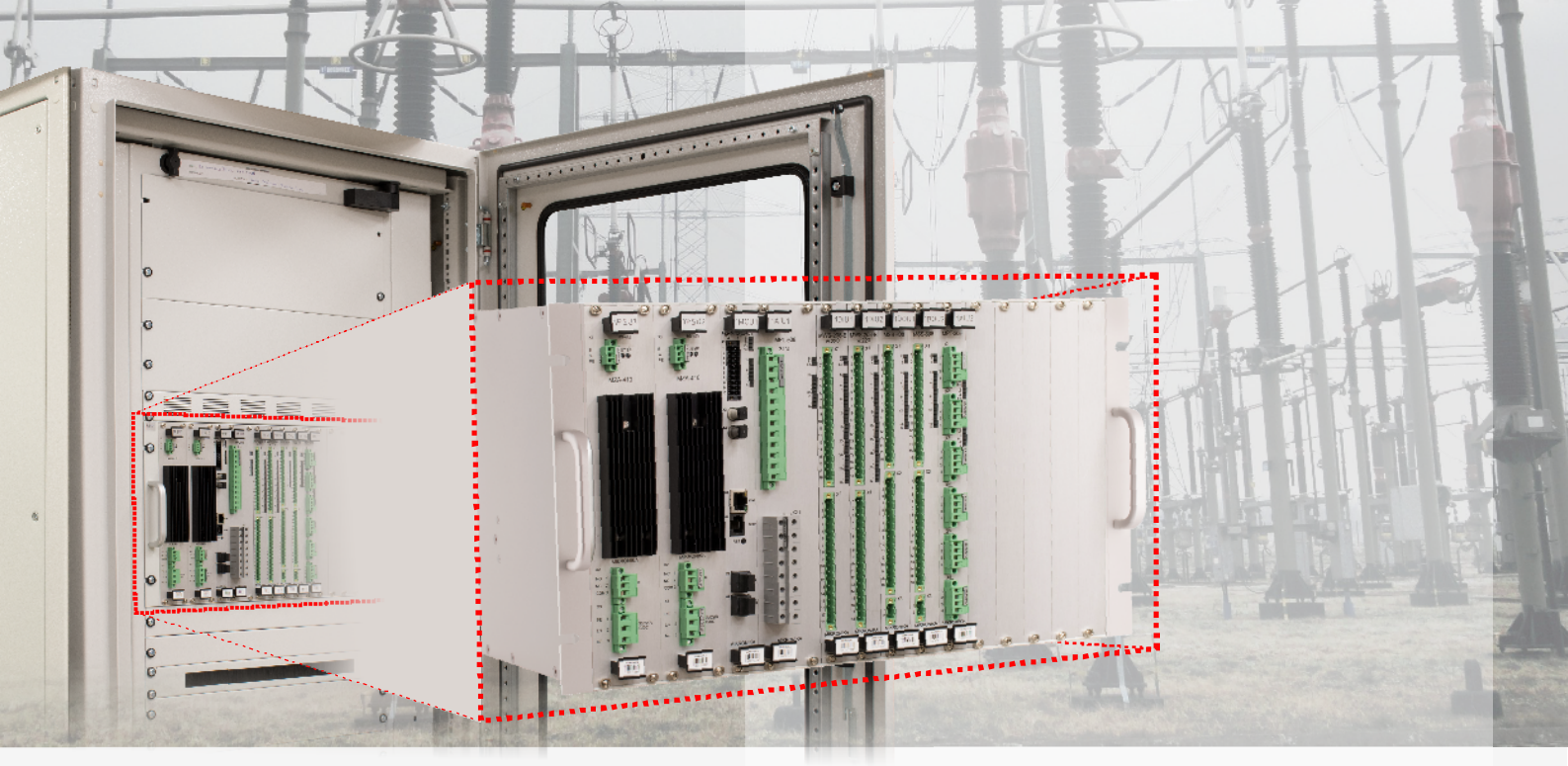

SO-52v11

bay controller family

SO-52v11 bay controller family performs telemetry and automation functions in bays of any voltage level in power substations. It also controls technological processes in industry automation. It implements cybersecurity mechanisms to protect communications, remote and local access, and sensitive data.

In substation bays the controllers supervise and control the breakers, isolators, earth switches and perform accurate measurements of currents, voltages, phases, powers and energies. The controllers operate automation functions of interlocking, control sequences, auto re-closing, synchrocheck, based on indications and variables received from other bays.

The controllers are linked to the supervision system by fiber optic channels, Ethernet 10/100Base TP/FX or RS-485, RS-232, CAN optionally. The devices can be equipped with wireless radio- transmission or GSM/GPRS module. Additional serial channels can be implemented for co-operation with protection devices or other IED devices. The communication channels feature various standardized or specific protocols, eg. DNP 3.0, PN-EN 61850, PN-EN 60870-5-101, -103, -104.

The controller has a modular structure. The controllers are housed in the ruggedized rack or panel type enclosure containing a redundant power supply module, binary input modules, analog inputs, controls, measure and communication modules. The modules quantity, type and configuration is composed according to application.

All engineering service can be performed remotely by means of Ethernet or other available communication channels. The controllers can be operated locally by an operating terminal with indicating panel integrated into enclosure or installed separately.

The SO-52v11 bay control family are not only an answer to the issue of responsible telemetry and automation in substation bays of all voltage levels and industry technological processes. The SO-52v11 family offers also advanced functions of disturbance recording and power quality assessment.

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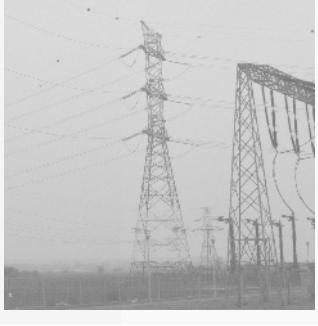
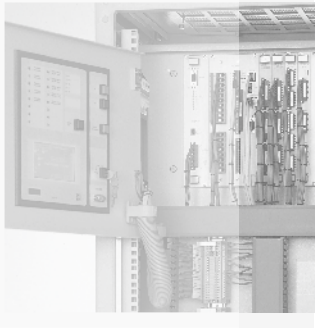




Features

- multichannel and multiprotocol transmission
  - DNP3.0; PN-EN 60870-5-101/104 MASTER/SLAVE mode
  - PN-EN 61850 full compatibility
  - PN-EN 60870-5-103 in MASTER mode
- centralised or distributed interlocking implementation
- cyber security
- communication protection, access control
- tools to edit the logic of control sequences and automation
- automatyki i logiki tworzone wg PN-EN 61131
- event log stored in non-volatile memory
- one bit/two bit BCD code input definition
- TCP 1566 synchronization protocol
- SNTP/NTP client/server
- time synchronization and events timing
  - GPS interface; 1 µs resolution
  - transmission protocol synchronization; 1ms resolution
- time stamping of events - resolution 1 ms

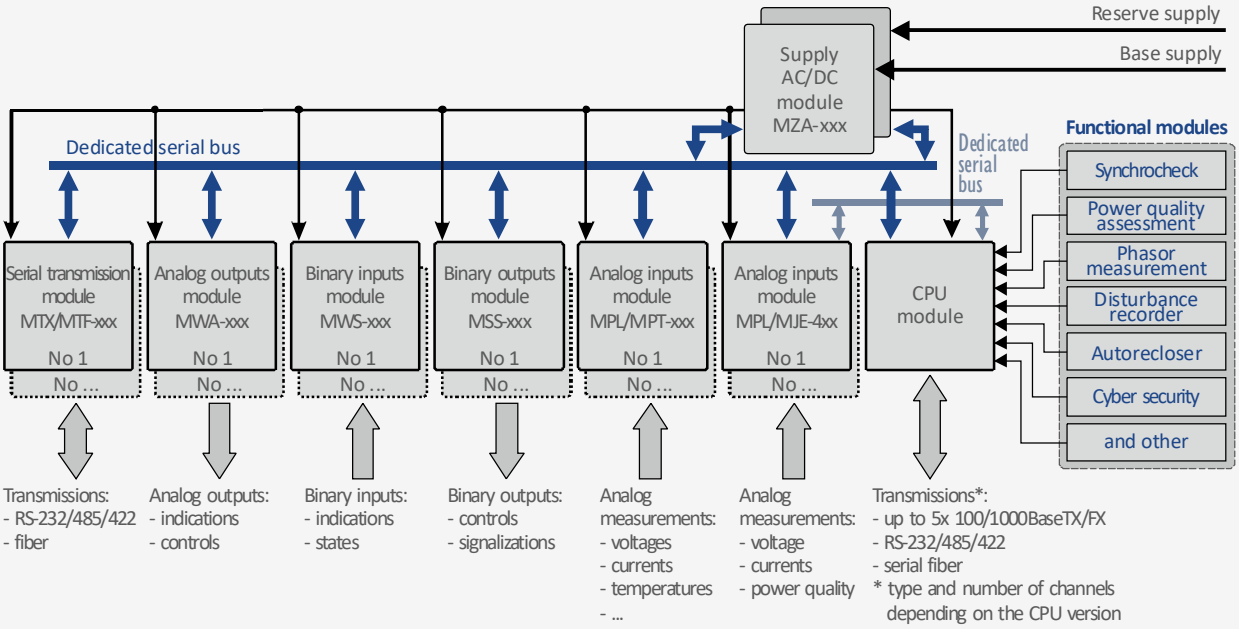
Functional modules

The controller can be equipped with the following functionalities by installing appropriate hardware and software modules, some of them may require additional hardware modules.

- synchrocheck
- fault locator
- power quality assessment
- phasor measurement
- disturbance recorder
- autorecloser
- transformer cooling controller

Modular structure

The construction of the SO-52v11 controllers family is based on the modular architecture. The set of pluggable modules is selected to perform the required functionality. Standard and specialized features are parametrized by pConfig configuration tool.

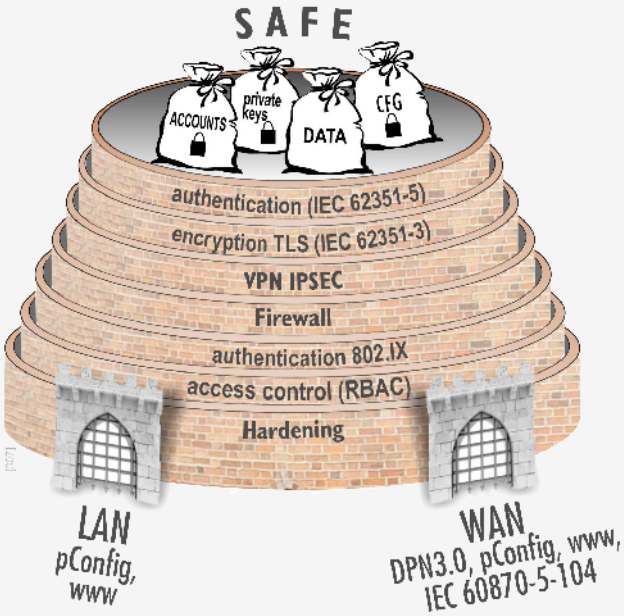


Transmission

- up to five multimode/single mode Ethernet 10/100/1000 Base TX/FX; protocols TCP/IP, PPP, UDP
- avalable option:
  - wireless 430MHz or 860MHz, dedicated band or GSM/GPRS
- serial async. transmission channels; isolated RS-485, CAN or RS-232, optical fiber: multimode POF 1mm or 62.5/125µm; 50/125µm or single-mode 9/125µm

Cyber security

Solutions based on ENISA, NIST, BDEW, BlueCrypt recomendations. The implementation of security mechanisms is compliant with PN-EN 62351, IEEE P1686, PN-ISO/IEC 27001, BDEW White Paper „Requirement for Secure Control and Telecommunication Systems".



Communication protection

- Firewall – network traffic filtering on all network interfaces
- hardening - unused accounts, services, interfaces, software modules are removed
- „Low-level incoming traffic limiter”- traffic in Ethernet ports is blocked when the limit of the number of packets per unit of time is exceeded
- tunneling - it is possible to set up several IPsec VPN tunnels with layer 3 encryption with PSK keys or X.509, IKEv2, AES256, SHA-2 certificates
- the user can change keys and certificates using the pConfig configuration software, the DM configuration server, and automatically using the SCEP protocol
- certificate validation - using the OCSP protocol
- authentication of critical operations, e.g. control commands, in accordance with PN-EN 62351-5

Access control

Remote and local access to the controller is possible only after a correct authentication of the user. The account database is based on the RBAC access control mechanism (Role Based Access Control) according to the PN-EN 62351-8 standard. Defined roles have appropriate permissions assigned.

Communication between the controller and the pConfig configuration program is encrypted using the TLS 1.2 or higher protocol. Access to the controller may be also realized with the application of central authentication RADIUS / TACACS+/LDAP.

Sensitive data protection

This type of data is TLS, IPsec, HTTPS private keys, database of users and passwords, keys used to authenticate communication in DNP3.0, PN-EN 60870-5-104, some configuration files. To store this data, so-called. "safe" - a dedicated, encrypted space in the controller's memory.

User activity monitoring/logging

The following management and security events are recorded in system logs. These logs can be sent to a remote server in the SysLog protocol.

- correct/incorrect user logging
- manual/automatic logout
- change/enforcing measurement values or states
- changing/downloading a new configuration
- firmware update
- adding, removing, changing roles and accounts
- viewing logs
- changing date and time
- control operations
- restarting
- ”replay attack” monitoring

Technical data

Enclosure	6U/19" - type	Binary inputs	24/48/110/220V DC; 230V AC
Voltage measurements	0÷57,7/100 up to /220V AC	Binary outputs	0,15/0,25A/5A for 220V DC* or AC
Current measurements	1A or 5A (2A **)	Analog outputs	0÷20mA, ±20mA, ±10V
Overvoltage	2x nominal range	Internal recorder	4GB
Overvoltages recording	Unw ≤ 500V	Transmission channels	RS-485, RS-232, fiber
Overvoltages measurements	sarge type 1,25µs/50µs	Network connections	100Base-FX, 100Base-TX
Current overloading	4x In, continously; 25x In for 1s	Modem	GSM/GPRS (opcjonalnie)
	2,5x Io (1s) for 10 ms (peak)	„Transient" measurement	up to 24 inputs

*- 6.3A option available for 220V DC, L/R ≤ 40ms; **- option available, e.g. for tap changer current measurements

Basic and reserve supply

Basic supply voltage Up	230/220V AC/DC or 110/48/24V DC
Reserve supply voltage Ur	230/220V AC/DC or 110/48/24V DC or battery 24V DC
Range of acceptable fluctuations for Ur and Up	class AC3/DC3 (-20 to +15 %)
Power consumption	40VA (power consumption depends on the number and type of modules)

Electromagnetic compatibility

PARAMETER	STANDARD	TEST LEVEL
Electrostatic discharges (ESD)	PN-EN 61000-4-2 level 4	15kV - air, 8kV - contact, class A
Resistance to electromagnetic field	PN-EN 61000-4-3 level 4	10V/m 80MHz, 80MHz 1GHz 80%, class A
Surge resistance 1,2/50 - 8/20µs	PN-EN 61000-4-4 level 4	4.0 kVp
Resistance to wire disturbances	PN-EN 61000-4-5 level 4	class A
Resistance to fast transient states	PN-EN 61000-4-6 level 4	±4.0 kV, class A
Resistance to magnetic field	PN-EN 61000-4-8	class A
Voltage dips	PN-EN 61000-4-11	60% for t=1s, class A
Interrupts in voltage	PN-EN 61000-4-11	100% for t=1s, class B
Electromagnetic emission	PN-EN 61000-6-4	30MHz ≤ f ≤ 1GHz, class B

Dielectric strength

PARAMETER	STANDARD	TEST LEVEL
Galvanic isolation	PN-EN 60870-2-1 class VW3	2.5kV/1min/RMS (for power supply and HV* I/O)
	PN-EN 60870-2-1 class VW2	1kV/1min/RMS (for LV** I/O)
Voltage surge	PN-EN 60870-2-1 class VW3	5kV/1.2/50µs (for power supply and HV* I/O)
	PN-EN 60870-2-1 class VW2	2kV/1.2/50µs (for LV** I/O)

where: *HV I/O - high voltage inputs/outputs
**LV I/O - low voltage inputs/outputs

Operation and storage

PARAMETER	STANDARD	TEST LEVEL
Operation temperature: -5°C do 55°C*	PN-EN 60870-2-2 class C1	(-5°C ÷ 55°C), 96-hour test
Protection against water and dust permeating	PN-EN 60529:2006	IP50 - standard
Humidity	PN-EN 60870-2-2 class Cm	10 ÷ 95 %
Vibrations	PN-EN 60870-2-2 class Cm	half-sine duration 11 [ms] max. acceleration 300 [m/s^2]

* - for type „B" construction: -25°C to 70°C

CPU modules

Central processo unit module PJC-86x-xx/PJC-9xx-x/MPA-408-xx

FEATURES	PJC-863-xx	PJC-865-xx	PJC-901-1	PJC-901-2	PJC-911-1	PJC-911-2	MPA-408-xx
Number of add. chanels ETH	3	5	3	5	3	5	to 5
Type of Ethernet channels	100TX/FX/MM	100TX/FX/MM	SFP modules	SFP modules	SFP modules	SFP modules	100TX/FX/MM
USB 2.0	No	No	Yes	Yes	Yes	Yes	No
DSP processor	No	No	No	No	Yes	Yes	Yes
RS-485/RS-232 channels	2/2	2/2	1/univ.	1/univ.	1/univ.	1/univ.	2/2
Service RS-232 channels	1	1	1(USB)	1(USB)	1(USB)	1(USB)	1
Add. bus on Y connector	No	No	Yes	Yes	Yes	Yes	No

where: MM - multimode fiber; single-mode fiber (SM) available as an option;
RS-univ. = RS-232/485/422 programmable

Functionality

The module functions as a central unit. It performs tasks related to data collection, information processing and communication.

Serial transmission modules

PTS-xxx serial fiber optic transmission module - for cooperation with PJC-86x-xx

FEATURES	PTS-514	PTS-518	PTS-524	PTS-528	PTS-812	PTS-814
type of optical fiber	multimode	multimode	multimode	multimode	single-mode	single-mode
fibre type	POF 1mm	POF 1mm	62.5/125µm*	62.5/125µm*	9/125µm*	9/125µm*
connector type	VLF*	VLF*	ST	ST	ST	ST
number of channels	4	8	4	8	2	4

where: * glass fibre opics
** VLF - Versatile Link Family HP for 1mm POF plastic fiber

PTS-xxx serial wired transmission module - for cooperation with PJC-86x-xx

FEATURES	PTS-604	PTS-608	PTS-656	PTS-724	PTS-728	PTS-758	PTS-918
transmission type	RS-232	RS-232	full RS-232	RS-485	RS-485	RS-232/485	RS-232/485
connector type	clamp*	clamp*	D-SUB	clamp*	clamp*	D-SUB	clamp*
number of channels	4	8	6	4	8	8(4/4)**	8***

where: * WAGO clamp connectors, type: socket 734-265, plug 734-205
** four RS-232 transmission channels and four RS-485 transmission channels
*** programmable transmission mode RS-232 or RS-485

Serial transmission module PTX-0xx/PTF-0xx - for cooperation with PJC-9xx-x

FEATURES	PTX-004	PTX-008	PTF-004	PTF-008	PTF-014	PTF-018
transmission type	RS-232/485	RS-232/485	fiber optic	fiber optic	fiber optic	fiber optic
type of optical fiber	-	-	multimode	multimode	multimode	multimode
fibre type	-	-	62.5/125µm	62.5/125µm	POF 1mm	POF 1mm
connector type	clamp*	clamp*	ST	ST	VLF	VLF
number of channels	4	8	4	8	4	8

where: * WAGO clamp connectors, type: socket 734-265, plug 734-205

Serial transmission module MTX-0xx/MTF-0xx - for cooperation with MPA-408-xx

FEATURES	MTX-004	MTX-008	MTF-004	MTF-008	MTF-014	MTF-018
transmision type	RS-232/485	RS-232/485	fiber optic	fiber optic	fiber optic	fiber optic
type of optical fiber	-	-	multimode	multimode	multimode	multimode
fibre type	-	-	62.5/125µm	62.5/125µm	POF 1mm	POF 1mm
connector type	clamp*	clamp*	ST	ST	VLF	VLF
ilość kanałów	4	8	4	8	4	8

where: * WAGO clamp connectors, type: socket 734-265, plug 734-205

Input/output modules

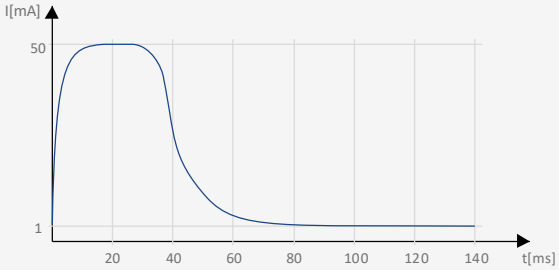
Binary input module MWS-xxx

FEATURES	MWS-156	MWS-208	MWS-208-B	MWS-208-BH	MWS-306	MWS-406	MWS-436
Inputs number	24	32	32	32	20	48	64
Structure (groups x inputs q.)	3x8	4x8	4x8	4x8	5x4	6x8	8x8
Ext. wiring testing	Yes	No	No	No	Yes	No	No
Nominal input voltage	220V DC	220V DC	220V DC	220V DC	220V DC	48V DC	48V DC
Burnishing/hysterese	No/No	No/No	Yes/No	Yes/Yes	No/No	No/No	No/No

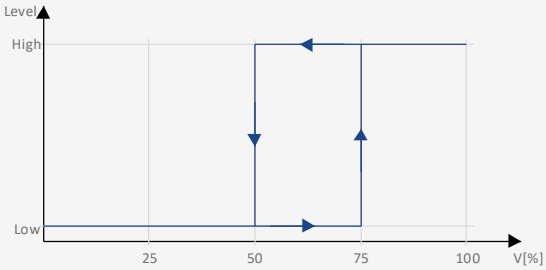
Functionality

- hysteresis or burnishing option
- available AC input options
- events time-stamping 1ms
- meters pulse accumulating

B - „Burnishing" - increased current in the initial phase of input controlling

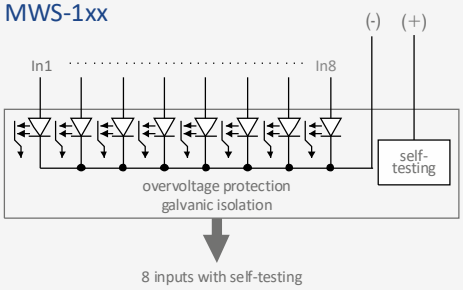


H - Histeresis - configurable switch-on/switch-off voltage levels

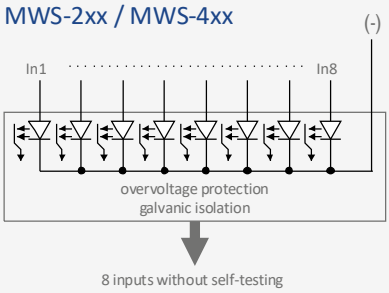


Inputs structure (one group)

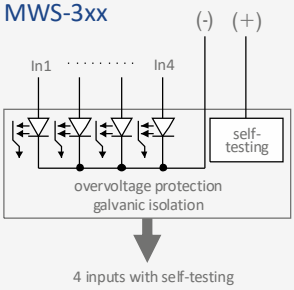
MWS-1xx



MWS-2xx / MWS-4xx



MWS-3xx



Caution: common (-) for above structure. (+) voltage required for self-testing

Control output module MSS-xxx

FEATURES	MSS-237	MSS-406	MSS-506	MSS-328	MSS-608	MSS-618	MSS-628
Outputs number	12	12	32	10	16	16	16
Outputs structure	independent	1 of 12	4 groups	independent	1 of 16	independent	1 of 16
Continuity testing	No	Yes	No	Yes	Yes	No	No
Relay contact type	NO	NO	NO	NO	NO	NO	NO
Make/break DC current*	0,3A	5A	0.15A **	5A	5A	0.3A	5A
Max. load current 230V AC	-	-	-	-	8A	8A	8A

* DC current for 220V DC and L/R ≤ 40ms; ** 4 groups of 8 outpus

Functionality

- specialised modules for controls and indications
- protection against control faults caused by component failure, software error, transmission disturbance etc.
- select before operation mode, continuity checking
- arming relay

Analog outputs module MWA-xxx

FEATURES	MWA-106-11	MWA-136-02	MWA-146-01
Number of outputs	24	12	12
Connectors type	SCREW	D-SUB	SCREW
Range	0÷20mA	+/-20mA	+/-20mA or +/-10V
Accuracy	0.2%	0.2%	0.2%

Functionality

- to perform analog controlling and signalling by means of current or voltage signals

Specialized modules

Modules with binary inputs / outputs

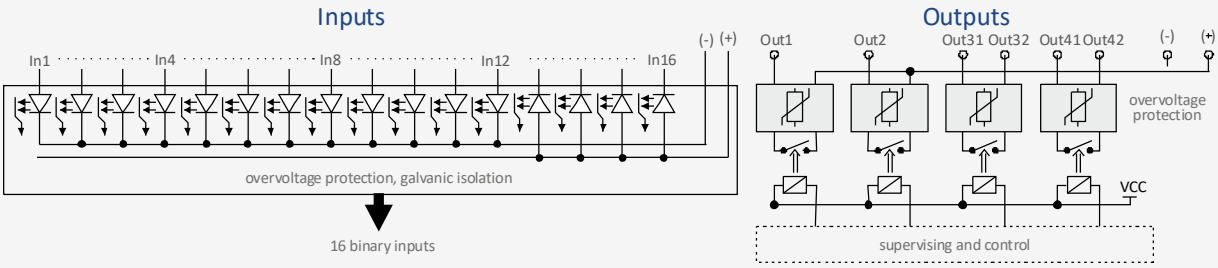
FEATURES	STP-106	STP-106-1	STP-116
Binary inputs / range	16 / 24V DC	16 / 110V DC	16 / 24V DC
Input structure	12(+), 4(-)*	12(+), 4(-)*	16(+)*
Binary outputs	4	4	4

* (+) stimulation with a positive signal, common negative pole; (-) stimulation with a negative signal, common positive pole

Functionality

- 16 binary inputs, optionally: 12 inputs stimulated (+) and 4 inputs stimulated (-) or all 16 inputs stimulated (+)
- 4 control outputs, 2 independently selectable, 2 with common contact

Inputs/outputs diagram



Specialized analog input / output modules

FEATURES	MJE-426-w.006	MPT-106	MPT-208	MTI-101	MIA-101
Binary inputs / range	-	-	-	-	8 / 24V DC
Inputs structure	-	-	-	-	2x 4 wejścia
Temperature measurements	-	8x PT100 or	6x PT100 or	4 x PT100	-
Analog measurements	4x U, 4x I	8x 4÷20mA	6x +/-20mA	4x 5A	-
Analog outputs	-	-	-	-	6x 4÷20mA
Accuracy	0.1%	0.2%	0.2%	0.2%	0.2%
Connector type	SCREW	SCREW	SCREW	SCREW	SCREW

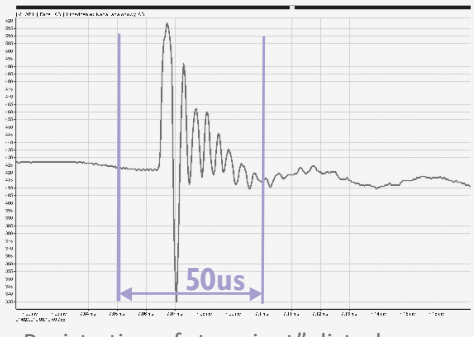
Functionality

MJE-426-w.006 transient measurement

- 8 galvanic isolated analog inputs, 4x 57,7V/100V/230V/280V and 4x 1A/5A/10A/50A, software-switched ranges
- transient registration 1/50µs

MPT-106 / MPT-208 temperature measurements

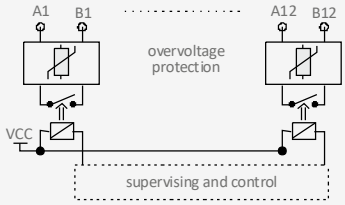
- temperature measurements for 8 (MPT-106, 3 wire) or 6 (MPT-208, 3 or 4 wire) resistance sensors PT100, PT1000, Ni/CD. The module can also measure DC signals 4÷20mA in selected channelsh
- temperature measurements: from -200°C to 600°C



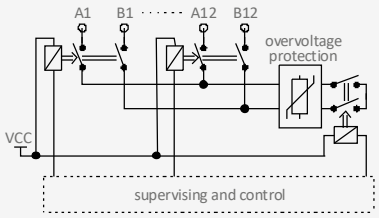
Registration of „transient" disturbances

Outputs structure

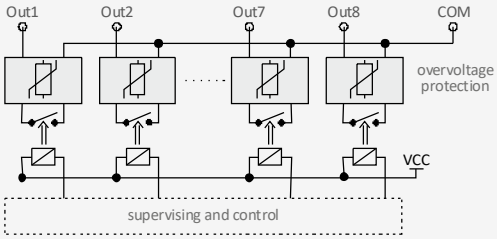
MSS-2xx



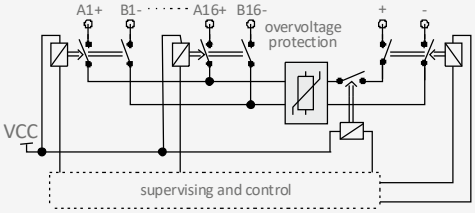
MSS-4xx



MSS-5xx (one group)



MSS-608



Analog measurement module MPL-xxx

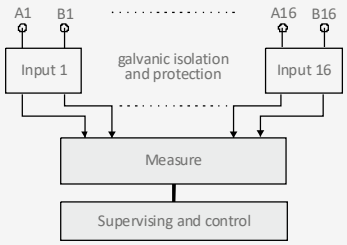
FEATURES	MPL-2xx	MPL-3xx	MPL-4xx	MPL-5xx	MPL-6xx
Number of inputs	8 or 16	16	8 or 16	32	10
Inputs structure	separately	separately	separately	4 groups x8 inputs	6 voltage/ 4 current
Connectors type	screw/D-SUB	screw	screw	screw/D-SUB	screw
Low level measurement ±5V/±10V DC	Yes	Yes	Yes	Yes	No
Voltage measurement 100V AC	Yes	Yes	Yes	No	Yes
Voltage measurement 230V AC	Yes	Yes	Yes	No	Yes
Low current measurement ±20mA	Yes	Yes	Yes	Yes	No
Current measurement 1A	Yes	Yes	Yes	No	Yes
Current measurement 5A	Yes	Yes	Yes	No	Yes
Current measurement 20A	No	No	Yes	No	Yes
Current measurement 100A	No	No	Yes	No	No
Accuracy	0.2%	0.2%	0.2%	0.2%	0.1%
Sampling resolution	14 bit	14 bit	16 bit	16 bit	16 bit

Functionality

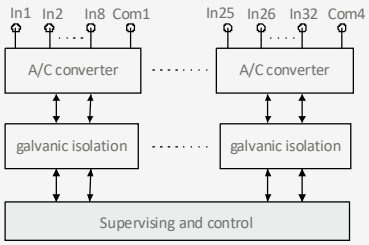
- MPL-2xx/MPL-3xx: up to 16 galvanic isolated analog inputs; each input can be adapted to measure voltage or current
- MPL-4xx: up to 16 galvanic isolated analog inputs
- MPL-5xx: up to 32 analog inputs in 4 galvanic isolated groups of 8 inputs
- MPL-6xx: 6 voltage inputs, 4 current inputs

Analog input structure

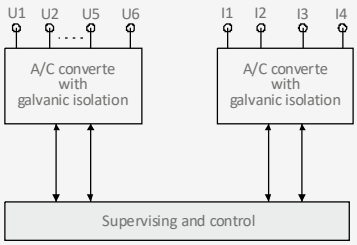
MPL-2xx/3xx/4xx



MPL-5xx



MPL-6xx



Graphic terminals

Graphic terminals KWG-xxx

FEATURES	KWG-301-44	KWG-301-55	KWG-301R-30	KWG-301R-35	KWG-301R-44
Independent terminal	Yes	Yes	Yes	Yes	Yes
Terminal to rack	No	No	No	No	No
Screen resolution	320x240 RGB	320x240 RGB	320x240 RGB	320x240 RGB	320x240 RGB
Front panel type	KF-301-1	KF-301-1	KF-301-1	KF-301-1	KF-301-1
Supply voltage	230V AC/DC	230V AC/DC	230V AC/DC	230V AC/DC	230V AC/DC
Transmision type	RS-485/LVDS	RS-485/LVDS	RS-485/LVDS	RS-485/LVDS	RS-485/LVDS
Ethernet type	100Base-TX	100Base-TX	100Base-TX	100Base-TX	100Base-TX
Pin connectors on the:	from bottom	from bottom	from bottom	from bottom	from bottom
Number of buttons/keylock	1/1	3/1	-/-	3/1	1/1
Number of LEDs signalization/status	16/5	16/5	16/5	16/5	16/5
Typ of LEDs for sygnalisation/status*	8x R, 8x G/5x G	16x R/5x G	16x RGB/5x RGB	16x RGB/5x RGB	16x RGB/5x RGB

* R - red LED
  G - green LED
  RGB - multi-color LED

Functionality

Local operating terminal with touch screen and LED indicating panel. The LED panel is integrated into the terminal to present important bay states, alarms, faults, controls.

Power supply module

Power supply module MZA-xxx

FEATURE	MZA-205	MZA-205-1	MZA-210	MZA-210-3	MZA-410*	MZA-502	MZA-502-3
Basic supply voltage	220V DC	110V DC	230V AC/DC	24V DC	230V AC/DC	230V AC/DC	48V DC
Reserve supply voltage	230V AC/DC	230V AC/DC	-	-	-	-	-
Output current	5V/6A	5V/6A	5V/6A	5V/6A	5V/12A	5V/16A	5V/10A
Parallel operation	No	No	Yes	Yes	Yes	Yes	Yes
Available transmission type	RS-485	RS-485	RS-485	RS-485	RS-485	RS-485	RS-485
Power ON/OFF switch	No	No	No	No	No	No	Yes
Control outputs	2	2	1	1	1	1	1

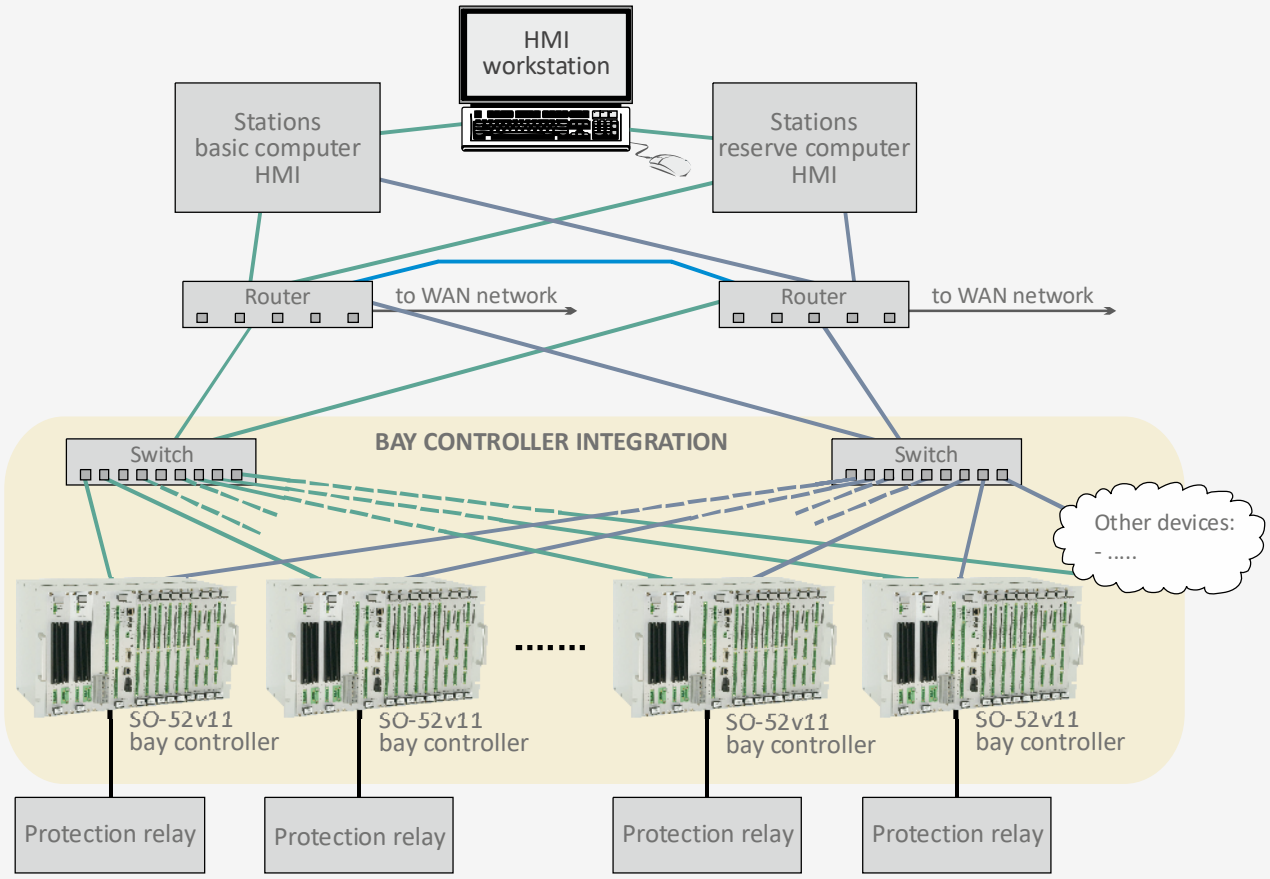
* the power supply does not have +/-12V voltages; dedicated to packages numbered "xx7" and "xx8"

Functionality

Supply module of various features to power the bay controller. A possibility to connect redundant 230/220 AC/DC voltage with automatic switching function of main supply to reserve.

Cooperation with the station network

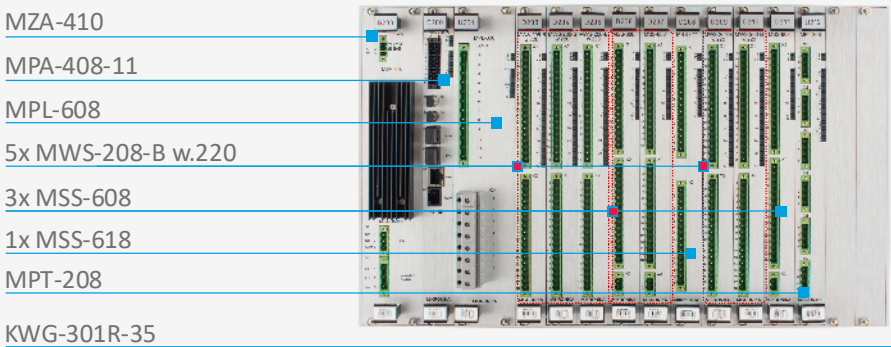
The redundant star transmision



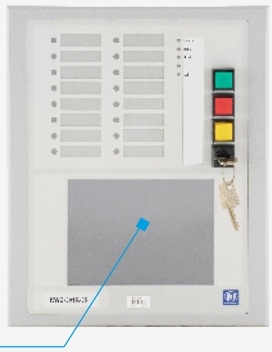
Example of implementation

The table below shows the configuration of the controller for controlling the 220kV bay. The device can be configured as a bay controller integrating control and measurement functions with synchrocheck and bay interlocks. The graphic terminal is installed on the synoptic board in the control room and the other controller modules are placed in a specialized 6U/10" housing:

FEATURES	QUANTITY / RANGE	MODULE
binary inputs	160 inputs / 220V DC	5x MWS-208-B w.220
control outputs	3x 16 outputs (1 of 16)/220V/5A DC; 16 outputs/220V/0.3A DC	3x MSS-608; 1x MSS-618
measurements	6 inputs 57,7/100V, 4 inputs 1A/5A	MPL-608
fiber optic transmission	1 channel, multi-mode 62,5/125µm, ST connector	MPA-408-11
Ethernet transmission	3 channels 100Base-FX/TX	
RS-485/RS-232 transmission	2 channels / 2 channels (+1 service)	
temperature measurements	6 inputs/PT100, PT1000, Ni100/current measurement 4÷20mA	MPT-208



Bay controller module in shockproof housing



An external operator terminal (optional)

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