

Specification for a communicating Panelboard system to monitor, control and maintain LV electrical installations

A system for:

- Monitoring the protection and control devices in an electrical installation and providing the Building Management System (BMS) with information on their status.
- Transmitting orders from the BMS to the switchboard control devices
- Metering and transmitting electrical installation power consumption data to the BMS

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1. General recommendations:

Communicating low voltage switchboards are a response to regulatory incentives and the need to control power consumption and energy costs

They also improve continuity of service by increasing the availability of power.

The installation switchboard shall therefore be equipped with a communicating system that makes it possible to:

- monitor modular protection and control units and provide the centralized management system (PLC, supervisor, management software, etc.) with information on their status.

- transmit orders from the centralized system to the switchboard control units

- meter and transmit installation power consumption data to the centralized system

2. Applicable standards:

Number	Title	Use
IEC/EN – 61131-2	Programmable controllers - Equipment requirements and tests	Define Input and Output signal characteristics
IEC/EN – 60947-5-1 Part 5-1	Control circuit devices and switching elements – Electromechanical control circuit devices	Performance and tests of auxiliary contacts
IEC 60947-5-4	Control circuit devices and switching elements – Method of assessing the performance of low-energy contacts	Performances of low energy auxiliary contacts
IEC/EN 61439-1 & 2	Low-voltage switchgear and controlgear assemblies	Performance of the electrical assembly
IEC/ EN – 60664-1	Insulation coordination	Characteristics of devices for insulation
IEC/EN – 62053-21 & 31	Meter standard	Pulse metering

3. Characteristics, operating principle and indications:

3.1 General characteristics

The communicating Panelboard system system comprises:

- One or more communicating data concentrators
 - using an open protocol such as Modbus RS485 serial line or Modbus TCP/IP
 - Gathering digital and analog inputs and controlling output
 - whose inputs / outputs are organized by channel, with each channel used to connect one electrical device
 - compliant with the IEC/EN – 61131-2 standard
 - supplied by safety extra low voltage <= 24 V DC
- Indication auxiliaries that signal modular circuit breaker open/closed and tripped status
 - compliant with the IEC/EN 60947-5-4 standard
 - output voltage 24 V DC
- Auxiliaries for control and indication of open/closed status of breakers or control units (contactors and impulse relays) in accordance with the IEC/EN 60947-5-1 standard
 - Output voltages 24 V DC and 230 V AC
- Energy meter in accordance with the IEC/EN – 62053-21 & 31 standard
- Connection cables between the data concentrator and the devices or auxiliaries equipped with **plug-in** connectors

The system shall allow the connection of monitoring and control units equipped with 24 V DC contacts.

The system will integrate a switchboard display unit which will be connected via the Ethernet TCP / IP network to the interfaces of communicating switchboard.

The switchboard display unit will offer a direct and real-time access of display, simple control of load and device.

The switchboard display unit will integrate functions of display :

- data of energy consumption
- Followed electric values for the monitoring of the installations
- alarms and events
- Followed from the qualitative value of the energy
- state / status of equipments, opened, closed, activated, typical of release
- Followed from the operation data and from predictive maintenance.

The switchboard display unit will integrate functions of simple control of load and device via logic outputs, orders of actuator.

3.2 Measure

3.3.1 – Incomer over 125A / Molded Case circuit breaker

Measure units shall offer measurement without additional module to circuit breakers. Measures shall be either:

- Currents (Phases, Neutral, average, max), voltage, power, Energy, Total Voltage Harmonic distortion, Total current harmonic distortion.
- Accuracies of the entire measurement system, including the sensors shall be :
 - Current: Class 1 as per IEC 61557-12
 - Voltage: 0.5 %
 - Power and energy: Class 2 as per IEC 61557-12
- Rogowski current transformers shall be used to ensure accurate measurements from low current up to high currents
- For safety reason, protection functions shall be electronically managed independently of measurement function by a dedicated ASIC.
- The measurements shall be displayed on the breaker itself and on a remote system via Ethernet or Modbus communication. In addition to these solutions it shall be possible to connect a remote display.

3.2.1 – Incomer under 125A

Energy metering counter should be or offer

- direct measure up to 125A without external current transformer,
- 1P+N, 3P, 3P+N LV network monitoring
- DC power self supply without external DC power supply
- equipped with LCD display.
- Measurement features:
 - Active Energy (kWh) total counter
 - Active Energy (kWh) part-time counter with reset
 - Active Energy (kWh) per time step
 - Reactive Energy (kVARh) total counter of consumption
 - Reactive Energy (kVARh) part-time counter with reset
 - Average voltage (V)
 - Current per phase (A)
 - Total active power (W)
 - Total reactive power (VAR)
 - Total apparent power (VA)
 - Total Power factor
 - Frequency (Hz)
 - Time of functioning (Hours)
- The energy meter will have to allow the counting up to 4 price rates thanks to an internal clock, or 2 price rates thanks to a logic input.

- The energy meter must be equipped with a port bearing of communication Modbus RS485. The smooth running of the communication Modbus can be visible thanks to a twinkling LED.
- The border of connecting of the bus of communication Modbus will be constituted by 4 borders:
 - 2 borders for Modbus RS485 2 wires
 - 1 border for 0V (mass for long outstrip of bus)
 - 1 border for the plait of earth(ground) (for electromagnetic compatibility - CEM)
- The energy meter must be equipped with a customizable output contact to make of the extension display(transfer) of consumption of active Energy or for the extension display(transfer) of alarm (customizable threshold)

3.2.2 – modular Feeder

Energy metering counter should be or offer

- direct measure up to 125A without external current transformer,
- 1P+N, 3P, 3P+N LV network monitoring
- DC power self supply without external DC power supply
- Equipped with LCD display.
- Measurement features:
 - Active Energy (kWh) total counter
 - Active Energy (kWh) part-time counter with reset
- Equipped with setting pulse output to communicate Active energy consumption

Product measurement capability shall offer:

- To communicate indication of
 - Fault types (LT, ST, instantaneous, ground fault), Interrupted current.
 - Status of circuit breaker operations: Open/Close/Tripped/NA
 -
- Ti24 direct device connexion with pre-connectorize patchcords (100 to 860 mm)

3.3 Operating and installation principles

3.3.1 – Positioning, installation and connection of communicating data concentrators

When the application requires the usage of several data concentrators:

- The data concentrator enabling communication with the monitoring system (outside the switchboard) could be using a Modbus TCP/IP
- The others data concentrators inside the switchboard shall be using Modbus RS485 SL
- The different data concentrators shall be interconnected by Modbus RS485 SL chaining, inside the switchboard
- The data concentrators shall be positioned for quick viewing of connections with the monitoring and control devices
- They shall be capable of being installed between the rows of modular devices, without taking up any additional space on the DIN rails
- The data concentrators shall be equipped with plug-in type input/output terminal blocks
- The concentrators / devices links shall preferably be of the prefabricated type with connectors that allow the concentrator to be connected to the devices in a single operation and with no risk of error
- The data concentrators may be mounted on the power distribution blocks so as to optimise the combined installation of power distribution and monitoring.

3.3.2 – Operation of the communicating system

- The data concentrators shall be capable of being easily integrated into the installation's communication network thanks to automatic adaptation of their communication parameters to match those of the network
- They shall provide data to the supervisor in Modbus tables, at fixed addresses that require no configuration
- The data shall be of the following type:
 - position of inputs/outputs or

- calculated values: number of switching operations of downstream devices, load operating time, pulse metering with conversion to significant values
- The concentrators shall be capable of receiving from the supervisor, by writing in the Modbus table at fixed addresses requiring no configuration, “open / close” type orders (0 or 1) applicable on each channel
- They shall be capable of having the orders executed by the control devices, after having taken into account the devices’ real positions
- The auxiliaries for control and indication of the open/closed status of control units (contactors and impulse relays) shall be capable of processing both 24 V DC and 230 V AC controls and of managing priorities between 24 V DC and 230 V AC.
- The Modbus TCP/IP data concentrator should enable to monitor and control auxiliaries and devices using integrated web page
- The Modbus TCP/IP data concentrator should enable to monitor analog sensors

3.3.3 – Testing of the system in the switchboard

The manufacturer shall supply a (software) tool for overall testing of the system, within the limits of the switchboard: the entire data transmission and control chain between the modular devices and all of the concentrators, including communication.

The test tool shall supply a report that includes the list of all the devices connected to each channel of the data concentrators as well as a diagram describing the configuration of the system with indication of the associated Modbus addresses.

4. Operation and maintenance

- The communicating data concentrators shall store all of the calculated values, including in the event of a 24 V DC power failure.
- They shall be replaceable without requiring any reconfiguration other than that related to the meters
- The system shall be capable of taking into account new modular devices added to the installation without requiring any reconfiguration of the data concentrator.

5. Sustainable development

Production site organization shall comply with the requirements of the ISO 9002 and ISO 14001 standards.

For the devices, the manufacturer should be able to provide following arguments:

- Hazardous substances content (RoHS conformity declaration & REACH assessment referring to last update of SVHC candidate list).
- Environmental impacts characterized by several indicators (through Life Cycle Analysis & Product Environmental Profile) with at least:
 - Raw material depletion
 - Energy depletion
 - Global warming / carbon footprint
 - Water depletion
 - Recyclability information (Product Environmental Profile / End of Life Instruction).

The devices shall be delivered in packaging compliant with European Directive 2004/12/CE.