate fixed on the horizontal barrier plate (Ref: 87305).



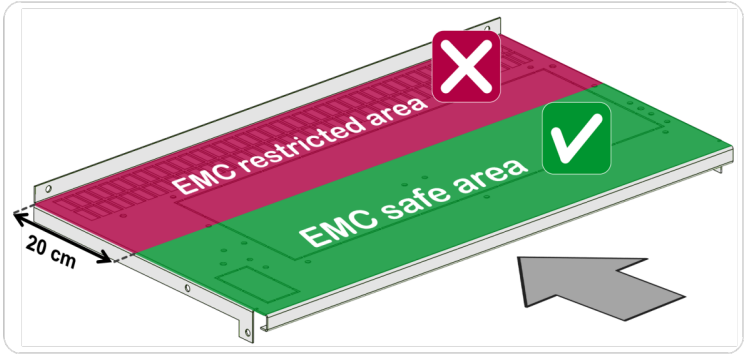
Picture 14: Horizontal barrier plate identification

☑ **EMC restricted area**

On this dedicated location, due to the proximity with circuit breakers and busbar, electronic devices **SHALL NEVER** be installed on the metallic back plate of the cubicle, and cables (Communication or power supply cables) **SHALL NOT** cross this area, due to very high level of EMC disturbances.
Only the first half of the metallic plate is fully safe for devices installation.

The metal plate defined to integrate Power Meter and their accessories has been designed to help to respect this rule.

The following illustration gives the detail of this rule:



Picture 15: EMC areas identification – Front face

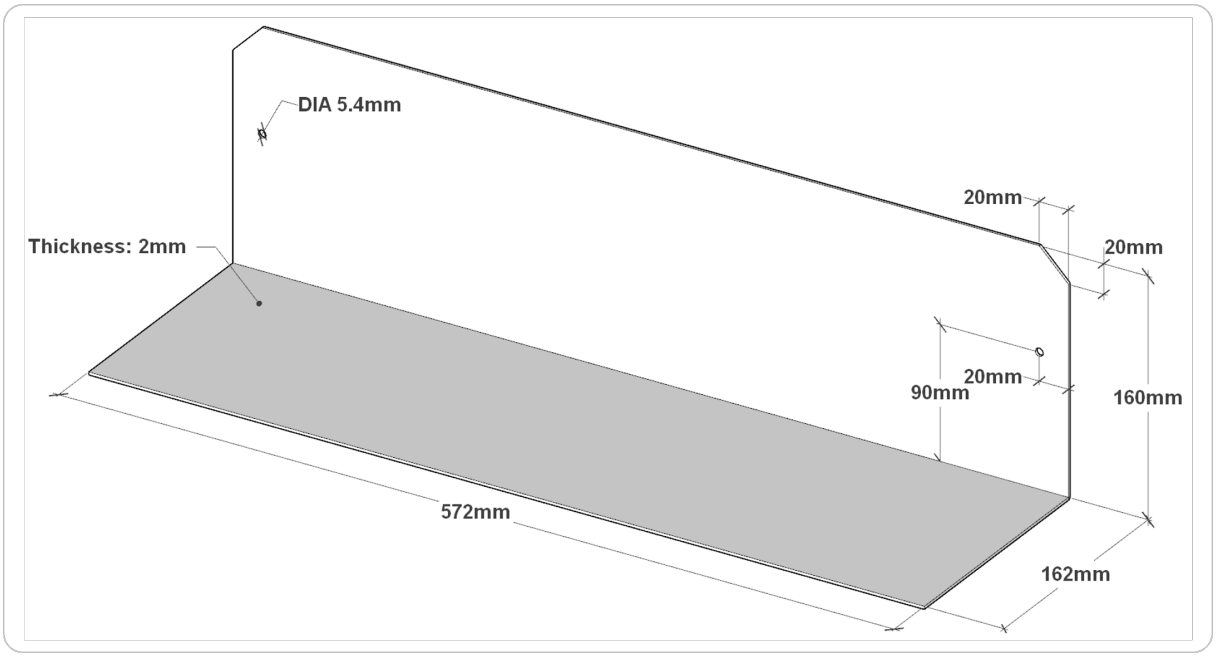
- Always install devices inside the EMC safe area
- Provide 20 cm width as distance for the restricted area

8.4.2 Metallic plate implementation

To optimize the installation inside this compartment, the Power Meter must be installed as explained in this section.

8.4.2.1 Metal plate details

The following picture gives the measures of the metallic plate.



Picture 16: Metal plate details and measurements

This metal plate shall be fixed on the horizontal barrier plate, on the EMC safe area.

8.4.2.2 Installing DIN rails on the metal plate

Designation	Reference
Metal plate*	**N/A**
500 mm DIN rail	**N/A**
Protection against sharp edges	**N/A**
M6 x 10 mm self-tapping screw	**87182**

* Refer to Picture 16: Metal plate details and measurements on page 31 for more details

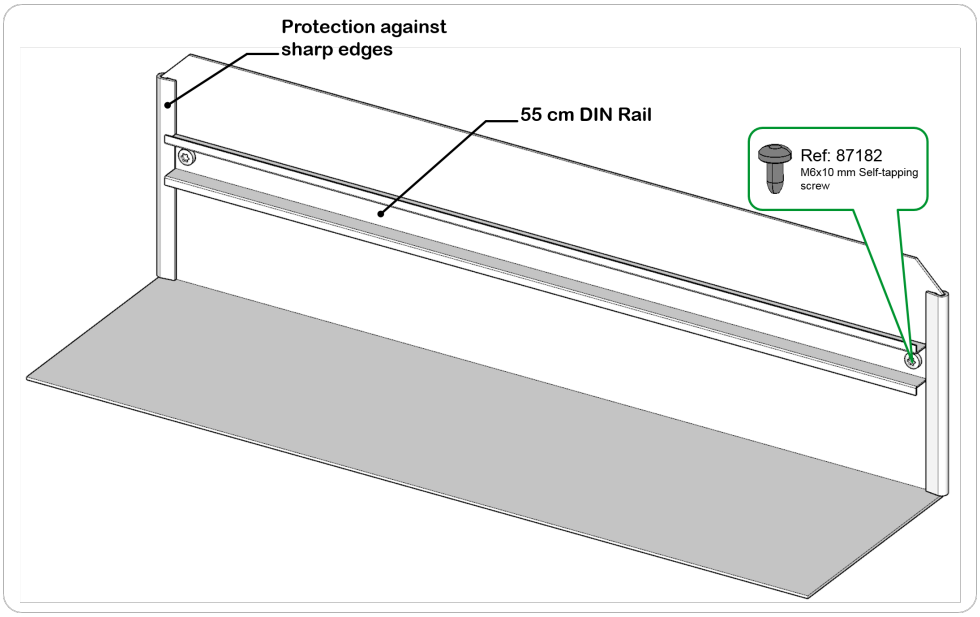
Table 8: Metal plate assembling BOM

Fix the 550-mm length DIN rail on the metal plate with two M6 x 10 mm self-tapping screw (Okken Reference: 87182).
To prevent wires and cables from being damaged by the sharp edges of the metal plate, use dedicated protection accessory.

The following picture shows the metal plate equipped with DIN rail and protection against sharp edges.

This specific implementation will allow to implement inside the compartment up to:

- 3 power measurement systems in case of flush mounted Power Meters
- 2 power measurement systems in case of DIN mounted Power Meters



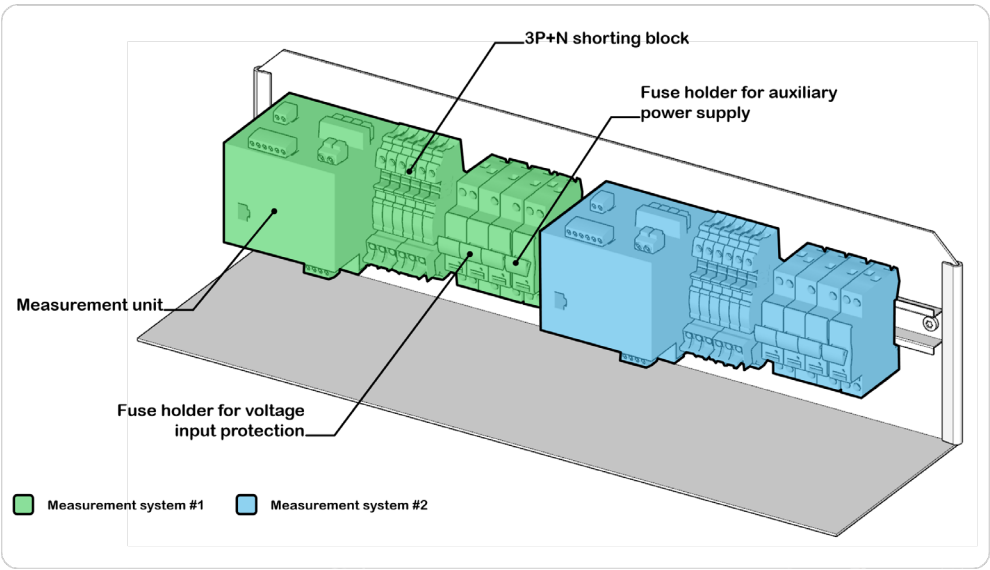
Picture 17: DIN rail and protection mounted on metal plate

8.4.3 Case of the DIN mounted measurement unit

8.4.3.1 Measurement unit and accessories

By considering the space taken on the DIN rail by the measurement unit and by the accessories, it is possible to integrate up to 2 measurement systems on the compartment.
The following picture gives an example of an 8 modules compartment equipped with 2 DIN mounted Power Meters.

NOTE:
In this case, the remote displays are not necessary installed on the door of this compartment. They can be installed on the door of another compartment, located on the next column.



Picture 18: DIN mounted measurement unit and its accessories

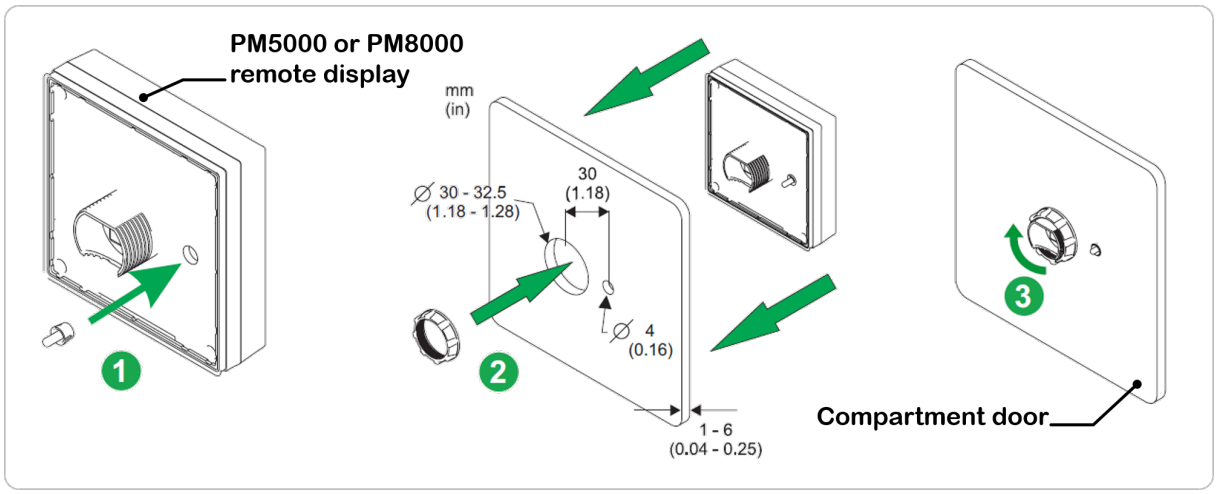
8.4.3.2 Installation of the remote display

The remote display can be mounted on the door of:

- The same compartment as the one used to integrate accessories
- Another functional unit compartments

Only if this compartment is not located between the floor and 60 cm height.

The remote display can be mounted easily thanks to its 30-mm round hole mounting capability.
Here under, an extract of the mounting guide:



Picture 19: Remote display round hole mounting option.

NOTE:
There existing other mounting options for remote display. Please refer to the mounting guide for more information and details.
After installing the measurement unit on the Din rail, and the remote display on the door, the connection between both devices is done via Ethernet cable.

8.4.3.3 Impact on the Index of Protection of the switchboard (IP)

⚠ CAUTION
EQUIPMENT INCOMPATIBILITY OR INOPERABLE EQUIPMENT Read and thoroughly understand all hardware and software documentation and specification before attempting any component substitutions. **Failure to follow these instructions can result in injury or equipment damage.**

Okken switchboards have been designed to ensure an Index of Protection (IP) of the enclosure up to IP54.
This very restrictive level of Index of Protection remains a switchboard option.

It is important to note that among the Power Meters 5000 and 8000 ranges, only PM8000 series are compliant with the IP54.

To ensure the IP of the switchboard, it is mandatory to install only Power Meter with an IP at least equal to the IP of the switchboard.

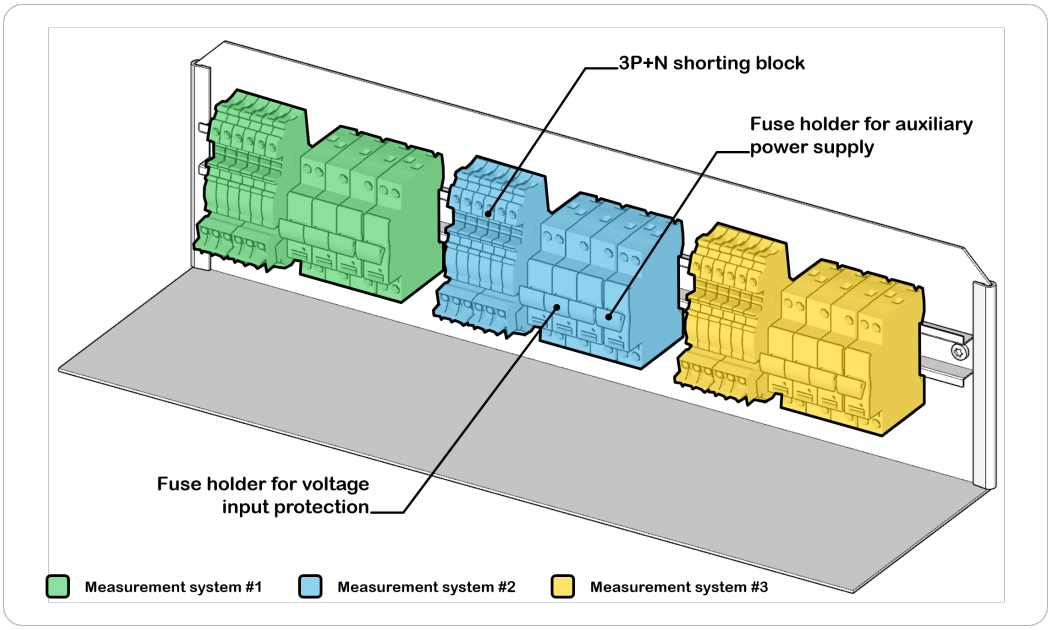
The following table gives the IP level of the Power Meters 5000 and 8000 ranges and their compatibility with Okken switchboard based on its IP:

- Never install Power Meter with an IP lower than the IP of the switchboard.
- PM51xx ➔ IP52 front display, IP30 meter body
- PM53xx ➔ IP52 front display, IP30 meter body
- PM5350 ➔ IP51 front display, IP30 meter body
- PM82xx ➔ IP54 front display, IP54 remote display, IP30 meter body

8.4.4 Case of the Flush mounted measurement unit

In this case, as the measurement unit is flush mounted, it is possible to integrate only the accessories on the DIN rail. By the way, it is possible to integrate up to 3 measurement system accessories.

The following picture shows the integration of 3 measurement system accessories on the same compartment:



Picture 20: Flush mounted Power Meter accessories

Schneider Electric highly recommends installing the flush mounted Power Meter on the door of the compartment used to install their accessories.

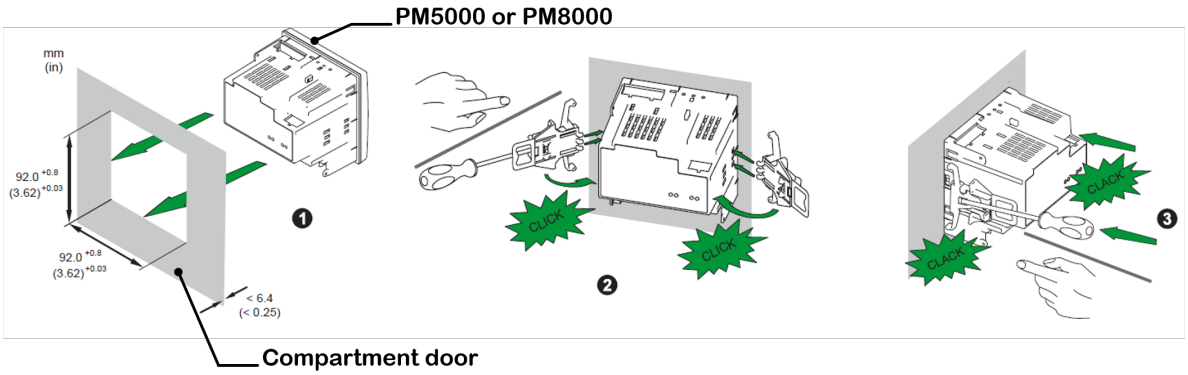
- Always install Flush mounted Power Meter on the door of the same compartment used to integrate its accessories.

8.4.4.1 Installing the flush mounted Power Meter on the door

Under this configuration, the Power Meter shall be mounted on the door of the compartment used to integrate its accessories.

The flush mount installation is based on a square hole of 92 mm x 92 mm (3.6 in x 3.6 in).

Here under, an extract of the mounting guide:



Picture 21: Flush mounted display implementation.

- Always install Flush mounted Power Meter on the door of the same compartment used to integrate its accessories.

8.4.4.2 Impact on the Index of Protection of the switchboard (IP)

⚠ CAUTION

EQUIPMENT INCOMPATIBILITY OR INOPERABLE EQUIPMENT

Read and thoroughly understand all hardware and software documentation and specification before attempting any component substitutions.

Failure to follow these instructions can result in injury or equipment damage.

Okken switchboards have been designed to ensure an Index of Protection (IP) of the enclosure up to IP54.
This very restrictive level of Index of Protection remains a switchboard option.
It is important to note that among the Power Meters 5000 and 8000 ranges, only PM8000 series are compliant with the IP54.
To ensure the IP of the switchboard, it is mandatory to install only Power Meter with an IP at least equal to the IP of the switchboard.
The following table gives the IP level of the Power Meters 5000 and 8000 ranges and their compatibility with Okken switchboard based on its IP:

- Never install Power Meter with an IP lower than the IP of the switchboard.
- PM51xx ➔ IP52 front display, IP30 meter body
- PM53xx ➔ IP52 front display, IP30 meter body
- PM5350 ➔ IP51 front display, IP30 meter body
- PM82xx ➔ IP54 front display, IP54 remote display, IP30 meter body

8.5 ELECTRICAL INTEGRATION

⚠ DANGER

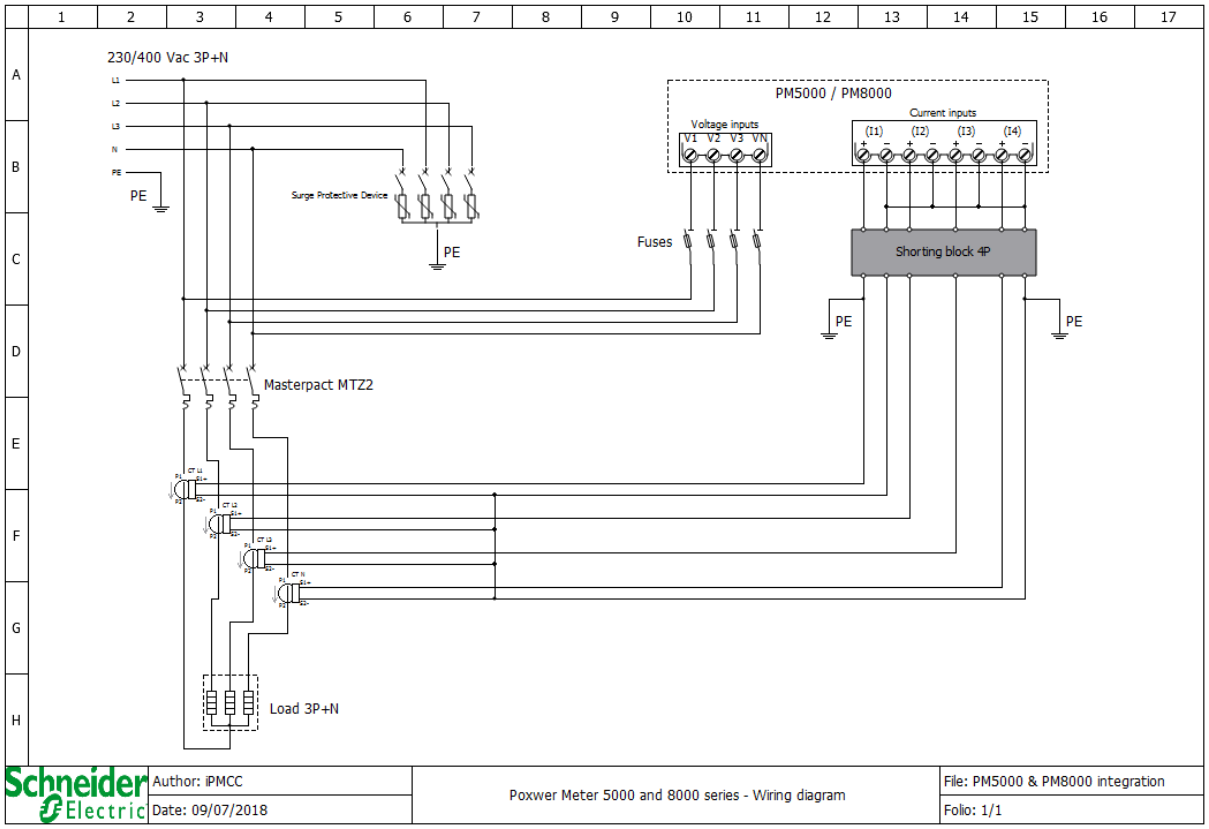
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Never open circuit a current transformer (CT).
- Always use grounded external current transformer (CT) for current inputs.
- Always use a shorting block to connect the current measurement circuit to the Power Meter terminals.
- Always use insulated ring lugs to connect current measurement circuit to Power Meter and current transformer terminals.
- Always use insulated cable ends.
- Insulated cable ends and rig lugs shall be adapted to the section of the wires.
- Never use current protection device (fuse or circuit breaker) on the current measurement circuit.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.
- Turn off all power supplying this device before working on it.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Do not exceed the accessories ratings for maximum limits.
- Never use insulated ring lugs to connect the voltage measurement wires to the switchboard busbar.
- Always use non-insulated ring lugs to connect the voltage measurement wires to the switchboard busbar.
- Always use voltage measurement wires with appropriate rated temperature range, up to 140°C.

Failure to follow these instructions will result in death or serious injury.

8.5.1 Electrical overview

The following wiring diagram shows a typical installation of a Power Meter 5000 or 8000 series.
This example is based on three phases + neutral system, many other wiring diagrams are available on the device mounting guides.



Picture 22: Typical PM8000 or PM5000 wiring diagram

8.5.2 How to select the appropriate current transformer ratio?

☑ Which ratio?

For an optimum selection of current transformer (CT[6]), Schneider Electric recommends that the ratio of the current transformer be chosen immediately higher than the maximum measured current (In).
Example:

- Nominal current to measure: In = 1103 A
- The recommended ratio to be chosen: Ratio= 1250/5

☑ What about small ratings?

From 40/5 to 75/5 and for an application with digital devices, Schneider Electric recommends that an higher rating be chosen, for example 100/5.
This is because small ratings are less accurate and the 40 A measurement, for example, will be more accurate with a 100/5 CT than with a 40/5 CT.

☑ Specific case of the motor starter:

To measure the current of a motor starter, a CT with primary current Ip = Id/2 (Id = motor starting current) shall be chosen.

[6] CT: Current Transformer

8.5.3 Validation of measurement solution according accuracy class

It consists in controlling the right adaptation of the CT on the accuracy class aspect.
The accuracy class is specified in the project.
The total dissipated power of the measurement circuit (meter + cables) should not be superior to the specified limit of the CT. This limit is for different standard classes.
If necessary, the choice of the cable section, the CT or meter should be modified to fit the requirement.
The following table gives the dissipated power per doubled meter at 20°C for coper cables in function of their cross section:

Coper cable cross-section (mm²)	Power per doubled meter at 20 °C (VA)
1	1
1.5	0.685
2.5	0.41
4	0.254
6	0.169
10	0.0975
16	0.062

Table 9: Dissipated power inside coper cables

NOTE:
For each temperature variation per 10 °C bracket, the power drawn up by the cables increases by 4 %.

The following table gives the standard consumption of current inputs (VA) of several Power Meter ranges:

Schneider Electric device	Consumption of the current input (VA)
Ammeter 72 x 72 / 96 x 96	1.1
Analogue ammeter	1.1
Digital ammeter	0.3
PM8000	0.15
PM5000	0.3
PM3000	0.3

Table 10: Current consumption of current inputs

☑ Application example
Project specification:

- In = 160A
- Accuracy class 1
- Section of measured cables: Ø27 mm

The ratio of the current transformer selected for this application is:

- 200/5, ref of the CT: **METSECT5MA020**.

Here under, the propositions for the wiring of the current measurement circuit:

- 4 meters length
- 2.5mm² wires
- PM5000

For this CT selected on the chart, the max acceptable power is 7 VA for "Accuracy class 1" which is specified in the project.

Internal profile type	Cables (mm)	Bars (mm)	Rating Ip/5 A (A)	Commercial reference number	Accuracy class 0.5	1	3
					Max. power (VA)		
MA							
	Ø27	10 x 32	150	METSECT5MA015	3	4	-
		15 x 25	200	METSECT5MA020	4	7	-
			250	METSECT5MA025	6	8	-
			300	METSECT5MA030	8	10	-
			400	METSECT5MA040	10	12	-

Control of the conformity of the measurement chain:

Consumption of current input for PM5000:

- **0.3 VA.**

Dissipated power inside 4 meters of 25mm²

- 4 meters of 2.5 mm2, doubled wires: 0.41 x 4 = **1.64 VA.**

Total: 0.3 + 1.64 = 1.94 VA (< 7 VA)

CONCLUSION:

This CT is well adapted as the accuracy class will be even better than 1.

8.5.4 Power Meter connectors

8.5.4.1 Current inputs

The use of insulated ring lugs adapted to the section of the wire is highly recommended to help to prevent a non-intended cable disconnection.

These insulated ring lugs shall be used to connect:

- The current measurement circuit wires to the Power Meter current input terminals
- The current measurement circuit wires to the current transformer terminals

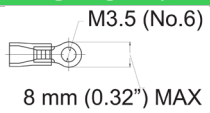
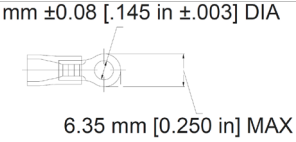
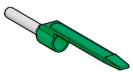
Power Meter series	Insulated ring lugs specifications
PM 8000 series	
PM 5000 series	

Table 11: Ring lugs specifications

8.5.4.2 Voltage inputs

☑ **Insulated cable ends shall be used at shorting block level. (DZ5 series)**



- Cable end insulated markable, 1mm², medium size, red, 10 bags. Ref: DZ5CA010

- Cable end insulated, 1mm², short size, red, 10 bags. Ref: DZ5CE010L6

These references are given as example. The size of the insulated cable ends shall be adapted to the section of wires used for the current measurement circuit.

9. IPMCC COMMUNICATION NETWORK

⚠ WARNING
LOSS OF CONTROL • The designer of any control scheme shall consider the potential failure modes of paths and, for certain critical control functions, provides a means to achieve a safe state during and after a path failure. Example of critical control functions are emergency stop and over travel stop. • Separate or redundant control paths shall be provided for critical control functions. • System control paths may include communication links. Consideration shall be given to the implications of anticipated transmission delays or failures of the link. * • Each implementation of equipment utilizing communication links shall be individually and thoroughly tested for proper operation before being placed into service. **Failure to follow these instructions can result in death, serious injury or equipment damage.**

*** For additional information about anticipated transmission delays or failures of the link, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation and Maintenance of Solid State Control* or its equivalent in your specific country, language, and/or location.**

9.1 COMMUNICATION BACKBONE

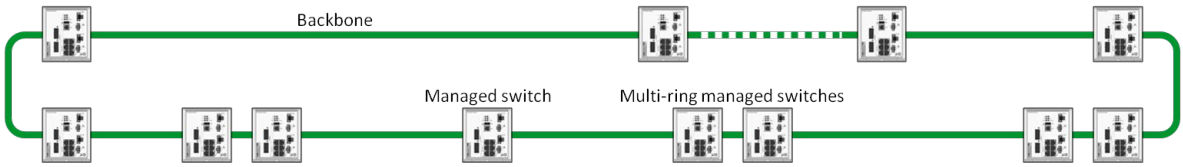
9.1.1 Backbone topologies

The backbone is the main network of an installation. It centralizes the devices' sub-networks. Among the many ways to implement a backbone, two have been identified by Schneider Electric as reference architectures. These two backbone reference architectures belong to:

9.1.1.1 High Dependability Ethernet Architecture

High Dependability Ethernet Architecture is based around a fault tolerant ring backbone (either optic fiber or copper) to which all the subsystems (devices' sub-network) are connected via managed switches. This solution of communication architecture increases process availability with high level of redundancy and performances.

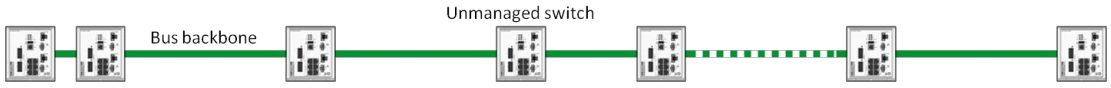
The main reason to do that is that a ring topology can deliver an extremely fast failover time as well as unlimited connectivity.



9.1.1.2 Competitive Ethernet Architecture

The Competitive Ethernet Architecture is based around a bus backbone (either optic fiber or copper) to which all the subsystems (devices' sub-network) are connected via unmanaged switches.

The competitive Ethernet architecture is an optimized and recommended reference for some dedicated application where redundancy is not required.

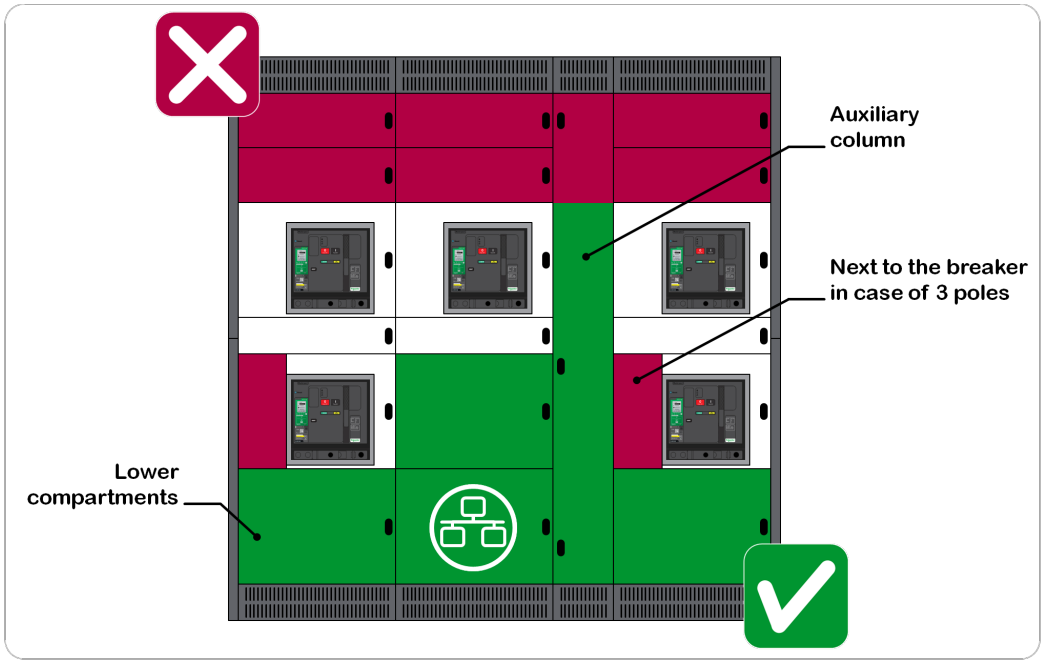


9.1.2 Where to install Ethernet Switches

Ethernet switches as all electronic devices, do not support high temperatures and high electromagnetic fields that could lead to unexpected operations of the device, and premature aging.

EMC with thermal tests and simulations have shown that specific areas shall not be used to install sensitive components such as communicating devices.

The following picture highlights these areas:



Picture 23: Where to install Ethernet switches

Ethernet switches shall be installed in the bottom compartments of the switchboards or in dedicated auxiliary column, due to EMC and thermal concerns.

Never install Ethernet switches inside top compartments of the switchboard

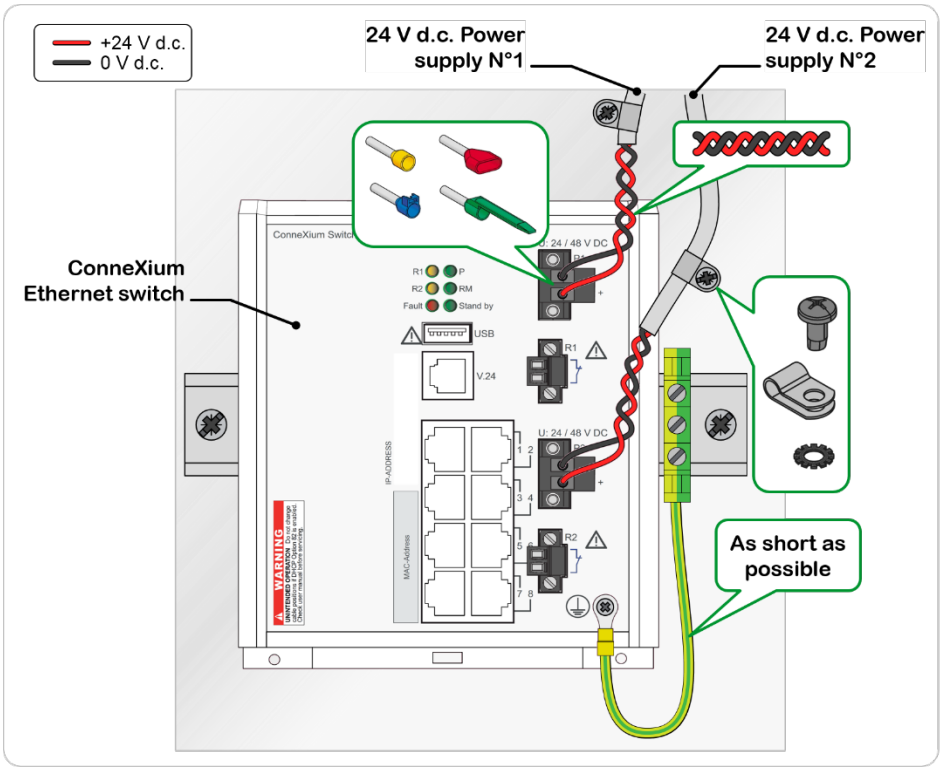
9.1.3 Ethernet switches Power supply

The dependability of a communication network (Please, refer to chapter 1)

iPMCC Communication network on page 40 of this document) is a criterion that depend on the selected network topology, that offers or not some redundancy and tolerance to device malfunction.
It is very important to approach the dependability of a system also via the power supply architecture.
Indeed, an Ethernet switch integrated inside a ring backbone architecture, offers a very high level of dependability and redundancy. But if this switch is not supplied by an uninterrupted power supply or by a dedicated power supply (Dual power supply), the overall dependability level of the communication architecture is impacted and decreased.

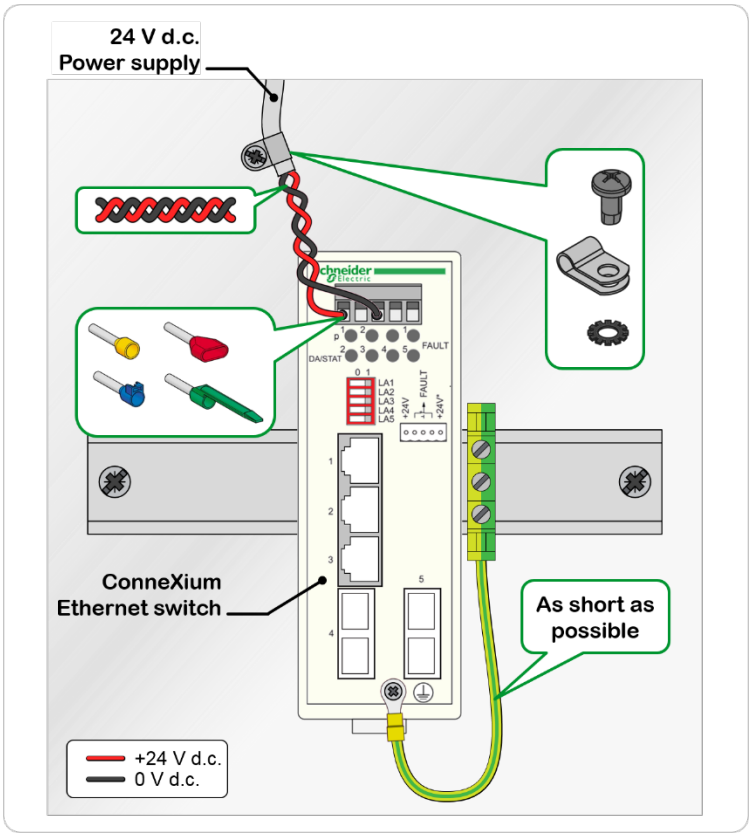
To do so, some Schneider Electric Ethernet switches offer the possibility to be supplied by two different 24 V D.C. auxiliary power supplies.

The following picture highlights the recommended power supply connectivity of a managed switch in case of star communication architecture (Redundancy needed at power supply side).



Picture 24: Star architecture – Switch power supply details

The recommended power supply connectivity of the unmanaged switch on which one daisy chains are connected is presented on the following picture.
The daisy chain architecture is the preferred architecture where redundancy is not required by the customer.
Therefore, it is not relevant to provide a redundant power supply to the unmanaged switch.



Picture 25: Daisy chain architecture – Switch power supply details

Whatever the selected architecture, star or daisy chain, the following rules shall be applied when implementing the Ethernet switch power supply.

- Never use 2 wires for power supply, use cable
- Use 1 pair cable, with braided shield
- Select a flexible wires cable (No need of twisted pair cable)
- Wire section from AWG22 (0.4mm²) to AWG14 (2.5mm²)
- Max length: Shall be adapted in order to respect a maximum voltage drop of 10%
- The wires shall be manually twisted before to be connected to the power supply connector
- Distance between device connection and shield connection has to be as short as possible
- Use insulated cable ends
- Earth connection length shall be as short as possible

9.1.4 Network Connectivity

The backbone configuration is not detailed inside this document. Please, refer to the reference documents table to get more information about the backbone configuration.
In order to simplify the selection of the Ethernet switch, the following tips could be helpful:

- 2 communication ports have to be reserved for the backbone connection (Ring or bus backbone)
- 1 communication port has to remain available (to connect a computer for network management)
- Never use a switch with more than 10 communication ports
- The use of optical fiber at backbone level highly increases the robustness of the communication

The following table gives the recommended references of Ethernet switches, based on the selected communication architecture and on the environment.

Standard environment		**Reference**
Description	**Com. architecture**	
Unmanaged switch without optic fiber ports	Daisy chain	499NES18100
Managed switch without optic fiber ports	Star	TCSESM083F23F0
Managed switch with optic fiber ports	Star	TCSESM083F2CU0
Harsh environment		**Reference**
Description	**Com. architecture**	
Unmanaged switch with optic fiber ports	Daisy chain	499NMS25102
Managed switch without optic fiber ports	Star	TCSESM083F23F1
Managed switch with optic fiber ports	Star	TCSESM063F2CU1

Table 12: Reference Ethernet switches

References given in this table are recommended references, other Ethernet switches are available on the Schneider electric catalog and might be used instead of them only if their device characteristics are the same.

9.2 POWER METER NETWORK TOPOLOGIES

The Power Meter 5000 and 8000 series allow several possibilities of connectivity to the end user communication architecture. Indeed, the two Ethernet ports and the RS485 port make possible to implement the following connection:

- Start topology
- Daisy chain topology
- Fieldbus topology

The choice between these three topologies should be made per the customer requirements and based on the users' values brought by the architecture itself.

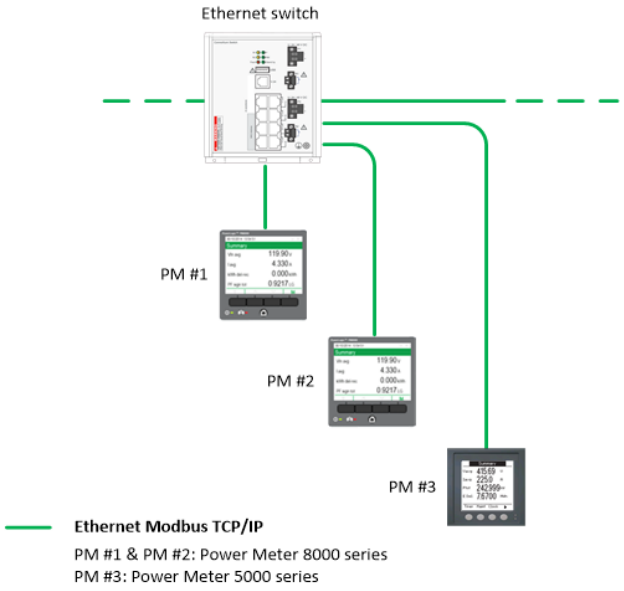
- The Power Meter built in Ethernet switch, even if it has two communication ports, does not support redundant protocols like RSTP or HiPeR ring
- Only star and daisy chain topologies are supported

9.2.1 Star topology

The star network topology consists in point to point connections with devices. The Star network topology choice allows to maximize the process availability with high level of redundancy and performances.

9.2.1.1 Star architecture

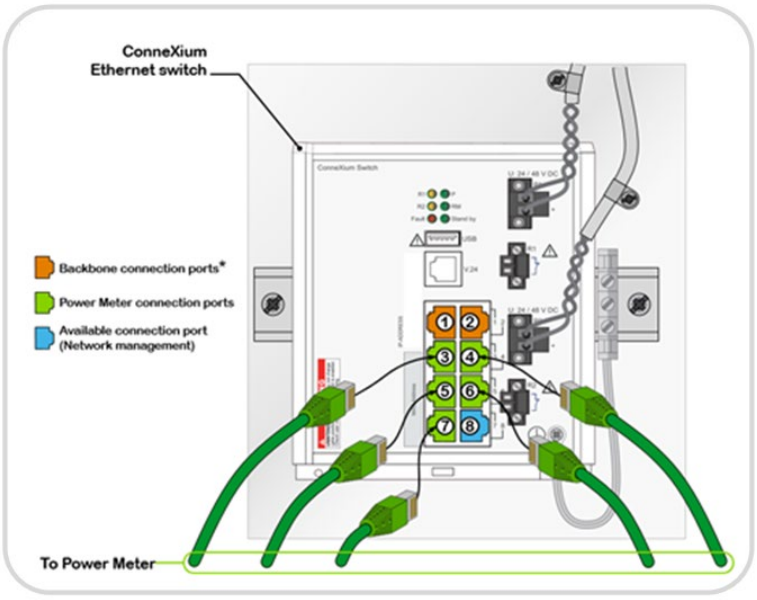
The following illustration gives the overview of a Star architecture implemented with Power Meters.



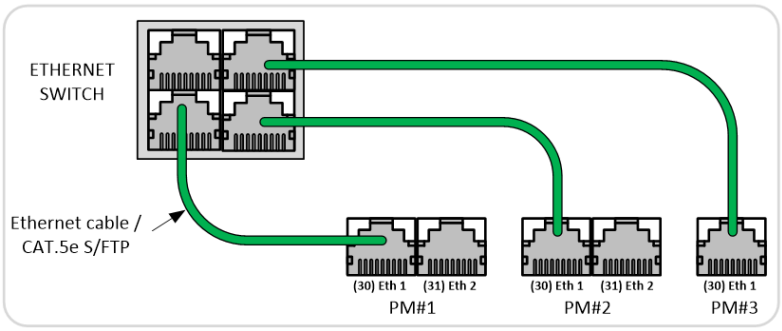
Picture 26: Star reference architecture

9.2.1.2 Star network connectivity

The following figures give an example of the network connection at switch level and Power Meter level:



Picture 27: Star architecture - Ethernet connectivity at switch level



Picture 28: Star architecture - Ethernet connectivity at Power Meter level

9.2.1.3 Star compatible devices

The following table gives the reference of compatible devices with star communication architecture:

Reference	Quantity of Ethernet ports
METSEPM5320	1
METSEPM5340	1
METSEPM5341	1
METSEPM5560	2
METSEPM5561	2
METSEPM5562	2
METSEPM5562MC	2
METSEPM5563RD	2
METSEPM5563	2
METSEPM8240	2
METSEPM8243	2
METSEPM8244	2

9.2.1.4 Recommendation

- To be integrate inside a star topology, Power Meter must be equipped with at least of one Ethernet communication port.
- iPMCC recommends to use Ethernet cable CAT.5e S/FTP as minimum for the communication network.

9.2.2 Daisy Chain topology

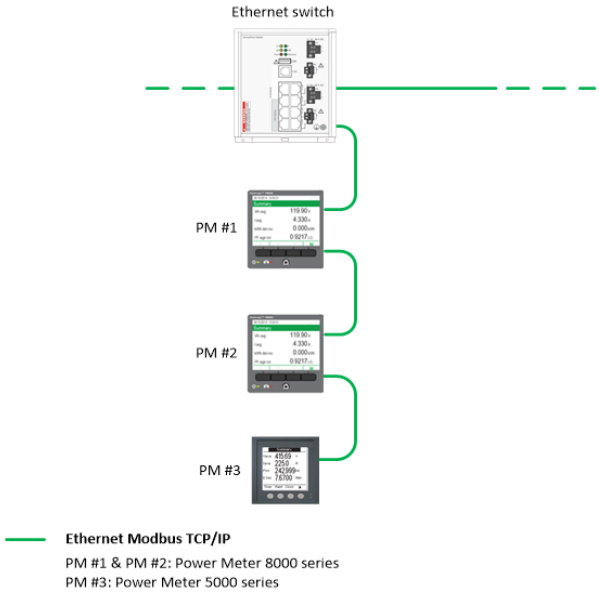
The daisy chain network topology consists in a bus connection between devices.

The Daisy chain network topology choice is implemented as part of a communicating system with dedicated application where redundancy is not required by the customer and where intelligent electronic devices are fix mounted and not intended to be disconnected during a normal operation, as installed inside a drawer for example.

Unlike the star topology and while maintaining the consistency with the overall system dependability approach, this topology could be connected, either to a redundant backbone (Ethernet High Dependability Architecture) or to a “BUS” backbone (Ethernet Competitive Architecture).

9.2.2.1 Daisy chain architecture

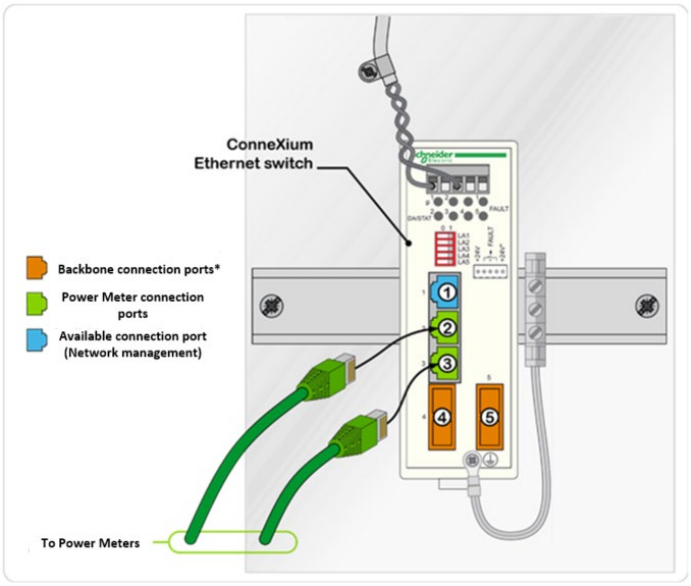
The following illustration gives the overview of the Daisy chain architecture implemented with Power Meter.



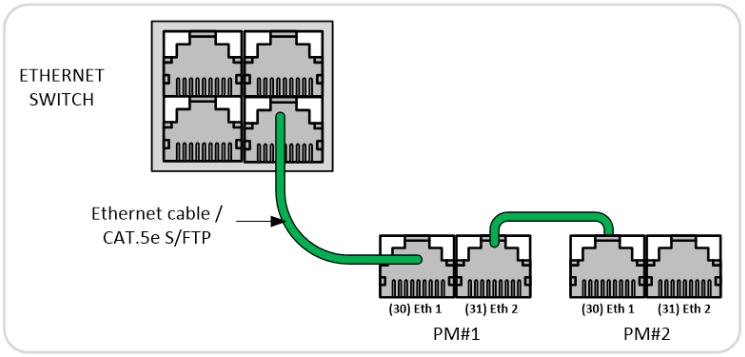
Picture 29: Daisy chain reference architecture

9.2.2.2 Daisy chain network connectivity

The following figures give an example of the network connection at switch level and Power Meters level:



Picture 30: Daisy chain architecture - Ethernet connectivity at switch level



Picture 31: Daisy chain architecture - Ethernet connectivity at Power Meter level

9.2.2.3 Daisy chain compatible devices

The following table gives the reference of compatible devices with daisy chain communication architecture:

Reference	Quantity of Ethernet ports
METSEPM5560	2
METSEPM5561	2
METSEPM5562	2
METSEPM5562MC	2
METSEPM5563RD	2
METSEPM5563	2
METSEPM8240	2
METSEPM8243	2
METSEPM8244	2

9.2.2.4 Recommendation

- To be integrate inside a daisy chain topology, Power Meter must be equipped with two Ethernet communication ports.
- iPMCC recommends to use Ethernet cable CAT.5e S/FTP as minimum for the communication network.
- It's recommended to never install device with one Ethernet communication port at the end of the RS-485 bus.

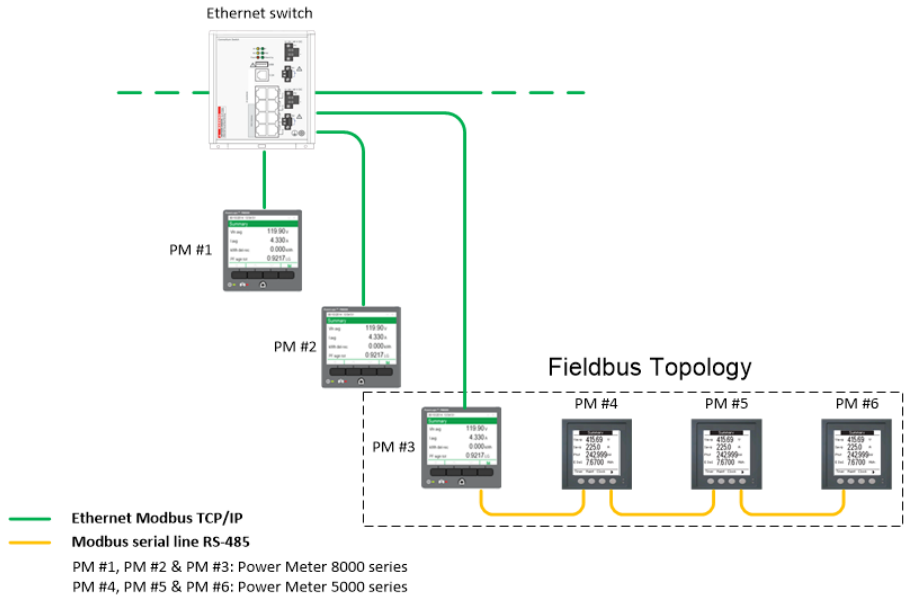
9.2.3 Fieldbus topology

The fieldbus architecture is a "Master - Slave" communication based on Modbus communication protocol (RS485). It's recommended to use Power Meters 8000 series as an Ethernet gateway for this communication architecture.

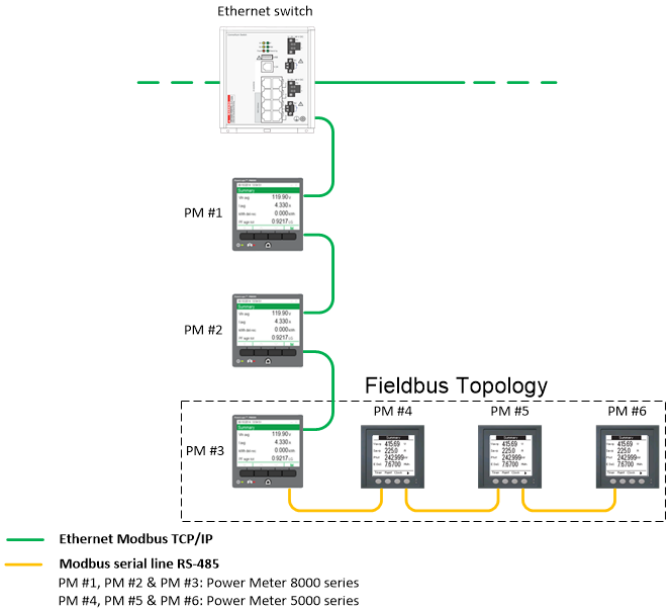
RS485 is an approved and simple communication protocol.

9.2.3.1 Fieldbus architecture

The Field bus topology can be installed inside a star or a daisy chain topology. The following figures detail how to implement that.



Picture 32: Fieldbus topology inside a star architecture



Picture 33: Fieldbus topology inside a daisy chain architecture

9.2.3.2 RS-485 Network connectivity

The current section details how to wire the RS-485 bus of the Power Meter.

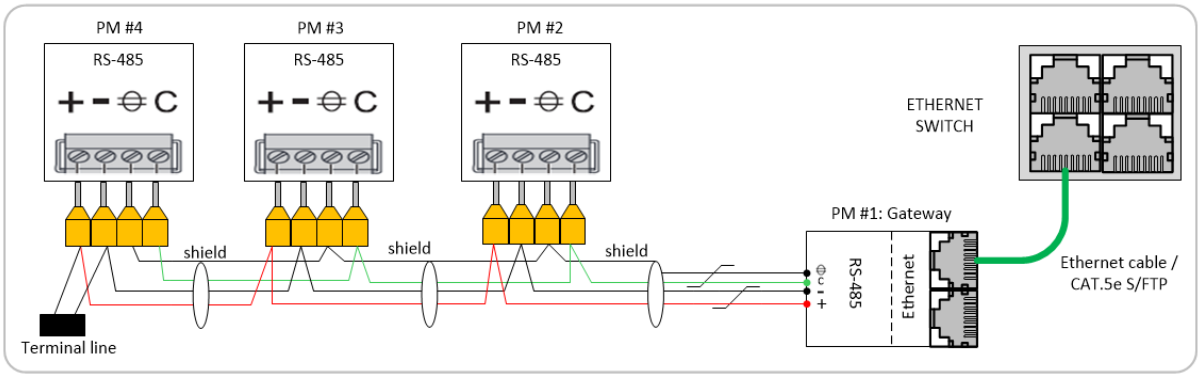
There are Power Meters with 3 and 4 terminals. The difference between the two types is the presence or not of the common terminal. In this paragraph, we will detail how to install all possible configurations, devices with 3 and 4 terminals between them and devices with 3 and 4 terminals together.

- **4-Wire RS-485 wiring**

Connect the devices on the RS-485 bus in a point-to-point configuration, with the (+) and (-) terminals from one device connected to the corresponding (+) and (-) terminals on the next device.

C	Common. This provides the voltage reference (zero volts) for the data plus and data minus signals
⊖	Shield. Connect the bare wire to this terminal to help suppress signal noise that may be present. Ground the shield wiring at one end only (either at the master or the last slave device, but not both.
-	Data minus. This transmits/receives the inverting data signals.
+	Data plus. This transmits/receives the non-inverting data signals.

The figure below details how to wire Meters with 4 terminals between them:

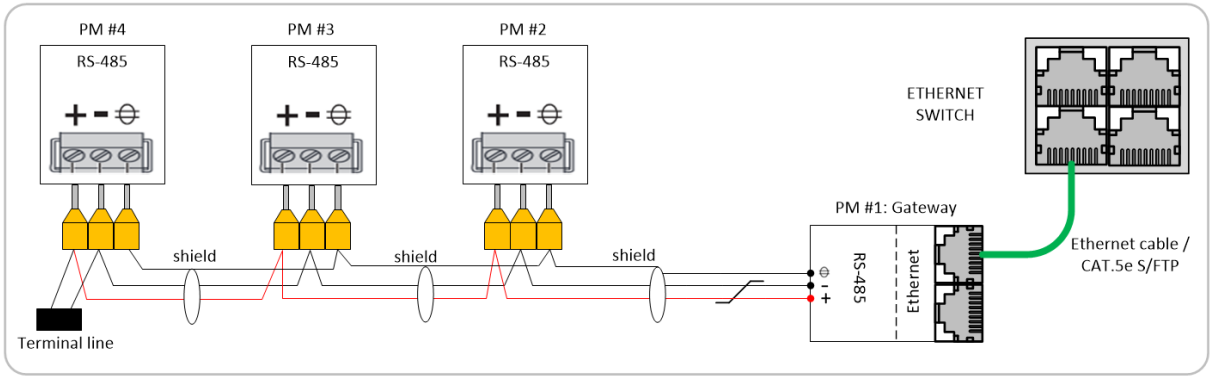


Picture 34: RS-485 implementation between 4-wire devices

- **3-Wire RS-485 wiring**

Refer to 4-Wire RS-485 wiring. The only difference is that devices with 3 terminals don't have the common terminal.

The figure below details how to wire Meters with 3 terminals between them:

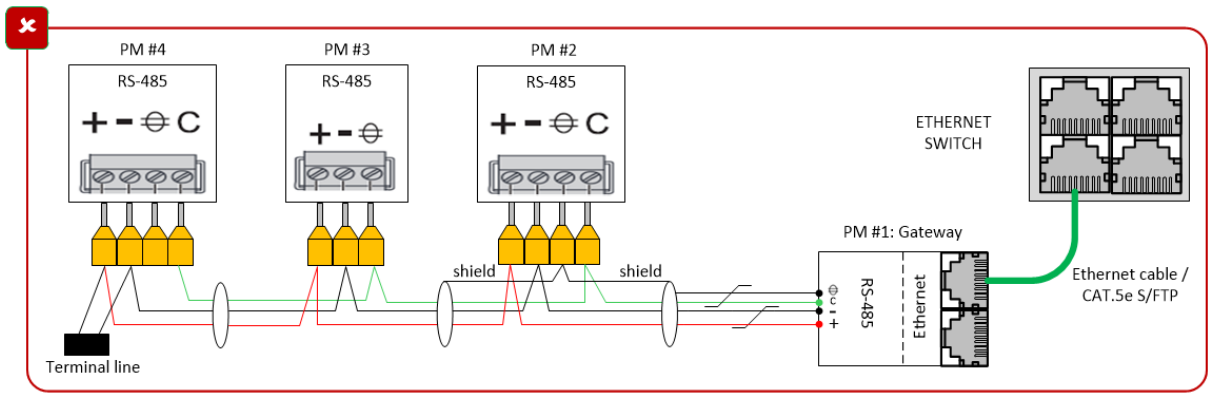


Picture 35: RS-485 implementation between 3-wire devices

- **3 and 4-Wire RS-485 wiring**

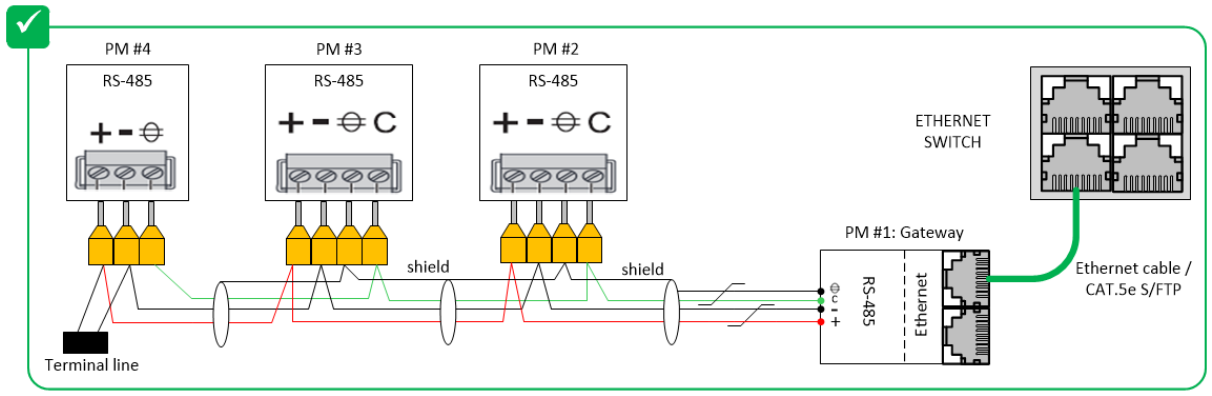
The figure below shows an example of wiring between devices with three and four terminals. We can note that the Power Meter with three terminals (PM #3) is connected between two Power Meters with four terminals (PM #2 & PM #4), what is not the good way to install this kind of architecture because it's recommended to always install devices with three terminals at the end of the installation.

It's not recommend proceeding as the following because, the PM #3 doesn't have a common terminal, so his shield terminal is connected to the common terminal of the PM #2. In doing so, it's no longer possible to properly connect the PM #4 to the RS-485 bus because there are only three wires out.



Picture 36: Wrong RS-485 implementation between 3 and 4-wire devices

The following illustration shows the good way to install devices with three and four terminals together. We can note that the device with three terminals is installed at the end of the installation as recommended.



Picture 37: Recommended RS-485 implementation between 3 and 4-wire devices

9.2.3.3 Gateway

Ethernet gateway is a communications method that allows you to communicate through a gateway device to a serial network.

The table below gives the references of Power Meters 8000 series that can provide the Gateway function:

Reference	Quantity of Ethernet ports	RS-485 port
METSEPM8240	2	1 screwed terminal
METSEPM8243	2	1 screwed terminal
METSEPM8244	2	1 screwed terminal

NOTE:
In this document, it's recommends to use Power Meters 8000 series as an Ethernet gateway but there are some Power Meter 5000 series that can provide the gateway function. Refer to Schneider Electric catalog.

9.2.3.4 Fieldbus compatible devices

The following table gives the references of Power Meters that can be installed inside a field bus topology:

Reference	RS485 port
METSEPM5110	1 screwed terminal
METSEPM5310	1 screwed terminal
METSEPM5330	1 screwed terminal
METSEPM5560	1 screwed terminal
METSEPM5563	1 screwed terminal
METSEPM5350	1 screwed terminal
METSEPM8240	1 screwed terminal
METSEPM8243	1 screwed terminal
METSEPM8244	1 screwed terminal

9.2.3.5 Recommendation

To maximize the performances of such architecture, iPMCC recommends the following limitations:

Rules	iPMCC
Maximum number of devices per bus	8
Bus speed	19.2 Kbps (19200 bauds)
Maximum bus length	1000 m

- Always install Power Meters with 3-Wire at the end of the of the RS-485 bus when there are Power Meters with 4-Wire.
- To install a Fieldbus topology inside a Daisy chain topology, the device gateway must have two ethernet communication ports.

10. SETTING UP POWER METER COMMUNICATIONS

10.1 ETHERNET COMMUNICATION SETUP

To use Ethernet communications, you must configure your device's IP address; you must also configure the subnet and gateway information if required by your network.

NOTE:
For meters that do not have a display, you must configure each one separately in order to set a unique IP address for each device.

You need to enter network information for any Ethernet servers used by the device.

NOTE:
Contact your network system administrator for your IP address and other Ethernet network configuration values.

Configure your device's Ethernet settings by using the display or directly connecting to your meter and using a web browser to access the device's webpages. Modify your meter's Ethernet settings to those provided by your network system administrator before connecting the device to your local area network (LAN).

After the meter's Ethernet port is configured and connected to the LAN, you can use ION Setup to configure other meter setup parameters.

10.1.1 Ethernet port setup

The meter is factory-configured with default Ethernet communications settings. You must modify the default Ethernet settings before connecting the meter to your local area network (LAN) using the meter webpages or the display.

The default Ethernet communications settings are:

- IP address = 169.254.0.10
- Subnet mask = 255.255.0.0
- Gateway = 0.0.0.0
- HTTP server = Enabled
- Device name = PMxx-#xxxxxxxxxx, where xxxxxxxxxx is the meter's factory serial number (with leading zeros if serial number is less than 10 characters)
- IP method = Stored

NOTE:
Your meter's serial communications port ID (Com1 ID) is used in both Ethernet and serial communications; you need to change the Com1 ID meter property in ION Setup if you modify the meter's RS-485 address.

10.1.2 Setting up Ethernet communications using the display

You can configure basic Ethernet communications settings using the display. Obtain your meter's IP address and other network information from your network administrator or IT department before you begin.
You can use the display to select the IP address assignment mode for IPv4 and IPv6, configure stored IPv4 addresses, and view other settings. To configure the Ethernet settings that are not available on the display or are read-only, use the meter's webpages or ION Setup.

1. Go to Setup Menu > Communications Setup.
2. Scroll through the screens until you reach the setting you want to configure then press the edit icon.
3. Select the IPv4 or IPv6 Assignment Mode, if required.

Option	Description
Stored	The meter uses the IP addresses that you manually enter for the IPv4 (address, subnet mask and gateway) and IPv6 (Global address, gateway address).
DHCP / DHCP v6	The meter acquires its IP addresses from your network's DHCP server.

You can have different assignment modes for IPv4 and for IPv6.

If you set the **IPv4 Assignment Mode** to Stored, continue with the remaining steps to configure stored IPv4 addresses. If you are using addresses acquired from a DHCP server, press the down arrow to view the assigned addresses.

4. Go to the **Stored IPv4 Address Setup** screen and press the edit icon.
5. Configure your meter's stored IPv4 Addresses, as required.

Stored IPv4 address settings available using the display

Parameter	Values	Description
IP Address	Contact your local network administrator for parameter values.	Sets the IP address for the meter. Your meter's default IP address is 169.254.0.10
Subnet Mask	Contact your local network administrator for parameter values.	Used if subnetting applies to your network. Your meter's default address is 250.240.0.0
Gateway	Contact your local network administrator for parameter values.	Used if networks with multiple segments. Your meter's default gateway address is 0.0.0.0
MAC Address	Read-only	Your meter's media access control (MAC) address

10.2 RS-485 COMMUNICATION SETUP

Before connecting your device to the RS-485 bus, use the meter's display, webpages or ION Setup to configure your meter's default RS-485 settings.

Your meter has one RS-485 connection.

Your meter must have a unique unit identifier (address) and have the following settings match the rest of devices on the RS-485 bus:

- Protocol
- Baud rate
- Parity and stop bits

You can configure the following settings to help optimize communications performance:

- RTS delay
- RS-485 bias

You can use a communications converter (USB to RS-485 or RS-232 to RS-485) or an Ethernet gateway device to connect to your meter.

You can configure the RS-485 bus settings using ION Setup, the display or the webpage.

10.2.1 Setting up RS-485 using the display

Before configuring serial parameters, make sure you have a unique ID for your meter and know the serial network settings (protocol, baud, rate, parity and stop bits).

1. Go to **Setup Menu > Communications Setup > COM1 Setup**.
2. Configure your meter's serial settings as required.

Serial communication settings

Parameter	Values	Description
Protocol	ION, Modbus RTU, Modbus Master, DNP v3.00, EtherGate, GPS: Truetime/Datum, GPS: Arbiter, GPS: Arbiter-Vorne, Factory, None	Sets the communications protocol for your meter's RS-485 port **NOTE:** the NONE setting stops communications using this port.
Baud Rate	2400, 4800, 9600, 19200, 38400, 57600, 115200	Sets the data rate, in bits per second
Rx Timeout	0 to 1	Sets the transmit delay in seconds
Unit ID	1 to 9999	Sets the meter's unique ID on the RS-485 network **NOTE:** Modbus serial device range 1 to 247
Serial Port	8N1, 8N2, 8E1, 8E2, 8O1, 8O2	Sets the parity and stop bits for the port
RS-485 Bias	Off, On	Turns on biasing when mastering devices over the RS-485 port

11. APPENDICES

11.1 ETHERNET CABLES CATEGORIES DETAILS

11.1.1 Category 3

Category 3 cable, commonly known as Cat 3 or station wire, and less commonly known as VG or Voice-grade (as, for example, in 100BaseVG), is an unshielded twisted pair (UTP) cable used in telephone wiring.
It is part of a family of copper cabling standards defined jointly by the Electronic Industries Alliance and the Telecommunications Industry Association and defined in TIA/EIA-568-B. Although designed to reliably carry data up to 10 Mb/s.

11.1.2 Category 4

Category 4 (Cat 4) is a cable that consists of four unshielded twisted-pair (UTP) copper wires with a data rate of 16 Mb/s and performance of up to 20 MHz.
It is used in telephone networks which can transmit voice and data up to 16 Mb/s.

11.1.3 Category 5 & 5e

Category 5 (cat 5) is a twisted pair cable for carrying signals. This type of cable is used in structured cabling for computer networks such as Ethernet. The cable standard provides performance of up to 100 MHz designed to reliably carry data up to 125 Mb/s and is suitable for 10BASE-T, 100BASE-TX (Fast Ethernet), and 1000BASE-T (Gigabit Ethernet). Cat 5 is also used to carry other signals such as telephony and video.
This cable is commonly connected using punch-down blocks and modular connectors. Most category 5 cables are unshielded, relying on the balanced line twisted pair design and differential signaling for noise rejection
Category 5 vs. 5e:
The category 5e specification improves upon the category 5 specification by tightening some crosstalk specifications and introducing new crosstalk specifications that were not present in the original “category 5” specification. The bandwidth of category 5 and 5e is the same (100 MHz).

11.1.4 Category 6

Category 6 cable, commonly known as Cat 6, is a standardized cable for Gigabit Ethernet and other network physical layers that is backward compatible with the Category 5/5e and Category 3 cable standards. Compared with Cat 5 and Cat 5e, Cat 6 features more stringent specifications for crosstalk and system noise. The cable standard provides performance of up to 250 MHz and is suitable for 10BASE-T, 100BASE-TX (Fast Ethernet), 1000BASE-T/1000BASE-TX (Gigabit Ethernet), and 10GBASE-T (10-Gigabit Ethernet).

The following table makes a sum up of performances for each category of cable:

Detail on Ethernet cables categories									
Category	Length (meters)	Speed (Mb/s) < 10	10	100	(Gb/s) 1	10	Power Over Ethernet	Frequency (MHz)	
Power Meter 5000 and 8000 series compliant?									
Cat-3	100	X						10	x
Cat-4	100	X	X				X	20	x
Cat-5	100	X	X	X			X	100	x

Detail on Ethernet cables categories									
Category	Length (meters)	Speed (Mb/s) < 10	10	100	(Gb/s) 1	10	Power Over Ethernet	Frequency (MHz)	
Power Meter 5000 and 8000 series compliant?									
Cat-5e	100	X	X	X	X		X	100	✅
Cat-6	100	X	X	X	X	X	X	250	✅
Cat-6a	100	X	X	X	X	X	X	500	✅

Table 13: Ethernet cable categories

11.2 OVER VOLTAGE CATEGORIES DETAILS

Example of equipment of overvoltage category

Overvoltage category I

☑ **Equipment of overvoltage category 1 is only suitable for use in the fixed installation of buildings where protective means are applied outside the equipment – to limit transient overvoltage to the specified level.**

Examples of such equipment are those containing electronic circuits like computers, appliances with electronic programs, etc.

Overvoltage category II

☑ **Equipment of overvoltage category 2 is suitable for connection to the fixed electrical installation, providing a normal degree of availability normally required for current-using equipment.**

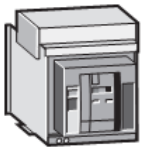
Examples of such equipment are household appliances and similar loads.

Overvoltage category III

☑ **Equipment of overvoltage category 3 is for use in the fixed installation downstream of, and including the main distribution board, providing a high degree of availability.**

Examples of such equipment are distribution boards, circuit-breakers, wiring systems including cables, bus-bars, junction boxes, switches, socket-outlets) in the fixed installation, and equipment for industrial use and some other equipment, e.g. stationary motors with permanent connection to the fixed installation.

Overvoltage category IV



☑ **Equipment of overvoltage category 4 is suitable for use at, or in the proximity of, the origin of the installation, for example upstream of the main distribution board.**

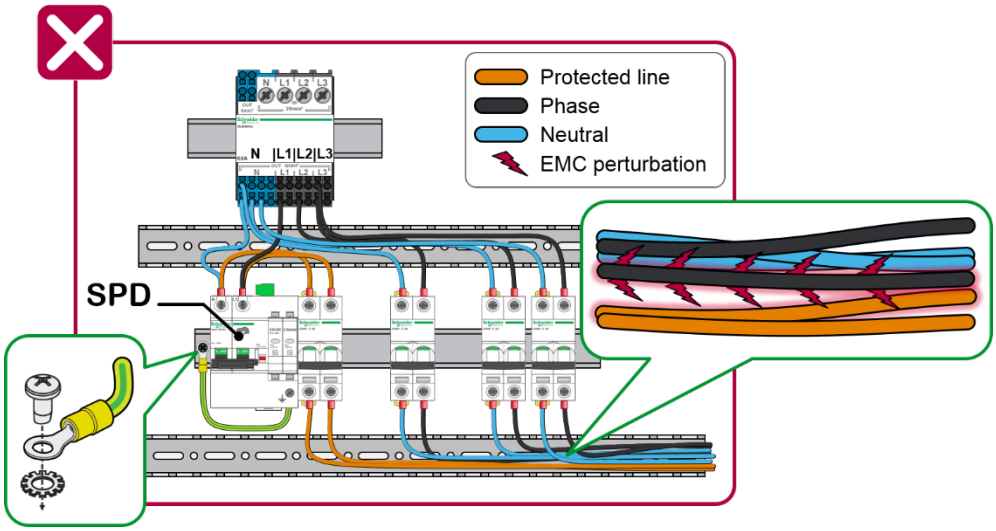
Examples of such equipment are electricity meters, primary over current protection devices and ripple control units.

11.3 WIRING RECOMMENDATION WHEN IMPLEMENTING AN SPD

The layout of the cables is very important and could have a big impact on the effectiveness of the surge protective device.
To give you a better understanding of the impact that cable layout could have on the robustness of the system, the two following illustrations will be based on the same architecture and on the same physical integration of devices:

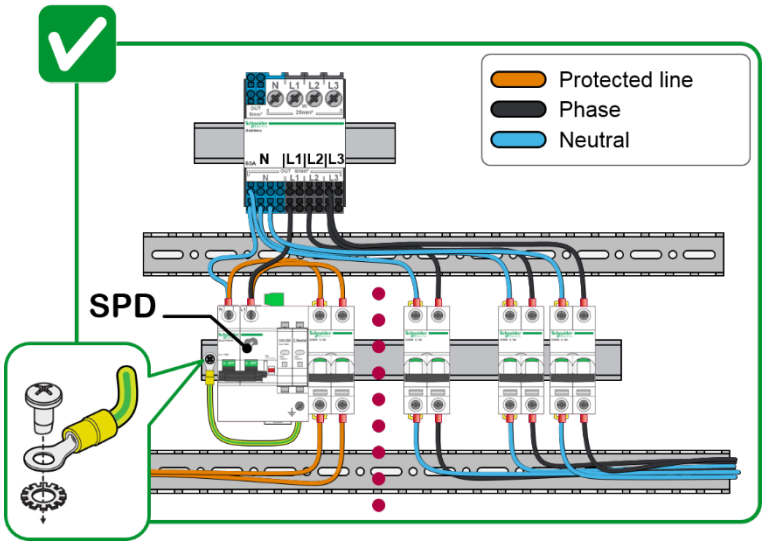
- One distribution bloc
- One SPD
- Four circuit breakers

☑ **The aim of the SPD is to protect a phase against overvoltage or other EMC phenomena.**
See below the "wrong" cable layout:



Picture 38: Wrong SPD implementation

In this example, if a surge occurs on the line upstream the distribution bloc, because the cables are rooted in parallel in the same electrical trunking; the protected line will be polluted by the other lines, due to electromagnetic coupling.
Therefore, the device that is supposed to be protected by the surge protective device will be disturbed and its operation could be drastically impacted or even a destruction of the device could occur.
In that case, the implementation of the surge protective device is not effective at all.
The following picture gives an example of a recommended implementation:



Picture 39: Recommended SPD implementation

Protected lines (in green) and other lines are not routed in parallel. There is no more EMC coupling between polluted lines and protected lines in case of overvoltage on the network.

This is a robust and efficient surge protective device implementation.

- **Never route** the lines protected by an SPD in parallel of polluted (non-protected) lines
- **Never route** the cables as loops can be created

11.4 POWER METER 5000 SERIES FEATURES

	PM5100		PM5300						PM5500	
Features and options	**PM5100**	**PM5110**	**PM5310**	**PM5310R**	**PM5320**	**PM5320R**	**PM5330**	**PM5340**	**PM5560**	**PM5563**
Installation										
Fast panel mount with integrated display	■	■	■	■	■	■	■	■	■	–
Fast installation, DIN rail mountable	–	–	–	■	–	■	–	–	–	■
Quick Click enabled	–	–	–	■	–	■	–	–	–	–
Accuracy	Cl 0.5S	Cl 0.5S	Cl 0.5S		Cl 0.5S		Cl 0.5S	Cl 0.5S	Cl 0.2S	Cl 0.2S
Display										
Backlit LCD, multilingual, bar graphs, 6 lines, 4 concurrent values	■	■	■	■	■	■	■	■	■	–
Remote display (optional)	–	–	–	■	–	■	–	–	–	■
Power and energy metering										
Three-phase voltage, current, power, demand, energy, frequency, power factor	■	■	■	■	■	■	■	■	■	■
Multitariff	–	–	4	4	4	4	4	4	8	8
Power quality analysis										
THD, thd, TDD	■	■	■	■	■	■	■	■	■	■
Harmonics, individual (odd) up to	15th	15th	31st	31st	31st	31st	31st	31st	63rd	63rd
I/Os and relays										
I/Os	1DO	1DO	2DI/2DO	2DI/2DO	2DI/2DO	2DI/2DO	2DI/2DO	2DI/2DO	4DI/2DO	4DI/2DO
Relays	0	0	0	0	0	0	2	2	0	0
Alarms and control										
Alarms	33	33	35	35	35	35	35	35	52	52
Set point response time, seconds	1	1	1	1	1	1	1	1	1	1
Single and multicondition alarms	–	–	■	■	■	■	■	■	■	■
Boolean alarm logic	–	–	–		–		–	–	■	■
Communications										
Serial ports with modbus protocol	–	1	1	–	–	–	1	–	1	1
Ethernet port with modbus TCP protocol	–	–	–	–	1	1	–	1	2*	2*
Ethernet port with BACnet/IP Protocol*	–	–	–	–	1	1	–	1	2*	2*
Ethernet-to-serial gateway	–	–	–	–	–	–	–	–	■	■
Onboard Web server with Web pages	–	–	–	–	–	–	–	–	■	■
MID ready compliance, EN50470-1/3, Annex B and Annex D Class C		PM5111					PM5331	PM5341	PM5561	

* Ability to simultaneous communicate via Modbus TCP/IP and BACnet/IP

** 2 Ethernet ports for daisy chain, one IP address

Compliance with international standards:

- 62053-22 Class 0.5S/Class 0.2S
- ANSI C12.20 Class 0.2 (PM5500 models)
- IEC 61557-12 PMD/S/K70/0.5 (PM5100 & PM5300 models)
- IEC 61557-12 PMD/S/K70/0.2 (PM5500 models)
- IEC 62053-23
- IEC 62052-11
- MID, EN50470-1/3, Annex B & Annex D
- CE as per IEC 61010-1 Ed.3
- cULus as per UL 61010-1 Ed.3

11.5 POWER METER 8000 SERIES FEATURES

Intermediate meter		
General		
Use on LV and MV systems		■
Current accuracy (5 A Nominal)		0.1% reading
Voltage accuracy (57 V LN/100 V LL to 400 V LN/690 V LL)		0.1% reading
Active energy accuracy		0.2%
Number of samples/cycle or sample frequency		256
Instantaneous rms values		
Current, voltage, frequency		■
Active, reactive, apparent power	Total and per phase	■
Power factor	Total and per phase	■
Current measurement range (autoranging)		0.05 – 10 A
Energy values		
Active, reactive, apparent energy		■
Settable accumulation modes		■
Demand values		
Current	Present and max values	■
Active, reactive, apparent power	Present and max values	■
Predicted active, reactive, apparent power		■
Synchronisation of the measurement window		■
Setting of calculation mode	Block, sliding	■
Power quality measurements		
Harmonic distortion	Current and voltage	■
Individual harmonics	Via front panel and Web page	63
	Via StruxureWare software	127
Waveform capture		■
Detection of voltage swells and sags		■
Fast acquisition	1/2 cycle data	■
EN 50160 compliance checking		■
Customisable data outputs (using logic and math functions)		■
Data recording		
Min/max of instantaneous values		■
Data logs		■
Event logs		■
Trending/forecasting		■
SER (Sequence of event recording)		■
Time stamping		■
GPS synchronisation (+/- 1 ms)		■
Memory (in Mbytes)		512
Display and I/O		
Front panel display		■
Wiring self-test		■
Pulse output		1
Digital or analog inputs (max)		27 digital 16 analog
Digital or analog outputs (max, including pulse output)		1 digital 8 relay 8 analog
Communication		
RS 485 port		1
Ethernet ports		2
Serial port (modbus, ION, DNP3)		■
Ethernet port (modbus/TCP, ION TCP, DNP3 TCP, IEC 61850)		■
Ethernet gateway		■
Alarm notification via email		■
HTTP Web server		■
SNMP with custom MIB and traps for alarms		■
SMTP email		■
NTP time synchronisation		■
FTP file transfer		■

- Four metered-current inputs allow direct measurement of three-phase currents and neutral current for enhanced view of harmonics
- Modular, field-installable I/O architecture for Scalability
- Dual Ethernet ports support daisy chaining, removing the need for an Ethernet switch inside power equipment, while redundant ring topology provides enhanced availability

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